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A QUALITY COMPANY TO AS/ISO9001

## SP280 LAWSON PLACE SEWAGE PUMP STATION SWITCHBOARD

## OPERATION \& MAINTENANCE MANUAL



## 1. S400NE MCCB TECHNICAL DETAILS

2. S125GJ \& E125NJ MCCB TECHNICAL DETAILS
3. MCCB ACCESSORIES

## NHP

## Electronic type S400NE

## 50kA

Current rating: $100-400 A$

Approvals and Tests:
Standards: AS/NZS 3947-2, and IEC60947-2
Interrupting capacity:

AC use | Voltage | Icu | Ics |
| :--- | :--- | :--- |
|  | $380 / 415$ | 50 |

## Over Current Relay:

- Electronic, for general \& selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications

- Base current $I r$ is adjustable from $40 \%-100 \%$ of the nominal rated current $I n$.
- STD setting 2.5-10(x $\left.I_{R}\right)$ 2)
- INST setting 13-14 ( $\left.x I_{R}\right)^{2)}$


## OCR Options:

- Ground Fault Trip
- Neutral Pole protection for 4 pole ONLY MCCBs
- Pre-Trip Alarm

Dimensions (mm)

| Poles |  |  |  |
| :--- | :--- | :--- | :--- |
| $H$ | 260 | 4 | 260 |
| $W$ | 140 | 185 |  |
| D (less toggle) | 103 | 103 |  |


| Ampere <br> Rating | $I_{R}$ Adjustment |  |  |
| :--- | :--- | :--- | :--- |
| NRC | Min. | Max. | Cat. No. 1) |
| 250 | 100 | 250 | S400 NE 250 |
| $\mathbf{4 0 0}$ | 160 | 400 | S400 NE $^{2000}$ |

Price Adder - if OCR options are required, add the selected OCR option price below to the above MCCB price to calculate the total MCCB cost.

| 3P OCR options: | PTA 3) GF ${ }_{3}$ ) PTA + GF $_{3}$ ) | S400 NE 3 AP \# S400 NE 3 AG \# S400 NE 3 APG \# |
| :---: | :---: | :---: |
| 4P OCR options: | PTA 3) | S400 NE 4 AP \# |
|  | AP ${ }^{\text {s) }}$ | S400 NE 4 AN\# |
|  | PTA + NP ${ }_{3}{ }^{\text {P }}$ | S400 NE 4 APN\# |
|  | $\mathrm{GF}+\mathrm{NP}_{3}{ }^{\text {) }}$ | S400 NE 4 AGN \# |
|  | PTA + GF + NP ${ }_{3}$ | S400 NE 4 APGN \# |
| 1) | Add poles to complete MCCB catalogue number. Eg: 3 pole 250A: S400NE 3 250. '\#' add OCR trip unit rating where shown. |  |
| 2) | The STD and instantaneous pickup currents $\left(l_{\mathrm{sd}} \& h_{1}\right)$ settings are not individually adjustable, however by selecting different curve types and different $I_{R}$ settings the values will vary. Curve $1 \& 2 I_{R d}=2.5 \times i_{R}$, curve $3 I_{\mathrm{zd}}=5 \times I_{R}$, curve $4-7 I_{\mathrm{ad}}=10 \times I_{R}$. $I_{R}$ dial setting $0.4-0.9 h_{h}=14 \times I_{R}$ and $I_{R}$ dial setting $0.95-1.0 h_{i}=13 \times I_{R}$. Refer curve examples \& setting data on pages 18 to 30 . |  |
|  | NRC $=$ Nominal rated current, $\quad I_{R}=$ Current adjustment dial setting, $\quad$ STD $=$ Short Time Delay, $\quad$ INS $T=$ instantaneous |  |
| 3) | To order a MCCB with 250 is a S400GE 4 Po | on after the pole to make Protection and Ground |

Replaces: XS400SE, Note: check exacl ratings or dimenions to suit your application requirement

OPERRATNG CHARACTERISTICS

## ELECTRONIC CHARACTERISTICS

S400-NE, S400-GE, H400-NE, L400-NE


In = 400A; 250 A


Note
(1) $I_{\text {I }}$ max. $=13 \times I_{n}$. (2) Standard setting of $I_{\mathrm{N}}$ is $100 \%$ of $I_{\mathrm{n}}$. For any other setting please specify when ordering.


OPERATING CHARACTRRISTUCS

## LET-THROUGH PEAK CURRENT CHARACTERISTICS

H160-NJ, L160-NJ, S250-PE, H250-NJ, H250-NE, L250-NJ. 440 V AC.


Prospective short circuit current in RMS sym.(KA)
E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, 415V AC.


Prospective short circult current in RMS sym. (KA)

H160-NJ, L160-NJ, S250-PE, H250-NJ, H250-NE, L250-NJ. 690V AC.


S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, 690 V AC.


## Selectivity \＆Cascade Tables

## ＠ $400 / 415 \mathrm{~V}$



| Upstream MCCBs |  | $\begin{aligned} & \text { 山⿱艹⿹弔㇒} \\ & \text { 资 } \end{aligned}$ | $\begin{aligned} & \text { 宸 } \\ & \text { 符 } \end{aligned}$ | 宸 | 容 | 岩 | ㄹㅡㅡㅡㅎ | 蒝 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Downstrea MCCBs | （RMS） |  | $\begin{array}{r} \text { N } \\ 125 \\ \hline \end{array}$ | $\begin{gathered} \text { あ } \\ 50 \\ \hline \end{gathered}$ |  | $\begin{array}{r} \text { Y } \\ 125 \\ \hline \end{array}$ | $\begin{array}{r}  \pm \\ 200 \\ \hline \end{array}$ | $\begin{array}{r}\text { ¢ } \\ 36 \\ \hline\end{array}$ | \％ |
| E125NJ | 25 | 25／25 | 25／65 | 25／36 | 25／50 | $25 / 65$ | 25／85 | 25／36 | 25／25 |
| ［S125NJ | 36 | 36／36 | 36／85 | 36／50 | 36／65 | 36／85 | 36／125 | 36／36 | 36／36 |
| ［S125GJ | 65 | 65／65 | 65／25 | 50／50 | 65／70 | 65／125 | 65／150 | 36／36 | 50／50 |
| H125NJ | 125 | 70／70 | 125／125 | 50／50 | 70，70 | 125／125 | 125／200 | 36／36 | 50／50 |
| S160NJ | 36 |  | I | 36／50 | 36／65 | 36／85 | 36／125 | 36／36 | 36／50 |
| S160GJ | 65 |  |  | 50／50 | 65，70 | 65／125 | 65／150 | 36／36 | 50，50 |
| H160NJ | 125 |  |  |  |  | 125／125 | 125／200 | 36／36 | 50／50 |
| ［E250NJ | 25 |  | 1 |  |  | 25／65 | 25／85 | 25／36 | 25／25 |
| S250NJ | 36 |  | I |  | 1 | 36／85 | 36／125 | 36／38 | 36／36 |
| S250GJ | 65 |  |  |  |  | 65／125 | 65／150 | 36／36 | 50／50 |
| S250PE | 70 |  | ！ |  |  | 40／125 | 70／150 | 36／36 | 50／50 |
| H250NJ | 125 |  |  |  |  | 125／125 | 125／200 | 36／36 | 50，50 |
| ［H250PE | 125 |  |  |  |  | 125／125 | 125／200 | 36／36 | 50／50 |
| ［E400NJ | 25 |  |  |  | ！ |  |  | 10／25 | 10／25 |
| S4000 J | 36 |  |  |  |  |  |  | 10／36 | 10／36 |
| S400NE | 50 |  |  |  |  |  |  | 10／36 | 10／50 |
| S400NJ | 50 |  |  |  |  |  |  | 10／36 | 10／36 |
| S400G | 70 |  |  |  |  |  |  | 10／36 | 10：50 |
| ［H400NJ | 125 |  |  |  |  |  |  | 10／36 | 10／50 |
| H400NE | 125 |  |  |  |  |  |  | 10／36 | 10，50 |
| ［E630NE | 36 |  |  |  |  |  |  |  |  |
| E630CE | 50 |  |  | 1 | ， |  |  |  |  |
| S630GE | 70 |  |  | 1 |  |  |  |  |  |
| xs630G | 45 |  |  |  |  |  |  |  |  |
| XS630NJ | 65 |  |  | 1 |  |  |  |  |  |
| XS630PJ | 85 |  |  | I |  |  |  |  |  |
| XS630SE | 50 |  |  | 1 |  |  |  |  |  |
| XH630SE | 65 | 1 |  |  |  | 1 |  |  |  |
| XH630PE | 65 |  |  |  |  |  |  | 1 |  |
| XS800NJ | 65 |  |  |  | 1 |  |  |  |  |
| XS800SE | 50 |  |  |  | 1 | $!$ |  |  |  |
| XJ800PJ | 85 |  | 1 |  |  | 1 | 1 | 1 |  |
| XH800SE | 65 |  |  |  |  |  |  | 1 |  |
| XH800PE | 65 |  |  | 1 |  |  |  | 1 |  |
| XS1250SE | 65 |  |  |  |  |  |  |  |  |
| XS1600SE | 85 |  |  |  |  | 1 |  |  |  |

## SELECTIVITY TABLES <br> 




APPLICATION DATA

## CASCADE TABLES

| CASCADE <br> © 380－415 V AC ${ }^{1}$ ） |  | $\begin{aligned} & \text { M } \\ & \text { N } \\ & \text { ñ } \\ & \hline \end{aligned}$ | n N N Z | $$ | $$ | $\begin{aligned} & \text { 둘 } \\ & \underset{\sim}{\text { M }} \end{aligned}$ | $\begin{aligned} & \text { o } \\ & \frac{9}{0} \\ & \frac{2}{2} \end{aligned}$ | $n$ <br> $\stackrel{n}{\circ}$ <br> $\stackrel{\circ}{c}$ | $\begin{aligned} & \text { I } \\ & \stackrel{\rightharpoonup}{\circ} \\ & \stackrel{2}{2} \end{aligned}$ | $\begin{aligned} & \text { 들 } \\ & \text { 另 } \\ & \stackrel{1}{2} \end{aligned}$ | $\begin{aligned} & \text { M } \\ & \text { N} \\ & \underset{Z}{2} \end{aligned}$ | $\begin{aligned} & \text { N} \\ & \text { N} \\ & \text { 元 } \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { N } \\ & \text { N } \\ & \text { 이 } \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { N} \\ & \text { H} \\ & 0 \\ & 0 \end{aligned}$ | $\begin{aligned} & \text { 工 } \\ & \text { M } \\ & \text { 른 } \end{aligned}$ | T N O O m | $\begin{aligned} & \text { N } \\ & \text { H } \\ & \text { Z } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Downstream MCCBs | KA （RMS） | 25 | 36 | 65 | 125 | 200 | 36 | 65 | 125 | 200 | 25 | 36 | 65 | 70 | 125 | 125 | 200 |
| E125NJ | 25 | － | 36 | 36 | 65 | 85. | 36 | －36 | $\overline{6} 5$ | 85 | － | 36 | 36 | － | 65 | 65. | 85 |
| S125NJ | 36 | － | － | 50 | 85 | 125 | － | 50 | 85 | 125 | － | － | － | － | 85 | 85 | 125 |
| S125GJ | 65 | － | － | ＇－ | ． 125 | 150 | $\cdots$ | ：－ | 125 | 150 | － | － | 65 | $\cdots$－ | 125 | 125 | 150 |
| H125NJ | 125 | － | － | － | － | 200 | － | － | － | $200{ }^{\circ}$ | － | － | 65 | － | － | － | 200 |
| S160NJ | 36 | － | － | 65 | － | － | － | 65 | 85 | ＇125 | － | － | 65 | 65 | 85 | 85 | 125. |
| S160GJ | 65 | $\div$ | － | － | － | － | － | － | 125 | 150 | － | － | － | 70 | 125 | 125 | 150 |
| H160NJ | 125. | － | － | － | － | － | － | － | － | 200 | － | － | － | － | － | － | 200 |
| S250NJ | 36 | － | － | － | － | － | － | 65 | － | － | － | － | － | 65 | 85 | 85 | 125 |
| S250GJ | 65 | － | － | － | － | － | － | － | － | － | － | － | － | 70 | 125 | 125 | 150 |
| S250PE | 70 | － | － | － | － | － | － | ＇－ | － | － | － | － | － | － | 125 | 125 | 150 |
| H250NJ． | 125 | － | － | － | $\cdots-$ | － | － | －－ | － | － | － | $\stackrel{-}{-}$ | － | － | － | － | 200 |
| E400NJ | 25 | － | － | － | － | － | － | － | － | － | － | － | － | 36 | 65 | 65 | － |
| S400CJ | 36. | － | － | － | － | － | － | － | － | － | － | － | － | 50 | 70 | 70 | － |
| S400NJ． | 50 | ：－ | － | － | － | － | － | － | － | － | － | $\because$ | 50 | 65 | 85 | 85 | － |
| S4006J | $70^{\circ}$ | － | ＇－ | －－ | － | － | － | － | － | － | － | － | 50 | － | 125 | 125 | － |
| H400NJ | 125 | ．－ | － | － | － | － | － | － | － | － | － | － | － | ．－ | － | － | － |

Note：＇）Ratings have not been verified where a dash＂－＂is shown．
All pick－up and time delay settings are to be set at a maximum for upstream MCCB＇s

| Upstream MCCBs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CASCADE$\left.\oplus_{0} 380-415 V^{\prime} C^{\prime}\right)$ |  | ® $\stackrel{\circ}{\circ}$ 0 8 |  |  | 포몽 융 를 | 「 $\stackrel{\rightharpoonup}{\circ}$ 己 | $\begin{aligned} & \text { 「 } \\ & \text { 吕 } \\ & \text { in } \end{aligned}$ | M W O 而 | $\begin{array}{r}\text { 』 } \\ \text { \＃} \\ \text { O} \\ \hline\end{array}$ | 川 W D n | －1 $\mathbf{W}$ W o in |  | 중 O O 를 |  |  | $\begin{aligned} & \text { 区 } \\ & \text { N } \\ & \text { NO } \\ & \text { O } \\ & \text { in } \end{aligned}$ | $\times$ $\stackrel{\times}{0}$ $\stackrel{\circ}{0}$ in |
| Downstream MCCBs | $\begin{gathered} \text { KA } \\ \text { (RMS) } \end{gathered}$ | 36 | 50 | 70 | 125 | 200 | 200 | 36 | 50 | 70 | 125 | 65 | 65 | 65 | 200 | 65 | 85 |
| E125NJ | － 25 | 36 | 36 | 50 | 65 | 85. | 85 | 36 | $\bullet$ | 50 | － | 36 | 38 | 36 | － | － | － |
| S125NJ | 36 | － | 50 | 65 | 85 | 125 | 125 | － | － | 65 | － | 50 | 50 | － | － | － | － |
| S125GJ | 65 | － | － | 70 | 125 | 150 | 150 | $-$ | 50 | 70 | － | － | － | 65 | － | － | － |
| H125NJ | 125 | － | － | － | － | 200 | 200 | － |  | － | － | － | － | 65 | － | 50 | － |
| S160NJ | 36 | － | 50 | 65 | 85 | 125 | 125 | － | 50 | 50 | － | － | 65 ： | 65 | － | － | － |
| S160GJ | 65 | － | － | 70 | 125 | 150 | 150 | － | － | 70 | － | － | －${ }^{1 \prime}$ | － | － | － | － |
| H160NJ | 125. | － | － | － | － | 200 | 200 | － | － | － | － | $\cdots$ | － | 65 | － | 65 | － |
| E250NJ | 25 | 36 | 36 | 50 | 65 | 85 | 85 | 36 | － | 50. | － | － | 36 | 50 | － | － | － |
| S250NJ | 36 | － | 50 | 65 | 85 | 125 | 125 | － | － | 65 | － | $\bar{\square}$ | 65 | － | － | － | － |
| S250G」 | 65 | － | $=$ | 70 | 125. | 150 | 150 | － | － | 70 | － | － | － | － | － | $\because$ | － |
| S250PE | 70 | － | － | － | 125 | 150 | 150 | － | － | － | － | $\stackrel{\sim}{-}$ | － | － | － | － | － |
| H250NJ | 125 | ．- | － | － | － | 200 | 200 | － | － | － | － | － | － | － | － | － | － |
| E400NJ | 25 | 36 | 36 | 50 | 65 | 85 | 85 | 36 | － | 50 | 36. | $\stackrel{-}{i}$ | －． | － | 36 | － | 36 |
| S400Cd | 36 | － | 50 | 65 | 70 | 100 | 100 | $\bigcirc$ | － | 65 | 50 | － | －． | － | 50 | － | 50 |
| S400NJ | 50 | $-$ | － | 70 | 85 | 125 | 125 | $\therefore-$ | 36 | 70 | 65 | $\div$ | － | 50 | 65 | － | 65 |
| S400G J | 70 | － | － | － | 125 | 150 | 150 | － | 36 | － | － | $\bigcirc$ | －${ }^{\text {i }}$ | 50 | － | 36 | 85 |
| H400NJ | 125. | － | － | － | － | 200 | 200 | － | － | － | － | － | － | － | － | － | － |

Note：＇）Ratings have not been verified where a dash＂－＂is shown
All pick－up and time delay settings are to be set at a maximum for upstream MCCBs


## SELECTIVITY AND CASCADE TEMBREAK 2 MCCBs AND DIN-T / SAFE-T MCBs

| Upstream MCCB |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SELECTIVITY / CASCADE <br> © 415 V AC |  |  | $\begin{aligned} & \text { m } \\ & \text { N } \\ & \text { M } \\ & \mathbf{Z} \end{aligned}$ | $\begin{aligned} & \frac{\pi}{N} \\ & \stackrel{N}{\Sigma} \end{aligned}$ | $\begin{aligned} & \text { QI } \\ & \text { NN } \\ & \text { GNOM } \\ & \text { Diz } \end{aligned}$ | 0 0 0 0 2 2 | $\begin{aligned} & \text { n } \\ & \text { O} \\ & 0 \\ & 0 \\ & C \end{aligned}$ | 0 + $\stackrel{8}{8}$ |  |  |
| MCB | rating | (RMS) | 25 | 36 | 65 | 36 | 65 | 36 | 70 | 125 |
| Dтсв6 | 2-20 | 6. | 18/18 | 25/25 | 35/35 | 35/35. | 35/35 | - | - | - |
|  | 25-63 | 6 | 18/18 | 20/25 | 20/25 | 30/30 | 30/30 | - | - | - |
| DTCB10 | 0.5-32 | 10. | 18/18 | 30/30 | 30/50 | $35 / 35$ | 40/50 | 35/35 | 40/50 | 40/50 |
|  | 40-63 | 10 | 18/18 | 20/25 | 25/25 | 30/30 | 30/30 | 30/30 | 30/30 | 30/30 |
| DSRCBH $/$ | 0.5-32 | 10 | 18/18 | 30/30 | 30/50 | 35/35 | 40/50. | 35/35 | 40/50 | 40/50 |
| DSRCD | 40 | 10 | 18/18 | 20/25 | 25/25 | 30/30 | 30/30 | 30/30 | 30/30 | 30/30 |
| Din-T10H | 80-125. | 10 | 4/18 | 4/25 | 4/25 | 15/15 | 15/15 | 10/10 | 10/10 | - |
| DTCH15 | 0.5-32 | 15 | 18/18 | 30 | 30/50 | 35/35 | 40/50 | 35/35 | 40/50 | 40/50 |
|  | 40-63 | 15 | 18/18 | 20 | 25/25 | 30/30 | 30/30 | 30/30 | 30/30 | 30/30 |
| Safe-T | 16-20 | 6 | 3/10 | 3/10 | 3/10 | - | - | - | - | - |
| SRCB | 16-20 | 6. | 3/10 | 3/10 | 3/10 | - | - | - | - | - |



Notes: All figures stated are at $400 / 415 \vee \mathrm{AC}$.


APPLICATION DATA

## MOTOR STARTING TYPE 1 CO-ORDINATION TABLES

Short-Circult Co-Ordination Motor Starting Table
Type '1'
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting 50/65 kA 400/415 V to AS/NZS 60947.4.1

|  |  | Terasakd Comblnations |  |
| :---: | :---: | :---: | :---: |
| Motor Size <br> (kW) | Approx. amps ${ }^{9}$ 400/415 V (A) | Mcce | Comtactor |
| 0.37 | 1.1 | XM30PE11.4 | CA7- ${ }^{\text {a }}$ |
| 0.55 | 1.5 | XM30FER2 | CAT-A |
| 0.75 | 1.8 | XM30Р日/2.8 | CA7-9 |
| 1.1 | 2.6 | XM30FE/4.0 | CA7- - |
| 1.5 | 3.4 | XM30PE/5 | CA7- ${ }^{\text {- }}$ |
| 2.2 | 4.8 | XM30PE/8 | CA7. ${ }^{\text {c }}$ |
| 3 | 6.5 | XM30PE/10 | CA7- |
| 4 | 8.2 | XM30PB/12 | CA7- |
| 5.5 | 11 | S125G/20 | CA7-12 |
| 7.5 | 14 | S125G.120 | CA7-18 |
| 11 | 21 | S125G/1/32 | CA7-28 |
| 15 | 28 | S125G $\sqrt{50}$ | CA7-80 |
| 18.5 | 34 | 8125G/50 | CA7-37 |
| 22 | 40 | S125GV/bs | CA7-49 |
| 30 | 55 | 8125G.1/100 | CA7-80 |
| 37 | 66 | B125G.1/100 | CA7-72 |
| 45 | 80 | S125GL/125 | CA7-85 |
| 55 | 100 | S125GI/125 | CAB-110 |
| 5 | 130 | 8250PE/250 | CAB-140 |
| 0 | 155 | S250PE/250 | CAB-180 |
| 10 | 200 | S250PE/250 | CAB-210 |
| 32 | 225 | S400GE/400 | CAB-210 |
| 60 | 270 | S400GE/400 | CAB-300 |
| 00 | 361 | S400GE/400 | CAB-420 |


| Terasald Combinations |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overland Relay | Thermal <br> Setung (A) | KT7 Circult Breaker | Contactor |
| CT 7-24 | 1.0-1.8 | KTA7-25S-1.0A | CA7-9 |
| CT 7-24 | 1.0-1.0 | KTA7-25S-1.6A | CA7-9 |
| \|CT 7-24 | 1.0-24 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-4.0A | CA7-9 |
| CT 7-24 | 4.0-6.0 | KTA7-25S-6.3A | CA7-9 |
| CT 7-24 | 0.0-10 | KTA7-25S-6.3A | CA7.9 |
| CT 7-24 | 8.0-10 | KTA7-25S-10A | CA7-9 |
| CT 7-24 | 10-10 | KTA $7-25 \mathrm{H}-16 \mathrm{~A}$ | CA7-12 |
| CT 7-24 | 10-10 | KTA7-25H-16A | CA7-16 |
| CT 7-24 | 10-34 | KTA $7-45 \mathrm{H}-20 \mathrm{~A}$ | CA7-23 |
| CT 7-45 | 18-30 | KTA7-45H-32A | CA7.30 |
| CT 7-45 | 30-45 | KTA7-45H-45A | CA7-37 |
| CT 7-45 | 30-45 | KTA $7-45 \mathrm{H}-45 \mathrm{~A}$ | CA7-43 |
| \|CT 7-75 | 45-60 | КТАЗ-100-63A | CA7-60 |
| CT 7-75 | EO-75 | КТАЗ-100-90A | CA7-72 |
| \|cT 7-100 | 70-80 | КТАЗ-100-90A | CA7-85 |
| CEF 1-11/12 | 20-180 | KTA3-160S-100A | CA6-110 |
| CEF 1-11/12 | 20-180 | KTA3-160S-160A | CA6-140 |
| CEF 1-11/12 | 20-180 | KTA3-160S-160A | CA6-180 |
| CEF 1-41/42 | 180-400 | KTA3-250S-200A | CA6-210 |
| CEF 1-41/42 | 180-400 | KTA3-250S-250A | CA6-250 |
| CEF 1-41/42 | 160-400 | KTA3-400S-320A | CA6-300 |
| CEEF 1-41/42 | 1800-400 | KTA3-400S-400A | CA6-420 |

Notes: - Thermal or electronic overtoad relays may be used.
XM30PB MCCB's can be replaced with S125GJ/20 it required.
Combinations based on the thermal overioad retay tripping before the circuin. breaker at overtoad currents up to the motor locked rotor current.



## MOTOR STARTING TYPE 2 CO-ORDINATION TABLES

## Short-CIrcult Co-Ordination DOL Motor Starting Table

Type ' 2 '
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting 50/65 KA © 400/415 V to ASNZS 60947.4.1

|  |  | Terasald Comblnations |  |
| :---: | :---: | :---: | :---: |
| Motor Size (kW) | Approx. amps © 400/415 V (A) | MCCB | Cortactor |
| 0.37 | 1.1 | ХMSOPBM. 4 | CAT-E |
| 0.55 | 1.5 | XM30PE/2 | CA7-E |
| 0.75 | 1.8 | XM30P8/2.8 | CA7- ${ }^{\text {c }}$ |
| 1.1 | 2.6 | ХMSOP退4.0 | CA7-18 |
| 1.5 | 3.4 | XM80PB/5 | CA7-18 |
| 2.2 | 4.8 | XM30PE8 | CA7-18 |
| 3 | 6.5 | XMSOPEMO | CA7-SO |
| 4 | 8.2 | ХM30РВН2 | GA7.30 |
| 5.5 | 11 | S125G./20 | CA7-SO |
| 7.5 | 14 | S125GL/20 | CA7-30 |
| 11 | 21 | S125GL/32 | CA7-30 |
| 15 | 28 | $8125 \mathrm{GL} / 50$ | CA7-43 |
| 18.5 | 34 | S125Gl/50 | CA7-43 |
| 22 | 40 | S125GL/ $/ 8$ | CA7-43 |
| 30 | 55 | S125G3/700 | CA7-72 |
| 37 | 66 | S125Gl/ 00 | CA7-72 |
| 45 | 80 | S125Gul/ 25 | CAB-105 |
| 55 | 100 | S200PE/180 | CAB-105 |
| 75 | 130 | S200FER250 | CAB-140 |
| 90 | 155 | 8250FE/250 | CAB-170 |
| 110 | 200 | 6250FER250 | CABm10 |
| 132 | 225 | S400FE/400 | CAO-210 |
| 160 | 270 | S400PE 400 | CAB-300 |
| 200 | 361 | S400PE 1400 | CAB-420 |


| Terasakl Comblnetions |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overload Reley | Thermal Setting (A) | KT7 Circult Breaker | Contactor |
| CT 7-24 | 1.0-1.8 | KTA7-25S-1A | CA7-9 |
| CT 7-24 | 1.0-1.6 | KTA7-25S-1.6A | CA7.9 |
| CT 7-24 | 1.8-24 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 24-4.0 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-4A | CA7-9 |
| CT 7-24 | 4.0-8.0 | KTA7-25S-6.3A | CA7-9 |
| CT 7-24 | 8.0-10 | KTA7-25S-6.3A | CA7-9 |
| CT 7-24 | 8.0-10 | KTA7-25S-10A | CA7-9 |
| CT 7-24 | 10-18 | KTA7-25H-16A | CA7-12 |
| CT 7-24 | 10-18 | KTA7-25H-16A | CA7-16 |
| CT 7-24 | 18-24 | KTA7-45H-20A | CA7-23 |
| CT 7-46 | 18-30 | KTA7-45H-32A | CA7-30 |
| CT $7-46$ | 30.46 | KTA7-45H-45A | CA7-37 |
| CT 7-45 | 30-46 | KTA7-45H-45A | CA7-43 |
| CT 7-76 | 45-80 | КTA3-100-63A | CA7-60 |
| CT 7-75 | 60-75 | KTA3-100-90A | CA7-72 |
| CT 7-100 | 70-80 | KTA3-100-90A | CA7-85 |
| CEF 1-11/12 | 20-180 | КTA3-160S-100A | CA6-110 |
| CEF 1-11/12 | 20-180 | KTA3-160S-160A | CA6.140 |
| CEF 1-11/12 | 20-180 | КTA3-160S-160A | CA6-180 |
| CEF 1-41/42 | 100-400 | KTA3-250S-200A | CA6-210 |
| CEF 1-41/42 | 180-400 | KTA3-250S-250A | CA6-250 |
| CEF 1-41/42 | 180-400 | КTA3-400S-320A | CA6-300 |
| CEF 1-41/42 | 180-400 | KTA3-400 S-400A | CA6-420 |

[^0]- XM30PB combinations can be replaced with S 125 G J/20 and CA7-30 if required.

Combinations based on the thermal overioad relay tripping before the circuin
breaker at overioad currents up to the motor locked rotor current.
$\square$


APPLICATION DATA

## MOTOR STARTING TYPE 2 CO-ORDINATION

Short-Clrcult Co-Ordination DOL Motor Starting Table
Type '2'
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting $85 \mathrm{KA} \oplus 400 / 415 \mathrm{~V}$ to AS/NZS 60947.4.1


|  |  | Teresakd Combinations |  |
| :---: | :---: | :---: | :---: |
| Motor Size (kW) | Approx. amps © $400 / 415 \mathrm{~V}$ (A) | mсcв | Contactor |
| 0.37 | 1.1 | XMB0PB/7. 4 | CA 7 - ${ }^{\text {a }}$ |
| 0.55 | 1.5 | XM30PB/2 | CA 7 - |
| 0.75 | 1.8 | XM30PE/2. 6 | CA 7.8 |
| 1.1 | 2.6 | XM30 PB/4.0 | CA 7-18 |
| 1.5 | 3.4 |  | CA 7-18 |
| 2.2 | 4.8 | XM30FE/B | CA 7.30 |
| 3 | 6.5 | XM30FEM0 | CA 7-30 |
| 4 | 8.2 | XM30FE/42 | CA 7.30 |
| 5.5 | 11 | Hi25NL/20 | CA $7-30$ |
| 7.5 | 14 | H125N/20 | CA 7-30 |
| 11 | 21 | H125N//32 | CA 7 -30 |
| 15 | 28 | H125N1/50 | CA 7-49 |
| 18.5 | 34 | $\mathrm{H} 125 \mathrm{NJ} / 50$ | CA 7-43 |
| 22 | 40 | H125NL/E3 | CA 7-49 |
| 30 | 55 | H125Nu/Hod | CA 7-72 |
| 37 | 66 | H12.5Nu/100 | CA 7-72 |
| 45 | 80 | H125N//480 | CA 8105 |
| 55 | 100 | H180NL/M80 | CA 3 -105 |
| 75 | 130 | H250PE/250 | CA $\mathrm{C}-210$ |
| 90 | 155 | H250PE/250 | CA $8-210$ |
| 110 | 200 | H250PE/250 | CA 8210 |
| 132 | 225 | H400NE/400 | CA 8-210 |
| 160 | 270 | H400NE/400 | CA 8.300 |
| 200 | 361 | H400NE/400 | CA $0-420$ |

Notes: - Thermal or electronic overload relays may be used.

- XM30PB combinations can be replaced with H125GJ/20 and CA7-30 it required.

Combinations based on the thermal overioad relay tripping before the circuit braaker at overioad currents up to the motor locked rotor current.

| Terasakd Combinations |  | Sprecher + Schuh Combinatlons |  |
| :---: | :---: | :---: | :---: |
| Overicad Relay | Thermal Setting (A) | KT7 Clircult Breaker | Contactor |
| CT 7-24 | 1.0-1.0 | KTA7-25S-1A | CA 7.9 |
| CT 7.24 | 1.0-1.6 | KTA7-25S-1.6A | CA 7-9 |
| CT 7.24 | 1.0-2.4 | KTA7-25S-2.5A | CA 7-9 |
| CT 7.24 | 24-4.0 | KTA7-25H-2.5A | CA 7-9 |
| CT 7-24 | 2.4-4.0 | KTA 7-25H-4A | CA 7-9 |
| CT $7-24$ | 4.0-8.0 | KTA7-25H-6.3A | CA 7.9 |
| CT 7.24 | 8.0-10 | KTA7-25H-6.3A | CA 7.9 |
| CT 7-24 | 8.0-10 | KTA 7-25H-10A | CA 7 -9 |
| CT 7-24 | 10-16 | KTA7-45H-16A | CA 7-12 |
| CT 7-24 | 10-18 | KTA7-45H-16A | CA 7-16 |
| \|CT 7-24 | $18=24$ | KTA7-45H-20A | CA 7-23 |
| CT 7-45 | 10-30 | KTA7-45H-32A | CA 7-30 |
| CT 7-45 | S0-45 | KTA7-45H-45A | CA 7-37 |
| \|GT 7-45 | S0-45 | KTA7-45H-45A | CA 7-43 |
| CT 7.75 | 45-80 | KTA3-100-63A | CA7-60 |
| CT 7-75 | 80-75 | КТАЗ-100-90A | CA7-72 |
| CT 7-100 | 70-80 | KTA3-100-90A | CA7-85 |
| CEF 1-11/12 | 20-180 | - | - |
| CEEF 1-11/12 | 20-180 | - | - |
| CEF 1-11/42 | 20-180 | - | - |
| CEF 1-41/42 | 180-400 | - | - |
| CEF 1-41/42 | 180.-400 | - | - |
| CCEF 1-41/42 | 160-400 | - | - |
| CEF 1-41/42 | 180-400 | - | - |



## MOTOR STARTING TYPE 2 CO-ORDINATION

## Short-CIrcult Co-Ordination DOL Motor Starting Table

Type ' 2 '
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting 100 kA © 400/415 V to AS/NZS 60947.4.1

|  |  | Terrsakd Combinations |  |
| :---: | :---: | :---: | :---: |
| Motor Size <br> (kW) | Approx. amps © 400/415 V (A) | MCCB | Contactor |
| 0.37 | 1.1 | H125N1/20 | CA 7-30 |
| 0.55 | 1.5 | H125NJ/20 | CA 7 -30 |
| 0.75 | 1.8 | H125NJ/20 | CA 7-30 |
| 1.1 | 2.6 | H125NJ/20 | CA 7-30 |
| 1.5 | 3.4 | H125Nu/20 | CA 7 -30 |
| 2.2 | 4.8 | H125N1/20 | CA 7.30 |
| 3 | 6.5 | H125N1/20 | CA $7-30$ |
| 4 | 8.2 | H125N/20 | CA 7 -30 |
| 5.5 | 11 | H125NJ/20 | CA 7-30 |
| 7.5 | 14 | H125N/20 | CA $7-30$ |
| 11 | 21 | H125NV/32 | CA 7.30 |
| 15 | 28 | H125NL/50 | CA 7-43 |
| 18.5 | 34 | $\mathrm{H} 125 \mathrm{NL} / 50$ | CA 7-43 |
| 22 | 40 | H125NL/63 | CA 7-43 |
| 30 | 55 | H125-N/H00 | CA 7 - ${ }^{\text {a }}$ |
| 37 | 66 | H125-N/1100 | CA 7 -72 |
| 45 | 80 | H125-Ni/125 | CA $7-85$ |
| 55 | 100 | H250-NEM60 | CA E-85 |
| 75 | 130 | H250-NE/250 | CA B-140 |
| 90 | 155 | H250-NE/250 | CA B-140 |
| 110 | 200 | H250-NE/250 | CAE-180 |
| 132 | 225 | H400-NE/400 | CA B-420 |
| 160 | 270 | H400-NE/400 | CA B-420 |
| 200 | 361 | H400-NE/400 | CA $8-420$ |


| Terasakd Comblnations |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overtoad Relay | Thermal Setting (A) | $K T 7$ CIrcuit Breaker | Contactor |
| CT 7-24. | 1.0-1.0 | KTA7-25S-1A | CA 7-9 |
| CT 7-24 | 1.0-1.0 | KTA7-255-1.6A | CA 7-9 |
| CT 7-24 | 1.8-2.4 | KTA7-25S-2.5A | CA 7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25H-2.5A | CA 7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25H-4A | CA 7.9 |
| CT 7-24 | 4.0-8.0 | KTA7-25H-6.3A | CA $7-9$ |
| CT 7-24 | 0.0-10 | KTA7-25H-6.3A | CA 7-9 |
| CT 7-24 | 8.0-10 | KTA 7 -25H-10A | CA 7.9 |
| CT 7-24 | 10-18 | KTA7-45H-16A | CA 7-12 |
| CT 7-24 | 10-10 | KTA7-45H-16A | CA $7-16$ |
| CT 7-24 | 10-24 | KTA 7 -45H-20A | CA 7-23 |
| CT 7-46 | 18-30 | KTA7-45H-32A | CA 7-30 |
| CT 7-45 | 30.46 | КTA7-45H-45A | CA 7-37 |
| CT 7-45 | 30-46 | KTA7-45H-45A | CA 7-43 |
| CT 7-75 | 45-80 | - | - |
| CT 7-75 | B0-75 | - | - |
| CT 7 -100 | 70-80 | - | - |
| CEF 1-11/12 | $20-180$ | - | - |
| CEF 1-11/12 | 20-180 | - | $-$ |
| CEF 1-11/12 | 20-180 | $\bullet$ | $\cdot$ |
| CEF 1-41/42 | 180-400 | - | - |
| CEF 1-41/42 | 180-400 | - | - |
| CEF 1-41/42 | 100-400 | - | $\cdot$ |
| CEF 1-41/42 | 180-400 | $\cdot$ | - |

[^1]- Combinations based on the thermal overload relay tripping before the circuit
breaker at overioad currenis up to the motor locked rotor current.


## INSTALLATION

TEMPERATURE RATINGS \& DERATINGS
Calibration Temperature: $45^{\circ} \mathrm{C}$


Calibration Temperature: $30^{\circ} \mathrm{C}$

|  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $35^{\circ} \mathrm{C}$ | $40^{\circ} \mathrm{C}$ | $45^{\circ} \mathrm{C}$ | $50^{\circ} \mathrm{C}$ | $55^{\circ} \mathrm{C}$ | $60^{\circ} \mathrm{C}$ | $6^{6}{ }^{\circ} \mathrm{C}$ |
| H250-NJ <br> 1250-NJ | Plug-in Conn. |  | 250 A | 244 | 236 | 225 | 219 | 209 | 200 | 190 |


|  |  |  | $\cdots$ Rated Curient (A) |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $30^{\circ} \mathrm{C}$ | $35^{\circ} \mathrm{C}$ | $40^{\circ} \mathrm{C}$ | $45^{\circ} \mathrm{C}$ | $50^{\circ} \mathrm{C}$ | $55^{\circ} \mathrm{C}$ | $60^{\circ} \mathrm{C}$ | $65^{\circ} \mathrm{C}$ |
| S250-PEH250-NE | Front Rear | 250A | 250 | 250 | 250 | 250 | 237.5 | 225 | 200 | 200 |
|  | Plug-in | 250A | 250 | 237.5 | 225 | 225 | 200 | 200 | 157.5 | 157.5 |
| $\begin{aligned} & \text { S400-NE } \\ & \text { S400-GE } \end{aligned}$ | Front | 250A | 250 | 250 | 250 | 250 | 250 | 250 | 225 | 200 |
|  | Rear Plug-in | 400A | 400 | 400 | 400 | 400 | 400 | 380 | 360 | 320 |
| $\begin{aligned} & \text { H400-NE } \\ & \text { L400-NE } \end{aligned}$ | Front | 250A | 250 | 250 | 250 | 250 | 250 | 250 | 225 | 200 |
|  | Rear | 400A | 400 | 400 | 400 | 400 | 400 | 380 | 360 | 320 |
|  | Plug-in | 250A | 250 | 250 | 250 | 250 | 250 | 250 | 225 | 200 |
|  |  | 400A | 400 | 400 | 400 | 400 | 400 | 380 | 360 | 320 |
| $\begin{aligned} & \text { E630-NE } \\ & \text { S630-CE } \\ & \text { S630-GE } \end{aligned}$ | 6. Front <br> : Rear* | 630A | 630 | 630 | 630 | 630 | 598.5 | 598.5 | 567 | 504 |

## DROMENSIONS

E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE

ASL: Arrangement Standard Line
H: Handle Frame Centre Line
Front connected



## ©PRRATMNG CHMRACTERUSTICS LET-THROUGH ENERGY CHARACTERISTICS

H160-NJ, L160-NJ, S250-PE, H250-NE, H250-NJ, L250-NJ. 440 V AC.


E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE. 415 V AC


H160-NJ, L160-NJ, S250-PE, H250-NE, H250-NJ, L250NJ. 690 V AC .


S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE. 690 V AC.



## aCcESSORDES

## INSULATION ACCESSORIES

## Terminal Covers for Front Connection (CF)

Terminal covers for front connection are suitable for covering the exposed live parts of conductors terminated on the MCCB.


Teminal Covers for Front Connection

## Flush Terminal Covers (CS)

Flush terminal covers are useful for increasing the ingress protection rating at the terminals without increasing the overall length. They can be used with busbar and for direct entry of stranded cable (with solderless cable clamp terminals (FW), refer to Section 6, Installation).
Flush terminal covers are identical to rear terminal covers for 400A and 630A frame models.
The user can remove a section of the rear terminal cover using a tool to allow entry of the conductor.

## Terminal covers for Rear Connection (CR)

Terminal covers for rear connection may be used on MCCBs fitted with rear connections (RP) or plug-in connections (PM). They prevent access to the terminals from the front and top.


Terminal Covers for Rear Connection


## UNSTALLATION

## CONNECTION AND MOUNTING OPTIONS AND ACCESSORIES

## Plug-in Mounting

The plug in mounting system allows fast replacement of the MCCB body without the need to disturb the terminations. Solid conductors or cables terminated with compression terminals can be used.

## Plug-In Safety Lock



The plug-in MCCB body is automatically locked to the base when the contacts are closed (toggle ON). It cannot be removed unless the contacts are in the isolated position (toggle OFF or TRIPPED). This system ensures safe removal of the MCCB from the base.


The connection bars for plug-in bases are optional and can be configured in the field either for front or rear access. The illustrations below show possible mounting and connection options for plug in bases.


1. Mounted on base plate with connection bars mounted for front access.
Insulation plates are supplied as standard and must be fitted.

2. Terminations in separate compartment. Connection bars are mounted for top access at the top and rear access at the bottom.

3. Mounted on angle bars. Connection bars are mounted for rear access.

## NHP

## Thermal magnetic type S125GJ

## 65kA

Current rating:
12.5-125A

Approvals and Tests:
Standards AS/NZS 3947-2, and IEC60947-2


Interrupting capacity:

|  | Voltage | Icu | Ics |
| :--- | :--- | :--- | :--- |
|  | AC use | $380 / 400$ | 65 |
| DC use | 250 V | 40 | 40 |

Trip unit:
Adjustable thermal ( 0.63 Ir to $100 \% \mathrm{Ir}$ ) and adjustable magnetic ( 6 lm to 12 lm )

| Dimensions (mm) |  |  |
| :--- | :--- | ---: |
| Poles | 3 | 4 |
| $H$ | 155 | 155 |
| $W$ | 90 | 120 |
| (less toggle) | 68 | 68 |
| Togale cut-out |  | Standard DIN |


| Ampere Rating NRC | Adj. Ir 1 Min-Max. | $\begin{aligned} & \text { Adj. Im } \\ & \text { Min - Max. } \end{aligned}$ | Cat. No. |
| :---: | :---: | :---: | :---: |
| 20 | 12.5-20 | 120-240 | $\begin{aligned} & \text { S125 GJ } 320 \\ & \text { S125 GJ } 420 \\ & \hline \end{aligned}$ |
| 32 | 20-32 | 192-384 | $\begin{aligned} & \text { S125 GJ } 332 \\ & \text { S125 GJ } 432 \end{aligned}$ |
| 50 | 32-50 | 300-600 | $\begin{aligned} & \text { S125 GJ } 350 \\ & \text { S125 GJ } 450 \end{aligned}$ |
| 63 | 40-63 | 378-756 | S125 GJ 363 S125 GJ 463 |
| 100 | 63-100 | 600-1200 | S125 GJ 3100 S125 GJ 4100 |
| 125 | 80-125 | 750-1500 | S125 GJ 3125 S125 GJ 4125 |
| 1) |  | rated current thermal setting magnetic setting |  |

Replaces: XH 125 NJ, TL100NJ, Note: check exact ratings or dimenions to suit your application requirement

## Thermal magnetic type

## E125NJ

## 25kA

Current rating: 12.5-125A

Approvals and Tests:
Standards AS/NZS 3947-2, and IEC60947-2
Interrupting capacity:

|  | Voltage | ICu | ICs |
| :--- | :--- | :--- | :--- |
| AC use | $380 / 415$ | 25 | 19 |
| DC use | 250 V | 25 | 19 |



Trip unit:
Adjustable thermal ( 0.63 lr to $100 \% \mathrm{Ir}$ ) and adjustable magnetic ( 6 Im to 12 Im )

| Dimensions (mm) |  |
| :--- | :---: |
| Poles | 3 |
| H | 155 |
| W | 90 |
| D (less toggle) | 68 |
| Toggle cut-out | Standard DIN |



## DTMENSIONS

E125-NJ, S125-NJ, S125-GJ


Beyond the Standard ${ }^{\text {im }}$ Tembreak. page 85


ONSTALLATION

## INSULATION DISTANCE IN mm（AT 440V AC MAXIMUM）

|  | model | Type | A | B1 | B2 | C | D | E |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | E125 | NJ | 50 | 10 | 10 | 0 | 25 | ＇（1） |
|  | S125 | NF | 50 | 10 | 10 | 0 | 25 | ＊（1） |
|  | S125 | NJ | 50 | 10 | 10 | 0 | 25 | ${ }^{*}(1)$ |
|  | S125 | GJ | 75 | 45 | 25 | 0 | 25 | ${ }^{\prime}(1)$ |
|  | H125 | NJ | 100 | 80 | 60 | 0 | 50 | ${ }^{*}(1)$ |
|  | L125 | $\mathrm{N} J$ | 100 | 80 | 60 | 0 | 50 | ${ }^{*}(1)$ |
|  | S160 | NF | 50 | 40 | 30 | 0 | 25 | ＊（1） |
|  | S160 | N | 50 | 40 | 30 | 0 | 25 | ＊（1） |
|  | S160 | GJ | 100 | 80 | 60 | 0 | 50 | ＇（1） |
|  | H160 | $\mathrm{N} 」$ | 100 | 80 | 60 | 0 | 50 | ＊（1） |
|  | L160 | NJ | 100 | 80 | 60 | 0 | 50 | ＊（1） |
|  | E250 | NJ | 50 | 40 | 30 | 0 | 25 | ${ }^{*}(1)$ |
|  | S250 | NJ | 50 | 40 | 30 | 0 | 25 | ＊（1） |
| 0 | S250 | G」 | 100 | 80 | 30 | 0 | 25 | ＊（1） |
|  | S250 | PE | 100 | 80 | 60 | 0 | 50 | ＇（1） |
| $0$ | H250 | NJ | 100 | 80 | 60 | 0 | 50 | ${ }^{(1)}$ |
| 准全納 | H250 | NE | 100 | 80 | 60 | 0 | 50 | ＊（1） |
|  | L250 | NJ | 100 | 80 | 60 | 0 | 50 | ${ }^{*}(1)$ |
|  | E400 | NJ | 100 | 80 | 40 | 0 | 30 | ${ }^{*}(1)$ |
|  | S400 | CJ | 100 | 80 | 40 | 0 | 30 | ＊（1） |
|  | S400 | NJ | 100 | 80 | 40 | 0 | 30 | ＊（1） |
|  | S400 | GJ | 100 | 80 | 40 | 0 | 30 | ＊（1） |
|  | S400 | GE | 100 | 80 | 40 | 0 | 30 | ＊（1） |
|  | H400 | NJ | 120 | 120 | 80 | 0 | 80 | ＊（1） |
|  | H400 | NE | 120 | 120 | 80 | 0 | 80 | ${ }^{\prime}(1)$ |
|  | L400 | NJ | 120 | 120 | 80 | 0 | 80 | ＇（1） |
|  | L400 | NE | 120 | 120 | 80 | 0 | 80 | －（1） |
|  | E630 | NE | 120 | 100 | 80 | 0 | 80 | ${ }^{\prime}(1)$ |
|  | S630 | CE | 120 | 100 | 80 | 0 | 80 | ＊（1） |
|  | S630 | GE | 120 | 100 | 80 | 0 | 80 | ${ }^{*}(1)$ |

＊Note：（1）Insulate the exposed conductor until it overlaps the moulded case at the terminal，or the terminal cover．


## APPLICATION DATA

## SELECTIVITY (DISCRIMINATION) AND CASCADE

## Selectivity

The principle of Selectivity (Discrimination) is based upon an analysis of several circuit breaker characteristics. These include time-current (tripping) curves, peak-let-through current ( $\mathrm{I}_{\text {pak }}$ ) and energy let-through $\left(\mathrm{I}^{2} \mathrm{t}\right)$.

The figures stated give the maximum selectivity level with the two nominated breakers in series under short-circuit conditions. For an indication on selectivity under overloads refer to the circuit breaker tripping/characteristic curves, or use the NHP TemCurve selectivity analysis software package.
Selectivity can be enhanced beyond the breaking capacity of the downstream breaker provided it is backed up by an appropriately selected upstream breaker, which should not trip (unlatch) under the stated short circuit current.

## Cascade

Cascading is achieved by using an upstream device to assist (back-up) a downstream device in clearing a fault current. This principal is necessary should the downstream device be required to clear a prospective short circuit current greater than the devices' breaking capacity.
In most cascading applications it is generally necessary for the upstream breaker to trip (unlatch), as well as the downstream breaker to give adequate back-up protection. As such, cascade is commonly used in feeding and protecting non-essential loads, such as basic lighting.
For more information on selectivity and cascading please refer to the latest NHP Part C catalogue.

## Selectivity \＆Cascade Tables

## ＠ 400 ／ 415 V

| Upstream MCCBs |  | 容 | $\begin{aligned} & \text { 宸 } \\ & \text { N} \end{aligned}$ | 宸 | 㟯 | 㟶 |  | $\begin{aligned} & \text { 唇 } \\ & \text { 2 } \end{aligned}$ | $\begin{aligned} & \text { 岂 } \\ & \text { B } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Downstrea MCCBs |  | $\begin{gathered} \text { ~ } \\ 70 \\ \hline \end{gathered}$ | $\begin{array}{r} \text { N } \\ 125 \\ \hline \end{array}$ | $50$ | $\begin{aligned} & \boldsymbol{W} \\ & 70 \end{aligned}$ | $\begin{array}{r} \text { 포 } \\ 125 \end{array}$ | $\begin{gathered} \underset{\mathbf{J}}{\overline{\boldsymbol{T}}} \end{gathered}$ | $36$ | $\begin{gathered} \infty \\ 50 \\ 50 \end{gathered}$ |
| ［E125NJ | 25 | 25／25 | 25／65 | 25／36 | 25／50 | 25／65 | 25／85 | 25／36 | 25／25 |
| S125NJ | 36 | 36／36 | 36／85 | 36／50 | 36／65 | 36／85 | 36／125 | 36／36 | 36／36 |
| ［S125GJ | 65 | 65／65 | 65／125 | ． $50 / 50$ | 65／70 | 65／125 | 65／150 | 36／36 | 50／50 |
| H125NJ | 125 | 70／70 | 125／125 | 50／50 | 70／70 | 125／125 | 125／200 | 36／36 | 50／50 |
| S160NJ | 36 |  |  | 36，50 | 36／65 | 36／85 | 36／125 | 36／36 | 36／50 |
| S160G | 65 |  |  | 50；50 | 65／70 | 65／125 | 65／150 | 36／36 | 50／50 |
| H160NJ | 125 |  |  |  |  | 125／125 | 125／200 | 36／36 | 50／50 |
| E250NJ | 25 |  |  |  |  | 25／65 | 25／85 | 25／36 | 25／25 |
| S250NJ | 36 |  |  |  |  | ．36／85 | 36／125 | 36／36 | 36／36 |
| S250G3 | 65 |  |  |  |  | 65／22 | 65／150 | 36／36 | 50／50 |
| S250PE | 70 |  |  |  |  | 40／125 | 70／150 | 36／36 | 50／50 |
| H250NJ | 125 |  |  |  |  | 125／125 | 125／200 | 36／36 | 50／50 |
| H250PE | 125 |  |  |  |  | 125／125 | 125／200 | 36／36 | 50／50 |
| E400NJ | 25 |  |  |  |  |  |  | 10，25 | 10／25 |
| S400CJ | 36 |  |  |  |  |  | ， | 10／36 | 1036 |
| S400NE | 50 |  |  |  |  |  |  | 10／36 | 10／50 |
| S400NJ | 50 |  |  |  |  |  |  | 10／36 | 10／36 |
| S400GJ | 70 |  |  |  |  |  |  | 10／36 | 10／50 |
| H400NJ | 125 |  |  |  |  |  |  | 10／36 | 10／50 |
| H400NE | 125 |  |  |  |  |  |  | 10／36 | 10／50 |
| E630NE | 36 |  |  |  |  |  |  |  |  |
| E630CE | 50 |  |  |  |  |  |  |  |  |
| S630GE | 70 |  |  |  |  |  | 1 |  |  |
| XS630CJ | 45 |  |  |  |  |  |  |  |  |
| XS630NJ | 65 | ， | I |  |  |  |  |  |  |
| XS630PJ | 85 |  | 1 |  |  |  |  |  |  |
| XS630SE | 50 |  |  |  |  |  |  |  |  |
| XH630SE | 65 |  |  |  |  |  |  |  |  |
| XH630PE | 65 |  |  |  |  |  |  |  |  |
| XS800NJ | 65 |  |  | 1 |  |  |  |  |  |
| XS800SE | 50 |  |  |  |  |  |  |  |  |
| XI800PJ | 85 |  |  |  |  |  | ， |  |  |
| XH800SE | 65 |  |  |  |  |  |  |  |  |
| XH800PE | 65 |  | 1 |  |  |  |  |  |  |
| XS1250SE | 65 |  |  |  |  | 1 | 1 |  |  |
| XS1600SE | 85 |  |  |  |  |  |  |  |  |

$X X / Y$

| 山 另 70 70 |  | $\begin{aligned} & \text { 苟 } \\ & \stackrel{0}{0} \\ & \times 0_{x} \\ & 50 \end{aligned}$ | $\begin{aligned} & \text { u } \\ & \stackrel{\rightharpoonup}{\mathbf{a}} \\ & \stackrel{\rightharpoonup}{x} \\ & \text { x } \\ & 65 \end{aligned}$ |  |  |  | $\begin{array}{r} \text { 炭 } \\ \stackrel{0}{0} \\ \stackrel{0}{6} \\ 100 \\ 10 \end{array}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 25／50 | 25／25 | 25／36 | 25／36 | 25／65 | $25 / 25$ | 25／25 | 25／25 | 25／25 | 25／25 |
| 36／65 | 36／36 | 36／50 | 36／36 | 36／36 | 36／36 | 36／36 | 38／36 | 36／36， | 36／36 |
| 65；70 | 65／65 | 65／50 | 65／65 | 65／65 | 65／65 | 65／65 | 65／65 | 65／65 | 65／65 |
| 70，70 | 70，70 | 50，50 | 65／65 | 65／65 | 85／50 | 85／50 | 100／100 | 85／85． | 85／85 |
| 36／50 | 36／36 | 36／36 | 36／65 | 36／65 | 36／38 | 36／36 | 36／36 | 36／36 | 36／36 |
| 65／70 | 65／65 | 50，50 | 50／65 | 50／65 | 65／65 | 65／65 | 65／65 | 65／65 | 65／65 |
| 70／70 | 70，70 | 50／50 | 50／65 | 50／65 | 85／65 | 85／65 | 100／100 | 85／85 | 85／85 |
| 25／50 | 25／25 | 25／25 | 25／50 | 25；50 | 25／25 | 25／25 | 25／25 | 25／25 | 25／25 |
| 36／65 | 36／36 | 36／36 | 36／36 | 36／36 | 36／36 | 36／36 | 36／36 | 36／36 | 36／36 |
| 65／70 | 65／65 | 50，50 | 50／65 | 50／65 | 65／65 | 65／65 | 65／65 | 65／65 | 65／65 |
| 7070 | 70，70 | 50，50 | 50／65 | 50／65 | 70／70 | 70／70 | 70／70 | 70／70 | 70／70 |
| 70／70 | 70，70 | －50／50 | 50／65 | 50／65 | 85／85 | 85／85 | 100，100 | 85／85 | 85／85 |
| 70／70 | 70／70 | 50；50 | 50／65 | 50／65 | 85／85 | 85／85 | 100100 | 85／85 | 85／85 |
| 10，50 | 10／36 | 25／25 | 25，25 | 25／36 | 25／25 | 25／25 | 25／36 | 25i／25 | 25／25 |
| 10／65 | 10／50 | 25／36 | 25／36 | 25／50 | 36，36 | 36／36 | 38／50 | 36i36 | 38／36 |
| 10，50 | 10，50 | 25／50 | 25／50 | 25；50 | 50／50 | 50，50 | 50，50 | 50／50 | 50／50 |
| 10，70 | 10／65 | 25／50 | 25／50 | 25／65 | 50／50 | 50／50 | 50／65 | 50／50 | 50，50 |
| 10，70 | 10／70 | 25／50 | 25／50 | 25／65 | 70／36 | 70，36 | 70，85 | 70，70 | 70，70 |
| 1070 | 10／70 | 25／50 | 25／65 | 25／65 | 125／85 | 125／85 | 125／100 | 125／85 | 125／85 |
| 10／70 | 10，70 | 25／50 | 25／65 | 25／65 | 125／85 | 125／85 | 125／100 | 125／85 | 125／85 |
|  |  | 25／36 | 25／36 | 25i36 | ． $36 / 36$ | 36／36 | 36／36 | 36／36 | 36／36 |
|  |  | 25／50 | 25／50 | 25／50 | 50／50 | 50／50 | 50／50 | 50，50 | 50／50 |
|  |  |  |  |  | 70\％0 | 70，70 | 70，70 | 70／70 | 70，70 |
| 1 |  |  |  |  | 30／45 | 30145 | 30／45 | 35／45 | 35／45 |
|  |  |  |  |  | 30／65 | 30／65 | ．30／65 | 35／65 | －36／65 |
|  |  |  |  |  | 30／85 | 30／85 | 30／85 | 35／85 | 35／85 |
|  |  |  |  |  | 30／65 | 30／65 | 30／85 | 30185 | 30\％85 |
|  |  |  |  |  | 30／65 | 30／65 | 30／85 | 30／65 | 30／85 |
|  |  |  |  |  | 30／65 | 30／65 | 30／85 | 30／85 | 30／85 |
|  |  |  |  |  | 15／65 | 15／65 | 20／65 | 35／65 | 35／65 |
|  |  |  |  |  | 15／50 | 15／50 | 20／50 | 35／50 | 35／50 |
|  |  |  |  |  | 15／85 | 15／85 | 20／85 | 35／85 | 35／85 |
|  |  |  |  |  | 15／65 | 15／65 | 20／65 | 35／65 | 35／65 |
|  |  |  |  |  | 15／65 | 15／65 | 20，65 | 35／65 | 35／65 |
|  |  |  |  |  |  |  | 20／65 | 35／65 | 35／65 |
|  |  |  |  |  |  |  |  | 35／85 | 35／85 |

##  <br> 




APPLICATION DATA

## CASCADE TABLES

| CASCADE <br> © 380－415VAC ${ }^{1}$ ） |  | $\begin{aligned} & \mathrm{m} \\ & \mathbf{N} \\ & \mathbf{N} \end{aligned}$ | $\begin{aligned} & \boldsymbol{n} \\ & \mathbf{N} \\ & \mathbf{U} \\ & \mathbf{Z} \end{aligned}$ | $\begin{aligned} & \text { N } \\ & \mathbf{N} \\ & \mathbf{N} \end{aligned}$ | $\begin{aligned} & I \\ & N \\ & N \\ & Z \end{aligned}$ | $\begin{aligned} & \stackrel{r}{n} \\ & \text { N } \\ & Z \end{aligned}$ | $\begin{aligned} & \text { O } \\ & \underset{\sim}{0} \\ & \underset{2}{2} \end{aligned}$ | $\begin{aligned} & \text { の } \\ & \text { O } \\ & \text { O} \end{aligned}$ | $\begin{aligned} & \text { I } \\ & \text { 另 } \\ & \text { ? } \end{aligned}$ | $\begin{aligned} & \text { r } \\ & \stackrel{B}{2} \\ & \mathbf{2} \end{aligned}$ | $\begin{aligned} & \text { m } \\ & \mathbf{N} \\ & \text { O } \\ & \mathbf{Z} \end{aligned}$ | $\begin{aligned} & \text { n } \\ & \text { N } \\ & \text { N } \\ & \mathbf{Z} \end{aligned}$ | $\begin{aligned} & \boldsymbol{n} \\ & \text { No } \\ & \text { O} \\ & \mathbf{O} \end{aligned}$ | 0 $\mathbf{N}$ $\mathbf{O}$ 0 | $\begin{aligned} & T \\ & \mathbf{N} \\ & \text { H } \\ & \mathbf{Z} \end{aligned}$ | T U O Z | H <br> 0 <br> 0 <br> 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Downstream MCCBs | $\begin{gathered} \text { KA } \\ \text { (RMS) } \end{gathered}$ | c |  |  |  |  |  |  | C | C | C | C | c | m | C | m |  |
|  |  | 25 | 36 | 65 | 125 | 200 | 36 | 65 | 125 | 200 | 25 | 36 | 65 | 70 | 125 | 125 | 200 |
| E125NJ | 25 | － | 36 | 36 | 65 | 85 | 36 | 36 | 65 | 85 | － | 36 | 36 | － | 65 | 65 | 85 |
| S125NJ | 36 | － | － | 50 | 85 | 125 | － | 50 | 85 | 125 | － | － | － | － | 85 | 85 | 125 |
| S125GJ | 65 | － | － | －： | 125 | 150 | － | － | 125 | 150 | － | － | 65 | － | 125 | 125 | 150 |
| H125NJ | 125 | － | － | － | $\cdots$ | 200 | － | － | － | 200 | － | － | 65 | － | － | － | 200 |
| S160NJ | 36 | － | － | 65 | －． | － | － | 65 | 85 | 125 | － | $\div$ | 65 | 65 | 85 | 85 | 125 |
| S160GJ | 65 | － | － | － | － | － | － | － | 125 | 150 | － | － | － | 70 | 125 | 125 | 150 |
| H160NJ | 125 | － | － | － | － | － | － | － | － | 200 | － | $\div$ | － | － | － | － | 200 |
| S250NJ | 36 | － | － | － | $\cdots$ | － | － | 65 | － | － | － | － | － | 65 | 85 | 85 | 125 |
| S250GJ | 65 | － | － | － | － | － | － | － | － | － | － | $\because$ | － | 70 | ． 125 | 125 | 150 |
| S250PE | 70 | － | － | － | － | － | － | － | － | － | － | － | － | － | 125 | 125 | 150 |
| H250NJ | 125 | － | － | － | － | － | － | － | － | － | － | $\square$ | － | － | － | － | 200 |
| E400NJ | 25 | － | － | － | － | － | － | － | － | － | － | － | － | 36 | 65 | 65 | － |
| S400CJ | 36 | － | － | － | － | － | － | － | － | －， | － | $\div$ | $\cdots$ | 50 | 70 | 70 | － |
| S400NJ | 50 | － | － | － | － | $\div$ | － | － | － | － | － | － | 50 | 65 | 85 | 85 | ＝ |
| S400GJ | 70 | － | － | － | － | － | － | － | － | － | － | $\triangle$ | 50 | $\therefore$－ | 125 | 125 | － |
| H400NJ | 125 | － | － | $\cdots$ | － | － | － | － | － | － | － | － | － | － | － | － | － |

Note：＇）Ratings have not been verified where a dash＂- ＂is shown
All pick－up and time delay settings are to be set at a maximum for upstream MCCB＇s

| Upstream MCCBs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CASCADE <br> （1）380－415VAC ${ }^{1}$ ） |  | \＆ <br> $\stackrel{\circ}{\circ}$ |  | $\begin{aligned} & \text { oc } \\ & \text { 莒莫 } \\ & \text { CR } \end{aligned}$ |  | $\begin{aligned} & \text { r } \\ & \text { O} \\ & \mathbf{Z} \end{aligned}$ | 荅 而 | $\begin{aligned} & \mathbf{m} \\ & \text { W } \\ & \mathbf{O} \\ & \mathbf{m} \end{aligned}$ | $\begin{aligned} & \text { ๗ } \\ & \text { 山్ర } \\ & \text { in } \end{aligned}$ | $\begin{aligned} & \text { 毋 } \\ & \underset{\sim}{\circ} \\ & \text { గim } \end{aligned}$ | $\begin{aligned} & -1 \\ & \underset{\sim}{\mathbf{O}} \\ & \mathbf{O} \\ & \mathbf{~} \end{aligned}$ | $\begin{aligned} & \times \\ & \infty \\ & \infty \\ & 0 \\ & 0 \\ & \text { m } \end{aligned}$ | $\begin{aligned} & \times \\ & \text { 区 } \\ & 0.0 \\ & \mathbf{O} \\ & \text { Z } \end{aligned}$ |  |  |  | $\begin{aligned} & \times \\ & \stackrel{\times}{0} \\ & \stackrel{\rightharpoonup}{\circ} \\ & \underset{\sim}{n} \end{aligned}$ |
| $\begin{gathered} \text { Downstream } \\ \text { MCCBs } \\ \hline \end{gathered}$ | $\begin{gathered} \text { KA } \\ \text { (RMS) } \end{gathered}$ | 36 | 50 | 70 | 125 | 200 | 200 | 36 | 50 | 70 | 125 | 65 | 65 | 65 | 200 | 65 | 85 |
| E125NJ | 25 | 36 | 36 | 50 | 65 | 85 | 85 | 38 | － | 50 | － | 36 | 36 | 36 | － | － | － |
| S125NJ | 36 | － | 50 | 65 | 85 | 125 | 125 | － | － | 65 | － | 50 | 50 | － | － | － | － |
| S125GJ | ， 65 | － | － | 70 | 125 | 150 | 150 | － | 50 | 70 | － | － | － | 65 | － | － | － |
| H125NJ | 125 | － | － | － | － | 200 | 200 | － |  | － | － | － | － | 65 | － | 50 | － |
| S160NJ | 36 | － | 50 | 65 | 85 | 125. | 125 | － | 50 | 50 | － | $=$ | 65 | 65 | － | － | － |
| S160GJ | 65 | － | － | 70 | 125 | 150 | 150 | － | － | 70 | － | － | － | － | － | － | － |
| H160NJ | 125 | － | － | －． | － | 200 | 200 | － | － | － | － | $\cdots$ | － | 65 | － | 65 | － |
| E250NJ | 25 | 36 | 36 | 50 | 65 | 85 | 85 | 36 | － | 50 | － | － | 36 | 50 | － | － | － |
| S250NJ | 36 | － | 50 | 65 | 85 | 125. | 125 | $\checkmark$ | － | 65 | － | $\div$ | 65 | － | － | － | － |
| S250G」 | 65 | － | － | 70 | 125 | 150 | 150 | － | － | 70 | － | － | － | － | － | － | － |
| S250PE | 70 | － | － | － | 125 | 150 | 150 | － | － | － | － | － | － | － | － | － | － |
| H250NJ | 125 | － | － | － | － | 200 | 200 | － | － | － | － | － | － | － | － | － | － |
| E400NJ | ： 25 | 36 | 36 | 50 | 65 | 85 | 85 | 36 | － | 50 | 36 | － | － | － | 36 | － | 36 |
| S400CJ | 36 | － | 50 | 65 | 70 | 100 | 100 | － | － | 65 | 50 | － | － | － | 50 | － | 50 |
| S400NJ | 50 | － | － | 70 | 85 | 125 | 125 | － | 36 | 70 | － 65 | － | － | 50 | 65 | － | 65 |
| S400GJ | 70 | － | － | － | 125 | 150 | 150 | － | 36 | － | － | － | － | 50 | － | 36 | 85 |
| H400NJ | ${ }^{\prime} 125$ | － | － | － | － | 200 | 200 | － | － | － | $\bigcirc$ | － | － | $\checkmark$ | － | － | － |

Note：＇）Ratings have not been verified where a dash＂－＂is shown．
All pick－up and time delay settings are to be set at a maximum for upstream MCCBs
page 46 TemBreak Beyond the Standard ${ }^{\text {TM }}$


APPLICATCON DATA
SELECTIVITY AND CASCADE TEMBREAK 2 MCCBs AND DIN-T/
SAFE-T MCBs

| Upstream MCCB |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SELECTIVITY / CASCADE <br> © 415 V AC |  |  | $\begin{aligned} & \mathrm{m} \\ & \stackrel{N}{\mathrm{~N}} \\ & \mathrm{Z} \end{aligned}$ | $\begin{aligned} & \text { n } \\ & \text { N} \\ & \text { NZ } \end{aligned}$ | $\begin{aligned} & \text { nI } \\ & \text { NU } \\ & \text { GZ } \\ & \text { Qz } \end{aligned}$ | $\begin{aligned} & \text { N } \\ & \text { N } \\ & \end{aligned}$ |  | $\begin{aligned} & \text { n } \\ & \stackrel{\rightharpoonup}{\circ} \\ & \stackrel{c}{c} \end{aligned}$ | $\begin{aligned} & \text { nes } \\ & \text { 劳菖 } \\ & \text { Cion } \end{aligned}$ | T <br> O <br> O <br> 2 |
| Downstream <br> MCB | rating | (RMS) | 25 | 36 | 65 | 36 | 65 | 36 | 70 | 125 |
| DTCB6 | 2-20 | 6 | 18/18 | 25/25 | 35/35 | 35/35 | 35/35 | - | - | - |
|  | 25-63 | 6 | 18/18 | 20/25 | 20/25 | 30/30 | 30/30 | - | - | - |
| DTCB10 | 0.5-32 | 10 | 18/18: | 30/30 | 30/50 | 35/35 | 40/50 | 35/35 | 40/50 | 40/50 |
|  | 40-63 | 10 | 18/18 | 20/25 | 25/25 | 30/30 | 30/30 | 30/30 | 30/30 | 30/30 |
| DSACBH/ | 0.5-32 | 10 | 18/18 | 30/30 | 30/50 | 35/35 | 40/50 | 35/35 | 40/50 | 40/50 |
| DSACD. | 40 | 10 | 18/18 | 20/25 | 25/25 | 30/30 | 30/30 | 30/30 | 30/30 | 30/30 |
| Din-T10H | 80-125 | 10 | 4/18 | 4/25 | 4/25 | 15/15 | 15/15 | 10/10 | 10/10 | - |
| DTCH15 | 0.5-32 | 15 | 18/18 | 30 | 30/50 | 35/35 | 40/50 | 35/35 | 40/50 | 40/50 |
|  | 40-63 | 15 | 18/18 | 20 | 25/25 | 30/30 | 30/30 | 30/30 | 30/30 | 30/30 |
| Safe-T | 16-20 | 6 | $3 / 10$ | 3/10 | 3/10 | - | - | - | - | - |
| SRCB | 16-20 | 6 | 3/10 | 3/10 | $3 / 10$ | - | - | - | - | - |

Guide
$\frac{\mathbf{X X ~ / ~ Y ~ Y ~}}{\underset{\text { Selectivity }}{\text { Cascade }}}$

Notes: All figures stated are at $400 / 415$ V AC.


APPLICATDON DATA

## MOTOR STARTING TYPE 1 CO-ORDINATION TABLES

## Short-Circult Co-Ordination Motor Starting Table

Type ' 1 '
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting $50 / 65 \mathrm{KA}$ © 400/415 V to AS/NZS 60947.4.1

|  |  | Terasak Combinations |  |
| :---: | :---: | :---: | :---: |
| Motor Size (kW) | Approx amps © $400 / 415 \mathrm{~V}$ (A) | MCCb | Comtartor |
| 0.37 | 1.1 | XM30PE/1.4 | CA7\% |
| 0.55 | 1.5 | XM30PE/2 | CA7-9 |
| 0.75 | 1.8 | XM30PB/2. 6 | CA7 - |
| 1.1 | 2.6 | XM30PE/4.0 | CA7- |
| 1.5 | 3.4 | XM30PE/5 | CAT-8 |
| 2.2 | 4.8 | Хм30Р8/8 | CA7.- |
| 3 | 6.5 | XM30P8/10 | CA7- |
| 4 | 8.2 | XM30PE/12 | CA7. ${ }^{\text {c }}$ |
| 5.5 | 11 | S125G//20 | CA7-12 |
| 7.5 | 14 | S125G./20 | CA7-16 |
| 11 | 21 | E125GJP32 | CA7-28 |
| 15 | 28 | 8125GV/50 | CA7-30 |
| 18.5 | 34 | S125G/55 | CA7-87 |
| $\underline{22}$ | 40 | 8125Gd/33 | CA7-49 |
| 30 | 55 | S125G/400 | CA7-80 |
| 37 | 66 | : S125G/400 | CA 7 -72 |
| 45 | 80 | S125GM25 | CA7-85 |
| 55 | 100 | S125G/M25 | CAB-110 |
| 5 | 130 | B250PEP250 | CAB-140. |
| 0 | 155 | S250PE/250 | CAB-180 |
| 10 | 200 | S250PE/2S0 | CAB-210 |
| 32 | 225 | S400GE/400 | CAB-210 |
| 60 | 270 | S400GE/400 | CAB-300 |
| 00 | 361 | S400GE/400 | CAB-420 |


| Terasald Combinatioris |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overloaid Relay | Thermaj Setting (A) | KT7 Circult Breaker | Contactor |
| CT 7-24 | 1.0-1.8 | KTA7-25S-1.0A | CA7-9 |
| CT 7-24 | 1.0-1.0 | KTA7-25S-1.6A | CA7-9 |
| CT 7-24 | 1.6-24 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-4.0A | CA7-9 |
| CTT 7-24 | 4.0-6.0 | KTA7-25S-6.3A | CA7-9 |
| CT 7-24 | 0.0-10 | KTA7-25S-6.3A | CA7-9 |
| CT 7 -24 | 8.0-10 | KTA7-25S-10A | CA7-9 |
| CT 7.24 | 10-18 | KTA7-25H-16A | CA7-12 |
| CT 7.24 | 10-16 | KTA7-25H-16A | CA7-16 |
| CT 7-24 | 18-34 | KTA 7 -45H-20A | CA7-23 |
| CT 7.45 | 18-30 | KTA7-45H-32A | CA7-30 |
| CT 7.45 | 30-45. | KTA7-45H-45A | CA7-37 |
| CT 7.45 | 30-45 | KTA $7-45 \mathrm{H}-45 \mathrm{~A}$ | CA7-43 |
| CT 7-75 | 45-60 | KTA3-100-63A | CA7-60 |
| CT 7-75 | 60-75 | KTA3-100-90A | CA7-72 |
| CT: 7-100 | 70-80 | KTA3-100-90A | CA7-85 |
| \|GEF 1-11/12 | 20-180 | KTA3-160S-100A | CA6-110 |
| CEF $1-11 / 12$ | $20-180$ | KTA3-160S-160A | CA6-140 |
| CEF 1-11/12 | 20-180 | KTA3-160S-160A | CA6-180 |
| CEEF 1-41/42 | 180-400 | KTA3-250S-200A | CA6-210 |
| CEF 1-41/42 | 180-400 | KTA3-250S-250A | CA6-250 |
| CEF 1-41/42 | 180-400 | KTA3-400S-320A | CA6-300 |
| CEEF 1-41/42 | 180-400 | KTA3-400S-400A | CA6-420 |

Notes: - Thermal or electronic overload relays may be used.

- XM30PB MCCB's can be replaced with S $125 \mathrm{GJ} / 20$ it required.
- Combinations based on the thermal overload relay tripping before the circuit.
breaker at overoad curents up to the motor locked rotor current.

[^2]TEMBREAK 2 MCCBs

## OPPLICATION DATA

## MOTOR STARTING TYPE 2 CO-ORDINATION TABLES

## Short-Circult Co-Ordinatlon DOL Motor StartIng Table

Type '2'
Terasaki MCCB's \& Sprecher + Schuh KT7's DOL starting 50/65 KA © 400/415 V to AS/NZS 60947.4.1

|  |  | Terasakd Comblnations |  |
| :---: | :---: | :---: | :---: |
| Motor Slze $(k W)$ | Approx. amps © $400 / 415 \mathrm{~V}$ (A) | Mcce | Cornactor |
| 0.37 | 1.1 | XMSOPBH. 4 | CAT-E |
| 0.55 | 1.5 | XMSOPBR2. | CA7-8 |
| 0.75 | 1.8 | XM30PBR2. ${ }^{\text {¢ }}$ | CA7- |
| 1.1 | 2.6 | XM30PB/4.0 | CA7-18 |
| 1.5 | 3.4 | XMSOPE/5 | CA7-18 |
| 2.2 | 4.8 | XMSOPB/8 | CA7-18 |
| 3 | 6.5 | ХM30РВ ${ }^{\text {( }}$ | CA7-S0 |
| 4 | 8.2 | ХМSDPBH2 | CA7-30 |
| 5.5 | 11 | S125G/120 | CA7-30 |
| 7.5 | 14 | S125GJ/20 | CA7-30 |
| 11 | 21 | S125GL/32 | CA7.30 |
| 15 | 28 | S125Gl/50 | CA7.43 |
| 18.5 | 34 | S125GL/50 | CA7-43 |
| 22 | 40 | S125G//83 | CA7.43 |
| 30 | 55 | S125GM00 | CA7-72 |
| 37 | 65 | S125GM00 | CA7-72 |
| 45 | 80 | S125G/125 | CAE-105 |
| 55 | 100 | S2050PE/180 | CAE-105 |
| 75 | 130 | S250PER250 | CAE-140 |
| 90 | 155 | 8250PE 250 | CAE-170 |
| 110 | 200 | 6250PE/250 | CAB-210 |
| 132 | 225 | 8400PE/400 | CAE-210 |
| 160 | 270 | S400PE/400 | CAB-300 |
| 200 | 361 | S400PE/400 | CAB-420 |


| Terasald Combinations |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overlaad Relay | Thermal <br> Setting (A) | KT7 Circult Breaker | Contactor |
| CT 7-24 | 1.0-1.0 | KTA7-25S-1A | CA7-9 |
| CT 7-24 | 1.0-1.0 | KTA7-25S-1.6A | CA7-9 |
| CT 7-24 | 1.8-24 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-2.5A | CA7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25S-4A | CA7-9 |
| CT 7-24 | 4.0-8.0 | KTA7-25S-6.3A | CA7-9 |
| CT 7-24 | 8.0-10 | KTA7-25S-6.3A | CA7-9 |
| CT 7-24 | 6.0-10 | KTA7-25S-10A | CA7-9 |
| CT] 7-24 | 10-18 | KTA $7-25 \mathrm{H}-16 \mathrm{~A}$ | CA7-12 |
| CT 7-24 | 10-18 | KTA7-25-16A | CA7-16 |
| CT 7-24 | 10-24 | KTA7-45H-20A | CA7-23 |
| CT 7.45 | 18-30 | KTA7-45H-32A | CA7-30 |
| CT 7-45 | 30-45 | KTA7-45H-45A | CA7-37 |
| CT 7.45 | 30-46 | KTA7-45H-45A | CA7-43 |
| [CT 7-75 | 45-60 | KTA3-100-63A | CA7-60 |
| CT 7-75 | 80-75 | KTA3-100.90A | CA7-72 |
| CT 7-100 | 70-80 | KTA3-100-90A | CA7-85 |
| CEF 1-11/12 | 20-180 | KTA3-160S-100A | CAG-110 |
| CEF 1-11/12 | 20-180 | KTA3-160S-160A | CA6-140 |
| CEF 1-11/12 | 20-180 | KTA3-160S-160A | CA6-180 |
| CEF 1-41/42 | 160-400 | KTA3-250S-200A | CA6-210 |
| CEF 1-41/42 | 180-400 | KTA3-250S-250A | CA6-250 |
| CEF 1-41/42 | 160-400 | KTA3-400S-320A | CA6-300 |
| CEF 1-41/42 | 180-400 | KTA3-400S-400A | CA6-420 |

[^3]XM30PB combinaicons can be replaced with S125GJ/20 and CA7-30 if required.
Combinations based on the thermal overload relay tripping before the circuit
breaker at overioad currents up to the motor locked rolor current.


APPLPCATDON DATA

## MOTOR STARTING TYPE 2 CO-ORDINATION

Short-CIrcult Co-Ordination DOL Motor Starting Table
Type '2'
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting $85 \mathrm{KA} @ 400 / 415 \mathrm{~V}$ to AS/NZS 60947.4.1

|  |  | Terasakd Combinations |  |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Motor Size } \\ & \text { (kW) } \\ & \hline \end{aligned}$ | Approx. amps © $400 / 415 \mathrm{~V}$ (A) | MCCB | Contactar |
| 0.37 | 1.1 | XM30PE/1.4 | CA 7 -8 |
| 0.55 | 1.5 | XM30PB/2 | CA 7-8 |
| 0.75 | 1.8 | XM30PE/2. | CA $7-\theta$ |
| 1.1 | 2.6 | XMSOPE/4.0 | CA 7-18 |
| 1.5 | 3.4 | XMSOPES 5 | CA 7-18 |
| 2.2 | 4.8 | XM30PE/8 | CA 730 |
| 3 | 6.5 | XM30PE/10 | CA 7-30 |
| 4 | 8.2 | XM30PE/12 | CA 7-30 |
| 5.5 | 11 | H125NJ/20 | CA 7 -30 |
| 7.5 | 14 | H125N1220 | CA 7-30 |
| 11 | 21 | H125Na/32 | CA 7 -30 |
| 15 | 28 | H125N//50 | CA 7-49 |
| 18.5 | 34 | H125NL/50 | CA $7-43$ |
| 22 | 40 | H125N1/日3 | CA 7-49 |
| 30 | 55 | H125NL/M00 | CA 7-72 |
| 37 | 66 | H125N1M00 | CA 7-72 |
| 45 | 80 | H125NIM80 | CA Q-105 |
| 55 | 100 | H160NLMEO | CA O-105 |
| 75 | 130 | H250PE/2SO | CA 8-210 |
| 90 | 155 | H250PE/250 | CA 6210 |
| 110 | 200 | H250PE/250 | CA 8-210 |
| 132 | 225 | H400NE/400 | CA 6-210 |
| 160 | 270 | H400NE/400 | CA 8-300 |
| 200 | 361 | H400NE/400 | CA 8-420 |


| Terasald Combinatlons |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overload Relay | Thentral Setting (A) | KT7 Circult Breaker | Contactor |
| CT 7-24 | 1.0-1.8 | KTA7-25S-1A | CA 7-9 |
| CT 7.24 | 1.0-1.6 | KTA7-25S-1.6A | CA 7-9 |
| CT 7-24 | 1.8-2.4 | KTA 7 -25S-2.5A | CA 7.9 |
| CT 7-24 | 2.4-4.0 | KTA7-25H-2.5A | CA 7-9 |
| CT 7-24 | 2.4-4.0 | KTA $7-25 \mathrm{H}-4 \mathrm{~A}$ | CA 7-9 |
| CT 7-24 | 4.0-6.0 | KTA7-25H-6.3A | CA 7-9 |
| CT 7-24 | 8.0-10 | KTA7-25H-6.3A | CA 7-9 |
| CT 7-24 | 8.0-10 | KTA7-25H-10A | CA 7.9 |
| CT 7-24 | 10-18 | KTA7-45H-16A | CA 7-12 |
| CT 7.24 | 10-18 | KTA7-45H-16A | CA 7-16 |
| CT $7-24$ | 18-24 | KTA7-45H-20A | CA 7-23 |
| CT 7-45 | 18-30 | KTA7-45H-32A | CA 7.30 |
| CT 7-45 | 90-45 | KTA7-45H-45A | CA 7.37 |
| 1CT 7-45 | 90-45 | КTA7-45-45A | CA 7.43 |
| \|CT 7-75 | 45-80 | КТАЗ-100-63A | CA7-60 |
| CT 7-75 | 60-75 | КТАЗ-100-90А | CA7-72 |
| CT 7-100 | 70-80 | KTA3-100-90A | CA7-85 |
| CEF 1-11/12 | 20-180 | - | - |
| CEF 1-11/12 | 20-180 | - | $\cdot$ |
| GEF 1-11/H2 | 20-180 | - | - |
| CEF 1-41/42 | 180-400 | - | - |
| CEF 1-41/42 | 180-400 | - | - |
| CEF 1-41/42 | 180-400 | - | - |
| CEF 1-41/42 | 180-400 | - | - |

Notes: - Thermal or electronic overload retays may be used.

- XM30PB combinations can be replaced with H125GJ/20 and CA7-30 if required

Combinations based on the thermal overibad relay tripping betore the circuth
breaker at overload currents up to the motor locked rotor current.


## MOTOR STARTING TYPE 2 CO-ORDINATION

## Short-CIrcult Co-OrdInatlon DOL Motor Starting Table

Type '2'
Terasaki MCCB's \& Sprecher + Schuh KT7's
DOL starting $100 \mathrm{KA} @ 400 / 415 \mathrm{~V}$ to AS/NZS 60947.4.1

|  |  | Terasakd Comblnations |  |
| :---: | :---: | :---: | :---: |
| Motor Size (kW) | Approx. amps © 400/415 V (A) | MCCB | Contactor |
| 0.37 | 1.1 | H125Na/20 | CA 7-30 |
| 0.55 | 1.5 | H125NL/2O | CA 7 -30 |
| 0.75 | 1.8 | H125NL/2O | CA 7.30 |
| 1.1 | 2.6 | H125N4/20 | CA 7-30 |
| 1.5 | 3.4 | H125NL/2O | CA 7-30 |
| 2.2 | 4.8 | H125NL/20 | CA 7.80 |
| 3 | 6.5 | H125N/20 | CA 7.30 |
| 4 | 8.2 | H125NL/2O | CA 7-30 |
| 5.5 | 11 | H125NL/2O | CA 7-30 |
| 7.5 | 14 | H125NL/20 | CA 7.30 |
| 11 | 21 | H125N $/ 32$ | CA 7.30 |
| 15 | 28 | H125Ni/50 | CA 7-43 |
| 18.5 | 34 | $\mathrm{H} 125 \mathrm{~N} / 50$ | CA 7-43 |
| 22 | 40 | H125NJ/E3 | CA 7-43 |
| 30 | 55 | H125-Na/M00 | CA 7-80 |
| 37 | 66 | H125-N/M00 | CA 7-72 |
| 45 | 80 | H125-N/H25 | CA 7-85 |
| 55 | 100 | Haso-NETEO | CA 8 -85 |
| 75 | 130 | HRS0-NE/250 | CA -140 |
| 90 | 155 | H250-NE/250 | CA $8-140$ |
| 110 | 200 | H250-NE/250 | CA E-180 |
| 132 | 225 | H400-NE/400 | CA $8-420$ |
| 160 | 270 | H400-NE/400 | CA B-420 |
| 200 | 361 | H400-NE/400 | CA 6-420 |


| Terasakd Combinations |  | Sprecher + Schuh Combinations |  |
| :---: | :---: | :---: | :---: |
| Overtoad Relay | Thermal Setting (A) | KT7 Circult Breaker | Contactor |
| CT 7-24 | 1.0-1.8 | KTA7-25S-1A | CA 7-9 |
| GT 7-24 | 1.0-1.8 | KTA7-25S-1.6A | CA 7-9 |
| CT 7-24 | 1.6-2.4 | KTA7-25S-2.5A | CA 7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25H-2.5A | CA 7-9 |
| CT 7-24 | 2.4-4.0 | KTA7-25H-4A | CA 7-9 |
| CT 7-24 | 4.0-8.0 | KTA7-25H-6.3A | CA 7-9 |
| CT 7-24 | 6.0-10 | KTA7-25H-6.3A | CA 7-9 |
| CT 7-24 | 8.0-10 | KTA7-25H-10A | CA 7-9 |
| CT 7-24 | 10-10 | KTA 7 -45H-16A | CA 7-12 |
| CT 7-24 | 10-10 | KTA7-45H-16A | CA 7-16 |
| CT 7-24 | 10-24 | KTA7-45H-20A | CA 7-23 |
| CT 7-45 | 18-30 | KTA7-45H-32A | CA 7-30 |
| CT 7-45 | 30-45 | KTA7-45H-45A | CA 7-37 |
| CT 7-45 | 30-46 | KTA7-45H-45A | CA 7-43 |
| CT 7.75 | 45-80, | - | - |
| CT 7.75 | 60-75 | - | - |
| CT 7-100 | 70-80 | - | - |
| CEF 1-11/12 | 20-180 | - | $\bullet$ |
| CEF 1-11M2 | 20-180 | $\cdot$ | - |
| CEF 1-11/12 | 20-180 | $\bullet$ | $\bullet$ |
| CEF 1-41/42 | 160-400 | - | $\bullet$ |
| CEF 1-41/42 | 100-400 | $\cdot$ | - |
| CEF 1-41/42 | 160-400 | $\cdot$ | $\bullet$ |
| CEF 1-41/42 | 100-400 | - | - |

[^4]Combinations based on the thermal overload relay tripping before the circuit
breaker at overioad currents up to the motor locked rotor current.
TYPE 2
100 kA



## OPERATMNG CHARACTERUSTICS

## THERMAL MAGNETIC CHARACTERISTICS

125A Frame MCCBs

Time/current characteristic curves
E125-NJ, S125-NJ, S125-GJ


Time/current characteristic curves H125-NJ,L125-NJ



## OPRRATMNG CHARACTERISTICS

## THERMAL MAGNETIC PROTECTION

## Adjustment Dials



1. $I_{\mathrm{R}}$ is the thermal element adjustment dial and is used to set the rated current to match the conductor rating.
$I_{\mathrm{R}}$ can be set between 0.63 and 1.0 times $I_{n}$.
2. $I_{\mathrm{i}}$ is the magnetic element adjustment dial and is used to set the short circuit tripping threshold to suit the application.
$I_{\mathrm{i}}$ can be set between 6 and 12 times $I_{\mathrm{n}}$ on 125 A and 400A frame models.
$I_{i}$ can be set between 6 and 13 times $I_{\mathrm{n}}$ on 250A frame models with ratings of $160 \mathrm{~A}, 200 \mathrm{~A}$ and 250A.
$I_{\mathrm{i}}$ can be set between 6 and 12 times $I_{\mathrm{n}}$ on 250A frame models with ratings of 125 A and less.

Models, Types and Rated Currents of Thermal Elements

| (1)0der | Type | Current Rating |
| :---: | :---: | :---: |
| S125 | -NF | $16,20,25,32,40,50,63,80,100,125$ |
| E125 | -NJ | 20, 32, 50, 63, 100, 125 |
| S125 | -NJ | 20, 32, 50, 63, 100, 125 |
| S125 | -CJ | 20, 32, 50, 63, 100, 125 |
| H125 | -NJ | $20,32,50,63,100,125$ |
| L125 | -NS | 20, 32, 50, 63, 100, 125 |
| S160 | -NF | $16,20,25,32,40,50,63,80,100,125,160$ |
| 5160 | -NJ | $20,32,50,63,100,125,160$ |
| S160 | -G.J | $50,63,100,125,160$ |
| H160 | -NJ | 160 |
| L160 | $-N J$ | 160 |
| E250 | -NJ | $20,32,50,63,100,125,160,200,250$ |
| S250 | -NJ | 160, 200, 250 |
| 5250 | -GJ | 160, 200, 250 |
| H250 | -NJ | 160, 250 |
| L250 | -NJ | 160, 250 |
| E400 | -NJ | 250,400 |
| S400 | -C. | 250, 400. |
| S400 | -NJ | 250,400 |
| S400 | -GJ | 250, 400, |
| H400. | -NJ | 250, 400 |
| L400 | - NJ | 250, 400: |



OPERATING CHARAGTERISTICS

## LET-THROUGH PEAK CURRENT CHARACTERISTICS

S125-NF. 240V AC


E125-NJ, S125-NJ, S125-GJ. 440 V AC.


S160-NF. 240V AC.


S125-NJ, S125-GJ. 690V AC.




OPERATING CHARACTERISTICS
LET-THROUGH ENERGY CHARACTERISTICS

S125-NF. 240V AC



E125-NJ, S125-NJ, S125-GJ. 440 V AC.


S160-NF. 240 VAC


S125-NJ, S125-GJ. 690V AC.



Prospective short circuit current in RMS sym.(kA)

Accessories to suit 125-630AF MCCBs $\square$


Note: Handles supplied with shaft


## ACCESSORIES

## OPERATING HANDLES \& LOCKING DEVICES

TemBreak 2 handles are extremely reliable, having been designed to endure the same switching duty as the host MCCB.

It is easy to fit the operating unit to the MCCB. Fitting involves three easy steps:

1. Align breaker toggle with operating mechanism
2. Push handle into position (the handle's round pegs locate securely in the breaker's round holes and the handle's* square pegs in the breaker's square holes).
3. Twist locking screws through 45 degrees.*

## Safety Features

- Door interlock mechanism with override facility included as standard
- IP54 (door mounted version), IP 54 as standard (breaker mounted version)
- IP65 (door mounted version), IP 65 optional (breaker mounted version)
- Locks OFF with up to 3 padlocks ( 8 mm hasps)
- Optional keylock in OFF position
- Available in black or red and yellow
- A trip test can be performed with the handle fitted to the MCCB


## Orientation

To switch the breaker from OFF to ON the handle is rotated through 90 degrees in a clockwise direction.

The ON ( 1 ) and OFF ( O ) indication of the handle can be re-oriented in steps of 90 degrees with respect to the operating mechanism. This allows the indication position to remain the same whether the breaker is mounted vertically (right side up or upside down) or horizontally (on its left side or on its right side). The hole cut-out dimensions for a panel or door will remain unchanged if the handle is re-oriented. The handle's axis of rotation


MCCB ON
 is on the intersection of the centre lines of a 3P MCCB. This means that the positioning of the door cutouts is symmetrical for breakers mounted horizontally on either side of a vertical busbar system.

Cubicle Door Cutouts


Using TemBreak 2 Operating Handles


Using other MCCB Operating Handles


## aCcRSSORIES

## OPERATING HANDLES \& LOCKING DEVICES

Door Mounted Handle (HP)


Door Mounted Handle with Oprional Keylock
Breaker Mounted Handle (HB)

Breaker Mounted Handle Padlocked in the OFF Posirion


The door mounted operating handle is used to operate a circuit breaker mounted inside a cubicle from outside the door. It consists of an operating mechanism that is mounted on the breaker, an operating handle that is mounted on the door, and a shaft that transmits the turning force from the handle to the operating unit. The shaft can be cut to the required length.

## Locking Devices

Toggle locking devices allow MCCBs to be locked ON or OFF using up to three padlocks. Locking devices for 125A, 160A and 250A frame models accept padlocks with 5 mm hasp diameter. Locking devices for 400A and 630A frame models accept padlocks with 8 mm hasp diameter.


S250 Locked OFF


S400 Locked OFF

Fittings for Castell and Fortress locks are available. They are suitable for use on toggle-operated MCCBs, or on door mounted handles (HP) for MCCBs.


## Door Mounted Handle

| Applicable MCCB | A ${ }^{\text {t1 }}$ | B | C | Shaft eupport |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { E125 } \\ & \text { S125 } \end{aligned}$ | 540 max. | 370 | 421 | With + |

+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.


ASL: Arrangement Standard Line
H: Handle Frame Centre Line
\& : Handle Centre Line

Padlock dimensions (mm)



## DrancNsoons

## Door Mounted Handle

|  | Applicablo MCCB | A ${ }^{1} 1$ | B | c | D | Shaft eupport |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \text { E250 } \\ & \text { S250 (except S250-PE) } \end{aligned}$ | 540 max. | 370 | 421 | 186 | With + |
|  | $\begin{aligned} & \text { S250-PE } \\ & \text { H125 L125 } \\ & \text { H160 L160 } \end{aligned}$ | 575 max. | 370 | 421 | 221 | With + |
| - | H250 L250 |  |  |  |  |  |

* 1: Max. means the maximum length for $A$ without cutting the shaf.
+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft suppor may be removed.



ASL: Arrangement Standard Line $\underline{L}$ : Handle Frame Centre Line q:Handle Centre Line

Padlock dimensions (mm)



## DUNEDNSIONS

## Door Mounted Handle

| Appilcible MCCB | A *1 | B | C | D | Shaft aupport |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E400 E630 | 270 min . | 12 | 107.5 | - | Without |
| S400 S630 | 610 max. | 280 | 447.5 | 261 | With + |
| H400 | 307 min . | 12 | 107.5 | - | Without |
| L400 | 647 max. | 280 | 447.5 | 298 | With + |

* 1 :Min. means the minimum length for $A$ by cutting the shaft.

Max. means the maximum length for $A$ without cutting the shaft.
+The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.


ASL:Arrangement Standard Line
$\mathbb{L}$ : Handle Frame Centre Line
$q:$ Handle Centre Line


TemBreak MCCB's

## NHP

## Accessories to suit 125-630AF MCCBs

External accessories Cat. No.

Door interlocking, variable depth
Suits MCCB types
E400, S400, H400, L400, E630, S630


IP54 rated
Grey/black
Grey/black c/w key lock
T2HP40R5BNA4

Red/yellow
Red/yellow c/w key lock
T2HP40R5BKA4 T2HP40R5RNA4

IP65 rated
Grey/black
T2HP40R5RKA4

Grey/black c/w key lock
T2HP40R6BNA4

Red/yellow
T2HP40R6BKA4 T2HP40R6RNA4
Red/yellow olw key lock
T2HP40R6RKA4

Note: Handles supplied with shaft

Mechanical Interlocks

Link Interlock - suitable for manual or motorised operation. Will accept handles. Suitable for front or rear connection


E125, S125

| With trip interlock function |  |
| :--- | :--- |
| 3 or 4 pole right side section | T2ML12RA |
| 3 pole left side section | T2ML12L3A |
| 4 pole left side section | T2ML12L4A |
|  |  |
|  |  |
| H125, L125, S160, H160, L160, E250, S250, H250, L250 |  |
|  |  |
| With trip interlock function |  |
| 3 or 4 pole right side section | T2ML25RA |
| 3 pole left side section | T2ML25L3A |
| 4 pole left side section |  |
|  |  |
|  |  |
| E400, S400, H400, L400, E630, S630 | T2ML40RA |
|  | T2ML40L3A |
| With trip interlock function | T2ML40L4A |
| 3 or 4 pole right side section |  |
| 3 pole left side section |  |
| 4 pole left side section |  |
| Refer page 53 if MCCB labels are required or refer to NHP. |  |



## accessornes

## OPERATING HANDLES \& LOCKING DEVICES

TemBreak 2 handles are extremely reliable, having been designed to endure the same switching duty as the host MCCB.

It is easy to fit the operating unit to the MCCB. Fitting involves three easy steps:

1. Align breaker toggle with operating mechanism
2. Push handle into position (the handle's round pegs locate securely in the breaker's round holes and the handle's* square pegs in the breaker's square holes).
3. Twist locking screws through 45 degrees.*

## Safety Features

- Door interlock mechanism with override facility included as standard
- IP54 (door mounted version), IP 54 as standard (breaker mounted version)
- IP65 (door mounted version), IP 65 optional (breaker mounted version)
- Locks OFF with up to 3 padlocks ( 8 mm hasps)
- Optional keylock in OFF position
- Available in black or red and yellow
- A trip test can be performed with the handle fitted to the MCCB


## Orientation

To switch the breaker from OFF to ON the handle is rotated through 90 degrees in a clockwise direction.

The ON (I) and OFF (O) indication of the handle can be re-oriented in steps of 90 degrees with respect to the operating mechanism. This allows the indication position to remain the same whether the breaker is mounted vertically (right side up or upside down) or horizontally (on its left side or on its right side). The hole cut-out dimensions for a panel or door will remain unchanged if the handle is re-oriented. The handle's axis of rotation


MCCB ON


MCCB ON is on the intersection of the centre lines of a 3 P MCCB. This means that the positioning of the door cutouts is symmetrical for breakers mounted horizontally on either side of a vertical busbar system.

Cubicle Door Cutouts


Using TonBreak 2 Operating Handles


Using other MCCB Operating Handles


## ACCESSORUES

## OPERATING HANDLES \& LOCKING DEVICES

Door Mounted Handle (HP)


Door Mounted Handle with Oprional Keylock
Breaker Mounted Handle (HB)


The door mounced operacing handle is used to operate a circuit breaker mounted inside a cubicle from outside the door. It consists of an operating mechanism that is mounted on the breaker, an operating handle that is mounted on the door, and a shaft that transmits the turning force from the handle to the operating unit. The shaft can be cut to the required length.

This handle is used to operate a circuit breaker mounted just behind a compartment door with the door closed. The operating unit and the handle itself are mounted directly onto the circuit breaker. The handle protrudes through a cutout in the door. A moulded door flange is supplied with the handle which covers the cutout from the front.
Padlocking and keylocking is possible in the OFF position or both the ON and OFF position depending on the mounting direction.
Breaker Mounted Handle Padlocked in the OFF Posirion

## Locking Devices

Toggle locking devices allow MCCBs to be locked ON or OFF using up to three padlocks. Locking devices for 125A, 160A and 250 A frame models accept padlocks with 5 mm hasp diameter. Locking devices for 400 A and 630 A frame models accept padlocks with 8 mm hasp diameter.


S 550 Lacked OFF

,5400 Lacked OFF

Fittings for Castell and Fortress locks are available. They are suitable for use on toggle-operated MCCBs, or on door mounted handles (HP) for MCCBs.


## DOWENSIONS

## Door Mounted Handle

| Applicable MCCB | A \$1 | B | C | Shaft Eupport |
| :---: | :---: | :---: | :---: | :---: |
| E125 |  |  |  |  |
| S125 | 540 max. | 370 | 421 | With + |

* 1:Max. means the maximum length for $A$ without cutting the shaft
+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.


ASL: Arrangement Standard Line te : Handle Frame Centre Line $\mathbb{E}$ : Handle Centre Line

Padiock dimensions (mm)



## DINAENSUONS

## Door Mounted Handle



* 1:Max.means the maximum length for $A$ without cutting the shaft.

The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.


ASL: Arrangement Standard Line f : Handle Frame Centre Line $q$ :Handle Centre Line

Padlock dimensions (mm)



DIMENSIONS

## Door Mounted Handle



* 1: Min. means the minimum length for $A$ by cutting the shaft.

Max.means the maximum length for $A$ without cutting the shaft

+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.



ASL: Arrangement Standard Line
H: Handle Frame Centre Line
$G:$ Handle Centre Line

1

# MINIATURE CIRCUIT BREAKER 

## 1. MCB TECHNICAL DETAILS

2. MCB/RCD TECHNICAL DETAILS

NHP

## Miniature circuit breakers

## Din-T6 series 6 kA MCB

- Standards AS/NZS 4898
$\square$ Approval No. N17481
- Current range 2-63 Amps 1, 2 and 3 pole
- Sealable and lockable handle
$\square$ Available in curve type C and D
D Mounts on CD chassis (250 A and 355 A)
1 pole 1 module

| In (A) | C - Curve 5-10 In |
| :--- | :--- |
| 2 | DiCB6102C |
| 4 | DTCB6104C |
| 6 | OTCB6106C |
| 10 | DTCB6110C |
| 13 | DTCB6113C |
| 16 | DTCB6116C |
| 20 | DTCB6120C |
| 25 | DTCB6125C |
| 32 | DTCB6132C |
| 40 | DTCB6140C |
| 50 | DTCB6150C |
| 63 | DTCB6163C |

2 pole 2 modules

| 2 | DTCB6202C |
| :--- | :--- |
| 4 | DTCB6204C |
| 6 | DTCB6206C |
| 10 | DTCB6210C |
| 13 | DTCB6213C |
| 16 | DTCB6216C |
| 20 | DTCB6220C |
| 25 | DTCB6225C |
| 32 | DTCB6232C |
| 40 | DTCB6240C |
| 50 | DTCB6250C |
| 63 | DTCB6263C |

3 pole 3 modules

| 2 | ØTCB6302C |
| :--- | :--- |
| 4 | DTCB6304C |
| 6 | DTEB6306C |
| 10 | DTCB6310C |
| 13 | DTCB6313C |
| 16 | DTCB6316C |
| 20 | DTCB6320C |
| 25 | DTCB6325C |
| 32 | DTCB6332C |
| 40 | DTCB6340C |
| 50 | DTCB6350C |
| 63 | DTCB6363C |

Short circuit capacity 6 kA

| In (A) | $2-63$ |  |
| :--- | :--- | :--- |
| $1 P$ | 240 V AC |  |
| $2 P$ | $240-415 \mathrm{~V} \mathrm{AC}$ |  |
| $3 P$ | $240-415 \mathrm{~V} \mathrm{AC}$ |  |
| DC use | $1 \mathbf{P}$ | $\left.2 \mathbf{P}^{1}\right)$ |
| Short circuit | 20 kA | 25 kA |
| Max.voltage (DC) | 48 V | 110 V |

Use at DC
When using Din-T6 in a DC application the magnetic tripping current is approximately $40 \%$ higher than in AC $50 / 60 \mathrm{~Hz}$.

Shock resistance (In $X, Y, Z$ directions).
20 g with shock duration 10 ms (minimum 18 shocks).
40 g with shock duration 5 ms (minimum 18 shocks).
Vibration resistance (In $X, Y, Z$ directions).
3 g in frequency range 10 to 55 Hz
(operating time at least 30 min ).
According to IEC 60068-2-6.
Storage temperature
From $-55^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}$, according to IEC 88 part $2-1$ (duration 96 hours).

Operating temperature
From $-25^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}$, according to VDE 0664 parts 1 and 2.

Use at 400 Hz
At 400 Hz the magnetic trip current is approximately $50 \%$ higher than in $A C 50 / 60 \mathrm{~Hz}$.

Notes: ${ }^{1}$ ) 2 pole MCB connected in series.
The line side is the "OFF" (bottom) side of the MCB, and connects to CD chassis tee-offs. i) Available on indent only.

## Din-T MCBs Technical data

## Characteristics according to BS EN 60898

Miniature Circuit Breakers are intended for the protection of wiring installations against both overloads and short-circuits in domestic or commercial wiring installations where operation is possible by uninstructed people

Tripping characteristic curves


## Magnetic release

An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The NHP Din-T range has 3 different types, following the current for instantaneous release: types B, C and D curve.

| Icn <br> (A) | Test current | Tripping time | Applications |
| :---: | :---: | :---: | :---: |
| B | $\begin{aligned} & 3 \times \operatorname{In} \\ & 5 \times \text { In } \end{aligned}$ | $\begin{gathered} 0.1<t<45 \mathrm{~s}(\mathrm{In} \leq 32 \mathrm{~A}) \\ 0.1<t<90 \mathrm{~S}(\mathrm{In}>32 \mathrm{~A}) \\ \mathrm{t}<0.1 \mathrm{~s} \end{gathered}$ | Only for resistive loads eg: <br> - electrical heating <br> - water heater <br> - stoves. |
| C | $\begin{aligned} & 5 \times \operatorname{In} \\ & 10 \times \operatorname{In} \end{aligned}$ | $\begin{gathered} 0.1<t<15 s(\operatorname{In} \leq 32 A) \\ 0.1<t<30 s(\operatorname{In}>32 A) \\ t<0.1 \mathrm{~s} \end{gathered}$ | Usual loads such as: <br> - lighting <br> - socket outlets <br> - small motors |

D $10 \times \operatorname{In} 0.1<t<4 \mathrm{~s}\left(^{* *}\right)(\mathrm{In} \leq 32 \mathrm{~A})$ Control and protection of $20 \times$ In $0.1<t<8 \mathrm{~s}(\mathrm{In}>32 \mathrm{~A})$ $t<0.1 \mathrm{~s}$ circuits having important transient inrush currents (large motors)

## Thermal release

The release is initiated by a bimetal strip in the event of overload. The standard defines the range of releases for specific overload values. Reference ambient temperature is $30^{\circ} \mathrm{C}$.

| Test <br> current | Tripping <br> time |
| :---: | :---: |
| $1.13 \times$ In | $t \geq 1 \mathrm{~h}(\mathrm{In} \leq 63 \mathrm{~A})$ |
|  | $\mathrm{t} \geq 2 \mathrm{~h}(\mathrm{In}>63 \mathrm{~A})$ |
| $1.45 \times \mathrm{In}$ | $\mathrm{t}<1 \mathrm{~h}(\mathrm{In} \leq 63 \mathrm{~A})$ |
|  | $\mathrm{t}<2 \mathrm{~h}(\mathrm{In}>63 \mathrm{~A})$ |
| $2.55 \times$ In | $1 \mathrm{~s}<\mathrm{t}<60 \mathrm{~s}(\mathrm{In} \leq 32 \mathrm{~A})$ |
|  | $1 \mathrm{~s}<\mathrm{t}<120 \mathrm{~s}($ In $>32 \mathrm{~A})$ |

Rated short-circuit breaking capacity (Icn) Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: $0-\mathrm{t}$-C0.

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 900 V . Moreover, the MCB shall be capable of tripping when loaded with 2.8 In within the time corresponding to 2.55 In but greater than 0.1s.
Service short-circuit breaking capacity (Ics) Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: $0-\mathrm{t}-\mathrm{CO}-\mathrm{t}-\mathrm{CO}$.

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 1500 V . Moreover, the MCB shall not trip at a current of 0.96 In. The MCB shall trip within 1 h when curent is 1.6 In .

## 0 - Represents an opening operation

C - Represents a closing operation followed by an automatic opening.
t - Represents the time interval between two successive short-circuit operations: 3 minutes.

The relation between the rated short-circuit capacity (Icn) and the rated service short-circuit breaking capacity (Ics) shall be as follows:

| Icn (A) | Ics (A) |
| :---: | :---: |
| $\leq 6000$ | 6000 |
| $>6000$ | 0.75 Icn min. 6000 |
| $\leq 10000$ | 0.75 Icn min. 7500 |

In both sequences all MCBs are tested for emission of ionized gases during short-circuit (grid distance), in a safety distance between two MCBs of 35 mm when devices are installed in two different rows in the enclosure. This performance allows the use of any NHP/Terasaki enclosure.


## Din-T MCBs Technical data

Tripping curves according to EN 60898

The following tables show the average tripping curves of the Terasaki Din-T MCBs based on the thermal and magnetic characteristics.

## Curve C



Din-T MCBs Technical data
Influence of ambient air temperature on the rated current

The maximum value of the current which can flow through an MCB depends on the nominal current of the MCB, the conductor cross-section and the ambient air temperature.
The values shown in the table below are for devices in free air. For devices installed with other modular devices in the same switchboard, a correction factor $(K)$ shall be applied relative to the mounting situation of the MCB, the ambient temperature and the number of main circuits in the installation.

| No of devices | K $^{1}$ ) |
| :---: | :--- |
| 2 or 3 | 0.9 |
| 4 or 5 | 0.8 |
| 6 or 9 | 0.7 |
| $>10$ | 0.6 |

## Calculation example

Within a distribution board consisting of eight 2 Pole, $16 \mathrm{~A},{ }^{\prime} \mathrm{C}$ ' curve type MCBs, with an operating ambient temperature of $45^{\circ} \mathrm{C}$, which is the highest temperature the MCB can operate at without unwanted tripping?

## Calculation

The correction factor $\mathrm{K}=0.7$, for use in an eight circuit installation: $16 \mathrm{~A} \times 0.7=11.2 \mathrm{~A}$
As the MCB is working at $45^{\circ} \mathrm{C}$ it shall be given another factor ( $90 \%=0.9$ ):
In at $45^{\circ} \mathrm{C}=$ In at $30^{\circ} \mathrm{C} \times 0.9=11.2 \mathrm{~A} \times 0.9=10.1 \mathrm{~A}$.

Note: ${ }^{1}$ ) Applicable for MCBs working at maximum rated currents.

The thermal calibration of the MCBs was carried out at an ambient temperature of $30^{\circ} \mathrm{C}$. Ambient temperatures different from $30^{\circ} \mathrm{C}$ influence the bimetal and this results in earlier or later thermal tripping.
0.5-6A


10 A


16-40 A


50-63A

: 1P (single pole)

## Din-T MCBs Technical data

## Effects of frequency on the tripping characteristic

All the MCBs are designed to work at frequencies of $50-60 \mathrm{~Hz}$, therefore to work at different values, consideration must be given to the variation of the tripping characteristics. The thermal tripping does not change with variation of the frequency but the magnetic tripping values can be up to $50 \%$ higher than the ones at $50-60 \mathrm{~Hz}$.

Tripping current variation

| 60 Hz | 100 Hz | 200 Hz | 300 Hz | 400 Hz |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 1.1 | 1.2 | 1.4 | 1.5 |

## Power losses

The power losses are calculated by measuring the voltage drop between the incoming and the outgoing terminals of the device at rated current.

Power loss per pole

| In <br> $(\mathrm{A})$ | Voltage drop <br> $(\mathrm{V})$ | Energy loss <br> $(W)$ | Resistance <br> $(\mathrm{mOhm})$ |
| :---: | :---: | :---: | :---: |
| 0.5 | 2.230 | 1.115 | 4458.00 |
| 1 | 1.270 | 1.272 | 1272.00 |
| 2 | 0.620 | 1.240 | 310.00 |
| 3 | 0.520 | 1.557 | 173.00 |
| 4 | 0.370 | 1.488 | 93.00 |
| 6 | 0.260 | 1.570 | 43.60 |
| 8 | 0.160 | 1.242 | 19.40 |
| 10 | 0.160 | 1.560 | 15.60 |
| 13 | 0.155 | 2.011 | 11.90 |
| 16 | 0.162 | 2.586 | 10.10 |
| 20 | 0.138 | 2.760 | 6.90 |
| 25 | 0.128 | 3.188 | 5.10 |
| 32 | 0.096 | 3.072 | 3.00 |
| 40 | 0.100 | 4.000 | 2.50 |
| 50 | 0.090 | 4.500 | 1.80 |
| 63 | 0.082 | 5.160 | 1.30 |
| 80 | 0.075 | 6.000 | 0.90 |
| 100 | 0.075 | 7.500 | 0.75 |
| 125 | 0.076 | 9.500 | 0.60 |
|  |  |  |  |

## Limitation curves

Let-through energy $I^{2} t$
The limitation capacity of an MCB in short-circuit conditions, is its capacity to reduce the value of the let-through energy that the short-circuit would be generating.

Peak current Ip
Is the value of the maximum peak of the short-circuit current limited by the MCB.


See following pages

## Din-T MCBs Technical data

## Din-T 6

6 kA
C curve
$\mathbf{1}^{2} \mathbf{t}$ Let-through energy át 240/415 V


Id. Limited peak current at 230/400 V


## Din-T MCBs Technical data

## Use of standard MCB for DC use

For MCBs designed to be used in alternating current but used in installations in direct current, the following should be taken into consideration:

For protection against short-circuits it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is $40 \%$ higher than the one in alternating current.

- For protection against overloads it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is similar to alternating current.

Use in DC selection table

| Series | Rated <br> current (A) | 48 V 1 pole <br> $\mathrm{Icu}(\mathrm{kA})$ | 110 V 2 poles in series <br> $\mathrm{Icu}(\mathrm{kA})$ | 250 V 1 pole <br> $\mathrm{Icu}(\mathrm{kA})$ | 440 V 2 poles in series <br> Icu (kA) |
| :--- | :--- | :---: | :---: | :---: | :---: |
| Din-T 6 | $0.5 \ldots . .63 \mathrm{~A}$ | 20 | 25 | - | - |

## Din-T MCBs Technical data

## Text for specifiers

## MCB Series Din-T 6

- According to EN 60898 standard
- For DIN rail mounting according to DIN EN 50022; EN 50022; future EN 60715; IEC 60715 (top hat rail 35 mm )
- Grid distance 35 mm
- Working ambient temperature from $-25^{\circ} \mathrm{C}$ up to $+50^{\circ} \mathrm{C}$
- Approved by CEBEC, VDE, KEMA, IMQ.
- 1 pole is a module of 18 mm wide
- Nominal rated currents are: $0.5 / 1 / 2 / 3 / 4 / 6 / 10 / 13 / 16 / 20 / 25 / 32 / 40 / 50 / 63 \mathrm{~A}$
- Tripping characteristics: B,C,D (B curve Din-T 10 only).
- Number of poles: $1 \mathrm{P}, 1 \mathrm{P}+\mathrm{N}, 2 \mathrm{P}, 3 \mathrm{P}, 3 \mathrm{P}+\mathrm{N}, 4 \mathrm{P}$
- The short-circuit breaking capacity is: $6 / 10 \mathrm{k} A$, energy limiting class 3
- Terminal capacity from 1 up to $35 \mathrm{~mm}^{2}$ rigid wire or 1.5 up to $25 \mathrm{~mm}^{2}$ flexible wire.
- Screw head suitable for flat or Pozidrive screwdriver
- Can be connected by means of both pin or fork busbars
- The toggle can be sealed in the $0 N$ or $0 F F$ position
- Rapid closing
- Both incoming and outgoing terminals have a protection degree of IP 20 and they are sealable
- Isolator function thanks to Red/Green printing on the toggle.
- Maximum voltage between two phases; 440 V ~
- Maximum voltage for utilisation in DC current: 48 V 1 P and 110 V 2 P
- Two position rail clip
- Mechanical shock resistance 40 g (direction $\mathrm{x}, \mathrm{y}, \mathrm{z}$ ) minimum 18 shocks 5 ms half-sinusoidal acc. to IEC 60068-2-27
- Vibration resistance: 3 g (direction $x, y, z$ ) minimum 30 min . according to IEC 60068-2-6
- Extensions can be added on both left or right hand side
- Auxiliary contact
- Shunt trip
- Undervoltage release
- Motor operator
- Panelboard switch

Add-on RCD can be coupled.

## Din-T MCBs Technical data



# Din-T MCBs Technical data 

Miniature circuit breakers - Din-T 6

Dimensions in mm.


## 5 NPMP

## Miniature circuit breakers

Din-T15 series 15 kA, 20 kA, 25 kA MCBs

- Standards AS/NZS 3947-2
- Current range 6-63 Amp 1, 2, 3 and 4 pole
- Sealable and lockable handle
- Modular design
- Mounts on CD chassis ( 250 A and 355 A )
- Industrial applications

| 1 pole 1 module ${ }^{3}$ ) |  |  |
| :---: | :---: | :---: |
| $\underline{\ln (A)}$ | Icu (kA) | C - Curve <br> 5-10 In |
| 6 | 25 | DTCB15106C |
| 10 | 25 | dTCB15110C |
| 13 | 25 | DTCB15113C |
| 16 | 25 | DTCB15116C |
| 20 | 25 | DTCB15120C |
| 25 | 25 | DTCB15125C |
| 32 | 20 | DíCB15132C |
| 40 | 20 | DTCB15140C |
| 50 | 15 | DíćB15150C |
| 63 | 15 | ÓTCB15163C |

$$
2 \text { pole } 2 \text { modules }{ }^{3} \text { ) }
$$

| In (A) | Icu (kA) | $\begin{aligned} & \text { C-Curve } \\ & 5-10 \mathrm{In} \\ & \hline \end{aligned}$ |
| :---: | :---: | :---: |
| 6 | 25 | - Dicber |
| 10 | 25 | (i) DTCB15210C |
| 13 | 25 | -i) Dicbis213C |
| 16 | 25 | [ DTCB15216C |
| 20 | 25 | - DTCB15220C |
| 25 | 25 | [1) DTCB15225C |
| 32 | 20 | (i) DTCB15232C |
| 40 | 20 | (i) DTCB15240C |
| 50 | 15 | - OTCB15250\% |
| 63 | 15 | - ¢TCB15263C |

3 pole 3 modules ${ }^{3}$ )

| 6 | 25 | - DTCB15306C |
| :---: | :---: | :---: |
| 10 | 25 | D才CB15310C |
| 13 | 25 |  |
| 16 | 25 | DTCB15316C |
| 20 | 25 | - t CB15320C |
| 25 | 25 | Dicisis325C |
| 32 | 20 | DTCB15332C |
| 40 | 20 | DİCB15340C |
| 50 | 15 | DTCB15350C |
| 63 | 15 | DTCB15363C |

4 pole 4 modules ${ }^{2}$ ) ${ }^{3}$ )

| 6 | 25 | (1) ÓcB154060 |
| :---: | :---: | :---: |
| 10 | 25 | [1] OfCB15410¢ |
| 13 | 25 | (i) Dicbi5413C |
| 16 | 25 | 1) DTCB15416\% |
| 20 | 25 | [1) DTCB15420C |
| 25 | 25 | [i] DTCB15425C |
| 32 | 20 | (1) DicB15432C |
| 40 | 20 | (i) dTCB154400 |
| 50 | 15 | [ DTCB15450C |
| 63 | 15 | i- DTCB15463C |


| In (A) | $6-63$ |
| :--- | :--- |
| 1 P | 240 VAC |
| 2 P | $240 / 415 \mathrm{~V} \mathrm{AC}$ |
| 3 P | $240 / 415 \mathrm{~V} \mathrm{AC}$ |
| 4 P | $240 / 415 \mathrm{~V} \mathrm{AC}$ |

Shock resistance (in $x, y, z$ direction) 20 g with shock duration of 10 ms (minimum 18 shocks)
40 g with shock duration of 5 ms (minimum 18 shocks)

Vibration resistance (in $x, y, z$ direction) 3 g in frequency range 10 to 55 Hz (operating time at least 30 mins ) according to IEC 60068-2-6

Storage temperature from $-55^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}$ according to VDE 0664 parts 1 and 2
Operating temperature from $-25^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}$ according to VDE 0664 Parts 1 and 2.

Use at 400 Hz
At 400 Hz the magnetic tripping current is approximately $50 \%$ higher than at AC $50 / 60 \mathrm{~Hz}$

Notes: ${ }^{1}$ ) 2 P MCB connected in series.
The LINE-side is the OFF or bottom of the MCB and connects to CD chassis tee-offs.
${ }^{2}$ ) All poles include overcurrent and short circuit protection.
${ }^{2}$ ) Refer Section 3 for kA ratings at $240 / 415 \mathrm{~V}$. The above ratings are at 415 VAC .
i Available on indent only.

## Din-T MCBs Technical data

## Characteristics according to EN 60947-2

Miniature Circuit Breakers are intended for the protection of the lines against both overloads and short-circuits in industrial wiring installations where normal operation is done by instructed people

## Tripping characteristic curves



## Magnetic release

An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The standard leaves the calibration of magnetic release to the manufacturers discretion.

NHP offers instantaneous tripping ranges:

- release between 5 and 10 In
- release between 10 and 20 In


## Thermal release

The release is initiated by a bimetal strip in the event of overload. The standard defines the range of release for two special overload values. Reference ambient temperature is $40^{\circ} \mathrm{C}$.

| Test <br> current | Tripping <br> time |
| :---: | :---: |
| $1.05 \times \operatorname{In}$ | $t \geq 1 \mathrm{~h}(\operatorname{In} \leq 63 \mathrm{~A})$ |
| $\mathrm{t} \geq 2 \mathrm{~h}(\operatorname{In}>63 \mathrm{~A})$ |  |
| $1.30 \times \operatorname{In}$ | $\mathrm{t}<1 \mathrm{~h}(\operatorname{In} \leq 63 \mathrm{~A})$ |
|  | $\mathrm{t}<\mathrm{2h}(\operatorname{In}>63 \mathrm{~A})$ |

Rated ultimate short-circuit breaking capacity (Icu) Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: $0-\mathrm{t}-\mathrm{CO}$.
After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 1000 V . Moreover the MCB shall be capable of tripping when loaded with 2.5 In within the time corresponding to 2 In but greater than 0.1 s .

Rated service short-circuit breaking capacity (Ics) Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: $0-\mathrm{t}-\mathrm{CO}-\mathrm{t}-\mathrm{CO}$.

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of twice its rated insulation voltage with a minimum of 1000 V . A verification of the overload releases on In and moreover the MCB shall trip within 1 h when current is 1.45 In (for In<63 A) and 2 h (for In>63 A).

0 - Represents an opening operation
C - Represents a closing operation followed by an automatic opening.
t - Represents the time interval between two successive short-circuit operations: 3 minutes.

Category A: Without a short-time withstand current rating.

Utilization
category Application with respect to selectivity
A Circuit breakers not specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay provided for selectivity under short-circuit conditions, and therefore without a short-time withstand current rating according to 4.3.5.4

B Circuit breakers specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay (which may be adjustable), provided for selectivity under short-circuit conditions. Such circuit-breakers have a short-time withstand current rating according to 4.3.5.4

## Din-T MCBs Technical data

## Tripping curves according to EN 60898

The following tables show the average tripping curves of the Terasaki Din-T MCBs based on the thermal and magnetic characteristics.

Curve C


## Din-T MCBs Technical data

## Definitions related to circuit breakers

$M C B=$ Miniature Circuit Breaker

## Short-circuit (making and breaking) capacity

Alternating component of the prospective current, expressed by its RMS value, which the circuit breaker is designed to make, to carry for its opening time and to break under specified conditions.

Ultimate or rated short-circuit breaking capacity (Icn - EN 60898)
A breaking capacity for which the prescribed conditions, according to a specified test sequence, do not include the capability of the MCB to carry 0.96 times its rated current for the conventional time.

Ultimate short-circuit breaking capacity (Icu - EN 60947-2)
A breaking capacity for which the prescribed conditions, according to a specified test sequence, do not include the capability of the MCB to carry its rated current for the conventional time.

## Service short-circuit breaking capacity

 (Ics - EN 60898)A breaking capacity for which the prescribed conditions, according to a specified test sequence, include the capability of the MCB to carry 0.96 times its rated current for the conventional time.

## Prospective current

The current that would flow in the circuit, if each main current path of the MCB were replaced by a conductor of negligible impedance.

Conventional non-tripping current (Int)
A specified value of current which the circuit breaker is capable of carrying for a specified time without tripping.

## Open position

The position in which the predetermined clearance between open contacts in the main circuit of the MCB is secured.

## Closed position

The position in which the predetermined continuity of the main circuit of the MCB is secured.

Maximum prospective peak current (Ip)
The prospective peak current when the initiation of the current takes place at the instant which leads to the highest possible value.

## Din-T MCBs Technical data

## Influence of ambient air temperature on the rated current

The maximum value of the current which can flow through an MCB depends on the nominal current of the MCB, the conductor cross-section and the ambient air temperature.
The values shown in the table below are for devices in free air. For devices installed with other modular devices in the same switchboard, a correction factor ( $K$ ) shall be applied relative to the mounting situation of the MCB, the ambient temperature and the number of main circuits in the installation.
No of devices $\quad K{ }^{\prime}$ )

| 2 or 3 | 0.9 |
| :---: | :---: |
| 4 or 5 | 0.8 |
| 6 or 9 | 0.7 |
| $>10$ | 0.6 |

## Calculation example

Within a distribution board consisting of eight 2 Pole, $16 \mathrm{~A}, ~ ' C '$ curve type MCBs, with an operating ambient temperature of $45^{\circ} \mathrm{C}$, which is the highest temperature the MCB can operate at without unwanted tripping?

## Calculation

The correction factor $K=0.7$, for use in an eight circuit installation: $16 \mathrm{~A} \times 0.7=11.2 \mathrm{~A}$

As the MCB is working at $45^{\circ} \mathrm{C}$ it shall be given another factor ( $90 \%=0.9$ ):
In at $45^{\circ} \mathrm{C}=$ In at $30^{\circ} \mathrm{C} \times 0.9=11.2 \mathrm{~A} \times 0.9=10.1 \mathrm{~A}$.

Note: ') Applicable for MCBs working at maximum rated currents.

The thermal calibration of the MCBs was carried out at an ambient temperature of $30^{\circ} \mathrm{C}$. Ambient temperatures different from $30^{\circ} \mathrm{C}$ influence the bimetal and this results in earlier or later thermal tripping.


10 A


16-40A


50-63 A


## Din-T MCBs Technical data

## Effects of frequency on the tripping characteristic

All the MCBs are designed to work at frequencies of $50-60 \mathrm{~Hz}$, therefore to work at different values, consideration must be given to the variation of the tripping characteristics. The thermal tripping does not change with variation of the frequency but the magnetic tripping values can be up to $50 \%$ higher than the ones at $50-60 \mathrm{~Hz}$.

## Tripping current variation

| 60 Hz | $\mathbf{1 0 0 ~ H z}$ | 200 Hz | $\mathbf{3 0 0 ~ H z}$ | 400 Hz |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 1.1 | 1.2 | 1.4 | 1.5 |

## Power losses

The power losses are calculated by measuring the voltage drop between the incoming and the outgoing terminals of the device at rated current.

## Power loss per pole

| Inn <br> $(\mathrm{A})$ | Voltage drop <br> $(\mathrm{V})$ | Energy loss <br> $(\mathrm{W})$ | Resistance <br> $(\mathrm{mOhm})$ |
| :---: | :---: | :---: | :---: |
| 0.5 | 2.230 | 1.115 | 4458.00 |
| 1 | 1.270 | 1.272 | 1272.00 |
| 2 | 0.620 | 1.240 | 310.00 |
| 3 | 0.520 | 1.557 | 173.00 |
| 4 | 0.370 | 1.488 | 93.00 |
| 6 | 0.260 | 1.570 | 43.60 |
| 8 | 0.160 | 1.242 | 19.40 |
| 10 | 0.160 | 1.560 | 15.60 |
| 13 | 0.155 | 2.011 | 11.90 |
| 16 | 0.162 | 2.586 | 10.10 |
| 20 | 0.138 | 2.760 | 6.90 |
| 25 | 0.128 | 3.188 | 5.10 |
| 32 | 0.096 | 3.072 | 3.00 |
| 40 | 0.100 | 4.000 | 2.50 |
| 50 | 0.090 | 4.500 | 1.80 |
| 63 | 0.082 | 5.160 | 1.30 |

## Limitation curves

Let-through energy I't
The limitation capacity of an MCB in short-circuit conditions, is its capacity to reduce the value of the let-through energy that the short-circuit would be generating.
Peak current Ip
Is the value of the maximum peak of the short-circuit current limited by the MCB.

See following pages


Din-T MCBs Technical data

## Din-T 15

15 kA
C curve
$\mathbf{I}^{2} \mathbf{t}$ Let-through energy at $\mathbf{2 4 0} \mathbf{V}$


## Din-T MCBs Technical data

## Use of standard MCB for DC use

For MCBs designed to be used in alternating current but used in installations in direct current, the following should be taken into consideration:

- For protection against overloads it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is similar to alternating current.

For protection against short-circuits it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is $40 \%$ higher than the one in alternating current.

## Din-T MCBs + RCDs Technical data

## Text for specifiers

## MCB Series Din-T 15

- According to EN 60947.2 standard
- For DIN rail mounting according to DIN EN 50022; EN 50022; future EN 60715; IEC 60715 (top hat rail 35 mm )
- Working ambient temperature from $-25^{\circ} \mathrm{C}$ up to $+50^{\circ} \mathrm{C}$
: 1 pole is a module of 18 mm wide
- Nominal rated currents are: 6/10/13/16/20/25/32/40/50/63 A
- Tripping characteristic: $C$
- Number of poles: 1 P, 2 P, 3 P, 4 P
- Short-circuit capacity is: 15 kA
- Terminal capacity from 1 up to $35 \mathrm{~mm}^{2}$ rigid wire or 1.5 up to $25 \mathrm{~mm}^{2}$ flexible wire
- Screw head suitable for flat or Pozidrive screwdriver
- Can be connected by means of both pin or fork busbars
- The toggle can be sealed in the $0 N$ or OFF position
- Rapid closing
- Both incoming and outgoing terminals have a protection degree of IP 20 and they are sealable
- Isolator function thanks to Red/Green printing on the toggle.
E Maximum voltage between two phases; $440 \mathrm{~V} \sim$
- Maximum voltage for utilisation in DC current: 48 V 1 P and 110 V 2 P
- Two position rail clip
- Mechanical shock resistance 40 g (direction $x, y, z$ ) minimum 18 shocks 5 ms half-sinusoidal acc. to IEC 60068-2-27
- Vibration resistance: 3 g (direction $x, y, z$ ) minimum 30 min . according to IEC 60068-2-6
- Extensions can be added on both left or right hand side
- Auxiliary contact
- Shunt trip
* Undervoltage release
- Motor operator
* Panelboard switch

Add-on RCD can be coupled.

## Din-T MCBs Technical data



Notes Refer pages 3-23. 24 for information on SAFE-T MCGs.
${ }^{2}$ ) Preferied values of rated control supply voltage (IEC 60947-2): $24 \mathrm{~V}, 48 \mathrm{~V}, 110 \mathrm{~V}, 125 \mathrm{~V}, 250 \mathrm{~V}$
') $0.5 \cdot 4 \mathrm{~A} / 6-25 \mathrm{~A} / 32-60 \mathrm{~A} / 50-63 \mathrm{~A}$ 7) $10(125 \vee D C)$

، 10 (250 V DC)
') On request.

Din-T MCBs + RCDs Technical data
Miniature circuit breakers - Din-T 15

Dimensions in mm.


## Miniature circuit breakers

## Din-Safe single pole width residual current circuit breaker (RCBO)

- Standards AS/NZS 61009
( $\downarrow$ Approval N 17482
- One module wide ( 18 mm )
[ Short circuit, overcurrent and earth leakage protection
- Short circuit protection 10 kA

E Sensitivity 10 and 30 mA
■ Din rail mount

- Suits CD chassis
( Type " A " residual current device ( $\mathrm{AC} / \mathrm{DC}$ )

| Amp rating (A) | Modules <br> ( 18 mm ) | Voltage (AC) | Short circuit (kA) | Trip <br> Sensitivity $(m A)$ | (at. No ' ${ }^{\text {2 }}{ }^{2}$ ) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 6 | 1 | 240 | 10 | 30 | DSRCBH0630A |
| 10 | 1 | 240 | 10 | 30 | DSRCBH1030A |
| 16 | 1 | 240 | 10 | 30 | DSRCBH1630A |
| 20 | 1 | 240 | 10 | 30 | DSRCBH2030A |
| 25 | 1 | 240 | 10 | 30 | DSRCBH2530A |
| 32 | 1 | 240 | 10 | 30 | DSRCBH3230A |
| 40 | 1 | 240 | 10 | 30 | DSRCBH4030A |
| 6 | 1 | 240 | 10 | 10 | [i] DSRCBH0610A |
| 10 | 1 | 240 | 10 | 10 | DSRCB'H1010A |
| 16 | 1 | 240 | 10 | 10 | OSRCBH1610A |
| 20 | 1 | 240 | 10 | 10 | DSRCBH2010A |
| 25 | 1 | 240 | 10 | 10 | DSSRCBH2510A |
| 32 | 1 | 240 | 10 | 10 | - DSERCBH3210A |
| 40 | 1 | 240 | 10 | 10 | DSSRCBH4010A |

Note: ${ }^{1}$ ) Neutral not switched.
${ }^{2}$ ) Will not accept side mounting accessories. Available on indent only.

## Operation

This unit combines the overload and short circuit protection of an MCB with earth leakage protection of an RCD. The unit occupies one, sub- circuit (one pole) of the distribution board and provides single phase protection against overload, short circuit and earth leakage current.

- The MCB element provides thermal and magnetic tripping protection which is rated to 10 kA prospective fault current.
- $\quad$ The RCD element of the device provides core-balance detection of the difference between the active and neutral currents and amplification to provide high sensitivity. The rated residual operating current (I $\Delta n$ ) is 10 mA or 30 mA .
- The green/yellow earth reference cable, in case of loss of supply neutral, ensures the device will continue to provide earth leakage protection and will operate normally upon detection of an earth leakage current.

Dimensions (mm)

Note: A 1.2 m long pigtail lead is included as standard.


## Application

The Din-Safe single pole width residual current circuit breaker will fit the standard Din-T chassis for use in NHP panelboards. The design makes it possible to provide an MCB complete with earth leakage protection in an 18 mm wide module, which allows a greater number of devices to be fitted into a distribution board.

Connection diagram


## Din-T MCBs + RCDs Technical data

## Tripping curves according to EN 60898

The following tables show the average tripping curves of the Terasaki Din-T MCBs based on the thermal and magnetic characteristics.

Curve C


# Din-T MCBs + RCDs Technical data 

## What is an RCD?

The RCD (Residual Current Device) is a device intended to protect people against indirect contact, the exposed conductive parts of the installation being connected to an appropriate earth electrode. It may be used to provide protection against fire hazards due to a persistent earth fault current, without operation of the overcurrent protective device.
RCDS having a rated residual operating current not exceeding 30 mA are also used as a means for additional protection in case of failure of the protective means against electric shock (direct contact).

## Working Principle

The main components of an RCD are the following:

- The core transformer: which detects the earth fault current.
- The relay: when an earth fault current is detected, the relay reacts by tripping and opening the contacts.
- The mechanism: element to open and close the contacts either manually or automatically.
- The contacts: to open or close the main circuit.

The RCD constantly monitors the vectorial sum of the current passing through all the conductors. In normal conditions the vectorial sum is zero $(11+12=0)$ but in case of an earth fault, the vectorial sum differs from zero (I1+12-Id), this causes the actuation of the relay and therefore the release of the main contacts.


## Definitions related to RCDs

RCCB = Residual Current Circuit Breaker without overcurrent protection.

RC80 = Residual Current Circuit Breaker with overcurrent protection.

## Breaking capacity

A value of $A C$ component of a prospective current that an RCCB is capable of breaking at a stated voltage under prescribed conditions of use and behaviour.
Residual making and breaking capacity ( $\mathrm{I} \Delta \mathrm{m}$ )
A value of the $A C$ component of a residual prospective current which an RCCB can make, carry for its opening time and break under specified conditions of use and behaviour.

Conditional residual short-circuit current ( $\mathrm{I} \Delta \mathrm{c}$ )
A value of the $A C$ component of a prospective current which an RCCB protected by a suitable SCPD (short-circuit protective device) in series, can withstand, under specific conditions of use and behaviour.

## Conditional short-circuit current (Inc)

A value of the $A C$ component of a residual prospective current which an RCCB protected by a suitable SCPD in series, can withstand, under specific conditions of use and behaviour.

## Residual short-circuit withstand current

Maximum value of the residual current for which the operation of the RCCB is ensured under specified conditions, and above which the device can undergo irreversible alterations.

## Prospective current

The current that would flow in the circuit, if each main current path of the RCCB and the overcurrent protective device (if any) were replaced by a conductor of negligible impedance.

## Making capacity

A value of $A C$ component of a prospective current that an RCCB is capable to make at a stated voltage under prescribed conditions of use and behaviour.

## Open position

The position in which the predetermined clearance between open contacts in the main circuit of the RCCB is secured.

## Closed position

The position in which the predetermined continuity of the main circuit of the RCCB is secured.

## Tripping time

The time which elapses between the instant when the residual operating current is suddenly attained and the instant of arc extinction in all poles.
Residual current ( $1 \Delta n$ )
Vector sum of the instantaneous values of the current flowing in the main circuit of the RCCB.

## Residual operating current

Value of residual current which causes the RCCB to operate under specified conditions.
Rated short-circuit capacity (Icn)
Is the value of the ultimate short-circuit breaking capacity assigned to the circuit breaker. (Only applicable to RCBO)
Conventional non-tripping current (Int)
A specified value of current which the circuit breaker is capable of carrying for a specified time without tripping. (Only applicable to RCBO)
Conventional tripping current (It)
A specified value of current which causes the circuit breaker to trip within a specified time.
(Only applicable to RCBO)

## Din-T MCBs + RCDs Technical data <br> RCDs classification according to EN 61008/61009

RCDs may be classified according to:
The behaviour in the presence of $D C$ current
(types for general use).

- Type $A C$
- Type A

The time-delay (in the presence of residual current)

- RCDs without time delay: type for general use
- RCDs with time delay: type 5 for selectivity

Type AC $\sim{ }^{1}{ }^{2}{ }^{2}$ )
The type AC RCDs are designed to release with sinusoidal residual currents which occur suddenly or slowly rise in magnitude.


| Residual current | Tripping time |
| :---: | :---: |
| $0.5 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=\propto$ |
| $1 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=<300 \mathrm{~ms}$ |
| $2 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=<150 \mathrm{~ms}$ |
| $5 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=\leq 40 \mathrm{~ms}$ |



Tripping curve type $A C$
${ }^{1}$ ) Standard in Australia
${ }^{7}$ ) Type A acceptable in Australia
$\begin{array}{lll}\text { Type } A & { }^{3} \\ \\ & \text { ") }\end{array}$
Certain devices during faults can be the source of nonsinusoidal earth leakage currents ( $D C$ components) due to the electronic components e.g. diodes, thyristors etc.
Type A RCDs are designed to ensure that under these conditions the residual current devices operate on sinusoidal residual current and also with pulsating direct current(*) which occur suddenly or slowly rise in magnitude.
(*) Pulsating direct current: current of pulsating wave form which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding $0.006 \mathrm{~A} D C$ during one single interval of time, expressed in angular measure of at least $150^{\circ}$.

|  | Residual current | Tripping time |
| :--- | :--- | :--- |
| 1. For sinusoidal residual current |  |  |
|  | $0.5 \times I \Delta n$ | $\mathrm{t}=\infty$ |
| $1 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=<300 \mathrm{~ms}$ |  |
| $2 \times I \Delta \mathrm{n}$ | $\mathrm{t}=<150 \mathrm{~ms}$ |  |
| $5 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=\leq 40 \mathrm{~ms}$ |  |

2. For residual pulsating direct current


| At point of wave $0^{\circ}$ |  |
| ---: | :--- |
| $0.35 \times I \Delta n$ | $t=\infty$ |
| $1.4 \times I \Delta n$ | $t=<300 \mathrm{~ms}$ |
| $2.8 \times I \Delta n$ | $t=<150 \mathrm{~ms}$ |
| $7 \times I \Delta n$ | $t=\leq 40 \mathrm{~ms}$ |



| $0.25 \times I \Delta n$ | $t=\infty$ |
| ---: | :--- |
| $1.4 \times I \Delta n$ | $t=<300 \mathrm{~ms}$ |
| $2.8 \times I \Delta n$ | $t=<150 \mathrm{~ms}$ |
| $7 \times I \Delta n$ | $t=\leq 40 \mathrm{~ms}$ |


| At point of wave $135^{\circ}$ |  |
| ---: | :--- |
| $0.11 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=\infty$ |
| $1.4 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=<300 \mathrm{~ms}$ |
| $2.8 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=<150 \mathrm{~ms}$ |
| $7 \times \mathrm{I} \Delta \mathrm{n}$ | $\mathrm{t}=\leq 40 \mathrm{~ms}$ |

(mas)

Tripping curve type A
${ }^{3}$ ) Standard in New Zealand
${ }^{\text {•) }}$ DSRCBH is type $A$.

## Din-T MCBs + RCDs Technical data

## Nuisance tripping

All DinSafe RCDs have a high level of immunity to transient currents, against current impulses of $8 / 20 \mu \mathrm{~s}$ according to EN 61008/61009 and VDE 0664.T1.
Type A, AC.
. 250 A $8 / 20 \mu \mathrm{~s}$
Type S.. . 3000 A $8 / 20 \mu \mathrm{~s}$


RCDs have a high level of immunity against alternating currents of high frequency according to EN 61008/61009.


## Din-T MCBs + RCDs Technical data

## Use of an RCBO (DSRCBH)



## IEST-BUTTON

To ensure the correct functioning of the RCBO, the test-button $T$ shall be pressed frequently. The device must trip when the test-button is pressed.


## CONTACT POSITION INDICATOR

Printing on the toggle to provide information of the real contact position.


00 HR
O-OFF
Contacts in open position. Ensure a distance between contacts $>4 \mathrm{~mm}$.


I-ON
Contacts in closed position. Ensure continuity in the main circuit.

## CABLE CONNECTION

The power supply (L) must be done at the bottom terminal, and the supply neutral flying cable (black) shall be connected to the neutral bar.
Load connection stiall be done in both terminals at the top side (L out / N out).
The earth reference cable (FE white) ensures protection against earth leakage in case of loss of supply neutral.


## TOGGLE

To manually switch the RCBO ON or OFF

## Din-T MCBs + RCDs Technical data

## Product related information

Influence of temperature on RCBOs (DinSafe DSRCB)
The thermal calibration of the RCB0 was carried out at an ambient temperature of $30^{\circ} \mathrm{C}$. Ambient temperatures different from $30^{\circ} \mathrm{C}$ influence the bimetal and this results in earlier or later thermal tripping.


10 A



## Din-T MCBs + RCDs Technical data

## Tripping current as a function of the frequency

All RCDs are designed to work at frequencies of $50-60 \mathrm{~Hz}$, therefore to work at different values, we must consider the variation of the tripping sensitivity according to the tables below. It should be taken into consideration that there is a no tripping risk when pushing the test-button, due to the fact that such action is made by means of an internal resistor with a fixed value.
RCBO DSRCBH ')

| Type AC ${ }^{\text { }}$ ) | 10 Hz | 30 Hz | 50 Hz | 100 Hz | 200 Hz | 300 Hz | 400 Hz |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 30 mA | 0.62 | 0.65 | 0.80 | 0.91 | 1.24 | 1.55 | 1.88 |
| 100 mA | 0.74 | 0.71 | 0.80 | 0.95 | 1.16 | 1.38 | 1.59 |
| 300 mA | 0.80 | 0.74 | 0.80 | 0.97 | 1.19 | 1.44 | 1.64 |
| 500 mA | 1.10 | 0.81 | 0.80 | 0.89 | 1.18 | 1.38 | 1.68 |
| Type $A^{\text {i }}$ ) |  |  |  |  |  |  |  |
| 30 mA | 8.17 | 3.13 | 0.75 | 1.70 | 3.10 | 3.52 | 3.67 |
| 100 mA | 6.81 | 2.71 | 0.75 | 1.43 | 2.35 | 2.58 | 2.71 |
| 300 mA | 6.20 | 2.16 | 0.75 | 0.49 | 0.87 | 0.74 | 0.95 |
| 500 mA | 4.34 | 1.53 | 0.75 | 0.39 | 0.59 | 0.62 | 0.64 |

Notes: ') The standard NHP/Terasaki type is the "type $A C$ " in Australia, Type " $A$ " in New Zealand.
${ }^{2}$ ) The standard NHP/Terasaki DSRCBH single pole RCBO is "type A" in Australia and New Zealand.
${ }^{\prime}$ ) The numbers in the table above are multipliers, e.g. A "OSRCD" at 50 hz has an 0.8 multiplier.
Therefore a 30 mA , "type $A C$ " RCD will trip at $(0.8 \times 30 \mathrm{~mA}) 24 \mathrm{~mA}$.

## Power losses

The power losses are calculated by means of measuring the voltage drop between the incoming and the outgoing terminal of the device at rated current. Power loss per pole:
RCBO-Single pole DSRCBH

| In (A) | $\mathbf{6}$ | $\mathbf{1 0}$ | $\mathbf{1 3}$ | $\mathbf{1 6}$ | $\mathbf{2 0}$ | $\mathbf{2 5}$ | $\mathbf{3 2}$ | $\mathbf{4 0}$ | $\mathbf{5 0}$ | $\mathbf{6 3}$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathbf{Z}$ (m0hm) | 45.8 | 16.4 | 12.5 | 10.6 | 7.3 | 5.4 | 3.2 | 2.6 | 1.9 | 1.4 |
| Pin (M) | 1.65 | 1.7 | 2.1 | 2.7 | 2.9 | 3.3 | 3.4 | 4.2 | 4.8 |  |

## Din-T MCBs + RCDs Technical data

## RCBO (DSRCB) let-through energy I ${ }^{2}$ t

The benefit of an RCBO in short-circuit conditions, is its ability to reduce the value of the let-through energy that the short-circuit would be generating.

Din-T single pole width RCD (DSRCBH)
Curve C


RCCB - Din-Safe safety switch (DSRCD)

RCBO - Din-Safe (DSRCBH)


Dimensions in mm

Din－T MCBs＋RCDs Technical data


## CONTACTOR

## 1. CA7 CONTACTOR TECHNICAL DETAILS



Contactor CA 7-9


Contactor CA 7 -72


Contactor CA 6-105-EI


Contactor CA 6-170-EI


Contactor CA 6-250-EI


Contactor CA 6-420-EI

Ratings to IEC 947 and AS $3497400 / 415$ V
O For CA 7 contactors with coil terminals on line side, add ...V AC to Catalogue No. Eg-CA 7-9-10-240 V AC ${ }^{3}$ )
O For CA 7 contactors with coil terminals on load side, add ...V AC-U to Catalogue No. Eg - CA 7-9-10-240 V AC-U

$\left.A C 3 \quad A C 3 \quad A C 1^{\circ}\right) A C 1^{\circ}$ ) Auxiliary contacts $400 / 415 \mathrm{~V} 400 / 415 \mathrm{~V}$ Amps Amps standard

| $\left.k W^{1}\right)$ | Amps ') | $40^{\circ} \mathrm{C}$ | $60^{\circ} \mathrm{C}$ | N/O | $\mathrm{N} / \mathrm{C}$ | Max. | Cat. No. ${ }^{\text {a }}$ ) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4 | 9 | 32 | 32 | 1 | 0 | 9 | CTA 7-9-10..V AC |  |
|  |  |  |  | 0 | 1 | 9 | CA 7-9-01... V AC |  |
| 5.5 | 12 | 32 | 32 | 1 | 0 | 9 | CA 7-12-10..V. ${ }^{\text {C/ }}$ |  |
|  |  |  |  | 0 | 1 | 9 | CA 7-12-01...V AC |  |
| 7.5 | 16 | 32 | 32 | 1 | 0 | 9 | CA 7-16-10...V AC |  |
|  |  |  |  | 0 | 1 | 9 | CA 7-16-01...V AC |  |
| 11 | 23 | 32 | 32 | 1 | 0 | 9 | CA 7-23-10...V AC |  |
|  |  |  |  | 0 | 1 | 9 | CA 7-23-01...V AC |  |
| 15 | 30 | 50 | 45 | 0 | 0 | 8 | CA 7-30-00...V AC |  |
| 18.5 | 37 | 50 | 45 | 0 | 0 | 8 | CA 7-37-00...V AC |  |
| 22 | 43 | 85 | 63 | 0 | 0 | 8 | CA 7-43-00...V AC |  |
| 30 | 60 | 100 | 100 | 0 | 0 | 8 | CA 7 -60-00...V AC |  |
| 37 | 72 | 100 | 100 | 0 | 0 | 8 | CA 7-72-00..:V AC |  |
| 45 | 85 | 100 | 100 | 0 | 0 | 8 | CA 7-85-00...V AC |  |
| 55 (45) | 95 (33) | 160 | 135 | 1 | 1 | 8 | CA 6-85-11...V.AC |  |
| 75 (55) | 130 (40) | 160 | 135 | 1 | 1 | 8 | CA 6-105-11...V AC |  |
| 90(75) | 155 (55) | 250 | 210 | 1 | 1 | 8 | CA 6-140-11 $\therefore$ V AC |  |
| 75 (55) | 130 (40) | 160 | 135 | 1 | 1 | 8 | CA 6-105-El-11...V.AC') |  |
| 90 (75) | 155 (55) | 250 | 210 | 1 | 1 | 8 | \| CA 6-140-E!-11... V ACV) |  |
| $100(90)$ | 170 (65) | 250 | 210 | 1 | 1 | 8 | CA 6-170-El-11...V AC) |  |
| 132 (111) | 225 (80) | 350 | 300 | 1 | 1 | 8 | \|CA 6-210El-11..V AC)| |  |
| 150 (133) | 258 (95) | 350 | 300 | 1 | 1 | 8 | $\mid$ CA 6-250-El-11...V AC)\| |  |
| 185 (163) | 320 (115) | 450 | 380 | 1 | 1 | 8 | CA 6-300-El-11..V AC? |  |
| 250 (225) | 425 (160) | 500 | 425 | 1 | 1 | 8 | $\mid C A \cdot 6-420-E l-11 . . . V A C 7) \mid$ |  |
| 220 (220) | 370 (155) | 500 | 420 | 2 | 2 | 8 | CA 5-370...V AC') |  |
| 265 (280) | 450 (200) | 600 | 510 | 2 | 2 | 8 | CA 5-450...V AC') |  |
| 325 (355) | 550 (250) | 780 | 645 | 2 | 2 | 8 | CA 5-550...V AC) |  |
| 430 (500) | 700 (340) | 1000 | 850 | 2 | 2 | 8 | CA 5-700 ...V AC') |  |
| 520 (550) | 860 (380) | 1100 | 930 | 2 | 2 | 8 | CA 5-860...V AC') |  |
| 600 | 1000 | 1200 | 1020 | 1 | 1 | 8 | CA 5-1000...V AC) |  |
| 700 | 1150 | 1350 | 1150 | 1 | 1 | 8 | CA 5-1200...V AC) |  |

Notes: ') 1000 volt ratings ( ).
${ }^{2}$ ) Add control voltage to Cat. No. when ordering: 24, 32, 110, 240, 415, 440 V 50 Hz . Standard voltages for CA 6-105-EI...250-El are 24, 48, 110, 240 and 415 V AC. Standard voltages for CA 6-300-EI...420-EI 48, 110, 240 and 415 V AC. Standard voltages for CA 5-370...1200, 110, 240 and 415 V AC.
${ }^{3}$ ) All CA 7 coils can be reversed for line or load side coil terminals as required. Both versions are held in NHP stock for convenience.
${ }^{4}$ ) Electronically controlled mechanism (ECM) with interface suffix (EI).
$\left.{ }^{3}\right) 55^{\circ} \mathrm{C}$ enclosed.
${ }^{5}$ ) Contact NHP for recommended cable size.
$240 / 415 \mathrm{~V}$ rated coils are suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038 : 2000.

## ACSGOREGOMGAT

Refer catalogue SĀCS

## The highest switching capacity in the smallest space



## Compact without compromise

Compact without compromise is the best way to describe the CA 7 range of contactors and motor protection relays from Sprecher + Schuh. In spite of the new compact dimensions, the CA 7 range features high breaking capacity and extraoidinary flexibility. Up to 18.5 kW the contactors are only 45 mm wide and even the largest 45 kW frame is only 72 mm wide. The CA 7 contactors are the main component in the new Advanced Control System (ACS).

With CA 7 you have flexibility with auxiliary contacts
Common auxiliaries from 9 to 85 amps
Three fitting positions
O Front mounting
O Side mounting left
O Side mounting right
Alternatively you can choose to combine left, right and front mounting auxiliary contacts to fulfil your requirements.
Instead of the top mounted auxiliary contacts, on or off delay timing modules or mechanical latches can be fitted.



Motor switching rating AC 3 @ 400/415 V

| CA 7-9 | 4 kW |  |  | 9 A |
| :---: | :---: | :---: | :---: | :---: |
| CA 7-12 | 5.5 kW | 45 mm | Priver | 12 A |
| CA 7-16 | 7.5 kW | 5 | - | 16 A |
| CA 7-23 | 11 kW |  | 5 | 23 A |
| CA 7-30 | 15 kW |  | - | 30 A |
| CA 7-37 | 18.5 kW | 45 mm |  | 37 A |
| CA 7-43 | 22 kW | 54 mm |  | 43 A |
| CA 7-60 | 30 kW |  |  | 60 A |
| CA 7-72 | 37 kW | 72 mm |  | 72 A |
| CA 7-85 | 45 kW |  |  | 85 A |

## With CA 7 you have more clip on

## accessories

Common accessories from 9 to 85 amps
On and off delay pneumatic timers

- Coil mounted electronic timers on delay, off delay, star delta
O Coil mounted 24 V DC interface
O Coil mounted RC and varistor suppressor modules
O Mechanical latch
O Mechanical interlock
O Mechanical interlock with integrated N/C interlock contacts
O Moulded wire link sets for DOL, reversing and star delta starters
O Large choice of front and side mounting auxiliary contacts



## Innovation and ease of use provide solutions for your control systems

## Coil terminals are always in the correct position

The coil terminations on the CA 7 contactors can be supplied optionally at the top or the bottom of the contactor. It is also a simple task to change this on site should the requirements change.
When CA 7 contactors are used in combination with KTA 7 circuit motor circuit breakers the bottom coil terminations are used. For use with standard CT 7 thermal or CEP 7 electronic overloads the top coil termination should be selected.


## Mechanical interlocks save space

Only 9 mm wide, the CM 7 mechanical interlock snaps into place between any of the CA 7 contactors. It is allowed also to interlock different sizes of the CA 7 range with the same interlock.
The basic mechanical interlock is supplemented by a variation with built in N/C auxiliary contacts for electrical interlocking. This version is also only 9 mm wide and further minimises space requirements.


## With Sprecher + Schuh you can choose the best protection for your motors.



## CA 7 contactors provide improved wiring

 terminalsThe main terminals of all CA 7 contactors are designed to accept at least two cables. At the same time they comply with safety standards regarding touch protection.
The larger contactors CA 7-30 and upwards employ a special cage terminal which allows the connection of two cables in separate chambers.
The ease of wiring with CA 7 contactors saves both time and money.



High tech electronic protection type CEP 7 in trip class 10 or 20.


Standard thermal overloads type CT 7

Réfer Catalogue C -co
Automatic Type ' 2 ' co-ordination ${ }^{1}$ ) with no-oversizing of contactors

DOL starting
50/65 kA @ 400/415 V

| Motor <br> size <br> kW | Approx. <br> amps @ <br> 400/415 $V$ | Sprecher + <br> Schuh <br> circuit breaker | Setting <br> range <br> amps | Magnetic <br> amps | Sprecher + Schuh <br> contactor | AC-3 <br> amps |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0.18 | 0.60 | KT 7-25S | $0.40-0.63$ | 8.2 | CA 7-9 | 9 |
| 0.25 | 0.80 | KT 7-25S | $0.63-1.00$ | 13 | CA 7-9 | 9 |
| 0.37 | 1.10 | KT 7-25S | $1.00-1.60$ | 21 | CA 7-9 | 9 |
| 0.55 | 1.50 | KT 7-25S | $1.00-1.60$ | 21 | CA 7-9 | 9 |
| 0.75 | 1.80 | KT 7-25S | $1.60-2.50$ | 33 | CA 7-9 | 9 |
| 1.10 | 2.60 | KT 7-25S | $2.50-4.00$ | 52 | CA 7-9 | 9 |
| 1.15 | 3.40 | KT 7-25S | $2.50-4.00$ | 52 | CA 7-9 | 9 |
| 2.20 | 4.80 | KT 7-25S | $4.00-6.30$ | 80 | CA 7-9 | 9 |
| 3.00 | 6.50 | KT 7-25S | $6.30-10.0$ | 130 | CA 7-9 | 9 |
| 4.00 | 8.20 | KT 7-25S | $6.30-10.0$ | 130 | CA 7-9 | 9 |
| 5.50 | 11.00 | KT 7-25S | $10.0-16.0$ | 208 | CA 7-12 | 12 |
| 7.50 | 14.00 | KT 7-25S | $10.0-16.0$ | 208 | CA 7-16 | 16 |
| 9.00 | 17.00 | KT 7-25H | $14.5-20.0$ | 260 | CA 7-23 | 23 |
| 11.00 | 21.00 | KT 7-25H | $18.0-25.0$ | 325 | CA 7-23 | 23 |
| 15.00 | 28.00 | KT 7-45H | $23.0-32.0$ | 416 | CA 7-30 | 30 |
| 18.50 | 34.00 | KT 7-45H | $32.0-45.0$ | 585 | CA 7-37 | 37 |
| 22.00 | 40.00 | KT 7-45H | $32.0-45.0$ | 585 | CA 7-43 | 43 |
| 30.00 | 55.00 | KT 3-100 | $40.0-63.0$ | 882 | CA 7-60 | 60 |
| 37.00 | 66.00 | KT 3-100 | $63.0-90.0$ | 1260 | CA 7-72 | 72 |
| 45.00 | 80.00 | KT 3-100 | $63.0-90.0$ | 1260 | CA 7-85 | 85 |
|  |  |  |  |  |  |  |

Definition Type ' 2 ' co-ordination according to IEC 947-4-1:

- The contactor or the starter must not endanger persons or systems in the event of a short circuit
- The contactor or the starter must be suitable for further use
- No damage to the overload relay or other parts may occur with the exception of welding of the contactor or starter contacts provided that these can be easily separated without significant deformation (such as with a screwdriver)
- In the event of a short circuit, fast opening current limiting circuit breakers KT 7 make it possible to build economical, fully short circuit co-ordinated starter combinations in accordance with IEC 947-4-1, Type ' 2 ' co-ordination
- Type ' 2 ' co-ordination without oversizing of contactors means: Type ' 1 ' = Type ' 2 '

Note: ') What is meant by Automatic Type ' 2 ' co-ordination?
The high speed operation of the new KT 7 motor protection circuit breakers means that contactors need not be oversized to achieve type ' 2 ' co-ordination. Simply select the normal AC 3 rated contactor and the corresponding KT 7 circuit breaker and type ' 2 ' co-ordination is assured.
240/415 V rating suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038: 2000



| Motor size kW | Approx. amps | Terasaki circuit or breaker | NHP HRC fuse to BS88 | Sprecher + Schuh contactor type | Sprecher + Schuh thermal O/L relay type | Setting range amps |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | XM30PB/1.4 | NTIA-6 | CA 7-9 | CT 7-24 | 1-1.6 |
| 0.55 | 1.5 | XM30PB/2 | NTIA-6 | CA 7-9 | CT 7-24 | 1-1.6 |
| 0.75 | 1.8 | XM30PB/2.6 | NTIA-10 | CA 7-9 | CT 7-24 | 1.6-2.4 |
| 1.1 | 2.6 | XM30PB/4.0 | NTIA-10 | CA 7-9 | CT 7-24 | 2.4-4 |
| 1.5 | 3.4 | XM30PB/5 | NTIA-10 | CA 7-9 | CT 7-24 | 2.4-4 |
| 2.2 | 4.8 | XM30PB/8 | NTIA-16 | CA 7-9 | СТ 7-24 | 4-6 |
| 3.0 | 6.5 | XM30PB/10 | NTIA-16 | CA 7-9 | CT 7-24 | 6-10 |
| 4.0 | 8.2 | XM30PB/12 | NTIA-25 | CA 7-9 | CT 7-24 | 6-10 |
| 5.5 | 11 | XH125NJ/20 | NTIA-32 | CA 7-12 | CT 7-24 | 10-16 |
| 7.5 | 14 | XH125NJ/20 | NTIS-40 | CA 7-16 | CT 7-24 | 10-16 |
| 11 | 21 | XH125NJ/32 | NTIS-50 | CA 7-23 | CT 7-24 | 16-24 |
| 15 | 28 | XH125NJ/50 | NTIS-63 | CA 7-30 | CT 7-45 | 18-30 |
| 18.5 | 34 | XH125NJ/50 | NTCP-80 | CA 7-37 | CT 7-45 | 30-45 |
| 22 | 40 | XH125NJ/63 | NTCP-80 | CA 7-43 | CT 7-45 | 30-45 |
| 30 | 55 | XH125NJ/100 | NTCP-100 | CA 7-60 | CT 7-75 | 45-60 |
| 37 | 66 | XH125NJ/100 | NTF-160 | CA 7-72 | CT 7-75 | 60-75 |
| 45 | 80 | XH125NJ/125 ') | NTF-160 | CA 6-85 | CT 7-100 | 70-90 |
| 55 | 100 | XH125NJ/125 ${ }^{\text {') }}$ | NTF-200 | CA 6-105-El | CT 6-110 | 85-110 |
| 75 | 130 | XH250NJ/250 | NTKF-250 | CA 6-140-EI | CT 6-150 | 105-150 |
| 90 | 155 | XH250NJ/250 ${ }^{\text {') }}$ | NTKF-250 | CA 6-170-EI | CT 6-200 | 140-200 |
| 110 | 200 | XH250NJ/250 ${ }^{\text {') }}$ | NTKF-315 | CA 6-210-EI | CEF 1-41/42 | 160-400 |
| 132 | 225 | XH400NE/400 | NTMF-355 | CA 6-210-EI | CEF 1-41/42 | 160-400 |
| 150 | 250 | XH400NE/400 | NTMF-355 | CA 6-250-EI | CEF 1-41/42 | 160-400 |
| 160 | 270 | XH400NE/400 | NTMF-400 | CA 6-300-EI | CEF 1-41/42 | 160-400 |
| 185 | 310 | XH400NE/400 | NTTF-450 | CA 6-300-EI | CEF 1-41/42 | 160-400 |
| 200 | 361 | XH400NE/400 | NTTM-500 | CA 6-420-E1/CA 5-450 | CEF 1-41/42 | 160-400 |
| 250 | 425 | XH630NE/630 | NTTM-630 | CA 6-420-EI/CA 5-450 | CEF 1-52 | 160-630 |
| 315 | 530 | XH630NE/630 | NTLM-710 | CA 5-550 | CEF 1-52 | 160-630 |

Notes: Fuses 65 kA . XH125NJ circuil breaker combinations limited to 50 kA , others 65 kA .
Overloads may be changed to different types eg. thermal style to electronic.
Some combinations also gives Type ' 2 ' performance.
') Use 'magnetic only' breaker - Refer NHP.
240/415 V rating suitable for use on 230/400 V in accordance with AS 60038: 2000

Refer Catalogue C-CO
Fuse protection DOL starting ${ }^{1}$ )
50/65 kA @ 400/415 V to AS 3947.4.1

## Fuse

| Motor size kW | Approx. amps @ 400/415 V | NHP HRC fuse to BS88 | Sprecher + Schuh contactor | Sprecher + Schuh overload relay ${ }^{2}{ }^{3}$ ) | Setting range amps |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | NTIA-4 | CA 7-9 | CEP 7 | 1.0-2.9 |
| 0.75 | 1.8 | NTIA-6 | CA 7-9 | CEP 7 | 1.0-2.9 |
| 1.5 | 3.4 | NTIA-10 | CA 7-9 | CEP 7 | 1.6-5 |
| 2.2 | 4.8 | NTIA-16 | CA 7-9 | CEP 7 | 3.7-12 |
| 4.0 | 8.2 | NTIA-20 | CA 7-9 | CEP 7 | 3.7-12 |
| 5.5 | 11 | NTIA-25 | CA 7-12 | CEP 7 | 3.7-12 |
| 7.5 | 14 | NTIA-32 | CA 7-16 | CEP 7 | 12-32 |
| 11 | 21 | NTIS-50 | CA 7-30 | CEP 7 | 12-32 |
| 15 | 28 | NTIS-63 | CA 7-30 | CEP 7 | 12-37 |
| 18.5 | 34 | NTCP-80 | CA 7-37 | CEP 7 | 12-37 |
| 22 | 40 | NTCP-80 | CA 7-43 | CEP 7 | 14-45 |
| 30 | 55 | NTCP-100 | CA 7-60 | CEP 7 | 26-85 |
| 37 | 66 | NTF-125 | CA 7-72 | CEP 7 | 26-85 |
| 45 | 80 | NTF-160 | CA 7-85 | CEP 7 | 26-85 |
| 55 | 100 | NTF-200 | CA 6-105-EI | CT 6-110 | 85-110 |
| 75 | 130 | NTKF-250 | CA 6-140-EI | CT 6-150 | 105-150 |
| 90 | 155 | NTKF-250 | CA 6-170-EI | CT 6-200 | 140-200 |
| 110 | 200 | NTKF-315 | CA 6-210-EI | CEF 1-41/42 ${ }^{4}$ ) | 160-400 |
| 132 | 225 | NTMF-355 | CA 6-210-EI | CEF 1-41/42 ${ }^{4}$ ) | 160-400 |
| 150 | 250 | NTMF-355 | CA 6-250-EI | CEF 1-41/42 ${ }^{4}$ ) | 160-400 |
| 185 | 320 | NTTM-450 | CA 6-300-EI | CEF 1-41/42 ${ }^{4}$ ) | 160-400 |
| 250 | 425 | NTTM-560 | CA 6-420-EI | CEF 1-52 ${ }^{4}$ ) | 160-630 |
| 320 | 538 | NTLM-710 | CA 5-550 | CEF 1-52 ${ }^{4}$ ) | 160-630 |
| 380 | 650 | NTLM-800 | CA 5-700 | CEF 1-11/12P ${ }^{4}$ ) | 300-1200 |

Notes: ') Fuses with equal or lower let through energy may also be used.
${ }^{2}$ ) Thermal overloads may be used instead of electronic CEP 7.
${ }^{3}$ ) Above 37 kW overloads may also be electronic or thermal.
${ }^{4}$ CET 4 may be used instead of CEF 1.
240/415 V rating suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038: 2000

Refer Catalogue C-CO
TemBreak circuit breakers DOL starting
TemBreak MCCBs 50 kA @ 400/415 V to AS 3947.4.1

| Motor size kW | Approx. amps | Terasaki circuit breaker | Sprecher + Schuh contactor | Sprecher + Schuh overload relay | Setting range amps |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | XM30PB/1.4 | CA 7-9 | CT 7-24-1.6 | 1-1.6 |
| 0.55 | 1.5 | XM30PB/2 | CA 7-9 | CT 7-24-1.6 | 1-1.6 |
| 0.75 | 1.8 | XM30РB/2.6 | CA 7-9 | CT 7-24-2.4 | 1.6-2.4 |
| 1.1 | 2.6 | XM30РB/4.0 | CA 7-16 | CT 7-24-4 | 2.4-4 |
| 1.5 | 3.4 | XM30PB/5 | CA 7-16 | CT 7-24-4 | 2.4-4 |
| 2.2 | 4.8 | XM30РB/8 | CA 7-16 | CT 7-24-6 | 4-6 |
| 3 | 6.5 | XM30PB/10 | CA 7-30 | CT 7-24-10 | 6-10 |
| 4 | 8.2 | XM30PB/12 | CA 7-30 | CT 7-24-10 | 6-10 |
| 5.5 | 11 | XH125NJ/20 | CA 7-30 | CT 7-24-16 | 10-16 |
| 7.5 | 14 | XH125NJ/20 | CA 7-30 | CT 7-24-16 | 10-16 |
| 11 | 21 | XH125NJ/32 | CA 7-30 | CT 7-24-24 | 16-24 |
| 15 | 28 | XH125NJ/50 | CA 7-43 | CT 7-45-30 | 18-30 |
| 18.5 | 34 | XH125NJ/50 | CA 7-43 | CT 7-45-45 | 30-45 |
| 22 | 40 | XH125NJ/63 | CA 7-43 | CT 7-45-45 | 30-45 |
| 30 | 55 | XH125NJ/100 | CA 6-85 | CT 7-75 ${ }^{\text {2 }}$ ) | 45-60 |
| 37 | 66 | XH125NJ/100 | CA 6-85 | CT 7-75 ${ }^{\text {2 }}$ ) | 60-75 |
| 45 | 80 | XH125NJ/125 | CA 6-105-EI | CT 6-90 | 70-90 |
| 55 | 100 | XH125NJ/125 ${ }^{\text {' }}$ | CA 6-105-EI | CT 6-110 | 85-110 |
| 75 | 130 | XH250NJ/250 | CA 6-140-EI | CT 6-150 | 105-150 |
| 90 | 155 | XH250NJ/250 | C A6-170-EI | CT 6-200 | 140-200 |
| 110 | 200 | XH250NJ/250 ${ }^{\text {) }}$ | CA 6-210-EI | CEF 1-41/42 | 160-400 |
| 132 | 225 | XS400SE/400 | CA 6-210-EI | CEF 1-41/42 | 160-400 |
| 150 | 250 | XS400SE/400 | CA 6-250-EI | CEF 1-41/42 | 160-400 |
| 160 | 270 | XS400SE/400 | CA 6-300-EI | CEF 1-41/42 | 160-400 |
| 200 | 361 | XS400SE/400 | CA 6-420-EI | CEF 1-41/42 | 160-400 |
| 200 | 361 | XS400SE/400 | CA 5-450 | CEF 1-22 ${ }^{2}$ ) | 160-400 |
| 250 | 425 | XS630SE/630 | CA 5-700 | CEF 1-52 ${ }^{2}$ ) | 160-630 |
| 320 | 538 | XS630SE/630 | CA 5-700 | CEF $1.52{ }^{2}$ ) | 160-630 |

Notes: Overloads may be thermal or electronic.
Combinations based on the overload tripping before the circuit breaker at overload currents up to the motor locked rotor current.
') Use 'magnetic only' breaker or next higher circuit breaker / contactor combination.
${ }^{2}$ ) Use with separate mounting bracket.
Data for 65 kA co-ordination available refer Cat. C-CO.
240/415 V rating suitable for use on 230/400 V in accordance with AS 60038:2000

Refer Catalogue C -CO
TemBreak circuit breakers DOL starting. 85 kA @ 400/415 V to AS 3947.4.1

## MCCBs

| Motor size kW | Approx. FLC @ 400/415 V (A) | Terasaki circuit breaker | Sprecher + Schuh contactor | Sprecher + Schuh thermal O/L type | Setting <br> range (A) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | XM30PB/1.4 | CA 7-9 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 0.55 | 1.5 | XM30PB/2.0 | CA 7-9 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 0.75 | 1.8 | XM30PB/2.6 | CA 7-9 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 1.1 | 2.6 | XM30PB/4 | CA 7-16 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 1.5 | 3.4 | XM30PB/5 | CA 7-16 | CEP 7-M32-5-10 | 1.6-5 |
| 2.2 | 4.8 | XM30PB/8 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 3 | 6.5 | XM30РB/8 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 4 | 8.2 | XM30PB/10 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 5.5 | 11 | TL100NJ/20 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 7.5 | 14 | TL100NJ/20 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 9 | 17 | TL100NJ/32 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 10 | 19 | TL100NJ/32 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 11 | 21 | TL100NJ/32 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 15 | 28 | TL100NJ/50 | CA 7-43 | CEP 7-M32-32-10 | 12-32 |
| 18.5 | 34 | TL100NJ/50 | CA 7-43 | CEP 7-M37-37-10 | 12-37 |
| 22 | 40 | TL100NJ/63 | CA 7-43 | CEP 7-M45-45-10 | 14-45 |
| 30 | 55 | TL100NJ/100 | CA 7-72 | CEP 7-M85-85-10 | 26-85 |
| 37 | 66 | TL100NJ/100 | CA 7-72 | CEP 7-M85-85-10 | 26-85 |
| 45 | 80 | TL250NJ/160 | CA 6-105 | CEP 7-M85-85-10 | 26-85 |
| 55 | 100 | TL250NJ/160 | CA 6-105 | CEF 1-11/12 | 0.5-180 |
| 75 | 135 | TL250NJ/250 | CA 6-210-EI | CEF 1-11/12 | 0.5-180 |
| 90 | 160 | TL250NJ/250 | CA 6-210-EI | CEF 1-11/12 | 0.5-180 |
| 110 | 200 | TL250NJ/250 | CA 6-210-EI | CEF 1-41/42/52 | 160-630 |
| 132 | 230 | TL400NE/400 | CA 6-210-EI | CEF 1-41/42/52 | 160-630 |
| 160 | 270 | TL400NE/400 | CA 6-300-EI | CEF 1-41/42/52 | 160-630 |
| 200 | 361 | TL400NE/400 | CA 6-420-EI | CEF 1-41/42/52 | 160-630 |

Din-T circuit breakers with rotary isolator. DOL starting. 50 kA @400/415 V to AS 3947.4.1

| Motor <br> size <br> kW | Approx. amps @ 400/415 V | Sprecher + Schuh isolator | Terasaki circuit breaker | Sprecher + Schuh current limiter | Sprecher + Schuh contactor | Sprecher + <br> Schuh thermal O/L relay | Thermal overload range |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | LÂ 7-80 | Din-T 10 / 4 | - | CA 7-9 | CT 7-24 | 0.6-1.6 |
| 0.55 | 1.5 | LA 7-80 | Din-T $10 / 4$ | - | CA 7-9 | CT 7-24 | 1-1.6 |
| 0.75 | 1.8 | LA 7-80 | Din-T 10 / 4 | - | CA 7-9 | CT 7-24 | 1.6-2.4 |
| 1.1 | 2.6 | LA 7-80 | Din-T $10 / 6$ | - | CA 7-23 | CT 7-24 | 2.4-4 |
| 1.5 | 3.4 | LA 7-80 | Din-T $10 / 6$ | - | CA 7-23 | CT 7-24 | 2.4-4 |
| 2.2 | 4.8 | LA 7-80 | Din-T 10/10 | KTL 3-65 | CA 7-23 | CT 7-24 | 4-6 |
| 3 | 6.5 | LA 7-80 | Din-T 10 / 16 | KTL 3-65 | CA 7-23 | CT 7-24 | 6-10 |
| 4 | 8.2 | LA 7-80 | Din-T 10 / 16 | KTL 3-65 | CA 7-23 | CT 7-24 | 6-10 |
| 5.5 | 11 | LA 7-80 | Din-T 10 / 20 | KTL 3-65 | CA 7-23 | CT 7-24 | 10-16 |
| 7.5 | 14 | LA 7-80 | Din-T 10 / 32 | KTL 3-65 | CA 7-30 | CT 7-45 | 10-16 |
| 11 | 21 | LA 7-80 | Din-T 10 / 40 | KTL 3-65 | CA 7-30 | CT 7-24 | 16-24 |
| 15 | 28 | LA 7-100 | Din-T 10/63 | KTL 3-65 | CA 7-37 | CT 7-45 | 18-30 |
| 18.5 | 34 | LA 7-100 | Din-T 10 / 63 | KTL 3-65 | CA 7-37 | CT 7-45 | 30-45 |

Note: $\quad 240 / 415 \mathrm{~V}$ rating suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038:2000

Rërer Catalogue C.co
TemBreak circuit breakers DOL starting. 85 kA @ 400/415 V to AS 3947.4.1

| Motor size kW | $\begin{aligned} & \text { Approx. FLC@ } \\ & 400 / 415 \mathrm{~V}(\mathrm{~A}) \end{aligned}$ | Terasaki circuit breaker | Sprecher + Schuh contactor | Sprecher + Schuh thermal $0 / L$ type | Setting range ( A ) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | XM30PB/1.4 | CA 7-9 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 0.55 | 1.5 | XM30РB/2.0 | CA 7-9 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 0.75 | 1.8 | XM30РB/2.6 | CA 7-9 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 1.1 | 2.6 | ХM30РB/4 | CA 7-16 | CEP 7-M32-2.9-10 | 1.0-2.9 |
| 1.5 | 3.4 | XM30PB/5 | CA 7-16 | CEP 7-M32-5-10 | 1.6-5 |
| 2.2 | 4.8 | XM30РB/8 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 3 | 6.5 | XM30PB/8 | CA 7.30 | CEP 7-M32-12-10 | 3.7-12 |
| 4 | 8.2 | XM30PB/10 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 5.5 | 11 | TL100NJ/20 | CA 7-30 | CEP 7-M32-12-10 | 3.7-12 |
| 7.5 | 14 | TL100NJ/20 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 9 | 17 | TL100NJ/32 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 10 | 19 | TL100NJ/32 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 11 | 21 | TL100NJ/32 | CA 7-30 | CEP 7-M32-32-10 | 12-32 |
| 15 | 28 | TL100NJ/50 | CA 7-43 | CEP 7-M32-32-10 | 12-32 |
| 18.5 | 34 | TL100NJ/50 | CA 7-43 | CEP 7-M37-37-10 | 12-37 |
| 22 | 40 | TL100NJ/63 | CA 7-43 | CEP 7-M45-45-10 | 14-45 |
| 30 | 55 | TL100NJ/100 | CA 7-72 | CEP 7-M85-85-10 | 26-85 |
| 37 | 66 | TL100NJ/100 | CA 7-72 | CEP 7-M85-85-10 | 26-85 |
| 45 | 80 | TL250NJ/160 | CA 6-105 | CEP 7-M85-85-10 | 26-85 |
| 55 | 100 | TL250NJ/160 | CA 6-105 | CEF 1-11/12 | 0.5-180 |
| 75 | 135 | TL250NJ/250 | CA 6-210-EI | CEF 1-11/12 | 0.5-180 |
| 90 | 160 | TL250NJ/250 | CA 6-210-EI | CEF 1-11/12 | 0.5-180 |
| 110 | 200 | TL250NJ/250 | CA 6-210-EI | CEF 1-41/42/52 | 160-630 |
| 132 | 230 | TL400NE/400 | CA 6-210-EI | CEF 1-41/42/52 | 160-630 |
| 160 | 270 | TL400NE/400 | CA 6-300-EI | CEF 1-4.1/42/52 | 160-630 |
| 200 | 361 | TL400NE/400 | CA 6-420-EI | CEF 1-41/42/52 | 160-630 |

Din-T circuit breakers with rotary isolator. DOL starting. 50 kA @ 400/415 V to AS 3947.4.1

| Motor size kW | Approx. amps @ 400/415 V | Sprecher + Schuh isolator | Terasaki circuit breaker | Sprecher + Schuh current limiter | Sprecher + Schuh contactor | Schuh thermal O/L relay | Thermal overload range |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.37 | 1.1 | LA 7-80 | Din-T 10/4 | - | CA 7-9 | CT 7-24 | 0.6-1.6 |
| 0.55 | 1.5 | LA 7-80 | Din-T 10/4 | - | CA 7-9 | CT 7-24 | 1-1.6 |
| 0.75 | 1.8 | LA 7-80 | Din-T $10 / 4$ | - | CA 7-9 | CT 7-24 | 1.6-2.4 |
| 1.1 | 2.6 | LA 7-80 | Din-T $10 / 6$ | - | CA 7-23 | CT 7-24 | 2.4-4 |
| 1.5 | 3.4 | LA 7-80 | Din-T $10 / 6$ | - | CA 7-23 | CT 7-24 | 2.4-4 |
| 2.2 | 4.8 | LA 7-80 | Din-T $10 / 10$ | KTL 3-65 | CA 7-23 | CT 7-24 | 4-6 |
| 3 | 6.5 | LA 7-80 | Din-T $10 / 16$ | KTL 3-65 | CA 7-23 | CT 7-24 | 6-10 |
| 4 | 8.2 | LA 7-80 | Din-T $10 / 16$ | KTL 3-65 | CA 7-23 | CT 7-24 | 6-10 |
| 5.5 | 11 | LA 7-80 | Din-T $10 / 20$ | KTL 3-65 | CA 7-23 | CT 7-24 | 10-16 |
| 7.5 | 14 | LA 7-80 | Din-T 10/32 | KTL 3-65 | CA 7-30 | CT 7-45 | 10-16 |
| 11 | 21 | LA 7-80 | Din-T $10 / 40$ | KTL 3-65 | CA 7-30 | CT 7-24 | 16-24 |
| 15 | 28 | LA 7-100 | Din-T $10 / 63$ | KTL 3-65 | CA 7-37 | CT 7-45 | 18-30 |
| 18.5 | 34 | LA 7-100 | Din-T 10/63 | KTL 3-65 | CA 7-37 | CT 7-45 | 30-45 |

Note: $\quad 240 / 415 \mathrm{~V}$ rating suitable for use on $230 / 400 \mathrm{~V}$ in accordance with $\mathrm{AS} 60038: 2000$



## Additional rating data - contactors to IEC 947

Contactor CA 7-9 CA 7-12 CA 7-16 CA 7-23 CA 7-30 CA 7-37 CA 7-43 CA 7-60 CA 7-72 CA 7-85
AC 1 resistive load
switching 3~
Ambient temperature $40^{\circ} \mathrm{C}$

| $\left.I_{\theta}{ }^{1}\right)$ | $[\mathrm{A}]$ | 32 | 32 | 32 | 32 | 50 | 50 | 85 | 100 | 100 | 100 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $230 / 240 \mathrm{~V}$ | $[\mathrm{~kW}]$ | 10 | 10 | 13 | 13 | 18 | 20 | 25 | 36 | 36 | 40 |
| $400 / 415 \mathrm{~V}$ | $[\mathrm{~kW}]$ | 18 | 18 | 23 | 23 | 32 | 36 | 45 | 64 | 64 | 71 |
| 690 V | $[\mathrm{~kW}]$ | 30 | 30 | 38 | 38 | 54 | 60 | 75 | 108 | 108 | 120 |
| Ambient temperature $60^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| $\left.I_{\theta}{ }^{1}\right)$ | $[\mathrm{A}]$ | 32 | 32 | 32 | 32 | 45 | 45 | 63 | 100 | 100 | 100 |
| $230 / 240 \mathrm{~V}$ | $[\mathrm{~kW}]$ | 8 | 8 | 10 | 10 | 14 | 16 | 20 | 29 | 29 | 34 |
| $400 / 415 \mathrm{~V}$ | $[\mathrm{~kW}]$ | 14 | 14 | 17 | 17 | 26 | 28 | 36 | 51 | 51 | 61 |
| 690 V | $[\mathrm{~kW}]$ | 24 | 24 | 29 | 29 | 44 | 48 | 60 | 86 | 86 | 102 |

AC motor switching
AC 2, AC 3, AC 4

| $230 / 240 \mathrm{~V}$ | $[\mathrm{~A}]$ | 11.5 | 14.5 | 20 | 26.5 | 34 | 37 | 42 | 62 | 70 | 85 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $400 / 415 \mathrm{~V}$ | $[\mathrm{~A}]$ | 9 | 12 | 16 | 23 | 30 | 37 | 43 | 60 | 72 | 85 |
| 690 V | $[\mathrm{~A}]$ | 5 | 7 | 9.3 | 12 | 17 | 20 | 25 | 34 | 42 | 49 |
| $230 / 240 \mathrm{~V}$ | $[\mathrm{~kW}]$ | 3 | 4 | 5.5 | 7.5 | 10 | 11 | 13 | 18.5 | 22 | 25 |
| $400 / 415 \mathrm{~V}$ | $[\mathrm{~kW}]$ | 4 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 |
| 690 V | $[\mathrm{~kW}]$ | 4 | 5.5 | 7.5 | 10 | 15 | 18.5 | 22 | 30 | 37 | 45 |
| Rated making capacity |  |  |  |  |  |  |  |  |  |  |  |
| $I_{\theta}$ AC 4, 50 Hz | max. $690 \mathrm{~V}[\mathrm{~A}]$ | 135 | 180 | 240 | 345 | 450 | 555 | 645 | 900 | 1080 | 1275 |
| Rated breaking capacity |  |  |  |  |  |  |  |  |  |  |  |
| $I_{\theta}$ AC 4 |  |  |  |  |  |  |  |  |  |  |  |

Short circuit protection
without protection relay
fuse $g G$ to IEC 947-4-1

| co-ordination type '1' [A] | 50 | 50 | 50 | 63 | 100 | 125 | 160 | 200 | 250 | 250 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| co-ordination type '2' [A] | 20 | 25 | 25 | 35 | 50 | 80 | 100 | 100 | 125 | 160 |
| Main current circuit resistance [m $]$ | 2.7 | 2.7 | 2.7 | 2 | 2 | 2 | 1.5 | 0.9 | 0.9 | 0.9 |
| Power dissipated by ail circuits at le AC 3 | 0.7 | 1.2 | 2.1 | 3.2 | 5.4 | 8.2 | 8.3 | 9.7 | 14 | 19.5 |
| Total power dissipation at le AC $3 \quad$ AC control $[w]$ | 3.3 | 3.8 | 4.7 | 6.2 | 8.4 | 11.2 | 11.5 | 14.2 | 18.5 | - |
| DC control [w] | 6.7 | 7.2 | 8.1 | 12.4 | 14.6 | 17.4 | 18.4 | 14.6 | 18.9 | - |
| Life span in millions of operations |  |  |  |  |  |  |  |  |  |  |
| Mechanical AC control | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 10 | 10 | 10 |
| DC control | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 10 | 10 | 10 |

Operating times (DC)
Make (mS) $40 \ldots 7040 \ldots 7040 \ldots 7040 \ldots 70 \quad 50 \ldots 80 \quad 50 \ldots 80 \quad 50 \ldots 80 \quad 20 \ldots 40 \quad 20 \ldots 40 \quad 20 \ldots 40$ Break (mS) $7 \ldots 15 \quad 7 \ldots 15 \quad 7 \ldots 15 \quad 7 \ldots 15 \quad 7 \ldots 15 \quad 7 \ldots 15 \quad-\quad$ - $\quad$ -

Note: ') Contact NHP for recommended cable size.

Dimensions in (mm)


## Mounting position



## Contactor (AC control)

| Type | $\mathbf{a}$ | $\mathbf{b}$ | $\mathbf{c}$ | $\mathbf{c 1}$ | $\mathbf{c 2}$ | od | $\mathbf{d 1}$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CA 7-9_..CA 7-23 ${ }^{2}$ ) | 45 | 81 | 80.5 | 75.5 | 6 | 4.5 | 60 |
| CA 7-30...CA 7-37 | 45 | 81 | 97.5 | 92.6 | 6.5 | 4.5 | 60 |
| CA 7-43 | 54 | 81 | 100.5 | 95.6 | 6.5 | 4.5 | 60 |
| CA 7-60...CA 7-85 | 72 | 122 | 117 | 111.5 | 8.5 | 5.4 | 100 |

(DC control)

| Type | $\mathbf{a}$ | $\mathbf{b}$ | $\mathbf{c}$ | $\mathbf{c 1}$ | $\mathbf{c 2}$ | ød | $\mathbf{d 1}$ | $\mathbf{d 2})$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CA 7-9C...CA 7-16C | 45 | 81 | 106.5 | 101.5 | 6 | 4.5 | 60 | 35 |
| CA 7-23C | 45 | 81 | 123.5 | 119 | 6 | 4.5 | 60 | 35 |
| CA 7-30C...CA 7-37C | 45 | 81 | 141.5 | 136.5 | 6.5 | 4.5 | 60 | 35 |
| CA 7-43C | 54 | 81 | 144.5 | 140 | 6.5 | 4.5 | 60 | 45 |
| CA 7-60C...CA 7-85C | 72 | 122 | 117 | 111.5 | 8.5 | 5.4 | 100 | 55 |

Accessories

| Contactor with |  | (AC control) (mm) | (DC control) (mm) |
| :---: | :---: | :---: | :---: |
| Front mounting auxiliary contact | 2 or 4 pole | $\mathrm{c} / \mathrm{c} 1+39$ | $\mathrm{c} / \mathrm{c} 1+39$ |
| Side mounting auxiliary contact | 1 or 2 pole | a +9 | $a+9$ |
| Pneumatic timing module |  | $\mathrm{c} / \mathrm{c} 1+58$ | - |
| Electronic timing module | coil mounting | b +24 | $b+24$ |
| Mechanical interlock | mounts between contactors | $a+9$ | $a+9$ |
| Mechanical latch |  | $\mathrm{c} / \mathrm{c} 1+61$ | - |
| Interface | coil mounting | b +9 | - |
| Suppressor | coil mounting | $b+3$ | $b+3$ |
| With inscriptions ${ }^{3}$ ) | labels | +0 | +0 |
|  | label support system V4N5 | +5.5 | +5.5 |

[^5]${ }^{2}$ ) Dimensions for 4 pole contactors same as 3 pole with auxiliary.
${ }^{3}$ ) Dimensions with inscriptions.


Dimensions in (mm)
CEP 7, CEP 7s and CEP 7-B mounted on CA 7 contactors


CEP 7 with separate mounting bracket



Contactor, timer and overload selection chart for star delta starters

| SDS kW | Line contactor | Delta contactor | Star contactor | Timer | Overload |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 7.5 | CA 7-9-10 | CA 7-9-01 | CA 7-9-01 | RZ7 FSY2D | CEP 7-M32-12-10 |
| 11 | CA 7-12-10 | CA 7-12-01 | CA 7-9-01 | RZ7 FSY2D | CEP 7-M32-32-10 |
| 15 | CA 7-16-10 | CA 7-16-01 | CA 7-9-01 | RZ7 FSY2D | CEP 7-M32-32-10 |
| 18.5 | CA 7-23-10 | CA 7-23-01 | CA 7-12-01 | RZ7 FSY2D | CEP 7-M32-32-10 |
| 22 | CA 7-23-10 | CA 7-23-01 | CA 7-16-01 | RZ7 FSY2D | CEP 7-M32-32-10 |
| 30-37 | CA 7-37-00 | CA 7-37-00 | CA 7-23-01 | RZ7 FSY2D | CEP 7-M45-45-10 |
| 45 | CA 7-60-11 | CA 7-60-11 | CA 7-30-00 | RZ7 FSY2D | CEP 7-M85-85-10 |
| 55 | CA 7-60-11 | CA 7-60-11 | CA 7-37-00 | RZ7 FSY2D | CEP 7-M85-85-10 |
| 75 | CA 7-85-00 | CA 7-85-00 | CA 7-43-00 | RZ7 FSY2D | CEP 7-M85-85-10 |
| 90 | CA 6-85-11 | CA 6-85-11 | CA 7-60-00 | RZ7 FSY2D | CT 6-90 |
| 110 | CA 6-105-11 | CA 6-105-11 | CA 7-72-00 | RZ7 FSY2D | CT 6-110 |
| 132 | CA 6-140El-11 | CA 6-140EI-11 | CA 7-85-00 | RZ7 FSY2D | CT 6-150 |
| 150 | CA 6-170EI-11 | CA 6-170El-11 | CA 6-85-00 | RZ7 FSY2D | CTA 6-200 |
| 185 | CA 6-210EI-11 | CA 6-210El-11 | CA 6-105-11 | RZ7 FSY2D | CEF 1-41 |
| 220 | CA 6-210-EI-11 | CA 6-210-EI-11 | CA 6-140-El-11 | RZ7 FSY2D | CEF 1-41 |

Mounted on CA 7 contactors
$\rightarrow$

CT 7-24, CT 7-45, CT 7.75

| Type | For contactor | a | b | b1 | c | c1 | c2 | c3 | c4 | c5 | -d | d1 | d2 | e1 | e2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CT 7-24 | CA 7-9... 23 | 45 | 127 | 83 | 96 | 91 | 15 | 51 | 39 | 5 | 4.5 | 60 | $\left.35^{\prime}\right)$ | 16.5 | 51 |
|  | CA 7-30... 37 | 45 | 127 | 83 | 105 | 99 | 6.5 | 51 | 39 | 9.5 | 4.5 | 60 | $\left.35^{\prime}\right)$ | 16.5 | 51 |
| CT 7-45 | CA 7-30... 37 | 60 | 140 | 97 | 105 | 99 | 6.5 | 51 | 39 | 6.5 | 4.5 | 60 | $\left.35^{\prime}\right)$ | 16.5 | 57 |
|  | CA 7-43 | 60 | 140 | 97 | 107 | 103 | 6.5 | 51 | 39 | 8.5 | 4.5 | 60 | $\left.45^{\prime}\right)$ | 16.5 | 57 |
| CT 7-75 | CA 7-60... 85 | 72 | 185 | 120 | 125 | 120 | 8.5 | 51 | 39 | 28.5 | 5.4 | 100 | $55^{\text {') }}$ | 16.5 | 82 |

Separate mounting with bracket


Separate mounting


| Type | a | b | b1 | c | c1 | c2 | c3 | -d | d1 | d2 | e1 | e2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CT 7-24 | 45 | 85 | 44 | 95 | 70.5 | 5 | 51 | 4.5 | $60 . .74$ | $\left.35^{\prime}\right)$ | 16 | 3 |
| CT 7-75 | 60 | 90 | 44 | 117 | 112 | 15 | 51 | 5.4 | 74 | $50^{\prime}$ ) | 16 | 0 |
| CT 7-90 | 100 | 120 | - | 135 | - | 5 | 51 | 6.2 | 74 | $80^{\text {1 }}$ ) | 16 | 7 |

Notes: ${ }^{1}$ ) Standard DIN rail to EN 50 022-35.
${ }^{2}$ ) With reset rod, maintain 9 mm maximum operating radius from centre of reset button.
c3 Reset magnet.
c4 Auxiliary contact block.

# CONTROL RELAY \& PHASE FAILURE RELAY 

1. IDEC CONTROL RELAY TECHNICAL DETAILS
2. PHASE FAILURE RELAY TECHNICAL DETAILS

RH Series

## RH Series Compact Power Relays

## SPDT through 4PDT, 10A contacts Compact power type relays

The RH series are miniature power relays with a large capacity. The RH relays feature 10A contact capacity as large as the RR series but in a miniature package. The compact size saves space.


A. 1. "Caries no UL recognition mark.
2. PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information
When ordering, specify the Part No. and coil voltage code:
(example) RH3B-U AC120V ParíNo. LCoil Voltage Code

Sockets (for Blade Terminal Models)


Hold Down Springs \& Clips


AC Coil Ratings

| Voltage (V) | Rated Current ( mA$) \pm 15 \%$ at $20{ }^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  | Coil Resistance ( n ) $\pm 10 \%$ at $20^{\circ} \mathrm{C}$ |  |  |  | Operation Characteristics (ägainat rated values at $20^{\circ} \mathrm{C}$ ) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | AC 50H2 |  |  |  | AC EOH2 |  |  |  |  |  |  |  |  |  |  |
|  | SPPT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPOT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltäge |
| 6 | 170 | 240 | 330 | 387 | 150 | 200 | 280 | 330 | 330 | 9.4 | 6.4 | 5.4 |  |  |  |
| 12 | 86. | 121 | 165 | 196 | 75 | 100 | 140 | 165 | 165 | 39.3 | 25.3 | 21.2 |  |  |  |
| 24 | 42 | 60.5 | 81 | 98 | 37 | 50 | 70 | 83 | 83 | 153 | 103 | 84.5 |  |  |  |
| 110 | 9.6 | - | 18.1 | 21.6 | 8.4 | - | 15.5 | 18.2 | 18.2 | - | 2,200 | 1,800 |  |  |  |
| 110-120 | - | $\begin{aligned} & 9.4- \\ & 10.8 \end{aligned}$ | - | - | - | 8.0-9.2 | - | - | - | - | - | - | 110\% | $\begin{aligned} & 80 \% \\ & \text { maximum } \end{aligned}$ | 30\% minimum |
| 120 | 8.6 | - | 16.4 | 19.5 | 7.5 | - | 14.2 | 16.5 | 16.5 | - | 10,800 | 7,360 |  |  |  |
| 220 | 4.7 | - | 8.8 | 10.7 | 4.1 | - | 7.7 | 9.1 | 9.1 | - | 10;800 | 7.360 |  |  |  |
| 220-240 | - | 4.7-5.4 | - | - | - | 4.0-4.6 | - |  | - | 18,820 | - | - |  |  |  |
| 240 | 4.9 | - | 8.2 | 9.8 | 4.3 | - | 7.1 | 8.3 | 8.3 | - | 12,100 | 9,120 |  |  |  |

UĈ Coil Katings

| Voltage (V) | Rated Current (mA) $\pm 15 \%$ at $20^{\circ} \mathrm{C}$ |  |  |  | Coil Resistance: ( Q ) $\pm 10 \%$ at $20^{\circ} \mathrm{C}$ |  |  |  | Operation Charactoristics: (against rated values at $20^{\circ} \mathrm{C}$ ) |  |  | Standard coil voltages are in BOLD. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | SPOT | DRDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Volitagé | Pickup Voltage | Dropoiut Voltage |  |
| 6 | 128 | 150 | 240 | 250 | 47 | 40 | 25 | 24 | 110\% | $\begin{aligned} & 80 \% \\ & \text { maximum } \end{aligned}$ | $\begin{gathered} 10 \% \\ \text { minimum } \end{gathered}$ |  |
| 12 | 64 | 75 | 120 | 125 | 188 | 160 | 100 | 96 |  |  |  |  |
| 24 | 32 | 36.9 | 60 | 62 | 750 | 650 | 400 | 388 |  |  |  |  |
| 48 | 18 | 18.5 | 30 | 31 | 2.660 | 2.600 | 1,600 | 1.550 |  |  |  |  |
| 100-110 | - | 8.2-9.0 | - | - | - | 12.250 | - | - |  |  |  |  |
| 110 | 8 | - | 12.8 | 15 | 13,800 | - | 8,600 | 7,340 |  |  |  |  |

## Contact Ratings

| Voltage | RH1 | RH2 | RH3 | RH4 |
| :---: | :---: | :---: | :---: | :---: |
| 240 VAC | 10 A | 10 A | 7.5 A | 7.5 A |
| 30 VDC | 10 A | 10 A | 10 A | 10 A |

## Ut Ratings

| Voltrge <br> 6 | Resistive |  |  | General Use |  |  | Horse Power Rating |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \hline \mathrm{RH1} \\ & \text { HH7 } \end{aligned}$ | RH3 | RH4 | $\overline{\mathrm{RH1}}$ | RH3 | HH4 | $\begin{aligned} & \mathrm{RH} 1 \\ & \hline \end{aligned}$ | RH3 | RH4 |
| 240 VaC | 10A | 7.5A | 7.5A | 7 A | 6.5A | 5A | $1 / 3 \mathrm{HP}$ | $1 / 3 \mathrm{HP}$ | - |
| 120 VAC | - | 10A | 10A | - | 7.5A | 7.5A | 1/6 HP | 1/6 HP | - |
| 30 VDC | 10A | 10A | - | 7 A | - | - | - | - | - |
| 2BV DC | - | - | 10 A | - | - | - | - | - | - |

## CSA Ratings

| Yoltage | Resistive |  |  |  | General Use |  |  |  | Horse <br> Power <br> Rating |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | RH1 | RH2 | HH3. | BH4 | RH1 | RH2 | RH3 | RH4 | AH1. 2,3 |
| 240 V AC | 10A | 10A | - | 7.5A | 7A | 7A | 7A | 5A | $1 / 3 \mathrm{HP}$ |
| 120 VAC | 10A | 10A | 10A | 10A | 7.5A | 7.5A | - | 7.5A | 1/6 HP |
| 30V DC | 10A | 10A | 10A | 10A | 7 A | 7.5A | - | - | - |

$$
\Delta^{A C \cos 8=1.00 c: L A n=0 n s}
$$

Socket Specifications

|  | Sockots | Terminai | Electrical Reting | Y Wire Size | Torupe |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | SH1B-05 | (Coil) M3 screws <br> (contact) M3.5 screws with captive wire clamp | 250Y, 10A | Maximum up to 2-\#12AWG | $\begin{aligned} & 5.5-9 \mathrm{in} \bullet \mathrm{lbs} \\ & 9-11.5 \text { in } * \mathrm{los} \end{aligned}$ |
|  | SH2日-05 SH3B-05 SH48-05 | M3.5 screws with captive wire clamp | 300V, 10A | Maximum up to 2-812AWG | $9 \cdot 11.5 \mathrm{in} \bullet \mathrm{lbs}$ |
| fingerr-sale DIN Riail Mourt | SS18-05C | $\begin{aligned} & \text { (coill M3 screws } \\ & \text { (contact) M3.5 screws with captive wire clamp, fingersafe } \end{aligned}$ | 250V, 10A | - Maximum up to 2-*12AWG | $\begin{aligned} & 5.5-9 \mathrm{in} e \mathrm{lbs} \\ & 9-11.5 \cdot \mathrm{in} \mathrm{el} \mathrm{lbs} \end{aligned}$ |
|  | $\begin{aligned} & \text { SH2B-05C } \\ & \text { SH3B-05C } \\ & \text { SH4B-0SC } \end{aligned}$ | M3.5 screws with captive wire clamp. fingersafe | 300V, 10A | Maximum up to 2- ${ }^{\text {P12AWG }}$ | 9-11.5 in•lbs |
| Thiough <br> Panel <br> Mount <br> Socket | $\begin{aligned} & \text { SH18-51 } \\ & \text { SH2Q-51 } \\ & \text { SH38-51 } \\ & \text { SH48-51 } \end{aligned}$ | Salder $\quad$ ! $\quad$. | 300V. 10A |  | - |
| PCB Hount SSocket | SH18-62 | PCB mount | 250V, 10A | - | $\square$ |
|  | SH2B-62 SH3B-62 SH48-62 | PCB mount | 300V. 10A | $\therefore \quad-$ | 3 |

Accessories

| Description: | Appoarance | Use with | Pari No. | Hemarks |
| :---: | :---: | :---: | :---: | :---: |
| Aluminum DIN Rail (1 meter length) |  | All DIN rail sockets | BNDN1000 | IDEC offers a low-profile DIN rail (BNDN10DO). The BNON1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNON1000 measures $0.413(10.5 \mathrm{~mm})$ in height and 1.37 ( 35 mm ) in width ( $\mathrm{D}!\mathrm{N}$ standard). Standard length is $39^{\circ}(1,000 \mathrm{~mm}$ ). |
| DIN Räil End Stop |  | DIN rail | 8NL5 | 9.1 mm wide. |
| Replacement Hold-Down Spring Anchor. |  | DIN mount sockets and hold down springs. | Y778-011 | For use on DIN rail mount socket when using pullover wire hold dawn spring. 2 pieces included with each socket. |


| Contact Material |  | Silver cadmium oxide |
| :---: | :---: | :---: |
| Contact Resistance ${ }^{1}$ |  | 50 mh maximum |
| Minimum Applicable Load |  | 24 V DC, $30 \mathrm{~mA} ; 5 \mathrm{VDC}, 100 \mathrm{~mA}$ (reference value) |
| Operate Time ${ }^{2}$ | SPDT <br> DPDT | 20 ms maximum |
|  | $\begin{aligned} & 3 \mathrm{PDDT} \\ & \text { 4PDT } \end{aligned}$ | 25 ms maximum |
| Release Time ${ }^{\text { }}$ | SPDT DPDT | 20 ms maximum |
|  | $\begin{aligned} & 3 \mathrm{PDT} \\ & 4 \mathrm{PDT} \end{aligned}$ | 25ms maximum |
| Power Consumption (approx.) | SPDT | AC: $1.1 \mathrm{VA}(50 \mathrm{~Hz})$, , VA $(60 \mathrm{~Hz})$ DC: 0.8 W |
|  | DPDT | AC: $1.4 \mathrm{VA}(50 \mathrm{~Hz}) .1 .2 \mathrm{VA}(60 \mathrm{~Hz}) \quad$ DC: 0.9 W |
|  | 3PDT | AC: $2 \mathrm{VA}(50 \mathrm{~Hz}), 1.7 \mathrm{VA}(60 \mathrm{~Hz}) \quad$ DC: 1.5 W |
|  | 4PDT | AC: $2.5 \mathrm{VA}(50 \mathrm{~Hz})$; 2 VA ( 60 Hz ) DC: 1.5 W |
| Insulation Resistance |  | 100M0 minimum ( 500 V DC megger) |
| Dielectric Strength ${ }^{\text {a }}$ | SPDT | Between live and dead parts: $2,000 \mathrm{~V} \mathrm{AC}, 1$ minute <br> Between contact and coil: $2,000 \mathrm{~N} \mathrm{AC}, 1$ minute <br> Between contacts of the same pole: $1,000 \mathrm{~N} \mathrm{AC}, 1$ minute  |
|  | $\begin{aligned} & \text { DPDT } \\ & \text { 3PDT } \\ & \text { 4PDT } \end{aligned}$ | Between live and dead parts: $2,000 \mathrm{~V}$ AC, 1 minute <br> Between contact and coil: $2,000 \mathrm{~V} \mathrm{AC}, 1$ minute <br> Between contacts of diferent poles: $2,000 \mathrm{~V} \mathrm{AC},$,1 minute  <br> Between contacts of the same pole: $1,000 \mathrm{~V}$ AC, 1 minute |
| Opporating Froquency |  | Electical: 1,800 operations/hour maximum <br> Mechanical: 18,000 operations/hour maximum |
| Vibration Resistance |  | Darmage limits: 10 to 55 Hz , amplitude 0.5 mm <br> Operating extremes: 10 to 55 Hz , amplitude 0.5 mm |
| Shoct Resistance |  | Damage limits: $1,000 \mathrm{~m} / \mathrm{s}^{2}(100 \mathrm{G})$ <br> Operating extremes: $200 \mathrm{~m} / \mathrm{s}^{2}(20 \mathrm{G}-\mathrm{SPDT}$, DPUT) <br>  $100 \mathrm{~m} / \mathrm{s}^{2}(10 \mathrm{G}-3 P D \mathrm{~T}$ 4PDT) |
| Mechanical Life |  | 50,000.000 operations minimum |
| Electrical Lite | DPDT | 500,000 operations minimum (120V AC, 10A) |
|  | $\begin{aligned} & \hline \text { SPDT } \\ & \text { 3PDT } \\ & 4 P D T \end{aligned}$ | 200,000 operations minimum (120V AC. 10A) |
| Operating Temperature ${ }^{4}$ | SPDT | -25 to $+50^{\circ} \mathrm{C}$ (no freezing) |
|  | $\begin{aligned} & \text { OPDT } \\ & \text { 3PDT } \\ & \text { 4PDT } \end{aligned}$ | -25 to $+40^{\circ} \mathrm{C}$ (no freezing) |
| Operating Humidity |  | 45 to 85\% RH (no condensation) |
| Weight (approx.) |  | SPDT: 24g. DPDT: 37g. 3PDT: 50g. 4PDT: 74g |

Note: Above values are initiai values.

1. Measured using 5V DC. 1A voltage drop method
2. Measured at the rated voltage (at $20^{\circ} \mathrm{C}$ ). excluding contact bouncing

Release time of relays with diode: 40 ms maximum
3. Relays with indicator or diode: 1000 VAC , minute
4. For use under difterent temperature conditions, refer to Continuous Load Current vs. Operating Temperalure Curve. The operating temperature range of relays with indicator or diade is -25 to $+40^{\circ} \mathrm{C}$

## Characteristics (Reference Data)

## $\stackrel{n}{5}$ Electrical Lite Curves <br> AC Load





DC Load




## Maximum Switching Capacity



Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)


Internal Connection (View from Bottom)
Basic Type


Contacts can be operated by pressing the check button.

With Indicator (-L type)


With Diode (-D type)


With Indicator LED \& Diode (-LD type)



RH1B-U/RH1B-UL/RH1B-UD/RH1B-ULD

$\stackrel{\text { n }}{\stackrel{y}{\mid}}$
RH4B-U/RH4B-UL/RH4B-UD/RH4B-LD


RH3B-UT


RH4B-UT


Dimensions con't (mm)

RH1V2-U/RH1V2-UD


RH2V2-U/RH2V2-UL/RH2V2-UD


RH4V2-U/RH4V2-UL/RH4V2-UD


SH2B-05


Timers

SH4B-05
Standard DIN Rail Mount Sockets


## SH3B-05



SH1B-05



## Dimensions con't (mm)



Through Panel Mount Socket
SH1B-51

SH2B-51
SH2B-05C


SH4B-05C


SH4B-51


SH3B-51



## Dimensions con't (mm)

PCB Mount Sockets
SH1B-62


SH3B-62


SH2B-62


SH4B-62


## Operating Instructions

## Driving Circuit for Relays

1. To ensure correct relay operation, apply rated voltage to the relay coil.
2. Input voltage for the DC coil:

A complete DC voltage is best for the coil power to make sure of stable relay operation. When using a power supply containing a ripple voltage, suppress the ripple factor within $5 \%$. When power is supplied through a rectification circuit, the relay operating characteristics, such as pickup voltage and dropout voltage, depend on the ripple factor. Connect a smoothing capacitor for better operating characteristics as shown below.


Rippla Factor ( $\%$ ) $\frac{\text { Emax }- \text { Emin }}{\text { Emaan }} \times 100 \%$
$E_{\text {max }}=$ Maximum of oulsating current
Emin $=$ Minimum of pulselling currem Emean = DC mean yalue
3. Leakage current while relay is off:

When driving an element at the same time as the relay operation, special consideration is needed for the circuit design. As shown in the incorrect circuit below, leakage current ( 10 ) fiows through the relay coil while the relay is off. Leakage current causes coil release failure or adversely affects the vibration resistance and shock resistance. Design a circuit as shown in the correct example.
4. Surge suppression for transistor driving circuits

When the relay coil is turned off, a high-voltage pulse is generated, causing a transistor to deteriorate and sometimes to break. Be sure to connect a diode to suppress the back electromotive force. Then, the coil release time becomes slightly longer. To shorten the coil release time, connect a Zener diode between the collector and emitter of the transistor. Select a Zener diode with a Zener voltage slightly higher than the power voltage.


Operating Instructions con't

## Other Precautions

1. General notice:

To maintain the initial characteristics, do not drop or shock the relay.
The relay cover cannat be removed from the base during normal operation. To maintain the initial characteristics, do not remove the relay cover.

Use the relay in environments free from condensation, dust, sulfur dioxide $\left\{\mathrm{SO}_{2}\right.$ ) and hydrogen sulfide $\left\{\mathrm{H}_{2} \mathrm{~S}\right\}$.

Make sure that the coil voltage does not exceed applicable coil voltage range.
2. UL and CSA ratings may differ from product rated values determined by IDEC.
3. Do not use relays in the vicinity of strong magnetic field, as this may aflect relay operation.

## Safety Precautions

- Turn off the power to the relay before starting installation, removal, wiring, maintenance, and inspection of the relays. Failure to turn power off may cause electrical shock or fire hazard.
- Dbserve specifications and rated values, otherwise electrical shock or fire hazard may be caused.
- Use wires of the proper size to meet voltage and current requirements. Tighten the terminal screws on the relay socket to the proper tightening torque.
- Surge absorbing elements on AC relays with RC or DC relays with diode are provided to absorb the back electromotive force generated by the coil. When the relay is subject to an excessive external surge voltage, the surge absorbing element may be damaged. Add another surge absorbing provision to the relay to prevent damage.


## Precautions for the RU Relays

- Before operating the latching lever of the RU relay, turn off the power to the RU relay. After checking the circuit, return the latching lever to the original position.
- Do not use the latching lever as a switch. The durability of the latching lever is a minimum of 100 operations.
- When using DC loads on 4PDT relays, apply a positive voltage to terminals of neighboring poles and a negative voltage to the other terminals of neighboring poles to prevent the possibility of short circuits.
- DC relays with a diode have a polarity in the coil terminals. Apply the DC voltage to the correct terminals.




## Features

Three-phase, three or four-wire
Adjustable set point
Adjustable time delay
Internal differential
LED trip indication
Double-pole relay contacts
Automatic reset

## Benefits

Monitoring of correct phase rotation Protects against phantom or regenerated phase voltage
Protection against phase loss, reversal or sequence
Under-voltage and unbalanced voltage monitoring
Prevents reverse rotation of motor driven equipment
Ensures correct engine rotation
Protects portable electrical equipment Nuisance tripping avoidance

## Applications

Marine panels
Switchgear
Distribution systems
Generator sets
Control panels
Process control
Motor protection
Transformers
Overload protection

## 250 Series DIN-rail and Wall Mounted Relays

## Phase Balance

The 250 series phase balance protector module provides continuous surveillance of a three-phase, three-or four-wire system and monitors the correct phase rotation or sequence of three-phase supply systems. The module protects against phase loss, reversal or sequence, phase unbalance and system under-voltage.

## Operation

Rotating machines are particularly vulnerable to incorrect phase sequence. Threephase motors can rotate in the wrong direction, potentially leading to physical damage or the risk of injury to personnel, yet voltage and current readings may appear normal. If one phase is lost because of a blown fuse, electric motors can continue to operate (single-phasing) which can result in severe electrical or mechanical damage. This relay has the added advantage that it will detect the phantom or regenerated phase that can be caused by a single-phase failure on some equipment or when running motors at low load levels.

An unbalanced supply voltage can lead to temperature rises in motors. An unbalanced voltage as little as $10 \%$ can increase operating temperature to $150 \%$ of normal. For permanent installations, this relay should be used to monitor the incoming supply, protecting all equipment against incorrect connection at initial installation or after maintenance work. Rotating machines that cannot tolerate reverse rotation or pose significant risk to personnel under this condition should be individually protected with this relay. The possibility of incorrect supply connection is much more likely in portable equipment or marine applications.

The protector continuously monitors the three-phase supply. With the correct phase sequence applied and all three voltages balanced within the required limits, the front panel LED will illuminate and the output relay will be energised. An incorrect sequence, missing phase, out of balance or under-voltage condition will de-energise the relay and the LED will be extinguished.

The set point control allows adjustment of the voltage matching between $5 \%$ and $15 \%$. The time delay function operates only for the voltage unbalance condition. The delay can be used to prevent nuisance tripping due to short term unbalance situations. Incorrect phase rotation, a missing phase or an under-voltage condition trip the relay immediately.

## Product Codes

| Relay | Rrotecfioi | ANSInO. | Cafno |
| :--- | :--- | :--- | :--- |
| 3-phase 3- or 4-wire | Phase loss and <br> unbalance 5-15\% | 47 | $252-\mathrm{PSF}$ |
| 3-phase 3- or 4-wire | Phase loss, unbalance <br> and under-voltage 5-15\% | $47 / 27$ | 252-PSG |

Please specify system voltage, frequency and required options at time of ordering.

## Specification - Phase Balance

| Nominal voitage | $110 \mathrm{~V}, 120 \mathrm{~V}, 208 \mathrm{~V}, 220 \mathrm{~V}, 230 \mathrm{~V}, 240 \mathrm{~V}, 277 \mathrm{~V}$, $380 \mathrm{~V}, 400 \mathrm{~V}, 415 \mathrm{~V}, 440 \mathrm{~V}$ or 480 V |
| :---: | :---: |
| System frequency | 50 or 60 Hz |
| Voltage burden | 3VA approx. |
| Overload | $1.2 \times$ rating continuously, $1.5 \times$ rating for $10 \times$ seconds |
| Set point repeatability | >0.5\% of full span |
| Under-voltage set point | Pre-set at $15 \%$ of nominal voltage. Other values 10 to $30 \%$ to order (model 252-P5G only) |
| Trip level adjustment | Phase unbalance adjustable 5 to 15\% |
| Time delay | 10 seconds as standard. Up to 30 seconds available |
| Auxiliary voltage burden | 4VA (max) |
| Output relay | 2-pole change over |
| Relay contact rating | AC: 240 V 5 A , non inductive DC: $24 \vee 5 \mathrm{~A}$ resistive |
| Relay mechanical life | 0.2 million operations at rated loads |
| Relay reset | Automatic |
| Operating temperature | $0^{\circ} \mathrm{C}$ to $+60^{\circ} \mathrm{C}\left(0^{\circ} \mathrm{C}\right.$ to $+40^{\circ} \mathrm{C}$ for UL models) |
| Storage temperature | , $-20^{\circ} \mathrm{C}$ to $+70^{\circ} \mathrm{C}$ |
| Temperature co-efficient | 0.05\% per ${ }^{\circ} \mathrm{C}$ |
| Interference immunity | Electrical stress surge withstand and non-function to ANSI/IEEE C37 90a |
| Enclosure style | DIN-rail with wall mounting facility |
| Material | Flame retardant polycarbonate/ABS |
| Enclosure integrity | - 1 P 50 |
| Model 252 dimensions | 55 mm (2.2") wide $\times 70 \mathrm{~mm}$ (2.8") high $\times 112 \mathrm{~mm}$ (4.4") deep |
| Weight | 0.4 Kg approx. |

## Connections

252-PSF Relay
252-PSG Contact Set 1 Contact Set 2


Input

Note: Neutral connection not required.

## Dimensions

Model 252


## CHASSIS

## 1. CD-2 CHASSIS TECHNICAL DETAILS

## NHP

## Panelboards, loadcentres and accessories

```
CONCEPT•PLUS and Premier busbar chassis - Din-T
■ Standards AS/NZS 3439
- Current rating 250 A
- Withstand rating \(250 \mathrm{~A} / 20 \mathrm{kA}\) for 0.2 sec
- Splayed busbar to suit 160 A \& 250 A switch
- Top and bottom feed - splayed top \& bottom
- Tee-offs stripped and \(50 \%\) capped
- Top power feed stripped and capped
- Full 35 mm DIN rail, improved MCB mounting security
- Improved insulation coating
```

Concept Din-T - 250 to suit Din-T MCBs ( 18 mm pole pitch) ${ }^{3}$ )
250 A
Pole capacity (at. No. ${ }^{1}$ )

| 12 | CD-2-12/18-3U |
| :--- | :--- |
| 18 | CD-2-18/18-3U |
| 24 | $C D-2-24 / 18-3 U$ |
| 30 | $C D-2-30 / 18-3 U$ |
| 36 | $C D-2-36 / 18=3 U$ |
| 42 | $C D-2-42 / 18-3 U$ |
| 48 | $C D-2-48 / 18-3 U$ |
| 54 | $C D-2-54 / 18-3 U$ |
| 60 | $C D-2-60 / 18-3 U$ |
| 72 | $C D-2-72 / 18-3 U$ |
| 78 | $C D=2-78 / 18-3 U$ |
| 84 | $C D-2-84 / 18: 3 U$ |
| 96 | $C D-2-96 / 18-3 U$ |

Accessories

| Description |  |
| :--- | :--- |
| Cat. No. |  |
| Split tariff kit 250/355 A (supplied loose) | STKCD |
| Split tariff kit (fitted) | REFER NHP |
| Plastic tee-off cap $250 / 355$ A | CD250TOPC |


| Technical data - CD/CT busbar chassis <br> Description |  |  |
| :--- | :--- | :--- |
| Busbar rating | (Amp) | 250 |
| Voltage rating | $(\mathrm{V})$ | 415 |
| Short circuit rating | $(\mathrm{kA})$ | 20 |
| Short circuit time | $(\mathrm{sec})$ | 0.2 |
| Insulation material |  | Polyolefin |
|  |  | PPA-441 |

Catalogue number structure - CD/CT busbar chassis


$\left\lvert\,$| XX |  |  |
| :--- | :---: | :---: |
|  |  |  |
| Pole pitch (mm) |  |  |
| 18 |  |  |$\quad$| Din-T |  |
| :--- | :--- |
| 27 | Din-T10H |
| $27 / 18$ | Hybrid <br> Din-T10H/Din-T |
| 25 | Safe-T |\right.


$|$| X |
| :--- |
| No. of phases  <br> 2 $1 \mathrm{P}+\mathrm{N}$ (red, black) <br> 3 $3 P$ (red, white, blue) <br> 4 $3 P+N$ (red, white, <br> blue, black)  | OFF (line) side of MCB connects to chassis tee-off.

MCB DIN clips may be disengaged or removed when mounting onto "CD" chassis. If applicable use insulated tool provided to disengage DIN clip when removing MCB from chassis.
${ }^{1}$ ) Not suitable for CONCEPT economy Panelboards. Contact NHP for availability. Available on indent only.
(i)

3 pole CD chassis to suit Din-T MCBs

Notes: ') 4 pole and other special configurations available to special order refer NHP.
(i)

Technical data - CD/CT busbar chassis


Panelboards, loadcentres and accessories

## Dimensions (mm)

CD chassis 250 to suit Din-T6, 10 and 15


Escutcheon cut-out details


Notes: ' " "X" insert 2-250 A or 3-355 A, current rating does not effect above dims. Maximum current rating of tee-off $=100 \mathrm{~A}$.
'OFF (line) side of MCB connects to chassis tee-off.
MCB DIN clips may be disengaged or removed when mounting onto "CD" chassis Use insulated tool provided to disengage DIN clip when removing MCB from chassis.

Halmac Services (Qld) Pty. Ltd.
AB.N. 40741712113

## FUSE \& FUSE HOLDER

## 1. FUSE LINKS TECHNICAL DETAILS

2. FUSE HOLDER TECHNICAL DETAILS

NHP ${ }_{\text {rusts }}^{\text {compact }}$


Clip-in offset tags

Note: $\quad$ ') ' $M$ ' in catalogue No. denotes motor starting type.

DIN and BS fuse link selection chart

## BS Fuses



## DIN Fuses

| Switch-fuses |  |  |  |  |  | Fuse type Cat No. Prefix |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 800 | 630 | 400 | 250 | 160 | 125 |  |
|  |  |  |  | $\checkmark$ | $\checkmark$ | N00 |
|  |  |  | $\checkmark$ |  |  | N1 |
|  |  | $\checkmark$ |  |  |  | N2 |
| $\checkmark$ | $\checkmark$ |  |  |  |  | N3- |

Legend: $\quad$ fuse links fit direct.
$\checkmark$ ') Fuses require 100 MFLK adaptor, see page 11-107.
$\boldsymbol{V}^{2}$ ) 'M' type (motor rated) NTIS not suitable for NC63.. Use NC100 fuse holder.

HRC
को
High rupturing capacity' (HRC) or High breaking
capacity denotes the ability of afuselink to interrupt.
extremely high fault currents, usually up to 80 kA :
Current limiting füse link
A fuse-link that limits the circuit current duying it's doperation to a value much lower than the peak value of the prospectivecurrent. In practice, the terms $H R C$ and currentimiting aresynonymous.
Rated breaking capacity
The highest yalue of fault current that fuse-link has been tested to interrupt eg. 80 kA .
Rated voltage
The maximum system voltage that the fuse link is
désigned to interrupt. Rated voltagestmay be iñac, De, or bothers
The value of current that arfuse link will cariy of of Continuously without deterioration underspecified $f=0$ conditions.
Minimum fusion eurrent
Théminimum value of current that will tand melting Tof fuse elent Powedissipation The power released in a fuse link carrying fated intwatts.

Discriminatioń (refer tables 4 ạd 5) Discrimination'is the ability of fuse-links to-operate? selectively and todisconnect only the parts of the , circuit that are subject to faults Disofimination ican be checked by ensuring that the time current characteristics," including their toleãances, do not overlap at any point and that the total let throughe energy (It) of the downstream (or minor) fuse-link doestrot exceêd the pre-arcing energy (rt) of the ùpstrean (or major) fuse link at the ápplied system voltage. Discrimination is normally achieved with the ratio of $1.66^{\circ}$ between upstreanand downstream ,


Time current characteristict (refer table i)
A curve detailing the prezarcing or-operating time as a finction of pospective current.
Let through, characteristics (12) (refer table 2 ) A curve or chart showing values preatang ande poperating letthroughenergies as a function of prospective current, 12 is proportional to energy in it
FAmp seconds.
Cut off characteristic
Acurve detailing the
prospective curnent,
maximuminstantane
bye fuse link durin
ant



Discrimination achieved


Cut off chacteristics 3 ?


Discrimination NOT achieved


14 characteristics




Compact fuse holders (Bolt-in)
O New compact size
O Front (FW) or stud/front (SFW) versions
O Smaller dimensions
O Saves panel space

Dimensions (mm)

|  | $\mathbf{H}$ | $\mathbf{W}$ | $\mathbf{D}$ | cable size |
| :--- | :--- | :--- | :--- | :--- |
| NC32_ | 87 | 27 | 50 | $10 \mathrm{~mm}^{2}$ |
| NC63_ | 109 | 31 | 62 | $25 \mathrm{~mm}^{2}$ |
| NC100_ | 118 | 35 | 72 | $50 \mathrm{~mm}^{2}$ |
| NC200_ | 154 | 54 | 108 | $95 \mathrm{~mm}^{2}$ |



Rating (A) | Fuse link to suit
UP TO 30\% SMALLER

Front wired - bolt in

| 32 |  |  | NNIT | NC32FW |  |
| :---: | :--- | :--- | :--- | :--- | :--- |
| 63 |  | NTIA | NTIS | NC63FW |  |
| 100 | NOS | NTIA | NTIS | NC100FW |  |
| 200 |  | NTIA $^{\prime}$ ) | NTIS ${ }^{1}$ ) | NC200FW |  |
|  | NTFP | NOS $\left.^{\prime}\right)$ | NTCP |  |  |

Back stud/front wired - bolt in

| 32 |  |  | NNIT | NC32SFW |  |
| :---: | :--- | :--- | :--- | :--- | :--- |
| 63 |  | NTIA | NTIS | NC63SFW |  |
| 100 | NOS | NTIA | NTIS | NC100SFW |  |
| 200 |  | NTIA $\left.^{\prime}\right)$ | NTIS $\left.{ }^{1}\right)$ | NC200SFW |  |
|  | NTFP | NOS $\left.^{1}\right)$ | NTCP |  |  |

Note: $\quad \mathrm{y}$ Fuses can be fitted using adaptor 100M FLK.

## Standard fuse holders (Bolt-in)

O Ratings from 20 to 200 A
O Front (FW) or stud/front (SFW) versions
O Complies with BS88


N20FW
Dimensions (mm)

|  | H | W | D | cable size |
| :--- | :--- | :--- | :--- | :--- |
| N20_ | 87 | 27 | 50 | $10 \mathrm{~mm}^{2}$ |
| N32_ | 109 | 31 | 62 | $10 \mathrm{~mm}^{2}$ |
| N63_ | 118 | 35 | 72 | $50 \mathrm{~mm}^{2}$ |
| N100_ | 154 | 54 | 108 | $70 \mathrm{~mm}^{2}$ |
| N200_ | 193 | 70 | 149 | $150 \mathrm{~mm}^{2}$ |

Clip-in fuse holders - DIN rail mount
Fast, reliable fitting and removal of fuse links
Rating (A)
Fuse link to suit
Cat. No.


Front wired - clip-in - Black

| 20 | NSS | NV20FW |  |
| :---: | :---: | :---: | :--- |
| 32 | NSS | NV32FW |  |
| 63 | NES | NV63FW |  |
| Front wired - Clip-in - White |  |  |  |
| 32 | NNS | NV32FWW |  |
| 63 | NES | NV63FWW |  |

## GSM MODEM

## 1. FASTRACK SUPREME GSM MODEM TECHNICAL DETAILS

2. FASTRACK SUPREME GSM MODEM USER GUIDE


Fastrack Supreme is a versatile Plug \& Play Wireless CPU* that will carry your applications well into the future. It has been designed to accommodate any additional features you can imagine, thanks to a revolutionary, open standard Internal Expansion Socket which you can populate with an expansion card from Wavecom - or one of your own.

## SECURE CELLULAR INTERNET

Prevent hacker attacks by using our Security software Plug-In to connect your sales terminal, meter, vehicle, asset tracking or monitoring product via GSM, GPRS or high speed EDGE to the cellular Internet highway.

POWERFUL CORE APPLICATION PROCESSING
Every Fastrack Supreme features a Wavecom Q26-family Wireless CPU*: a powerful central processing unit with an ARM9 32 bit, $26-104 \mathrm{MHz}$ core, programmable via any combination of AT commands, C and Lua.

## FASTRACK = YOUR PRODUCT

By designing your product value as an expansion card you save time and money in cellular learning curve, certification, mechanical design and time to market. Fastrack can now become your product.

## UNHEARD-OF EXPANDABILITY

Add additional IO connectivity or features like GPS, WiFi, Bluetooth, Zigbee and more. The open interface means you can develop your own expansion modules for your specific needs.

## INTELLIGENT DEVICE SERVICES

Our Intelligent Device Services enable you to remotely monitor and securely upgrade the software of your product, in order to reduce post-deployment field maintenance costs.

PROFESSIONAL SERVICES
Accelerate your product design and ensure you capitalize on market opportunities!

# MEVECOMN 

Smart wireless. Smart business.


Evolve to the latest cellular technology and add functionality without sacrificing the form factor you have come to rely on. The Fastrack Supreme is the same size, has the same interfaces and is completely backward compatible with previous Fastrack products, and is packed with a host of new features.

Wavecom has developed an exciting new, open-standard Internal Expansion Socket (IES) interface for you to add additional 10 connectivity or features like GPS, Wifi, Bluetooth, Zigbee and more. The open interface means you can develop your own expansion modules and customize the product for your specific requirements, or you can look to Wavecom for new expansion modules designed to address your most-pressing needs.

Features



Open AT® Software Suite 2.0

## Industrial software for industrial design demands

The Open AT* Software Suite allows you to develop, compile, test, debug, download and natively execute your applications written in standard ANSI C directly on the Fastrack Supreme, or indeed any other Wavecom Wireless CPU*. It is royalty free and comprises operating system, compiler and integrated development environments. There are no hidden costs - maintenance and qualification are provided for free by Wavecom.

- Multitasked Pre-Emptive Event-Based Real-Time Operating System
- Integrated Development Environment built on Eclipse ${ }^{\text {TM }}$
- Extensive Set of Plug-Ins (Internet Suite, C-GPS and more)
- GSM Release 99 compliant modem firmware
- Secure Intelligent Device Services (IDS) compatible


## REAL TIME OPERATING SYSTEM

Real-Time
Guarantied response time to interruption
(even during GSM/GPRS/EDGE activities, calls and transfer).
Wireless CPU• Resources Direct Access and IT Management
$\rightarrow$ Hardware and Software Timers
$\rightarrow$ DSP
$\rightarrow \mathrm{SPI}$
$\rightarrow \mathrm{ADC}$
$\rightarrow$ External Interrupt Pins
$\rightarrow$ GPIOs
$\rightarrow$ UARTS (coming in 2008)
Multitasking
Auto shut-down feature
Feature improving the overall consumption of the application by deactivating the RS232 interface.
Application dedicated Hardware Watchdog
$\rightarrow$ application dedicated for close monitoring
$\rightarrow$ tunable depending on the complexity of the processing (ex: Pulse count Vs RSA signature calculation...)

## CROSS-PLATFORM INTEGRATED <br> DEVELOPMENT ENVIRONMENT

For eased application debug it can be performed on $P C$ : for very fast and convenient application debugging through Remote Task Environment.
On target for final Integration and time-critical behavior management:
$\rightarrow$ Live through Traces
$\rightarrow$ Post mortem through BackTraces
On field:
$\rightarrow$ for difficult error causing operating scenarios through IDS device monitoring services and BackTraces over the air retrieval.

## SEAMLESSLY PLUG-IN ADDITIONAL FEATURES

Plug-Ins are an optional range of software feature packages that are selected when your order your Wireless CPU. The standard range provides access to internet clients \& protocols, controllerless companion wireless peripherals such as Bluetooth \& GPS. Of course, the powerful flexibility of Open AT ${ }^{\star}$ Software Suite means that you can also develop your own Plug-Ins and own custom AT commands.


Lua Easy Scripting


Internet
Clients \& Protocols


C-GPS
Companion


C-Bluetooth" Companion

aqLink* in-band modem

WAVECOM BSP-BASED EMBEDDED SOFTWARE ARCHITECTURE


## Wavecom Services

The wireless products you are developing are most probably very complex, and they will stay in the field for many years. With this in mind, Wavecom has created a range of professional and operated services to make the development process easier and to help you protect your investment, enrich your products and services, and reduce the lifetime cost of your device network.

## Professional services: Less pain, more gain

Wavecom Professional Services help you be faster, sleeker and more adaptable to the ever changing needs of your market, all along the typical product lifecycle timeline:

| WAVECOM UNIVERSITY | PRODUCT BUILD |
| :---: | :---: |
| $\rightarrow$ Open AT* Developer course | $\rightarrow$ IMEI implementation |
| $\rightarrow$ Open AT* Expert course | $\rightarrow$ Tailored Delivery (Express \& Fast) |
|  | $\rightarrow$ Tailored Product Configuration |
| PRODUCT DESIGN | AFTER SALES |
| $\rightarrow$ Customer Design Revie | $\rightarrow$ Reconfiguration for Wireless CPU* |
| $\rightarrow$ Customer Product Certification | $\rightarrow$ Out Of Warranty repair for Wireless CPU |
| $\rightarrow$ Open AT:Application Code Review | $\rightarrow$ Repair Equipment Wireless CPU* |

## Intelligent Device Services: Investment protection

Wavecom has created the world's first cellular operated service portfolio to benefit from easy to use end-to-end Intelligent Device Services that enable to remotely monitor and securely upgrade the application software of your product in addition to the entire Wavecom embedded Open AT* Software:

```
WIRELESS DEVICE MANAGEMMENT
    >>)Simplify your device installation and protect your wireless investment
        while reducing your field service costs
COMMUNICATION MANAGEMENT
    Analyze your traffic load and roaming usage, and adjust your tariff plans to your real usage
APPLICATION MANAGEMENT
\(\rightarrow\) Bènefit from proactive maintenance services to diagnose issues and take action before a significant problem occurs
```

See the Fastrack Supreme online: unw.wavecom.com/fastracksupreme

Join the Wavecom Developer community: www.wavecom.com/forum


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Smart wireless. Smart business.

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FASTRACK Supreme
User Guide

Reference: WA_DEV_Fastrk_UGD_001
Revision: 001e
Date: 5 june, 2007


[^6]

| Revision | Date | List of revisions |  |
| :---: | :---: | :--- | :--- |
| 001 | 9 February, 07 | First Issue |  |
| 001 a | 23 February, 2007 | Update DC cable GPIO mapping, add AutoShutDown |  |
| 001 b | 21 May, 07 | Add detail of IES, RTC and serial port autoshutdown |  |
| 001 c | 1 Jun, 07 | Change to Quad Band |  |
| 001 d | 4 Jun, 07 | Update label/packaging photo |  |
| 001 e | 5 Jun, 07 | Comment |  |

## Ovenview

The FASTRACK Supreme 10 and FASTRACK Supreme 20 are discrete, rugged cellular Plug \& Play Wireless CPU ${ }^{\otimes}$ offering state-of-the-art GSM/GPRS (and EGPRS for FASTRACK Supreme 20) connectivity for machine to machine applications.
Proven for reliable, stable performance on wireless networks worldwide, Wavecom's latest generation of FASTRACK Supreme continues to deliver rapid time to market and painless integration.
Having comparable size with the previous M1306B generation, and updated with new features, the FASTRACK Supreme offers an Internal Expansion Socket (IES) interface accessible for customer use. Expanding application features is easy without voiding the warrantee of the FASTRACK Supreme by simply plugging in of an Internal Expansion Socket Module (IESM) board.
Fully certified, the quad band $850 / 900 / 1800 / 1900 \mathrm{MHz}$ FASTRACK Supreme 10 offers GPRS Class 10 capability and FASTRACK Supreme 20 offers GPRS/EGPRS Class 10 capability. Both support a powerful open software platform (Open $A T^{\circledR}$ ). Open $A T^{\circledR}$ is the world's most comprehensive cellular development environment, which allows embedded standard ANSI C applications to be natively executed directly on the Wireless CPU ${ }^{*}$.
FASTRACK Supreme is controlled by firmware through a set of AT commands.
This document describes the FASTRACK Supreme and gives information on the following topics:

- general presentation,
- functional description,
- basic services available,
- technical characteristics,
- installing and using the FASTRACK Supreme,
- user-level troubleshooting.
- recommended accessories to be used with the product.


## Note:

This document covers the FASTRACK Supreme Plug \& Play alone and does not include

- The programmable capabilities provided via the use of Open $A T^{\circledR}$ Software Suites.
- The development guide for IESM for expanding the application feature through the IES interface.

For detailed, please refer to the documents shown in the "Reference documents" section.


The FASTRACK Supreme is now compliant with RoHS Directive 2002/95/EC, which sets limits for the use of certain restricted hazardous substances. This directive states that "from 1st July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)".

Plug \& Plays which are compliant with this directive are identified by the

RoHS logo on their label.

RoHS
COMPLIANT 2002/95/EC

Disposing of the product
This electronic product is subject to the EU Directive 2002/96/EC for Waste Electrical and Electronic Equipment (WEEE). As such, this product must not be disposed off at a municipal waste collection point. Please refer to local regulations for directions on how to dispose off this product in an environmental friendly manner.


## RoHS Directive

## Cautions

Information furnished herein by WAVECOM is accurate and reliable. However, no responsibility is assumed for its use. Please read carefully the safety recommendations given in Section 9 for an application based on FASTRACK Supreme Plug \& Play.

## Trademarks

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| General information about Wavecom and its range of <br> products: | www.wavecom.com |
| :--- | :--- |
| Specific support is available for the FASTRACK Supreme <br> Plug \& Play Wireless CPU: | TBD |
| Open AT ${ }^{\oplus}$ Introduction: | $\underline{\text { ww.wavecom.com/OpenAT }}$ |
| Developer community for software and hardware: | $\underline{w w . w a v e c o m . c o m / f o r u m ~}$ |

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## 1 References

### 1.1 Reference Documents

For more details, several reference documents may be consulted. The Wavecom reference documents are provided in the Wavecom documents package contrary to the general reference documents, which are not Wavecom owned.

### 1.1.1 Open $\mathrm{AT}^{\boldsymbol{\beta}}$ Software Documentation

[1] Getting started with Open AT ${ }^{\text {® }}$ (Ref.WM_ASW_OAT_CTI_001)
[2] Open AT ${ }^{\text {® }}$ Tutorial (Ref.WM_ASW_OAT_UGD_001)
[3] Tools Manual (Ref. WM_ASW_OAT_UGD_003)
[4] Open $A T^{8}$ Programming Guide (Ref. TBD)
[5] Open AT ${ }^{\text {® }}$ Customer Release Note (Ref. WM_ASW_OAT_DVD_00062)
Remark: The document above is for Open AT3.12 and FASTRACK Supreme will use new release of Open AT4.21. Reference document not yet available and TBC.

### 1.1.2 AT Software Documentation

[6] AT commands interface Guide for X51 (Ref. WM_ASW_OAT_UGD_00016)
[7] Customer Release Note X51 (Ref. WM_ASW_OAT_DVD_00120)
Remark: The document above is for X51 and FASTRACK Supreme will use new release of FW6.63. Reference document not yet available and TBC.

### 1.1.3 Firmware Upgrade Documents

[8] Firmware upgrade procedure (Ref. WM_SW_GEN_UGD_001)

### 1.1.4 Delta between M1306B Documents

[9] Delta between M1306B and FASTRACK Supreme (Ref. WA_DEV_Fastrk_UGD_004)

### 1.1.5 IESM Related Documents

[10] IESM Product Technical Specification (Ref. WA_DEV_Fastrk_PTS_001)
[11] IESM-GPS+USB User Guide (Ref. WA_DEV_Fastrk_UGD_002)
[12] IESM-GPS+USB Installation Guide (Ref. WA_DEV_Fastrk_UGD_003)
[13] IESM-IO+USB Installation Guide (Ref. WA_DEV_Fastrk_UGD_005)
[14] IESM-IO+USB User Guide (Ref. WA_DEV_Fastrk_UGD_006)
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References
Note:
New versions of software may be available. Wavecom recommends customers to check the web site for the latest documentation.

### 1.2 Abbreviations

| Abbreviation | Definition |
| :---: | :---: |
| AC | Alternating Current |
| ACM | Accumulated Call Meter |
| AMR | Adaptive Multi-Rate |
| AT | ATtention (prefix for Wireless CPU ${ }^{\text {® }}$ commands) |
| CLK | CLock |
| CMOS | Complementary Metal Oxide Semiconductor |
| CS | Coding Scheme |
| CTS | Clear To Send |
| dB | Decibel |
| dBc | Decibel relative to the Carrier power |
| dBi | Decibel relative to an Isotropic radiator |
| dBm | Decibel relative to one milliwatt |
| DC | Direct Current |
| DCD | Data Carrier Detect |
| DCE | Data Communication Equipment |
| DCS | Digital Cellular System |
| DSR | Data Set Ready |
| DTE | Data Terminal Equipment |
| DTMF | Dual Tone Multi-Frequency |
| DTR | Data Terminal Ready |
| EEPROM | Electrically Erasable Programmable Read-Only Memory |
| EFR | Enhanced Full Rate |
| E-GSM | Extended GSM |
| EMC | ElectroMagnetic Compatibility |
| EMI | ElectroMagnetic Interference |
| ESD | ElectroStatic Discharges |
| ETSI | European Telecommunications Standards Institute |
| FIT | Series of connectors (micro-FIT) |
| FR | Full Rate |

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| Abbreviation | Definition |
| :---: | :---: |
| FTA | Full Type Approval |
| GCF | Global Certification Forum |
| GND | GrouND |
| GPIO | General Purpose Input Output |
| GPRS | General Packet Radio Service |
| GSM | Global System for Mobile communications |
| HR | Half Rate |
| I | Input |
| IEC | International Electrotechnical Commission |
| IES | Internal Expansion Socket |
| IESM | Internal Expansion Socket Module |
| IMEI | International Mobile Equipment Identification |
| 1/O | Input / Output |
| LED | Light Emitting Diode |
| MAX | MAXimum |
| ME | Mobile Equipment |
| MIC | MICrophone |
| Micro-Fit | Family of connectors from Molex |
| MIN | MINimum |
| MNP | Microcom Networking Protocol |
| MO | Mobile Originated |
| MS | Mobile Station |
| MT | Mobile Terminated |
| NOM | NOMinal |
| 0 | Output |
| Pa | Pascal (for speaker sound pressure measurements) |
| PBCCH | Packet Broadcast Control CHannel |
| PC | Personal Computer |
| PCL | Power Control Level |
| PDP | Packet Data Protocol |
| PIN | Personal Identity Number |
| PLMN | Public Land Mobile Network |
| PUK | Personal Unblocking Key |
| RF | Radio Frequency |

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| Abbreviation | Definition |
| :--- | :--- |
| RFI | Radio Frequency Interference |
| RI | Ring Indicator |
| RMS | Root Mean Square |
| RTS | Request To Send |
| RX | Receive |
| SIM | Subscriber Identification Module |
| SMA | SubMiniature version A RF connector |
| SMS | Short Message Service |
| SNR | Signal-to-Noise Ratio |
| SPL | Sound Pressure Level |
| SPK | SpeaKer |
| SRAM | Static RAM |
| TCP/IP | Transmission Control Protocol / Internet Protocol |
| TDMA | Time Division Multiple Access |
| TU | Typical Urban fading profile |
| TUHigh | Typical Urban, High speed fading profile |
| TX | Transmit |
| TYP | TYPical |
| VSWR | Voltage Stationary Wave Ratio |



Packaging

## 2 Packaging

### 2.1 Contents

The complete package content of the FASTRACK Supreme consists of (see):

- one packaging box (A),
- one FASTRACK Supreme (B),
- two holding bridles (C),
- one power supply cable with fuse integrated (D)
- a mini notice (E) with:
- a summary of the main technical features,
- safety recommendations,
- EC declaration of conformity.


Figure 1: Complete package contents

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Fastrack Supreme User Guide
Packaging

### 2.2 Packaging Box

The packaging box is a carton box (see) with the following external dimensions:

- width: 54.5 mm ,
- height: 68 mm ,
- length: 108 mm .

A packaging label is slicked on the packaging box cover and supports the:

- WAVECOM logo,
- Product reference (Supreme),
- CE marking
- 15-digit IMEI code
- Open $\mathrm{AT}^{(8)}$ Logo
- RoHS logo
- WEEE logo


Figure 2: Packaging box
The packaging label dimensions are:

- height: 40 mm ,
- length: 65 mm .



### 2.3 Production Labelling

A production label (see Figure 3) located at the FASTRACK Supreme back side gives the following information:

- product reference (FASTRACK Supreme 10 or FASTRACK Supreme 20),
- part number (WM19183),
- CE marking,
- 15-digit IMEI code,
- OpenAT ${ }^{\otimes}$ logo


Figure 3: Production Label
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## Fastrack Supreme User Guide <br> General Presentation

## 3 General Presentation

### 3.1 Description

The FASTRACK Supreme description is given in the Figure 4 below.


Figure 4: FASTRACK Supreme general description

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5 lune, 2007

CAUTION: Users are free to remove the back plate for IESM board plug in/unplug without voiding the warrantee of the FASTRACK Supreme. However, the warrantee will be voided if unscrewing any screw of the back cap.
In addition, two holding bridles are provided to tighten the FASTRACK Supreme on a support.


Figure 5: FASTRACK Supreme holding bridles

[^7]
## wavecom ${ }^{\text {s }}$



### 3.2 External Connections

### 3.2.1 Connectors

### 3.2.1.1 Antenna Connector

The antenna connector is a SMA type connector for a $50 \Omega$ RF connection.


Figure 6: SMA connector for antenna connection

### 3.2.1.2 Power Supply Connector

The power supply connector is a 4-pin Micro FIT connector for:

- external DC Power Supply connection,
- GPIOs connection (two General Purpose Input/Output signals available).


Figure 7: Power supply connector

Table 1: Power supply connector pin description

| Pin \# | Signal | I/O | VO type. | Description | Reset State | Comment |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | V+BATTERY | 1 | Power <br> supply | Battery voltage input: <br> 5.5 V Min. <br> 13.2 V Typ. <br> . <br> $32 \mathrm{~V} \mathrm{Max}$. |  | High current |
| 2 | GND |  | Power <br> supply | Ground |  |  |
| 3 | GPIO21 | I/O | $2 \mathrm{V8}$ | General Purpose Input/output | Undefined | Not mux |
| 4 | GPIO25 | I/O | 2 V 8 | General Purpose Input/output | Z | Multiplex with INT1 |

## Warning:

Both pin 3 and pin 4 are used by GPIO interface. It is strictly prohibited to connect them to any power supply at the risk of damage to the FASTRACK Supreme.

### 3.2.1.3 Sub HD 15-pin Connector

The Sub D high density 15 -pin connector is used for:

- RS232 serial link connection,
- Audio lines (microphone and speaker) connection,
- BOOT and RESET signal connection.

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5 June. 2001

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Figure 8: Sub HD 15-pin connector

Table 2: Sub HD 15-pin connector description

| Pin \# | Signal (CCITT / EIA') | I/O | VO type | Description | Comment |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | CDCD/CT109 | 0 | STANDARD RS232 | RS232 Data Carrier Detect |  |
| 2 | CTXD/CT103 | 1 | STANDARD RS232 | RS232 <br> Transmit serial data |  |
| 3 | BOOT | 1 | CMOS | Boot | This signal must not be connected. Its use is strictly reserved to Wavecom or competent retailers. |
| 4 | CMIC2P. | 1 | Analog | Microphone positive line |  |
| 5 | CMIC2N | 1 | Analog | Microphone negative line |  |
| 6 | CRXD/CT104 | 0 | STANDARD RS232 | RS232 <br> Receive serial data |  |
| 7 | CDSR/CT107 | 0 | STANDARD RS232 | $\begin{gathered} \text { RS232 } \\ \text { Data Set Ready } \end{gathered}$ |  |
| 8 | CDTR/CT108-2 | 1 | STANDARD RS232 | RS232 Data Terminal Ready |  |
| 9 | GND | - | GND | Ground |  |

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| Pin \# | Signal (CCITT / EIA) | 1/0 | 1/0 type | Description | Comment |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 10 | CSPK2P | 0 | Analog | Speaker positive line |  |
| 11 | CCTS/CT106 | 0 | STANDARD RS232 | $\begin{gathered} \text { RS232 } \\ \text { Clear To Send } \end{gathered}$ |  |
| 12 | CRTS/CT105 | 1 | STANDARD RS232 | RS232 <br> Request To Send |  |
| 13 | CRI/CT125 | 0 | STANDARD RS232 | RS232 <br> Ring Indicator |  |
| 14 | RESET | 1/0 | Schmitt | Supreme Plug \& Play reset | Active low |
| 15 | CSPK2N | 0 | Analog | Speaker negative line |  |

### 3.2.1.4 IES Connector

The IES connector is a 50 pins board-to-board connector for expanding application features like GPS, USB, I/O expander... Currently there are already 3 IESM boards available for customer to expand the FASTRACK Supreme features immediately. They are:

- IESM-GPS+USB+I/O
- IESM-GPS+USB
- IESM-USB+I/O

For detail, please refer to Document in Section 1.1.5.


For sales and support, please contact Wavecom sales/FAE or your distributor.


Figure 9: IES connector for feature expansion

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Table 3: IES Connector Description

| Pin <br> Number | Signal Name |  | $\begin{aligned} & 1 / 0 \\ & \text { type } \end{aligned}$ | Voltage | 1/0* | Reset State | Desçription | Dealing with unused pins |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Nominal | Mux |  |  |  |  |  |  |
| 1 | GND |  |  |  |  |  | Ground |  |
| 2 | GND |  |  |  |  |  | Ground |  |
| 3 | GPIO4 | COLO | C8 | GSM-1V8 | 1/0 | Pull-up | Keypad column 0 | NC |
| 4 | GPIO5 | COL1 | C8 | GSM-1V8 | 1/0 | Pull-up | Keypad column 1 | NC |
| 5 | GPIO6 | COL2 | C8 | GSM-1V8 | 1/0 | Pull-up | Keypad column 2 | NC |
| 6 | GPIO7 | COL3 | C8 | GSM-1V8 | 1/0 | Pull-up | Keypad column 3 | NC |
| 7 | VPAD-USB |  |  | VPAD-USB | 1 |  | USB Power supply input | NC |
| 8 | USB-DP |  |  | VPAD-USB | 1/0 |  | USB Data | NC |
| 9 | USB-DM |  |  | VPAD-USB | 1/0 |  | USB Data | NC |
| 10 | GSM-1V8* |  |  | GSM-1V8 | 0 |  | 1.8 V Supply Output (for GPIO pull-up only) | NC |
| 11 | GSM-2V8* |  |  | GSM-1V8 | 0 |  | 2.8 V Supply Output (for GPIO pull-up only) | NC |
| 12 | BOOT |  |  | GSM-1V8 | 1 |  | Not Used | Add a test point / a jumper/ a switch to VCC_IV8 (Pin 10) in case Download Specific mode is used (See product specification for details) |
| 13 | $\sim$ RESET |  | C4 | GSM-1V8 | 110 |  | RESET Input | NC or add a test point |
| 14 | AUX-ADC |  | A2 | Analog | 1 |  | Analog to Digital Input | Pull to GND |
| 15 | ~SPI1-CS | GPIO31 | C1 | GSM-2V8 | 0 | $Z$ | SP11 Chip Select | NC |
| 16 | SPI1-CLK | GPIO32 | C1 | GSM-2V8 | $\bigcirc$ | z | SPl1 Clock | NC |
| 17 | SPI1-I | GP1030 | C1 | GSM-2V8 | 1 | Z | SPI1 Data Input | NC |
| 18 | SPI1-10 | GPIO29 | C1 | GSM-2V8 | 1/0 | $z$ | SPI1 Data Input / Output | NC |
| 19 | SP12-CLK | GPIO32 | C1 | GSM-2V8 | $\bigcirc$ | z | SPI2 Clock | NC |
| 20 | SP12-IO | GPIO33 | C1 | GSM-2V8 | $1 / 0$ | Z | SPI2 Data Input / Output | NC |
| 21 | -SP12-CS | GPIO35 | C1 | GSM-2V8 | $\bigcirc$ | Z | SPI2 Chip Select | NC |
| 22 | SPI2-1 | GPIO34 | C1 | GSM-2V8 | 1 | Z | SPI2 Data Input | NC |
| 23 | $\begin{aligned} & \hline \text { CT104- } \\ & \text { RXD2 } \end{aligned}$ | GPIO15 | C1 | GSM-1V8 | 0 | z | Auxiliary RS232 Receive | Add a test point for firmware upgrade |
| 24 | CT103-TXD2 | GPIO14 | C1 | GSM-1V8 | 1 | z | Auxiliary RS232 Transmit | (TXD2) Pull-up to VCC_1V8 with 100 k ת and add a test point for firmware update |
| 25 | $\begin{aligned} & \text { ~CT106- } \\ & \text { CTS2 } \end{aligned}$ | GPIO16 | C1 | GSM-1V8 | $\bigcirc$ | Z | $\begin{aligned} & \text { Auxiliary RS232 Clear To } \\ & \text { Send } \end{aligned}$ | (CTS2) Add a test point for firmware update |
| 26 | $\begin{aligned} & \sim \text { CT105- } \\ & \text { RTS2 } \end{aligned}$ | GPIO17 | C1 | GSM-1V8 | 1 | Z | Auxiliary RS232 Request To Send | (RTS2) Pull-up to VCC_1V8 with $100 \mathrm{k} \Omega$ and add a test point for |

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| Pin Number | Signal Name |  | $\begin{aligned} & \text { I/O } \\ & \text { type } \end{aligned}$ | Voltagé | 1/0* | Reset State | Description | Dealing with unused pins |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Nominal | Mux |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | firmware update |
| 27 | GPIO8 | COL4 | C8 | GSM-1V8 | $1 / 0$ | Pull-up | Keypad column 4 | NC |
| 28 | GPIO26 | SCL | A1 | Open Drain | $\bigcirc$ | z | $1^{12} \mathrm{C}$ Clock | NC |
| 29 | GPIO19 |  | C1 | GSM-2V8 | 1/0 | z |  | NC |
| 30 | GPIO27 | SDA | A1 | Open Drain | $1 / 0$ | z | ${ }^{12} \mathrm{C}$ Data | NC |
| 31 | GPIO20 |  | C1 | GSM-2V8 | 1/0 | Undefined |  | NC |
| 32 | INTO | GPIO3 | C1 | GSM-1V8 | 1 | 2 | Interruption 0 Input | If INTO is not used, it should be configured as GPIO |
| 33 | GPIO23 | ** | C1 | GSM-2V8 | $1 / 0$ | $z$ |  | NC |
| 34 | GPIO22 | ** | C1 | GSM-2V8 | 1/0 | 2 |  | NC |
| 35 | $\begin{gathered} \hline \text { CT108-2- } \\ \text { DTR1 } \end{gathered}$ | GPIO41 | C1 | GSM-2V8 | 1 | $z$ | Main RS232 Data Terminal Ready | (DTR1) Pull-up to VCC_2V8 with $100 \mathrm{k} \Omega$ |
| 36 | PCM-SYNC |  |  | GSM-1V8 | 0 | Pull-down | PCM Frame Synchro | NC |
| 37 | PCM-IN |  | C5 | GSM-1V8 | 1 | Pull-up | PCM Data Input | NC |
| 38 | PCM-CLK |  |  | GSM-1V8 | 0 | Pull-down | PCM Clock | NC |
| 39 | PCM-OUT |  |  | GSM-1V8 | 0 | Pull-up | PCM Data Output | NC |
| 40 | AUX-DAC |  |  | Analog | 0 |  | Digital to Analog Output | NC |
| 41 | VCC-2V8 |  |  | VCC_2V8 | 0 |  | LDO 2.8V Supply Output | NC |
| 42 | GND |  |  |  |  |  | Ground |  |
| 43 | DC-IN |  |  | $\begin{aligned} & \text { DC-IN from } \\ & 5.5 \mathrm{~V}-32 \mathrm{VDC} \end{aligned}$ | 0 |  | DC voltage input through <br> Micro-Fit connector | NC |
| 44 | DC-IN |  |  | $\begin{aligned} & \text { DC-IN from } \\ & 5.5 \mathrm{~V} \sim 32 \mathrm{VDC} \end{aligned}$ | 0 |  | DC voltage input through Micro-Fit connector | NC |
| 45 | GND |  |  |  |  |  | Ground |  |
| 46 | 4 V |  |  | 4V | 0 |  | 4 V DC/DC converter Output | NC |
| 47 | 4 V |  |  | 4 V | 0 |  | 4V DC/DC converter Output | NC |
| 48 | GND |  |  |  |  |  | Ground |  |
| 49 | GND |  |  |  |  |  | Ground |  |
| 50 | GND |  |  |  |  |  | Ground |  |

### 3.2.2 Power supply cable



Figure 10: Power supply cable

General Presentation

| Component | Characteristics |
| :--- | :--- |
| Micro-Fit connector <br> 4 -pin | Part number: MOLEX 43025-0400 |
| Cable | Cable length: $\sim 1.5 \mathrm{~m}$ |
| Wire | Core: tinned copper $24 \times 0.2 \mathrm{~mm}$ |
|  | Section: $0.75 \mathrm{~mm}^{2}$ |

## 4 Features and Services

### 4.1 Basic Features and Services

Basic features of the FASTRACK Supreme and available services are summarized in the table below.
Table 4: Basic features of the FASTRACK Supreme

\begin{tabular}{|c|c|c|}
\hline 5itheartas \& \multicolumn{2}{|l|}{} \\
\hline Open AT \& \multicolumn{2}{|l|}{\begin{tabular}{l}
Open \(\mathrm{AT}^{28}\) programmable: \\
Native execution of embedded standard ANSI C applications, Custom AT command creation, \\
Custom application library creation, Standalone operation.
\end{tabular}} \\
\hline Standard \& \begin{tabular}{l}
\(850 \mathrm{MHz} / 900 \mathrm{MHz}\). \\
E-GSM compliant. \\
Output power: class 4 (2W). \\
Fully compliant with ETSI GSM phase \(2+\) small MS.
\end{tabular} \& \begin{tabular}{l}
\[
1800 \mathrm{MHz} / 1900 \mathrm{MHz}
\] \\
Output power: class 1 (1W). \\
Fully compliant with ETSI GSM phase \(2+\) small MS.
\end{tabular} \\
\hline GPRS

$\square$ \& \multicolumn{2}{|l|}{| Class 10. PBCCH support. |
| :--- |
| Coding schemes: CS1 to CS4. Compliant with SMG31bis. |
| Embedded TCP/IP stack. |} <br>

\hline EGPRS \& Output power: 0.5W \& Output power: 0.4W <br>

\hline | (for |
| :--- |
| FASTRACK |
| Supreme 20 only) | \& \multicolumn{2}{|l|}{| Class 10. |
| :--- |
| PBCCH support. |
| Coding schemes: MCS1 to MCS9. |
| Compliant with SMG31bis. |
| Embedded TCP/IP stack. |} <br>

\hline
\end{tabular}

|  |  |
| :---: | :---: |
| Interfaces | RS232 (V.24N.28) Serial interface supporting: <br> - Baud rate (bits/s): $300,600,1200,2400,4800,9600,19200,38400,57600$, $115200,230400,460800$ and 921600. <br> - Autobauding (bits/s): from 1200 to 921600. <br> 2 General Purpose Input/Output gates (GPIOs) available. <br> $1.8 \mathrm{~V} / 3 \mathrm{~V}$ SIM interface. <br> AT command set based on V.25ter and GSM $07.05 \& 07.07$. <br> Open $A T^{\circledR}$ interface for embedded application. <br> Open AT ${ }^{\text {® }}$ Plug-In Compatible. |
| S'Ms. | Text \& PDU. <br> Point to point (MT/MO). <br> Cell broadcast. |
| Data | Data circuit asynchronous. <br> Transparent and Non Transparent modes. <br> Up to 14.400 bits/s. <br> MNP Class 2 error correction. <br> V42.bis data compression. |
| Fax | Automatic fax group 3 (class 1 and Class 2). |
| Audio | Echo cancellation <br> Noise reduction <br> Telephony. <br> Emergency calls. <br> Full Rate, Enhanced Full Rate, Half Rate operation and Adaptive Multi-Rate (FR/EFR/HR/AMR). <br> Dual Tone Multi Frequency function (DTMF). |

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For other detailed technical characteristics, refer to Section 8.

### 4.2 Additional NEW Features

### 4.2.1 Support Additional GSM850/PCS1900 Bands

Apart from GSM900/DCS1800, the FASTRACK Supreme Plug \& Play now supports also the GSM850/PCS1900 bands. FASTRACK Supreme is fully compliant to PTCRB and FCC also.

### 4.2.2 IES Interface for Easy Expansion of Application Features

The FASTRACK Supreme Plug \& Play offers a 50 pin Internal Expansion Socket (IES) Interface accessible for customer use. It is the additional interface which is easy for customers to expand their application features without voiding the warrantee of the FASTRACK Supreme, by simply plugging in an Internal Expansion Socket Module (IESM) board through the matting connector of the IES interface.

Thanks to the flexible IES interface, customers are ready to expand the application features by plugging in the corresponding Internal Expansion Socket Module (IESM) of GPS, I/O expander..., etc.

For brief description of the interface, please refer to Section 3.2.1.4.
For technical detail, please refer to Document [11] or contact your Wavecom distributor or Wavecom FAE.

### 4.2.3 Serial Port Auto Shut Down or Improving Power Consumption

In order to save power consumption when there is no data communication between the Plug \& Play and the DTE, FASTRACK Supreme has now implement the Serial Port Auto Shut Down feature. User can activate or deactivate the Serial Port Auto Shut Down mode by simple AT-command.

For detail, please refer to Section 7.3.4.

### 4.2.4 Real Time Clock (RTC) for Saving Date and Time

The FASTRACK Supreme has now implemented the Real Time Clock for saving date and time when the Plug \& Play is unplugged from the DC power supply through the DC power cable.

For detail, please refer to Section 7.8.

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### 4.2.5 SIM Card Lock Feature

The FASTRACK Supreme has now implemented a SIM connector having a carrier with lock. This helps ensuring the user to have proper SIM card insertion and locked before proper use of GSM network.


SIM card is inserted but not locked. GSM network is not ready for use. Only emergency call 112 is possible.


SIM card is inserted and being locked properly. GSM network is ready for use.

Figure 11: SIM card lock feature

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## 5 Using the FASTRACK Supreme Plug \& Play

### 5.1 Getting Started

### 5.1.1 Mount the FASTRACK Supreme

To mount the FASTRACK Supreme on its support, bind it using the holding bridles as shown in the Figure 12 below.


Figure 12: FASTRACK Supreme mounting

For the drill template, refer to Figure 18.

### 5.1.2 Set up the FASTRACK Supreme

To set up the FASTRACK Supreme, perform the following operations:

- Insert the SIM card into the SIM card holder of the FASTRACK Supreme.
- Lock the SIM card by sliding the lever towards the SIM card.
- Connect the antenna to the SMA connector.
- Connect both sides of the serial and control cable (15-pin Sub HD connector on the FASTRACK Supreme side).
- Connect the power supply cable to the external power supply source.


## Note:

For automotive application, it is recommended to connect the $V+B A T T E R Y$ line of the FASTRACK Supreme directly to the battery positive terminal.

- Plug the power supply cable into the FASTRACK Supreme and switch on the external power supply source.
- The FASTRACK Supreme is ready to work. Refer to Section 5.10 for the description of AT commands used to configure the FASTRACK Supreme.

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### 5.1.3 Check the communication with the FASTRACK Supreme

To check the communication with the FASTRACK Supreme, do the following operations:

- Connect the RS232 link between the DTE (port COM) and the FASTRACK Supreme (DCE).
- Configure the RS232 port of the DTE as follows:
- Bits per second: 115.200 bps,
- Data bits: 8,
- Parity: None,
- Stop bits: 1 ,
- Flow control: hardware.
- Using a communication software such as a HyperTerminal, enter the AT, $\downarrow$ command. The response of the FASTRACK Supreme must be OK displayed in the HyperTerminal window.
- If the communication cannot be established with the FASTRACK Supreme, do the following:
- Check the RS232 connection between the DTE and the FASTRACK Supreme (DCE),
- Check the configuration of the port COM used on the DTE.
- Example of AT commands which can be used after getting started the FASTRACK Supreme:
- AT+CGMI : FASTRACK Supreme answer is "WAVECOM MODEM" when serial link is OK.
- AT+CPIN=XXXXX: to enter a PIN code xxxx (if activated).
- AT+CSQ: to verify the received signal strength.
- AT+CREG?: to verify the registration of the FASTRACK Supreme Plug \& Play on the network.
- ATD<phone number>;: to initiate a voice call.
- ATH: to hang up (end of call).

For further information on these AT commands and their associated parameters, refer to "AT Commands Interface Guide" [6].

### 5.1.4 Reset the FASTRACK Supreme

To reset the FASTRACK Supreme, a hardware reset signal is available on pin 14 of the Sub HD 15-pin connector (RESET).

The FASTRACK Supreme reset is carried out when this pin is low for at least $200 \mu \mathrm{~s}$.
Warning This signal has to be considered as an emergency reset only. For further details on the FASTRACK Supreme reset, refer to Section 7.7.
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### 5.2 Specific Recommendations when Using the FASTRACK Supreme on Trucks

Warning: The power supply connection of the FASTRACK Supreme must NEVER be directly connected to the truck battery.

### 5.2.1 Recommended Power Supply Connection on Trucks

All trucks have a circuit breaker on the exterior of the cabin. The circuit breaker is used for safety reasons: if a fire blazes in the trucks, (for example, on the wiring trunk) the driver may cut the current source to avoid any damage (explosion). The circuit breaker is connected to the truck ground, most often associated with the fuse box.
Most of truck circuit breakers do not cut the Positive Supply line of the battery, but cut the ground line of the later.


Figure 13: Recommended power supply connection on trucks
Figure 13 gives the recommended power supply connection where the ground connection of the FASTRACK Supreme is not directly connected to the battery but is connected after the Circuit Breaker (on the truck ground or the fuse box).

### 5.2.2 Technical Constraints on Trucks

It is highly not recommended to connect directly the power supply on the battery rather than on the circuit breaker. The FASTRACK Supreme may be damaged when starting the truck if the circuit breaker is switched OFF (in this case, the truck ground and the battery ground will be connected through the FASTRACK Supreme as shown in the figure below).


Figure 14: Example of electrical connection which may dramatically damage the FASTRACK Supreme

Figure 14 gives an example of electrical connection which may dramatically damage the FASTRACK Supreme when its ground connection is directly connected to the battery ground.
In this example, when the circuit breaker is switched OFF, the current flows through the FASTRACK Supreme and powers the electrical circuit of the truck (for example, dashboard).
Furthermore, when the Starter Engine command will be used, it will destroy the cables or the FASTRACK Supreme.
Since the internal tracks are not designed to support high current (up to 60 A when starting the truck), they will be destroyed.

### 5.3 FASTRACK Supreme Operational Status

The FASTRACK Supreme operational status is given by the red LED status located next to the SIM connector on the FASTRACK Supreme panel.
The Table 5 below gives the meaning of the various statuses available.

Table 5: FASTRACK Supreme operational status

| LED Status | LED light activity | FASTRACK Supreme Plug \& Play, status |
| :--- | :--- | :--- |
| ON | LED ON permanent | FASTRACK Supreme is switched ON but <br> not registered on the network |
|  | LED Flashing slowly | FASTRACK Supreme is switched ON and registered <br> on the network, but no communication is in progress <br> (Idle mode) |
|  | LED Flashing rapidly | FASTRACK Supreme is switched ON and <br> registered on the network, and a communication is <br> in progress |
|  | FASTRACK Supreme is switched OFF, or Flash <br> LED is disabled* by the user. |  |

* : Flash LED can be disabled by user when in Slow Standby mode in order to save power consumption. For detail, please refer to Section 7.9.


### 5.4 Echo Function Disabled

If no echo is displayed when entering an AT command, that means:

- The "local echo" parameter of your communication software (such as HyperTerminal) is disabled.
- The FASTRACK Supreme echo function is disabled.

To enable the FASTRACK Supreme echo function, enter the ATE1.
When sending AT commands to the FASTRACK Supreme by using a communication software, it is recommended:

- to disable the "local echo" parameter of your communication software (such as HyperTerminal),
- to enable the FASTRACK Supreme echo function (ATE1 command).

In a Machine To Machine communication with the FASTRACK Supreme, it is recommended to disable the FASTRACK Supreme echo function (ATEO command) in order to avoid useless CPU processing.

For further information on ATEO and ATE1 commands, refer to "AT Commands Interface Guide" [6]

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### 5.5 Verify the Received Signal Strength

The FASTRACK Supreme establishes a call only if the received signal is sufficiently strong.
To verify the received signal strength, do the following operations:

- Using a communication software such as HyperTerminal, enter the AT command AT+CSQ . The response returned has the following format: +CSQ: <rssi>, <ber> with:
- <rssi> = received signal strength indication,
- <ber> = channel bit error rate.
- Verify the <rssi> value returned using the Table 6 below.

Table 6: Values of received signal strength

| Value of received signal <br> strength indication (<rssi>) | Interpretation of the <br> received signal strength |
| :---: | :---: |
| $0-10$ | Insufficient(*) |
| $11-31$ | Sufficient(*) |
| $32-98$ | Not defined |
| 99 | No measure available |

(*) Based on general observations.
For further information on AT commands, refer to "AT Commands Interface Guide" [6].

### 5.6 Check the Pin Code Status

To check that the pin code has been entered, use a communication software such as a HyperTerminal, then enter AT+CPIN? command.

The table below gives the main responses returned:
Table 7: AT+CPIN Responses

| AT+CPIN response (*) |  |
| :---: | :--- |
| +CPIN : READY | Code PIN has been entered |
| +CPIN : SIM PIN | Code PIN has not been entered |

(*)For further information on the other possible responses and their meaning, refer to "AT Commands Interface Guide" [6].

### 5.7 Switch between EU/US Band(s)

To switch between EU/US band(s) for the FASTRACK Supreme, use a communication software such as a HyperTerminal, then enter AT+WMBS =<band> [, <param>] command.

The table below gives the commands for various band(s) selection:

Table 8: AT+WMBS Band Selection

| AT+WMBS response (*) | Interpretation |
| :---: | :--- |
| AT+WMBS $=0, x$ | Select mono band mode 850 MHz |
| AT+WMBS $=1, x$ | Select mono band mode extended 900 MHz |
| AT+WMBS $=2, x$ | Select mono band mode 1800 MHz |
| AT+WMBS $=3, x$ | Select mono band mode 1900 MHz |
| AT+WMBS $=4, x$ | Select dual band mode $850 / 1900 \mathrm{MHz}$ |
| AT+WMBS $=5, x$ | Select dual band mode extended $900 \mathrm{MHz} / 1800 \mathrm{MHz}$ |
| AT+WMBS $=6, x$ | Select dual band mode extended $900 \mathrm{MHz} / 1900 \mathrm{MHz}$ |

$\left(^{*}\right)$ For further information on the other possible responses and their meaning, refer to "AT Commands Interface Guide" [6].
Remark:
$\mathbf{x}=0$ : The Plug \& Play will have to be reset to start on specified band(s).
$\mathbf{x}=1$ : The change is effective immediately. This mode is forbidden while in communication and during Plug \& Play initialization.
Refer to "AT Commands Interface Guide" [6] for further information on AT commands.

### 5.8 Check the Band(s) Selection

To check the band selection for the FASTRACK Supreme, use a communication software such as a HyperTerminal, then enter AT+WMBS? command.

The table below gives the main responses returned:
Table 9: AT+WMBS Responses

| AT+WMBS response (*) | Interpretation |
| :---: | :--- |
| +WMBS : $0, x$ | Mono band mode 850 MHz is selected |
| +WMBS : $1, x$ | Mono band mode extended 900 MHz is selected |
| +WMBS : $2, x$ | Mono band mode 1800 MHz is selected |
| +WMBS : $3, x$ | Mono band mode 1900 MHz is selected |
| +WMBS : $4, x$ | Dual band mode $850 / 1900 \mathrm{MHz}$ are selected |
| +WMBS : $5, x$ | Dual band mode extended $900 \mathrm{MHz} / 1800 \mathrm{MHz}$ are selected |
| +WMBS : $6, x$ | Dual band mode extended $900 \mathrm{MHz} / 1900 \mathrm{MHz}$ are selected |

${ }^{*}$ *)For further information on the other possible responses and their meaning, refer to "AT Commands Interface Guide" [6].

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### 5.9 Verify the FASTRACK Supreme Network Registration

1. Make sure a valid SIM card has been previously inserted and locked in the FASTRACK Supreme SIM card holder.
2. Using a communication software such as a HyperTerminal, enter the following AT commands:
a. $\mathbf{A T}+\mathbf{C P I N}=\mathbf{x x x x}$ to enter PIN code xxxx .
b. AT+WMBS? To check the current band setting in the Plug \& Play
c. AT+WMBS =<Band $>$ [, <param>] To switch band/mode when needed
d. AT+CREG? . To ascertain the registration status.

The format of the returned response is as follows:

```
+CREG: <mode>,<stat> with:
```

- <mode> = unsolicited registration message configuration,
- <stat> = registration state .

3. Verify the state of registration according the returned value given in the table below.

Table 10: Values of network registration

| Returned Valué (*) <br> <mode>,<stat> | Network régistration |
| :---: | :--- |
| +CREG: 0,0 | No (not registered) |
| +CREG: 0,1 | Yes (registered, home network) |
| +CREG: 0,5 | Yes (registered, roaming) |

(*)For further information on the other returned values and their meaning, refer to "AT Commands Interface Guide" [6].

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If the FASTRACK Supreme is not registered, perform the following procedure:

- Check the connection between the FASTRACK Supreme and the antenna.
- Verify the signal strength to determine the received signal strength (refer to Section 5.5).

Note: For information on AT command relating to the network registration in GPRS mode, and in particular: CGREG, CGCLASS, CGATT, refer to "AT Commands Interface Guide" [6].

### 5.10 Main AT Commands for the Plug \& Play

The table below lists the main AT commands required for starting the Plug \& Play.
For other AT commands available or further information on the AT commands, refer to "AT Commands Interface Guide" [6].

Table 11: Main usual AT commands for the Plug \& Play

| Description | AT commands | FASTRACK Supreme Plug \& Play response. | Comment |
| :---: | :---: | :---: | :---: |
| Check for selected band(s) | AT+WMBS? | +WMBS:<Band>,<ResetFlag> OK | Current selected band mode is return |
| Band(s) switch | AT+WMBS $=$ <Band $>$ | OK | Band switch is accepted, Plug \& Play has to be reset for change to be effective |
|  | AT+WMBS $=<$ Band $>, 0$ | OK | Band switch is accepted, Plug \& Play has to be reset for change to be effective |
|  | AT+WMBS $=<$ Band $>, 1$ | OK | Band switch is accepted and GSMS stack restarted |
|  | AT+WMBS $=<$ Band $>$ | +CME ERROR: 3 | Band not allowed |
| Enter PIN Code | $\begin{aligned} & \text { AT+CPIN=xxxx } \\ & (x x x x=\text { PIN code }) \end{aligned}$ | OK | PIN Code accepted. |
|  |  | +CME ERROR: 16 | Incorrect PIN Code ( with + CMEE $=1$ mode) $\left({ }^{*}\right)$ |
|  |  | +CME ERROR: 3 | PIN code already entered (with + CMEE $=1$ mode) $\left({ }^{* *)}\right.$ |
| Network registration checking | AT+CREG? | +CREG: 0,1 | FASTRACK Supreme Plug \& Play registered on the network. |
|  |  | +CREG: 0,2 | FASTRACK Supreme Plug \& Play not registered on the network, registration attempt. |

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Using the FASTRACK Supreme Plug \& Play

| Description | ÂT commands | FASTRACK Supreme P̈lug <br> \& Play response | Comment |
| :---: | :---: | :---: | :---: |
|  |  | +CREG: 0,0 | FASTRACK Supreme Plug \& Play not registered on the network, no registration attempt. |
| Receiving an incoming call | ATA | OK | Answer the call. |
| Initiate a call | ATD<phone number>; <br> (Don't forget the ${ }^{;}$; » at the end for "voice» call) | OK | Communication established. |
|  |  | +CME ERROR: 11 | PIN code not entered (with +CMEE = 1 mode). |
|  |  | +CME ERROR: 3 | AOC credit exceeded or a communication is already established. |
| Initiate an emergency call | ATD112; <br> (Don't forget the $«$; » at the end for «voice» call) | OK | Communication established. |
| Communication loss |  | NO CARRIER |  |
| Hang up | ATH | OK |  |
| Store the parameters in EEPROM | AT\&W | OK | The configuration settings are stored in EEPROM. |

(1*) The command "AT+CMEE=1" switch to a mode enabling more complete error diagnostics.

### 5.11 Firmware Upgrade Procedure

The firmware upgrade procedure is used to update the firmware embedded into the FASTRACK Supreme.
That procedure consists in downloading the firmware into internal memories through the RS232 serial link available on the SUB-D 15-pin connector.
Refer to "Firmware upgrade procedure" [8] for a detailed description of this procedure.

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Troubleshooting

## 6 Troubleshooting

This section of the document describes possible problems encountered when using the FASTRACK Supreme and their solutions.
To review other troubleshooting information, refer the 'FAQs' (Frequently Asked Questions) page at www.wavecom.com or use the following link:
http://www.wavecom.com/suppor/fags.php

### 6.1 No Communication with the FASTRACK Supreme through the Serial Link

If the FASTRACK Supreme does not answer to AT commands through the serial link, refer to the table below for possible causes and solutions.

Table 12: Solutions for no connection with FASTRACK Supreme through serial link

| If the Supreme returns | then ask | Action |
| :---: | :---: | :---: |
| Nothing | Is the FASTRACK Supreme powered correctly? | Make sure the external power supply is connected to the FASTRACK Supreme and provides a voltage in the range of 5.5 V to 32 V. |
|  | Is the serial cable connected at both sides? | Check the serial cable connection |
|  | Does the serial cable follow correctly pin assignment shown in paragraph 3.2.1.2. | Connect the cable by following pin assignment given in paragraph 3.2.1.1. |
| Nothing or nonsignificant characters | Is the communication program properly configured on PC? | Ensure the setting of the communication program is fit to setting of FASTRACK Supreme. FASTRACK Supreme factory setting is: <br> Data bits $=8$ <br> Parity = none <br> Stop bits $=1$ <br> Baud = 115200 bps. <br> Flow control = hardware |
|  | is there another program interfering with the communication program (i.e. Conflict on communication port access) | Close the interfering program. |

### 6.2 Receiving "ERROR" Message

The FASTRACK Supreme returns an "ERROR" message (in reply to an AT command) in the following cases:

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- AT command syntax is incorrect: check the command syntax (refer to "AT Commands Interface Guide" [6]),
- AT command syntax is correct, but transmitted with wrong parameters:
- Enter the AT+CMEE=1 command in order to change the error report method to the verbose method, which includes the error codes.
- Enter again the AT command which previously caused the reception of "ERROR" message in order to get the Mobile Equipment error code.
When the verbose error report method is enabled, the response of the FASTRACK Supreme in case of error is as follows:
- Either +CME ERROR: <error result code>,
- Or +CMS ERROR: <error result code>.

Refer to "AT Commands Interface Guide" [6] for error result code description and further details on the AT +CMEE command.

Note: It is strongly recommended to always enable the verbose error report method to get the Mobile Equipment error code (enter AT + CMEE $=1$ command).

### 6.3 Receiving "NO CARRIER" Message

If the FASTRACK Supreme returns a "NO CARRIER" message upon an attempted call (voice or data), then refer to the table below for possible causes and solutions.

Table 13: Solutions for "NO CARRIER" message

| If the Supreme returns... | Then ask... | Action... |
| :---: | :---: | :---: |
| "NO CARRIER" | Is the received signal strong enough? | Refer to section 5.5 to verify the strength of the received signal. |
|  | Is the FASTRACK Supreme registered on the network? | Refer to section 5.9 to verity the registration. |
|  | Is the antenna properly connected? | Refer to section 8.2.7.3 for antenna requirements. |
|  | Is the band selection correction? | Refer to Section 7.2 for band switch |
| "NO CARRIER" (when trying to issue a voice communication) | Is the semicolon (;) entered immediately after the phone number in the AT command? | Ensure that the semicolon (;) is entered immediately after the phone number in the AT command. e.g. ATD\#\#\#\#\#\#; |
| "NO CARRIER" (when trying to issue a data communication) | Is the SIM card configured for data / fax calls? | Configure the SIM card for data / fax calls (Ask your network provider if necessary). |
|  | Is the selected bearer type supported by the called party? | Ensure that the selected bearer type is supported by the called party. |
|  | Is the selected bearer type supported by the network? | Ensure that the seiected bearer type is supported by the network. <br> If no success, try bearer selection type by AT command: $A T+C B S T=0,0,3$ |

If the FASTRACK Supreme returns a "NO CARRIER" message, you may have the extended error code by using AT command AT+CEER. Refer to the table below for interpretation of extended error code.

Table 14: Interpretation of extended error code

| Error Code | Diagnostic | Hint |
| :---: | :---: | :---: |
| 1 | Unallocated phone number |  |
| 16 | Normal call clearing |  |
| 17 | User busy |  |
| 18 | No user responding |  |
| 19 | User alerting, no answer |  |
| 21 | Call rejected |  |
| 22 | Number changed |  |
| 31 | Normal, unspecified |  |
| 50 | Requested facility not subscribed | Check your subscription (data subscription available?). |
| 68 | ACM equal or greater than ACMmax | Credit of your pre-paid SIM card expired. |
| 252 | Call barring on outgoing calls |  |
| 253 | Call barring on incoming calls |  |
| $\begin{gathered} 3,6,8,29,34,38, \\ 41,42,43,44,47 \\ 49,57,58,63,65 \\ 69,70,79,254 \end{gathered}$ | Network causes | See "AT Commands Interface Guide" [6] for further details or call network provider. |

Note: For all other codes, and/or details, see AT commands documentation [6].

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Functional Description

## 7 Functional Description

### 7.1 Architecture



Figure 15: Functional architecture

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Functional Description

### 7.2 EU and US Bands

### 7.2.1 General Presentation

The FASTRACK Supreme is a quad band Plug \& Play. It supports either EU bands (EGSM900/DCS1800) or US bands (GSM850/ PCS1900), depending on the band setting within the Plug \& Play. Users are free to switch between EU bands and US bands by simple AT commands when the selected bands are supported.

### 7.2.2 AT COMMAND for Bands Switch

EU/US band is easily switched/checked by AT command AT+WMBS.
For detail, please refer to Section 5.7 and 5.8 .

### 7.3 Power Supply

### 7.3.1 General Presentation

The FASTRACK Supreme is supplied by an external DC voltage ( $V+B A T T E R Y$ ) from +5.5 V to +32 V at 2.2 A.

Main regulation is made with an internal DC/DC converter in order to supply all the internal functions with a DC voltage.

Correct operation of the FASTRACK Supreme in communication mode is not guaranteed if input voltage ( $\mathrm{V}+\mathrm{BATTERY}$ ) falls below 5.5 V .

Note: The minimum input voltage specified here is at the FASTRACK Supreme input. Be careful of the input voltage decrease caused by the power cable. See paragraph 8.2.1 for more information.

### 7.3.2 Protections

The FASTRACK Supreme is protected by a $800 \mathrm{~mA} / 250 \mathrm{~V}$ fuse directly bonded on the power supply cable.
The FASTRACK Supreme is also protected against voltage over +32 V .
Filtering guarantees:

- EMI/RFI protection in input and output,
- Signal smoothing.


### 7.4 RS232 Serial Link

### 7.4.1 General Presentation

The RS232 interface performs the voltage level adaptation (V24/CMOS $\Leftrightarrow \mathrm{V} 24 \mathrm{~N} 28$ ) between the internal FASTRACK Supreme Plug \& Play (DCE) and the external world (DTE).

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The RS232 interface is internally protected (by ESD protection) against electrostatic surges on the RS232 lines.

Filtering guarantees:

- EMI/RFI protection in input and output,
- Signal smoothing.

Signals available on the RS232 serial link are:

- TX data (CT103/TX),
- RX data (CT104/RX),
- Request To Send (CT105/RTS),
- Clear To Send (CT106/CTS),
- Data Terminal Ready (CT108-2/DTR),
- Data Set Ready (CT107/DSR),
- Data Carrier Detect (CT109/DCD),
= Ring Indicator (CT125/RI).


Figure 16: RS232 Serial Link signals

RS232 interface has been designed to allow flexibility in the use of the serial interface signals. However, the use of TX, RX, CTS and RTS signals is mandatory, which is not the case for DTR, DSR, DCD and RI signals which can be not used.

### 7.4.2 Autobauding Mode

The autobauding mode allows the FASTRACK Supreme to detect the baud rate used by the DTE connected to the RS232 serial link.

Autobauding mode is controlled by AT commands. See "AT Commands Interface Guide" [6] for details on this function.

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### 7.4.3 Pin Description

| Signal | Sub HD connector <br> Pin number | I/O | I/O type <br> RS232 <br> STANDARD | Description |
| :---: | :---: | :---: | :---: | :--- |
| CTXD/CT103 | 2 | 1 | TX | Transmit serial data |
| CRXD/CT104 | 6 | 0 | RX | Receive serial data |
| CRTS/CT105 | 12 | I | RTS | Request To Send |
| CCTS/CT106 | 11 | 0 | CTS | Clear To Send |
| CDSR/CT107 | 7 | 0 | DSR | Data Set Ready |
| CDTR/CT108-2 | 8 | 1 | DTR | Data Terminal Ready |
| CDCD/CT109 | 1 | 0 | DCD | Data Carrier Detect |
| CRI/CT125 | 13 | 0 | RI | Ring Indicator |
| CT102/GND | 9 |  | GND | Ground |

### 7.4.4 Serial Port Auto shut down Feature

The UART1 can be shut down when there is no activity between the DTE and the FASTRACK Supreme Plug \& Play. This can help for improving power consumption performance.

Serial Port Auto shut down feature is easily controlled by AT command AT+WASR.

- $A T+$ WASR $=1$ for entering the serial port auto shut down mode
- AT+WASR=0 for exiting the serial port auto shut down mode

Refer to "AT Commands Interface Guide" [6] for further information on AT commands.
CAUTION: GPIO24 is reserved for serial port auto shut down feature. It is prohibited for customer use. Improper access to GPIO24 by customer may lead to unexpected behavior on UART1 performance.

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### 7.5 General Purpose Input/Output (GPIO)

The FASTRACK Supreme provides two General Purpose Input / Output lines available for external use: GPIO21 and GPIO25.

These GPIOs may be controlled by AT commands:

- AT+WIOW for a write access to the GPIO value, when the GPIO is used as an output,
- AT+WIOR for a read access to the GPIO value, when the GPIO is used as an input.

Refer to "AT Commands Interface Guide" [6] for further information on AT commands.
After reset, both GPIOs are configured as inputs. The AT+WIOM command has to be used to change this configuration (refer to "AT Commands Interface Guide" [6] for further details).

Pin description

| Signal | Power Supply <br> connector <br> (4-pin Micro-Fit) | I/O | I/O <br> VoItage | Reset <br> state | Description | Mulitplex with |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| GPIO21 | 3 | I/O | 2 V8 | Undefined | General Purpose I/O | No mux |
| GPIO25 | 4 | I/O | 2V8 | $Z$ | General Purpose I/O | INT1 |

## Notes:

- The power supply cable may need to be modified due to the GPIO signals (GPIO21 \& GPIO25) available on the 4-pin Micro-FIT connector of the FASTRACK Supreme.
- The previous generation M1306B have GPIO4 and GPIO5 being replaced by GPIO21 and GPIO25 respectively, for which both are of LOW level at reset state.


### 7.6 BOOT

This signal must not be connected. Its use is strictly reserved to Wavecom or competent retailers.
Caution: Previous generation M1306B has BOOT signal of HIGH level at 2.8 V . But the FASTRACK Supreme now of 1.8 V BOOT instead.

### 7.7 RESET

### 7.7.1 General presentation

This signal is used to force a reset procedure by providing low level during at least $200 \mu \mathrm{~s}$.
This signal must be considered as an emergency reset only. A reset procedure is automatically driven by an internal hardware during the power-up sequence.

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This signal may also be used to provide a reset to an external device. It then behaves as an output. If no external reset is necessary, this input may be left open, if used (emergency reset), it has to be driven either by an open collector or an open drain output:

- RESET pin $14=0$, for FASTRACK Supreme Reset,
- RESET pin 14 = 1, for normal mode.


## Pin description

| Signal | Sub HD 15-Pin connector <br> RESET | Pin number. | IO type | Voltage | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| RESET | 14 | $I / O$ | Open Drain | 1 V 8 | FASTRACK Supreme <br> Reset |

Caution: Previous generation M1306B has RESET signal of HIGH level at 2.8 V . But the FASTRACK Supreme now of 1.8 V RESET instead.

## Additional comments on RESET:

The RESET process is activated either by the external RESET signal or by an internal signal (coming from a RESET generator). This automatic reset is activated at Power-up.

The FASTRACK Supreme remains in RESET mode as long as the RESET signal is held low.
Caution: This signal should be used only for "emergency" reset.
A software reset is always preferred to a hardware reset.
Note: See "AT Commands Interface Guide" [6] for further information on software reset.

### 7.7.2 Reset Sequence

To activate the "emergency" reset sequence, the RESET signal has to be set to low for $200 \mu \mathrm{~s}$ minimum.
As soon as the reset is done, the AT interface answers "OK" to the application. For this, the application must send AT.」.

If the application manages hardware flow control, the AT command may be sent during the initialization phase. Another solution is to use the AT+WIND command to get an unsolicited status from the FASTRACK Supreme.

For further details, refer to AT commands "AT Commands Interface Guide" [6].

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Figure 17: Reset sequence diagram

### 7.8 Audio

Audio interface is a standard one for connecting a phone handset.
Echo cancellation and noise reduction features are also available to improve the audio quality in case of hand-free application.

### 7.8.1 Microphone Inputs

The microphone inputs are differential ones in order to reject common mode noise and TDMA noise.
They already include the convenient biasing for an electret microphone ( 0.5 mA and 2 Volts) and are ESD protected.

This electret microphone may be directly connected to these inputs allowing an easy connection to a handset.

The microphone impedance must be around $2 \mathrm{k} \Omega$.
AC coupling is already embedded in the Wireless CPU ${ }^{\oplus}$.
The gain of the microphone inputs is internally adjusted and may be tuned from 30 dB to 51 dB using an AT +VGT command (refer to AT commands documentation [6]).

Pin description

| Signal | Sub D 15゙-pin <br> Pin \# | I/O | I/O type | Descriptiọn |
| :---: | :---: | :---: | :---: | :---: |
| CMIC2P | 4 | I | Analog | Microphone positive input |
| CMIC2N | 5 | I | Analog | Microphone negative input |

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### 7.8.2 Speaker Outputs

This connection is differential to reject common mode noise and TDMA noise.
Speaker outputs are connected to internal push-pull amplifiers and may be loaded down between 32 to 150 Ohms and up to 1 nF (see details in table Speaker gain vs Max output voltage, in "AT Commands Interface Guide" [6]). These outputs may be directly connected to a speaker.
The output power may be adjusted by step of 2 dB . The gain of the speaker outputs is internally adjusted and may be tuned using an AT +VGR command (refer to AT commands documentation [6]).

Pin description

| Signal | Sub D 15-pin Pin\# | I/O | V/O type | Description |
| :---: | :---: | :---: | :---: | :---: |
| CSPK2P | 10 | 0 | Analog | Speaker positive output |
| CSPK2N | 15 | 0 | Analog | Speaker negative output |

### 7.9 Real Time Clock (RTC)

The FASTRACK Supreme has now implemented the Real Time Clock for saving date and time when the Plug \& Play is unplugged from the DC power supply through the DC power cable.

|  | Typical | Max |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Charging Time start from fully discharged to fully charged |  | . Min | Them | 940 min |
| RTC Time Period* | Guarantee |  | 2475 min |  |
|  | Non-guarantee |  | 5225 min |  |

Remark: The RTC time period is measured from the RTC battery is fully charged before being unplugged from the DC power source.

### 7.10 FLASH LED

The FASTRACK Supreme has a red LED indicator to show the status of the GSM network. For detail description of the various status, please refer to Section 5.3.
However, during operation mode of Slow Standby, there will be no network registration and so the red LED indicator will always be ON. It is possible for user to deactivate the LED indication during Slow Standby mode, in order to reduce power consumption.

The Fiash LED can be deactivated by AT command at + whenf $=1,0$
The Flash LED can be activated by AT command at + when $f=1,1$
However, the new setting will be taken into account only after a restart. For detail, please refer to Document[6].

## 8 Technical Characteristics

### 8.1 Mechanical Characteristics

Table 15: Mechanical characteristics

| Dimensions | $73 \times 54.5 \times 25.5 \mathrm{~mm}$ (excluding connectors) |
| :---: | :--- |
| Overall Dimension | $88 \times 54.5 \times 25.5 \mathrm{~mm}$ |
| Weight $\quad \because$ | $\approx 80$ grams (FASTRACK Supreme only) |
| $\because$ | $<120$ grams (FASTRACK Supreme + bridles + power supply cable) |
| Volume | $101.5 \mathrm{~cm}^{3}$ |
| Housing | Aluminum profiled |

The next page gives the dimensioning diagram of the FASTRACK Supreme including the clearance areas to take into account for the FASTRACK Supreme installation.

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Figure 18: Dimensioning diagram

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Table 16: Electrical characteristics

| Operating Voltage ránges | 5.5 V to 32 VDC. |
| :---: | :--- |
| Maximum current | 480 mA Average at 5.5 V. |
|  | 2.1 A Peak at 5.5 V . (TBC) |

## Note:

The FASTRACK Supreme is permanently powered once the power supply is connected. The following table describes the consequences of over-voltage and under-voltage with the FASTRACK Supreme.

## Warning:

All the input voltages specification described in this Section are at the FASTRACK Supreme input. While powering the FASTRACK Supreme, take into account the input drop caused by the power cable. With the delivered cable, this input drop is around 700 mV at 5.5 V and 220 mV at 32 V .

Table 17: Effects of power supply defect

| If the voltage | then |
| :--- | :--- |
| falls below 5.5 V, | the GSM communication is not guaranteed. |
| is over 32 V <br> (Transient peaks), | the FASTRACK Supreme guarantees its own protection. |
| Is over 32 V <br> (continuous overvoltage) | the protection of the FASTRACK Supreme is done by the <br> fuse (the supply voltage is disconnected). |

The fuse is a $800 \mathrm{~mA} / 250$ V FAST-ACTING $5 * 20 \mathrm{~mm}$. See Section 10 for recommended references.
The following table provides information on power consumption of the FASTRACK Supreme, assuming an operating temperature of $+25^{\circ} \mathrm{C}$ and using a 3 V SIM card.

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### 8.2.2 Power Consumption

The following table provides information on power consumption of the FASTRACK Supreme, assuming an operating temperature of $+25^{\circ} \mathrm{C}$ and using a 3 V SIM card.

Table 18: Power consumption (1*)

| Power Consumption in E-GSM 900/DCS 1800 MHz - GRRS class 10 |  |  |  | E-GSM 900 | DCS 1800. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & 5 \\ & 0 \end{aligned}$ | $I_{\text {peak }}$ | GSM900: During TX bursts @ PCL5 DCS1800 : During TX bursts @ PCLo | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  | 1 mvi | GSM900 : Average @ PCL5 DCS1800: Average @ PCLO | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  | $I_{\text {paak }}$ | GSM900: During 1TX bursts @ PCL5 DCS1800 : During 1TX bursts @ PCLO | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  | $\mathrm{I}_{\text {gvg }}$ | GSM900 : Average 1TX/1RX @PCL5 DCS1800: Average 1TX/1RX @PCLO | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
| $\begin{aligned} & \text { 을 } \\ & \text { id } \\ & \frac{0}{0} \\ & 00 \\ & \frac{0}{0} \\ & \hline 0 \end{aligned}$ | $\mathrm{I}_{\text {peak }}$ | GSM900: During 2TX bursts @ PCL5 (Gamma 3) DCS1800 : During 2TX bursts @ PCLO (Gamma 2) | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  | $I_{\text {avg }}$ | GSM900: Average 2TX/3RX @ PCL5. (Gamma 3) DCS1800 : Average 2TX/3RX © PCLO (Gamma 2) | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  | $I_{\text {poak }}$ | GSMī900: During 1TX bursts @ PCL8 (Gamma 6) DCS1800 : During 1TX bursts @ PCL2 (Gamma 5) | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  | I\% | GSM900: Average:1TX/1RX @ PCL8 (Gamma 6) DCS1800 : Average 1TXU1RX @ PCL2 (Gamma 5) | @ 5.5V | TBC | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |

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| Power Consumption in E-GSM 900/DCS 1800 MHz - GPRS class 10 |  |  |  |  | E-GSM 900 | DCS 1800 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\mathrm{I}_{\text {peak }}$ | GSM900: During 2TX bursts @ PCL8 (Gamma 6) DCS1800 : During 2TX bursts @ PCL2 (Gamma 5) |  | @ 5.5V | TBC | TBC |
|  |  |  |  | @ 13.2V | TBC | TBC |
|  |  |  |  | @ 32V | TBC | TBC |
|  |  | GSM900 : Average 2TX 3 RX @ PCL8 (Gamma 6) DCS1800 : Average 2TX13RX © PCL2 (Gammá 5) |  | @ 5.5V | TBC | TBC |
|  |  |  |  | @ 13.2V | TBC | TBC |
|  |  |  |  | @ 32V | TBC | TBC |
| $I_{\text {avg }}$ in Fast Idle mode Page 9$\left(2^{*}\right)$ |  |  | Serial port auto shut down deactivated | @ 5.5V | 33 | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
|  |  |  | Serial port auto shut down activated | @ 5.5V | 17 | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
| $I_{\text {avg }}$ in Slow Idie mode Page 9$\left(3^{*}\right)$ |  |  |  | Serial port auto shut down deactivated | @ 5.5V | 23 | TBC |
|  |  |  | @ 13.2V |  | TBC | TBC |
|  |  |  | @ 32V |  | TBC | TBC |
|  |  |  | Serial port auto shut down activated | @ 5.5V | 5 | TBC |
|  |  |  | @ 13.2V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |
| 1 avg in Fast Standby mode$\left(4^{*}\right)$ |  |  |  | Serial port auto shut down deactivated | @ 5.5V | 52 | TBC |
|  |  |  | @ 13.2V |  | TBC | TBC |
|  |  |  | @ 32V |  | TBC | TBC |
|  |  |  | Serial port auto shut down activated | @ 5.5V | 35 | TBC |
|  |  |  | @ 13.2 V | TBC | TBC |
|  |  |  | @ 32V | TBC | TBC |

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| Power Consumption in E-GSM 900/DCS 1800 MHz - GPRS class 10 |  |  | E-GSM 900 | DCS 1800 |
| :---: | :---: | :---: | :---: | :---: |
| $1{ }_{\text {avg }}$ in Slow Standby mode (with FLASH LED activated) (4*) | Serial port auto shut down deactivated | @ 5.5V | 24 | TBC |
|  |  | @ 13.2V | TBC | TBC |
|  |  | @ 32V | TBC | TBC |
|  | Serial port auto shut down activated | @ 5.5V | 8 | TBC |
|  |  | @ 13.2V | TBC | TBC |
|  |  | @ 32V | TBC | TBC |
| $I_{\text {avg }}$ in Slow Standby mode (with FLASH LED deactivated) (4*) | Serial port auto shut down deactivated | @ 5.5V | TBC | TBC |
|  |  | @ 13.2V | TBC | TBC |
|  |  | @ 32V | TBC | TBC |
|  | Serial port auto shut down activated | @ 5.5V | 4 | TBC |
|  |  | @ 13.2V | TBC | TBC |
|  |  | @ 32V | TBC | TBC |

( $1^{*}$ ): The power consumption might vary by $5 \%$ over the whole operating temperature range $\left(-20^{\circ} \mathrm{C}\right.$ to $\left.+55^{\circ} \mathrm{C}\right)$.
$\left(2^{*}\right)$ : In this Mode, the RF function is active and the FASTRACK Supreme synchronized with the network, but there is no communication.
( $3^{*}$ ): In this Mode, the RF function is disabled, but regularly activated to keep the synchronization with the network. This Mode works only when the DTE send AT command to shut down the serial link by software approach (DTE turns DTR in inactive state).
( $4^{*}$ ): In this Mode, the RF function is disabled, and there is no synchronization with the network.

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### 8.2.3 Audio Interface

The audio interface is available through the Sub HD 15-pin connector.
Table 19: Audio parameters caracteristics

| Audio parameters | Min | Typ | Max | Unit | Comments |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Microphone input current @2 $\mathrm{V} / 2 \mathrm{k} \Omega$ |  | 0.5 |  | mA |  |
| Absolute microphone input voltage |  |  | 100 | mVpp | AC voltage |
| Speaker output current $150 \Omega / / 1 \mathrm{nF}$ |  | 16 |  | mA |  |
| Absolute speaker impedance | 32 | 50 |  | $\Omega$ |  |
| Impedance of the speaker amplifier output in <br> differential mode |  |  | 1 | $\Omega$ | $+/-10 \%$ |

Table 20: Microphone inputs internal audio filter characteristics

| Frequency | Gain |
| :--- | :--- |
| $0-150 \mathrm{~Hz}$ | $<-22 \mathrm{~dB}$ |
| $150-180 \mathrm{~Hz}$ | $<-11 \mathrm{~dB}$ |
| $180-200 \mathrm{~Hz}$ | $<-3 \mathrm{~dB}$ |
| $200-3700 \mathrm{~Hz}$ | 0 dB |
| $>4000 \mathrm{~Hz}$ | $<-60 \mathrm{~dB}$ |

Table 21: Recommended characteristics for the microphone:

| Feature |  |
| :--- | :--- |
| Type | Electret $2 \mathrm{~V} / 0.5 \mathrm{~mA}$ |
| Impedance | $\mathrm{Z}=2 \mathrm{k} \Omega$ |
| Sensitivity | -40 dB to -50 dB |
| SNR | $>50 \mathrm{~dB}$ |
| Frequency response | compatible with the GSM specifications |

[^12]Pege: $65 / n$

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Table 22: Recommended characteristics for the speaker:

| Feature | Value |
| :--- | :--- |
| Type | 10 mW, electro-magnetic |
| Impedance | $\mathrm{Z}=32$ to $50 \Omega$ |
| Sensitivity | 110 dB SPL min. $(0 \mathrm{~dB}=20 \mu \mathrm{~Pa})$ |
| Frequency response | compatible with the GSM specifications |

### 8.2.4 General Purpose Input/Output

Both GPIO21 and GPIO25 may be interfaced with a component that comply with 3 Volts CMOS levels.
Table 23: Operating conditions

| Pärameter | IUO type | Min | Typ | Max | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathbf{V}_{\mathrm{IL}}$ | CMOS |  |  | 0.84 V |  |
| $\mathbf{V}_{\mathrm{IH}}$ | CMOS | 1.96 V |  |  |  |
| $\mathrm{~V}_{\mathrm{OL}}$ | CMOS |  |  | 0.4 V | $\mathrm{I}_{\mathrm{OL}}=-4 \mathrm{~mA}$ |
| $\mathrm{~V}_{\mathrm{OH}}$ | CMOS | 2.4 V |  |  | $\mathrm{I}_{\mathrm{OH}}=4 \mathrm{~mA}$ |
| $\mathrm{I}_{\mathrm{OH}}$ |  |  |  | 4 mA |  |
| $\mathrm{I}_{\mathrm{OL}}$ |  |  |  | -4 mA |  |

Clamping diodes are present on I/O pads.

### 8.2.5 SIM Interface

Table 24: SIM card characteristics

| SIM card | $1.8 \mathrm{~V} / 3 \mathrm{~V}$ |
| :---: | :--- |

8.2.6 RESET Signal

Table 25: Electrical characteristics

| Parameter | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: |
| Input Impedance (R)* |  | 330 K |  | $\mathrm{k} \Omega$ |
| Input Impedance (C) |  | 10 n |  | nF |

*Internal pull-up

Table 26: Operating conditions

| Parameter | Minimum | Typ | Maximum | Unit |
| :---: | :---: | :---: | :---: | :---: |
| ~RESET time (Rt) $^{1}$ | 200 |  |  | $\mu \mathrm{~s}$ |
| $\sim$ RESET time (Rt) ${ }^{2}$ at power up only | 20 | 40 | 100 | ms |
| Cancellation time (Ct) $^{\mathrm{V}_{\mathrm{H}}}$ |  | 34 |  | ms |
| $\mathrm{~V}_{\mathrm{IL}}$ | 0.57 |  |  | V |
| $\mathrm{~V}_{\mathrm{IH}}$ | 0 |  | 0.57 | V |

* $\mathrm{V}_{\mathrm{H}:}$ Hysterisis Voltage

1 This reset time is the minimum to be carried out on the $\sim$ RESET signal when the power supply is already stabilized.
2 This reset time is internally carried out by the Wireless CPU power supply supervisor only when the Wireless CPU power supplies are powered ON.

### 8.2.7 RF Characteristics

### 8.2.7.1 Frequency Ranges

Table 27: Frequency ranges

| Characteristic | GSM $\mathbf{8 5 0}$ | E-GSM $\mathbf{9 0 0}$ | DCS 1800 | PCS 1900 |
| :--- | :---: | :---: | :---: | :---: |
| Frequency TX | 824 to 849 MHz | 880 to 915 MHz | 1710 to 1785 MHz | 1850 to 1910 MHz |
| Frequency RX | 869 to 894 MHz | 925 to 960 MHz | 1805 to 1880 MHz | 1930 to 1990 MHz |

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### 8.2.7.2 RF Performances

RF performances are compliant with the ETSI recommendation GSM 05.05.
The RF performances for receiver and transmitter are given in the table below.
Table 28: Receiver and transmitter RF performances

|  | Receiver |  |
| :--- | :--- | :---: |
| E-GSM900/GSM850 Reference Sensitivity | -104 dBm Static \& TUHigh |  |
| DCS1800/PCS1900 Reference Sensitivity | -102 dBm Static \& TUHigh |  |
| Selectivity @ 200 kHz | $>+9 \mathrm{dBc}$ |  |
| Selectivity @ 400 kHz | $>+41 \mathrm{dBc}$ |  |
| Linear dynamic range | 63 dB |  |
| Co-channel rejection | $>=9 \mathrm{dBc}$ |  |
|  | Transmitter |  |
| Maximum output power (E-GSM 900/GSM850) <br> at ambient temperature | $33 \mathrm{dBm}+/-2 \mathrm{~dB}$ |  |
| Maximum output power (DCS1800/PCS1900) <br> at ambient temperature | $30 \mathrm{dBm}+/-2 \mathrm{~dB}$ |  |
| Minimum output power (E-GSM 900/GSM850) <br> at ambient temperature | $5 \mathrm{dBm}+/-5 \mathrm{~dB}$ |  |
| Minimum output power (DCS1800/PCS1900) <br> at ambient temperature | $0 \mathrm{dBm}+/-5 \mathrm{~dB}$ |  |

### 8.2.7.3 External Antenna

The external antenna is connected to the FASTRACK Supreme via the SMA connector.
The external antenna must fulfill the characteristics listed in the table below.
Table 29: External antenna characteristics

| Ańtenna frequency. range | Quad-band GSM 850/GSM900/DCS1800/PCS1900 MHz |
| :--- | :--- |
| Impedance | 50 Ohms nominal |
| DC impedance | 0 |
| Gain (antenna + cable) | 0 Ohm |
| VSWR (antenna + caable) | 0 dBi |

Note: Refer to Section 10 for recommended antenna.

### 8.3 Environmental Characteristics

The FASTRACK Supreme Plug \& Play is compliant with the following operating class. To ensure the proper operation of the FASTRACK Supreme, the temperature of the environment must be within a specific range as described in the table below.

Table 30: Ranges of temperature

| Conditions | Temperature range |
| :---: | :---: |
| Operating / Class A | $-20^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}$ |
| Operating / Class B | $-30^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ |
| Storage | $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ |

## Function Status Classification:

## Class A:

The FASTRACK Supreme remains fully functional, meeting GSM performance criteria in accordance with ETSI requirements, across the specified temperature range.

## Class B:

The FASTRACK Supreme remains fully functional, across the specified temperature range. Some GSM parameters may occasionally deviate from the ETSI/PTCRB specified requirements and this deviation does not affect the ability of the FASTRACK Supreme to connect to the cellular network and function fully, as it does within the Class A range.

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The detailed climatic and mechanics standard environmental constraints applicable to the FASTRACK Supreme are listed in the table below:

Table 31: Environmental standard constraints

| Environmental Tests (IEC TR 60721-4) |  | Environmental Classes <br> (IEC 60721-3) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Storage | Transportation | - | eration |
| Tests | Standards | (IEC 60721-3-1) Class [E13 | (IEC 60721-3-2) Class IE23 | Stationary (IEC 60721-3-3) Class IE35 | Non-Stationary <br> (IEC 60721-3-7) Class IE73 |
| Cold | IEC 60068-2-1 : <br> $\mathrm{Ab} / \mathrm{Ad}$ | $-25^{\circ} \mathrm{C}, 16 \mathrm{~h}$ | $-40^{\circ} \mathrm{C}, 16 \mathrm{~h}$ | $-5^{\circ} \mathrm{C}, 16 \mathrm{~h}$ | $-5^{\circ} \mathrm{C}, 16 \mathrm{~h}$ |
| Dry heat | IEC 60068-2-2 : Bb/Bd | $+70^{\circ} \mathrm{C}, 16 \mathrm{~h}$ | $+70^{\circ} \mathrm{C}, 16 \mathrm{~h}$ | $+55^{\circ} \mathrm{C}, 16 \mathrm{~h}$ | $+55^{\circ} \mathrm{C} .16 \mathrm{~h}$ |
| Change of temperature | $\begin{gathered} \text { IEC 60068-2-14 : } \\ \mathrm{Na} / \mathrm{Nb} \end{gathered}$ | $-33^{\circ} \mathrm{C}$ to ambient 2 cycles, $\mathrm{t} 1=3 \mathrm{~h}$ $1^{\circ} \mathrm{C} . \mathrm{min}^{-1}$ | $-40^{\circ} \mathrm{C}$ to ambient 5 cycles, $\mathrm{t} 1=3 \mathrm{~h}$ t2<3 min | $-5^{\circ} \mathrm{C}$ to ambient 2 cycles, $11=3 \mathrm{~h}$ $0,5^{\circ} \mathrm{C} \cdot$ min $^{-4}$ | $-5^{\circ} \mathrm{C}$ to ambient 5 cycles, $11=3 \mathrm{~h}$ t2<3 min |
| Damp heat | IEC 60068-2-56 : Cb | $\begin{gathered} +30^{\circ} \mathrm{C}, 93 \% \mathrm{RH} \\ 96 \mathrm{~h} \end{gathered}$ | $+40^{\circ} \mathrm{C}, 93 \% \mathrm{RH}$ $96 \text { h minimum }$ | $+30^{\circ} \mathrm{C}, \underset{\mathrm{~h}}{93 \%} \mathrm{RH}, 96$ | $+30^{\circ} \mathrm{C}, 93 \% \mathrm{RH}, 96 \mathrm{~h}$ |
| Säñop heat cyclic | 60068-2-30: Db Variant 1 or 2 | $+40^{\circ} \mathrm{C}, 90 \%$ to 100\% RH One cycle Variant 2 | $+55^{\circ} \mathrm{C}, 90 \%$ to $100 \% \mathrm{RH}$ <br> Two cycles Vanant 2 | $\begin{gathered} +30^{\circ} \mathrm{C}, 90 \% \text { to } 100 \% \\ \mathrm{RH} \end{gathered}$ <br> Two cycles Variant 2 | $+40^{\circ} \mathrm{C}, 90 \% \text { to } 100 \% \mathrm{RH}$ <br> Two cycles Variant 1 |
| Vibration (sinusoidal) | IEC 60068-2-6 : Fc | $\begin{gathered} 1-200 \mathrm{~Hz} \\ 2 \mathrm{~m} \cdot \mathrm{~s}^{-2} \\ 0,75 \mathrm{~mm} \\ 3 \text { axes } \\ 10 \text { sweep cycles } \end{gathered}$ | $\begin{gathered} 1-500 \mathrm{~Hz} \\ 10 \mathrm{~m} \cdot \mathrm{~s}^{-2} \\ 3,5 \mathrm{~mm} \\ 3 \text { axes } \\ 10 \text { sweep cycles } \end{gathered}$ | $\begin{gathered} 1-150 \mathrm{~Hz} \\ 2 \mathrm{~m} \cdot \mathrm{~s}^{-2} \\ 0,75 \mathrm{~mm} \\ 3 \text { axes } \\ 5 \text { sweep cycles } \end{gathered}$ | $\begin{gathered} 1-500 \mathrm{~Hz} \\ 10 \mathrm{~m} . \mathrm{s}^{-2} \\ 3,5 \mathrm{~mm} \\ 3 \text { axes } \\ 10 \text { sweep cycles } \end{gathered}$ |
| Vibration (random) | IEC 60068-2-64 : Fh | - | $\begin{gathered} 10-100 \mathrm{~Hz} / 1,0 \mathrm{~m}^{2} . \mathrm{s}^{-3} \\ 100-200 \mathrm{~Hz} /-3 \mathrm{~dB} .0 c t a v \mathrm{c}^{-1} \\ 200-2000 \mathrm{~Hz} / 0,5 \mathrm{~m}^{2} . \mathrm{s}^{-3} \\ 3 \text { axes } \\ 30 \mathrm{~min} \end{gathered}$ | - | - |
| Shock (half-sine) | IEC 60068-2-27 : Ea | - | - | $50 \mathrm{~m} . \mathrm{s}^{-2}$ <br> 6 ms <br> 3 shocks <br> 6 directions | $150 \mathrm{~m} . \mathrm{s}^{-2}$ <br> 11 ms <br> 3 shocks <br> 6 directions |
| Bump | IEC 60068-2-29 : Eb | - | $250 \mathrm{~m} . \mathrm{s}^{-2}$ 6 ms 50 bumps vertical direction | - | - |
| Free fall | ISO 4180-2 | - | Two falls in each specified attitude | - | 2 falls in each specified attitude $0,025 \mathrm{~m} \text { (<1kg) }$ |
| Drop and topple | IEC 60068-2-31 : Ec | - | One drop on relevant comer One topple about each bottorn edge | - | One drop on each relevant comer One topple on each of 4 bottom edges |

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Technical Characteristics

## Notes:

Short description of Class IE13 (For more information see standard IEC 60721-3-1)
"Locations without controlled temperature and humidity, where heating may be used to raise low temperatures, locations in buildings providing minimal protection against daily variations of external climate, prone to receiving rainfall from carrying wind".

## Short description of Class IE23 (For more information, see standard IEC 60721-3-2)

"Transportation in unventilated compartments and in conditions without protection against bad weather, in all sorts of trucks and trailers in areas of well developed road network, in trains equipped with buffers specially designed to reduce shocks and by boat".

## Short description of Class IE35 (For more information see standard IEC 60721-3-3)

"Locations with no control on heat or humidity where heating may be used to raise low temperatures, to places inside a building to avoid extremely high temperatures, to places such as hallways, building staircases, cellars, certain workshops, equipment stations without surveillance".

## Short description of Class IE73 (For more information see standard IEC 60721-3-7)

"Transfer to places where neither temperature nor humidity are controlled but where heating may be used to raise low temperatures, to places exposed to water droplets, products can be subjected to ice formation, these conditions are found in hallways and building staircases, garages, certain workshops, factory building and places for industrial processes and hardware stations without surveillance".

Warning: The specification in the above table applies to the FASTRACK Supreme product only. Customers are advised to verify that the environmental specification of the SIM Card used is compliant with the FASTRACK Supreme environmental specifications. Any application must be qualified by the customer with the SIM Card in storage, transportation and operation.

The use of standard SIM cards may drastically reduce the environmental conditions in which the Product can be used. These cards are particularly sensible to humidity and temperature changes. These conditions may produce oxidation of the SIM card metallic layers and cause, in the long term, electrical discontinuities. This is particularly true in left alone applications, where no frequent extraction/insertion of the SIM card is performed.
In case of mobility when the application is moved through different environments with temperature variations, some condensation may appear. These events have a negative impact on the SIM and may favor oxidation.
If the use of standard SIM card, with exposition to the environmental conditions described above, can not be avoided, special care must be taken in the integration of the final application in order to minimize the impact of these conditions. The solutions that may be proposed are:

- Lubrication of the SIM card to protect the SIM Contact from oxidation.
- Putting the FASTRACK Supreme Plug \& Play in a waterproof enclosure with desiccant bags.

Lubrication of the SIM card had been tested by Wavecom (using Tutela Fluid 43EM from MOLYDUVAL) and gives very good results.
If waterproof enclosure with a desiccant solution is used, check with your desiccant retailer the quantity that must be used according to the enclosure dimensions. Ensure humidity has been removed before sealing the enclosure.
Any solution selected must be qualified by the customer on the final application.
To minimize oxidation problem on the SIM card, its manipulation must be done with the greatest precautions. In particular, the metallic contacts of the card must never be touched with bare fingers or any matter which
may contain polluted materials liable to produce oxidation (such as, e.g. substances including chlorine). In case a cleaning of the Card is necessary, a dry cloth must be used (never use any chemical substance).

### 8.4 Conformity

The complete product complies with the essential requirements of article 3 of R\&TTE 1999/5/EC Directive and satisfied the following standards:

| Domain | Applicable standard |
| :--- | :--- |
| Safety standard | EN 60950 (ed.1999) |
| Efficient use of the radio frequency <br> spectrum | EN 301 419-(v 4.1.1) <br> EN 301 511 (V 7.0.1) |
| EMC | EN 301 489-1 (edition 2002) <br> EN 301 489-7 (edition 2002) |
| Global Certification Forum - Certification <br> Criteria | GCF-CC V3.13.0 |
| PTCRB |  |
| FCC |  |
| IC |  |

### 8.5 Protections

### 8.5.1 Power Supply

The FASTRACK Supreme is protected by a $800 \mathrm{~mA} / 250 \mathrm{~V}$ fuse directly bonded on the power supply cable. The model of fuse used is: FSD $800 \mathrm{~mA} / 250$ V FAST-ACTING.

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# Fastrack Supreme User Guide <br> Technical Characteristics 

### 8.5.2 Overvoltage

The FASTRACK Supreme is protected against voltage over +32 V
When input voltages exceed +32 V , the supply voltage is disconnected in order to protect the internal electronic components from an overvoltage.

### 8.5.3 Electrostatic Discharge

The FASTRACK Supreme withstands ESD according to IEC 1000-4-2 requirements for all accessible parts of the FASTRACK Supreme except the RF part:

- 8 kV of air discharge,
- 4 kV of contact discharge.


### 8.5.4 Miscellaneous

Filtering guarantees:

- EMI/RFI protection in input and output,
- Signal smoothing


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Safety recommendations

## 9 Safety recommendations

### 9.1 General Safety

It is important to follow any special regulations regarding the use of radio equipment due in particular to the possibility of radio frequency (RF) interference. Please follow the safety advice given below carefully.
Switch OFF your Wireless CPU ${ }^{\text {® }}$ :

- When in an aircraft. The use of cellular telephones in an aircraft may endanger the operation of the aircraft, disrupt the cellular network and is illegal. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both,
- When at a refueling point,
- When in any area with a potentially explosive atmosphere which could cause an explosion or fire,
- In hospitals and any other place where medical equipment may be in use.

Respect restrictions on the use of radio equipment in:

- Fuel depots,
- Chemical plants,
- Places where blasting operations are in progress,
- Any other area where signalization reminds that the use of cellular telephone is forbidden or dangerous.
- Any other area where you would normally be advised to turn off your vehicle engine.

There may be a hazard associated with the operation of your FASTRACK Supreme Plug \& Play close to inadequately protected personal medical devices such as hearing aids and pacemakers. Consult the manufacturers of the medical device to determine if it is adequately protected.

Operation of your FASTRACK Supreme Plug \& Play close to other electronic equipment may also cause interference if the equipment is inadequately protected. Observe any warning signs and manufacturers' recommendations.

The FASTRACK Supreme Plug \& Play is designed for and intended to be used in "fixed" and "mobile" applications:

- "Fixed" means that the device is physically secured at one location and is not able to be easily moved to another location.
- "Mobile" means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm ( 8 inches) is normally maintained between the transmitter's antenna and the body of the user or nearby persons.

The FASTRACK Supreme Plug \& Play is not designed for and intended to be used in portable applications (within 20 cm or 8 inches of the body of the user) and such uses are strictly prohibited.

### 9.2 Vehicle Safety

Do not use your FASTRACK Supreme Plug \& Play while driving, unless equipped with a correctly installed vehicle kit allowing 'Hands-Free' Operation.

Respect national regulations on the use of cellular telephones in vehicles. Road safety always comes first.

# Fastrack Supreme User Guide 

Safety recommendations
If incorrectly installed in a vehicle, the operation of FASTRACK Supreme Plug \& Play telephone could interfere with the correct functioning of vehicle electronics. To avoid such problems, make sure that the installation has been performed by a qualified personnel. Verification of the protection of vehicle electronics should form part of the installation.
The use of an alert device to operate a vehicle's lights or hom on public roads is not permitted.

### 9.3 Care and Maintenance

Your FASTRACK Supreme Plug \& Play is the product of advanced engineering, design and craftsmanship and should be treated with care. The suggestion below will help you to enjoy this product for many years.
Do not expose the FASTRACK Supreme Plug \& Play to any extreme environment where the temperature or humidity is high.

Do not use or store the FASTRACK Supreme Plug \& Play in dusty or dirty areas. Its moving parts (SIM holder for example) can be damaged.
Do not attempt to disassemble the Wireless CPU ${ }^{*}$. There are no user serviceable parts inside.
Do not expose the FASTRACK Supreme Plug \& Play to water, rain or spilt beverages. It is not waterproof.
Do not abuse your FASTRACK Supreme Plug \& Play by dropping, knocking, or violently shaking it. Rough handling can damage it
Do not place the FASTRACK Supreme Plug \& Play alongside computer discs, credit or travel cards or other magnetic media. The information contained on discs or cards may be affected by the Wireless CPU ${ }^{\oplus}$.
The use of third party equipment or accessories, not made or authorized by Wavecom may invalidate the warranty of the Wireless CPU
Do contact an authorized Service Center in the unlikely event of a fault in the Wireless CPU ${ }^{\otimes}$.

### 9.4 Your Responsibility

This FASTRACK Supreme Plug \& Play is under your responsibility. Please treat it with care respecting all local regulations. It is not a toy. Therefore, keep it in a safe place at all times and out of the reach of children.
Try to remember your Unlock and PIN codes. Become familiar with and use the security features to block unauthorized use and theft.

Recommended Accessories

## 10 Recommended Accessories

Accessories recommended by Wavecom for the FASTRACK Supreme are given in the table below.
Table 32: List of recommended accessories

| $\cdots \cdots$ Designation | - Part number | - Supplier |
| :---: | :---: | :---: |
| Quad-band antenna | 1140.26 | ALLGON |
|  | MA112VX00 | MAT Equipement |
|  | MCA1890 MH/PB/SMA m | HIRSCHMANN |
| SMAFFME Antenna adaptor |  | PROCOM |
| Power adaptor (Europe) | EGSTDW P2 EF9W3 24W <br> Out:12 V-2A <br> In: 100 to $240 \mathrm{~V}-50 / 60 \mathrm{~Hz}-550 \mathrm{~mA}$ <br> Mounted with micro-fit connector | EGSTDW (for power adaptor) <br> MOLEX (for micro-fit connector)* |
| Fuse | F800L250V | Shanghai Fulliness |
| IESM GPS + USB | M13SUE01 | WAVECOM |
| IESM IO + USB | M13SUE02 | WAVECOM |
| IESM IO + USB + GPS | M13SUE03 | WAVECOM |

* Information not available for this preliminary version.


## 11 Online Support

Wavecom provides an extensive range on online support which includes the following areas of Wavecom's wireless expertise:

- the latest version of this document
- new versions of our Operating System user guides
- comprehensive support for Open AT ${ }^{\text {B }}$
- regulatory certifications
- carrier certifications
- application notes

To gain access to this support, simply visit our web site at www.wavecom.com or click on the desire link in Page. Privileged access via user login is provided to Wavecom authorized distributors.

## HUMAN MACHINE INTERFACE

## 1. HUMAN MACHINE INTERFACE TECHNICAL DETAILS

## MODEL G306A - GRAPHIC COLOR LCD OPERATOR INTERFACE TERMINAL WITH TFT QVGA DISPLAY AND TOUCHSCREEN



- CONFIGURED USING CRIMSON ${ }^{8}$ SOFTWARE (BUILD 424 OR NEWER)
- UP TO 5 RS-232/422/485 COMMUNICATIONS PORTS (2 RS-232 AND 1 RS-422/485 ON BOARD, 1 RS-232 AND 1 RS422/485 ON OPTIONAL COMMUNICATIONS CARD)
- 10 BASE T/100 BASE-TX ETHERNET PORT TO NETWORK UNITS AND HOST WEB PAGES
- USB PORT TO DOWNL OAD THE UNIT'S CONFIGURATION FROM A PC OR FOR DATA TRANSFERS TO A PC
- UNIT'S CONFIGURATION IS STORED IN NON-VOLATILE MEMORY (8 MBYTE FLASH)
- COMPACTFLASH SOCKET TO INCREASE MEMORY CAPACITY
- 5.7-INCH TFT ACTIVE MATRIX 256 COLOR QVGA $320 \times 240$ PIXEL LCD
- 5-BUTTON KEYPAD FOR ON-SCREEN MENUS
- three front panel led indicators
- POWER UNIT FROM 24 VDC $\pm 20 \%$ SUPPLY
- resistive analog touchscreen


## GENERAL DESCRIPTION

The G306A Operator Interface Terminal combines unique capabilities normally expected from high-end units with a very affordable price. It is built around a high performance core with integrated functionality. This core allows the G306A to perform many of the normal features of the Paradigm range of Operator Interfaces while improving and adding new features.

The G306A is able to communicate with many different types of hardware using high-speed RS232/422/485 communications ports and Ethernet 10 Base T/100 Base-TX communications. In addition, the G306A features USB for fast downloads of configuration files and access to trending and data logging. A CompactFlash socket is provided so that Flash cards can be used to collect your trending and data logging information as well as to store larger configuration files.

In addition to accessing and controlling of external resources, the G306A allows a user to easily view and enter information. Users can enter data through the touchscreen and/or front panel 5 -button keypad.

## SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller.


The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.


WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I. DIVISION 2/CLASS II, DIVISION 2/CLASS III, DIVISION 2


CAUTION: Risk Of Danger Read complete instructions prior to installation and operation of the unit.

## CONTENTS OF PACKAGE

- G306A Operator Interface.
- Panel gasket.
- Template for panel cutout.
- Hardware packet for mounting unit into panel.
- Terminal block for connecting power.

ORDERING INFORMATION

| MODEL NO. | DESCRIPTION | PART NUMEER |
| :---: | :---: | :---: |
| G306A | Operator Interface for indoor applications, textured finish with embossed keys | G306A000 |
| G3CF | 64 MB CompactFlash Card ${ }^{5}$ | G3CF064M |
|  | 256 MB CompactFlash Card ${ }^{5}$ | G3CF256M |
|  | 512 MB CompactFlash Card ${ }^{5}$ | G3CF512M |
| G3RS | RS232/485 Optional Communication Card | G3RS0000 |
| G3CN | CANopen Optional Communication Card | G3CNOOOO |
| G3DN | DeviceNet option card for G3 operator interfaces lated high speed communications ports | G3DN0000 |
| G3PBDP | Profibus DP Optional Communication Card | G3PBDP00 |
| PSDR7 | DIN Rail Power Supply | PSDR7000 |
| SFCRM2 | Crimson $2.0{ }^{2}$ | SFCRM200 |
| CBL | RS-232 Programming Cable | CBLPROG0 |
|  | USB Cable | CBLUSB00 |
|  | Communications Cables ${ }^{1}$ | CBLxxxxx |
| DR | DIN Rail Mountable Adapter Products ${ }^{3}$ | DRxxxxxx |
|  | Replacement Battery ${ }^{4}$ | BNL20000 |
| G3FILM | Protective Films | G3FILM06 |

1 Contact your Red Lion distributor or visit our website for complete selection.
2 Use this part number to purchase the Crimson ${ }^{(8)}$ software on CD with a printed manual, USB cable, and RS-232 cable. Otherwise, download for free from www.redlion.net.
${ }^{3}$ Red Lion offers RJ modular jack adapters. Refer to the DR literature for complete details.
${ }^{4}$ Battery type is lithium coin type CR2025.
${ }^{5}$ Industrial grade two million write cycles.

## SPECIFICATIONS

1. POWER REQUIREMENTS:

Must use Class 2 or SELV rated power supply
Power connection via removable three position terminal block.
Supply Voltage: $\quad+24$ VDC $\pm 20 \%$
Typical Power: $\quad 8 \mathrm{~W}$
Maximum Power ${ }^{2}$ : 14 W
Notes:

1. Typical power with +24 VDC. RS232/485 communications, Ethernet communications, CompactFlash card installed, and display at full brightness.
2. Maximum power indicates the most power that can be drawn from the G306A. Refer to "Power Supply Requirements" under "Installing and Powering the G306A."
3. The G306A's circuit common is not connected to the enclosure of the unit. See "Connecting to Earth Ground" in the section "Installing and Powering the G306A."
4. Read "Power Supply Requirements" in the section "Installing and Powering the G306A" for additional power supply information.
5. BATTERY: Lithium coin cell. Typical lifetime of 10 years.
6. LCD DISPLAY:

| SIZE | 5.7-nch |
| :--- | :---: |
| TYPE | TFT |
| COLORS | 256 |
| PIXELS | $320 \times 240$ |
| BRIGHTNESS | $500 \mathrm{~cd} / \mathrm{m}^{2}$ |
| BACKLIGHT* | $40,000 \mathrm{HR}$ TYP. |

*Lifetime at room temperature. Refer to "Display" in "Software/Unit Operation"
4. 5-KEY KEYPAD: for on-screen menus.
5. TOUCHSCREEN: Resistive analog
6. MEMORY:

On Board User Memory: 8 Mbyte of non-volatile Flash memory
Memory Card: CompactFlash Type II slot for Type 1 and Type II CompactFlash cards.
7. COMMUNICATIONS:

USB Port: Adheres to USB specification 1.1. Device only using Type B connection.


WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND dIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.

Serial Ports: Format and Baud Rates for each port are individually software programmable up to 115,200 baud.
PGM Port: RS232 port via RJI2.
COMMS Ports: RS422/485 port via RJ45, and RS232 port via RJ12.
DH485 TXEN: Transmit enable; open collector, $\mathrm{V}_{\mathrm{OH}}=15 \mathrm{VDC}$, $\mathrm{V}_{\mathrm{OL}}=0.5 \mathrm{~V}$ @ 25 mA max.
Note: For additional information on the communications or signal common and connections to earth ground please see the "Connecting to Earth Ground" in the section "Installing and Powering the G306A."
Ethernet Port: 10 BASE-T / 100 BASE-TX
RJ45 jack is wired as a NIC (Network Interface Card).
Isolation from Ethernet network to G 3 operator interface: 1500 V rms
8. ENVIRONMENTAL CONDITIONS

Operating Temperature Range: 0 to $50^{\circ} \mathrm{C}$
Storage Temperature Range: - 20 to $70^{\circ} \mathrm{C}$
Operating and Storage Humidity: $80 \%$ maximum relative humidity (noncondensing) from 0 to $50^{\circ} \mathrm{C}$.
Vibration according to IEC 68-2-6: Operational 5 to $8 \mathrm{~Hz}, 0.8^{\prime \prime}(\mathrm{p}-\mathrm{p}), 8$ to 500 Hz , in X, Y, Z direction, duration: I hour, 3 g .
Shock according to IEC 68-2-27: Operational $40 \mathrm{~g}, 9 \mathrm{msec}$ in 3 directions. Altitude: Up to 2000 meters.
9. CERTIFICATIONS AND COMPLIANCES:

SAFETY
UL Recognized Component, File \#E179259, UL61010-1, CSA 22.2 No.61010-1 Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
UL Listed, File \#E211967, UL61010-1, UL1604, CSA 22.2 No. 61010.1, CSA 22.2 No. 213-M1987
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Indoor Enclosure rating (Face only), UL50
IECEE CB Scheme Test Certificate \#US/12460/UL
CB Scheme Test Report \#E179259-A1-CB-1
Issued by Underwriters Laboratories Inc.
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP66 Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

## Immunity to Industrial Locations:

Electrostatic discharge EN 61000-4-2 Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields
Fast transients (burst)

Surge
EN 61000-4-5 Crit $1 \mathrm{kVL}-\mathrm{L}$,

2 kV L\&N-E power
RF conducted interference
EN 61000-4-6 Criterion A
$3 \mathrm{~V} / \mathrm{mms}$
Emissions:
Emissions
Note:

1. Criterion A: Normal operation within speciffed limits.
2. CONNECTIONS: Compression cage-clamp terminal block.

Wire Gage: 12-30 AWG copper wire
Torque: 5-7 inch-pounds ( $56-79 \mathrm{~N}-\mathrm{cm}$ )
11. CONSTRUCTION: Steel rear metal enclosure with NEMA 4XIP66 aluminum front plate for indoor use only when correctly fitted with the gasket provided. Installation Category II, Pollution Degree 2.
12. MOUNTING REQUIREMENTS: Maximum panel thickness is 0.25 " (6.3 mm ). For NEMA 4X/IP66 sealing, a steel panel with a minimum thickness of $0.125^{\prime \prime}(3.17 \mathrm{~mm})$ is recommended.
Maximum Mounting Stud Torque: 17 inch-pounds ( $1.92 \mathrm{~N}-\mathrm{m}$ )
13. WEIGHT: $3.0 \mathrm{lbs}(1.36 \mathrm{Kg})$

## DIMENSIONS In inches (mm)



## Installing and Powering the G306A

## MOUNTING INSTRUCTIONS

This operator interface is designed for through-panel mounting. A panel cutout diagram and a template are provided. Care should be taken to remove any loose material from the mounting cut-out to prevent that material from falling into the operator interface during installation. A gasket is provided to enable sealing to NEMA 4X/IP66 specification. Install the ten kep nuts provided and tighten evenly for uniform gasket compression.

Note: Tightening the kep nuls beyond a maximum of 17 inch-pounds (1.92 N$m$ ) may cause damage to the front panel.


ALL NONINCENDIVE CIRCUITS MUST BE WIRED USING DIVISION 2 WIRING METHODS AS SPECIFIED IN ARTICLE 5014 (b), 502-4 (b), AND 503-3 (b) OF THE NATIONAL ELECTRICAL CODE, NFPA 70 FOR INSTALLATION WITHIN THE UNITED STATES, OR AS SPECIFIED IN SECTION $19-152$ OF CANADIAN ELECTRICAL CODE FOR INSTALLATION IN CANADA.

## CONNECTING TO EARTH GROUND



The protective conductor terminal is bonded to conductive parts of the equipment for safery purposes and must be connected to an external protective earthing system.

Each G306A has a chassis ground terminal on the back of the unit. Your unit should be connected to earth ground (protective earth).

The chassis ground is not connected to signal common of the unit. Maintaining isolation between earth ground and signal common is not required to operate your unit. But, other equipment connected to this unit may require isolation between signal common and earth ground. To maintain isolation between signal common and earth ground care must be taken when connections are made to the unit. For example, a power supply with isolation between its signal common and earth ground must be used. Also, plugging in a USB cable may connect signal common and earth ground. ${ }^{\text {l }}$
${ }^{1}$ USB's shield may be connected to earth ground at the host. USB's shield in turn may also be connected to signal common.

## POWER SUPPLY REQUIREMENTS

The G306A requires a 24 VDC power supply. Your unit may draw considerably less than the maximum rated power depending upon the options being used. As additional features are used your unit will draw increasing amounts of power. Items that could cause increases in current are additional communications, optional communications card, CompactFlash card, and other features programmed through Crimson.

In any case, it is very important that the power supply is mounted correctly if the unit is to operate reliably. Please take care to observe the following points:

- The power supply must be mounted close to the unit, with usually not more than 6 feet ( 1.8 m ) of cable between the supply and the operator interface. Ideally, the shortest length possible should be used.
- The wire used to connect the operator interface's power supply should be at least 22 -gage wire. If a longer cable run is used, a heavier gage wire should be used. The routing of the cable should be kept away from large contactors, inverters, and other devices which may generate significant electrical noise.
- A power supply with a Class 2 or SELV rating is to be used. A Class 2 or SELV power supply provides isolation to accessible circuits from hazardous voltage levels generated by a mains power supply due to single faults. SELV is an acronym for "safety extra-low voltage." Safety extra-low voltage circuits shall exhibit voltages safe to touch both under normal operating conditions and after a single fault, such as a breakdown of a layer of basic insulation or after the failure of a single component has occurred.


## Communicating With the G306A

## CONFIGURING A G306A

The G306A is configured using Crimson software. Crimson is available as a free download from Red Lion's website, or it can be purchased on CD. Updates 10 Crimson for new features and drivers are posted on the website as they become available. By configuring the G306A using the latest version of Crimson, you are assured that your unit has the most up to date feature set. Crimson ${ }^{8}$ software can configure the G306A through the RS232 PGM por, USB port, or CompaciFlash.

The USB port is connected using a standard USB cable with a Type B connector. The driver needed to use the USB port will be installed with Crimson.

The RS232 PGM port uses a programming cable made by Red Lion to connect to the DB9 COM port of your computer. If you choose to make your own cable, use the "G306A Port Pin Out Diagram" for wiring information.
The CompactFlash can be used to program a G3 by placing a configuration file and firmware on the CompactFlash card. The card is then inserted into the target G3 and powered. Refer to the Crimson literature for more information on the proper names and locations of the files.

## USB, DATA TRANSFERS FROM THE COMPACTFLASH CARD



WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.
In order to transfer data from the CompactFlash card via the USB porh a driver must be installed on your computer. This driver is installed with Crimson and is located in the folder C:IProgram FilesKRed Lion ControlstCrimson 2.00Devicel after crimson is installed. This may have already been accomplished if your G306A was configured using the USB port

Once the driver is installed, connect the G306A to your PC with a USB cabie, and follow "Mounting the CompactFlash" instructions in the Crimson 2 user manual.

## CABLES AND DRIVERS

Red Lion has a wide range of cables and drivers for use with many different communication types. A list of these drivers and cables along with pin outs is available from Red Lion's website. New cables and drivers are added on a regular basis. If making your own cable, refer to the "G306A Port Pin Outs" for wiring information.

## ETHERNET COMMUNICATIONS

Ethernet communications can be established at either 10 BASE-T or 100 BASE-TX. The G306A unit's RJ45 jack is wired as a NIC (Network Interface Card). For example, when wiring to a hub or switch use a straight-through cable, but when connecting to another NIC use a crossover cable.
The Ethernet connector contains two LEDs. A yellow LED in the upper right, and a bi-color green/amber LED in the upper left. The LEDs represent the following statuses:

| LED COLOR | DESCRIPTION |
| :--- | :--- |
| YELLOW solid | Link established. |
| YELLOW flashing | Data being transferred. |
| GREEN | 10 BASE-T Communications |
| AMBER | 100 BASE-TX Communications |

On the rear of each unit is a unique 12 -digit MAC address and a block for marking the unit with an IP address. Refer to the Crimson manual and Red Lion's website for additional information on Ethernet communications.

## RS232 PORTS

The G306A has two RS232 ports. There is the PGM port and the COMMS port. Although only one of these ports can be used for programming, both pors can be used for communications with a PLC.
The RS232 ports can be used for either master or slave protocols with any G306A configuration.
Examples of RS232 communications could involve another Red Lion product or a PC. By using a cable with RJ12 ends on it, and a twist in the cable, RS232 communications with another G3 product or the Modular Controller can be established. Red Lion part numbers for cables with a twist in them are CBLPROGO ${ }^{1}, \mathrm{CBLRLC01}{ }^{2}$, or CBLRC02 ${ }^{3}$.

G3 RS232 to a PC

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| G3: RJ12 | Name | PC: DB9 | Name |
| 4 | COMM | 1 | DCD |
| 5 | Tx | 2 | Rx |
| 2 | Rx | 3 | Tx |
|  | N/C | 4 | DTR |
| 3 | COM | 5 | GND |
|  | N/C | 6 | DSR |
| 1 | CTS | 7 | RTS |
| 6 | RTS | 8 | CTS |
|  | N/C | 9 | RI |

CONNECTING A GJOGA OPERATOR INTERFACE TO AN ICMS

${ }^{1}$ CBLPROG0 can also be used to communicate with either a PC or an ICM5.
${ }^{2}$ DB9 adapter not included, 1 foot long.
${ }^{3}$ DB9 adapter not included, 10 feet long


## RS422/485 COMMS PORT

The G306A has one RS422/485 port. This port can be configured to act as either RS422 or RS485.


Note: All Red Lion devices connect $A$ to $A$ and $B$ to $B$, except for Paradigm devices. Refer to www.redlion.net for additional information.

## Examples of RS485 2-Wire Connections

G3 to Red Lion RJ11 (CBLRLC00)
DLC, IAMS, ITMS, PAXCDC4C

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| G3: RJ45 | Name | RLC: RJ11 | Name |
| 5 | TxEN | 2 | TxEN |
| 6 | COM | 3 | COM |
| 1 | T×B | 5 | B- |
| 2 | TXA | 4 | A+ |

G3 to Modular Controller (CBLRLC05)

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| G3 | Name | Modular Controller | Name |
| 1,4 | TxB | 1,4 | TxB |
| 4,1 | RxB | 4,1 | RxB |
| 2,3 | TxA | 2,3 | TxA |
| 3,2 | RxA | 3,2 | RxA |
| 5 | TxEN | 5 | TxEN |
| 6 | COM | 6 | COM |
| 7 | TxB | 7 | TxB |
| 8 | TxA | 8 | TxA |

## DH485 COMMUNICATIONS

The G306A's RS422/485 COMMS port can also be used for Allen Bradley DH485 communications.

WARNING: DO NOT use a standard DH485 cable to connect this port to Allen Bradley equipment. A cable and wiring diagram are available from Red Lion.

G3 to AB SLC 500 (CBLAB003)

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| RJ45: RLC | Name | RJ45: A-B | Name |
| 1 | T×B | 1 | A |
| 2 | T×A | 2 | B |
| 3,8 | R×A | - | 24 V |
| 4,7 | R×B | - | COMM |
| 5 | TxEN | 5 | TxEN |
| 6 | COMM | 4 | SHIELD |
| 4,7 | T×B | - | COMM |
| 3,8 | T×A | - | $24 V$ |

## Software/Unit Operation

## CRIMSON ${ }^{\circledR}$ SOFTWARE

Crimson software is available as a free download from Red Lion's website or it can be purchased on a CD, see "Ordering Information" for part number. The latest version of the software is always available from the website, and updating your copy is free.

## DISPLAY

This operator interface uses a liquid crystal display (LCD) for displaying text and graphics. The display utilizes a cold cathode fluorescent tube (CCFL) for lighting the display. The CCFL tubes can be dimmed for low light conditions.
These CCFL tubes have a limited lifetime. Backlight lifetime is based upon the amount of time the display is turned on at full intensity. Turning the backlight off when the display is not in use can extend the lifetime of your backlight. This can be accomplished through the Crimson ${ }^{\text {s }}$ software when configuring your unit.

## FRONT PANEL LEDS

There are three front panel LEDs. Shown below is the default status of the LEDs.

| LED |
| :--- |
| RED (TOP, LABELED "PWR')  <br> FLASHING Unit is in the boot loader, no valid configuration is loaded. ${ }^{1}$ <br> STEADY Unit is powered and running an application. <br> YELLOW (MIDDLE)  <br> OFF no CompactFlash card is present. <br> STEADY Valid CompactFlash card present. <br> FLASHING <br> RAPIDLY CompactFlash card being checked. <br> FLICKERING Unit is writing to the CompactFlash, either because it is storing <br> data, or because the PC connected via the USB port has <br> locked the drive. ${ }^{2}$ <br> FLASHING Incorrectly formatted CompactFlash card present. <br> SLOWLY  <br> GREEN (BOTTOM)  <br> FLASHING A tag is in an alarm state. <br> STEADY Valid configuration is loaded and there are no alarms present. |

t The operator interface is shipped without a configuration. After downloading a configuration, if the light remains in the flashing state continuously, try cycling power. If the LED still continues to flash, try downloading a configuration again.
${ }^{2}$ Do not turn off power to the unit while this light is flickering. The unit writes data in two minute intervals. Later Microsoft operating systems will not lock the drive unless they need to write data; Windows 98 may lock the drive any time it is mounted, thereby interfering with logging. Refer to "Mounting the CompactFlash" in the Crimson 2 User Manual.

## TOUCHSCREEN

This operator interface utilizes a resistive analog touchscreen for user input. The unit will only produce an audible tone (beep) when a touch on an active touchscreen cell is sensed. The touchscreen is fully functional as soon as the operator interface is initialized, and can be operated with gloved hands.

## KEYPAD

The G306A keypad consists of five keys that can be used for on-screen menus.

## TROUBLESHOOTING YOUR G306A

If for any reason you have trouble operating, connecting, or simply have questions conceming your new G306A, contact Red Lion's technical support For contact information, refer to the back page of this bulletin for phone and fax numbers.

## BATTERY \& TIME KEEPING



WARNING - EXPLOSION HAZARD - THE AREA MUST BE KNOWN TO BE NON-HAZARDOUS BEFORE SERVICING/ REPLACING THE UNIT AND BEFORE INSTALLING OR REMOVING I/O WRING AND BATTERY


> WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN DISCONNECTED AND THE AREA IS KNOWN TO BE NON-HAZARDOUS.

A battery is used to keep time when the unit is without power. Typical accuracy of the G306A time keeping is less than one minute per month drift. The battery of a G306A unit does not affect the unit's memory, all configurations and data is stored in non-volatile memory.


CAUTION: RISK OF ELECTRIC SHOCK
The inverter board, attached to the mounting plate, supplies the high voltage to operate the backlight. Touching the inverter board may result in injury to personnel.


CAUTION: The circuit board contains static sensitive components. Before handling the operator interface without the rear cover attached, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the operator interface at a static controlled clean workstation. Also, do not touch the surface areas of the circuit board. Dirt, oil, or other contaminants may adversely affect circuit operation.
To change the batery of a G306A, remove power, cabling, and then the rear cover of the unit. To remove the cover, remove the four screws designated by the arrows on the rear of the unit. Then, by lifting the top side, hinge the cover, thus providing clearance for the connectors on the bottom side of the PCB as shown in the illustration below. Install in the reverse manner.


Remove the old battery* from the holder and replace with the new battery. Replace the rear cover, cables, and re-apply power. Using Crimson or the unit's keypad, enter the correct time and date.

* Please note that the old battery must be disposed of in a manner that complies with your local waste regulations. Also, the battery must not be disposed of in fire, or in a manner whereby it may be damaged and its contents come into contact with human skin.

The batrery used by the G306A is a lithium ype CR2025.


## Optional Features and Accessories

## OPTIONAL COMMUNICATION CARD

Red Lion offers optional communication cards for fieldbus communications. These communication cards will allow your G306A to communicate with many of the popular fieldbus protocols.

Red Lion is also offering a communications card for additional RS232 and RS422/485 communications. Visit Red Lion's website for information and availability of these cards.

## CUSTOM LOGO

Each G3 operator interface has an embossed area containing the Red Lion logo. Red Lion can provide custom logos to apply to this area. Contact your distributor for additional information and pricing.


## COMPACTFLASH SOCKET

CompactFlash socket is a Type 11 socket that can accept either Type 1 or 11 cards. Use cards with a minimum of 4 Mbytes and a maximum of 2 Gbytes with the G306A's CompactFlash socket. Cards are available at most computer and office supply retailers.

CompactFlash can be used for configuration transfers, larger configurations, data logging, and trending.

the CompactFlash card while
power is applied. Refer to
"Front Panel LEDs."
Information stored on a CompactFlash card by a G306A can be read by a card reader attached to a PC. This information is stored in IBM (Windows ${ }^{8}$ ) PC compatible FAT 16 file format.

## NOTE

For reliable operation in all of our products, Red Lion recommends the use of SanDisk ${ }^{\text {® }}$ and SimpleTech brands of CompactFlash cards.

Industrial grade versions that provide up to two million write/erase cycles minimum are available from Red Lion.

## LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited 10 two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.
The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buryer, its empioyees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safery Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.
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## LOAD BREAK SWITCH

## 1. SLB SERIES LOAD BREAK SWITCH TECHNICAL DETAILS

## SLB Standard load-break switches

COMO M 20 to 100 A


The COMO M range of load-break switches offer compact IP 20 finger safe solutions for switching up to and including 100 A . They are ideal for the arduous switching of motors.

Standard mounting is by DIN rail or base mount with screws.
The COMO M comes complete with direct mount handle, or pistol handles and shaft. Fourth pole and auxiliary switching can also be achieved with easy clip-on modules - refer accessories.

Front operated surface mount
(Supplied with direct or external handle)
AC 22400 V AC $23400 \mathrm{~V} \quad$ AC 23400 V



5LB 63... 100


## SLB Standard load-break switches <br> SIRCO 125 to 4000 A




SLB 125... 630

The SIRCO range of load-break switches offer compact solutions for switching from 125 A to 4000 A . Base mounting is standard.

The SIRCO range are a proven, reliable design that more than suit harsh Australian conditions.
The switches come complete with extended shaft and door mountable pistol grip handle.
Available in three and four pole versions with a large range of accessories to choose from.
Front operated surface mount
(Supplied with external handle and shaft)

|  | AC 21400 V <br> (A) | AC 23400 V <br> (A) | $\begin{aligned} & \text { AC } 23400 \mathrm{~V} \\ & (\mathrm{~kW}) \end{aligned}$ | No. of poles ${ }^{1}$ ) | Cat. No. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 125 A | 125 | 125 | 63 | 3 | SLB 125 3P |
|  |  |  |  | 4 | SLB 125 4P |
| 160 A | 160 | 160 | 80 | 3 | SLB 160 3P |
|  |  |  |  | 4 | SLB 160 4P |
| 200 A | 200 | 200 | 100 | 3 | SLB 200 3P |
|  |  |  |  | 4 | SLB 200 4P |
| 250 A | 250 | 250 | 132 | 3 | SLB 250 3P |
|  |  |  |  | 4 | SLB 250 4P |
| 315 A | 315 | 315 | 160 | 3 | SLB 315 3P |
|  |  |  |  | 4 | SLB 315 4P |
| 400 A | 400 | 400 | 220 | 3 | SLB 400 3P' |
|  |  |  |  | 4 | SLB 400 4P |
| 500 A | 500 | 400 | 280 | 3 | SLB 500 3P |
|  |  |  |  | 4 | SLB 500 4P |
| 630 A | 630 | 500 | 280 | 3 | SLB 630 3P |
|  |  |  |  | 4 | i) SLB 630 4P |
| $800 \mathrm{~A}$ | 800 | 800 | 450 | 3 | SLB 800 3P |
|  |  |  |  | 4 | 1) SLB 800 4P' |

Notes: ${ }^{1}$ ) 6 and 8 pole switches available on indent. Refer NHP.
(i) Availabte on indent only.


SLB 800... 3150

## SLB Standard load-break switches <br> SIRCO 125 to 4000 A (cont'd)



The SIRCO range of load-break switches offer compact solutions for switching from 125 A to 4000 A . Base mounting is standard.


SLB 800... 3150

The SIRCO switches come complete with extended shaft and door mountable pistol grip handle. Available in three and four pole versions with a large range of accessories to choose from.

## Front operated surface mount

(Supplied with external handle and shaft)

| 1000 A | AC 21400 V <br> (A) | AC 23400 V <br> (A) | AC 23400 V (kW) | No. of poles ${ }^{1}$ ) | Cat. No. |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1000 | 1000 | 560 | 3 | $\because$ SLB 1000 3P |
|  |  |  |  | 4 | (i)SLB 10004 P |
| 1250 A | 1250 | 1000 | 560 | 3 | $\because S L B 12503$ P |
|  |  |  |  | 4 | S SLE 1250 4P |
| 1600 A | 1600 | 1000 | 560 | 3 | SLB 1600'3P |
|  |  |  |  | 4 | [1] SLB 1600 4P. |
| 1800 A | 1800 | 1000 | 560 | 3 | SLB 1800 3P |
|  |  |  |  | 4 | i) SLB 1800 4P |
| $2000 \mathrm{~A}$ | 2000 | 1250 | 710 | 3 | SLB 2000 3P |
|  |  |  |  | 4 | i) SLB 2000 4P |
| $2500 \text { A }$ | 2500 | 1250 | 710 | 3 | SLB 2500 3P |
|  |  |  |  | 4 | - SLE 2500 4P |
| 3150 A | 3150 | 1250 | 710 | 3 | SLB 3150 3P |
|  |  |  |  | 4 | - Sti 3150 4P. |
| $4000 A$ | 4000 | 1250 | 710 | 3 | SLB 4000 3P ${ }^{\text {2 }}$ |
|  |  |  |  | 4 | (1)SLB $40004 \mathrm{P}^{2}$ ) |

Notes: ') 6 and 8 pole switches available on indent. Refer NHP.
${ }^{2}$ ) Supplied with $2 \mathrm{~N} / 0$ and $2 \mathrm{~N} / \mathrm{C}$ auxiliaries as standard. i Available on indent only.


SLB 4000

Technical data and dimensions (mm)
COMO M SLB 20 to 100 A

COMO M 20 to 40 A


COMO M 63 to 100 A


COMO M Selector handle door drilling


COMO M Pistol handle door drilling


# Technical data and dimensions (mm) 

## SIRCO SLB 125 to 2500 A

SIRCO 125 to 2500 A




| Rating | Switch body |  | Switch mounting |  | $T$ | Connection terminals |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| A | F 3p | F 4p | M 3p | M 4p |  | U | $v$ | Y | X 1 | $\times 2$ | 2 | AA |
| 800 | 280 | 360 | 255 | 335 | 80 | 50 | 60.5 | 7 | 47.5 | 47.5 | 46.5 | 321 |
| 1000 | 280 | 360 | 255 | 335 | 80 | 50 | 60.5 | 7 | 47.5 | 47.5 | 46.5 | 321 |
| 1250 | 372 | 492 | 347 | 467 | 120 | 90 | 44 | 8 | 53.5 | 53.5 | 47.5 | 288 |
| 1600 | 372 | 492 | 347 | 467 | 120 | 90 | 44 | 8 | 53.5 | 53.5 | 47.5 | 288 |
| 1800 | 372 | 492 | 347 | 467 | 120 | . 90 | 44 | 8 | 53.5 | 53.5 | 47.5 | 288 |



| $\begin{array}{c}\text { Rating } \\ \text { A }\end{array}$ | A |
| :---: | :---: |
| 2000 | 372 |
| 2500 | 372 |


Castell Drilling

 Overall dimensions | $3 p$ | Overall dimensions |
| :---: | :---: |
| 72 |  |
| 72 |  |

Switch mounting

|  | M 4p |
| :--- | :--- |
|  | 467 |
|  | 467 |



天 faconn

## Technical data and dimensions (mm)

## SIRCO SLB 3150 to 4000 A

SIRCO 3150 A


Castell Drilling


| Rating <br> A | A 3p | Overall dimensions | M | M 3pitch mounting |
| :--- | :---: | :---: | :---: | :---: | :---: |
| 3150 | 372 | 492 | 347 | 467 |

SIRCO 4000 A

Castell Drilling


| Rating | Overall dimensions |  | Switch body |  | Switch mounting |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| A | A 3p | A 4p | F 3p | F 4p | M 3p | M 4p |
| 4000 | 684 | 804 | 470 | 590 | 347 | 467 |

## SIRCO Connection terminals - 800 to 4000 A




1250-1800 A


2000-2500 A


3150-4000 A

NHP
Technical data and ratings chart

## COMO M SLB 20 to 100 A

Ratings to AS 3947-3 and IEC 60947-3

|  |  |  | 20 A | 25 A | 32 A | 40 A | 63 A | 80 A | 100 A |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rated insulation voltage and rated operation voltage AC 20/DC 20 |  | V | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| Rated impulse withstand voltage |  | kV | 8 | 8 | 8. | 8 | 8 | 8 | 8 |
| Rated operational current |  |  |  |  |  |  |  |  |  |
| AC 21A | 400 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
|  | 500 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
|  | 690 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
| AC 22 A | 400 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
|  | 500 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
|  | 690 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
| AC23A | 400 V | A | 20 | 25 | 32 | 40 | 63 | 80 | 80 |
|  | 500 V | A | 16 | 20 | 25 | 32 | 50 | 63 | 63 |
|  | 690 V | A | 16 | 20 | 20 | 20 | 50 | 50 | 50 |
| Rated operational current |  |  |  |  |  |  |  |  |  |
| DC 21A | 400 V | A |  |  |  |  |  |  |  |
|  | 500 V | A |  |  |  |  |  |  |  |
| DC 22A | 400 V | A | Refer NHP |  |  |  |  |  |  |
|  | 500 V | A |  |  |  |  |  |  |  |
| DC 23A | 400 V | A |  |  |  |  |  |  |  |
|  | 500 V | A |  |  |  |  |  |  |  |
| Operational power |  |  |  |  |  |  |  |  |  |
| AC 23A | 400 V | kW | 9 | 11 | 15 | 18.5 | 30 | 40 | 40 |
|  | 500 V | kW | 9 | 11 | 15 | 18.5 | 33 | 40 | 40 |
|  | 690 V | kW | 11 | 15 | 15. | 15 | 45 | 45 | 45 |
| Overload capacity |  |  |  |  |  |  |  |  |  |
| Short time withstand current Icw $\text { (RMS 1s) } 690 \mathrm{~V}$ |  | kA | 1.25 | 1.26 | 1.26 | 1.26 | 1.5 | 1.5 | 1.5 |
| Breaking capacity <br> AC 23A | 400 V | A | 160 | 200 | 256 | 320 | 504 | 640 | 640 |
| Fuse protected short circuit withstand. (kA RMS prospective) | 400 V AC | kA | 50 | 50 | 50 | 50 | 25 | 25 | 25 |
|  | Fuse | A | 20 | 25 | 32 | 40 | 63 | 80 | 100 |
| Mechanical endurance |  | Ops | 100000 | 100000 | 100000 | 100000 | 30000 | 30000 | 30000 |
| Weight (3 pole) |  | Kg | 0.13. | 0.13 | 0.13 | 0.13 | 0.25 | 0.25 | 0.25 |
| Min. tightening torque |  | Nm | $?$ | 2 | ? | 2 | 4 | 4 | 4 |
| Connection cable size |  | $\mathrm{mm}^{2}$ | 2.5/16 | 2.5/16 | 4/16 | 6/16 | 16/50 | 16/50 | 25/50 |

Note: $240 / 415 \mathrm{~V}$ ratings suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038: 2000.


## Technical data and ratings chart

SIRCO SLB 125 to 630 A

Ratings to AS 3947-3 and IEC 60947-3

|  |  |  | 125 A | 160 A | 200 A | 250 A | 315 A | 400 A | 500 A | 630 A |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rated insulation voltage and rated operation voltage AC 20/DC 20 |  | V | 800 | 800 | 800 | 800 | 1000 | 1000 | 1000 | 1000 |
| Rated impulse withstand voltage |  | kV | 8 | 8 | 8 | 8 | 12 | 12 | 12 | 12 |
| Rated operational current |  |  |  |  |  |  |  |  |  |  |
| AC 21A | 400 V | A | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 |
|  | 500 V | A | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 |
|  | 690 V | A | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 500 |
| AC 22A | 400 V | A | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 |
|  | 500 V | A | 125 | 125 | 200 | 250 | 315 | 400 | 500 | 500 |
|  | 690 V | A | - | - | - | 125 | 250 | 250 | 250 | 315 |
| AC23A | 400 V | A | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 500 |
|  | 500 V | A | 100 | 100 | 160 | 200 | 315 | 315 | 315 | 315 |
|  | 690 V | A | - | - | - | 100 | 160 | 160 | 160 | 160 |
| Rated operational current |  |  |  |  |  |  |  |  |  |  |
| DC 21A | 400 V | A | 125 | 160 | 160 | 250 | 315 | 400 | 400 | 630 |
|  | 500 V | A | 125 | 125 | 160 | 200 | 315 | 400 | 400 | 500 |
| DC 22A | 400 V | A | 125 | 160 | $160^{\circ}$ | 200 | 315 | 400 | 400 | 500 |
|  | 500 V | A | 125 | 125 | 160. | 200 | 315 | 315 | 315 | 500 |
| DC 23A | 400 V | A | 125 | 125 | 160 | 200 | 315 | 400 | ! 400 | 500 |
|  | 500 V | A | 125 | 125 | 160 | 200 | 315 | 400 | ,400 | 500 |
| Operational power |  |  |  |  |  |  |  |  |  |  |
| AC 23A | 400 V | kW | 63 | 80 | 100 | 132 | 160 | 220 | 280 | 280 |
|  | 500 V | kW | 63 | 63 | 110 | 140 | 220 | 220 | 220 | 220 |
|  | 690 V | kW | 55 | 55 | 75 | 90 | 150 | 150 | 150 | 150 |
| Overload capacity |  |  |  |  |  |  |  |  |  |  |
| Short time withstand current Icw $\text { (RMS 1s) } 690 \mathrm{~V}$ |  | kA | 7 | 7 | 9 | 9 | 13 | 13 | 13 | 13 |
| Breaking capacity AC 23A | 400 V | A | 1000 | 1280 | 1600 | 2000 | 2520 | 3200 | 4000 | 4000 |
| Fuse protected short circuit withstand. (kA RMS prospective) | 400 V AC | kA | 100 | 100 | 80 | 50 | 100 | 100 | $100^{\circ}$ | 70 |
|  | Fuse | A | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 |
| Rated capacitor power |  | kVAr | 55 | 75 | 90 | 115 | 145 | 185 | 230 | 290 |
| Mechanical endurance |  | Ops | 10000 | 10000 | 10000 | 10000 | 15000 | 5000 | 5000 | 5000 |
| Weight (3 pole) |  | Kg | 1 | 1.5 | 2 | 2 | 3.5 | 3.5 | 3.5 | 3.5 |
| Min. tightening torque |  | Nm | 6.5 | 6.5 | 10 | 10 | 15.4 | 14.5 | 14.5 | 14.5 |
| Connection cable size |  | $\mathrm{mm}^{2}$ | 35/50 | 50/95 | 70/95 | 95/150 | 150/240 | 185/240 | 240/240 | $2(150 / 300)$ |

Note: $240 / 415 \mathrm{~V}$ ratings suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038: 2000.

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NHP

## Technical data and ratings chart <br> SIRCO SLB 800 to 4000 A

Ratings to AS 3947-3 and IEC 60947-3

|  |  | 800 A | 1000 A | 1250 A | 1600 A | 1800 A | 2000 A | 2500 A | 3150 A | 4000 A |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rated insulation voltage and rated operation voltage AC 20/DC 20 | V | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Rated impulse withstand voltage | kV | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Rated operational current |  |  |  |  |  |  |  |  |  |  |
| AC 21A | A | 800 | 1000 | 1250 | 1600 | 1600 | 2000 | 2500 | 3150 | 3150 |
|  | A | 800 | 1000 | 1250 | 1600 | 1600 | 2000 | 2500 | 3150 | 3150 |
|  | A | 800 | 1000 | 1000 | 1600 | 1600 | 2000 | 2000 | 2000 | 2000 |
| AC 22A | A | 800 | 1000 | 1250 | 1250 | 1250 | 2000 | 2000 | 2500 | 2500 |
|  | A | 800 | 1000 | 1000 | 1250 | 1250 | 1600 | 1600 | 2000 | 2000 |
|  | A | 800 | 630 | 630 | 800 | 800 | 1000 | 1000 | 1000 | 1000 |
| AC 23A | A | 800 | 1000 | 1000 | 1000 | 1000 | 1250 | 1250 | 1250 | 1250 |
|  | A | 630 | 800 | 800 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
|  | A | 200 | 400 | 400 | 500 | 500 | 800 | 800 | 800 | 800 |
| Rated operational current |  |  |  |  |  |  |  |  |  |  |
| DC 21A | A | 800 | 1000 | 1250 | 1600 | 1600 | 2000 | 2000 | 2000 | 2000 |
|  | A | 630 | 1000 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 |
| DC 22A | A | 800 | 1000 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 |
|  | A | 800 | 1000 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 |
| DC 23A | A | 800 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
|  | A | 800 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Operational power |  |  |  |  |  |  |  |  |  |  |
| AC 23A | kW | 450 | 560 | 560 | 560 | 560 | 710 | 710 | 710 | 710 |
|  | kW | 450 | 560 | 560 | 710 | 710 | 710 | 1710 | 710 | 710 |
|  | kW | 185 | 400 | 400 | 475 | 4775 | 750 | 750 | 750 | 750 |
| Overload capacity |  |  |  |  |  |  |  |  |  |  |
| Short time withstand current $\text { Icw (RMS 1s) } 690 \mathrm{~V}$ | kA | 26 | $35^{\text {1 }}$ ) | 50 | 50 | 50 | 50 | 50 | 55 | 70 |
| Breaking capacity $400 \mathrm{~V}$ <br> AC 23A | A | 6400 | 8000 | 8000 | 8000 | 8000 | 10000 | 10000 | 10000 | 10000 |
| Fuse protected short circuit withstand. (kA RMS prospective) | kA | 50 | 100 | 100 | 100 | 100 | 100 | 100 | - | - |
|  | A | 800 | 1000 | 1250 | $2 \times 800$ | $2 \times 800$ | 2×1000 | $2 \times 1000$ | - | - |
| Rated capacitor power | kVAri | 365 | 460 | 575 | - | $=$ | - | - | - | - |
| Mechanical endurance | Ops | 4000 | 4000 | 4000 | 3000 | 3000 | 3000 | 2500 | 2500 | 2500 |
| Weight (3 pole) | Kg | 8 | 10.5 | 10.5 | 16 | 17 | 31 | 32 | 42 | 90. |
| Min. tightening torque | Nm | 37 | 37 | 37 | 50 | 50 | 60 | 160 | 60 | 110 |
| Connection cable size | $\mathrm{mm}^{1}$ | 2 (185/300) | 2240/4 185 | 4185 max | 6240 max | - | - | + | - |  |

Notes: り 50 kA switch available in larger frame size. Refer NHP.
240/415 V ratings suitable for use on 230/400 V in accordance with AS 60038:2000.

## LEVEL TRANSMITTER

## 1. LEVEL TRANSMITTER TECHNICAL DETAILS



Technical Information

## Waterpilot FMX167

## Hydrostatic level measurement

Reliable and robust level probe with ceramic measuring cell Compact device for level measurement in fresh water, wastewater and saltwater


## Application

The Waterpilot FMX167 is a pressure sensor for hydrostatic level measurement.
Three versions of FMX167 are available at Endress+Hauser:

- FMX167 with a stainless stee! housing, outer diameter of $22 \mathrm{~mm}(0.87$ inch): Standard version suitable for drinking water applications and for use in bore holes and wells with small diameters
- FMX167 with a stainless steel housing, outer diameter of 42 mm ( 1.00 inch): Heavy duty version, easy clean flush-mounted process diaphragm. Ideally suited to wastewater and sewage treatment plants
- FMX167 with a coated housing, outer diameter of 29 mm ( 1.15 inch): Corrosion resistant version generally for use in saltwater, particularly for ship ballast water tanks.


## Your benefits

- High mechanical resistance to overload and aggressive media
- High-precision, robust ceramic measuring cel with long-term stability
- Climate proofed sensor thanks to completely potted electronics and 2 -filter pressure compensation system
- 4 to 20 mA output signal with integrated overvoltage protection
- Simultaneous measurement of level and temperature with optionally integrated Pt100 temperature sensor
- Drinking water approvals: KTW, NSF, ACS
- Approvals: ATEX, FM and CSA
- Marine certificate: GL, ABS
- Extensive range of accessories provides complete measuring point solutions


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Function and system design
Device selection

| Waterpilot FMX 167 |  |  |  |
| :---: | :---: | :---: | :---: |
| Field of application | Hydrostatic level measurement in deep wells e.g. drinking water | Hydrostatic level measurement in wastewater | Hydrostatic level measurement in saltwater |
|  | $\}$ Caution! <br> The Waterpilot is not suitable for use in biogas plants since the gases can diffuse through the elastomers (seals, extension cable). Endress+Hauser offers the Deltapilot level transmitter for biogas applications. |  |  |
| Process connection | - Mounting clamp <br> - Extension cable mounting screw with G1 $1 / 2$ A or $11 / 2$ NPT thread |  |  |
| Outer diameter | 22 mm (0.87") | 42 mm (1.65*) | Max. 29 mm (1.14*) |
| Extension cable | - PE extension cable <br> - PUR extension cable <br> - FEP extension cable |  |  |
| Seals | - FKM Viton <br> - EPDM ${ }^{1 /}$ | - FKM Viton | - FKM Viton <br> - EPDM |
| Measuring ranges | - Nine fixed pressure measuring ranges in bar, $\mathrm{mH}_{2} \mathrm{O}$, psi and $\mathrm{ft}_{2} \mathrm{O}$, from 0 to 0.1 bar to 0 to 20 bar (0 to $1 \mathrm{mH}_{2} \mathrm{O}$ to 0 to $200 \mathrm{mH}_{2} \mathrm{O}$ / 0 to 1.5 psi to 0 to $300 \mathrm{psi} / \mathrm{O}$ to $3 \mathrm{ftH}_{2} \mathrm{O}$ to 0 to $600 \mathrm{ft}_{2} \mathrm{O}$ ) <br> - Customer-specific measuring ranges; factory-calibrated |  | - Seven fixed pressure measuring ranges in bar, $\mathrm{mH}_{2} \mathrm{O}$, psi and $\mathrm{ftH}_{2} \mathrm{O}$, from 0 to 0.1 bar to 0 to 4 bar 10 to $1 \mathrm{mH}_{2} \mathrm{O}$ to 0 to $40 \mathrm{mH}_{2} \mathrm{O} /$ 0 to 1.5 psi to 0 to $60 \mathrm{psi} /$ 0 to $3 \mathrm{ftH}_{2} \mathrm{O}$ to 0 to $150 \mathrm{ft}_{2} \mathrm{O}$ ) <br> - Customer-specific measuring ranges; factory-calibrated |
| Overioad | Up to 40 bar ( 580 psi ) |  | Up to 25 bar ( 362 psi) |
| Process temperature | -10 to $+70^{\circ} \mathrm{C}\left(14\right.$ to $\left.158^{\circ} \mathrm{F}\right)$ |  | 0 to $+50^{\circ} \mathrm{C}\left(32\right.$ to $\left.122^{\circ} \mathrm{F}\right)$ |
| Ambient temperature range | -10 to $+70^{\circ} \mathrm{C}\left(14\right.$ to $\left.158^{\circ} \mathrm{F}\right)$ |  | 0 to $+50^{\circ} \mathrm{C}\left(32\right.$ to $\left.122^{\circ} \mathrm{F}\right)$ |
| Maximum measured error | $\pm 0.2$ \% of upper range value (URV) |  |  |
| Supply voltage | 10 to 30 V DC |  |  |
| Output | 4 to 20 mA |  |  |
| Options | - Drinking water approval |  |  |
|  | - Integrated Pt 100 temperature sensor <br> - Integrated Pt100 temperature sensor and TMT181 temperature head transmitter (4 to $20 \mathrm{~mA} / \mathrm{HART}$ ) <br> - Marine approval |  |  |
| Specialties | - Large selection of approvals, including ATEX II $2 \mathrm{G}, \mathrm{FM}$ and CSA <br> - High-precision, robust ceramic measuring cell with long-term stability <br> - Customer-specific cable marking |  |  |

1) Recommended for drinking water applications, not suitable for use in hazardous areas

The ceramic measuring cell is a dry measuring cell, i.e. pressure acts directly on the robust ceramic process isolating diaphragm of the Waterpilot.
Any changes in the air pressure are routed through the extension cable, via a pressure compensation tube, to the rear of the ceramic process isolating diaphrapm and compensated for. A pressure-dependent change in capacitance caused by the movement of the process isolating diaphragm is measured at the electrodes of the ceramic carrier. The electronics conver the movement into a pressure-proportional signal which is linear to the medium level


## Measuring principle

1 Ceramic measuring cell
2 Pressure compensation tube
Total pressure $=$ hydrostatic pressure + atmospheric pressure
$\rho$ Density of the medium
g Gravitational acceleration
Phydr. Hydrostatic pressure
Patm Atmospheric pressure

## Temperature measurement with optional Pt100 ${ }^{1}$

Endress+Hauser also offers the Waterpilot FMX167 with an optional 4-wire Pt100 resistance thermometer to measure level and temperature simultaneously. The Pt100 belongs to Accuracy Class B in accordance with DIN EN 00751 , see also $\rightarrow$ 22, Sect. "Accessories.

Temperature measurement with optional Pt100 and TMT181 temperature head transmitter
To convert the Pt 100 signal to a 4 to 20 mA signal, Endress + Hauser also offers the TMT181 temperature transmitter.

[^13]
## Measuring system

The complete standard measuring system consists of Waterpilot and a transmitter power supply unit with supply voltage of 10 to 30 V DC.

Possible measuring point solutions with a transmitter and evaluation units from Endress+Hauser:


Application examples with FMX167
OVP $=$ Overvoltage protection e.g. HAW from Endress + Hauser (not for use in hazardous areas)

- OVP on the sensor side for field installation: HAW569/for top-hat rail/DINrail: HAW562
- OVP on the supply side for top-hat rail/DINrail: HAW561 (115/230 V) and HAW561K ( $24 / 48 \mathrm{~V}$ AC/DC) Option dependent on supply voltage.

1. Simple cost-effective measuring point solution: Power supply of Waterpilot in hazardous and nonhazardous areas using RN22IN active bartier.
Power supply and additional control of two consumers, e.g. pumps, via limit switch RTA421 with onsite display.
2. Evaluation unit RIA45 (for panel mounting) provides a power supply system, an onsite display and two switch outputs.
3. If several pumps are used, the pump service life can be prolonged by alternate switching. With altemating pump control, the pump which was out of service for the longest period of time is switched on. The evaluation unit RIA452 (for panel mounting) provides this option in additional to several other functions.
4. State-of-the-art recording technology with graphic display recorders from Endress+Hauser, such as Ecograph T, Memograph M, or paper recorders such as Alphalog for documenting, monitoring, visualizing and archiving purposes.


Application examples with FMX167
OVP = Overvoltage protection e.g. HAW from Endress+Hauser (not for use in hazardous areas)

- OVP on the sensor side for field installation: HAW569/for top-hat rail/DINrail: HAW562
- OVP on the supply side for top-hat rail/DINrail: HAW561 (115/230 V) and HAW561K (24/48 V AC/DC)

Option dependent on supply voltage.
5. If you want to measure, display and evaluate the temperature as well as the level, e.g. to monitor temperature in fresh water to detect temperature limits for germ formation, you have the following options:
The optional TMT181 temperature head transmitter can convert the Ptl00 signal to a 4 to 20 mA HART signal and transfer it to any common evaluation unit. The RMA421, RIA45 and RIA452 evaluation units also offer a direct input for the Ptl00 signal.
6. If you want to record and evaluate the level and temperature measured value with one device, use the PMAA422, RIA45 and RIA46 evaluation units with two inputs. It is even possible to mathematically link the input signals with this unit. These evaluation units are not HART-compatible.

The device can be fitted with a tag name, see $\rightarrow 21 \mathrm{ff}$, "Ordering information", feature 995 "Marking" version " 1 ".

## Input

| Measured variable | FMX107 + Pt100 (optional) <br> - Hydrostacic pressure of a liquid <br> - P1100: Temperature of a liquid |  | TMT181 temperature (optional) <br> - Temperature | head transmitter |
| :---: | :---: | :---: | :---: | :---: |
| Measuring range | - Nine fixed pressure measuring ranges in bar, $\mathrm{mH}_{2} \mathrm{O}$, psi and $f \mathrm{H}_{2} \mathrm{O}$; $\rightarrow 21$, "Ordering information" Section <br> - Customer-specific measuring ranges; factory-calibrated <br> - Temperature measurement from -10 to $+70^{\circ} \mathrm{C}$ (optional with Pt100) |  |  |  |
|  | Sensor measuring range <br> bar (psi) | Lowest span that can be calibrated <br> bar (psi) | Maximum overload/OPL ${ }^{1)}$ <br> bar (psi) | Vacuum resistance <br> barasa $_{\text {asa }}$ (psia) |
|  | 0.1 (1.5) | 0.01 (0.15) | 5.0 (73) | 0.3 (4.3) |
|  | 0.2 (3) | 0.02 (0.29) | 5.0 (73) | 0.3 (4.3) |
|  | $0.4(0)$ | 0.04 (0.58) | 7.0 (101) | 0 |
|  | 0.6 (10) | 0.06 (0.87) | 10.0 (150) | 0 |
|  | 1.0 (15) | 0.1 (1.5) | 10.0 (150) | 0 |
|  | 2.0 (30) | 0.2 (3) | 18.0 (261) | 0 |
|  | 4.0 (00) | 0.4 (6) | 25.0 (362) | 0 |
|  | $10.0{ }^{2)}$ (150) | 1.0 (15) | 40.0 (580) | 0 |
|  | $20.0^{21}$ (300) | 2.0 (30) | 40.0 (580) | 0 |

1) OPL: overpressure limit, depending on the weakest element, in terms of pressure, of the selected components
2) These measuring ranges are not offered for the probe version with a coated housing, outer diameter $29 \mathrm{~mm}\left(1.14^{*}\right)$.

| Input signal | FMX107 + Pt100 (optional) | TMT181 temperature head transmitter <br> (optional) |
| :--- | :--- | :--- |
|  | - Change in capacitance |  |
| - Pt100: change in resistance |  |  |

## Output




FMX167 load chart for estimating the load resistance. Additional resistances, such as the resistance of the extension cable, have to be subtracted from the value calculated as shown in the equation.


Temperature head transmitter load chart for estimating the load resistance. Additional resistances have to be subtracted from the value calculated as shown in the equation.

## Power supply

Measuring unit electrical connection

Note!

- When using the measuring device in hazardous areas, installation must comply with the applicable national standards and regulations and the Safety Instructions (XAs) or the Installation or Control Drawings (ZDs), see also $\rightarrow$ 23, Sect. "Safety instructions", "Installation/Control Drawings".
- Reverse polarity protection is integrated in the Waterpilot FMX167 and in the temperature head transmitter TMT181. Changing the polarities will not result in the destruction of the devices.
- The cable must end in a dry room or a sultable terminal box. For installation outside, use the terminal box (IP 60/IP 67) with a GORE-TEX ${ }^{\text {® }}$ filter from Endress+Hauser. The terminal box can be ordered using the order code of the FMX167 $\rightarrow$ 21, Sect. "Ordering information") or as an accessory Accessories (order number: 52006252).

Waterpilot FMX167, standard


FMX 167 electrical connection, versions " 7 " or " 3 " for Feature 70 "Additional options" in the order code $(\rightarrow 21)$. "4" for Feature 70 "Additional options" in the order code $(\rightarrow$ 21).
(i) Not for FMX 167 with outer diameter 29 mm ( 1.15 in)

Waterpilot FMX 167 with Pt100 and TMT181 temperature head transmitter TMT181) ( 4 to 20 mA )


FMX167 with Pt100 and TMT181 temperature head transmitter ( 4 to 20 mA ),
version " 5 " for Feature 70 in the order code $(\rightarrow 21)$.
(1) Not for FMX167 with outer diameter 29 mm ( 1.14 in )

Wire colors: $R D=$ red, $\mathrm{BK}=$ black, $\mathrm{WH}=$ white, $\mathrm{YE}=$ yellow, $\mathrm{BU}=$ blue, $\mathrm{BR}=$ brown


| Accuracy |  |  |
| :---: | :---: | :---: |
| Reference operating conditions | FMX167 + PII00 (optional) <br> DIN EN $60770 \mathrm{~T}_{\mathrm{U}}=25^{\circ} \mathrm{C}\left(77^{\circ} \mathrm{F}\right)$ | TMT181 temperature head transmitter (optional) <br> Calibration temperature $23^{\circ} \mathrm{C} \pm 5 \mathrm{~K}\left(73^{\circ} \mathrm{F} \pm 5 \mathrm{~K}\right)$ |
| Maximum measured error | FMX167 + Pt100 (optional) <br> - Non-linearity including hysteresis and nonrepeatability as per DIN EN 60770: $\pm 0.2 \%$ of upper range value (URV) <br> - Pt100:-max. $\pm 0.7 \mathrm{~K}$ <br> (Class B to DIN EN 60751). | TMT181 temperature head transmitter (optional) <br> - $\pm 0.2 \mathrm{~K}$ <br> - With Pt100: max. $\pm 0.9 \mathrm{~K}$ |
| Long-term stability | FMX167 + Pt100 (optional) <br> $\pm 0.1 \%$ of the upper range limit (URL) per year | TMT181 temperature head transmitter (optiona) $\leq 0.1 \mathrm{~K}$ per year |
| Influence of medium temperature | - Thermal change in zero signal and output span for typical application temperature range 0 to $+30^{\circ} \mathrm{C}\left(+32\right.$ to $\left.+86^{\circ} \mathrm{F}\right)$ : $\pm 0.4 \%( \pm 0.5 \%)^{*}$ of the upper range limit (URL) <br> - Thermal change in zero signal and output span for the entire medium temperature range -10 to $+70^{\circ} \mathrm{C}\left(+14\right.$ to $\left.+158^{\circ} \mathrm{F}\right)$ : $\pm 1.0 \%( \pm 1.5 \%)^{*}$ of the upper range limit (URL) <br> - Temperature coefficient ${ }_{\mathrm{x}}$ ) of zero signal and output span: $0.15 \% / 10 \mathrm{~K}(0.3 \% / 10 \mathrm{~K})^{*}$ of the uppes range limit (URL) <br> * Specificalions for sensors 0.1 bar $\left(1 \mathrm{mH}_{2} \mathrm{O}, 1.5 \mathrm{psi}, 3 \mathrm{fH}_{2} \mathrm{O}\right)$ and $0.6 \mathrm{bar}(6$ |  |
| Warm-up period | $\begin{aligned} & \text { FMX167 + Pt100 (optional) } \\ & 20 \mathrm{~ms} \end{aligned}$ | TMT181 temperature head transmitter (optional) 45 |
| Rise time | FMX167 + Pt100 (optional) <br> - FMX167: 80 ms <br> - Ptl00: 160 s | - |
| Setting time | FMX167 + Pt100 (optional) <br> - FMX167: 150 ms <br> - Pti00: 300 s | - |

Installation conditions
Installation instructions


Installation examples, here shown with FMX 167 with an outer diameter 22 mm

$$
\begin{aligned}
& \text { Extension cable mounting screw can be ordered via order code or as an accessory, } \rightarrow 21 \mathrm{ff} \\
& \text { Terminal housing can be ordered using the order code or as an accessory } \rightarrow 21 \\
& \text { Extension cable bending radius }>120 \mathrm{~mm} \\
& \text { Mounting clamp can be ordered via order code or as an accessory, } \rightarrow 21 \mathrm{ff} \\
& \text { Extension cable, cable length } \rightarrow 18 \\
& \text { Guide pipe } \\
& \text { Additional weight can be ordered as an accessory with an outer diameter of } 22 \mathrm{~mm} \text { and } 29 \mathrm{~mm}\left(0.87^{\prime \prime} \text { and } 1.14^{\text {n }}\right) \text {, } \\
& \vec{~} 22 \\
& \text { Protection cap }
\end{aligned}
$$

## Ǹote!

- Sideways movement of the level probe can result in measuring errors. For this reason, install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least $1 \mathrm{~mm}\left(0.04{ }^{\prime \prime}\right)$ larger than the outer diameter of the selected FMX167.
- The cable must end in a dry room or a suitable terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation.
- Protection cap: The device is provided with a protection cap to prevent mechanical damage to the measuring cell. This cap should not be removed during the transportation and installation process.
- Endress+Hauser recommends using twisted, shielded cables for any further wiring.


## Environment

| Ambient temperature range | FMX $167+$ Pt100 (optional) | TMT181 temperature head transmitter (optional) |
| :---: | :---: | :---: |
|  | - FMX167 with outer diameter of $22 \mathrm{~mm}\left(0.87^{\prime \prime}\right)$ and $42 \mathrm{~mm}\left(1.65^{\mathrm{\prime}}\right)$ : -10 to $+70^{\circ} \mathrm{C}\left(14\right.$ to $\left.158^{\circ} \mathrm{F}\right)=$ medium (emperatue) <br> - FMX167 with outer diameter of $29 \mathrm{~mm}\left(1.14^{\prime \prime}\right)$ : 0 to $+50^{\circ} \mathrm{C}\left(32\right.$ to $\left.122^{\circ} \mathrm{F}\right)=$ medium temperature) | -40 to $+85^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+185^{\circ} \mathrm{F}\right)$ |
|  | Terminal box |  |
|  | -40 to $+80^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+176^{\circ} \mathrm{F}\right)$ |  |


| Storage temperature range | FMX167 + Pt100 (optional) $-40 \text { to }+80^{\circ} \mathrm{C}\left(-40 \text { to }+176^{\circ} \mathrm{F}\right)$ <br> Terminal box $-40 \text { to }+80^{\circ} \mathrm{C}\left(-40 \text { to }+176^{\circ} \mathrm{F}\right)$ | TMT181 temperature head transmitter (optional) $-40 \text { to }+100^{\circ} \mathrm{C}\left(-40 \text { to }+212^{\circ} \mathrm{F}\right)$ |
| :---: | :---: | :---: |
| Degree of protection | FMX167 + Pt100 (optional) <br> - IP 68 (NEMA OP), permanently hermetically sealed <br> - Optional terminal box: IP $60 /$ IP 67 (NEMA 4X) | TMT181 temperature head transmitter (optional) <br> - IP 00, moisture condensation permissible <br> - When mounted in the optional terminal boxes: IP 60/IP67 (NEMA 4X) |
| Electromagnetic compatiblity (EMC) | FMX167 + Pt100 (optional) <br> - Interference emission to EN 01326 Class B equipment, interference immunity to EN 01326 Appendix A (Industria) <br> - Maximum deviation $<0.5 \%$ of the span. | TMT181 temperature head transmitter (optional) <br> - Interference emission to EN 61326 Class 8 equipment, interference immunity to EN 01326 Appendix A (Industrial) |
| Overvoltage protection | FMX167 + Pt100 (optonal) <br> Integated overvoltage protection to EN 61000-4-5 ( 500 V symmetrical/ 1000 asymmetrical) Install overvoltage protection $\geq 1.0 \mathrm{kV}$, extemal if necessary | TMT181 temperature head transmitter (optional) <br> Instadl overvoltage protection, external if necessary. |

## Process conditions

| Medium temperature range | FMX167 $+\mathrm{Pt100}$ (optional) | TMT181 temperature head transmitter (optional) |
| :--- | :--- | :--- |
|  | - FMX167 |  |
|  | with outer diameter of $22 \mathrm{~mm}\left(0.87^{\prime \prime}\right)$ and | -40 to $+85^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+185^{\circ} \mathrm{F}\right)=$ ambient temperature, <br> install temperature head transmitter outside medium. |
|  | $42 \mathrm{~mm}\left(1.65^{\prime \prime}\right):$ |  |
|  | -10 to $+70^{\circ} \mathrm{C}\left(14\right.$ to $\left.158^{\circ} \mathrm{F}\right)$ |  |
|  | - FMX167 with outer diameter of $29 \mathrm{~mm}\left(1.14^{\prime \prime}:\right.$ |  |
|  | 0 to $+50^{\circ} \mathrm{C}\left(32\right.$ to $\left.122^{\circ} \mathrm{F}\right)$ |  |

## Medium temperature limits

## FMX167 + Pt100 (optional)

- FMX167
with outer diameter of $22 \mathrm{~mm}\left(0.87^{\prime \prime}\right)$ and 42 mm (1.65")
-20 to $+70^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+158^{\circ} \mathrm{F}\right)$
- FMX167 with outer diameter of 29 mm ( $1.14^{\prime \prime}$ ): 0 to $+50^{\circ} \mathrm{C}$ ( 32 to $122^{\circ} \mathrm{F}$ )
(You may operate the FMX167 in this temperature range. The specification can then be exceeded, e.g measuring accuracy).

Mechanical construction
Dimensions of the level probe


Versions of FMX167
FMX167, version " A " or "D" for Feature 30 "Probe tube" in the order code $\left(\begin{array}{ll}\rightarrow & 21)\end{array}\right.$
FMX167. version "B" for Feature 30 "Probe tube" in the order code $(\rightarrow \quad 21)$
FMX167, version "C" for Feature 30 "Probe tube" in the order code $\left(\begin{array}{ll}\rightarrow & 21)\end{array}\right.$
Pressure compensation tube
Extension cable
Protection cap

Dimensions of the mounting clamp


Mounting clamp, version " 2 " for Feature 20 "Connection" in the order code ( $\rightarrow 2$ 21)

Dimensions of the extension cable mounting screws


Extension cable mounting screws
Extension cable mounting screw GI $1 / 2 \mathrm{~A}$, version " 3 " for Feature 20 "Connection" in the order code ( $\rightarrow$ 21) Extension cable mounting screw $11 / 2$ NPT, version " 4 " for Feature 20 "Connection" in the order code $(\rightarrow 21)$

Note!
Application in unpressurized containers only.

## Dimensions of the terminal

 box IP 66/IP 67 with filter

Terminal box
Version "3", "4" or "5" for Feature 70 "Additional options" in the order code $(\rightarrow$ 21)
Dummy plug M 20×1.5
GORE-TEX ${ }^{\otimes}$ filter
Terminals for 0.08 to $2.5 \mathrm{~mm}^{2}$

Dimensions of the TMT181 temperature head transmitter


TMT181 temperature head transmitter ( 4 to 20 mA )
Version "5" for Feature 70 "Additional options" in the order code ( $\rightarrow$ 21). The temperature head transmitter can be used in non-hazardous areas and for EEx nA.

Terminal box with integrated TMT181 temperature head transmitter


|  | Note! <br> A distance of $>7 \mathrm{~mm}\left(0.27{ }^{\prime \prime}\right)$ must be maintained between the terminal strip and the TMT181 temperature head transmitter. |
| :---: | :---: |
| Weight | - Level probe, outer diameter $22 \mathrm{~mm}(0.87 \mathrm{c}): 290 \mathrm{~g}(0.6 \mathrm{lb})$ <br> - Level probe, outer diameter $42 \mathrm{~mm}\left(1.65^{\prime \prime}\right): 1150 \mathrm{~g}(2.5 \mathrm{lb})$ <br> - Level probe, outer diameter $29 \mathrm{~mm}\left(1.14^{\prime \prime}\right): 340 \mathrm{~g}(0.7 \mathrm{lb})$ <br> - PE extension cable: $52 \mathrm{~g} / \mathrm{m}$ ( $1.80 \mathrm{oz} / 3 \mathrm{ft}$ ) <br> - PUR extension cable: $00 \mathrm{~g} / \mathrm{m}(2.1 \mathrm{oz} / 3 \mathrm{ft})$ <br> - FEP extension cable: $108 \mathrm{~g} / \mathrm{m}(3.8 \mathrm{oz} / 3 \mathrm{ft})$ <br> - Mourting clamp: $170 \mathrm{~g}(0.4 \mathrm{lb})$ <br> - Extension cable mounting screw G $1 / 1 / 2 \mathrm{~A}: 770 \mathrm{~g}$ ( 1.7 lb ) <br> - Extension cable mounting screw $11 / 2$ NPT: 724 g ( 1.6 lb ) <br> - Terminal box: $235 \mathrm{~g}(0.5 \mathrm{lb})$ <br> - Temperature head transmitter TMT181: $40 \mathrm{~g}(0.08 \mathrm{lb})$ <br> - Additional weight: $300 \mathrm{~g}(0.7 \mathrm{lb})$ <br> - Testing adapter: $39 \mathrm{~g}(1.4 \mathrm{lb})$ |


| Material | Level probe <br> - Level probe, outer diameter $22 \mathrm{~mm}\left(0.87^{\prime \prime}\right): 1.4435$ (AISI 316L SS) <br> - Level probe, outer diameter 42 mm (1.65"): 1.4435 (AISI 316L SS) <br> - Level probe, outer diameter 29 mm (1.14"): 1.4435 (AISI 316LSS) <br> - Sensor sleeve: PPS (polyphenylene sulfide) <br> - Heat-shrink sleeve/cover: Polyolefin <br> Metai does not come into contact with the medium. <br> - Process ceramic: $\mathrm{Al}_{2} \mathrm{O}_{3}$ aluminum oxide ceramic <br> - Seal (internal): EPDM or Viton <br> - Protection cap: <br> - PE-HD (high-density polyethylene) for FMX167 with outer diameter $22 \mathrm{~mm}\left(0.87{ }^{\prime \prime}\right)$ and 29 mm (1.14"). <br> - PFA (perfluoroalkoxy) for FMX167 with outer diameter 42 mm (1.05"). <br> - Extension cable insulation: Either PE-LD (low-density polyethylene), FEP (fluorinated ethylene propylene) or PUR (polyurethane). For more information, see $\rightarrow$ 18, "Extension cable" <br> - Mounting clamp: 1.4404 (AISI 316L SS) and fiberglass reinforced PA (polyamide) <br> - Extension cable mounting screw G $11 / 2 \mathrm{~A}: 1.4301$ (AISI 304 SS) <br> - Extension cable mounting screw I 1/2NPT: 1.4301 (AISI 304 SS) <br> - Terminal box: PC (polycarbonate) <br> - Temperature head transmitter TMT181: PC housing (polycarbonate) |
| :---: | :---: |
| Extension cable | PE extension cable <br> - Abrasion-resistant extension cable with Dynema strain-relief members; shielded with aluminum-coated film; insulated with polyethylene (PE), black; copper wires, twisted <br> - Pressure compensation tube with Teflon filter |
|  | PUR extension cable <br> - Abrasion-resistant extension cable with Dynema strain-relief members; shielded with aluminum-coated film; insulated with polyurethane (PUR), black; copper wires, twisted <br> - Pressure compensation tube with Teflon filter |
|  | FEP extension cable <br> - Abrasion-resistant extension cable; shielded with galvanized steel wire netting; insulated with fluorinated ethylene propylene (FEP), black; copper wires, twisted <br> - Pressure compensation tube with Teflon filter |
|  | Cross-section of PE/PUR/FEP extension cable <br> - Total outer diameter: $8.0 \mathrm{~mm}\left(0.31^{\prime \prime}\right) \pm 0.25 \mathrm{~mm}\left(0.001^{\prime \prime}\right)$ <br> - FMX167: $3 \times 0.227 \mathrm{~mm}^{2}\left(0.0004^{\prime \prime}\right)+$ pressure compensation tube with Teflon filter <br> - FMX167 with Pt100 (optional): $7 \times 0.227 \mathrm{~mm}^{2}\left(0.0004^{\prime \prime}\right)+$ pressure compensation tube with Teflon filter <br> - Pressure compensation tube with Teflon filter: <br> Outer diameter 2.5 mm ( 0.1 inch), internal diameter 1.5 mm ( 0.06 inch) |
|  | Cable resistance of PE/PUR/FEP extension cable <br> - Cable resistance per wire: $\leq 0.09 \Omega / \mathrm{m}$ |
|  | Cable length of PE/PUR/FEP extension cable <br> - Please refer also to $\rightarrow$ 8, Sect. "Load". <br> - Cable length that can be ordered <br> - Customer-specific length in meters or feet ( $\rightarrow$ 21, "Ordering information") <br> - Limited cable length when performing installation with freely suspended device with extension cable mounting screw or mounting clamp, as well as for Ex approval: max. 300 m ( 984 ft ). <br> - When using the measuring device in hazardous areas, installation must comply with the applicable national standards and regulations and the Safety Instructions (XAS) or the Installation or Control Drawings (ZDs). See also $\rightarrow 23$, "Safety instructions" and "Installation/Control Drawings" Sections. |
|  | Further technical data of PE /PUR/FEP extension cable <br> - Minimum bending radius: 120 mm ( $4.7^{\prime \prime}$ ) <br> - Tensile strength: max. $950 \mathrm{~N}(214 \mathrm{lbf})$ <br> - Cable extraction force: typical $\geq 450 \mathrm{~N} / 101 \mathrm{lbf}$ (FE, FEP) / typical $\geq 150 \mathrm{~N} / 34 \mathrm{lbf}$ (PUR) (The extension cable could be extracted from the level probe with a appropriate tensile force.) <br> - Resistance to UV light <br> - PE: Approved for use with drinking water |
| Terminals | - Three terminals as standard in the terminal box <br> - 4-terminal strip can be ordered as an accessory, Order No: 52008938 Conductor cross-section 0.08 to $2.5 \mathrm{~mm}^{2}$ ( 20 to 14 AWG) |

Installation tool indicating the customerspecific length on the cable


- To make installation easier, Endress+Hauser offers a mark on the extension cable for a customer-specific length, see also $\rightarrow 21$, "Ordering information".
- Mark tolerance: up to $\pm 50 \mathrm{~mm}$ (2") (the mark tolerance corresponds to a measured error from up to $\pm 50 \mathrm{~mm} / 2^{\prime \prime}$ )
- Material: PET
- Adhesive: acrylic
- Immunity to temperature change:
-30 to $+100^{\circ} \mathrm{C}\left(-22\right.$ to $\left.+212^{\circ} \mathrm{F}\right)$

1 cable marking, distance to the lower end of the cahle probe

Note!

- The mark is for installation purposes only.

It must be thoroughly removed without trace in the case of devices with drinking water approval. The extension cable must not be damaged in the process.

- Not for use in hazardous areas.


## Certificates and approvals

| CE mark | The device meets the legal requirements of the applicable EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark. |
| :---: | :---: |
| Ex approval, type of protection | - ATEX Il 2 G EEx ia ICC Toll <br> - ATEX II 3 G EEx nA II To') <br> - FM: IS, Class I, Division I, Groups A-D ${ }^{11}$ <br> - CSA: IS, Class I, Division 1, Groups A-D ${ }^{11}$ <br> 1) Only for Waterpilot FMX167 without Pt100 and TMT181 <br> Note! <br> - Waterpilot FMX1 67 is only available for use in hazardous areas with the FKM Viton seal. <br> - The cable marking cannot be ordered with the Ex approvals listed due to a potential electrostatic charge (see $\rightarrow 21$, "Ordering information"). <br> - All explosion-protection data are given in a separate documentation which is available upon request. The Ex documentation is provided with all Ex-systems as standards, see also $\rightarrow$ 23, Sect. "Additional documentation", "Safety instructions" and "Installation/Control Drawings". |
| Drinking water approval (for FMX167 with Outer diameter $22 \mathrm{~mm}(0.87 \mathrm{in})$ ) | - KTW certificate <br> - NSF 61 approval <br> - ACS approval |
| Marine approval | - CL approval <br> - ABS approval |
| Standards and guidelines applied | The European standards and guidelines that have been applied are listed in the associated EC Declarations of Conformity. In addition, the following standards were also applied for the Waterpilot FMX167: <br> DIN EN 60770 (IEC 60770): <br> Transmitters for use in industrial process control systems <br> Part 1: Methods for performance evaluation <br> DIN 16086: <br> Electrical pressure measuring instruments, pressure sensors, pressure transmitters, pressure measuring instruments, concepts, specifications on data sheets <br> EN 61320: <br> Electrical equipment for measurement, control and laboratory use - EMC requirements |

## Ordering information

## FMX167

You can enter the versions for the specific feature in the following table. The versions entered make up the complete order code. Options which are mutually exclusive are not marked.


| 20 | Corinection |  |
| :---: | :---: | :---: |
|  | \|l| 1 | Probe cable <br> Mounting clamp, AlSI 316 L <br> Cable mounting screw $\mathrm{CI}-1 / 2$, AISI 304 <br> Cable mounting screw NPT 1-1/2, AISI 304 |


| 30 | Probe tabe: |  |  |
| :---: | :---: | :---: | :---: |
|  |  | A | Outer diameter $\mathrm{d}=22 \mathrm{~mm}$, AISI 31 6 L . <br> Outer diameter $\mathrm{d}=42 \mathrm{~mm}$, flush-mounted, AlSI 316L <br> Outer diameter $\mathrm{d}=29 \mathrm{~mm}(1.15 \mathrm{in})$, AISI 310 L with heat-shrink sleeve PPS/polyolefin for saltwater applications <br> Outer diameter $\mathrm{d}=22 \mathrm{~mm}(0.87 \mathrm{in})$, AlSI $316 \mathrm{~L}+$ drinking water approval (can only be selected in conjunction with EPDM seal and PE probe cable) |





## FMX167 (continued)


${ }^{1)}$ incl. terminal box, see feature " 3 " or "4"

## Accessories



TMT181 temperature head transmitter

- 2-wire temperature head transmitter, configured for a measuring range from -20 to $+80^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+176^{\circ} \mathrm{F}\right)$. This setting offers a temperature range of 100 K which can be easily mapped. Please note that the Pt100 resistance thermometer is designed for a temperature range from -10 to $+70^{\circ} \mathrm{C}\left(14\right.$ to $\left.158^{\circ} \mathrm{F}\right) \rightarrow 22$.
- Order number: 52008794

| Extension cable mounting screw | - Endress+Hauser offers extension cable mounting screws to simplify the installation of the FMX167 and to close the measuring open $\rightarrow 10$. <br> - Material: 1.430) (AISI 304 SS) <br> - Order number for extension cable mounting screw with G $11 / 2$ A thread: 52008204 <br> - Order number for extension cable mounting screw with $11 / 2$ NPT thread: 52009311 |
| :---: | :---: |
| Terminals | - Four terminals in strip for FMX167 terminal box, suitable for wire cross-section of 0.08 to $2.5 \mathrm{~mm}^{2}$ (20 to 14 AWG) <br> - Order number: 52008938 |

Test adapter
(for FMX167 with an outer diameter of $22 \mathrm{~mm} / 0.87$ " and $29 \mathrm{~mm} / 1.14^{\prime \prime}$ )


Testing adapter
A FMX167 level probe connection
B Compressed air hose connection, intemal diameter of quick coupling piece 4 mm

## Additional documentation

| Field of activities | - Pressure measurement: FA004P/00/EN <br> - Recording technology: FAO14R/09/EN <br> - System components: FA010K/09/EN |
| :---: | :---: |
| Technical Information | - Technical Information Waterpilot FMX21 with 4 to 20 mA with HART output signal: T1431P/00/EN <br> - Technical Information Deltapilot M: T1437P/00/EN <br> - Temperature Head Transmitter iTEMP PCP TMT181: T1070R/09/EN |
| Operating Instructions | - Waterpilot FMX107: BA231 P/00/EN |
| Safety instructions | - ATEXII 2 G ExiallC T6: XA131P/00/A3 <br> - ATEXII 3 G Ex חA II TO: XA132P/00/A3 |
| Installation/Control Drawings | - FM IS Class I, Div. 1, Groups A - D: ZD003P/00/EN <br> - CSA IS Class I, Div. I, Groups A - D: ZD064P/00/EN |
| Drinking water approval | - SD126P/00/A3 |

1. MTR LEVEL RELAY TECHNICAL DETAILS
2. MTR WIRING DETAILS
3. MTR INSTALLATION \& TROUBLESHOOTING DETAILS

$\qquad$Sample MTR Application:


Sample MTR Application


Dip Switch Setitings


Wiring Diacram


Physical Dimensions


Sample Application


Product Specifications


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IvIULTITRODE RELAY 240VAC (MTR 2) INSTALLATION SHEEII. NO1 CONTROL OF THREE APPLIANCES IN A CHARGING SITUATION


MultiTrode Relay 240vac (mTR 2) Installation sheet. NO2 CONTROL of three appliances in a discharging situation


## 1 Introduction

The MultiTrode level control relay is a solid-state electronic module in a hi-impact plastic case with a DIN rail attachment on the back, making a snap-on-snap-off installation. Any number of relays can be easily added to the DIN metal rail then wired together to form a complex pumping system that other wise may have to be controlled and operated by a programmed PLC.
The relay is normally matched with the MultiTrode probe which works in conjunction with the relay and uses the conductivity of the liquid to complete an electrical circuit.

## 2 Electrical Overview



There are 10 screw terminals on the unit. Facing the relay as shown, we look at the bottom terminals (left to right):

- Lo-(Charge mode). This is the point when the probe is dry the relay will turn on.
- Lo - (Discharge mode). This is the point when the probe in the tank is dry the relay will turn off.
- $\mathrm{Hi}-$ (Charge mode). This is the point when the probe in the tank is wet a relay will turn off
- Hi - (Discharge mode). This is the point when the probe in the tank is wet a relay will turn on.
- C - is common earth. All earth bonding must be terminated here for correct operation.
- "L." is "live" ( 240 VAC )
- " $N$ " is "neutral" (240V AC)

If the tank is plastic, or if you are conducting tests in a plastic bucket, or the vessel has no earth point inside, you must install an earth rod within the tank, vessel or bucket and make sure that it is bonded back to $C$ on the relay unit.

## 3 DIP Switches

### 3.1 DIP Switches

(See Wiring Diagram for full program functions.)

### 3.1.1 DIP 1 \& 2

DIP 1 and 2 control the Sensitivity, in other words the cleaner the liquid the higher the sensitivity setting must be. Concentrated acids, minerals are by their own chemical composition highly conductive, so a low level of sensitivity is required, purified water is almost an insulator against electrical current flow so a higher sensitivity inside the relay is required.

### 3.1.2 DIP 3, 4 \& 5

DIP switches 3,4 and 5, control delay on activation. For example, in discharge mode with DIP switches 3,4 and 5 set to 10 seconds, when the Hi point becomes wet it will activate the motor and it will take 10 seconds of continual coverage of the probe sensor to make the relay close and start the pump. This is invaluable when the probe is in a turbulent part of a well where fluid is splashing around touching the sensors momentarily, and false activation cannot be tolerated.

### 3.1.3 DIP 6

DIP switch 6 controls the charge/discharge function. Set "ON" for charge, and "OFF" for discharge

### 3.2 Relay Contacts \& their Applications

### 3.2.1 Contacts 15, 16 \& 18

Contacts 15,16 , and 18 are used for electronic or visual notification of a change in state at the pump itself. Contacts 15,16 , and 18 are used for more advanced applications because they are a changeover relay, their state may be the same as contacts 25,28 or the opposite. Both sets of contactors are triggered simultaneously. An example is when in discharge mode, (see Figure 1).

You have a gravity flow coming in so the fluid reaches the lower sensor PB1, contacts 15 and 18 are open ( 15 being common to both contact 16 and 18) contacts 25 and 28 are also normally open but contacts 1516 in this current situation are closed, whether PB1 is wet or dry is of no concern all will stay the same. The level now rises to PB2 and both relays change state, contacts 25 and 28 close to turn on the pump, contacts 15 and 16 are open, with 15 and 18 closed.

In advanced applications this state change may be fed into a logic device to indicate the pump is running or the pump has stopped and perhaps light an LED or incandescent light source for visual confirmation that a change has occurred in the relay.

### 3.2.2 Contacts 25 \& 28

Contacts 25 and 28 are used to control pump states. Contacts 25 and 28 are mostly used for turning on motors via a starting relay or solenoid, so, these sets of contacts react to the rising or falling levels of the fluid inside the tank, they will operate to turn on a pump in discharge mode when the top sensor is wet and in charge mode turn on the pump when the bottom sensor is dry.

## 4 Practical Overview

### 4.1 Discharge Mode - DIP switch 6 set to "OFF"



Figure 1 - Discharge Mode
Figure 1 shows two probes, (PB1 connected to Lo and PB2 connected to Hi ). The pit is mostly underground and there is a gravity-fed inlet at the top left-hand side. The pit is empty with PB1 completely dry. Dipswitch 6 is set to "OFF."


The relay operation depends on the electrical conductivity of liquid in the pit, i.e. no liquid $=$ no current flow. The level starts to rise and covers PB1.

## MTR/MTRA Installation \& Troubleshooting

This is a discharge operation so we do not want the relay to close and start a pump until the well is full so as the water rises it reaches PB2, the relay closes and the pump starts. The level now drops below PB2 but the pump still continues to run, the level continues to drop below PB1 the relay opens the pump stops.

### 4.2 Charge Mode - DIP switch 6 set to "On"



Figure 2 - Charge Mode

!
NOTE:
" $C$ " is connected to common bonded earth. The unit will not operate correctly if not earthed.

Let's look at the same relay but in a tank that is charging (DIP 6 is now on). See Figure 3, where liquid is being pumped into a tank, and discharging through a gravity feed, the tank is on steel stands " $x$ " metres above the ground.


With the tank full, PB1 and PB2 will be wet, the relay is off, and the pump has stopped. Water is slowly fed out from the bottom, and now as PB2 (HI) becomes dry nothing happens; the water now drops to below PB1 (Lo), and the pumps restarts to fill the tank.
The pump will continue to fill the tank until PB2 $(\mathrm{HI})$, becomes wet again.

### 4.3 MTRA Relay with Alarm (Discharge Applications Only)



Figure 3-MTRA Operation

The MTRA relay works in the same way as the MTR relay except the MTRA has a separate alarm output, and does not have a charge mode. The planned application is to close a contact to illuminate a warning alarm light. . Various other applications have included introducing a third probe to latch another relay.

In Figure 2 we see three probes in a pit that is plastic, note the steel rod in the tank. (In a plastic vessel a steel rod must be used to create an earth return in the liquid so probes can function.) PB1, PB2, and PB3 are dry, and the relay power LED is on. When water enters the pit and wets PB1, nothing happens, water now reaches PB2 causing contacts 13 and 14 to close, the pump LED to light, and the water to drop.

If, for example, the pump has its inlet partially blocked, the level continues to rise and wets PB3. This closes a separate relay that can activate a red flashing light, an audible fog horn or send a 5 volt pulse into another device with the common cause to warn human beings that a spill is due to occur. If the pumps become unclogged and PB3 becomes dry the alarm opens again and breaks the circuit that stops the light from flashing or the foghorn from sounding.

## 5 Most Common Installation Problems

The relay requires a path between the probes to earth through the liquid. If you are testing in a plastic bucket, have installed the probe in a plastic tank or have no good earthing in the vessel you will need to install a separate earth and make sure all earth bonding comes back to the C terminal. Most problems like these are traced back to a lack of or poor earthing, or open circuits in the probe wiring.

Now is the time to check the relay by using "the bridge testing line technique" remember you must simulate a fluid flow to correctly ascertain a good relay or a bad one. (All DIPswitch settings from 1 to 6 should be off.)

Cut two pieces of insulated flexible copper wire one black one red 250 mm long, strip both ends back 10 mm on both cables, and join one black end and one red end. Insert the joined ends into C on the relay box, observing all safe electrical practises. You should have one black wire and one red wire free.
Set your relay for discharge mode (DIP switch 6 is off) with no sensors connected to the unit, connect the red wire to Lo - nothing should happen (if it does return the relay for replacement or repair*). Now connect the black wire to the Hi terminal the relay activated LED should light instantly (if it does not, the relay should be returned for repair*).

## 6 Troubleshooting

| I have checked all the DIPswitches and settings but in discharge mode as soon as the bottom sensor gets wet the pump turns on then turns off almost straight away. | - This is the most common problem encountered with relay set up and commissioning, the probe in the bottom of the tank is wired into the Hi terminal instead of the Lo terminal. |
| :---: | :---: |
| The installation went fine but now and again the pump will not turn on even though I am sure the probe is wet. | - Check the sensitivity level set on the relay, some times the level is set for foul water but due to changes in the flow the water becomes grey or clear, try changing the setting from $20 \mathrm{~K} \Omega$ to $80 \mathrm{~K} \Omega$ and monitor the results carefully. |
| All wiring is complete and all DIPswitches have been checked but the pump will not turn on at all. | - If you have completed the test schedule for the relay and it passed then check the wining to the sensors - for this is now where the problem lies or in the earthing arrangements. If possible check the resistance between the sensor cable and the steel sensor on the probe to prove a solid connection. |

* Please contact your distributor or agent before returning any product for repair or warranty claim.

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Visit www.multitrode.com for the latest information

Halmac Services (Qld) Pty. Ltd. AB.N. 40741712113

## POWER SUPPLY \& BATTERY

1. 24VDC POWER SUPPLY TECHNICAL DETAILS
2. BATTERY TECHNICAL DETAILS

## PB251 Series

## 220-330 WATTS DC UPS

## Features

- Ultra-low noise output
- Independent battery charging output
- DC output OK \& battery OK alarms \& LEDs
- Battery-LVD and alarm
- Over-temperature protection
- Battery fuse fail LED



## STANDARDS \& APPROVALS

| Safety | Complies with AS/NZS 60950, class 1, <br>  <br> NSW Office of Fair Trading Approval N20602 |
| :--- | :--- |
| EMC | Emissions comply with AS/NZS CISPR11, |
|  | Group 1, Class B. Complies with ACA EMC |
|  | Scheme, Safety \& EMC Regulatory Compliance |
|  | Marked |
| Isolation $\mathrm{i} / \mathrm{p}-\mathrm{o} / \mathrm{p}$ | 4242 VDC for 1 minute |
| $\mathrm{i} / \mathrm{p}$-ground | 2121VDC for 1 minute |
| $\mathrm{o} / \mathrm{p}$-ground | 707VDC for 1 minute |


| ALARMS \& BATTERY FUNCTIONS |  |
| :--- | :--- |
| Converter ON/OK alarm | Indicated by voltage-free changeover relay <br>  |
| green LED | ON=PSU OK |
| Battery low (\& fuse) alarm | 10.2 to 12.6 V for 12 V battery, adjustable 20.4 <br> to 25.2 V for 24 V battery, adjustable Indicated <br>  <br> green LED: ON=BAT OK |
| Low voltage disconnect | 9.6 to 12 V for 12 V battery, adjustable <br>  <br> Charger over-load protection |
| Reverse polarity protection | Internal battery fuse |
| Battery to load voltage drop | 0.2 to. 0.25 V typical for 4 V battery, adjustable |

## MECHANICAL

| Case size | $264 \mathrm{~L} \times 172 \mathrm{~W} \times 67 \mathrm{H} \mathrm{mm}$ |
| :--- | :--- |
| Case size with heatsink | $264 \mathrm{~L} \times 186 \mathrm{~W} \times 67 \mathrm{H} \mathrm{mm}$ |
| Rack size | $232 \mathrm{D} \times 19^{\mathrm{N}} \mathrm{W} \times 2 \mathrm{RU} \mathrm{H}$ |
| Weight | 1.9 kg |
| Weight with heatsink | 2.1 kg |
| Weight (rack mounted version) | 5.5 kg |

## Selection Table

Specifications

| INPUT |  |
| :--- | :--- |
| Voltage: | 190 to 264 vac, or 190 to 400VDC |
| Line regulation: | $0.2 \%$ typical |
| Current: | 1.4 A maximum |
| Inrush current: | 10A maximum |
| Frequency: | 45 to 65 Hz |
| OUTPUT |  |
| Voltage | See table |
| Current | See table |
| Load regulation | $0.5 \%$ typical |
| Current limit type - load cct | Constant current |
| Current limit type - batt. cct | Constant current |
| Short circuit protection | Indefi nite, auto-resetting |
| Over-voltage protection | 17.5 to 20V latching (13.8Vdc output) |
| Ripple \& noise | 31.5 to 39V latching (27.6Vdc output) |
| 100 MHz bandwidth | $28 \mathrm{mVp-p}$ (13.8Vdc output) |
| ENVIRONMENTAL | $55 \mathrm{mVp-p}$ (27.6Vdc output) |
| Operating temperature | 0 |


| MODEL <br> NUMBER | OUTPUT |  |  | OUTPUT | Note: Non standard battery charging current available on request. ie PB251-12CM-H-10 for 10A. |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | VDC | ILOAD | $\mathrm{I}_{\text {BATT }}$ | POWER |  |
| PB251-12CM | 13.8 V | 16A | 2A | 220 W |  |
| PB251-12CM-H | 13.8 V | 20A | 2A | 275W |  |
| PB251-24CM | 27.6 V | 11 A | 2A | 300 W |  |
| PB251-24CM-H | 27.6 V | 12A | 2 A | 330W |  |
| PB251-12RML | 13.8 V | 20A | 4A | 275W |  |
| PB251-128 | 13.8 V | 20A | 4A | 275W |  |
| PB251-24RML | 27.6 V | 12A | 2A | 330W |  |

Technical Illustrations


PB251-*RML \&-12B ME CHANICAL OUTLINE


NOTES:

1. $2 R \mathrm{~K} \times 19^{\circ}$ rack enclosure per IE C 297
2. Mounting slots are suibble for M6 hardware.
3. Input connestor is a 10A Class 1 IEC60320 inlet
4. 2 mever IEC mains cord with Aus ralis a plog is supplied with unt
5. P8251.128 a larm ir minal is DS 25 femote.
6. P8251-128 oupur and bamery connector is Hirose pn HS 28R-4A. Masing connector is Hirose po. H5 $28 \mathrm{P}-4 \mathrm{~A}$ (not supplec).
7. PB251-"RML alarm and ounput ierminats are M3. 5 strews suita ble lor ring or fork lugs up to $\varepsilon$ rmm wide.


FRONT VIEW


REAR VIEW (PB25I-~RML)

hear view (pb2s1-128)

PB251-12 ALARM CONNECTOR
PIN I: COMNON
PIN S: DC OK (NC) PIN IS: BATIERY OK (HO)





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## PROXIMITY SWITCH

## 1. NCB5-18GM40-Z0 PROXIMITY SWITCH TECHNICAL DETAILS

## Dimensions



| Model Number |
| :--- |
| NCB5-18GM40-z0 |
| Features |

- Comfort series
- 5 mm embeddable



Halmac Services (Qld) Pty. Ltd. ACN 098852923
A日N 40741712113

## PUSHBUTTON \& INDICATORS

## 1. PUSH BUTTON TECHNICAL DETAILS <br> 2. HOUR RUN METER TECHNICAL DETAILS

## Series D7 Pilof Devices

22mm Design<br>Saves Panel Space

Heavy Duty<br>Ratings

## Features

## TWO OPERATOR TYPES

- Plastic operator with captive front bezel
- Metal operator with die-cast zinc housing and captive shiny metal bezel


## LESS INVENTORY, MORE CHOICES

- Wide range of style choices
- Modular design for mix and match flexibility
- Endless configurations from core components


## QUICK, EASY INSTALLATION

- Tool-less mounting latch for quick assembly
- Anti-rotation tab for one person installation
- Snap-on back panel components


## LONG ELECTRICAL \& MECHANICAL LIFE

- 10 million mechanical operations
- 10 million electrical cycles

ENVIRONMENTAL RATINGS

- UL Type 4/4X/13, IP66 Sealing
- Chemical resistant industrial grade thermoplastic body
- Corrosion and UV resistant

Modular Design<br>Reduces Inventory demanding environments.

Sprecher + Schuh's rugged D7 pilor devices offer maximum flexibility and a wide choice for all applications. This 22 mm line is aesthetically appealing and modularly designed to make assembly and interchangeability easy. The D7 operators are available in two different body styles to meet every industrial application need. Both operators exhibit a new lower profile srylish appearance while maintaining the rugged performance necessary for


Fisit Mownitig


## Completioncossorits

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20


Simerfior Desigu:


Selector Switch Safety

- Positive Detent
- Constant Energy


Diaphragm Seal

- Flexes with operation
- Dependent on ubrrication

$K$-Seal
- Dual wiping action
- Lubrication tanaing - Lubrication trapping
extends sealing life





Illuminated and Non-Illuminated Knob Selector Switch Operators (07x-LS \& D7x-S)


Illuminated and Non-llluminated
Momentary Mushroom Operators
40 mm and 60 mm ( $07 \mathrm{x}-\mathrm{LMM} \& 07 \mathrm{x}-\mathrm{MM}$ )


Illuminated and Non-Illuminated
Push-Pull Mushroom Operators $30 \mathrm{~mm}, 40 \mathrm{~mm}$, and 60 mm (07x-MP)

liluminated and Non-Illuminated
Extended Push Bution Operators


Pilot Light Operators (D7x-P)


Key Selector Switch Operators ( $\mathrm{D} 7 \mathrm{x}-\mathrm{K}$ )


Illuminated and Non-Illuminated Twist-to-Release Operators $30 \mathrm{~mm}, 40 \mathrm{~mm}$, and 60 mm (D7x-MT)


Mushroom Key Release Operator 40mm (07x-MK)


Non-Illuminated 3-Position Multi-Function Operators (D7x-U3)


Illuminated and Non-Illuminated 2-Position Multi-Function Operators (D7x-LU2 \& D7x-U2)


Toggle Switch Operators (D7M-JM)


Reset Dperators (D7x-R)


Selector Jog 0perators (D7x-SJ)


Potentiometer with Resistive Element (07P- POT)

$$
\because \quad 46 \quad \because-28.5-
$$



* For Monolithic Devices see the D7D Monolithic Flyer

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sprecher +
schuh

Front-of-Panel (Operators) 0
Mechanical Ratings


Back-of-Panel Components 0
Electrical Ratings


0 Performance data given in this publication is provided only as a guide for the user in determining suitability and do not constitute a performance warranty of any kind. Such data may represent the results of accelerated testing at elevated stress levels, and the user is responsible for correlating the data to actual application requirements. ALL WARRANTIES AS TO ACTUAL PERFORMANCE, WHETHER EXPRESS OR IMPLIED, ARE EXPRESSLY DISCLAIMED.
(9) Momentary mushroom operators are IP65, multi-function operators have no Type 13 rating. Plastic operators with keys have no Type 4 X rating.
(3) Operating temperatures below $0^{\circ} \mathrm{C}\left(32^{\circ} \mathrm{F}\right)$ are based on the absence of freezing moisture and liquids, UL recognized to $55^{\circ} \mathrm{C}\left(131^{\circ} \mathrm{F}\right)$ - incandescent module, max $40^{\circ} \mathrm{C}\left(104^{\circ} \mathrm{F}\right)$
(5) Low voltage contacts are recommended for applications below $17 \mathrm{~V}, 5 \mathrm{~mA}$.
© Wires less than \#18 $\left(0.75 \mathrm{~mm}^{\text {² }}\right)$ may not hold in terminal securely.

Technical Information Series D7 - Heavy Duty/Oil Tight

## Back-of-Panel Components ©, continued

| Ilumination |  |  |  |
| :---: | :---: | :---: | :---: |
| LED dominant wavelength | Green | [ nm ] | 525 nm |
|  | Red |  | 629 nm |
|  | Yellow |  | 590 nm |
|  | Blue |  | 470 nm |
|  | White |  | - |
| LED luminous intensity | Green | [mod) | 890 mcd |
|  | Red |  | 890 mcd |
|  | Yellow |  | 690 med |
|  | Blue |  | 193 med |
|  | White |  | 412 mcd |
| Incandescent maximum watlage |  | [W] | 2.6W |
| Materials |  |  |  |
| Springs |  | Stainless steel and zinc coated music wire |  |
| Electrical contacts | Standard | Silver-nicke |  |
|  | Low voltage | Gold-plated over silver |  |
| Teminals | Screw | Brass |  |
|  | Screwless | Silver-plated brass |  |

Environmental Approval Note: Front elements UL Recognized; Complete assemblies UL Approved.
See Table A2 for your application.
This table is extracted from Sprecher + Schut's Lit 508A file and can be used to determine which
D7 Pilod Device is approved for a particular enclosure type.

| TABLEA2-Openings in Enclosure |  |
| :---: | :---: |
| Enclosure Type | Openings May Be Closed By Equipment Marked... |
| 2 | 2, 3, 3R, 3S, 4, 4X, 6, 6P, 11, 12, 12K, 13 |
| 3 | 3, 3R, 3S, 4, 4X, 6, 6P |
| 3R | 3, 3F, 3S, 4, 4X, 6, 6P |
| 35 | 3, 3R, 3S, 4, 4X, 6, 6P |
| 4 | 4, 4X, 6, 6P |
| 4 x | 4x |
| 6 | 6,6P |
| 6 P | 6 P |
| 11 | 11 |
| 12, 12k | 12, 12K, 13 |
| 13 | 13 |

## Product Certifications

| Centifications | UL, UR, CSA, CCC, CE |
| :--- | :---: |
| Conformity of Standards - CE marked | NEMA ICS-5; UL 508, EN 418, EN 60947-1, EN 60947-5-1, EN 60947-5-5 |
| Terminal identification | IEC 60947-1 |
| Shipping approvals | RINA, LR, ABS |
| RoHS | $\checkmark$ |

- Performance data given in this publication is provided only as a guide for the user in determining suitability and do not constilute a performance warranty of any kind. Such data may represent the results of accelerated testing at elevated stress levels, and the user is responsible for correlating the data to actual application requirements. AL WARRANTIES AS TO ACTLAL PERFORMANCE, WHETHER EXPRESS OR IMPLIED, ARE EXPRESSLY DISCLAIMED.

Technical Information

## Material Listing

|  | Component | For Use with | Material Used |
| :---: | :---: | :---: | :---: |
|  | Panel gasket | All operators | Nitrile, TPE |
|  | Diaphragm seal | Illuminated push button, non-illuminated push bution | Automotive industry acceptable silicone |
|  | K-seal | Selector switch, key selector switch, push/twist-to-release E-stop, key E-stop, push/pull mushroom | Nitrile |
|  | Diaphragm retainer, return spring \| | Illuminated push button, non-illuminated push button, momentary mushroom | Stainless stee! |
|  | Return spring II | Reset, selector switch, key selector switch, maintained action, push/twist-to-release E-stop, key E-stop, push/pull mushroom | Zinc coated music wire |
| $\left.\square \square_{0}^{0}\right]$ | Button cap/mushroom head | Non-illuminated push button, momentary mushroom, reset, push/twist-torelease E-stop, key E-stop, push/pull mushroom, multi-function | PBT/polycarbonate blend |
|  | 2-color molded button cap | Non-illuminated push button | PBT/polycarbonate blend |
| ¢ | Lens | Multi-function | Acetal |
| 害 | Lens, knob | Illuminated push button, illuminated momentary mushroom, illuminated selector switch | Polyamide |
| 믈 | Knob | Non-illuminated selector switch | Glass-filled polyamide |
| D7 | Plastic beze/bushing I | Non-illuminated push button, illuminated push button, momentary mushroom, selector switch, key selector switch, push/twist-to-release E-stop, key E-stop, push/pull mushroom, multi-function, reset | Glass-filled polyamide |
|  | Plastic bezel/bushing 11 , jam nut | Pilot light, reset jam nut, reset pusher | Glass-filled PBT |
|  | Metal bezel/bushing | All metal operators | Zinc |
|  | Diffuser | Illuminated push button, pilot light | Polycarbonate |
|  | Legend frames | - | Glass-filled polyamide |
|  | Plastic mounting ring | All plastic operators | Glass-filled polyamide |
|  | Metal mounting ring | All metal operators | Chromated zinc |
|  | Plastic latch | - | Glass-filled polyamide |
|  | Metal latch | - | Chromated zinc + stainless steel |
|  | Plastic enclosure | - | $\mathrm{PBT} /$ polycarbonate blend |
|  | Metal enclosure | - | Aluminum |
|  | Terminal screws | LED module, incandescent module, contact blocks | Zinc-plated steel with chromate |
|  | Terminals | LED module, incandescent module, contact blocks | Brass with silver-nickel contacts |
|  | Screwless | LED module, incandescent module, contact blocks | Stainless steel |
|  | Lamp socket | Incandescent module | Brass |
|  | Housing | Incandescent module, LED module | Glass-filled polyamide |
|  | Low voltage terminals | Contact blocks | Gold plated silver-nickel contacts |
|  | Low voltage spanner | Contact blocks | Gold-plated silver-nickel contacts |
|  | Spanner | Contact blocks | Brass with silver-nickel contacts |
|  | Boot | Toggle Switch, illuminated push button, non-illuminated push button, multi-function illuminated an non-illuminated | Automotive industry acceptable silicone |

Pilot Devices
Series D7D Monolithic

## Specifications

Mechanical Ratings

| Vibration (assembled to panel) | Tested at $10 \ldots 2000 \mathrm{~Hz}, 1.52 \mathrm{~mm}$ displacement (peak-to-peak) max. 10 G max. for 3 hr duration, no damage |  | Temperature range (operating) 0 | $-25 \ldots+60^{*} \mathrm{C}(-13 . .140 \mathrm{~F})$ |
| :---: | :---: | :---: | :---: | :---: |
| Shock | Tested at $1 / 2$ cycle sine wave for 11 ms ; no damage at 100 G |  | Temperature range |  |
| Degree of protection | IP 66 (Type 3/3R/4 |  | (short term storage) | -40 |
| mechanical durability per EN 60947-5-1 (Annex C) | 2,000,000 Cycles | Momentary Push Button | Humidity | 50...95\% RH from |
|  | 300,000 Cycles | Selector Switch and E-Stop |  | $25 . .60^{\circ} \mathrm{C}\left(77 . . .140{ }^{\circ} \mathrm{F}\right.$ |
| Operating forces | Flush/Extended $=9 \mathrm{~N}, \mathrm{E}-$ stop $=36 \mathrm{~N}$ |  |  |  |
| Operating torque (typical application with one contact block) | Selector Switch $=0.25 \mathrm{~N} \bullet \mathrm{~m}$ |  |  |  |
| Contact operation | N.O. | Slow double make and break |  |  |
|  | N.C. | Slow double make and break - p |  |  |
| Push button travel to change electrical state | N.O. | 2.5 mm (0.1 in.) |  |  |
|  | N.C. | $1.5 \mathrm{~mm}(0.060 \mathrm{in}$. |  |  |

$\ominus$ Positive Opening per EN60947-5-1 (applies to all NC contact block styles)
Etectrical Ratings

| Standard contact block ratings | B300, P300; AC 15, DC 13; 300 VAC; ENIEC 60947-5-1 and UL 508, 17V, 5 mA min. |  |  |
| :---: | :---: | :---: | :---: |
| Nominal Voltage | Range | Nominal Curent Draw | Frequency |
| 24 V AC | $20 . .26 \mathrm{~V}$ AC | 32 mA | $50 / 60 \mathrm{~Hz}$ |
| LED Module Ratings | 18...30V DC | 24 mA | DC |
| 120 VAC | 102...132V AC | 22 mA | 50/60 Hz |
| 240 VAC | 204...264V AC | 22 mA | $50 / 60 \mathrm{~Hz}$ |
| Thermal current | 5 A max. enclosed (400 ${ }^{\circ} \mathrm{C}$ ambient) to UL508, EN/EC 60947-5-1 |  |  |
| Insulation voltage (ui) | 300 V |  |  |
| Wire capacity (screw terminal) | \#18...14 AWG (0.75...2.5 mm²), Max. (2) \#14 AWG, uses same size wire only |  |  |
| Recommendations for Ring Lug termination option (2) | $6.35 \mathrm{~mm}(0.250 \mathrm{in}$.$) Max. outer diameter with 3.8 \mathrm{~mm}(0.148 \mathrm{in}$.) hole diameter |  |  |
| Recommened tightening torque on screw terminals | $0.7 \ldots 0.9 \mathrm{~N} \bullet \mathrm{~m}$ (6...8 $8 \mathrm{lb}-\mathrm{in}$. |  |  |
| Dielectric strength (minimum) | 25DOV for one minute |  |  |
| Extemal shorl circuit protection | 5 A type gL/gG cartidge fuse to EN 60269-2-1 or gN (Class J to Ul 248-B or Class CC to UL 248-4) |  |  |
| Electrical shock protection | Finger-safe conforming to IP2X |  |  |


| Illumination |
| :--- |
| LEO Dominant Wavelength |
|  |  |
|  |
|  |
|  |

Materials

| Springs | Stainless steel and zinc coated music wire |
| :---: | :---: |
| Electrical contacts | Brass with siver-nickel contacts |
| Terminals | Brass and phosphor bronze |
| Panel gasket | nitrile and polyester-based TPE |
| Seal | Nitrile |
| Button cap/mushroom head | Polyester/polycarbonate blend |
| Lens (pilat light) | Acrylic |
| Knob (selector switch) | Glass-filled polyamide |
| Bezel/bushing, housing | Glass filled polyester |
| Legend frames | Glass filled polyamide |
| Mounting ring | Glass filled polyamide |
| Terminal screws | Zinc-plated steel with chromate |
| Lamp Socket | Brass and Phosphor bronze |
| Product Certifications |  |
| Certifications | U, CSA, CCC, CE |
| Conformity to standards - CE marked | UL 508, EN 60947-1, EN 60947-5-1, EN 60947-5-5 |
| Terminal Identification | ENIEC 60947-1. |
| - Operating temperatures below $0^{\circ} \mathrm{C}\left(32^{\circ} \mathrm{F}\right)$ are based on the absence of freezing moisture and liquids. <br> (2) 3M MV018-R/S \#(22... 18 AWG) or 3M MVU14-6R/S ( $\# 16 . . .14$ AWG) |  |

Pilot Devices
Series D7 - Heavy Duty/Oil Tight

Approximate Dimensions - millimeters ©
Panel Hole Spacing


(0) Dimensions are not intended to be used for manufacturing purposes.

Approximate Dimensions - millimeters (1)



Back-of-Panel Components -
Contact Cartridges with Latch (D7-X/Q + D7-ALP/M)



[^14]Pilot Devices

Approximate Dimensions - millimeters $0 \longdiv { 2 }$


[^15](2) Panel thickness range is 1.0 ...6.0 maximum. Panel thickness reduced to 4.5 when optional legend plates are used.

Pilot Devices

Approximate Dimensions - millimeters $\mathbf{0}$


[^16]
## Approximate Dimensions - millimeters $\mathbf{0}$



Approximate Dimensions - millimeters ©


Dimensions are not intended to be used for manufacturing purposes.

## TH63.TH64 Hour Meters



TH63 series (without reset button)

## RoHS Directive compalibility information http://www.nais-e.com/

## Features

## 1. Compact to save panel space

The $24 \times 48 \mathrm{~mm}$ hour meters are just half the DIN $48 \times 48$ standard size. They help save the panel space.

## UL File No.: E42876 <br> CSA File No.: LR39291

지 ( 1

## 2. Reset button

The hour meters can be reset to zero (TH64 series). 3. Wide-ranging measurement display

The measurement can be displayed from 0.1 hour up to 99999.9 hours (TH63 series). The dial size is the same as that of $48 \times 48 \mathrm{DIN}$ size hour meters (TH14 and TH24 series).

## 4. Easy to install

The flat terminals (\#187) are used for easier wiring. There is no need to undo the lock spring.
5. High-performance sync motor with $\mathbf{5 0 / 6 0 ~ H z ~ s e l e c t o r ~}$ The noise-resistant, accurately turning motor is employed to provide for longer period of measurement. The power frequency can be selected for 50 or 60 Hz .

## 6. Rotary indicator

The rotary indicator makes one turn every 72 seconds for monitoring.
7. Compliant with UL, CSA and CE.

## Typical applications

Management of small generators and food processing machines; hour counting for leased equipment; maintenance management of various equipment, etc.

## Specifications



## Product types

| Type. | Operataing voltage | Pärt number | Operating voltage | Pait number | Operating voltage | Part number |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TH63 series (without reset button) | 100 V AC | TH631 | 24 VAC | TH634 | 115 to 120V AC | TH637 |
|  | 200 V AC | TH632 | 48 V AC | TH635 | 220 VAC | TH638 |
|  | 12 VAC | TH633 | 110 VAC | TH636 | 240 V AC | TH639 |
| TH64 series (with reset button) | 100 V AC | TH641 | 24 V AC | TH644 | 115 to 120V AC | TH647 |
|  | 200 V AC | TH642 | 48 V AC | TH645 | 220 V AC | TH648 |
|  | 12 V AC | TH643 | 110 V AC | TH646 | 240 V AC | TH649 |

Notes) 1. Only the metallic-looking (silver) panel mounting type is available.
2. Standard products are UL-recognized as well as CSA-certified. There is no need to add " $U$ " at the end of the part number. Just specify the standard part number when ordering.

## Applicable standard

| Safaty standard | EN61010-1 | Pohution Degree 2/Overvottage Category II |
| :---: | :---: | :---: |
| EMC | (EMI)EN61000-6-4 <br> Radiation interference electric field strength <br> Noise terminal voltage <br> (EMS)EN61000-6-2 <br> Static discharge immunity <br> RF electromagnetic field immunity <br> EFT/B immunity <br> Surge immunity <br> Conductivity noise immunity <br> Power frequency magnetic field immunity <br> Voltage dip/Instantaneous stop/Vollage illuctuation immunity | EN55011 Group 1 ClassA <br> EN55011 Group1 ClassA |

## Dimensions



## Wiring diagram

## - Panel cutout dimensions



Operating power supply


## Mounting

1. Cut a $22.2+0.3 \times 45_{0}^{+0.6} \mathrm{~mm}\left(.874+.80^{12} \times\right.$ $1.772+.024$ inch) opening in the panel.
2. Swing the mounting spring to the rear of the hour meter and fit the hour meter into the panel opening. (There is no rieed to detach the mounting spring from the hour meter.) If the panel is 5 to 9 mm .197 to .354 inch thick, move the mounting spring to the other hole toward the rear of the hour meter.
3. Swing the mounting spring to the front of the hour meter to secure the hour meter to the panel.
4. Wire the supplied quick connectors and connect to the hour meter. Be sure to use the supplied insulating sleeves to cover the connectors.


## PRECAUTIONS IN USING THE HOUR METERS

## 1. Frequency setting

Frequency is specified for AC motor-driven hour meters. Before installing, be sure to check your local power frequency.

## 2. Connections

-TH13,23,14,24,40,50,63,64


Note) Make the connection with the accompanying flat connector first and then with the hour meter's terminal (\#187). In such case, be sure to cover the connection with the accompanying insulating sleeve.

- TH70, TH8


Note) Solder the lead wires in position.

## 3. Safety precautions

Do not use the hour meters in the following places.

- Where ambient temperature is below $-10^{\circ}$ or above $+50^{\circ} \mathrm{C}$
- In wet, dusty or gaseous environments
- Where exposed to vibrations and shocks
- Outdoors, or where exposed to rain or direct sunlight

4. Compliant with CE.

- LH2H

Ambient conditions:
Overvoltage category III, contamination factor 2 , indoor use.
Ambient temperature and humidity -10 and $+55^{\circ} \mathrm{C}$ and $35 \%$ to $85 \% \mathrm{RH}$ respectively.

- TH13, 23, 14, 24, 40, 50, 63, 64

Ambient conditions:
Overvoltage category II, contamination factor 2 , indoor use. Ambient temperature and humidity -10 and $+50^{\circ} \mathrm{C}$ and below $85 \%$ RH respectively.

## 5. Reset-type hour meter

- Precautions for use

If the number indications are off before use, press the reset button and confirm that all zeroes ("0") are displayed.

- Resetting caution

Exercise due caution as an insufficient amount of pressure on the reset button may result in abnormal readings.
6. Acquisition of CE marking

Please abide by the conditions below when using in applications that comply with EN 61010-1/IEC 61010-1

1) Ambient conditions

- Overvoltage category II, pollution level 2
- Indoor use
- Acceptable temperature and humidity range: -10 to $+55^{\circ} \mathrm{C}$, 35 to $85 \% \mathrm{RH}$ (with no condensation at $20^{\circ} \mathrm{C}$ )
- Under 2000 m elevation

2) Use the main unit in a location that matches the following conditions.

- There is minimal dust and no corrosive gas.
- There is no combustible or explosive gas.
- There is no mechanical vibration or impacts.
- There is no exposure to direct sunlight.
- Located away from large-volume electromagnetic switches and power lines with large electrical currents.

3) Connect a breaker that conforms to EN60947-1 or EN609473 to the voltage input section.
4) Applied voltage should be protected with an overcurrent protection device (example: T 1A, 250 V AC time lag fuse) that conforms to the EN/IEC standards. (Free voltage input type)

## Halmac Services (Qld) Pty. Ltd. A.C.N. 098852923 AB.N. 40741712113

## PRESSURE TRANSMITTER \& ADJUSTMENT UNIT

## 1. VEGABAR74 PRESSURE TRANSMITTER TECHNICAL DETAILS

## 2. VEGADIS PRESSURE ADJUSTMENT UNIT TECHNICAL DETAILS

Drocess pressure/Hydrostatic


## Product Information



## Content

1 Description of the measuring principle ..... 3
2 Type overview ..... 4
3 Mounting Instructions ..... 5
4 Electrical connection
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## Take note of satety instructions for Ex applications

 which comes with every instrument. In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units. The sensors must only be operated on intrinsically safe circuits. The permissible electrical values are stated in the certificate.
## 1 Description of the measuring principle

## Measuring principle

VEGABAR 74 and 75 pressure transmitters are specially adapled to their respective application areas. That is why different sensor elements and measuring units are implemented.

## VEGABAR 74

The sensor element of VEGABAR 74 is the dry ceramic-capacitive CERTEC ${ }^{\left({ }^{( }\right.}$measuring cell. Base element and diaphragm consist of high purity sapphire-ceramic ${ }^{\oplus}$.
The process pressure causes via the diaphragm a change in an electrical parameter of the measuring cell. This change is converted into an appropriate output signal.
The CERTEC ${ }^{(1)}$ measuring cell is also equipped with a temperature sensor. The temperature value can be displayed via the indicating and adjustment module or processed via the signal output.


Fig. 1: Configuration of the CERTEC ${ }^{\circ}$ measuring cell in VEGABAR 74

## 1 Diaphragm

2 Soldered glass bond
3 Base element
The advantages of the CERTEC ${ }^{\text {© }}$ measuring cell are:

- Very high overload resistance
- No hysteresis
- Excellent long-term stability
- Completely front flush installation
- Good corrosion resistance
- Very high abrasion resistance


## VEGABAR 75

The METEC ${ }^{\oplus}$ measuring cell is the measuring unit of VEGABAR 75. This unit consists of a CERTEC ${ }^{\left({ }^{( }\right)}$measuring cell and a special isolating system with metallic process diaphragm. A special feature of this isolating system is the direct mechanical compensation of temperature influence.
The process pressure causes via the diaphragm a change in an electrical parameter of the measuring cell. This change is converted into an appropriate output signal.


Fig. 2: Configuration of the METEC* measuring cell in VEGABAR 75
1 Diaphragm Hastalloy C276
2 Isolating liquid (approx. $0.3 \mathrm{~cm}^{3}$, FDA-fisted)
3 FeNi adapter
4 CERTEC ${ }^{\circ}$ maasuring cell
The advantages of the METEC ${ }^{\text {® }}$ measuring cell are:

- Completely welded, elastomer-free
- Very high overload resistance
- Full vacuum resistance (also with 0.1 bar measuring range)
- Good thermo-shock reaction
- Excellent long-term stability
- High degree of flushness


## Wide application range

VEGABAR 74 and 75 transmitters are designed for front flush process pressure measurement of gases, vapours and liquids. Their application-optimised housings in IP 68 and high resistance materials ensure reliable use even in harsh environments and in extremely moist areas. Thanks to their compact configuration with completely integrated electronics, the instruments can be connected directly to the respective signal processing equipment.

VEGABAR 74 is best suited for use in abrasive media in the paper industry or in waste water treatment.

VEGABAR 75 with its hygienic fittings is particularly suitable for the food processing and pharmaceutical industries.

Information:
Continuative documentation such as operating instructions manuals:

- 28432 -VEGABAR 74
- 28433 - VEGABAR 75


## 2 Type overview


Measuring cell:

Diaphragm:
Media:
Process fitting:

Material:
Measuring range:
Smallest measuring range:
Process temperature:

## CERTEC ${ }^{(1)}$

Ceramic
gas, vapours and liquids, also abrasive
Thread from $11 / 2^{\prime \prime}$, flanges from DN 40, fittings for the food processing and paper industry
316L
-1 ... 60 bar ( -14.5 ... 870 psi )

Deviation in characteristics: < $0.075 \%$
Signal output:
Remote adjustment/ indication:

## METEC ${ }^{\text {¹ }}$

Metal
gases, vapours and liquids also with higher temperatures
Thread from $11 / 2^{\prime \prime}$, flanges from DN 40, fittings for the food processing industry
316L
-1 ... 25 bar (-14.5 ... 363 psi)
0.1 bar (1.45 psi)
$-12 \ldots+200^{\circ} \mathrm{C}\left(-40 \ldots+392^{\circ} \mathrm{F}\right)$
$<0.075 \%$
4... 20 mA/HART

VEGADIS 12

## 3 Mounting instructions

## Installation position

VEGABAR functions in any installation position. Depending on the measuring system, the installation position can influence the measurement. This can be compensated by a position correction.

[^17]
## 4 Electrical connection

### 4.1 General prerequisites

The supply voltage range can differ depending on the instrument version. You can find exact specifications in chapter "Technical data".
The national installation standards as well as the valid safety regulations and accident prevention rules must be observed.


In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

### 4.2 Voltage supply

Supply voltage and current signal are carried on the same twowire cable. The requirements on the power supply are specified in chapter "Technical data".

The VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as VEGAMET signal conditioning instruments are suitable for power supply. When one of these instruments is used, a reliable separation of the supply circuits from the mains circuits according to DIN VDE 0106 part 101 is ensured.

### 4.3 Connection cable

## Generally

The sensors are connected with standard cable without screen. An outer cable diameter of $5 \ldots 9 \mathrm{~mm}$ ensures the seal effect of the cable entry.

## 4 ... $20 \mathrm{~mA} / \mathrm{HART}$ two-wire and four-wire

If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used. In HART multidrop mode the use of screened cable is generally recommended.

In Ex applications, the corresponding installation regulations must be noted for the connection cable.

### 4.4 Cabie screening and grounding

If screened cable is necessary, the cable screen must be connected on both ends to ground potential. If potential equalisation currents are expected, the connection on the evaluation side must be made via a ceramic capacitor (e.g. $1 \mathrm{nF}, 1500 \mathrm{~V}$ ).

### 4.5 Wiring plan VEGABAR 74, 75

## Direct connection



Fig. 3: Wire assignment, connection cable
brown ( + ): to power supply or to the processing system
blue (-): to power supply or to the processing system
yellow: is only required with VEGADIS 12, otherwise connect to minus Screon
Breather capillaries with filter element

## Connection vla VEGABOX 02



Fig. 4: Terminal assignment VEGABAR
1 To power supply or the processing system
2 Screen

## Connectlon via VEGADIS 12



Fig. 5: Teminal assignment, VEGADIS 12
1 To power supply or the processing system
2 Control instrument (4 ... 20 mA measurement)
3 Screen
4 Breather capillarias
5 Suspension cable

## 5 Operation

### 5.1 Overview

VEGABAR 74 and 75 can be adjusted with the following adjustment media:

- Indication/Adjustment VEGADIS 12
- Adjustment software according to FDT/DTM standard, e.g. PACTware ${ }^{\text {TM }}$ and PC
- HART handheld


### 5.2 Adjustment with VEGADIS 12

## VEGADIS 12

VEGADIS 12 is connected directly to the connection or suspension cable of VEGABAR or VEGAWELL. It is looped into the supply and signal circuit and requires no separate external energy.


Fig. 6: Adjustment elements of VEGADIS 12
1 Rotary switch: choose the requested function
2 [+] key change value
3 l.]key change value

### 5.3 Adjustment with PACTware ${ }^{\text {TM }}$

## PACTware ${ }^{T M} / D T M$

VEGABAR 74 and 75 sensors are adjusted via the signal cable by means of PACTware ${ }^{\text {TM }}$.

An instrument driver for the respective VEGABAR is necessary for the adjustment with PACTware ${ }^{\text {TM }}$.

All currently available VEGA DTMs are provided as DTM Collection with the current PACTware ${ }^{T M}$ version on CD. They are available from the responsible VEGA agency for a token fee. The basic version of this DTM Collection incl. PACTware ${ }^{\text {TM }}$ is available as a free-of charge download from the Internet.
To use the entire range of functions of a DTM, incl. project documentation, a DTM licence is required for that particular instrument family, e.g. VEGABAR. This licence can be bought from the VEGA agency serving you.

## Connection of the PC via VEGACONNECT 3



Fig. 7: Connecting the PC to the signal cable
1 RS232 connection (with VEGACONNECT 3) or USB connection (with VEGACONNECT 4)
2 VEGABAR
3 HART adapter cable
4 HART resistor $250 \Omega$

## Connection of the PC via VEGACONNECT 4



Fig. 8: Connecting the PC via HART to the signal cable

## VEGABAR

HART resistor $250 \Omega$ (optional depending on processing)
Connection cable with 2 mm pins and terminals

- Processing systemPPLCNottage supply


### 5.4 Adjustment with other adjustment programs

## PDM

For VEGA PA sensors, instrument descriptions for the adjustment program PDM are available as EDD. The instrument descriptions are already implemented in the current version of PDM. For older versions of PDM, a free-of-charge download is available via Internet.

## AMS

For VEGA FF sensors, instrument descriptions for the adjustment program $A M S^{\top M}$ are available as DD. The instrument descriptions are already implemented in the current version of AMS™. For older versions of AMS $^{\text {TM }}$, a free-of-charge download is available via Internet.

## 6 Technical data

## General data

Material 316L corresponds to 1.4404 or 1.4435

## VEGABAR 74

Materials, wetted parts

- Process fitting

316L

- Diaphragm
sapphire ceramic ${ }^{\text {© }}$ ( $99.9 \%$ oxide ceramic)
- Seal
- Seal process fitting thread $G 1 / 2 A, G 11 / 2 A$

FKM (Viton), Kalrez 6375, EPDM, Chemraz 535

VEGABAR 75
Materials, wetted parts

- Process fitting

Hastelloy C276

- Process diaphragm

Materials, non-wetted parts

- Isolating liquid
med. white oil, FDA listed (silicone-free)


## Common data

Materials, non-wetted parts

- Housing

316L

- Ground terminal

316T1/316L

- Connection cable

PUR, FEP, PE

- type label support on cable

PE-HART
Weight
$0.8 \ldots 8 \mathrm{~kg}$ ( $1.764 \ldots 17.64 \mathrm{lbs}$ ), depending on process fitting

## Output variable

| Output signal | $4 \ldots 20 \mathrm{~mA} / \mathrm{HART}$ |
| :--- | :--- |
| Failure signal | $22 \mathrm{~mA}(3.6 \mathrm{~mA})$, adjustable |
| Max. outpui current | 22.5 mA |
| Damping ( $63 \%$ of the input variable) | $0 \ldots 10 \mathrm{~s}$, adjustable |
| Step response or adjustment time | $70 \mathrm{~ms}(\mathrm{ti}: 0 \mathrm{~s}, 0 \ldots 63 \%)$ |
| Fulfilled NAMUR recommendations | NE 43 |

Additional output variable - temperature (with VEGABAR 74)
Processing is made via HART-Multidrop

| Range | $-50 \ldots+150^{\circ} \mathrm{C}\left(-58 \ldots+302{ }^{\circ} \mathrm{F}\right)$ |
| :---: | :---: |
| Resolution | $1^{\circ} \mathrm{C}\left(1.8{ }^{\circ} \mathrm{F}\right)$ |
| Accuracy |  |
| - in the range of $0 \ldots+100^{\circ} \mathrm{C}\left(+32 \ldots+212^{\circ} \mathrm{F}\right)$ | $\pm 3 \mathrm{~K}$ |
| - in the range of $-50 \ldots 0^{\circ} \mathrm{C}\left(-58 \ldots+32^{\circ} \mathrm{F}\right)$ and $+100 \ldots+150^{\circ} \mathrm{C}$ | typ. $\pm 4 \mathrm{~K}$ |

## Input variable

| Parameter | Level |
| :--- | :--- |
| Measuring range | see product code |
| Turn down |  |
| - recommended | $1: 10$ |
| - Max. | $1: 30$ |

## Reference conditions and actuating variables (similar to DIN EN 60770-1)

Reterence conditions according to DIN EN 61298-1

- Temperature
- Relative humidity
- Air pressure

Determination of characteristics
Characteristics
Calibration position
$+18 \ldots+30^{\circ} \mathrm{C}\left(+64 \ldots+86^{\circ} \mathrm{F}\right)$
45 ... $75 \%$
860 ... $1060 \mathrm{mbar} / 86 \ldots 106 \mathrm{kPa}$ (12.5 ... 15.4 psi )
limit point adjustment according to DIN 16086
linear
upright, diaphragm points downward

## Deviation determined according to the limit point method according to IEC 60770"

Applies to digital HART interface as well as to analogue current output $4 \ldots 20 \mathrm{~mA}$. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span. Deviation

- Turn down 1:1 up to 5:1 <0.075\%
- Turn down > $10: 1$
- Turn down 1:1 up to 5:1 < $0.05 \%$
- Turn down > $10: 1 \quad<0.01 \% \times$ TD

Deviation with absolute pressure measuring range 0.1 bar

- Turn down 1: 1 up to 5 : 1
< 0.25 \% x TD
- Turn down > $10: 1<0.05 \% \times$ TD


## Influence of the product or ambient temperature

Applies to digltal HART interiace as well as to analogue current output $4 \ldots 20 \mathrm{~mA}$. Specifications refer to the set span. Tum down (TD) = nominal measuning range/set span.
Average temperature coefficient of the zero signal
In the compensated temperature range $0 \ldots+100^{\circ} \mathrm{C}\left(212^{\circ} \mathrm{F}\right)$,
reference temperature $20^{\circ} \mathrm{C}\left(68^{\circ} \mathrm{F}\right)$.
Average temperature coefficient of the zero signal

- Turn down 1:1 < $0.05 \% / 10 \mathrm{~K}$
- Turn down $1: 1$ up to $5: 1 \quad<0.1 \% / 10 \mathrm{~K}$
- Turn down up to 10 : 1
< $0.15 \% / 10$ K
Outside the compensated temperature range
Average temperature coefficient of the zero signal
- Turn down 1 : 1
typ. $<0.05 \% / 10 \mathrm{~K}$
Thermal change, current output
Applies also to the anaiogue $4 \ldots 20 \mathrm{~mA}$ current output and
refers to the set span.
Thermal change, current output $<0.15 \%$ at $-40 \ldots+80^{\circ} \mathrm{C}\left(-40 \ldots+176{ }^{\circ} \mathrm{F}\right)$

Long-term stability (similar to DIN 16086, DINV 19259-1 and IEC 60770-1)
Applies to digital interfaces (HART, Profibus PA, Foundation
Fieldbus) as well as for the analogue current output $4 \ldots 20 \mathrm{~mA}$.
Specifications refer to the set span. Turn down (TD) = nominal
measuring range/set span.
Long-term drift of the zero signal < $0.1 \% \times$ TD $) / 1$ year

## Amblent conditions

Ambient, storage and transport temperature

- Connection cable PE $\quad-40 \ldots+60^{\circ} \mathrm{C}\left(-40 \ldots+140^{\circ} \mathrm{F}\right)$
- Connection cable PUR, FEP $\quad-40 \ldots+85^{\circ} \mathrm{C}\left(-40 \ldots+185{ }^{\circ} \mathrm{F}\right)$


## Process condlitions

## VEGABAR 74

Product temperature depending on the measuring cell seal

- FKM (e.g. Viton)
- EPDM
- Kalrez 6375 (FFKM)
- Chemraz 535

VEGABAR 75
Medium temperature (temperature: $\mathrm{pabs}>1 \mathrm{bar}(14.5 \mathrm{psi}) / \mathrm{p}_{\mathrm{abs}}<1 \operatorname{bar}(14.5 \mathrm{psi})$

- Standard
$-12 \ldots+150^{\circ} \mathrm{C} /-12 \ldots+130^{\circ} \mathrm{C}\left(+10 \ldots+302^{\circ} \mathrm{F} /+10 \ldots+266^{\circ} \mathrm{F}\right)$
$-12 \ldots+180^{\circ} \mathrm{C} /-12 \ldots+130^{\circ} \mathrm{C}\left(+10 \ldots+356^{\circ} \mathrm{F} /+10 \ldots+266^{\circ} \mathrm{F}\right)$
$-12 \ldots+200^{\circ} \mathrm{C} /-12 \ldots+130^{\circ} \mathrm{C}\left(+10 \ldots+392^{\circ} \mathrm{F} /+10 \ldots+266^{\circ} \mathrm{F}\right)$

[^18]```
Common data
Vibration resistance mechanical vibrations with 4 g and \(5 \ldots 100 \mathrm{~Hz}^{2)}\)
Shock resistance
Acceleration \(100 \mathrm{~g} / 6 \mathrm{~ms}^{3}\)
```


## Electromechanical data

Connection cable

- Configuration
four wires, one suspension cable, one breather capillary, screen braiding, metal foil, mantle
- Wire cross-section
$0.5 \mathrm{~mm}^{2}$ (AWG no. 20)
- wire resistance $<0.036 \Omega / \mathrm{m}(0.011 \Omega / t)$
- Standard length 6 m (19.69 ft)
- max. length with VEGADIS 12

200 m ( 656.2 tt )

- Min. bending radius at $25^{\circ} \mathrm{C} / 77^{\circ} \mathrm{F}$ 25 mm ( 0.985 in )
- Diameter approx.

8 mm (0.315 in)

- Colour - standard PE

Black

- Colour - standard PUR

Blue

- Colour - Ex-version

Blue

## Voitage supply

Supply voltage

| - Non-Ex instrument | $12 \ldots 36 \mathrm{VDC}$ |
| :--- | :--- |
| - EEx-ia instrument | $12 \ldots 29 \mathrm{VDC}$ |
| Permissible residual ripple |  |
| $-<100 \mathrm{~Hz}$ | $\mathrm{U}_{\mathrm{ss}}<1 \mathrm{~V}$ |
| $-100 \mathrm{~Hz} \ldots 10 \mathrm{kHz}$ | $\mathrm{U}_{\text {ss }}<10 \mathrm{mV}$ |
| Load | see diagram |



Fig. 9: Voltage diagram
1 HART load
2 Vottage limit Ex instrument
3 Vothage limit non-Ex instrument
4 Supply voltage
Load in conjunction with VEGADIS 12
see diagram

[^19]

Fig. 10: Vohage diagram
HARTioad
2 Vohage limit Ex instrument
3 Vohage limit non-Ex instrument
4 Supply voltage

## Electrical protective measures

| Protection | IP 68 (25 bar)IP 69 K |
| :--- | :--- |
| Overvaltage category | III |
| Protection class | III |

## Approvals ${ }^{253}$

ATEX ia
ATEXD
ATEX ia+D
Ship approval
Other approvals
ATEX II 1G EEx ia IIC T6, ATEX II 2G EEx ia IIC T6
ATEX II 1/2D, 2D IP6XT
ATEX II 1G EEx ia IIC T6, ATEX II 1/2D, 2D IP6X T
GL, LRS, ABS, CCS, RINA, DNV
WHG

## CE conformity

EMC (89/336/EWG)
Emission EN 61326: 1997 (class B), susceptibility EN 61326: 1997/A1: 1998
LVD (73/23/EWG)
EN 61010-1: 2001

## Environmental instructions

VEGA environment management system certified according to DIN EN ISO 14001
You can find detailed information under www.vega.com.

## 7 Dimensions

VEGABAR 74 - threaded fitting


Fig. 11: VEGABAR 74. threaded fiting: $G V=G 1 / 2$ A manometer connection EN837, $G I=G 1 / 2 A$ inner $G Y, ~ A, G G=G 11 / 2, G N=11 / 2 N P T, G M=G 11 / 2 A 70 \mathrm{~mm}$

VEGABAR 74 - hyglenic fltting 1


Fig. 12: VEGABAR 74 - hygienic fiting $C C=T A-C l a m p ~ 1 / 2^{\circ}, C A=T r-C l a m p 22^{\prime}, L A$ $=$ hyglenic fitting with compression nut F40, TA = Tuchenhegan Varivent DN $32, T B=$

Tuchenhagen Varvent DN 25, RAMB = botting DN 4010 N 50 according to DIN 11851, KA = conus DN 40

VEGABAR 74 - hygienic fitting 2


Fig. 13: VEGABAR $74 \mathrm{AA}=\mathrm{DRD}, \mathrm{KA}=$ conus DN 40
VEGABAR 74 - flange filting


Fig. 14: VEGABAR 74 - flange fitting
1 Flange connection according to DIN 2501
2 Flange filing according to ANSI B16.5
3 Flange with extension
4 Order-specific

VEGABAR 74 - threaded fitting for paper Industry


Fig. 15: VEGABAR - connection for paper industry: $B A / B B=M 44 \times 1.25$
VEGABAR 74 - extension fitting for paper industry


Fig. 16: VEGABAR - extension fitting for paper industry: EV/FT = absolutely flush for pulper (EV 2-times flattened), $E G=$ extension for ball valve fitting ( $L=$ order-specific)

VEGABAR 75 - threaded fitting


Fig. 17: VEGABAR - threaded fitting: $G G=G 11 / 2 A, G N=11 / 2 N P T, G L=G 11 / 2 A$ thread length $55 \mathrm{~mm}, B B=M 44 \times 1.25, B E=M 56 \times 1.25$

VEGABAR 75 - hygienic fitting 1


Fig. 18: VEGABAR 75 - hygienic fitting: CANF = Tri-Clamp $22^{2} /$ Tri-Clamp 21⁄2", LA = hygienic fitting with compression nut F40, TA = Tuchenhagen Varivent DN 32, RV/ $R W=$ bolting DN $4 O D N 50$ according to DIN 11851, KA = conus DN $40, A A=D R D$

## VEGABAR 75 - hygienic fitting 2

Fig. 19: VEGABAR 75 - hygienic fitting: $S A=S M S D N 38, S B=S M S D N 51$


VEGABAR 75 - flange fitting


Fig. 20: VEGABAR - flange connection
Flange connection according to DIN 2501
Flange fitting according to ANSI B16.5

8 Product code

## VEGABAR 74


Approval
xX without
XM Ship approva
CX ATEXII 1G EEx la IC $T$,
AX ATEX II 2 GEEx ia $\| C$ T
AM ATEX II 2GEEx ia HC T6 + Ship approval
Process fiting / Material
GI G1/2A inner GYA PN160/316L
GG Thread G11/2A PN60 / 316L
CA Tri-Clamp 2" PN16/316L
Hyg.connection w. compression
Varivent N50-40 PN25 /316L
RA Bolting ON4OPN40 DIN11851/316L
R Boling DNSOFN25 DIN11851/316L
BA M44×1.25 with pressure screw Alu PN25/316L
BB M44×1.25; with pressure screw PN60 $/ 316 \mathrm{~L}$
EA Flange DN4OPN40 Form C. DiN2501 / 316L
FB Flange DN50PN40 Form C. DIN2501 / 316L
FH Flange ON80PN40 Form C. DIN2501/316L
Fl Flange 2" $\mathbf{3}^{*}$ 1501b RF, ANSI B16.5 / 316L
lange $3^{*} 1501 \mathrm{~b}$ RF, ANSI B16.5 / 316L
Seal maasuring cell
2 Kalrez 6375
3 EPDM
Pressure / measuring range
A rel. $10 . .0 .1 \mathrm{bar}(0 . .10 \mathrm{kPa})$
rel. $10 . . .0 .2 \mathrm{bar}(0 \ldots . .20 \mathrm{kPa})$
C rel. $10 \ldots . .0 .4 \mathrm{bar}(0 . . .40 \mathrm{kPa})$
E rel. $10 \ldots .2 .5 \mathrm{bar}(0 \ldots .100 \mathrm{kPa})$
F rel. $10 \ldots . .5 \mathrm{bar}(0 \ldots .250 \mathrm{kPa})$
G rel $10 . . .5 .0 b a r$ ( $0 \ldots . .500 \mathrm{kPa}$ )
H cel 10 . $25.0 \mathrm{bar}(0 \ldots 1000 \mathrm{kPa})$
U rel $10 . .250$ bar ( $0 \ldots 2500 \mathrm{kPa}$
Prel $/-1$ 0
Q rel / - $1.15 \mathrm{bar}(-100 \quad 150 \mathrm{kPa})$
R rel. / -1...5.0bar $(-100 \ldots 500 \mathrm{kPa})$
S rel. / -1...10.Obar ( $-100 \ldots 1000 \mathrm{kPa}$ )
T rel. / $-1 \ldots 25.0$ bar $(-100 \ldots 250 \mathrm{kPa})$

$K$ rel. $/-0.05 \ldots . .0 .05$ bar $(-5 \ldots 5 \mathrm{kPa})$
L rel. $/-0.1 \ldots 0.1$ bar $(-10 \ldots 10 \mathrm{kPa})$
M rel. $/-0.2 \ldots . .0 .2 \mathrm{bar}(-20 \ldots .20 \mathrm{kPa})$
O rel. $/-0.5 \ldots 0.5 \mathrm{bar}(-50 \ldots . .50 \mathrm{kPa})$
I abs. $/ 0 . .0,1$ bar ( $0 . . .10 \mathrm{kPa}$ )
1 abs. $10 \ldots 1.0 \mathrm{bar}(0 \ldots 100 \mathrm{kPa})$
2 abs. $10 \ldots . . .5 .0 b a r(0 . . .500 \mathrm{kPa})$
4 abs. $10 \ldots 10.0 \mathrm{bar}(0 . .1000 \mathrm{kPa})$
Elactronics
Electrical connectlon / Protectlon
A Direct cable ouller axial / IP6B
Cablo materlal / Lateral / IP68
$1 \mathrm{PE} / 6 \mathrm{~m}$
2 PE / Special length
3 PUR / Special length
FEP / Special length
Overvoltage arrester
$x$ without
B
B
with
"Deviation in characteristic 0.25\%
${ }^{2}$ ) Only in conjunction with Approval ' XX ' or ' AX

VEGABAR 75

Indicating and adjustment

年

## Product Information



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## Take note of safety Instructions for Ex applications

Please note the Ex specific safety information which you will find on our homepage www.vega.comlservicesldownloads and which come with the appropriate instrument with Ex approval. In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units. Each VEGADIS with Ex approval is an associated, intrinsically safe instrument and must not be installed in hazardous areas.

## 1 Product description

In continuous measurement, the level in a vessel or the pressure in a pipeline, for example, is detected by a sensor. The measured value is converted into an analogue $4 \ldots 20 \mathrm{~mA}$ output signal or a digital output signal, e.g. Profibus PA. The output signal is then further processed, e.g. in a PLCS or a control system.
On-site indication of the measured value or sensor adjustment is often desired. To fulfill this need, VEGA offers a wide range of indicating instruments. Indication, power supply and mounting differ depending on the model. This product information manual provides an overview and helps you select a suitable instrument.

## VEGADIS 11

VEGADIS 11 is a universal, digital indicating instrument that operates without additional power. It is used for remote (i.e. at some distance from the measuring site) measured value indication. VEGADIS 11 can be connected at any point to the $4 \ldots 20 \mathrm{~mA}$ signal cable. It is suitable for any VEGA sensor as well as sensors from other manufacturers, i.e. for active (four-wire) as well as passive (two-wire) sensors.


Fig. 1: Configuration VEGADIS 11
1 To the sensor
2 To the processing system

## Advantages:

- Universal use for active or passive $4 \ldots 20 \mathrm{~mA}$ sensors
- No separate external energy required
- mounting to the wall or on carrier rail


## VEGADIS 12

VEGADIS 12 is a digital indicating instrument that operates without additional power. It is used for remote (i.e. at some distance from the measuring site) measured value indication and adjustment of VEGABAR 74, 75 and VEGAWELL $72-4 \ldots 20 \mathrm{~mA} /$ HART hydrostatic pressure transmitters. VEGADIS 12 can be connected at any point to the $4 \ldots 20 \mathrm{~mA}$ signal cable. It is provided with a breather facility for sensor ventilation via the capillary line in the special cable.


Fig. 2: Configuration VEGADIS 12
1 To the sensor
2 To the processing system

## Advantages:

- No separate external energy required
- mounting to the wall or on carrier rail


## VEGADIS 61

VEGADIS61 is an external indicating and adjustment module that operates without additional power. It is used for remote (i.e. at some distance from the measuring site) measured value indication and adjustment of VEGA plics ${ }^{\Phi}$ sensors. The sensors can be 4 ... 20 mA , Profibus PA or Foundation Fieldbus sensors. VEGADIS 61 is connected to the sensors with a standard four-wire screened cable up to 25 m long. Communication is carried out via this cable and, what is more, VEGADIS 61 is powered by the sensor. An additional power supply is not required.

## PLICSCOM

The indicating and adjustment module PLICSCOM is used for measured value indication, adjustment and diagnosis of VEGA plics ${ }^{\Phi}$ sensors. It is mounted in the respective sensor housing or in the external indicating and adjustment module VEGADIS 61. After mounting, the sensor and PLICSCOM are splash-proof even without housing cover.

An integrated backlightenables readingeven under unfavourable lighting conditions. As an option, the display can also be equipped with heating that ensures good readability at low temperatures down to $-40^{\circ} \mathrm{C}\left(-40^{\circ} \mathrm{F}\right)$.


Fig. 3: Configuration VEGADIS 61 and PLICSCOM
1 Sensor
2 VEGADIS 61
3 PLICSCOM

## Advantages:

- Universal use for all plics ${ }^{\text {® }}$ sensors
- Splash-proof adjustment with open cover
- No separate external energy required
- mounting VEGADIS 61 to the wall, on carrier rail or tube


## VEGADIS 175

VEGADIS 175 is a digital indicating instrument for front panel mounting. It can be connected at any point to the $4 \ldots 20 \mathrm{~mA}$ signal cable and is suitable for active (four-wire) as well as passive (two-wire) sensors.

## -

Fig. 4: Configuration VEGADIS 175
1 To the sensor
2 VEGADIS 175
3 To the processing system

## Advantages:

- Universal use for passive or $4 \ldots 20 \mathrm{~mA}$ sensors
- No separate external energy required


### 1.1 Application examples

## Pump shaft



Fig. 5: Leval measurement in a pump shah with VEGAWELL 72, remote indication and edjustment whth VEGADIS 12

For hydrostatic level measurement in a pump shaft, VEGADIS 12 together a VEGAWELL 72 is well suited for remote indication and adjustment. The min./max. adjustment is carried out on site and the actual measured value can be read out during operation.

## Chip allo



Fig. 6: Level measuramentin a chip stlo with VEGAPULS 68, remote indication and adjustment with VEGADIS 61

In non-contact level measurement in a chip silo with VEGAPULS 68, the mounting location is not directly accessible. For that reason VEAGDIS 61 is an excellent solution for remote indication
and adjustment. The min./max. adjustment can be carried out locally with or without filling.

## 2 Type overview

Indication:
Signal:
Sensors:

Mounting:
Ambient temperature:

Indication:
Signal:
Sensors:
Mounting:
Ambient temperature:

digital and quasi-analogue
4 ... $20 \mathrm{~mA}, 4$... $20 \mathrm{~mA} / \mathrm{HART}$
4 ... 20 mA passive or active

Wall, rail mounting
$-20^{\circ} \ldots+70^{\circ} \mathrm{C}\left(-4 \ldots+158^{\circ} \mathrm{F}\right)$

PLICSCOM


Dot-Matrix
$1^{2} \mathrm{C}$ bus
plics ${ }^{*}$ sensors
in the sensor or in VEGADIS 61
$-15 \ldots+70^{\circ} \mathrm{C}\left(+5 \ldots+158^{\circ} \mathrm{F}\right)$

digital and quasi-analogue
$4 \ldots 20 \mathrm{~mA}, 4 \ldots 20 \mathrm{~mA} / \mathrm{HART}$
VEGABAR 74, 75; VEGAWELL plics ${ }^{\text {® }}$ sensors 72-4... 20 mA/HART

Wall, rail mounting
$-20 \ldots+70^{\circ} \mathrm{C}\left(-4 \ldots+158^{\circ} \mathrm{F}\right)$

VEGADIS 175

digital
$4 \ldots 20 \mathrm{~mA}, 4 \ldots 20 \mathrm{~mA} / \mathrm{HART}$
4 ... 20 mA passive or active
Front panel
$-10 \ldots+60^{\circ} \mathrm{C}\left(+14 \ldots+140^{\circ} \mathrm{F}\right)$

## 3 Mounting instructions

## VEGADIS 11 and VEGADIS 12

VEGADIS 11 and VEGADIS 12 are configured for the following installation and mounting options:

- Carrier rail $35 \times 7.5$ according to EN 50022
- Wall mounting


## Carrier rall mounting



Fig. 7: VEGADIS 11 and VEGADIS 12 carrier rail mounting
1 Camier rail

## Wall mounting



Fig. 8: VEGADIS 11 and VEGADIS 12 wall mounting
1 Drill dimension

## VEGADIS 61

VEGADIS 61 can be mounted in the following ways:

- Carrier rail $35 \times 7.5$ according to EN 50022
- Wall mounting
- Tube mounting


Fig. 9: VEGADIS 61 for wall mounting, boltom view of mounting plate.
1 Drill dimension

## Carrier rall mounting

VEGADIS 61 for mounting on carrier rail is supplied with a mounting adapter.


Fig. 10: VEGADIS 61 for mounting on carrier rail
1 Adapter plate
2 Screw M4 $\times 6$
3 Carrier rail

Tube mounting
VEGADIS 61 for tube mounting is supplied with the measuring instrument holder BARMONT.C (comes with delivery as mounting accessory).


Fig. 11: VEGADIS 61 for tube mounting
14 screws M5 $\times 12$
2 Measuring instrument hoider BARMONT.C
3 Tube

## Wall mounting

VEGADIS 61 for wall mounting is supplied with a mounting socket.


Fig. 12: Measuring instrument holder BARMONT.C
$14 \times$ holes 5 mm for mounting screws M5 $\times 12$

## PLICSCOM

The indicating and adjustment module PLICSCOM can be inserted in the following housing versions and instruments:

- All sensors of the plics ${ }^{\circledR}$ instrument family, in the single as well as in the double chamber housing (optionally in the electronics or connection compartment)
- External indicating and adjustment unit VEGADIS 61


## VEGADIS 175

VEGADIS 175 can be mounted in the following ways:

- Front panel mounting


## Front panel mounting



Fig. 13: VEGADIS 175 for panel mounting

```
1 Front panel
1 Front panel
3 Screw
```


## 4 Connecting to power supply

### 4.1 Preparing the connection

## Note safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, overvoltage arresters should be installed
1 Tip:
We recommend VEGA overvoltage arresters B61-300 (power supply VEGADIS) and B62-36G (sensor supply).


## Take note of safety instructions for Ex applications



In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

## Selecting connection cable

Standard two-wire cable without screen is used for connection of the sensors.

## Cable screening and grounding

Connect the cable screen on both ends to ground potential. In the sensor, the screen must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation.
If potential equalisation currents are expected, the screen connection on VEGADIS must be made via a ceramic capacitor (e.g. $1 \mathrm{nF}, 1500 \mathrm{~V}$ ). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

## Select connection cable for Ex applications

Take note of the corresponding installation regulations for Ex applications. In particular, make sure that no potential equalisation currents flow over the cable screen. In case of grounding on both sides this can be achieved by the use of a capacitor or a separate potential equalisation.

### 4.2 Wiring plan, VEGADIS 11

## Passive sensors



Fig. 14: Wiring plan, VEGADIS 11 for passive sensors
Sensor (passive)
2 Indicaling module (assignment see chant)
3 Control instrument

## Note:

Passive sensors need a power supply. They represent current sinks and emboss a current of $4 \ldots 20 \mathrm{~mA}$ to the supply circuit. The supply voltage is loop through VEGADIS 11. On the output (terminals $1 / 2$ ), VEGADIS 11 provides the power supply for the connected sensors. Power supply and measured value transmission are carried along the same two-wire cable.

## Active sensors



Fig. 15. Wiring plan, VEGADIS 11 for active sensors
1 Sensor (active)
2 Indicating module
3 Controlinstrument
4 Vottage supply/Signal output

## Note:

The input (terminals 10/11) is provided for connection of transmitters with own, separate power supply. The output (terminal $1 / 2$ ) is bridged.

Sensors with signal conditioning instrument


Fig. 16: Wining plan, VEGADIS 11 for signal conditioning instrument
Signal conditioning instrument
2 Indicating module
3 Control instrumen

## -

Note:
The input (terminals 10/11) is provided for connection of signal conditioning instruments. Connection and operation in Ex ia is not possible. The output (terminal $1 / 2$ ) is bridged.

### 4.3 Wiring plan, VEGADIS 12



Fig. 17: Wiring plan, VEGADIS 12

[^20]
### 4.4 Wiring plan, VEGADIS 61

## Wiring plan



Fig. 18: Wining plan, single chamber housing
1 plics ${ }^{\text {* }}$ sensor
2 Grounding on both ends with non-Ex. With Ex, grounding at one sensor end is recommended, see EN 60079-14.

### 4.5 Wiring plan, VEGADIS 175

## Passive sensors



Fig. 19: Wiring plan, VEGADIS 175 for passive sensors
1 Sensor (passive)
2 Bridged internally
3 Voltage supply/Signal output
4 Exarea
5 Nor-Ex area

Connecting to power supply

Active sensors


Fig. 20: Wiring plan, VEGADIS 175 for active sensors
1 Sensor (active)
Eridgedintemally

## 5 Operation

### 5.1 Adjustment on VEGADIS 11

The display is located in the housing cover, the adjustment elements are accessible after removing the cover.


Fig. 21: Indicating and adjustment elements
1 Digital indication
2 Bar graph indication
3 Tendency indication
4 Rotary switch
5 Adjustment keys +/-

## Key functions

- [Rotary swifch] to select:
- Operate $=$ Measured value indication
- ZERO = Adjustment of the min. value
- SPAN = Adjustment of the max. value
- Point $=$ Shitting of the decimal point
- [+/-] key:
- Change value of the digital indication


### 5.2 Adjustment on VEGADIS 12

The display is located in the housing cover, the adjustment elements are accessible after removing the cover.


Flg. 22: Indicating and adjustment elements
1 Digital indication
2 Bar graph indication
3 Tendency indication
4 Rotary switch "ndication"
5 Adjustment keys + -display
6 Rotary switch "Pressure transmitter"
7 Adjustment keys $+/$ - Pressure transmitter

## Key functions

- [Rotary switch] to select:
- Operate $=$ Measured value indication
- ZERO = Adjustment of the min. value
- SPAN = Adjustment of the max. value
- Point $=$ Shifting of the decimal point
- [+/-] key:
- Change value of the digital indication


### 5.3 Adjustment on VEGADIS 61 and PLICSCOM



Fig. 23: Indicating and adjustment elements
1 LC display
2 Indication of the menu item number
3 Adjustment keys

## Key functions

- [OK] key:
- Move to the menu overview
- Confirm selected menu
- Edit parameter
- Save value
- $[\rightarrow]$ key to select:
- menuchange
- list entry
- Select editing position
- [+] key:
- Change value of the parameter
- [ESC]key:
- interrupt input
- jump to the next higher menu


### 5.4 Adjustment on VEGADIS 61 with PACTware ${ }^{\text {TM }}$

## PACTware ${ }^{\text {TM/DTM }}$

plics ${ }^{\oplus}$ sensors can be adjusted via PACTware ${ }^{\text {TM }}$ independent of the respective signal output $4 \ldots 20 \mathrm{~mA} / \mathrm{HART}$, Profibus PA or Foundation Fieldbus via VEGADIS 61. To adjust with PACTware ${ }^{\text {TM }}$, an instrument driver for the particular sensor is required.
All currently available VEGA DTMs are provided as DTM Collection with the current PACTware ${ }^{\text {TM }}$ version on CD. They are available from the responsible VEGA agency for a tokenfee. The basic version of this DTM Collection incl. PACTware ${ }^{\text {TM }}$ is available as a free-of charge download from Internet.

To use the entire range of functions of a DTM, incl. project documentation, a DTM licence is required for that particular instrument family. This licence can be bought from the VEGA agency serving you.

## Connection of the PC to VEGADIS 61



Fig. 24: Connection to VEGADIS 61
1 AS232 connection
2 VEGADIS 61
$3 I^{2} C$ adapter cable for VEGACONNECT 3
To adjust with PACTware ${ }^{\text {TM }}$, a VEGACONNECT 3 with ${ }^{2} \mathrm{C}$ adapter cable (art. no. 2.27323) as well as a power supply unit is necessary in addition to the PC and the suitable VEGA-DTM.

### 5.5 Adjustment on VEGADIS 175

Indication and adjustment are carried out on the front via a clear LC display and three keys.


Fig. 25: Indicating and adjustment elements
1 Digltal indication
2 Key (OK)
3 Adjustment keys +/-

## Key functions

- [OK] key:
- Move to the menu overview
- Confirm selected menu
- Edit parameter
- Save value
- $[+] / \pi-]$ keys:
- Change value of the parameter


## 6 Technical data

## General data

VEGADIS 11, 12

Series

Materials

- Housing
- Inspection window of the indication
- Breather facility
- Ground terminal

Weight approx.
VEGADIS 61
Series

Materials

- Housing
- Inspection window in housing cover
- Ground terminal

Weight, depending on the housing material and mounting technology

PLICSCOM
Series
Materials

- Housing
- Inspection window

Weight approx.
VEGADIS 175
Series
Materials

- Housing front
- Housing
- Rear of the housing

Weight approx.

Instrument for panel or wall mounting or mounting on carrier rail $35 \times 7.5$ according to EN 50022
plastic PBT
Lexan
PTFE filter element
316TV/316L
400 g ( 0.882 lbs )

Instrument for panel or wall mounting or mounting on carrier rail $35 \times 7.5$ according to EN 50022

Plastic PBT, Alu die-casting powder-coated, 316L
Polycarbonate (UL-746-C listed)
316T1/316L
$500 \ldots 1300 \mathrm{~g}(1.10 \ldots 2.87 \mathrm{lbs})$

Module for insertion in VEGADIS 61

ABS
Polyester foil
100 g ( 0.22 lbs )

Module unit for front panel mounting

Alu die-casting
Sheet steel galvanized
ABS
300 g ( 0.66 lbs )

Input

VEGADIS 11
Connection to

Transmission
Max. input current
Connection cable to the sensor
Voltage loss
VEGADIS 12
Connection to

Transmission
Max. input current
Connection cable to the sensor
Max. cable length
Voltage loss
VEGADIS 61
Connection to
Data transmission
Connection cable
Max. cable length
VEGADIS 175
Transmission
individual passive or active sensors $4 \ldots 20 \mathrm{~mA} / \mathrm{HART}$
analogue, 4 ... 20 mA
150 mA
2-wire
4.5 V at 20 mA

VEGAWELL 72-4... 20 mA/HART, VEGABAR 74, 75
analogue, $4 \ldots 20 \mathrm{~mA}$
150 mA
3-wire (VEGA special cable with breather capillaries or standard cable)
200 m
4.5 V at 20 mA

VEGA plics ${ }^{6 \pi}$ sensors
digital ( $1^{2} \mathrm{C}-\mathrm{Bus}$ )
4-wire, screened
25 m
analogue, $4 \ldots 20 \mathrm{~mA}$ (reverse battery protection)

| HART protocol | The indicator is suitable for transmission of the HART protocol |
| :--- | :--- |
| Max．input current | 150 mA （shortcircuit current） |
| Voltage loss | $<2 \mathrm{~V}$ with 20 mA |

## Indications

VEGADIS 11， 12
LC multiple function display
－Bargraph（quasianalogue indication） 20 segments
－Digital value
－Tendency indicators
VEGADIS 61，PLICSCOM
LC display
Power supply display light
Power supply display heating
－Operating voltage
－9999 ．．． 9999
Symbols for rising or falling values
in dot matrix
through the sensor，voltage range see sensor operating instructions manual

24 V DC＋5 \％
－Power
1.7 W
－Switch on point
$-5^{\circ} \mathrm{C}\left(+23^{\circ} \mathrm{F}\right)$
VEGADIS 175
LC display
－Height of figures 17 mm
－Indication range
－19999 ．．． 19999
－Offset
－19999 ．．． 32767

## Ambient conditions

VEGADIS 11， 12
Ambient temperature
$-20 \ldots+70^{\circ} \mathrm{C}\left(-4 \ldots+158^{\circ} \mathrm{F}\right)$
Storage and transport temperature
$-40 \ldots+85^{\circ} \mathrm{C}\left(-40 \ldots+185^{\circ} \mathrm{F}\right)$
VEGADIS 61，PLICSCOM
Ambient temperature
Ambient temperature with heating
$-15 \ldots+70^{\circ} \mathrm{C}\left(+5 \ldots+158^{\circ} \mathrm{F}\right)$

Storage and transport temperature
$-40 \ldots+70^{\circ} \mathrm{C}\left(-40 \ldots+158^{\circ} \mathrm{F}\right)$

VEGADIS 175
Ambient temperature
Storage and transport temperature
Climatic class
$-40 \ldots+80^{\circ} \mathrm{C}\left(-40 \ldots+176^{\circ} \mathrm{F}\right)$
$-10 \ldots+60^{\circ} \mathrm{C}\left(+14 \ldots+140^{\circ} \mathrm{F}\right)$
$-25 \ldots+70^{\circ} \mathrm{C}\left(-13 \ldots+158^{\circ} \mathrm{F}\right)$
according to EN 60654－1，class B2

## Electrical protective measures

VEGADIS 11， 12
Protection IP 67
Overvoltage category III
Protection class III
VEGADIS 61
Protection
Overvoltage category III
Protection class II

## PLICSCOM

Protection
－unassembled IP 20
－mounted into VEGADIS 61 without cover
IP 40
VEGADIS 175
Protection
－between front frame and front panel IP 65
－Terminal IP 20

| ESD | $6 \mathrm{kV} / 8 \mathrm{kV}$ |
| :--- | :--- |
| Electromagnetic fields | $10 \mathrm{~V} / \mathrm{m}$ |
| Burst (power supply) | 2 kV |
| Surge | 1 kV |
| Electromagnetic fields | $10 \mathrm{~V} / \mathrm{m}$ |

## Approvals"

VEGADIS 11
ATEX ATEXII 2G EEx ia IIC T6

VEGADIS 12
ATEX ATEX II 2G EEx ia IIC T6

UL
Cl. I,II,II; Div. 1; Gr. A-G

VEGADIS 61
ATEXia
ATEX D ATEXII 1/2D IP6XT
IEC
IEC Ex ia IIC T6
FM
FM CIII-III, Div1 (IS)
CSA
CSA CII-III, Div1 (IS)
VEGADIS 175
ATEX

## ATEX II 1G EEX ia IIC T6

## Environmental instructions

VEGA environment management system certified according to DIN EN ISO 14001
You can find detailed information under www.vega.com.
" Deviating data in Ex applications: see separate safety instructions.

## 7 Dimensions

VEGADIS 11， 12


Fig．26：VEGADIS 11， 12

## VEGADIS 61



Fig．27：VEGADIS 61

PLICSCOM


Fig．28：PLICSCOM
VEGADIS 175


Fig．29：VEGADIS 175

## 8 Product code

## VEGADIS 11



VEGADIS 12


VEGADIS 61


PLICSCOM


VEGADIS 175


Halmac Services (Qldd) Pty. Ltd.
A.B.N. 40741712113

## SOFT STARTER

## 1. MSF SOFT STARTER TECHNICAL DETAILS

Valid for the following Soft starter Models: MSF-017 to MSF-1400

## MSF

SOFT STARTER
INSTRUCTION MANUAL

Document number: 01-1363-01
Edition: r2
Date of release: 2001-04-20
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## SAFETY INSTRUCTIONS

## Safety

The soft starter should be installed in a cabinet or in an electrical control room.

- The device must be installed by trained personnel.
- Disconnect all power sources before servicing.
- Always use standard commercial fuses, slow blow e.g. type gl, gG, to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valid even if superfast semiconductor fuses are not used.


## Operating and maintenance personnel

1. Read the whole Instruction Manual before installing and putting the equipment into operation.
2. During all work (operation, maintenance, repairs, etc.) observe the switch-off procedures given in this instruction as well as any other operating instruction for the driven machine or system. See Emergency below.
3. The operator must avoid any working methods which reduce the safety of the device.
4. The operator must do what he can to ensure that no unauthorised person is working on the device.
5. The operator must immediately report any changes to the device which reduce its safety to the user.
6. The user must undertake all necessary measures to operate the device in perfect condition only.

## Installation of spare parts

We expressly point out that any spare parts and accessories not supplied by us have also not been tested or approved by us.

Installing and/or using such products can have a negative effect on the characteristics designed for your device. The manufacturer is not liable for damage arising as a result of using non-original parts and accessories.

## Emergency

You can switch the device off at any time with the mains switch connected in front of the soft starter (both motor and control voltage must be switched off).

## Dismantling and scrapping

The enclosure of the soft starter is made of recyclable material as aluminium, iron and plastic. Legal requirements for disposal and recycling of these materials must be complied with.

The soft starter contains a number of components demanding special treatment, as for example thyristors. The circuit board contain small amounts of tin and lead. Legal requirements for disposal and recycling of these materials must be complied with.

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### 1.1 Integrated safety systems

The device is fitted with a protection system which reacts to:

- Over temperature.
- Voltage unbalance.
- Over- and under voltage.
- Phase reversal
- Phase loss
- Motor overload protection thermal and PTC.
- Motor load monitor, protecting machine or process max or min alarm
- Starts per hour limitation

The soft starter is fitted with a connection for protective earth $\stackrel{\perp}{=}$ (PE).

MSF soft starters are all enclosed IP 20, except MSF-1000 and MSF-1400 which are delivered as open chassi IP00.

### 1.2 Safety measures

These instructions are a constituent part of the device and must be:

- Available to competent personnel at all times.
- Read prior to installation of the device.
- Observed with regard to safety, warnings and information given.

The tasks in these instructions are described so that they can be understood by people trained in electrical engineering. Such personnel must have appropriate tools and testing instruments available. Such personnel must have been trained in safe working methods.

The safety measures laid down in DIN norm VDE 0100 must be guaranteed.

The user must obtain any general and local operating permits and meet any requirements regarding:

- Safety of personnel.
- Product disposal.
- Environmental protection.

NOTE! The safety measures must remain in force at all times. Should questions or uncertainties arlse, please contact your local sales outlet.

### 1.3 Notes to the Instruction Manual



WARNING: Warnings are marked with a warning trlangle.

## Serial number

The information given in these instructions only applies to the device with the serial number given on the label on the front page. A plate with the serial number is fixed to the device.

## Important

For all enquiries and spare parts orders, please quote the correct name of the device and serial number to ensure that your inquiry or order is dealt with correctly and swiftly.

NOTE! These Instructions only apply to the soft starters having the serial number given on the front page, and not for all models.

### 1.4 How to use the Instruction Manual

This instruction manual tells you how to install and operate the MSF soft starter. Read the whole Instruction Manual before installing and putting the unit into operation. For simple start-up, read chapter 2. page 8 to chapter 3. page 10.

Once you are familiar with the soft starter, you can operate it from the keyboard by referring to the chapter 13. page 79. This chapter describes all the functions and possible setting.

### 1.5 Standards

The device is manufactured in accordance with these regulations.

- IEC 947-4-2
- EN 60204-1 Electrical equipment of machines, part 1, General requirements and VDE 0113.
- EN 50081-2, EMC Emission
- EN 50081-1, EMC Emission with bypass
- EN 50082-2, EMC Immunity
- GOST
- UL508


### 1.6 Tests in accordance with norm EN60204

Before leaving the factory, the device was subjected to the following tests:

- Through connection of earthing system;
a) visual inspection.
b) check that earthing wire is firmly connected.
- Insulation
- Voltage
- Function


### 1.7 Inspection at delivery



Fig. 1 Scope of delivery.

### 1.7.1 Transport and packing

The device is packed in a carton or plywood box for delivery. The outer packaging can be returned. The devices are carefully checked and packed before dispatch, but transport damage cannot be ruled out.

## Check on receipt:

- Check that the goods are complete as listed on the delivery note, see type no. etc. on the rating plate.


## Is the packaging damaged?

- Check the goods for darnage (visual check).


## If you have cause for complaint

If the goods have been darnaged in transport:

- Contact the transport company or the supplier immediately.
- Keep the packaging (for inspection by the transport company or for returning the device).


## Packaging for returning the device

- Pack the device so that it is shock-resistant.


## Intermediate storage

After delivery or after it has been dismounted, the device can be stored before further use in a dry room.

### 1.8 Unpacking of MSF-310 and larger types

The soft starter is attached to the plywood box/loading stool by screws, and the soft starter must be unpacked as follows:

1. Open only the securing plates at the bottom of the box (bend downwards). Then lift up the box from the loading stool, both top and sides in one piece.
2. Loosen the three ( 3 pcs ) screws on the front cover of the soft starter, down by the lower logo.
3. Push up the front cover about 20 mm so that the front cover can be removed.
4. Remove the two ( 2 pcs ) mounting screws at the bottom of the soft starter.
5. Lift up the soft starter at the bottom about 10 mm and then push backwards about 20 mm so that the soft starter can be removed from the mounting hooks ${ }^{\star}$ at the top. The hooks are placed under the bottom plate and cannot be removed until the soft starter is pulled out.
6. Loosen the screws ( 2 pcs ) for the mounting hooks and remove the hooks.
7. The hooks are used as an upper support for mounting the soft starter.


Fig. 2 Unpacking of MSF-310 and larger models.
2. DESCRIPTION

### 2.1 General

The MSF is installed directly between the mains and the supply cable to the motor. If a mains contactor is used it can be activated by the integrated K1 relay.


The MSF is developed for soft starting, stopping and braking three-phase motors.

There are 3 different kinds of soft starting control methods:

## - Control method 1-Phase

The single phase controlled soft starters provide only a reduction in starting torque no control of current or torque. These starters need a main and bypass contactor as well as external motor protections. This is a open loop voltage controller. These starters are mainly in the power up to 7.5 kW .

- Control method 2-Phase The two phase starters can start a motor without a mains contactor, but in that case voltage still is present at the motor when it's stopped. These starters are mainly in the power up to 22 kW .
- Control method 3-Phase

In the three phase Soft Starters there are different technologies:

- Voltage control
- Current control
- Torque control


## Voltage control

This method is the most used control method. The starter gives a smooth start but doesn't get any feedback on current or torque. The typical settings to optimize a voltage ramp are: Initial voltage, ramp time, dual ramp time.


Fig. 3 Voltage control

## Current control

The voltage ramp can be used with a current limit which stops the voltage ramp when the set maximum current level is reached. The maximum current level is the main setting and must be set by the user depending the maximum current allowed for the application.


Fig. 4 Current control

## Torque control

Is the most sufficient way of starting motors. Unlike voltage and current based systems the soft starter monitors the torque need and allows to start with the lowest possible current. Using a closed loop torque controller also linear ramps are possible. The voltage ramp can not hold back the motor starting torque this results in a current peak and unlinear ramps. In the current ramp there will be no peak current, but a higher current for a longer period of time during the start compared to torque control. Current starting doesn't give linear ramps. The linear ramps are very important in many applications. For an example, to stop a pump with an unlinear ramp will give water hammer. Soft starters which doesn't monitor the torque, will start and stop to fast if the load is lighter than the setting of current or ramp time.


Fig. 5 Torque control

### 2.2 MSF control methods

MSF Soft Starters control all three phases supplied to the motor. It manages all the 3 possible starting methods where the closed loop Torque control is the most efficient way of starting and stopping motors.

### 2.2.1 General features

As mentioned above soft starters offer you several features and the following functions are available:

- Torque controlled start and stop
- Current limit control at start
- Application "Pump"
- External analogue input control
- Torque booster at start
- Full voltage start (D.O.L)
- Dual voltage ramp at start and stop
- Bypass
- Dynamic DC-brake or Softbrake
- Slow speed at start and stop
- Jogging forward and reverse
- Four parameter sets
- Analogue output indicating current, power or voltage
- Viewing of current, voltage, power, torque, power consumption, elapsed time etc.
- Integrated safety system acc. to $\$ 1.1$, page 6 , with an alarm list.

3. HOW TO GET STARTED


Fig. 6 Standard wiring.
This chapter describes briefly the set-up for basic soft start and soft stop by using the default "Voltage Ramp" function.


WARNING! Mounting, wifing and setting the device into operation must be carried out by property trained personnel. Before set-up, make sure that the installation is according to chapter 6. page 24 and the Checkllst below.

### 3.1 Checklist

- Mount the soft starter in accordance with chapter 6 . page 24 .
- Consider the power loss at rated current when dimensioning a cabinet, max. ambient temperature is $40^{\circ} \mathrm{C}$ (see chapter 12 . page 74 ).
- Connect the motor circuit according to Fig. 6.
- Connect the protective earth.
- Connect the control voltage to terminals 01 and 02 ( $100-240 \mathrm{VAC}$ or $380-500 \mathrm{VAC}$ ).
- Connect relay K1 (PCB terminals 21 and 22) to the contactor - the soft starter then controls the contactor.
- Connect PCB terminals 12 and 13 to, e.g., a 2-way switch (closing non-return) or a PLC, etc., to obtain control of soft start/soft stop. ${ }^{1}$ )
- Check that the motor and supply voltage corresponds to values on the soft starter's rating plate.
- Ensure the installation complies with the appropriate local regulations.

1) The menu 006 must be put to 01 for start/stop command from keyboard.

### 3.2 Main functions/Applications



WARNING! Make sure that all safety measures have been taken before switching on the supply.

Switch on the control voltage (normally $1 \times 230$ V), all segments in the display and the two LED's will be illuminated for a few seconds. Then the display will show menu 001. An illuminated display indicates there is supply voltage on the PCB. Check that you have mains voltage on the mains contactor or on the thyristors. The settings are carried out according to following:

The first step in the settings is to set menu 007 and 008 to "ON" to reach the main functions 020-025 and motor data 041-046.

NOTE! The main function is chosen according to the application. The tables in the applications and functions selection (table 1, page 15), gives the information to choose the proper main function.

### 3.3 Motor Data

Set the data, according to the motor type plate to obtain optimal settings for starting, stopping and motor protection.

NOTE! The default settings are for a standard 4-pole motor acc. to the nominal power of the soft-starter. The soft starter will run even if no specific motor data is selected, but the performance will not be optimal.

| $0 \mid$ | 0 1 0 <br>    <br>  4 0$\quad 0$ |
| :--- | :--- | :--- | :--- |
|  | Nominal motor voltage |
| Default: | 400 V |
| Range: | $200-700 \mathrm{~V}$ |




NOTEI Now go back to menu 007 and set it to "oFF" and then to menu 001.

### 3.4 Setting of the start and stop ramps

The menu's 002 and 003 can now be set to adjust the start ramp up time and the stop ramp down time.


Estimate the starting-time for the motor/machine. Set "ramp up time" at start ( $1-60 \mathrm{sec}$ ).
Key "ENTER $\leftarrow$ " to confirm new value.
Key "NEXT $\rightarrow$ ", "PREV $\leftarrow$ " to change menu.

| 0 0 4 0 <br>     <br>  0 $F$ $F$ |  |
| :--- | :--- | :--- |
| Stofault: | oFF time ramp 1 |
| Range: | oFF, 2-120 sec |

Set "ramp down time" at stop (2-120 s). "oFF" if only soft start requires.

### 3.5 Setting the start command

As default the start command is set for remote operation via terminal 11, 12 and 13 . For easy commissioning it is possible to set the start command on the start key on the keyboards. This is set with menu 006.

| 0 | 0 | 6 |  |
| :--- | :--- | :--- | :--- |
|  |  |  |  |
|  |  |  | 2 |$\quad$ Selection of control mode

Menu 006 must be set to 1 to be able to operate from keyboard.

NOTE! Factory default setting is remote control (2).
To start and stop from the keyboard, the "START/ STOP" key is used.

To reset from the keyboard, the "ENTER $\leftarrow$ / RESET" key is used. A reset can be given both when the motor is running and when the motor is stopped. A reset by the keyboard will not start or stop the motor.

### 3.6 Viewing the motor current

Set the display to menu 005 . Now the Motor current can be viewed on the display.


NOTE! The menu 005 can be selected at any time when the motor Is running.

### 3.7 Starting

WARNING! Make sure that all safety measures have been taken before starting the motor in order to avold personal InJury.

Start the motor by pressing the "START/STOP" key on the keyboard or through the remote control, PCB terminal 11,12 and 13 . When the start command is given, the mains contactor will be activated by relay K1 ( PCB terminal 21 and 22), and the motor then starts softly.


Fig. 7 Example of start ramp with main function voltage ramp.

## 4. APPLICATIONS AND FUNCTIONS SELECTION

This chapter is a guide to select the correct soft starter rating and the selection of the Main function and additional functions for each different application.

To make the right choice the following tools are used:

- The norm AC53a.

This norm helps selecting the soft starter rating with regard to duty cycle, starts per hour and maximum starting current.

- The Application Rating List.

With this list the soft starter rating can be selected depending on the kind of application used. The list use 2 levels of the AC53a norm. See table 1, page 15.

- The Application Function List.

This table gives an complete overview of most common applications and duties. For each applications the menu's that can be used are given. See table 2, page 17.

- Function and Combination matrix.

With these tables it is easy to see which combinations of Main and additional functions are possible, see table 3 , page 19 and table 4 , page 19.

### 4.1 Soft starter rating according to AC53a

The IEC947-4-2 standard for electronic starters defines AC53a as a norm for dimensioning of a soft starter.

The MSF soft starter is designed for continuous running. In the Applications table (table 1, page 15) two levels of AC53a are given. This is also given in the technical data tables (see chapter 12. page 74).


Fig. 8 Rating example AC53a.
The above example indicates a current rating of 210 Amps with a start current ratio of $5.0 \times$ FLC (1050A) for 30 seconds with a $50 \%$ duty cycle and 10 starts per hour.

NOTE! If more than 10 starts/hour or other duty cycles are needed, please contact your suppller.


Fig. 9 Duty cycle, non bypass.

### 4.2 Soft starter rating according to AC53b

This norm is made for Bypass operation. Because the MSF soft starter is designed for continuous operation this norm is not used in the selection tables in this chapter.


Fig. 10 Rating example AC53b.


Fig. 11 Duty cycle, bypassed
The above example indicates a current rating of 210 Amps with a start current ratio of $5.0 \times$ FLC (1050A) for 30 seconds with a 24 -minute period between starts.

### 4.3 MSF Soft starter ratings

According to the norms AC53a and AC53b a soft starter can have many current ratings.

NOTE! Because the MSF soft starter Is designed for continuous operation the norm AC53b Is not used in the application rating list.

With help of the Application Rating List with typical starting currents and categories in the AC53a level (see table 1 , page 15 and table 2, page 17) it is easy to select the proper soft starter rating with the application.

The Application Rating List uses two levels for the AC53a norm:

## - AC53a 5.0-30:50-10 (heavy duty)

This level will be able to start all applications and follows directly the type number of the soft starter. Example: MSF 370 is 370 Amps FLC and then 5 time this current in starting.

- AC 53a 3.0-30:50-10 (normal/light duty)

This level is for a bit lighter applications and here the MSF can manage a higher FLC.
Example: MSF 370 in this norm manage 450 Amps
FLC and the 3 times this current in starting
NOTE! To compare Soft Starters It's important to ensure that not only FLC (Full Load Current) is compared but also that the operating parameters are identical.

### 4.4 The Application Ratings List

Table 1 gives the Application Ratings List. With this list the rating for the soft starter and Main Function menu can be selected.

Description and use of the table:

## - Applications.

This column gives the various applications. If the machine or application is not in this list, try to identify a similar machine or application. If in doubt pleas contact your supplier.

- AC53a ratings.

The rating according to AC53a norm is here classified in 2 ratings. The first for normal/light duty (3.0-30:50-10) and the second for heavy duty (5.0-30:50-10)

- Typical Starting current.

Gives the typical starting current for each application

- Main Function menu.

The Main Function menu is advised here.
"25;=1", means: program selection 1 in menu 25.

- Stop function.

Gives a possible Stop function if applicable. " $36 ;=1 / 38-40$ ", means: program selection 1 in menu 36 , also menus 38 to 40 can be selected.

## EXAMPLE:

## Roller Mill:

- This is an application for heavy duty,
- Typical starting current of $350 \%$.
- Main function Torque ramp start (menu 25) will give the best results.
- Stop function Dynamic Brake (menu 36, selection 1) can be used.
- As well as the Slow Speed at start and stop (menu $38-40$ ) can be used for better start and stop performance.

Table 1 Applications Rating List


0

### 4.5 The Application Functions List

This list gives an overview of many different applications/duties and a possible solution with one of the many MSF functions.

## Description and use of the table:

## - Application /Duty.

This column gives the various applications and level of duty. If the machine or application is not in this list, try to identify a similar machine or application. If in doubt pleas contact your supplier.

- Problem.

This column describes possible problems that are familiar for this kind of application.

- Solution MSF.

Gives the possible solution for the problem using one the MSF function.

- Menus.

Gives the menu numbers and selection for the MSF function.
"25;=1", means: program selection 1 in menu 25. " $36 ;=1 / 34,35$ ", means: program selection 1 in menu 36, menus 34 and 35 are related to this function.

Table 2 Application Function List

| Application/ Duty | Problem | Solution MSF | Menus |
| :---: | :---: | :---: | :---: |
| PUMP <br> Normal | Too fast start and stops | MSF Pump application with following start/stop features: | 22 |
|  | Non linear ramps | Linear ramps without tacho. |  |
|  | Water hammer | Torque ramps for quadratic load |  |
|  | High current and peaks during starts. |  |  |
|  | Pump is going in wrong direction | Phase reversal alarm | 88 |
|  | Dry running | Shaft power underload | 96-99 |
|  | High load due to dirt in pump | Shaft power overload | 92-95 |
| COMPRESSOR Normal | Mechanical shock for compressor, motor and transmissions | Linear Torque ramp or current limit start. | $\begin{aligned} & 25:=1 \text { or } \\ & 20,21 \end{aligned}$ |
|  | Small fuses and low current available. |  |  |
|  | Screw compressor going in wrong direction | Phase sequence alarm | 88 |
|  | Damaged compressor if liquid ammonia enters the compressor screw. | Shaft power overload | 92-95 |
|  | Energy consumption due to compressor is running unloaded | Shaft power underload | 96-99 |
| CONVEYOR Normal/Heavy | Mechanical shocks for transmissions and transported goods. | Linear Torque ramp | $25 ;=1$ |
|  | Filling or unloading conveyors | Slow speed and accurate position control. | 37-40,57,58 |
|  | Conveyor jammed | Shaft power overload | 92-95 |
|  | Conveyor belt or chain is off but the motor is still running | Shaft power underload | 96-99 |
|  | Starting after screw conveyor have stopped due to overload. | Jogging in reverse direction and then starting in forward. |  |
|  | Conveyor blocked when starting | Locked rotor function | 75 |
| FAN Normal | High starting current in end of ramps | Torque ramp for quadratic need | $25:=2$ |
|  | Slivering belts. |  |  |
|  | Fan is going in wrong direction when starting. | Catches the motor and going easy to zero speed and then starting in right direction. |  |
|  | Belt or coupling broken | Shaft power underload | 96-99 |
|  | Blocked filter or closed damper. |  |  |
| PLANER Heavy | High inertia load with high demands on torque and current control. | Linear Torque ramp gives linear acceleration and lowest possible starting current. | 25:=1 |
|  | Need to stop quick both by emergency and production efficiency reasons. | Dynamic DC brake without Contactor for medium loads and controlled sensor less soft brake with reversing contactor for heavy loads. | $\begin{aligned} & 36 ;=1,34,35 \\ & 36 ;=2,34,35 \end{aligned}$ |
|  | High speed lines | Conveyor speed set from planer shaft power analog output. | 54-56 |
|  | Worn out tool | Shaft power overload | 92-95 |
|  | Broken coupling | Shaft power underload | 96-99 |
| ROCK CRUSHER Heavy | High enertia | Linear Torque ramp gives linear acceleration and lowest possible starting current. | $25 ;=1$ |
|  | Heavy load when starting with material | Torque boost | 30,31 |
|  | Low power if a diesel powered generator is used. |  |  |
|  | Wrong material in crusher | Shaft power overload | 92-95 |
|  | Vibrations during stop | Dynamic DC brake without Contactor | 36;=1,34,35 |
| BANDSAW Heavy | High inertia load with high demands on torque and current control. | Linear Torque ramp gives linear acceleration and lowest possible starting current. | 25;=1 |
|  | Need to stop quick both by emergency and production efficiency reasons. | Dynamic DC brake without Contactor for medium loads and controlled sensor less soft brake with reversing contactor for heavy loads. | $\begin{aligned} & 36 ;=1,34,35 \\ & 36 ;=2,34,35 \end{aligned}$ |
|  | High speed lines | Conveyor speed set from band saw shaft power analog output. | 54-56 |
|  | Worn out saw blade | Shaft power overload |  |
|  | Broken coupling, saw blade or belt | Shaft power underload |  |
| CENTRIFUGE Heavy | High inertia load | Linear Torque ramp gives linear acceleration and lowest possible starting current. | $25 ;=1$ |
|  | To high load or unbalanced centrifuge | Shaft power overload |  |
|  | Controlled stop | Dynamic DC brake without Contactor for medium loads and controlled sensor less soft brake with reversing contactor for heavy loads. | $\begin{aligned} & 36 ;=1,34,35 \\ & 36 ;=2,34,35 \end{aligned}$ |
|  | Need to open centrifuge in a certain position. | Braking down to slow speed and then positioning control. | 37-40,57,58 |

Table 2 Application Function List

| Application/ <br> Duty | Problem | Solution MSF | Menus |
| :--- | :--- | :--- | :--- |
| MIXER <br> Heavy | Different materials | Linear Torque ramp gives linear acceleration and lowest <br> possible starting current. | $25 ;=1$ |
|  | Need to control material viscosity | Shaft power analog output | $54-56$ |
|  | Broken or damaged blades | Shaft power overload | $92-95$ |
|  |  | Shaft power underload | $96-99$ |
|  | Heavy load with high breakaw ay torque | Linear Torque ramp gives linear acceleration and lowest <br> possible starting current. | $25 ;=1$ |
|  |  | Torque boost in beginning of ramp. | 30,31 |
|  | Jamming | Shaft power overload | $92-95$ |
|  | Fast stop | Controlled sensor less soft brake with reversing contactor <br> for heavy loads. | $36 ;=2,34,35$ |
|  | Motor blocked | Locked rotor function | 75 |

## EXAMPLE:

Hammer Mill:

- This is an application for heavy duty,
- Main function Torque ramp start (menu 25) will give the best results.
- Torque boost to overcome high breakaway torque (menu 30 and 31)
- Overload alarm function for jamming protection (menu 92 and 95)
- Stop function Soft Brake (menu 36, selection 2) can be used. Menu 34 and 35 to set the brake time and strength.


### 4.6 Function and combination matrix

Table 3 gives an overview of all possible functions and combination of functions.

1. Select function in the horizontal "Main Function" column. Only one function can be selected in this column, at a time.
2. In the vertical column "Additional Functions" you will find all possible function that can be used together with your selected main function.

Table 3 Combination matrix

|  |  |  |  | m 0 0 0 0 0 0 0 0 $\vdots$ 0 0 0 0 0 0 0 |  | Jogging with keyboard/terminal |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Voltage ramp start/stop (default) | X | X | X | X | X | X | X | X | X | X | X |  |
| Torque control start/stop (menu 025) |  |  | X | X | X | X | X | X | X | X | X |  |
| Voltage ramp with current limit (menu 020) |  | X | X | X | X | X | X | X | X | X | X | X |
| Current limit start (menu 021) |  | X | X | X | X | X | x | X | X | X | X | X |
| Pump control (menu 022) |  |  | X |  |  |  |  |  | X | X |  |  |
| Analog input (menu 023) |  |  |  |  |  |  |  |  | X | X |  |  |
| Direct on line start (menu 024) |  |  | X |  |  |  |  |  | X | X |  |  |

By using one parameter set, the following start/stop table is given.

NOTE! Voltage and torque ramp for starting only with softbrake.

Table 4 Start/stop combination.

| START FUNCTION | $\begin{aligned} & z \\ & \frac{z}{0} \\ & \frac{0}{6} \\ & 2 \\ & \frac{2}{1} \\ & \frac{1}{0} \\ & \frac{0}{5} \end{aligned}$ |  | 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 |  |  |  |  | 0 0 0 0 0 0 0 0 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Voltage ramp start |  | X |  |  |  | X | X | $x$ |
| Torque control start |  |  | X |  |  | X | $x$ | X |
| Current limit start |  | X |  |  |  | X | X | $x$ |
| Volt age ramp with current limit |  | X |  |  |  | X | X | X |
| Pump control |  |  |  | X |  | X |  |  |
| Analog input |  |  |  |  | X | X |  |  |
| Direct on line start |  |  |  |  |  | $X$ |  |  |

By using different parameter sets for start and stop, it is possible to combine all start and stop functions.

### 4.7 Special condition

### 4.7.1 Small motor or low load

The minimum load current for the soft starter is $10 \%$ of the rated current of the soft starter. Except for the MSE-017 there the min. current is 2 A . Example MSE-210, rated current $=210 \mathrm{~A}$. Min. Current 21 A . Please note that this is "min. load current" and not min. rated motor current.

### 4.7.2 Ambient temperature below $0^{\circ} \mathrm{C}$

For ambient temperatures below $0^{\circ} \mathrm{C}$ e.g. an electrical heater must be installed in the cabinet. The soft starter can also be mounted in some other place, due to that the distance between the motor and the soft starter is not critical.

### 4.7.3 Phase compensation capacitor

If a phase compensation capacitor is to be used, it must be connected at the inlet of the soft starter, not between the motor and the soft starter.

### 4.7.4 Pole-changing contactor and two speed motor

The switching device must be connected between the output of the soft starter and the motor.

### 4.7.5 Shielded motor cable

It is not necessary to use shielded wires together with soft starters. This is due to the very low radiated emissions.

NOTE! The soft starter should be wired with shlelded control cable to fulfill EMC regulations acc. to $\S 1.5$, page 6.

### 4.7.6 Sllp ring motors

Slip ring motors can not be used together with the soft starter. Unless the motor is rewinded (as a squirrel cage motor). Or keep the resistors in, please contact your supplier.

### 4.7.7 Pump control with soft starter and frequency inverter together

It is possible e.g. in a pump station with two or more pumps to use one frequency inverter on one pump and soft starters on each of the other pumps. The flow of the pumps can then be controlled by one common control unit.

### 4.7.8 Starting with counter clockwise rotating loads

It is possible to start a motor clockwise, even if the load and motor is rotating counter clockwise e.g. fans. Depending on the speed and the load "in the wrong direction" the current can be very high.

### 4.7.9 Running motors in parallel

When starting and running motors in parallel the total amount of the motor current must be equal or lower than the connected soft starter. Please note that it is not possible to make individual settings for each motor. The start ramp can only be set for an average starting ramp for all the connected motors. This applies that the start time may differ from motor to motor. This is also even if the motors are mechanically linked, depending on the load etc.

### 4.7.10 How to calculate heat dissipation in cabinets

See chapter 12. page 74 "Technical Data", "Power loss at rated motor load ( $\mathrm{I}_{\mathrm{N}}$ )", "Power consumption control card" and "Power consumption fan". For further calculations please contact your local supplier of cabinets, e.g. Rittal.

### 4.7.11 Insulation test on motor

When testing the motor with high voltage e.g. insulation test the soft starter must be disconnected from the motor. This is due to the fact that the thyristors will be seriously damage by the high peak voltage.

### 4.7.12 Operation above 1000 m

All ratings are stated at 1000 m over sea level.
If a MSF is placed for example at 3000 m it must be derated unless that the ambient temperature is lower than 40 C and compensate for this higher pressure.

To get information about motors and drives at higher altitudes please contact your supplier to get technical information nr 151.

### 4.7.13 Reversing

Motor reversing is always possible. See Fig. 31 on page 34 for the advised connection of the reverse contactors.

At the moment that the mains voltage is switched on, the phase sequence is monitored by the control board. This information is used for the Phase Reverse Alarm (menu 88 , see $\S 7.22$, page 56 ).

However if this alarm is not used (factory default), it is also possible to have the phase reversal contactors in the input of the soft starter.
5. OPERATION OF THE SOFT STARTER


Fig. 12 MSF soft starter models.

### 5.1 General description of user interface



WARNING! Never operate the soft starter with removed front cover.

To obtain the required operation, a number of parameters must be set in the soft starter.

Setting/configuration is done either from the builtin keyboard or by a computer/control system through the serial interface or bus (option). Controlling the motor i.e. start/stop, selection of parameter set, is done either from the keyboard, through the remote control inputs or through the serial interface (option).

## Setting



WARNING! Make sure that all safety measures have been taken before switching on the supply.

Switch on the supply (normally $1 \times 230 \mathrm{~V}$ ), all segments in the display will light up for a few seconds. Then the display will show menu 001. An illuminated display indicates there is supply voltage on the PCB.

Check that you have voltage on the mains contactor or on the thyristors. To be able to use all extended functions and optimize of the performance, program the motor data.

### 5.2 PPU unit



Fig. 13 PPU unit.
The programming and presentation unit (PPU) is a build-in operator panel with two light emitting diodes, three + four seven-segment LED-displays and a keyboard.

### 5.3 LED display

The two light emitting diodes indicates start/stop and running motor/machine. When a start command is given either from the PPU, through the serial interface (option) or through the remote control inputs, the start/stop~LED will be illuminated.

At a stop command the start/stop-LED will switch off. When the motor is running, the running-LED is flashing during ramp up and down and is illuminated continuously at full motor voltage.


Fig. 14 LED indication at different operation situation.

### 5.4 The Menu Structure

The menus are organised in a simple one level structure with the possibility to limit the number of menus that are reachable by setting the value in menu 007 to "oFF" (factory setting). With this setting only the basic menus 001, 002, 003, 004, 005, 006 and 007 can be reached.

This to simplify the setting when only voltage start/ stop ramps are used.

If menu 007 is in "on" and menu 008 "oFF" it is possible to reach all viewing menus and alarm lists as well.


Fig. 15 Menu stmacture.

### 5.5 The keys

The function of the keyboard are based on a few simple rules. At power up menu 001 is shown automatically. Use the "NEXT $\rightarrow$ " and "PREV $\leftarrow$ "keys to move between menus. To scroll through menu numbers, press and hold either the "NEXT $\rightarrow$ " or the "PREV $\leftarrow$ " key. The " + " and "-" keys are used to increase respectively decrease the value of setting. The value is flashing during setting. The "ENTER $\leftarrow$ " key confirms the setting just made, and the value will go from flashing to stable. The "START/STOP" key is only used to start and stop the motor/machine.
The $\Theta$ and $\Theta$ keys are only used for JOG from the keyboard. Please note one has to select enable in menu 103 or 104 , see $\S 7.25$, page 61 .

Table 5 The keys

| Start/stop motor operation. | START |
| :--- | :--- |
| STOP |  |
| Display previous menu. | PREV |
| Display next menu. |  |
| Decrease value of setting. |  |
| Increase value of setting. |  |
| Confirm setting just made. |  |
| Alarm reset. |  |
| JOG Reverse |  |
| JOG Forward |  |

Table 6 Control modes

| Control mode |  | Start/Stop | JOG fwd/rev | Alarm reset | Setting of parameters |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Parameter set with external selection Menu 061=0 |  |  | Parameter set with internal selection Menu 061=1-4 |
| Keyboard <br> Menu 006=1 | Unlocked keyboard |  | Keyboard | Keyboard | Keyboard | - | Keyboard |
|  | Locked keyboard | $\square$ | - | - | - | - - - |
| Remote <br> Menu 006=2 | Unlocked keyboard | Remote | Remote | Remote and keyboard | Remote | Keyboard |
|  | Locked keyboard | Remote | Remote | Remote | Remote | - |
| Serial comm. Menu 006=3 | Unlocked keyboard | Serial comm | Serial comm | Serial comm. and keyboard |  | Serial comm |
|  | Locked keyboard | Serial comm | Serial comm | Serial comm | - | Serial comm |

## 6. INSTALLATION AND CONNECTION

Mounting, wiring and setting the device into operation must be carried out by trained personnel (electricians specialised in heavy current technology):

- In accordance with the local safety regulations of the electricity supply company.
- In accordance with DIN VDE 0100 for setting up heavy current plants.
Care must be taken to ensure that personnel do not come into contact with live circuit components.


WARNING! Never operate the soft starter with removed front cover.

### 6.1 Installation of the soft starter in a cabinet

When installing the soft starter:

- Ensure that the cabinet will be sufficiently ventilated, after the installation.
- Keep the minimum free space, see the tables on page 25.
- Ensure that air can flow freely from the bottom to the top.

NOTC! When Instailing the soft starter, make sure it does not come into contact with live components. The heat generated must be dispersed via the cooling fins to prevent damage to the thyistors (free circulation of air).

MSF-017 to MSF-835 soft starters are all delivered as enclosed versions with front opening. The units have bottom entry for cables etc. see. Fig. 25 on page 29 and Fig. 27 on page 31. MSF-1000 and MSF-1400 are delivered as open chassis.

NOTE! The soft starter should be wired with shielded control cable to fulfill EMC regulations acc. to § 1.5, page 6.

NOTEI For UL-approval use $\mathbf{7 5}{ }^{\circ} \mathbf{C}$ Copper wire only.
MSF-017 to MSF-250


Fig. 16 MSF-017 10 MSF- 250 dimensions.


Fig. 17 Hole pattern for MSF-017 to MSF-250 (backside view).


Fig. 18 Hole pattern for MSF-170 to MSF-250 with upper mounsing bracket instead of DIN-rail.

MSF-017 to MSF-250

Table 7 MSF-017 to MSF-250.

| MSF model | Class | Connection | Conv./ <br> Fan | Dimension HxWxD (mm) | Hole dist. w1 (mm) | Hole dist. h1 (mm) | Diam./ screw | Weight (kg) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| -017, -030 | IP 20 | Busbars | Convection | 320x126×260 | 78.5 | 265 | 5.5/M5 | 6.7 |
| $\begin{array}{\|l} -045,-060, \\ -075,-085 \end{array}$ | IP 20 | Busbars | Fan | $320 \times 126 \times 260$ | 78.5 | 265 | 5.5/M5 | 6.9 |
| -110, -145 | IP 20 | Busbars | Fan | $400 \times 176 \times 260$ | 128.5 | 345 | 5.5/M5 | 12.0 |
| -170, -210, -250 | IP 20 | Busbars | Fan | $500 \times 260 \times 260$ | 208.5 | 445 | 5.5/M5 | 20 |

Table 8 MSF-017 to MSF-250

| MSF <br> model | Minimum free space (mm): |  |  | Dimension Connection busbars Cu | Tightening torque for bolt ( Nm ) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | above 1) | below | at side |  | Cable | PE-cable | Supply and PE |
| -017, -030, -045 | 100 | 100 | 0 | 15x4 (M6), PE (M6) | 8 | 8 | 0.6 |
| -060, -075, -085 | 100 | 100 | 0 | $15 \times 4$ (M8), PE (M6) | 12 | 8 | 0.6 |
| -110,-145 | 100 | 100 | 0 | $20 \times 4$ (M10), PE (M8) | 20 | 12 | 0.6 |
| -170, -210, -250 | 100 | 100 | 0 | 30x4 (M10), PE (M8) | 20 | 12 | 0.6 |
| 1) Above: wall-soft starter or soft starter-soft starter |  |  |  |  |  |  |  |

MSF-310 to MSF-1400

Table 9 MSF-310 to MSF-1400 see Fig. 20 on page 26.

| MSF model | Class | Connection | Conv./ | Dimension HxWxD (mm) | Hole dist. w1 (mm) | Hole dist. h1 (mm) | Diam./ screw | Weight (kg) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| -310 | IP 20 | Busbars | Fan | $532 \times 547 \times 278$ | 460 | 450 | 8.5/M8 | 42 |
| -370, -450 | IP 20 | Busbars | Fan | $532 \times 547 \times 278$ | 460 | 450 | 8.5/M8 | 46 |
| -570 | IP 20 | Busbars | Fan | $687 \times 640 \times 302$ | 550 | 600 | 8.5/M8 | 64 |
| -710 | IP 20 | Busbars | Fan | $687 \times 640 \times 302$ | 550 | 600 | 8.5/M8 | 78 |
| -835 | IP 20 | Busbars | Fan | $687 \times 640 \times 302$ | 550 | 600 | 8.5/M8 | 80 |
| -1000, -1400 | IP00 | Busbar | Fan | $900 \times 875 \times 336$ | Fig. 23 |  | 8.5/M8 | 175 |

Table 10 MSF- 310 to MSF- 1400.

| MSF model | Minimum free space (mm): |  |  | Dimension Connection, busbars Al | Tightening torque for bolt ( Nm ) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | above 1) | below | at side |  | Cable | PE-cable | Supply and PE |
| -310, -370, -450 | 100 | 100 | 0 | 40x8 (M12) | 50 | 12 | 0.6 |
| -570, -710, -835 | 100 | 100 | 0 | 40×10 (M12) | 50 | 12 | 0.6 |
| -1000, -1400 | 100 | 100 | 100 | 75x10 (M12) | 50 | 12 | 0.6 |
| 1) Above: Wall-soft starter or soft starter-soft starter |  |  |  |  |  |  |  |



Fig. 19 MSF - 310 to MSF - 835.


Fig. 20 Hole pattern for screw attachment, MSF-310 to MSF-835. Hole distance ( mm ).

| MSF | e | $\mathbf{f}$ |
| :---: | :--- | :--- |
| -310 to -450 | 44 | 39 |
| -570 to -835 | 45.5 | 39 |

Observe that the two supplied mounting hooks (see $\$ 1.8$, page 7 and Fig. 2 on page 7 must be used for mounting the soft starter as upper support (only MSF310 to MSF-835).


Fig. 21 Busbar distances MSF-310 to MSF-835.

Table 11 Busbar distruces

| MSF model | Dist. h1 <br> (mm) | Dist. w1 <br> (mm) | Dist. w2 <br> (mm) | Dist. w3 <br> (mm) |
| :--- | :--- | :--- | :--- | :--- |
| -310 to -450 | 104 | 33 | 206 | 379 |
| -570 to -835 | 129 | 35 | 239.5 | 444 |
| $-1000-1400$ |  | 55 | 322.5 | 590.5 |



Fig. 22 MSF-1000 to - 1400


Fig. 23 Hole pattern busbar MSF-1000 to - 1400 .
6.2 Connections


Fig. 24 Connection of MSF-017 to MSF -085.

## Connection of MSF-017 to MSF-085

## Device connections

1. Protective earth $\stackrel{\perp}{\underline{L}}$ (PE), Mains supply, Motor
(on the right and left inside of the cabinet)
2. Protective earth, $\xlongequal[=]{\perp}$ (PE), Control voltage
3. Control voltage connection 01, 02
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $\S 7.12$, page 43)
7. Mounting of EMC gland for control cables


Fig. 25 Connection of MSF-110 to MSF-145.

## Connection of MSF-110 to MSF-145

## Device connections

1. Protective earth, $\perp$ (PE), Mains supply, Motor (on the left inside of the cabinet)
2. Protective earth $\perp(\mathrm{PE})$, Control voltage
3. Control voltage connection 01,02
4. Mains supply $\mathbf{L} 1, \mathbf{L} 2, \mathrm{~L} 3$
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $\S 7.12$, page 43 )
7. Mounting of EMC gland for control cables


Fig. 26 Conneation of MSF-170 to MSF-250

## Connection of MSF-170 to MSF-250

## Device connections

1. Protective earth, $\perp$ (PE), Mains supply, Motor (on the left inside of the cabinet)
2. Protective earth $\perp$ (PE), Control voltage
3. Control voltage connection 01, 02
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $₫ 7.12$, page 43)
7. Mounting of EMC gland for control cables


Fig. 27 Connection of MSF-170 to MSF-1400.

## Connection of MSF-310 to MSF-1400

## Device connections

1. Protective earth, $\xlongequal{\perp}$ (PE), Mains supply and Motor
2. Protective earth, $\perp$ (PE), Control voltage
3. Control voltage connection 01,02
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $\$ 7.12$, page 43)
7. Mounting of EMC gland for control cables

### 6.3 Connection and setting on the PCB control card



Fig. 28 Connections on the $P C B$, control card.
Table 12 PCB Terminals

| Terminal | Function | Electrical characteristics |
| :---: | :---: | :---: |
| 01 | Supply voltage | 100-240 VAC $\pm 10 \% / 380-500$ VAC $\pm 10 \%$ |
| 02 |  |  |
| PE | Gnd | $\stackrel{1}{\underline{1}}$ |
| 11 | Digital inputs for start/stop and reset. | $0-3 \mathrm{~V} \rightarrow 0 ; 8-27 \mathrm{~V} \rightarrow 1 . \mathrm{Max} .37 \mathrm{~V}$ for 10 sec . Impedance to $0 \mathrm{VDC:} 2.2 \mathrm{k} \Omega$. |
| 12 |  |  |
| 13 | Supply/control voltage to PCB terminal 11 and 12, $10 \mathrm{k} \Omega$ potentiometer, etc. | +12 VDC $\pm 5 \%$. Max. current from +12 VDC: 50 mA . Short circuit proof. |
| 14 | Remote analogue input control, 0-10 V, 2-10 V, 0-20 mA and $4-20 \mathrm{~mA}$ /digital input. | Impedance to terminal 15 ( 0 VDC ) voltage signal: $125 \mathrm{k} \Omega$, current signal: $100 \Omega$. |
| 15 | GND (common) | 0 VDC |
| 16 | Digital inputs for selection of parameter set. | $0-3 \mathrm{~V} \rightarrow 0 ; 8$-27 V $\rightarrow$ 1. Max. 37 V for 10 sec. Impedance to $0 \mathrm{VDC}: 2.2 \mathrm{k} \Omega$. |
| 17 |  |  |
| 18 | Supply/control voltage to PCB terminal 16 and 17, $10 \mathrm{k} \Omega$ potentiometer, etc. | +12 VDC $\pm 5 \%$. Max. current from $+12 \mathrm{VDC}=50 \mathrm{~mA}$. Short circuit proof. |
| 19 | Remote analogue output control | Analogue Out put contact: <br> 0-10V, 2-10V; min load impedance $700 \Omega$ <br> $0-20 \mathrm{~mA}$ and $4-20 \mathrm{~mA}$; max load impedance $750 \Omega$ |
| 21 | Programmable relay K1. Factory setting is "Operation" indication by closing terminal $21-22$. | 1-pole closing contact, 250 VAC 8 A or 24 VDC $8 A$ resistive, 250 VAC, 3 A inductive. |
| 22 |  |  |
| 23 | Programmable relay K2. Factory setting is "Full voltage ${ }^{"}$ indication by closing terminal 23-24. | 1-pole closing contact, 250 VAC 8 A or 24 VDC $8 A$ resistive, 250 VAC, 3 A inductive. |
| 24 |  |  |
| 31 | Alarm relay K3, closed to 33 at alarm. | 1-pole change over contact, 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive. |
| 32 | Alarm relay K3, opened at alarm. |  |
| 33 | Alarm relay K3, common terminal. |  |
| 69-70 | PTC Thermistor input | Alarm level $2.4 \mathrm{k} \Omega$ Switch back level $2.2 \mathrm{k} \Omega$. |
| 71-72* | Clickson thermistor | Controlling soft starter cooling fine temperature MSF-310-MSF-1400 |
| 73-74* | NTC thermistor | Temperature measuring of soft starter cooling fine |
| 75 | Current transformer input, cable S1 (blue) | Connection of L1 or T1 phase current transformer |
| 76 | Current transformer input, cable S1 (blue) | Connection of L3, T3 phase (MSF 017 - MSF 250) or L2, T2 phase (MSF 310 - MSF 1400) |
| 77 | Current transformer input, cable S2 (brown) | Common connection for terminal 75 and 76 |
| 78* | Fan connection | 24 VDC |
| 79* | Fan connection | O VDC |

*Internal connection, no customer use.

### 6.4 Minimum wiring



Fig. 29 Wiring circuit, "Mininum wiring".
The figure above shows the "minimum wiring". See $\$ 6.1$, page 24 , for tightening torque for bolts etc.

1. Connect Protective Earth (PE) to earth screw marked $\stackrel{1}{\overline{5}}$ (PE).
2. Connect the soft starter between the 3-phase mains supply and the motor. On the soft starter the mains side is marked L1, L2 and L3 and the motor side with T1, T2 and T3.
3. Connect the control voltage ( $100-240 \mathrm{VAC}$ ) for the control card at terminal 01 and 02.
4. Connect relay K1 (terminals 21 and 22) to the control circuit.
5. Connect PCB terminal 12 and 13 ( PCB terminal 11-12 must be linked) to, e.g. a 2 -position switch (on/oFF) or a PLC, etc., to obtain control of soft start/stop. (For start/stop command from keyboard menu 006 must be set to 01).
6. Ensure the installation complies with the appropriate local regulations.

NOTE! The soft starter should be wired with shelded control cable to fulfill EMC regulations acc. to § 1.5, page 6.

NOTE! If local regulations say that a mains contactor should be used, the K1 then controls It . Always use standard commercial, slow blow fuses, e.g. type gl, gG to protect the wiring and prevent short circulting. To protect the thyristors against shortcircult currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valid even if superfast semiconductor fuses are not used. All signal Inputs and outputs are galvanically insulated from the mains supply.

### 6.5 Wiring examples

Fig. 30 gives an wiring example with the following
functions.

- Analogue input control, see $\S 7.7$, page 40
- Parameter set selection, see $\$ 7.20$, page 54
- Analogue output, see $\S 7.18$, page 52
- PTC input, see $\$ 7.21$, page 55

For more information see $\$ 6.3$, page 32 .


Fig. 30 Analogue inpur control, parameter set, analogue ourput and PTC input.


Fig. 31 Fonward/reverse wing arcuit.

## 7. FUNCTIONAL DESCRIPTION SET-UP MENU

This chapter describes all the parameters and functions in numerical order as they appear in the MSF. Table 13 gives an overview of the menus, see also Chapter 13. page 79 (set-up menu list).

Table 13 Sct-up Mem overvicw

|  | Menu number | Parameter group |  | Menu numbers | See § |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Basic functions | 001-008 | Basic | Ramp up/down parameters | 001-005 | 7.1 |
|  |  |  | Start/Stop/Reset command | 006 | 7.2 |
|  |  |  | Menu Ex pansion | 007-008 | 7.3 |
| Extended functions | 011-199 | Voltage control dual ramp |  | 011-014 | 7.4 |
|  |  | Torque control parameters |  | 016-018 | 7.5 |
|  |  | Main functions |  | 020-025 | 7.6-7.10 |
|  |  | Additional functions |  | 030-036 | 7.11-7.14 |
|  |  | Slow speed and Jog functions |  | $\begin{aligned} & \text { 037-040, 57-58, } \\ & 103-104 \end{aligned}$ | $\begin{aligned} & 7.15,7.19 \\ & 7.25 \end{aligned}$ |
|  |  | Motor Data Setting |  | 041-046 | 7.16 |
|  |  | Outputs | Relays | 051-052 | 7.17 |
|  |  |  | Analogue output | 054-056 | 7.18 |
|  |  | Input | Digital input | 057-058 | 7.19 |
|  |  | Parameter set selection |  | 061 | 7.20 |
|  |  |  | Motor protection | 071-075 | 7.21 |
|  |  |  | Main protection | 081-088 | 7.22 |
|  |  |  | Application protection | 089-099 | 7.23 |
|  |  |  | Resume alarms | 101, 102 | 7.24 |
|  |  | Auto retur | enu | 105 | 7.26 |
|  |  | Factory d |  | 199 | 7.28 |
| View functions | 201-915 | Main view |  | 201-208 | 7.29 |
|  |  | RMS current per phase |  | 211-213 | 7.29 |
|  |  | RMS voltage per phase |  | 214-216 | 7.29 |
|  |  | Keyboard lock status |  | 221 | 7.30 |
|  |  | Alarm list |  | 901-915 | 7.31 |

### 7.1 Ramp up/down parameters



Fig. 32 Menu numbers for start/stop ramps, initial voltage at start and step down voltage at stop.

Determine the starting time for the motor/machine. When setting the ramp times for starting and stopping, initial voltage at start and step down voltage at stop, proceed as follow:

## $001{ }^{\circ}{ }^{\circ}$



Setting the initial voltage at start ramp 1

| Default: | $30 \%$ |
| :--- | :--- |
| Range: | $25 \cdot 90 \% \mathrm{U}_{\mathrm{n}}$ |

Set the initial voltage. Normally the factory setting, $30 \%$ of $U_{n}$, is a suitable choice.

| $0\|0\| 40_{0}^{0}$ |  |  | Setting of stop ramp 1 |
| :---: | :---: | :---: | :---: |
| 0 | F | $F$ |  |
| Default: |  | OFF |  |
| Range: |  | oFF, 2-120 sec |  |
| oFF |  | Stop ramp disabled |  |
| 2-120 |  | Set | amp down time ${ }^{\text {a }}$ at stop |

### 7.1.1 RMS current [005]

NOTE! This is the same read-out as function 201, see $\$ 7.28$, page 63.

$0013_{0}^{\circ}$



### 7.2 Start/stop/reset command

Start/stop of the motor and reset of alarm is done either from the keyboard, through the remote control inputs or through the serial interface (option). The remote control inputs start/stop/reset (PCB terminals 11,12 and 13) can be connected for 2 -wire or 3 -wire control.

| $0060_{0}^{0}$ |  |
| :---: | :---: |
|  | 2 |
| Default: | 2 |
| Range: | 1,2,3 |
| 1 | START/STOP/RESET command via the keyboard. <br> - Press the "START/STOP" key on the keyboard to start and stop the soft starter. <br> - Press "ENTER/RESET" key to reset a trip condition. |
| 2 | Via Remote control. START/STOP/ RESET commands. The following control methods are possible: <br> - 2-wire start/stop with automatic reset, see §7.2.1, page 37 . <br> - 2-wire start / stop with separate reset, see § 7.2.2, page 37 . <br> - 3-wire start/stop with automatic reset at start, see § 7.2.3, page 37. <br> WARNING! The motor will start if terminals 11, 12, 13 is in start position. |
| 3 | START/STOP/RESET commands via serial interface option. Read the operating instruction supplied with this option. |

NOTE! A reset vla the keyboard will not start or stop the motor.

NOTE! Factory default setting is 2, remote control.
To start and stop from the keyboard, the "START/ STOP" key is used.

To reset from the keyboard, the "ENTER , / RESET" key is used. A reset can be given both when the motor is running and when the motor is stopped. A reset from the keyboard will not start or stop the motor.

### 7.2.1 2-wire start/stop with automatic reset at start



Closing PCB terminals 12 and 13 , and a jumper between terminal 11 and 12 , will give a start command. Opening the terminals will give a stop. If PCB terminals 12 and 13 is closed at power up a start command is given (automatic start at power up). When a start command is given there will automatically be a reset.

### 7.2.2 2-wire start/stop with separate reset



Closing PCB terminals 11,12 and 13 will give a start and opening the terminals 12 and 13 will give a stop. If PCB terminals 12 and 13 are closed at power up a start command is given (automatic start at power up). When PCB terminals 11 and 13 are opened and closed again a reset is given. A reset can be given both when the motor is running and stopped and doesn't affect the start/stop.

### 7.2.3 3-wire start/stop with automatic reset at start.



PCB terminal 12 and 13 are normally closed and PCB terminal 11 and 13 are normally open. A start command is given by momentarily closing PCB terminal 11 and 13. To stop, PCB terminal 12 and 13 are momentarily opened.

When a start command is given there will automatically be a reset. There will not be an automatic start at power up.

### 7.3 Menu expansion setting.

In order to use the viewing menus and/or the extended functions menu 007 must be set to "On", then one reach read out of the viewing menus 201915. To be able to set any extended functions in the menus 011-199 menu 008 must be set to "on" as well.


| 0 0 8 <br> 0   |  |  |  |
| :--- | :--- | :--- | :--- |
|  | 0 | F | F |
|  | Selecting of extended <br> functions |  |  |
| Default: | oFF |  |  |
| Range: | oFF, on |  |  |
| ofF | Only view function 201-915 are visi- <br> ble. |  |  |
| on | All the function menus are visible |  |  |

NOTEI Menu 007 must be "on".

### 7.4 Voltage control dual ramp

To achieve even smoother ramps at start and or stop, a dual ramp can be used.


Fig. 33 Mens numbers for dual voltage ramp at start/stop, initial voltage at start and step down-toltage at stop.

The settings are carried out by beginning with the settings in menus 001-004 and 007-008 and proceed with the following steps:


| 0 1 2 <br> 0   |  |
| :--- | :--- | :--- | :--- |
|  0 F |  |
| Default: | oFF |
| Range: | oFF, 1-60 sec |
| oFF | Start ramp 2 disabled |
| $\mathbf{1 - 6 0}$ | Set the start ramp 2 time. A dual <br> voltage ramp is active. |


| 0 | 1 | 3 | 0 |
| :--- | :--- | :--- | :--- |
|  |  | 4 | 0 |
|  | Setting of step down voltage <br> in stop ramp 2 |  |  |
|  |  |  |  |
| Default: | $40 \%$ |  |  |
| Range: | $100-40 \% U_{n}$ |  |  |
| Set the step down voltage for stop ramp 2. The <br> step down voltage for stop ramp 2 is limited to the <br> step down voltage at stop (menu 003). |  |  |  |


| 0 1 0 <br> 0   |  |  |  |
| :--- | :--- | :--- | :--- |
|  | 0 | $F$ | $F$ |

### 7.5 Torque control parameters

See also $\$ 7.10$, page 42 and chapter 4 . page 13 for more information on the Torque control setting.


| Default: | 10 |
| :--- | :--- |
| Range: | $0-250 \%$ of Tn |

Insert initial torque at start in percent of nominal shaft torque (Tn), see chapter 13. page 79.


Insert end torque at start in percent of nominal shaft torque.


### 7.6 Current limit (Main Function)

The Current Limit function is used to limit the current drawn when starting ( $150-500 \%$ of $\ln$ ). This means that current limit is only achieved during set start-up time.

Two kinds of current limit starts are available.

- Voltage ramp with a limited current.

If current is below set current limit, this start will act exactly as a voltage ramp start.

- Current limit start.

The soft starter will control the current up to set current limit immediately at start, and keep it there until the start is completed or the set start-up time expires.
See Fig. 34 Current limit.
NOTE! Make sure that nominal motor current In menu 042 Is correctly inserted.

### 7.6.1 Voltage ramp with current limit

The settings are carried out in three steps:

1. Estimate starting-time for the motor/machine and select that time in menu 002 (see $\S 7.1$, page 36 ).
2. Estimate the initial voltage and select this voltage in menu 001 (see §7.1, page 36).
3. Set the current limit to a suitable value e.g. $300 \%$ of In in menu 020.


NOTE! Only possible when Voltage Ramp mode is enabled. Menus 021-025 must be "oFF".


Fig. 34 Current limit

### 7.6.2 Current limit

The settings are carried out in two steps:

1. Estimate starting time for the motor/machine and select that time in menu 002 (see $\S 7.1$, page 36 ).
2. Set the current limit to a suitable value e.g. $300 \%$ of In in menu 021.


|  | O | F | F |
| :--- | :--- | :--- | :--- |
| \begin{tabular}{\|l|l|}
\hline
\end{tabular} |  |  |  |
| Default: | oFF |  |  |
| Range: | oFF, 150-500\% In lit at start |  |  |
| oFF | Current limit mode disabled. Voltage <br> Ramp enabled. |  |  |
| $\mathbf{1 5 0 - 5 0 0}$ | Current limit level in current limit <br> mode. |  |  |

NOTE! Only possible when Voltage Ramp mode is enabled. Menus 020, 022-025 must be "ofF".

NOTE! Even though the current limit can be set as low as 150\% of the nominal motor current value, this minimum value cannot be used generally. Considerations must be given to the starting torque and the motor before setting the approprlate current limit. "Real start time" can be longer or shorter than the set values depending on the load conditions. Thls applies to both current limit methods.


Fig. 35 Current limit
If the starting time is exceeded and the soft starter is still operating at current level, an alarm will be activated. It is possible to let the soft starter to either stop operation or to continue. Note that the current will rise uncontrolled if the operation continues (see $\S$ 7.24 .2 , page 61 ).

### 7.7 Pump control (Main Function)

By choosing pump control you will automatically get a stop ramp set to 15 sec . The optimising parameters for this main function are start and stop time; initial torque at start and end torque at start and stop. End torque at stop is used to let go of the pump when it's no longer producing pressure/flow, which can vary on different pumps. See Fig. 36.


Fig. 36 Pump control

## Pump application

The pump application is using Torque ramps for quadratic load. This gives lowest possible current and linear start and stop ramps. Related menus are 2, 4 (see $\S 7.1$, page 36 ), 16,17 and 18 (see $§ 7.5$, page 39 ).

|  2 2 <br> 0   |  |  |
| :--- | :--- | :--- | :--- |
|  | Setting of pump control |  |
|  | F | F |
| Default: | oFF |  |
| Range: | oFF, on |  |
| oFF | Pump control disabled. Voltage <br> Ramp enabled. |  |
| on | Pump control application is enabled. |  |

NOTE! Only possible when Voltage Ramp mode is enabled. Menu 020-021, 023-025 must be "ofF".

### 7.8 Analogue Input Control (Main Function)

Soft starting and soft stopping can also be controlled via the Analogue Input Control ( $0-10 \mathrm{~V}, 2-10 \mathrm{~V}, 0-20 \mathrm{~mA}$ and $4-20 \mathrm{~mA}$ ). This control makes it possible to connect optional ramp generators or regulators.

After the start command, the motor voltage is controlled through the remote analogue input.


WARNING! The remote analogue control may not be used for continuous speed regulation of standard motors. With this type of operation the increase in the temperature of the motor must be taken into consideration.

To install the analogue input control, proceed by:

1. Connect the ramp generator or regulator to terminal $14(+)$ and $15(-)$.


Fig. 37 Wiring for analogue input.
2. Set Jumper J1 on the PCB control card to voltage (U) or current control (I) signal position, see Fig. 38 and Fig. 24 on page 28. Factory setting is voltage (U).


Fig. 38 Setting voltage or current for analogue input.


NOTE! Only possible when Voltage Ramp mode is enabled. Menu 020-022, 024, 025 must be "oFF"

### 7.9 Full voltage start, D.O.L. (Main Function)

The motor can be accelerated as if it was connected directly to the mains. For this type of operation:

Check whether the motor can accelerate the required load (D.O.L.-start, Direct On Line start). This function can be used even with shorted thyristors.


NOTE! Only possible when Voltage Ramp mode is enabled. Menu 020-023, 025 must be "oFF".


Fig. 39 Full voltage start.

### 7.10 Torque control (Main function)

This main function can be used to make a start according to a pre-defined torque reference curve. Two different load characteristics, linear and square, are possible to select.

At start/stop the torque controller will follow the selected characteristic.

A torque start/stop behaviour can be seen in Fig. 40.

A perfect start and stop with torque ramps have a good linearity of current. To optimise this, use the setting of initial torque (menu 16) and end torque (menu $18)$. See also $\S 7.5$, page 39 .

## Example:

Default for initial torque is $10 \%$ so if starting a more heavy load this will result in a small current peak in beginning of ramp. By increasing this value to $30 /$ $70 \%$ the current peak will not appear.

The end torque is increased mainly if the application has a high inertial load, like planers, saws and centrifuges. A current peak will appear in the end of ramp because the load is pushing the speed more or less by itself. By increasing this level to $150-250 \%$ the current will be linear and low.

| 0 2 5 |  |  |  |
| :--- | :--- | :--- | :--- |
|  | 0 | $F$ | F Torque control at start/stop |
| Default: | ofF |  |  |
| Range: | oFF, 1, 2 |  |  |
| oFF | Torque control is disabled Volt age <br> Ramp enabled. |  |  |
| $\mathbf{1}$ | Torque control with linear torque <br> characteristic |  |  |
| $\mathbf{2}$ | Torque control with square torque <br> characteristic |  |  |

NOTEI Torque control mode is only possible when Voltage Ramp mode is enabled (menu 020-024 are "oFF").


Fig. 40 Torque control at starl/stop.


Fig. 41 Current and speed in torque control.

### 7.11 Torque boost

The Torque Booster enables a high torque to be obtained by providing a high current during $0.1-2$ sec at start. This enables a soft start of the motor even if the break away torque is high at start. For example in crushing mills applications etc.

When the torque booster function has finished, starting continues according to the selected start mode.


Fig. 42 The principle of the Torque Booster when starting the motor in voltage ramp mode.

See $\int 4.6$, page 19 , which main function that can be used with the torque boost.


| 0 | 3 | 1 | 0 |
| :--- | :--- | :--- | :--- |
|  |  |  |  |
|  | 3 | 0 | 0 | Torque boost current limit

NOTE! Check whether the motor can accelerate the load with "Torque booster", without any harmful mechanical stress.

### 7.12 Bypass

In cases of high ambient temperatures or other reason it may sometimes be necessary to use a by-pass contactor to minimize the power loss at nominal speed (see Technical Data). By using the built-in Full Voltage Relay function an external contactor can be used to Bypass the soft starter when operating at nominal speed.

Bypass contactor can also be used if soft stop is required. Normally a Bypass contactor is not necessary as the device is designed for continues running conditions, see Fig. 29 on page 33 for wiring example.

NOTE! If one like to use the alarm functlons, the extended functions or the viewing functions the 2-pas current transformers must be mounted outside the soft start as shown in Fig. 44 and Fg. 45 on page 45 . For this purpose an optional extension cable for the current transformers is avallable. Code No 01-2020-00.

| $0 \times 3120$ |  |  | Setting of Bypass |
| :---: | :---: | :---: | :---: |
| 0 |  | $F$ |  |
| Default: |  | oFF |  |
| Range: |  | OFF, |  |
| ofF |  | Byp | s disabled |
| on |  |  | s enabled. <br> meither relay K1 or K2 to on 2 to control the bypass con, see menu $51 / 52$. |

CAUTION! If the current transformers are not mounted as in Fig. 43 on page 44 and $\S 6.2$, page 28, the alarm and viewing functions will not work. Do not forget to set menu 032 to ON, otherwise there will be an F12 alarm and at the stop command will be a freewheeling stop.

For further information see chapter 6.2 page 28.


Fig. 43 Bypass wiring example MSF 310-1400.

SOFTSTARTER


Fig. 44 Current transformer position when Bypass MSF-017 to MSF-250.


Fig. 45 Current transformer position when Bypass MSF-310 to MSF-1400.

### 7.13 Power Factor Control

During operation, the soft starter continuously monitors the load on the motor. Particularly when idling or when only partially loaded, it is sometimes desirable to improve the power factor. If Power factor control (PFC) is selected, the soft starter reduces the motor voltage when the load is lower. Power consumption is reduced and the degree of efficiency improved.


NOTE! If the PFC is used the EMC-directive is not fulfilled.

### 7.14 Brake functions

There are two built in braking methods for applications were the normal stop ramp is not enough.

## - Dynamic DC-brake

Increases the braking torque by decreasing speed.

## - Soft brake

Gives a high torque at the start of the braking and then also increasing torque by decreasing speed.

In both methods the MSF detects when the motor is standing still, so rotating in wrong direction is avoided.

## Dynamic Vector Brake

- Possible to stop motors with high inertia loads from close to synchronous speed.
- At $70 \%$ of the nominal speed a DC-brake is activated until the motor is standing still or the selected Braking Time has expired (see menu 34, next page).
- No contactor needed.
- For extra safety, the soft starter has a digital input signal for monitoring standstill so that at real motor standstill will stop the output voltage immediately (see $₫ 7.19$, page 53 ).


## Soft brake

- Even very high inertia loads can be stopped
- The Soft brake is a controlled reversing of the motor as the MSF measures the speed during braking.
- Two contactors are needed which can be placed on the in- or output of the soft starter. On the input the first contactor is connected to relay K1 which is also used as a mains contactor.
- At $30 \%$ of the nominal speed a DC-brake is activated until the motor is standing still or the selected Braking Time has expired (menu 34, next page).
- For extra safety, the soft starter has a digital input signal for monitoring standstill. So that the output voltage is stopped immediately (see menu 57-58, § 7.19, page 53).

See Fig. 47 on page 47 for the following set-up sequence:

- Soft brake is activated if menu $36=2$ and menu 34 has a time selected (see next page).
- Menu 51 and 52 are automatically set to 5 and 4 to get the correct relay functions on K 1 and K 2 (see $\oint$ 7.17, page 51).
- Relay K1 should be used to connect a contactor for supply L1, L2, L3 to MSF or motor.
- Relay K2 is used to connect phase shifting contactor to change L1, L2 and L3 to MSF or motor.
- At start K1 is activated and connects L1, L2, L3 then the motor starts. At stop K1 opens and disconnects L1, L2, and L3 and after 1s K2 connects with the other phase sequence and the braking of the motor is active.

NOTE! Soft brake uses both programmable relays. For other functions, see also the function table in chapter 7. page 35.

## NOTE! For several start/stops it is recommend to use the PTC input.



WARNING! If the Soft Brake function has been selected once and after that the Bypass function Is selected, then the relay functions on K1 and K2 remain in the Soft Brake functionality. Therefore it Is necessary to change the relay functions in menu 51-52 manually to the Bypass functions (see $\$ 7.17$, page 51) or reset to default in menu 199 (see $\$ 7.28$, page 63) and select the Bypass function again.


Fig. 46 Braking time

| 0 3 0$\quad$ Braking Strength |  |  |  |
| :--- | :--- | :--- | :--- |
|  | 1 | 0 | 0 |
|  |  |  |  |
| Default: | 100 |  |  |
| Range: | $100-500 \%$ |  |  |




Fig. 47 Soft brake wiring example.

### 7.15 Slow speed and Jog functions

The soft starter is able to run the motor at a fixed slow speed for a limited period of time.

The slow speed will be about $14 \%$ of the full speed in the forward direction and $9 \%$ in the reverse direction.

The following functions are possible:

## - Slow speed controlled by an external signal.

 The digital input is used to run at slow speed at a start or stop command for a selected number of pulses (edges) generated by an external sensor (photo cell, micro switch, etc.). See. $\$ 7.19$, page 53 for more instructions.- Slow Speed during a selected time period.

The slow speed will be active after a stop command for a selected time period. See $\S 7.19$, page 53 for more instructions.

- Slow Speed using the "JOG"-commands.

The slow Speed can be activated via the JOG keys on the keyboard or externally via the analogue input. See $\$ 7.25$, page 61 for more instructions.

### 7.15.1 Slow speed controlled by an external signal.

With these setting it is possible to have an external pulse or edge signal controlling the time that the Slow Speed is active either after a Start command or a Stop command or at both commands. The following menu's are involved:

| Menu | Function | See page |
| :--- | :--- | :--- |
| 57 | Digital input selection | page 53 |
| 58 | Pulse selection | page 53 |
| 37 | Slow speed torque | page 49 |
| 38 | Slow speed time at start | page 49 |
| 39 | Slow speed time at stop | page 49 |
| 40 | DC-Brake at slow speed | page 49 |

Installation is as follows:

1. Set the analogue input selection for Slow Speed operation. Menu $57=2$. See $\S 7.19$, page 53 . See Fig. 37 on page 41 for a wiring example.
2. Select in menu 38 (see $\S 7.15 .2$, page 49 ) the Slow Speed at Start time. This time will now be the absolute maximum time for Slow Speed to be active after a start command, in case the external signal will not appear.
3. Select in menu 39 (see $\oint 7.15 .2$, page 49 ) the Slow Speed at Stop time. This time will now be the absolute maximum time for Slow Speed to be active after a stop command, in case the external signal will not appear.
4. Select in menu 57 (see $\$ 7.19$, page 53 ) the number of edges to be ignored by the Slow Speed input, before a start or stop is executed at slow speed. The edges are generated by an external sensor (photo cell, micro switch, etc.).

The Slow Speed torque (menu 37) and DC-Brake after Slow Speed (menu 40) can be selected if needed. (see $\$ 7.15 .4$, page 49 ).

When the number of edges exceeds or the time expire, a start according to selected main function is made.

At stop, the motor will ramp down (if selected) and DC brake (if selected) before a slow speed forward at stop will begin. Slow speed will last as long as the number of edges on the external input is below parameter value in menu 036 and the max duration time doesn't expires. When the number of edges exceeds or the time expire, a stop is made.

In Fig. 48 on page 48 the selected number of edges are 4. It is recommended to select DC-brake (se $\S 7.14$, page 46) before a slow speed at stop if it is a high inertia load. See Fig. 29 on page 33 for wiring diagram. In case one use DC-brake, see $\S 7.15 .4$, page 49.


Fig. 48 Slow speed controlled by an external signal.
This additional function can be used together with most of the main functions (see $₫ 4.6$, page 19).


### 7.15.2 Slow speed during a selected time

It is possible to have a slow speed in forward direction before a start and after a stop. The duration of the slow speed is selectable in menus 038 and 039.

It is recommended to select DC brake (see $\S 7.14$, page 46) before a slow speed at stop if it is a high inertia load. This slow speed function is possible in all control modes, keyboard, remote and serial communication.

| $0.380_{0}^{0}$ |  |
| :---: | :---: |
| 0 F | $F$ |
| Default: | OFF |
| Range: | oFF, 1-60 sec |
| oFF | Slow speed at start is disabled |
| $1-60$ | Set slow speed time at start. |




Fig. 49 Slou speed at start/stop during a selected time.
The Slow speed torque (menu 37) and the DC-Brake after Slow speed (menu $40, \S 7.15 .4$, page 49) can be selected if needed.

### 7.15.3 Jog Functions

The Jog commands can be used to let the motor run at a Slow speed (forward or reverse) as long as the Jog command is active.

The Jog commands can be activated in 2 different ways:

## - Jog keys

The Jog-Forward and Jog-reverse keys on the control panel. The keys can be programmed separate for each function. See $\mathbb{\$} 7.25$, page 61 for more instructions

- External Jog command

The external command is given via terminal 14 at the digital input. Only 1 function (forward or reverse) can be programmed to the digital input at the time. See $\S 7.19$, page 53 for more instructions.

### 7.15.4 DC-brake after slow speed at stop [040]

A DC-brake after a slow speed at stop is possible to have, i.e. for a high inertia load or for a precise stop.

The current is controlled and the reference value for the normal DC-brake function is used (see $\S 7.15 .4$, page 49).
The duration for the DC-brake is possible to select.
This DC-brake function is not applied when the "JOG $\Omega$ " and "JOG $\Omega$ " keys are used.

| 0 | 4 | 0 | 0 |
| :--- | :--- | :--- | :--- |
|  | 0 | DC-Brake at slow speed |  |
|  | 0 | $F$ |  |
| Default: | oFF |  |  |
| Range: | oFF, 1-60 |  |  |
| oFF | DC-brake after slow speed at stop <br> disabled. |  |  |
| $\mathbf{1 - 6 0}$ | DC-brake duration time after slow <br> speed at stop. |  |  |

### 7.16 Motor data setting

The first step in the settings is to set menu 007 and 008 to "on" to be able to reach the menus 041-046 and enter the motor data.

NOTE! The default factory settings are for a standard 4-pole motor acc. to the nominal current and power of the soft starter. The soft starter will run even If no specific motor data is selected, but the performance will not be optimal.

| 0 | 4 | 1 | 0 |
| :--- | :--- | :--- | :--- |
|  | 4 | 0 | 0 |
|  | \begin{tabular}{l\|l|l|l|}
\hline
\end{tabular} |  |  |
| Nominal motor voltage |  |  |  |
| Default: | 400 V |  |  |
| Range: | $200-700 \mathrm{~V}$ |  |  |
| Make sure the soft starters maximum voltage rat- <br> ing is suitable for chosen motor voltage. |  |  |  |



NOTE! Now go back to menu 007, 008 and set It to "oFF" and then to menu 001.



### 7.17 Programmable relay K1 and K2

The soft starter has three built-in auxiliary relays, K3 (change over contacts), is always used as an alarm relay. The other two relays, K1 and K2 (closing contacts), are programmable.

K1 and K2 can be set to either "Operation", "Full Voltage" or "Pre-alarm" indication. If DC-brake is chosen the relay K 2 will be dedicated to this function.


Fig. 50 Start/stop sequence and relay function "Operation" and "Full voltage".

| $0\|5\| l\|l\|$ |  |  |
| :--- | :--- | :--- |
|  |  |  |
|  |  | Setting of K1 indication |
| Default: | 1 |  |
| Range: | $1,2,3,4,5$ |  |
| $\mathbf{1}$ | K1 is set for "Operation" |  |
| $\mathbf{2}$ | K1 is set for "Full Voltage" |  |
| $\mathbf{3}$ | K1 is set for "Power pre-alarm" |  |
| $\mathbf{4}$ | No function |  |
| $\mathbf{5}$ | K1 is set for "Run" |  |


| $05 \mid 2$ | 0 |
| :--- | :--- |
|  |  |
|  | 2 |
| Default: | 2 |
| Range: | $1,2,3,4,5$ |
| $\mathbf{1}$ | K2 is set for "Operation" |
| $\mathbf{2}$ | K2 is set for "Full Voltage" |
| $\mathbf{3}$ | K2 is set for "Power pre-alarm" |
| $\mathbf{4}$ | K2 is set for "Softbrake" |
| $\mathbf{5}$ | K 2 is set for "Run" |

WARNING! If the Soft Brake function has been selected once and after that the Bypass function is selected, then the relay functions on K1 and K2 remain in the Soft Brake functionality. Therefore it is necessary to change the relay functions in menu 51-52 manually to the Bypass functions (see § 7.12, page 43) or reset to default in menu 199 (see § 7.28, page 63) and select the Bypass function again.

### 7.18 Analogue output

The soft starter can present current, voltage and power on an analogue output terminal, for connection to a recording instrument or a PLC. The output can be configured in 4 different ways, $0-10 \mathrm{~V}$,
$2-10 \mathrm{~V}, 0-20 \mathrm{~mA}$ or $4-20 \mathrm{~mA}$. To install the instrument proceed as follows:

1. Connect the instrument to terminal $19(+)$ and $15(-)$.


Fig. 51 Wiring for analogue outpur.
2. Set Jumper J2 on the PCB board to voltage ( U ) or current (I) signal position. Factory setting is voltage (U). See Fig. 52 on page 52 and Fig. 24 on page 28.

4. Choose a read-out value in menu 055

5. Set analogue output gain to adjust the range of chosen analogue output value in menu 056.


Example on settings:

| Set value | $\mathbf{I}_{\text {scale }}$ | $\mathbf{U}_{\text {scale }}$ | $\mathbf{P}_{\text {scale }}$ |
| :--- | :--- | :--- | :--- |
| $100 \%$ | $0-5 x I_{n}$ | $0-720 \mathrm{~V}$ | $0-2 x P_{\mathrm{n}}$ |
| $50 \%$ | $0-2.5 \times \mathrm{I}_{\mathrm{n}}$ | $0-360 \mathrm{~V}$ | $0-\mathrm{P}_{\mathrm{n}}$ |

Fig. 52 Setting of current or voltage output.
3. Set the parameter in menu 054.


### 7.19 Digital input selection

The analogue input can be used as a digital input. This is programmed in Menu 57. There are 4 different functions:

- Rotation sensor input for braking functions. See $\$ 7.14$, page 46.
- Slow speed external controlled. See $\S 7.15 .1$, page 48.
- Jog functions forward or reverse enabled. See $\S$ 7.25 , page 61 .

Fig. 53 shows how to set the input for voltage or current control, with jumper J1 the control board. The default setting for J 1 is voltage control.


Depending on the selection made in menu 57, menu 58 is used to program the number of the edges. The edges can be generated by an external sensor (photo cell, micro switch etc.).

| 0 | 5 | 8 | 0 |
| :--- | :--- | :--- | :--- |
|  |  |  | Digital input pulses |
|  |  | 1 |  |
| Default: | 1 |  |  |
| Range: | $1-100$ |  |  |
| If Menu $57=1$. <br> A positive or negative edge at analogue input from <br> a rotation sensor will give a signal to stop the <br> braking voltage. <br> If Menu $57=2$ <br> The number of edges to be ignored by the slow <br> speed input, before a start or stop is executed at <br> slow speed. |  |  |  |

Fig. 53 Setting of J1 for current or voltage control.
Fig. 54 shows a wiring example for the analogue input as it is used for digital input.


Fig. 54 Wiring for slow speed external input.
NOTE! If the Main Function Analogue control is programmed (see § 7.8, page 41) the analogue Input can not be used for digital signal Input. The menu 57 is then automatically set to OFF.


NOTE! Jog forward, reverse has to be enabled, see $\$ 7.25$, page 61.

### 7.20 Parameter Set

Parameter Set, an important function which can be handy when using one soft starter to switch in and start different motors, or working under variable load conditions. For example; starting and stopping conveyor belts with different weight on the goods from time to time.

For sets of parameters can be controlled either from the keyboard, the external control inputs or the serial interface (option). Up to 51 different parameters can be set for each Parameter Set.


Fig. 55 Parameter overview
When 'Parameter set' in menu 061 is set to 0 (external selection), only parameters in menu 006 (Control mode) and 061 (Parameter set) can be changed. All other parameters are not allowed to change.

It is possible to change parameter set at stop and at fuli voltage running.


Fig. 56 Connection of external control inputs.

| Parameter Set | PS1 (16-18) | PS2 (17-18) |
| :---: | :---: | :---: |
| 1 | Open | Open |
| 2 | Closed | Open |
| 3 | Open | Closed |
| 4 | Closed | Closed |

### 7.21 Motor protection, overload (F2 alarm)

In many cases it is convenient to have a complete starter. The soft starter have a possibility to use either an input PTC signal from the motor, an internal thermal model of the motor for thermal protection or both together at the same time. Slight overload for long time and several overloads of short duration will be detected with both methods.


NOTE! Open terminals will give an $\mathbf{F} 2$ alarm Immediately. Make sure the PTC is always connected or the terminals are shorted.

NOTE! The internal motor thermal protection will still generate an alarm if it is not selected ofF.

| 0 |  |  |  |
| :---: | :---: | :---: | :---: |
|  | $1$ | $0$ | Internal motor thermal protection |
| Default: |  | 10 |  |
| Range: |  |  | -40 sec |
| ofF |  |  | al motor protection is disabled. |
| 2-40 |  |  | ion of the thermal curve ding to Fig. 57 <br> $k$ that menu 042 is set to the motor current (see §7.16, 50). <br> current exceeds the 100\% an F2 alarm is activated. motor model thermal capacity cool down to $95 \%$ before reset be accepted. <br> thermal capacity in menu 073 7.21 , page 55 . |

NOTE! If 'Bypass' is used check that the current transformers are placed and connected correctly (see Fig. 43 on page 44).


CAUTION! Used thermal capacity is set to 0 if the control board loses its supply (terminal 01 and 02). This means that the internal thermal model starts with a 'cold' motor, which perhaps in reallty is not the case. This means that the motor can be overheated.


Fig. 57 The thermal curve

### 7.22 Mains protection



Read-out of the used thermal capacity. If menu 072 'Internal motor thermal protection' is selected oFF, the capacity is shown as if the default class 10 was selected.


Insert limit in \% of nominal motor voltage. Max unbalance in voltage between the 3 input phases is compared with the selected value. This is a category 2 alarm.



### 7.23 Application protection (load monitor)

### 7.23.1 Load monitor max and min/protection (F6 and F7 alarms)

MSF has a built in load monitor based on the output shaftpower. This is a unique and important function which enables protection of machines and processes driven by the motor connected to the soft starter. Both a Min and Max limit is possible to select.

In combination with the pre-alarm function, see §7.23.2, page 58, this create a powerful protection. An auto set function is also included for an automatic setting of the alarm limits. A start-up delay time can be selected to avoid undesired alarms at start-up, see Fig. 58 on page 60.

NOTE! The load monitor alarms are all disabled during a stop ramp.

| 0 8 9 0 <br> 0   $\quad$ Auto set power limits |  |  |  |
| :--- | :--- | :--- | :--- |
|  |  | $n$ | 0 |
|  |  |  |  |
| Default: | no |  |  |
| Range: | no, YES |  |  |
| no | Auto set is disabled |  |  |
| YES | Auto set is activated if ENTER is <br> pressed. |  |  |


| 0910 | 0 |  |
| :--- | :--- | :--- |
|  |  | 0 |
|  |  |  |

NOTE! System must be in full voltage running before an auto set is permitted.

The actual power is regarded as $1.00 \times \mathrm{Pact}$.
The set levels are:

| Power max alarm limit [092]: | $1.15 \times P$ actual |
| :--- | :--- |
| Power max pre-alarm limit $[094]:$ | $1.10 \times P$ actual |
| Power min pre-alarm limit[096]: | $0.90 \times \mathrm{xP}$ actual |
| Power min alarm limit[098]: | $0.85 \times \mathrm{P}$ actual |

A successful auto set shows a message 'Set' for 3 s and if

NOTE! The actual phase sequence can be viewed in menu 87.

Under voltage alarm
nsert limit in \% of nominal motor voltage. Min volt age of the 3 input phases is compared with the selected value. This is a category 2 alarm.

| 086 |  |  |
| :--- | :--- | :--- |
|  | 0 |  |
|  | F | F | \(\left.\begin{array}{l}Response delay under <br>

voltage alarm\end{array}\right]\)


something goes wrong a message 'no' will be showed.


From start command during selected delay time, all power load monitor alarms and pre-alarms are disabled.

## $0.92{ }_{\circ}^{\circ}$



Insert limit in \% of nominal motor power. The actual power in \% of nominal motor power, could be read out in menu 090. If output shaft power exceeds selected limit, an F6-alarm occurs after the response delay time. The 'Auto set' function in menu 089, affect this limit even if the alarm is set "oFF" in menu 093. This is a category 1 alarm.


### 7.23.2 Pre-alarm

It could be useful to know if the load is changing towards a load alarm limit. It is possible to insert both a Max and Min pre-alarm limit based on the motor output shaft power. If the load exceeds one of these limits, a pre-alarm condition occurs.

It should be noted that it is not normal alarms. They will not be inserted in the alarm list, not activating the alarm relay output, not displayed on the display and they will not stop operation. But it is possible to activate relay K 1 or K 2 if a pre-alarm condition occurs. To have pre-alarm status on any of these relays, select value 3 in menu 051 or 052 (see $\$ 7.17$, page 51 ).

A start-up delay time can be selected in menu 091 to avoid undesired pre-alarms at start-up. Note that this time is also shared with power Max and Min alarms.

NOTE! The pre-alarm status is always available on the serlal communication.


Insert limit in \% of nominal motor power. The actual power in \% of nominal motor power, could be read out in menu 090. If output shaft power exceeds selected limit, a pre-alarm occurs after the response delay time. The 'Auto set' function in menu 089, affect selected limit even if the pre-alarm is set "oFF" in menu 095.



Insert limit in \% of nominal motor power. The actual power in \% of nominal motor power, could be read out in menu 090. If output shaft power goes below selected limit, a pre-alarm occurs after the response delay time. The 'Auto set' function in menu 089, affect selected limit even if the prealarm is set "oFF" in menu 097.


|  | O F | F Min pre-alarm response delay |
| :--- | :--- | :--- |
| Default: | oFF |  |
| Range: | oFF, 0.1-25.0 sec |  |
| oFF | Min Pre-Alarm is disabled. |  |
| $\mathbf{0 . 1 - 2 5 . 0}$ | Sets the response delay of the Min <br> Pre-Alarm level. The Min Pre-alarm is <br> disabled during a stop ramp down. |  |



| $0990^{\circ}$ |  |
| :---: | :---: |
| 0 F | $F$ |
| Default: | oFF |
| Range: | oFF, 0.1-25.0 sec |
| oFF | Min Alarm is disabled |
| 0.1-25.0 | Sets the response delay of the Min Alarm level. The Min alarm is disabled during a stop ramp down. |



### 7.24 Resume alarms

### 7.24.1 Phase input failure F1

- Multiple phase failure.

Shorter failure than 100 ms is ignored. If failure duration time is between 100 ms and 2 s , operation is temporary stopped and a soft start is made if the failure disappears before 2 s . If failure duration time is longer than 2 s , an F 1 alarm is given in cat. 2.

- Single phase failure.

During start up (acceleration) the behaviour is like multiple phase failure below. When full voltage running there is a possibility to select the behaviour.

| 1\|0|10 |  |  | Run at single phase loss |
| :---: | :---: | :---: | :---: |
|  | n | 0 |  |
| Default: |  | no |  |
| Range: |  |  |  |
| no |  |  | arter trips if a single phase detected. Alarm F1 (category appear after 2 sec . |
| YES |  |  | tarter continues to run after a phase loss. <br> F1 appears after 2 sec . loose phase is reconnect the is reset automatically. ning on 2 phases, a stop comwill give a Direct on line stop wheel) |

### 7.24.2 Run at current limit time-out F4

In modes 'Current limit at start' and 'Voltage ramp with current limit at start' an alarm is activated if still operating at current limit level when selected ramp time exceeds. If an alarm occurs there is a possibility to select the behaviour.


### 7.25 Slow speed with JOG

Slow speed with "JOG" is possible from the "JOG" keys, but also from terminals, see menu 57 page 53 and serial comm. The "JOG" is ignored if the soft starter is running. The slow speed "JOG" function has to be enabled for both forward and reverse directions in menus 103 and 104, see below.

NOTE! The enable functions is for all control modes.


Fig. 59 The 2 Jog keys.

### 7.26 Automatic return menu

Often it is desirable to have a specific menu on the display during operation, i.e. RMS current or power consumption. The Automatic return menu function gives the possibility to select any menu in the menu system.

The menu selected will come up on the display after 60 sec . if no keyboard activity. The alarm messages (F1-F16) have a priority over menu 105 (as they have for all menus).

| 11050 |  |  | Automatic return menu |
| :---: | :---: | :---: | :---: |
| 0 | $F$ | $F$ |  |
| Default: |  | oFF |  |
| Range: |  | oFF, 1-999 |  |
| 1-999 |  | Pressing " + " /"-" will lead through the menu system. |  |

### 7.27 Communication option, related Parameters

The following parameters have to be set-up:

- Unit address.
- Baud rate.
- Parity
- Behaviour when contact broken.

Setting up the communication parameter must be made in local 'Keyboard control' mode. See $\$ 7.2$, page 37.



## Serial comm. broken alarm

If control mode is 'Serial comm. control' and no contact is established or contact is broken the Soft starter consider the contact to be broken after 15 sec , the soft starter can act in three different ways:

1 Continue without any action at all.
2 Stop and alarm after 15 sec .
3 Continue and alarm after 15 sec .
If an alarm occurs, it is automatically reset if the communication is re-established. It is also possible to reset the alarm from the soft starter keyboard.

| 1 1 4 <br> 0   |  |  |
| :--- | :--- | :--- |
|  |  |  |

### 7.28 Reset to factory setting [199]

When selecting reset to factory settings:

- All parameters in all parameter sets will have default factory settings.
- Menu 001 will appear on the display.
- Note that the alarm list, the power consumption and the operation time will not have default settings.


NOTE! Reset to factory settings is not allowed at run.

### 7.29 View operation

## General

The soft start includes as standard a numerous metering functions which eliminates the need of additional transducers and meters.

## Measured values

- Current RMS 3-phase current and per phase
- Voltage RMS 3-phase voltage and per phase
- Output shaft power /torque $\mathrm{kW} / \mathrm{Nm}$
- Power factor
- Power consumption in kWh
- Operation time in hours


## Viewing of the measured values

After setting motor data and extended functions one can set menu 008 in oFF and will then automatically move to menu 201, the first menu viewing the measured values and thus eliminate to scroll through menu 011 to menu 199.


NOTE! This is the same read-out as menu 005 see § 7.1.1, page 36.


NOTE! The power factor viewing will not work at bypass even if the current transformers are mounted outside the
soft start.



| $2\|0\| 6 \mid$   <br>    <br>   n |  |
| :--- | :--- | :--- |
| Reset of power consumption |  |
| Default: | no |
| Range: | no, YES |
| no | No reset of power consumtion. |
| YES | Reset power consumption in menu <br> 205 to 0.000. |




| 2-1\|10 |  | RMS current in phase L1 |
| :---: | :---: | :---: |
|  | 0.0 |  |
| Default: |  |  |
| Range: | 0.0- | 999Amp |
| View the current in phase L1. |  |  |



## $2130_{0}^{0}$



### 7.30 Keyboard lock

The keyboard can be locked to prohibit operation and parameter setting by an unauthorised. Lock keyboard by pressing both keys "NEXT $\rightarrow$ " and "ENTER $\leftrightarrow "$ for at least 2 sec . The message '- Loc' will display when locked. To unlock keyboard press the same 2 keys "NEXT $\rightarrow$ " and "ENTER $\leftarrow$ " for at least 2 sec. The message 'unlo' will display when unlocked.

In locked mode it is possible to view all parameters and read-out, but it is forbidden to set parameters and to operate the soft starter from the keyboard.

The message '-Loc' will display if trying to set a parameter or operate the soft starter in locked mode.

The key lock status can be read out in menu 221.

| 2 2 1$\quad$ Locked keyboard info |  |  |  |
| :--- | :--- | :--- | :--- |
|  |  | $n$ | 0 |
|  |  |  |  |
| Default: | no |  |  |
| Range: | no, YES |  |  |
| no | Keyboard is not locked |  |  |
| YES | Keyboard is locked |  |  |

### 7.31 Alarm list

The alarm list is generated automatically. It shows the latest 15 alarms ( $\mathrm{F} 1-\mathrm{F} 16$ ). The alarm hist can be useful when tracing a failure in the soft starter or its control circuit. Press key "NEXT $\rightarrow$ " or "PREV $\leftarrow$ " to reach the alarm list in menus 901-915 (menu 007 has to be ON).


## 8. PROTECTION AND ALARM

The soft starter is equipped with a protection system for the motor, the machine and for the soft starter itself.
Three categories of alarm are available:

## Category 1

Alarm that stops the motor and need a separate reset before a new start can be accepted.

## Category 2

Alarm that stops the motor and accepts a new start command without any separate reset.

## Category 3

Alarm that continues to run the motor.
All alarm, except pre-alarm, will activate the alarm relay output K3, flash a red fault number on the display and it will also be placed in the alarm list. As long as the alarm is active, the display is locked in the alarm indication.

The relay output K3 can be used in the control circuit for actions needed when alarm occurs.

If more than one alarm is active, it is the last alarm that is presented on the display.

### 8.1 Alarm description

### 8.1.1 Alarm with stop and requiring a separate reset

Operation will stop for a category 1 alarm. A separate reset is needed before a new start command is accepted. It is possible to reset from keyboard (pushing "ENTER/RESET") regardless of selected control mode. It is also possible to reset the alarm from the actual control mode (i.e. if control mode is serial communication, a reset is possible to do from serial communication).

A reset is accepted first when the alarm source goes back to normal.

When a reset is made, the alarm relay output K3 is deactivated, the alarm indication on the display disappear and the original menu shows.

After a reset is made the system is ready for a new start command.

### 8.1.2 Alarm with stop and requiring only a new start command

Operation will stop for a category 2 alarm. A restart can be done and at the same time the alarm relay output K3 is deactivated, the alarm indication on the display disappear and the original menu shows.

It is still possible to reset the alarm in the same way as for category 1 alarms (see 8.1.1), if a start is not required at the time.

### 8.1.3 Alarm with continue run

Operation will continue run for a category 3 alarm. Some different reset behaviour is possible (see remarks for the specific alarms in $\S 8.2$, page 67).

- Automatic reset when the alarm source goes back to normal.
- Automatic reset when a stop command is given.
- Manual reset during run.

When the reset occurs, the alarm relay output K3 is deactivated, the alarm indication on the display disappear and the original menu shows.
8.2 Alarm overview

| Display indication | Protective function | Alarm category | Remark |
| :---: | :---: | :---: | :---: |
| F1 | Phase input failure. | Cat 3. Run with auto reset. | Single phase failure when full voltage running if menu 101 'Run at phase loss' = YES. If the fault phase comes back, an automatic reset is made. |
|  |  | Cat 2. Stop with reset in start. | Multiple phase failure or single phase failure when not full volt age running or if menu $101^{\prime}$ Run at phase loss' $=$ no. |
| F2 | Motor protection, overload. | Cat 1. Stop with manual reset. | If menu 071 'Motor PTC input' = YES, cool down the motor. If menu 071 'Motor PTC input' = no, the internal model has to 'cool' down. |
| F3 | Soft start overheated | Cat 1. Stop with manual reset. | If not cooled down, a reset will not be accepted. |
| F4 | Full speed not reached at set current limit and start time. | If menu 102 'Run at current limit time-out' $=$ no. <br> Cat 2. Stop with reset in start. | The current limit start is not completed. |
|  |  | If menu 102 'Run at current limit time-out' = YES. <br> Cat 3 . Run with manual reset. | When start time expired, a 6 sec ramp is used to reach full voltage, without control of the current. Reset the alarm with either a manual reset or a stop command. |
| F5 | Locked rotor. | Cat 1. Stop with manual reset. | Motor and/or machine protection. |
| F6 | Above max power limit. | Cat 1. Stop with manual reset. | Machine protection. |
| F7 | Below min power limit. | Cat 1. Stop with manual reset. | Machine protection. |
| F8 | Voltage unbalance. | Cat 2. Stop with reset in start. | Motor protection. |
| F9 | Over voltage. | Cat 2. Stop with reset in start. | Motor protection. |
| F10 | Under voltage. | Cat 2. Stop with reset in start. | Motor protection. |
| F11 | Starts / hour exceeded. | Cat 2. Stop with reset in start. | Motor and/or machine protection. |
| F12 | Shorted thyristor. | Cat 3. Run with manual reset. | When stop command comes, the stop will be a 'Direct On Line' stop, and the soft starter will be resetted. After this fault it is possible to start only in 'Direct On Line' mode. One or more thyristors probably damaged. |
| F13 | Open thyristor. | Cat 1. Stop with manual reset. | One or more thyristors probably damaged. |
| F14 | Motor terminal open. | Cat 1. Stop with manual reset. | Motor not correctly connected. |
| F15 | Serial communication broken. | If menu 114 Serial comm. contact broken = 1. Cat 2. Stop with reset in start. | Serial communication broken will stop operation. Run from keyboard if necessary. |
|  |  | If menu 114 Serial comm. contact broken $=2$. Cat 3 . Run with auto reset. | Serial communication broken will not stop operation. Stop from keyboard if necessary. |
| F16 | Phase reversal alarm. | Cat 1. Stop with manual reset. | Incorrect phase order on main voltage input. |

9. TROUBLE SHOOTING

### 9.1 Fault, cause and solution

| Observation | Fault indication | Cause | Solution |
| :---: | :---: | :---: | :---: |
| The display is not illuminated. | None | No control voltage. | Switch on the control voltage. |
| The motor does not run. | F1 (Phase input failure) | Fuse defective. | Renew the fuse. |
|  |  | No mains supply. | Switch the main supply on. |
|  | F2 <br> (Motor protection, overload) | Perhaps PTC connection. Perhaps incorrect nominal motor current inserted (menu 042). | Check the PTC input if PTC protection is used. <br> If internal protection is used, perhaps an other class could be used (menu 072). <br> Cool down the motor and make a reset. |
|  | F3 <br> (Soft start overheated) | Ambient temperature to high. soft starter duty cycle exceeded. Perhaps fan failure. | Check ventilation of cabinet. Check the size of the cabinet. Clean the cooling fins. If the fan(s) is not working correct, contact your local MSF sales outlet. |
|  | F4 (Full speed not reached at set current limit and start time) | Current limit parameters are perhaps not matched to the load and motor. | Increase the starting time and/or the current limit level. |
|  | F5 (Locked rotor) | Something stuck in the machine or perhaps motor bearing failure. | Check the machine and motor bearings. Perhaps the alarm delay time can be set longer (menu 075). |
|  | F6 <br> (Above max power limit) | Overload | Over load. Check the machine. Perhaps the alarm delay time can be set longer (menu 093). |
|  | F7 (Below min power limit) | Underload | Under load. Check the machine. Perhaps the alarm delay time can be set longer (menu 099). |
|  | F8 (Voltage unbalance) | Main supply voltage unbalance. | Check mains supply. |
|  | F9 (Over voltage) | Main supply over voltage. | Check mains supply. |
|  | $\begin{aligned} & \text { F10 } \\ & \text { (Under voltage) } \end{aligned}$ | Main supply under voltage. | Check mains supply. |
|  |  | Number of starts exceeded according to menu 074. | Wait and make a new start. Perhaps the number of starts / hour could be increased in menu 074. |
|  | F13 <br> (Open thyristor) | Perhaps a damaged thyristor. | Make a reset and a restart. If the same alarm appears immediately, contact your local MSF sales outlet. |
|  | F14 <br> (Motor terminal open) | Open motor contact, cable or motor winding. | If the fault is not found, reset the alarm and inspect the alarm list. If alarm F12 is found, a thyristor is probably shorted. <br> Make a restart. If alarm F14 appears immediately, contact your local MSF sales outlet. |


| Observation | Fault indication | Cause | Solution |
| :---: | :---: | :---: | :---: |
| The motor does not run. | F15 <br> (Serial communication bro- <br> ken) | Serial communication broken. | Make a reset and try to establish contact. Check contacts, cables and option board. <br> Verify <br> - System address (menu 111). <br> - Baudrate (menu 112). <br> - Parity (menu 113). <br> If the fault is not found, run the motor with keyboard control if urgent (set menu 006 to "1"). See also manual for serial communica tion. |
|  | F16 <br> (Phase reversal) | Incorrect phase sequence on main supply. | Switch L2 and L3 input phases. |
|  | --. - | Star t command comes perhaps from incorrect control source. (l.e. start from keyboard when remote control is selected). | Give start command from correct source (menu 006). |
|  | -Loc | System in keyboard lock. | Unlock keyboard by pressing the keys 'NEXT' and 'ENTER' for at least 3 sec . |
| The motor is running but an alarm is given. | F1 <br> (Phase input failure) | Failure in one phase. Perhaps fuse defective. | Check fuses and mains supply. Deselect 'Run at single phase input failure' in menu 101, if stop is desired at single phase loss. |
|  | F4 (Full speed not reached at set current limit and start time) | Current limit parameters are perhaps not matched to the load and motor. | Increase the starting time and/or the current limit level. Deselect 'Run at current limit time-out' in menu 102, if stop is desired at current limit time-out. |
|  | F12 <br> (Shorted thyristor) | Perhaps a damaged thyristor. | When stop command is given, a free wheel stop is made. Make a reset and a restart. If alarm F14 appears immediately, contact your local MSF sales outlet. <br> If it is urgent to start the motor, set soft starter in 'Direct On Line' (menu 024). It is possible to start in this mode. |
|  |  | By pass contactor is used but menu 032 'Bypass' is not set to "on". | Set menu 032 'Bypass' to "on". |
|  | F15 <br> (Serial communication broken) | Serial communication broken. | Make a reset and try to establish contact. Check contacts, cables and option board. <br> Verify <br> - System address (menu 111). <br> - Baudrate (menu 112). <br> - Parity (menu 113). <br> If the fault is not found, run the motor with keyboard control if urgent, see also manual for serial communication. |


| Observation | Fault indication | Cause | Solution |
| :---: | :---: | :---: | :---: |
| The motor jerks etc. | When starting, motor reaches full speed but it jerks or vibrates. | If 'Torque control' or 'Pump control' is selected, it is necessary to input motor data into the system. | Input nominal motor data in menus 041-046. Select the proper load characteristic in menu 025. Select a correct initial- and end torque at start in menus 016 and 017. If 'Bypass' is selected, check that the current transformers are correct connected. |
|  |  | Starting time too short. | Increase starting time. |
|  |  | Starting voltage incorrectly set. | Adjust starting voltage. |
|  |  | Motor too small in relation to rated current of soft starter. | Use a smaller model of the soft starter. |
|  |  | Motor too large in relation to load of soft starter. | Use larger model of soft starter. |
|  |  | Starting voltage not set correctly | Readjust the start ramp. |
|  |  |  | Select the current limit function. |
|  | Starting or stopping time too long, soft does not work. | Ramp times not set correctly. | Readjust the start and/or stop ramp time. |
|  |  | Motor too large or too small in relation to load. | Change to another motor size. |
| The monitor function does not work. | No alarm or pre-alarm | It is necessary to input nominal motor data for this function. Incorrect alarm levels. | Input nominal motor data in menus 041-046. Adjust alarm levels in menus 091 - 099. If 'Bypass' is selected, check that the current transformers are correct connected. |
| Unexplainable alarm. | F5, F6, F7, F8, F9, F10 | Alarm delay time is to short. | Adjust the response delay times for the alarms in menus 075,082 , 084, 086, 093 and 099. |
| The system seems locked in an alarm. | F2 <br> (Motor protection, overload) | PTC input terminal could be open. <br> Motor could still be to warm. If internal motor protection is used, the cooling in the internal model take some time. | PTC input terminal should be short circuit if not used. Wait until motor PTC gives an OK (not overheated) signal. Wait until the internal cooling is done. Try to reset the alarm after a while. |
|  | F3 <br> (Soft start overheated) | Ambient temperature to high. Perhaps fan failure. | Check that cables from power part are connected in terminals 073, 074, 071 and 072. MSF-017 to MSF-145 should have a short circuit between 071 and 072 . Check also that the fan(s) is rotating. |
| Parameter will not be accepted. | - . - | If the menu number is one of 020-025, only one can bee selected. <br> In other words only one main mode is possible at a time. | Deselect the other main mode before selecting the new one. |
|  |  | If menu 061, 'Parameter set' is set to " 0 ", the system is in a remote parameter selection mode. It is now impossible to change most of the parameters. | Set the menu 061, 'Parameter set' to a value between "1" - "4" and then it is possible to change any parameter. |
|  |  | During acceleration, deceleration, slow speed, DC brake and Power factor control mode, it is impossible to change parameters. | Set parameters during stop or full voltage running. |
|  |  | If control source is serial comm., it is impossible to change parameters from keyboard and vice versa. | Change parameters from the actual control source. |
|  |  | Some menus include only read out values and not parameters. | Read-out values can not be altered. In table 13 , page 35 , read-out menus has '--' in the factory setting column. |
|  | -Loc | Keyboard is locked. | Unlock keyboard by pressing the keys 'NEXT' and 'ENTER' for at least 3 sec . |

## 10. MAINTENANCE

In general the soft starter is maintenance free. There are however some things which should be checked regularly. Especially if the surroundings are dusty the unit should be cleaned regularly.

## WARNING! Do not touch parts inside the enclosure of the unit when the control and motor voltage is switched on.

## Regular maintenance

- Check that nothing in the soft starter has been damaged by vibration (loose screws or connections).
- Check external wiring, connections and control signals. Tighten terminal screws and busbar bolts if necessary.
- Check that PCB boards, thyristors and cooling fin are free from dust. Clean with compressed air if necessary. Make sure the PCB boards and thyristors are undamaged.
- Check for signs of overheating (changes in colour on PCB boards, oxidation of solder points etc.). Check that the temperature is within permissible limits.
- Check that the cooling fan/s permit free air flow. Clean any external air filters if necessary.

In the event of fault or if a fault cannot be cured by using the fault-tracing table in chapter 9. page 68.

## 11. OPTIONS

The following option are available. Please contact your supplier for more detailed information.

### 11.1 Serial communication

For serial communication the MODBUS RTU (RS232/RS485) option card is available order number: 01-1733-00.


Fig. 60 Option RS232/485

### 11.2 Field bus systems

Various option cards are available for the following bus systems:

- PROFIBUS DP order number: 01-1734-01
- Device NET, order number:
- LONWORKS:

01-1736-01

- FIP IO: 01-1737-01
- INTERBUS-S:

01-1738-01
01-1735-01
Each system has his own card. The option is delivered with an instruction manual containing the all details for the set-up of the card and the protocol for programming.


Fig. 61 Option Profibus

### 11.3 External PPU.

The external PPU option is used to move the PPU (keyboard) from the soft starter to the front of a panel door or control cabinet.

The maximum distance between the soft starter and the external PPU is 3 m .
The option can be factory mounted (01-2138-01) or it can be built in later (01-2138-00). For both versions instruction /data sheet are available.


Fig. 62 Shows an example of the External PPU after it has been built in.

### 11.3.1 Cable kit for external current transformers

This kit is used for the bypass function, to connect the external current transformers more easy. order number: 01-2020-00.


Fig. 63 Cable kit

### 11.4 Terminal clamp

Data: Single cables, Cu or Al
Cables
MSF type Cu Cable
Bolt for connection to busbar
Dimensions in mm
Order No. single
Data: Parallel cables, Cu or Al
Cables
MSF type and Cu Cable
Bolt for connection to busbar
Dimensions in mm
Order No. parallel


Fig. 64 The terminal clamp.

## 12. TECHNICALDATA

| $3 \times 200-525$ V 50/60 Hz Model | MSF-017 |  | MSF-030 |  | MSF-045 |  | MSF-060 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter railng according to AC35a, see chapter 4, page 13 | $\begin{gathered} \text { 5.0-30:50.10 } \\ \text { heavy } \end{gathered}$ | $\begin{aligned} & 3.0-30: 50-10 \\ & \text { normal/IIght } \end{aligned}$ | $\begin{gathered} 5.0-30: 50-10 \\ \text { heavy } \end{gathered}$ | $\left.\begin{array}{\|l\|} \hline 3.0-30: 5010 \\ \text { normal/ } / \mathrm{lght} \end{array} \right\rvert\,$ | $\begin{gathered} 5.0-30: 5010 \\ \text { heary } \end{gathered}$ | $\begin{aligned} & 3.0-30: 50-10 \\ & \text { nommal/light } \end{aligned}$ | $\begin{array}{\|c\|} \hline \text { 5.0.30:50.10 } \\ \text { heary } \end{array}$ | $\begin{aligned} & \text { 3.0.0.30:50-10 } \\ & \text { normal/light } \end{aligned}$ |
| Rated current of soft starter (A) | 17 | 22 | 30 | 37 | 45 | 60 | 60 | 72 |
| Recommended motor size (kW) for 400 V | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 30 | 37 |
| Fecommended motor size ( kW ) for 525 V | 11 | 15 | 18.5 | 22 | 30 | 37 | 37 | 45 |
| Order number: supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1301-01 |  | 01-1302-01 |  | $01.1303-01$ |  | 01-1304-01 |  |
| Order number: supply voltage ( $380-500 \mathrm{~V}$ ) | 01-1301-02 |  | 01-1302-02 |  | 01-1303-02 |  | 01-1304-02 |  |
| $3 \times 200690 \mathrm{~V} 50 / 60 \mathrm{~Hz}$ Model | MSF-017 |  | MSF-030 |  | MSF-045 |  | MSF-060 |  |
| Rated current of soft starter (A) | 17 | 22 | 30 | 37 | 45 | 60 | 60 | 72 |
| Motor power for 690V | 15 | 18.5 | 22 | 30 | 37 | 55 | 55 | 75* |
| Order number: supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1321-01 |  | 01-1322-01 |  | 01-1323-01 |  | 01-1324.01 |  |
| Order number: supply voltage ( $380-50 \mathrm{~V}$ ) | 01-1321-02 |  | 01.1322-02 |  | 01-1323-02 |  | 01-1324-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |
| Recommended wiring fuse (A) 1) | 25/50 | 32 | 35/80 | 50 | 50/125 | 80 | 63/160 | 100 |
| Semi-conductor fuses, if required | 80 A |  | 125 A |  | 160 A |  | 200 A |  |
| Power loss at rated motor load (W) | 50 | 70 | 90 | 120 | 140 | 180 | 180 | 215 |
| Power consumption control card | 20 VA |  | 20 VA |  | 25 VA |  | 25 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |
| Dimensions in mm $\mathrm{H} \times \mathrm{W} \times \mathrm{D}$ | 320×126×260 |  | $320 \times 126 \times 260$ |  | 320×126×260 |  | $320 \times 126 \times 260$ |  |
| Mounting position (Vertical/Horizontal) | Vertical |  | Vertical |  | Vert, or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 6.7 |  | 6.7 |  | 6.9 |  | 6.9 |  |
| Connection busbars Cu, (bolt) | 15×4 (M6) |  | $15 \times 4$ (M6) |  | 15×4 (M6) |  | $15 \times 4$ (M8) |  |
| Cooting system | Convection |  | Convection |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |
| Number of futly controlled phases | 3 |  |  |  |  |  |  |  |
| Voltage tolerance control | Control $+/ \cdot 10 \%$ |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor $200-525+/ \cdot 10 \% / 200-690+5 \%,-10 \%$ |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |
| Frequency tolerance | +/-10\% |  |  |  |  |  |  |  |
| Relay contacts | $3 \times 8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, 3 A 250 VAC inductive $\langle\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |
| Type of protection/Insulation |  |  |  |  |  |  |  |  |
| Type of casing protection | IP 20 |  |  |  |  |  |  |  |
| Other General Date |  |  |  |  |  |  |  |  |
| Ambient temperatures |  |  |  |  |  |  |  |  |
| In operation | $0.40^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Max.e.g. at 80\% IN | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| In storage | (-25) - $(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |
| Norms/Standards, Contorm to: | IEC 947-42, EN 292, EN 60204-1, UL508 |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2, (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082.2 |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for:Heary (first column): ramp/direct st art <br> Normal/Lght (second column): ramp start |  |  |  |  |  |  |  |  |
| NOTEI Short clrcuit whthstand MSFO17-060 5000 rms A when used with K5 or RK5 tuses. |  |  |  |  |  |  |  |  |

* 2-pole motor

| 3x200-525 V 50/60 Hz Model | MSF-075 |  | MSF-085 |  | MSF-110 |  | MSF-145 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, see chapter 4. page 13 | $\begin{array}{\|c\|} \hline \text { 5.0-30:50-10 } \\ \text { heary } \end{array}$ | $\begin{array}{\|l\|} \hline \left.\begin{array}{l} 3.0-30: 50-10 \\ \text { normal/llght } \end{array} \right\rvert\, \end{array}$ | $\begin{gathered} 5.0-30: 50-10 \\ \text { heavy } \end{gathered}$ | $\begin{aligned} & \text { 3.0-30:50-10 } \\ & \text { normal/IIght } \end{aligned}$ | $\begin{gathered} 5.0-30: 50-10 \\ \text { heavy } \end{gathered}$ | $\left\|\begin{array}{c} 3.0-30: 50-10 \\ \text { normal/light } \end{array}\right\|$ | $\begin{gathered} 5.0-30: 50-10 \\ \text { heavy } \end{gathered}$ | $\begin{aligned} & \text { 3.0:30:50-10 } \\ & \text { normal/llght } \end{aligned}$ |
| Rated current of soft starter (A) | 75 | 85 | 85 | 96 | 110 | 134 | 145 | 156 |
| Recommended motor size (kW) for 400 V | 37 | 45 | 45 | 55* | 55 | 75 | 75 |  |
| Recommended motor size (kW) for 525 V | 45 | 55 | 55 | 75* | 75 | 90 | 90 | 110 |
| Order number for supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1305-01 |  | 01-1306-01 |  | 01-1307-01 |  | 01-1308-01 |  |
| Order number for supply voitage ( $380-550 \mathrm{~V}$ ) | 01-1305-02 |  | 01-1306-02 |  | 01-1307-02 |  | 01-1308-02 |  |
| $3 \times 200-690$ V 50/60 Hz Model | MSF075 |  | MSF-085 |  | MSF-110 |  | MSF145 |  |
| Rated current of soft starter (A) | 75 | 85 | 85 | 90 | 110 | 134 | 145 | 156 |
| Motor power for 690V | 55 | 75 | 75 | 90 | 90 | 110 | 132 | 160* |
| Order number for supply voltage (100-240 V) | 01-1325-01 |  | 01-1326-01 |  | 01-1327-01 |  | 01-1328.01 |  |
| Order number for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-1325-02 |  | 01-1326-02 |  | 01-1327-02 |  | 01-1328.02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |
| Recommended wiring fuse ( $A$ ) 1) | 80/200 | 100 | 100/250 | 125 | 125/315 | 180 | 160/400 | 200 |
| Semi-conductor fuses, if required | 250 A |  | 315 A |  | 350 A |  | 450 A |  |
| Power loss at rated motor load (W) | 230 | 260 | 260 | 290 | 330 | 400 | 440 | 470 |
| Power consumption control card | 25 VA |  | 25 VA |  | 25 VA |  | 25 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |
| Dimensions in mm HxW $\times \mathrm{D}$ | 320x126×260 |  | $320 \times 126 \times 260$ |  | 400×176×260 |  | 400×176×260 |  |
| Mounting position (Vertical/Horizontal) | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 6.9 |  | 6.9 |  | 12 |  | 12 |  |
| Connection, busbars Cu , (bolt) | 15x4 (M8) |  | 15×4 (M8) |  | $20 \times 4$ (M10) |  | 20×4 (M10) |  |
| Cooling system | Fan |  | Fan |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |
| Voltage tolerance control | Control +/-10\% |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor $200-525+/ \cdot 10 \% / 200-690+5 \%,-10 \%$ |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |
| Frequency tolerance | +/. 10\% |  |  |  |  |  |  |  |
| Relay contacts | $8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, 3A, 250 V inductive load ( $\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |
| Type of protection/insulation |  |  |  |  |  |  |  |  |
| Type of casing protection | 1920 |  |  |  |  |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |
| Ambient temperatures in operation | $0.40{ }^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Max.e.g. at $80 \% \mathrm{I}_{\mathrm{N}}$ | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| In storage | $(-25) \cdot(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-4-2. EN 292, EN 60204-1, UL.508 |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2. (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: $\begin{aligned} & \text { Heavy } \\ & \text { Norm }\end{aligned}$ | (first column): ramp/direct start mal/ Lght (second column): ramp start |  |  |  |  |  |  |  |
| NOTEI Short clrcult withstand MSF075-145 10000 rms A when used with K5 or RK5 fuses. |  |  |  |  |  |  |  |  |

* 2-pole motor

| $3 \times 200-525$ V 50/60 Hz Model | MSF-170 |  | MSF-210 |  | MSF-250 |  | MSF310 |  | MSF370 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, see chapter 4. page 13 | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50.10 } \\ & \text { heavy } \end{aligned}$ | $\left\lvert\, \begin{gathered} 3.0-30: \\ 50-10 \\ \text { normal/light } \end{gathered}\right.$ | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50.10: } \\ & \text { heavy } \end{aligned}$ | $\left\|\begin{array}{c} 3.0-30: \\ 50-10 \\ \text { normal/light } \end{array}\right\|$ | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\left\lvert\, \begin{gathered} \text { 3.0.30: } \\ \text { 50-10 } \\ \text { normal/light } \end{gathered}\right.$ | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50.10 } \\ & \text { heavy } \end{aligned}$ | $\left\|\begin{array}{c} 3.0-30: \\ 50-10 \\ \text { normal/Ight } \end{array}\right\|$ | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\left\lvert\, \begin{gathered} 3.0-30: \\ 50-10 \\ \text { normal/light } \end{gathered}\right.$ |
| Rated current of soft starter (A) | 170 | 210 | 210 | 250 | 250 | 262 | 310 | 370 | 370 | 450 |
| Recommended motor size (kW) for 400 V | 90 | 110 | 110 | 132 | 132 | 160* | 160 | 200 | 200 | 250 |
| Recommended motor size (kW) for 525 V | 110 | 132 | 132 | 160 | 160 | 200* | 200 | 250 | 250 | 315 |
| Order no. for supply voltage ( $100-240 \mathrm{~V}$ ) | 01.130911 |  | 01-1310-11 |  | 01-1311-11 |  | 01-1312-01 |  | 01-1313-01 |  |
| Order no. for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-130912 |  | 01-1310-12 |  | 01-1311-12 |  | 01-1312-02 |  | 01-1313-02 |  |
| $3 \times 200-690$ V 50/60 Hz Model | MSF-170 |  | MSF-210 |  | MSF-250 |  | MSF-310 |  | MSF370 |  |
| Rated current of soft starter (A) | 170 | 210 | 210 | 250 | 250 | 262 | 310 | 370 | 370 | 450 |
| Motor power for 690 V | 160 | 200 | 200 | 250 | 250 | 250 | 315 | 355 | 355 | 400 |
| Order no. for supply voltage (100-240V) | 01-132901 |  | 01-1330-01 |  | 01-1331.01 |  | 01.1332-01 |  | 01-1333-01 |  |
| Order no. for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-132902 |  | 01-1330-02 |  | 01-1331-02 |  | 01-1332-02 |  | 01-1333-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |  |  |
| Recommended wiring fuse (A) 1) | 200/400 | 200 | 250/400 | 315 | 250/500 | 315 | 315/630 | 400 | 400/800 | 500 |
| Semi-conductor fuses, if required | 700 A |  | 700 A |  | 700 A |  | 800 A |  | 1000 A |  |
| Power loss at rated motor load (W) | 510 | 630 | 630 | 750 |  | 50 W | 930 | 1100 | 1100 | 1535 |
| Power consumption control card | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |  |  |
| Dimensions mm HxW×D incl. brackets | $500 \times 260 \times 260$ |  | $500 \times 260 \times 260$ |  | $500 \times 260 \times 260$ |  | $532 \times 547 \times 278$ |  | 532x547x278 |  |
| Mounting position (Vertical/Horizontal) | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 20 |  | 20 |  |  |  | 42 |  | 46 |  |
| Connection, Busbars Al/Cu (bolt) | $30 \times 4$ (M10) |  | 30×4 (M10) |  | $30 \times 4$ (M10) |  | 40×8 (M12) |  | 40×8 (M12) |  |
| Cooling system | Fan |  | Fan |  | Fan |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |  |  |
| Voltage tolerance control | Control +/-10\% |  |  |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor $200-525+/-10 \% / 200-690+5 \%,-10 \%$ |  |  |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |
| Frequency tolerance | +/-10\% |  |  |  |  |  |  |  |  |  |
| Relay contacts | 8A, 250 V resistive load, 3A, 250 V inductive load ( $\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |  |  |
| Type of protection/Insulation |  |  |  |  |  |  |  |  |  |  |
| Type of casing protection | IP 20 |  |  |  |  |  |  |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |  |  |
| Ambient temperatures in operation | 0.40 ${ }^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |
| Max.e.g. at $80 \% \mathrm{I}_{\mathrm{N}}$ | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |
| In storage | (-25) $-(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-42, EN 292, EN 602094-1, (UL508, only MSF-170 to MSF-250) |  |  |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2, (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: $\begin{aligned} & \text { Heavy (first column): ramp/direct start } \\ & \text { Normal/Light (second column): } \mathrm{ramp} \text { start }\end{aligned}$ |  |  |  |  |  |  |  |  |  |  |
| NOTEI Short circult withstand MSF170-250 18000 mms A when used wlth K5 or RK5 fuses. |  |  |  |  |  |  |  |  |  |  |

[^21]| $3 \times 200-525 \mathrm{~V} 50 / 60 \mathrm{~Hz}$ Model | MSF-450 |  | MSF-570 |  | MSF-710 |  | MSF-835 |  | MSF-1000 |  | MSF-1400 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, 300 chapter 4. page 13 | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50.10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} 3.0-30: \\ 50-10 \\ \text { nommal/ } \\ \text { llght } \end{gathered}$ | $\begin{aligned} & 5.0-30: \\ & 50-10 \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} 3.0-30: \\ 50-10 \\ \text { nomal/ } \\ \text { light } \end{gathered}$ | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50.10 } \\ & \text { heary } \end{aligned}$ | $\begin{gathered} \text { 3.0-30: } \\ 50-10 \\ \text { nommal/ } \\ \text { light } \end{gathered}$ | 5.0-30: $50-10$ heavy | $\begin{gathered} \text { 3.0.30: } \\ \text { 50-10 } \\ \text { nomal/ } \\ \text { light } \end{gathered}$ | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} \text { 3.0.30: } \\ \text { s0-10 } \\ \text { nombal/ } \\ \text { Ileht } \end{gathered}$ | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ |  |
| Rated current of soft starter (A) | 450 | 549 | 570 | 710 | 710 | 835 | 835 | 960 | 1000 | 1125 | 1400 | 1650 |
| Recommended motor size (kW) for 400 V | 250 | 315 | 315 | 400 | 400 | 450 | 450 | 560 | 560 | 630 | 800 | 930 |
| Recommended motor size (kW) for 525 V | 315 | 400 | 400 | 500 | 500 | 560 | 600 | 630 | 660 | 710 | 1000 | 250 |
| Order no. for supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1341-01 |  | 01-1315-01 |  | 01-1316-01 |  | 01.1317-01 |  | 01-1318-01 |  | 01-131901 |  |
| Order no. for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-1314-02 |  | 01-1315-02 |  | 01-1316-02 |  | 01.1317-02 |  | 01-1318-02 |  | 01-1319-02 |  |
| 3x200-690V 50/60Hz Model | MSF-450 |  | MSF570 |  | MSF-710 |  | MSF-835 |  | MSF-1000 |  | MSF-1400 |  |
| Rated current of soft starter ( A ) | 450 | 549 | 570 | 640 | 710 | 835 | 835 | 880 | 1000 | 1125 | 1400 | 1524 |
| Motor power for 690 V | 400 | 560 | 560 | 630 | 710 | 800 | 800 |  | 1000 | 1120 | 1400 | 1600 |
| Order no. for supply voltage ( $100-240 \mathrm{~V}$ ) | 01.1334-01 |  | 01-1335-01 |  | 01-1336-01 |  | 01-1337-01 |  | 01.1338-01 |  | 01-1339-01 |  |
| Order no. for supply voltage ( $380-550 \mathrm{~V}$ ) | 01.1334.02 |  | 01-1335-02 |  | 01-1336-02 |  | 01-1337-02 |  | 01-1338-02 |  | 01-1339-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Recommended wiring fuse (A 1) | 500/1 k | 630 | 630/1 k | 800 | 800/1 k | 1 k | $1 \mathrm{k} / 1.2 \mathrm{k}$ | 1 k | 1k/1.4 k | 1.2 k | 1.4 k/1.8 | 1.8 k |
| Semi-conductor fuses, if required | 1250 A |  | 1250 A |  | 1800 A |  | 2500 A |  | 3200 A |  | 4000 A |  |
| Power loss at rated motor load (W) | 1400 | 1730 | 1700 | 2100 | 2100 | 2500 | 2500 | 2875 | 3000 | 3375 | 4200 | 4950 |
| Power consumption control card | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  |
| Mechantcal Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Dimensions mm $\mathrm{H} \times \mathrm{W} \times \mathrm{D}$ incl. brackets | $532 \times 547 \times 278$ |  | $687 \times 640 \times 302$ |  | 687x640×302 |  | $687 \times 640 \times 302$ |  | $900 \times 875 \times 336$ |  | 900×875×336 |  |
| Mounting position (Vertic al/Horizontal) | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 46 |  | 64 |  | 78 |  | 80 |  | 175 |  | 175 |  |
| Connection, Busbars Al (bolt) | 40x8 (M12) |  | 40×10(M12) |  | 40×10(M12) |  | 40×10(M12) |  | 75×10(M12) |  | 75x10(M12) |  |
| Cooling system | Fan |  | Fan |  | Fan |  | Fan |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |  |  |  |  |
| Voltage tolerance control | Control $+/-10 \%$ |  |  |  |  |  |  |  |  |  |  |  |
| voltage tolerance motor | Motor 200-525 +/-10\%/200-690 + 5\%, -10\% |  |  |  |  |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |  |  |
| Frequency tolerance | +/. 10\% |  |  |  |  |  |  |  |  |  |  |  |
| Relay contacts | $8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, 3A, 250 V inductive load ( $\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |  |  |  |  |
| Type of protection/trsulation |  |  |  |  |  |  |  |  |  |  |  |  |
| Type of casing protection | IP 20 |  |  |  |  |  |  |  | IPOO |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Ambient temperatures In operation | $0.40^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| Max. e.g. at $80 \% \mathrm{I}_{\mathrm{N}}$ | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| In storage | $(-25)-(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-4-2, EN 292, EN 60204-1 |  |  |  |  |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2. (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: | Heavy (first column): ramp/direct start Normal/Light (second column): ramp start |  |  |  |  |  |  |  |  |  |  |  |

## Semi-conductor fuses

Always use standard commercial fuses to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred (e.g. Bussmann type FWP or similar, see table below).

The normal guarantee is valid even if superfast semiconductor fuses are not used.

| Type | A | FWP Bussmann fuse |
| :---: | :---: | :---: |
| MSF-017 | 80 | $\mathbf{I}^{2} \mathbf{t}$ (fuse) $\times \mathbf{1 0 0 0}$ |
| MSF-030 | 125 | 2.4 |
| MSF-045 | 150 | 7.3 |
| MSF-060 | 200 | 11.7 |
| MSF-075 | 250 | 22 |
| MSF-085 | 300 | 42.5 |
| MSF-110 | 350 | 71.2 |
| MSF-145 | 450 | 95.6 |
| MSF-170B | 700 | 137 |
| MSF-210B | 700 | 300 |
| MSF-250B | 800 | 300 |
| MSF-310 | 800 | 450 |
| MSF-370 | 1000 | 450 |
| MSF-450 | 1200 | 600 |
| MSF-570 | 1400 | 2100 |
| MSF-710 | 1800 | 2700 |
| MSF-835 | 2000 | 5300 |
| MSF-1000 | 2500 |  |
| MSF-1400 | 3500 |  |

## 13. SET-UP MENU LIST

| Menu number | Function/Parameter | Range | Par.set | Factory setting | Value | Page |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 001 | Initial voltage at start | 25-90\% of U | 1-4 | 30 |  | page 36 |
| 002 | Start time ramp 1 | 1.60 sec | 1.4 | 10 |  | page 36 |
| 003 | Step down voltage at stop | 100-40\% U | 1.4 | 100 |  | page 36 |
| 004 | Stop time ramp 1 | OFF, $2 \cdot 120 \mathrm{sec}$ | 1.4 | ofF |  | page 36 |
| 005 | Current | 0.0-9999 Amp | - | - |  | page 36 |
| 006 | Control mode | 1, 2, 3 | 1-4 | 2 |  | page 37 |
| 007 | Extended functions \& metering | oFF, on | $\cdots$ | oFF |  | page 38 |
|  |  |  |  |  |  |  |
| 008 | Extended functions | oFF, on | - | oFF |  | page 38 |
|  |  |  |  |  |  |  |
| 011 | Initial voltage start ramp 2 | 30-90\% U | 1-4 | 90 |  | page 38 |
| 012 | Start time ramp 2 | OFF, 1-60 sec | 1-4 | oFF |  | page 38 |
| 013 | Step down voltage stop ramp 2 | 100-40\% U | 1-4 | 40 |  | page 38 |
| 014 | Stop time ramp 2 | oFF, 2-120 sec | $1 \cdot 4$ | oFF |  | page 38 |
|  |  |  |  |  |  |  |
| 016 | Initial torque at start | 0-250\% Tn | 1-4 | 10 |  | page 39 |
| 017 | End torque at start | 50-250\% Tn | 1-4 | 150 |  | page 39 |
| 018 | End torque at stop | 0-100\% Tn | 1-4 | 0 |  | page 39 |
| 020 | Voltage ramp with current limit at start | oFF, 150-500\% $\mathrm{In}_{n}$ | 1-4 | oFF |  | page 39 |
| 021 | Current limit at start | oFF, 150-500\% $\mathrm{In}^{\text {n }}$ | 1-4 | oFF |  | page 40 |
| 022 | Pump control | oFF, on | 1.4 | OFF |  | page 40 |
| 023 | Remote analogue control | oFF, 1, 2 | 1.4 | OFF |  | page 41 |
| 024 | Full voltage start D.O.L | oFF, on | 1-4 | OFF |  | page 41 |
| 025 | Torque control | oFF, 1, 2 | 1-4 | OFF |  | page 42 |
|  |  |  |  |  |  |  |
| 030 | Torque boost active time | oFF, 0.1-2.0 sec | 1-4 | OFF |  | page 43 |
| 031 | Torque boost current limit | 300-700\% $I_{n}$ | 1.4 | 300 |  | page 43 |
| 032 | Bypass | oFF, on | 1-4 | oFF |  | page 43 |
| 033 | Power Factor Control PFC | OFF, on | 1-4 | oFF |  | page 46 |
| 034 | Brake active time | oFF, 1-120 sec | 1-4 | oFF |  | page 47 |
| 035 | Braking strength | 100-500\% | $1 \cdot 4$ | 100 |  | page 47 |
|  |  |  |  |  |  |  |
| 036 | Braking methods | 1, 2 | 1.4 | 1 |  | page 47 |
| 037 | Slow speed torque | 10-100 | 1-4 | 10 |  | page 49 |
| 038 | Slow speed time at start | ofF, 1-60 sec | 1-4 | OFF |  | page 49 |
| 039 | Slow speed time at stop | ofF, 1-60 sec | 1-4 | OFF |  | page 49 |
| 040 | DC-Brake at slow speed | oFF, 1-60 sec | 1-4 | oFF |  | page 49 |
|  |  |  |  |  |  |  |
| 041 | Nominal motor voltage | 200-700 V | 1-4 | 400 |  | page 50 |
| 042 | Nominal motor current | $\begin{gathered} 25-\left.150 \%\right\|_{\text {nsoft }} \text { in } \\ \text { Amp } \end{gathered}$ | 1-4 | $I_{\text {nsoft }}$ in Amp |  | page 50 |
| 043 | Nominal motor power | $\begin{gathered} 25-300 \% \text { of } P_{\text {nsoft }} \text { in } \\ \mathrm{kW} \end{gathered}$ | 1-4 | $\mathrm{P}_{\text {nsoft }}$ in kW |  | page 50 |
| 044 | Nominal speed | 500-3600 rpm | 1-4 | $N_{\text {nsoft }}$ in rpm |  | page 50 |
| 045 | Nominal power factor | $0.50 \cdot 1.00$ | 1-4 | 0.86 |  | page 50 |
| 046 | Nominal frequency | $50,60 \mathrm{~Hz}$ | --- | 50 |  | page 50 |


| Menu number | Function/Parameter | Range | Par.set | Factory setting | Value | Page |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 051 | Programmable relay K1 | 1, 2, 3, (4), 5 |  | 1 |  | page 51 |
| 052 | Programmable relay K2 | 1, 2, 3, 4, 5 | - | 2 |  | page 51 |
| 054 | Analogue output | oFF, 1, 2 | 1-4 | oFF |  | page 52 |
| 055 | Analogue output value | 1, 2, 3 | 1-4 | 1 |  | page 52 |
| 056 | Scaling analogue output | 5-150\% | 1-4 | 100 |  | page 52 |
| 057 | Digital input selection | oFF, 1, 2, 3, 4 | 1-4 | oFF |  | page 53 |
| 058 | Digital input pulses | 1-100 | 1-4 | 1 |  | page 53 |
|  |  |  |  |  |  |  |
| 061 | Parameter set | 0, 1, 2, 3, 4 | ------ | 1 |  | page 54 |
|  |  |  |  |  |  |  |
| 071 | Motor PTC input | no, YES | - | no |  | page 55 |
| 072 | Internal motor thermal protection class | oFF, 2-40 sec | -_- | 10 |  | page 55 |
| 073 | Used thermal capacity | 0-150\% | - | -- |  | page 55 |
| 074 | Starts per hour limitation | oFF, 1-99/hour | 1.4 | ofF |  | page 55 |
| 075 | Locked rotor alarm | oFF, 1.0-10.0 sec | 1-4 | oFF |  | page 55 |
|  |  |  |  |  |  |  |
| 081 | Voltage unbalance alarm | 2-25\% Un | 1-4 | 10 |  | page 56 |
| 082 | Response delay voltage unbalance alarm | OFF, 1-60 sec | 1-4 | OFF |  | page 56 |
| 083 | Over volt age alarm | 100-150\% Un | 1-4 | 115 |  | page 56 |
| 084 | Response delay over voltage alarm | oFF, 1-60 sec | 1 - 4 | oFF |  | page 56 |
| 085 | Under voltage alarm | $75-100 \% U_{n}$ | 1-4 | 85 |  | page 57 |
| 086 | Response delay under voltage alarm | oFF, 1-60 sec | 1-4 | oFF |  | page 57 |
| 087 | Phase sequence | L123, L321 | - | - |  | page 57 |
| 088 | Phase reversal alarm | oFF, on | - | OFF |  | page 57 |
|  |  |  |  |  |  |  |
| 089 | Auto set power limits | no, YES | - | no |  | page 57 |
| 090 | Output shaft power | 0.0-200.0\% Pn | - | - |  | page 57 |
| 091 | Start delay power limits | 1-250 sec | 1-4 | 10 |  | page 58 |
| 092 | Max power alarm limit | 5-200\% Pn | 1-4 | 115 |  | page 58 |
| 093 | Max alarm response delay | oFF, $0.1 \cdot 25.0 \mathrm{sec}$ | 1-4 | oFF |  | page 58 |
| 094 | Max power pre-alarm limit | 5-200\% Pn | 1.4 | 110 |  | page 58 |
| 095 | Max pre-alarm response delay | oFF, $0.1-25.0 \mathrm{sec}$ | 1.4 | oFF |  | page 58 |
| 096 | Min pre-alarm power limit | 5-200\% Pn | 1-4 | 90 |  | page 58 |
| 097 | Min pre-alarm response delay | ofF, $0.1-25.0 \mathrm{sec}$ | 1-4 | oFF |  | page 59 |
| 098 | Min power alarm limit | 5-200\%Pn | 1-4 | 85 |  | page 59 |
| 099 | Min alarm response delay | oFF, 0.1-25.0 sec | 1-4 | oFF |  | page 59 |
|  |  |  |  |  |  |  |
| 101 | Run at single phase input failure | no, YES | 1-4 | no |  | page 61 |
| 102 | Run at current limit time-out | no, YES | 1-4 | no |  | page 61 |
|  |  |  |  |  |  |  |
| 103 | Jog forward enable | oFF, on | 1-4 | oFF |  | page 61 |
| 104 | Jog reverse enable | oFF, on | 1-4 | oFF |  | page 61 |
|  |  |  |  |  |  |  |
| 105 | Automatic return mienu | oFF, 1-999 | - | OFF |  | page 62 |
|  |  |  |  |  |  |  |
| 111 | Serial comm. unit address | 1-247 | - | 1 |  | page 62 |
| 112 | Serial comm. baudrate | $2.4 \cdot 38.4$ kBaud | - | 9.6 |  | page 62 |


| Menu number | Function/Parameter | Range | Par.set | Factory setting | Value | Page |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 113 | Serial comm. parity | 0, 1 | - | 0 |  | page 62 |
| 114 | Serial comm. contact broken | OFF, 1, 2 | - - | 1 |  | page 62 |
|  |  |  |  |  |  |  |
| 199 | Reset to factory settings | no, YES | $\square$ | no |  | page 63 |
|  |  |  |  |  |  |  |
| 201 | Current | 0.0-9999 Amp | - | - |  | page 63 |
| 202 | Line main voltage | 0.720 V | - | - |  | page 63 |
| 203 | Output shaft power | -9999-9999 kW | - | -- |  | page 63 |
| 204 | Power factor | 0.00-1.00 |  | - |  | page 63 |
| 205 | Power consumption | 0.000-2000 MWh | - | - |  | page 63 |
| 206 | Reset power consumption | no, YES |  | no |  | page 64 |
| 207 | Shaft torque | -9999-9999 Nm | - | - |  | page 64 |
| 208 | Operation time | Hours | - | -- |  | page 64 |
|  |  |  |  |  |  |  |
| 211 | Current phase L1 | 0.0-9999 Amp | - | - |  | page 64 |
| 212 | Current phase L2 | 0.0-9999 Amp | - | - |  | page 64 |
| 213 | Current phase L3 | 0.0-9999 Amp | - | - - |  | page 64 |
|  |  |  |  |  |  |  |
| 214 | Line main voltage L1-L2 | 0.720 V | - | -- |  | page 64 |
| 215 | Line main voltage L1-L3 | 0.720 V |  | - |  | page 64 |
| 216 | Line main voltage L2-L3 | 0.720 V |  | - |  | page 64 |
|  |  |  |  |  |  |  |
| 221 | Locked keyboard info | no, YES | - | no |  | page 65 |
|  |  |  |  |  |  |  |
| 901 | Alarm list, Latest error | F1-F16 | - | - |  | page 65 |
| 902-915 | Alarm list, Older error in chronological order | F1-F16 | - | -- |  | page 65 |

Explanation of units:

| U | Input line voltage |
| :--- | :--- |
| Un | Nominal motor voltage. |
| In | Nominal motor current. |
| Pn | Nominal motor power. |
| Nn | Nominal motor speed. |
| $\mathrm{T} n$ | Nominal shaft torque. |
| Insoft | Nominal current soft starter. |
| Pnsoft | Nominal power soft starter. |
| Nnsoft | Nominal speed soft starter. |

Calculation shaft torque

$$
T_{n}=\frac{P_{n}}{\left(\frac{N_{n}}{60} \times 2 \pi\right)}
$$

NOTE! The six main functions for motor control, menus 020-025, can only be selected one at a time.
Numerics
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3-wire start/stop ..... 37
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Alarm category ..... 67
Alarm list ..... 65
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Analogue output ..... 32, 52
Analogue output gain ..... 52
Analogue output value ..... 52
Auto set power limits ..... 57
automatic reset ..... 37
Automatic return menu ..... 62
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Basic parameter setting ..... 10
Below min power limit ..... 67
Brake method ..... 47
Braking Strenght ..... 47
Braking time ..... 46
Busbars ..... 25, 26
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Bypass contactor ..... 44
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Checklist ..... 10
Clickson thermistor ..... 32
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## SURGE DIVERTER \& SURGE REDUCTION FILTER

## 1. TDS1100 SURGE DIVERTER TECHNICAL DETAILS

2. DAR ALARM RELAY TECHNICAL DETAILS
3. TDF SURGE REDUCTION FILTER TECHNICAL DETAILS


## TDS Surge Diverter - TDS1100 Series



Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.
The TDS1 100 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. They are conveniently packaged for easy installation on 35 mm DIN rail within main distribution panelboards.

CRITEC* TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe or at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS 1100 provides a set of voltage-free contacts for remote signaling that maintenance is due.
The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.

| Model | TD51002SR150 | TDS11002SR240 | TD511002SR277 | TDS110025R560 |
| :---: | :---: | :---: | :---: | :---: |
| Nominal Voltage Un | 120.150 V - | 220-240V- | 240.277V~ | 480-560V~ |
| Max. Cont. Operating Voliage $U_{c}$ | 170 Vm | 275V~ | 320V- | $610 \mathrm{~V}-$ |
| Stand off Voltage | 240V- | 440V- | 480 V - | 700V- |
| Frequency | D-100Hz |  |  |  |
| Short Circuit Current Rating lse | 25 kAIC |  |  |  |
| Required Back-up Fuse | 12SAgh, il supply $>100 \mathrm{~A}$ |  |  |  |
| Technology Used | T0 with thermal discennect |  |  |  |
| Protertion |  |  |  |  |
| Maximum Oischarge Current l max | $100 \mathrm{kA} 8 / 20 \mu \mathrm{~s}$ |  |  |  |
| Nominal Discharge Current In | 50kA 8/20,5 | 40kA 8/20 ${ }^{\text {us }}$ | 40kA 8/20ps | 40kA 8/20 ${ }^{\text {s }}$ |
| Protection Modes | Single mode (L-G, L-N or $\mathrm{N}-\mathrm{G}$ ) |  |  |  |
| Volacge Protection Level Up © 3kA | $<400 \mathrm{~V}$ | $\leq 700 \mathrm{~V}$ | < 800 V | $<1.6 \mathrm{kV}$ |
| Voltage Protection Level Up © 20 kA | $<650$ | $\leq 1000$ | < 1.1 kV | $<2 \mathrm{kV}$ |
| Alarms and Indicators |  |  |  |  |
| Status indication | Mechanical flag / remote contacs ( R model only) Change-over, $250 \mathrm{~V}-/ 0.5 \mathrm{~A}$, max $1.5 \mathrm{~mm}^{2}$ ( H T 4 AWG ) terminals |  |  |  |
| Physical Data |  |  |  |  |
| Dimensions | 2 modules wide, $90 \mathrm{~mm} \times 68 \mathrm{~mm} \times 35 \mathrm{~mm}$ |  |  |  |
| Weight | 0.24 kg approx. |  |  |  |
| Encosure | DIN 43 880, UL94V-0 (hermoplastic, IP 20 (NEMA-1) |  |  |  |
| Connection | $\begin{aligned} & 535 \mathrm{~mm}^{7} \text { (\#2AWG) solid } \\ & 525 \mathrm{~mm}^{2} \text { (\#4AWG) stranded } \end{aligned}$ |  |  |  |
| Mounting | 35 mm top hat DIN rail |  |  |  |
| Termperature | $40^{\circ} \mathrm{C}$ to $+80^{\circ} \mathrm{C}\left(-40^{\circ} \mathrm{F}\right.$ to $\left.+776^{\circ} \mathrm{F}\right)$ |  |  |  |
| Humidity | 0 10 90\% |  |  |  |
| Test Standards |  |  |  |  |
| Approvals | CE, 1EC ${ }^{\text {iU4 }} 61643-1$, UL* 1449 Pending |  |  |  |
| Surge Rated to Meet | IEC 61643-1 Class I and II ANSIAEEE C62.41-1991 Cat $A_{t}$ Cat B, Cat C |  |  |  |

Dur to a policy of continual product development, specifications are subject to change without notice.

## DIN Decoupling Inductor/ <br> DINLINE Alarm Relay \& Surge Counter



Decoupling inductors are installed between spark gap and MOV protection devices to ensure correct coordination. As the decoupling inductors are installed in series with the load, two units are available, a compact unit for circuits up to 35A and a larger unit for 63A circuits.

The DAR (DINLINE Alarm Relay) can be connected to TDF units to provide potential free change-over alarm contacts. The TDS SC (Surge Counter) unit is designed to provide visual indication of the number of surges registered. It uses a current transformer through which the ground conductor connecting to one, or all, of the surge protection modules is fed. Current diverted by the operation of the surge module, which exceeds a 300A trip threshold, will be registered on the counter.

- Use for decoupling of spark gaps and MOVs - allows correct coordination of different SPD technologies
- $35 \mathrm{~mm}^{2}$ tunnel terminals - accepts large cable size
- 63A model features top and bottom terminals flexible installation
- The DINLINE Alarm Relay (DAR) is used with TDF products where alarm contacts are required for remote signaling.
- The TDS-SC Surge Counter provides a non-resettable record of the number of surges diverted

| Model | DDI 35 | DDI 63 | DAR275V | TDS SC |
| :---: | :---: | :---: | :---: | :---: |
| Item Number for Europe | 700465 | 700475 | 700900 | 701250 |
| Nominal Voltage $U_{n}$ | - | - | 20-110V---100-240V | - |
| System Compatibility(1) | - | - | TN-C, TN-S, TN-C-S \& TT |  |
| Max. Cont. Operating Voltage $\mathrm{U}_{c}$ | 500V ~ 200V~-- |  | 275 V | - |
| Stand-off Voltage | - | $=$ | 275 V | - |
| Operating Current © $\mathrm{U}_{\mathrm{n}}$ | . | . | 20 mA | - |
| Frequency | 0 to 60 Hz |  |  | - |
| Max. Line Current $\mathrm{I}_{\text {i }}$ | 35 A (9) $40^{\circ} \mathrm{C}$ | $63 \mathrm{~A} @ 40^{\circ} \mathrm{C}$ | - | - |
| Temperature Increase | $45^{\circ} \mathrm{C}$ @ max line current ( 10 |  | $\cdot$ | - |
| inductance | $7.5 \mu \mathrm{H}$ | $15 \mu \mathrm{H}$ | - | $\cdot$ |
| Resistance | $4.5 \mathrm{~m} \Omega$ | 1.7 mR | - | - |
| Technology | - | - | CT - trip threshold 300A 8/20 $/ \mathrm{s}$ |  |
| Status | - | - | Red/Green LEDs Change-over contact ${ }^{(1)}$ | Maximum count 9999 Non-resettable |
| Dimensions | $2 \mathrm{M} .90 \mathrm{~mm} \times 68 \mathrm{~mm} \times 36 \mathrm{~mm}$ ( $3.5^{\prime \prime} \times 2.6^{\prime \prime} \times 1.4^{\prime \prime}$ ) approx. | $4 \mathrm{M} .90 \mathrm{~mm} \times 68 \mathrm{~mm} \times 72 \mathrm{~mm}$ $\left(3.5^{\prime \prime} \times 2.6^{\prime \prime} \times 2.8^{\prime \prime}\right)$ approx. | 2 M . <br> $90 \mathrm{~mm} \times 68 \mathrm{~mm} \times 36 \mathrm{~mm}$ $\left(3.5^{\prime \prime} \times 2.6^{\prime \prime} \times 1.4^{\prime \prime}\right)(e$ | $19(T)$ |
| Weight | $0.45 \mathrm{~kg}(1 \mathrm{lb})$ approx. | $1 \mathrm{~kg}(2.2 \mathrm{lb})$ approx. | $0.2 \mathrm{~kg}(0.44 \mathrm{lb})$ |  |
| Enclosure | DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1) |  |  |  |
| Connection | $\begin{aligned} & \leq 35 \mathrm{~mm}^{2} \text { (\#2AWG) solid } \\ & \leq 25 \mathrm{~mm}^{2} \text { (\#4AWG) stranded } \\ & \hline \end{aligned}$ |  | $1 \mathrm{~mm}^{2}$ to $6 \mathrm{~mm}^{2}$ (\#18AWG to \#10) |  |
| Mounting | 35 mm top hat DIN rail |  |  |  |
| Back-up Overcurrent Protection | 35A | 63A | $-\quad-$ | - |
| Temperature | $-40^{\circ} \mathrm{C}$ to $+70^{\circ} \mathrm{C}\left(-40^{\circ} \mathrm{F}\right.$ to $\left.+158^{\circ} \mathrm{F}\right)$ |  | $-35^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}\left(-31^{\circ} \mathrm{F}\right.$ to $\left.+131^{\circ} \mathrm{F}\right)$ |  |
| Humidity | 0\% to 90\% |  |  |  |
| Warranty Approvals | $\begin{aligned} & 5 \text { years } \\ & C E \end{aligned}$ |  | $\begin{aligned} & \text { CSA22.2 } \\ & \text { C-Tick, AS } 3260, \text { CE } \end{aligned}$ | - |

[^22]
## Transient Discriminating Filter



## - In-line series protection

- High efficiency low pass sine wave filtering - ideal for the protection of switched mode power supplies
- Three modes of protection: L-N, L-PE \& N-PE
- 35 mm DIN rail mount - simple installation
- Transient Discriminating (TD) Technology provides increased service life
- LED status indication and opto-isolated output for remote status monitoring

The TDF series has been specifically designed for process control ipplications to protect the switched mode power supply units on Jevices such as PLC controllers, SCADA systems and motor controllers. Units are UL Recognized and available for 3A, 10A and 20 A loads and suitable for $110-120 \mathrm{Va} \mathrm{ddc}$ and $220-240 \mathrm{Vac}$ circuits.
The TDF is a series connected, single phase surge filter providing an aggregate surge capacity of $50 \mathrm{kA}(8 / 20 \mu \mathrm{~s}$ ) across L-N, L-PE, and N-PE. The low pass filter provides up to 65 dB of attenuation to voltage transients. Not only does this reduce the residual letthrough voltage, but it also helps further reduce the steep voltage rate-of-rise providing superior protection for sensitive electronic equipment.

| Model | $\begin{aligned} & \text { TDF3A } \\ & 120 \mathrm{~V} \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|l\|} \hline \text { TDF3A } \\ 240 \mathrm{~V} \\ \hline \end{array}$ | $\begin{aligned} & \text { TDF10A } \\ & 120 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & \text { TDF10A } \\ & 240 \mathrm{~V} \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { TDF20A } \\ & 120 \mathrm{~V} \\ & \hline \end{aligned}$ | TDF20A 240 V |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Item Number for Europe | 700001 | 700002 | 700003 | 700004 | 700005 | 700006 |
| Nominal Voltage $\mathrm{U}_{\mathrm{n}}$ | 120 V | 240 V | 120 V | 240 V | 120 V | 240 V |
| Distribution System | 1Ph 2W+G, TN-S \& TN-C-S |  |  |  |  |  |
| Max. Cont. Operating Voltage $U_{c}$ | 170 V | 340 V | 170 V | 340 V | 170 V | 340 V |
| Stand-off Voltage | 240 V | 400 V | 240 V | 400 V | 240 V | 400 V |
| Frequency | 0 to 60 Hz | 50/60Hz | 0 to 60 Hz | 0 to 60 Hz | 0 to 60 Hz | 50/60Hz |
| Max. Line Current $\mathrm{IL}^{\text {L }}$ | 3A |  | 10A |  | 20A |  |
| Operating Current @ $\mathrm{U}_{n}$ | 135 mA | 250 mA | 240 mA | 480 mA | 240 mA | 480 mA |
| Max. Discharge Current $I_{\text {max }}$ |  |  |  |  |  |  |
| Protection Modes | All modes protected |  |  |  |  |  |
| Technology | TD Technology <br> In-line series low pass sine wave filter |  |  |  |  |  |
| Voltage Protection Level $U_{p}$ @ 500A, $8 / 20 \mu \mathrm{~s}$ (UL SVR) © Cat B3, 3kA $8 / 20 \mu \mathrm{~s}$ | $\begin{aligned} & 500 \mathrm{~V} \\ & <250 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 700 \mathrm{~V} \\ & <600 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 500 \mathrm{~V} \\ & <250 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 700 \mathrm{~V} \\ & <600 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 500 \mathrm{~V} \\ & <250 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 700 \mathrm{~V} \\ & <600 \mathrm{~V} \end{aligned}$ |
| Filtering @100kHz | $-62 \mathrm{~dB}$ |  |  |  | -53dB |  |
| Status | Green LED. On=Ok. Isolated opto-coupler output ${ }^{(1)}$ |  |  |  |  |  |
| Dimensions | $4 \mathrm{M} .90 \mathrm{~mm} \times 68 \mathrm{~mm} \times 72 \mathrm{~mm}$ $8 \mathrm{M} .90 \mathrm{~mm} \times 68 \mathrm{~mm} \times 144 \mathrm{~mm}$ <br> $\left(3.5^{\prime \prime} \times 2.6^{\prime \prime} \times 2.8^{\prime \prime}\right)$ $\left(3.5^{\prime \prime} \times 2.6^{\prime \prime} \times 5.6^{\prime \prime}\right)$ <br> 0.35 k .0 .77 l$)$  |  |  |  |  |  |
| Weight | $0.35 \mathrm{~kg}(0.77 \mathrm{lb})$ |  | $0.75 \mathrm{~kg}(0.77 \mathrm{lb})$ |  | 0.8 kg (1.7 |  |
| Enclosure | DIN 43880 , UL94V-0 thermoplastic, IP 20 (NEMA-1) |  |  |  |  |  |
| Connection | $1 \mathrm{~mm}^{2}$ to $6 \mathrm{~mm}^{2}$ (\#18AWG to \#10) |  |  |  |  |  |
| Mounting | 35 mm top hat DIN rail |  |  |  |  |  |
| Back-up Overcurrent Protection | 3A 10 A |  |  |  | 20A |  |
| Temperature | $-35^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}\left(-31^{\circ} \mathrm{F}\right.$ to $\left.+131^{\circ} \mathrm{F}\right)$ |  |  |  |  |  |
| Humidity | 0\% to 90\% |  |  |  |  |  |
| Warranty | 5 years |  |  |  |  |  |
| Approvals | UL 1449, UL 1283, CSA 22.2, C-Tick, CE (NOM 3A, 120V) |  |  |  |  |  |
| Surge Rated to Meet | ANSI/EEE C62.41.2 Cat A, Cat B, Cat C |  |  |  |  |  |

(1) Opto-coupler output can be connected to DAR27SV to provide form C dry contacts, Page 35

## TIMER

## 1. IDEC DIGITAL TIMER TECHNICAL DETAILS <br> 2. ELECTRONIC TIMING RELAY TECHNICAL DETAILS

GT3D - Digital Timers

## Key features of the GT3D series include:

- Precise time setting using digital thumbwheel switches
- Elapsed or time remaining LCD display
- 6 time ranges. 16 timing functions
- Time delays up to 99.9 hours


UL Recognized File No. E55996


CSA Certified File No. LA58183 File No. LL996764 File No. LR83814

LR83814 Cer. No. BL9801133323911 (LVD)
Cer. No. E9971113332388 (EMC) Cert. No. E9971113332388 (EMC)


## Part Number List

|  | Mode of Operation | Time Renge | Output | Contact | Rated Voltage Code | Complete Part No. |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | 8 -Pin | 11-Pin |
|  | 1-A: ON-delay 1 <br> 1-B: Interval 1 first <br> 1-C: Cycle 1 (OFf first) <br> 1-D: Cycle 3 (DN first) | 0.01 s to 99.9 hours | 250 V AC, 3 A . | Delayed SPDT <br> + instantaneous SPDT | 100 to $240 \mathrm{VAC}(50 / 60 \mathrm{~Hz})$ | GT3D-2AF20 | GT3D-2EAF20 |
|  |  |  | (resistive load) |  | 24V AC/DC | GT3D-2AD24 | - |
|  |  |  | 240 VAC . <br> 24V DC, 5A (resistive load) | Delayed DPDT | 100 to $240 \mathrm{VAC}(50 / 60 \mathrm{~Hz})$ | GT3D-3AF20 | GT3D-3EAF20 |
|  |  |  |  |  | 24 V AC/DC | 6T3D-3AD24 | - |


Part Numbers: GT3D-4

| Mode of Oparation | Time <br> Renge | Output | Contact | Rated Voltage Code | Complata Part No. |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | A (11-Pin) | B (11-Pin) |
| 1-A: ON-delay 1 <br> 1-B: Interval 1 first <br> 1-C: Cycle 1 (OFF first) <br> 1-D: Cycle 3 (ON first) <br> 2-A: ON-delay 2 <br> 2-B: Cycle 2 <br> 2-C: Signal ON/OFF-delay 1 <br> 2-D: Signal OF-delay 1 <br> 2-E: Interval 2 <br> 2-F: One-shot cycle <br> 3-A: Signal ON/OFF-delay 2 <br> 3-B: Signal OFF-delay 2 <br> 3-C: One-shot 1 <br> 3-D: One-shot ON-delay <br> 3-E: One-shot 2 <br> 3-F: Signal 0N/OFF-delay 3 | 0.01 s to 99.9 hours | $240 \mathrm{~V} \mathrm{AC} / 24 \mathrm{~V}$ DC, 5 A (resistive load) | Delayed DPDT | 100 to 240 V AC ( $50 / 50 \mathrm{~Hz}$ ) | GT3D-4AF20 | GT3D-4EAF20 |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |
|  |  |  |  | 24 V AC/DC | GT3D-4AD24 | - |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |

Part Numbers: GT3D-8

| Mode of Operation | Timë Range | Output | Contact | Ratod Voltage Code | Complete Part No. (11-Pin) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1: DN-delay one-shot 1 <br> 2: Cycle one-shot <br> 3: ON-delay one-shot 2 | $\begin{aligned} & 0.01 \mathrm{~s} \text { to } \\ & 99.9 \text { hours } \end{aligned}$ | 240 V AC/24V DC. 5 A [resistive load) | Delayed DPDT | 100 to $240 \mathrm{~V} \mathrm{AC} \mathrm{( } 50 / 60 \mathrm{~Hz}$ ) | GT3D-8AF20 |
|  |  |  |  | 24V AC/DC | GT3D-8AD24 |

1. For wiring schematics and timing diagrams GT30, see pages 815 to 822
. For more details about time ranges see instructions on
2. $A(11$-pin) and $B(11$-pin) differ in the way inputs are wired.
3. For socket and accessory part numbers, see page 838.
4. For timing diagrams oveniew, see page 794.

## Timing Diagrams/Schematics

GT3D-2 Timing Diagrams
Delayed SPDT + Instantaneous SPDT

GT3D-3 Timing Diagrams
Delayed DPDT
Switches \& Pilot Lights




| Cycle 3 <br> (ON first) | lium | 1 Tominal Mumber | Opmation |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Sellime | 2.7360 | Sotimo |  |
|  | Power |  | = | ] |
| Time Remaining | $\left\{\begin{array}{l} \text { Dearned } \\ \text { Conaci } \end{array}\right.$ | ${ }^{1-1.4 .5-8.8(8)}$ |  | $\square \square$ |
| 1 - D |  |  |  | $\square \square$ |
| Time Elapsed | Indicalot | оит |  | $\square$ |
|  | $\left\lvert\, \begin{aligned} & \text { Dipital } I_{\text {mene }} \\ & \text { Display } \end{aligned}\right.$ | Down | $\checkmark$ | $N \sim N$ |
| 1 |  | up | , | 121 |

## GT3D-4 Timing Diagrams

These timers require a start input. A gate and reset input are optional. Inputs are controlled by external pushbuttons. Reset occurs when the power is removed or when the reset input is supplied. The gate signal can be used to interrupt (freeze) timer functions. Timer functions resume when the gate input is removed. B style timers are not equipped for gate input.

## Delayed DPDT




## GT3D-4 Timing Diagrams



GT3D-4 Timing Diagrams


GT3D-4 Timing Diagrams


GT3D-4 Timing Diagrams


GT3D Series

GT3D-8 Timing Diagrams
Delayed DPDT
Sull $5!701$ I!d 8 sayuums
Operation
Mode Selection



## $\mathrm{T}=\mathrm{Set}$ time

$\mathrm{Ta}=$ Shorter than set time
$\mathrm{Tb}=$ Shorter than single-shot output time
$\mathrm{T}=\mathrm{T}^{\prime}+\mathrm{T}^{\prime}$
$\mathrm{TO}=$ Single-shat output time (selected from $\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}, \mathrm{E}$ or F )

Instructions: Setting GT3D-2, GT3D-3 Timers


| Step 1 | \% | Desired M | /Selection' |  | 3 : Remarts |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Select the desired time display and operation modes. | $\begin{gathered} \text { Time Display } \\ : \text { Mode } \end{gathered}$ | (1) lindicator Mode Selector | Operation mode | (2) Operation Mode Selector: | 1. Use the flat screwdriver to set the selectors. Since selectors do not tum all the way around, both clockwise and counterclockwise rotation may be necessary. |
|  | Time elapsed | 1 | ON-delay 1 |  |  |
|  | Time remaining | 1 |  |  |  |
|  | Time elapsed | 1 | Interval |  | 2. The © Indicator Mode Selector determines whether the Digital Time Display shows the time elapsed or time remaining. The (1) Operation Mode Selector determines the desired operation mode. Decide which display and mode is desired, then use these two selectors $\mathcal{Q}$ (t) set the operation mode. |
|  | Time remaining | 1 |  |  |  |
|  | Time elapsèd | 1 | Cycle 1 | C |  |
|  | Time remaining | 1. |  |  | 3. The (1) Operation Mode Selector has two blank modes which are not intended for use. Always have this selector set to A; B, C, or D. |
|  | ? Time elapsed | 1 | Opcle 3 | D |  |
|  | Time remaining | 1. |  |  |  |
| Step 2 | Dosired Operation |  | Seleection |  | O, Remarks |
| Select a time range that contains the desired period of time. | Base Time Ranges, |  | 20. Tme Range Selectar , |  | 1. The (3) Time Range Selector controls both the decimal point indicator ( $9.99,99: 9,999$ ) and the time increment indicators S (seconds), M (minutes), and H (hours). <br> 2. Chose which base time range contains the targeted timer setting. Then use the (3) Time Range Selector to set the decimal point indicator and time increment indicator to its corresponding pair of settings. <br> 3. Since these configurations offer a complete range of settings from. 0.01 seconds to 99.9 hours, the setting of 9.99 for minutes and the 9.99 and 999 settings for hours are not listed and should not be used. |
|  |  |  | $\begin{gathered} \text { Dacimal Point } \\ \text { Indicator. } \\ \hline \end{gathered}$ | Time Incremént Indicator |  |
|  | 0.01 seconds | ds to 9.99 seconds | 9.99 | S ${ }^{1}$ |  |
|  | 0.1 second | ds to 99.9 seconds | '99.9 |  |  |
|  | 1 second | to 999 seconds | 999 |  |  |
|  | 0.1 minute | s to 99.9 minutes | 99.9 | M |  |
|  | 1 minute | to 999 minutes | 999 |  |  |
|  | 0.1 hour | 0.1 hours to 99.9 hours | $\cdots \mathrm{H}$ |  |  |
| Step 3 | Desired Operation- |  |  |  | $\cdots$ Reimarks |
| Set the precise period of time desired by using the (4) Time Setting Digital Switch. |  |  |  |  | Use the (4) Time Setting Digital Switch to set the desired period of time. It is important to remember that the setting of the (3) Time Range Selector determines the units of time measurement as well as the implied decimal point location. |

Instructions: Setting GT3D-4 Timers



It is important to remember that the (1) Time Range Selector not only selects the time range but also influences the interpretation of the Digital Time Display.
Changing the (1) Time Range Selector setting changes the units of time measurement (seconds, minutes, hours) as well as the decimal point location.

Instructions: Setting GT3D-8 Timers



## GT3 Series



Panel Mounting Accessories


For information on installing the hold-down springs, see page 838.

Flush Panel Mount Adapter and Sockets that use an Adapter


GT3 Series Instructions

## Instructions: Wiring Inputs for GT3 Series

## $\frac{\stackrel{n}{2}}{\frac{\omega}{5}}$ Inputs Inputs

To avoid electric shock, do not touch the input signal terminal during power voltage application
When connecting the input signal terminals of two or more GT3A timers to the same contact or transistor, the input terminals of the same number should be connected. (Connect Terminals No. 2 in common.)


In a transistor circuit for controliing input signals, with its primary and secondary power circuits isolated, do not ground the secondary circuit.


Connect the input signal terminals of the GT3A timers to Terminal No. 2 only. Never apply voltage to other terminass; otherwise, the internal circuit may be damaged.


Input signal lines must be made as short as possible and installed away from power cables and power lines. Use shielded wires or a separate conduit for input wiring.

## Inputs Instructions, continued

For contact input, use gold-plated contacts to make sure that the residual voltage is less than 1 V when the contacts are closed.


For transistor input, use transistors with the following specifications; $\mathrm{VCE}=40 \mathrm{~V}, \mathrm{VCES}=1 \mathrm{~V}$ or less, $\mathrm{IC}=50 \mathrm{~mA}$ or more, and $I C B O=50 \mu \mathrm{~A}$ or less. The resistance should be less than $1 \mathrm{k} \Omega$ when the transistor is on. When the output transistor switches on, a signal is input to the timer.


## Inputs: GT3A-1, -2, -3

Transistor output equipment such as proximity switches and photoelectric switches can input signals if they are voltage/current output type. with power voltage ranges from 18 to 30 V and have1V. When the signal voltage switches from H to L , a signal is input to the timer


Inputs: GT3A-4, -5, -6

| Start Input | The start input initiates a time-delay operation and controls output status. | No-voltage contact inputs and NPN open collector tansistor inputs are applicable. <br> $24 \mathrm{VCD}, 1 \mathrm{~mA}$ maximum <br> Input résponse time: 50msec maximum |
| :---: | :---: | :---: |
| Roset Input | When the reset input is activated, the time is reset, and contacts return to original state. |  |
| Gato Input | The time-delay operation is suspended while the gate input is on (pause). |  |

## Dimensions



NOTE: GT3W series are UL Listed when used in combination with following !DEC's sockets:
GT3W-A11, A33: SR2P-06* pin type socket.
GT3W-A11E: SR3P-05* pin type socket.
The socket to be used with these timers are rated
-Conductor Temperature Rating $60^{\circ} \mathrm{C} \mathrm{min}$.
-Use 14AWG max. ( $2 \mathrm{~mm}^{2}$ max.) Copper conductors only
-Terminal Torque 1.0 to $1.3 \mathrm{~N}-\mathrm{m}$

Analog GT3 Timer, 8-Pin with SR2P-06


Digital GT3 Timer, 8-Pin with SR2P-06


Analog GT3 Timer, 11-Pin with SR3P-05


Analog GT3 Timer, 11-Pin with SR3P-06


Digital GT3 Timer, 11-Pin with SR3P-06


Digital GT3 Timer, 11-Pin with SR3P-05


## Panel Mount Adapter

Analog GT3 Timer, 8-Pin and 11-Pin with SR6P-S08 or SR6P-S11


Digital GT3 Timer, 8-Pin and 11-Pin with SR6P-S08 or SR6P-S11


Mounting Hole Layout


Tolerance: +0.5 to 0 N : No. of timers mounted

Analog and Digital GT3 Timer, 8-Pin with SR6P-M08G


## General Instructions for All Timer Series



## Contact Protection

Switching an inductive load generates a counter-eiectromotive force (back EMF) in the coil. The back EMF will cause arcing, which may shorten the contact life and cause imperfect contact. Application of a protection circuit is recommended to safeguard the contacts.

## Temperature and Humidity

Use the timer within the operating temperature and operating humidity ranges and prevent freezing or condensation. After the timer has been stored below its operating temperature, leave the timer at room temperature for a sufficient period of time to allow it to return to operating temperatures before use.

## Environment

Avoid contact between the timer and sulfurous or ammonia gases, organic solvents (alcohol, benzine, thinner, etc.), strong alkaline substances, or strong acids. Do not use the timer in an environment where such substances are prevalent. Do not allow water to run or splash on the timer.

## Vibration and Shock

Excessive vibration or shocks can cause the output contacts to bounce, the timer should be used only within the operating extremes for vibration and shock resistance. In applications with significant vibration or shock, use of hold down springs or clips is recommended to secure a timer to its socket.

## Time Setting

The time range is calibrated at its maximum time scale; so it is desirable to use the timer at a setting as close to its maximum time scale as possible. For a more accurate time delay, adjust the control knob by measuring the operating time with a watch before application.

## Input Contacts

Use mechanical contact switch or relay to supply power to the timer. When driving the timer with a solid-state output device \{such as a two-wire proximity switch, photoelectric switch, or solid-slate relayl, malfunction may be caused by leakage current from the solid-state device. Since AC types comprise a capacitive load, the SSR dielectric strength should be two or more times the power voitage when switching the timer power using an SSR.

Generally, it is desirable to use mechanical contacts whenever possible to apply power to a timer or its signal inputs. When using solid state devices, be cautious of inrushes and back-EMF that may exceed the ratings on such devices. Some timers are specially designed so that signal inputs switch at a lower voltage than is used to power the timer \{models designated as " B " type).

## Timing Accuracy Formulas

Timing accuracies are calculated from the following formulas:

| Repeat Error | $= \pm \frac{1 \times \text { Maximum Measured Value }- \text { Minimum Measured Value } \times 100 \%}{2 \text { Maximum Scale Value }}$ |
| :--- | :--- |
| Voltage Error | $= \pm \frac{\operatorname{Tv}-\operatorname{Tr} \times 100 \%}{\operatorname{Tr}}$ |

Tv: Average of measured values at voltage $V$
Tr: Average of measured values at the rated voltage
Temperature Error

$$
= \pm \frac{\mathrm{Tt}-\mathrm{T} 20 \times 100 \%}{\mathrm{~T} 20}
$$

Tt : Average of measured values at ${ }^{\circ} \mathrm{C}$
T20: Average of measured values at $20^{\circ} \mathrm{C}$

$$
\text { Setting Error } \quad= \pm \frac{\text { Average of Measured Values - Set Value } \times 100 \%}{\text { Maximum Scale Value }}
$$

Technical Information


Dimensions


## Panel Mount Adaptor (26.506:221-01)

- Dimensions are in millimeters
- Dimensions not intended for manufacturing purposes



## TEST SHEET

## 1. PUMP STATION SP280 TEST SHEET

# Halmac Services (Qld) Pty Ltd <br> ACN 098852923 ABN 40741712113 ECL 53064 

30 Palmer Place, Murarrie Qld 4172
All hours Telephone (07) 32499500
Email: info@halmac.net.au

## CERTIFICATE OF:

(Please mark relevant check-box)

TESTING AND COMPLIANCE ( $\left.\begin{array}{c}\text { Electrical } \\ \text { installations }\end{array}\right)$
Issued in accordance with s159 of the Electrical Safety Regulation 2002

# TESTING AND SAFETY 

Issued in accordance with s15 of the Electrical Safety Regulation 2002

* Work performed for:
* Name $\frac{\text { QUU }}{\text { Title }} \xrightarrow{\text { QUEENSLAND URBAN }}$

UTILITIES

* Address FORTITUDE VALLEY

Street
$\frac{4001}{\text { Postcode }}$

* Electrical installation / equipment tested (detailed list of all work done):

REPLACEMENT OF SP280 SWITCHBOARD
LAWSON PLACE, DREWVALE. Q4116
AS PER AS BUILT DRAWINGS 486/5/7-0150 SHEETS 00 to 22

Name on contractor licence Halmac Services Qld Pty Ltd
Electrical contractor phone number 0732499500
For electrical installations, this certifies that the electrical installation, to the extent it is affected by the electrical work, has been tested to ensure that it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying under the Electrical Safety Regulation 2002 to the electrical installation.

For electrical equipment, this certifies that the electrical equipment, to the extent it is affected by the electrical work, is electrically safe.


## DESIGN \& INSPECTION ROUTE SCHEDULLE

| CUSTOMER: BRISBANE WATER | PROJECT NAME:REPLACEMENT SWITCHBOARDS |
| :--- | :--- | :--- |
| JOB NO: A4214 | SWITCHBOARD NAME: SP $28 D$ DRAWING NO: SUPPLIED |

IS THIS SWITCHBOARDIDENTICAL OR SIMILAR, TO A PREVIOUS DESIGN? YES (DELETE AS APSICABLE)
IF "NO" COMPLETE SWITCHBOARD DESIGN REVIEW. IF 'YES" PROVIDE PREVIOUS DRAWING NO. REFERENCE.
(TICK APPLICABLE SECTION BELOW: YES / NO / N/A (Noi Applicable)



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| Customer Witness: | Date:________ |

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[^1]:    Notes: - Thermal or electronic overload relays may be used.

[^2]:    page 48

[^3]:    Notes: - Thermal or electronic overioad relays may be used

[^4]:    Notes: - Thermal or electronic overload relays may be used

[^5]:    Notes: ${ }^{1}$ ) DIN Rail mounting 35 mm to EN 50022.

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[^14]:    (1) Dimensions are not intended to be used for manufacturing purposes.

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[^16]:    Dimensions are not intended to be used for manufacturing purposes.

[^17]:    - Information:

    2. We recommend using parts from the line of VEGA mounting accessories.
[^18]:    1) Incl. non-linearity, hysteresis and non-repeatability.
[^19]:    ${ }^{2)}$ Tested according to the regulations of German Lloyd, GL directive 2.
    ${ }^{3)}$ Tested according to EN 60068-2-27.

[^20]:    1 brown (+)
    blue (-)
    Yellow
    Screen
    Breather capillaries with filter element
    6 Indicating module
    7 Controlinstrument
    8 Vottage supply/Signal output

[^21]:    * 2-pole motor

[^22]:    (1) Form $C=$ Change-over contact (Form C dry contact), 400V~BA $1 \mathrm{~mm}^{2}$ to $6 \mathrm{~mm}^{2}$ (\#18AWG to \#10AWG) connecting wire

