## IPSWICH CITY COUNCIL

KARALEE B

## PUMP STATION

## ELECTRICAL SWITCHBOARD OPERATION AND MAINTENANCE MANUAL

Developed by:


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Rēf. Nō. 35026
made in germany

### 1.0 INTRODUCTION

These operating instructions cover the Karalee B pumping station electrical equipment supplied by J \& P Richardson Industries Pty Ltd in June 2005.

### 1.1 Operating Instructions

Normal operation of the pumping station is in the automatic mode with control by means of a Radio Telemetry Unit (RTU) which receives level signals from the Electronic Level Relays.

Manual operation control of the station is available by means of selector switches on the motor control switchboard.

### 2.0 DESCRIPTION OF OPERATION

### 2.1 Mode Selection

The station can be operated either automatically or manually with mode selection being made by means of the mode selector switches mounted on each pump section of the switchboard. These selector switches are designated with the following mode selections AUTO-OFF-MAN.

### 2.2 Manual Control

Each pumping unit can be run in manual control from the motor control centre by: -
a). Selecting the "MAN" setting on the "MODE SELECTOR SWITCHES" as described in Clause 2.1.
b). Starting by "START" pushbutton.
c). Stopping by "STOP" pushbutton.

## N.B. DO NOT LEAVE IN MANUAL WHILE STATION UNATTENDED

### 2.3 Automatic Control

For automatic control of the station: -
a). The "MODE SELECTOR SWITCHES" on the switchboard should be in the "AUTO" position.
b). The automatic Duty Selection is done via the RTU software. The total running hours of each pump unit is displayed on the hourmeter located on each pump section of the switchboard.
c). The automatic starting, and stopping of the pumps is controlled by signals from Master RTU.

For NORMAL OPERATION, each of the pump selector switches should have "AUTO" mode selected.

In the AUTOMATIC mode the selected Duty Pump unit will start automatically as preset by the level in the wet well. In the event of the duty pump not being capable of supplying enough flow to continue draining the wet well and the well level rises to a second preset level, then the Standby Pump unit will automatically start, to provide additional pumping. The supplementary pump unit also takes over for the respective pump duty on the occurrence of one the Duty Pump unit failing.

### 3.0 PUMPS

## SUPPLIER:

KSB Ajax Pumps Pty Ltd
55 Jijaws Street, Sumner Park, QLD 4074 PO Box 654, Sumner Park B.C., QLD 4074

Ph: (07) 37258200
Fax: (07) 37258299

MODEL:
F80-315 16kW 2Pole

## Operating And Maintenance Instructions

Client: J. P. RICHARDSON INDUSTRIES P/LProject:
$\qquad$ KARALEE 'B'Order No:P6454
Pump Type/Model: ..... KRT F80-315
KSB Works No: ..... 52399


# Quality 

# Company 

AS/NZS ISO9001:1994
LIC 768
27 Indwe St., Tottenham

| Head Office: | S.A. | N.S.W. | W.A. | Q.L.D. ${ }^{\text {d }}$ |
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- Amarex KRT Pump Operating Instructions
- Pump Performance Details (Pump A) No. 166-05
- Pump Performance Details (Pump B) No. 167-05


## Submersible motor pumps



Works-No.:
see data plate:


The operating manual contains important information and hazard/danger warnings. It is imperative to read the instructions set out in the manual prior to installation, making electrical connections and commissioning. Additional operating instructions relating to the components of this plant will also have to be observed.


In principle if any work has to be carried out to the plant all electrical supplies (inclusive of the control cable) should be disconnected at the mains supply switch. The plant has to be safeguarded against accidental starting.

Ident-No.
01055329

These operating instructions contain important notes for the individual material versions of the below sizes:

| Type Size |  | Material version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $S, F, E, K, D=$ impeller type |  |  |  |  |  |
|  |  | G | G1 | G2 | GH |
| S, F, K | 40-250 | S, F, K | F, K | F | F, K |
| F, E | 80-250 | F, E | F | F | F |
| F, E, K | 80-315 | F, E, K | F, K | F | F, K |
| F | 100-240 | F | F | F | F |
| F, E, K | 100-250 | F, E, K | F, K | F | F, K |
| F, E, K | 100-315 | F, E, K | F, K | F | F, K |
| D | 150.251 | D | 3 |  |  |
| F, E, K, D | 150-315 | $\underset{\mathrm{D}}{\mathrm{~F}, \mathrm{E},}$ | F, K | F | F, K |
| K | 200-280 | K | K |  | K |
| K | 200-281 | K |  |  |  |
| 0 | 200-315 | D | 5tsex |  |  |


| Type Size <br> Impeller type |  | Material version |  |  |
| :--- | :---: | :---: | :---: | :---: |
|  | H | C1 | C2 |  |
| K | $40-250$ | K | K | K |
| F, K | $80-315$ | F, K | F, K | F, K |
| F | $100-240$ | F | F | F |
| F, K | $100-250$ | F, K | F, K | F, K |
| F, K | $100-315$ | F, K | F, K | F, K |
| F, K | $150-315$ | F, K | F, K | F, K |
| F, K | $200-280$ | K | K | K |

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Amarex KRT

## 1 General

This KSB pump has been developed in accordance with the latest technology, it was manufactured with great care and is subject to constant quality control.
The operating manual is designed to introduce the pump to you to make operation easier and to make full use of all its applications.
The operating manual contains important information to ensure safe, correct and economic operation. It is imperative to observe the contents of the operating manual to ensure reliability and long operating life of the pump and to avoid dangerous practices.
The operating manual does not take into account any local regulations which have to be complied with by the operator or by any hired installation staff.
This pump must never be operated outside the limits laid down in the technical documentation with regard to pumped media, rate of flow, speed, density, pressure and temperature, including motor rating or contrary to any other instructions stipulated in the operating manual or contract documentation.
The data plate states series/size, the most important operating data and the Works No./Serial No., which must always be stated when making enquiries, subsequent orders and especially when ordering spare/replacement
parts.
Should any additional information or instructions be required, or if there is any damage to the equipment, then please contact your nearest KSB service.

## - 2 <br> Safety

This operating manual contains basic instructions, which must be observed during installation, operation and servicing. Therefore it is imperative that this manual is read prior to assembly by the fitter and relevant skilled staff/and operators, and it must always be kept within the locality of the machine/plant.
Do not only observe the general safety notes under this section, but as well any other notes regarding safety included in the manual.

### 2.1 Identification of symbols used within the operating manual

The symbols contained within this manual calling attention to situations where non-observance could endanger lives, are especially identified such as:


Waming sign in accordance with DIN 4844 - W9
Calling attention to electric current with


Warning sign in accordance with DIN 4844 - W8
Safety instructions relating to situations where non-observance could damage the machine and its functions are identified with the word

## Attention

Any instructions which are actually printed on the machine such as:

- Arrow indicating the direction of rotation
- Identification for fluid connections
must be observed without fail and be kept clean and legible.


### 2.2 Personnel skills and training

Operators, as well as service, inspection and assembly personnel must have proof of having the appropriate skills to carry out such work. Area of responsibility, allocation and supervision of the personnel must be controlled by the operator. Should the personnel not have the required knowledge, training must be arranged. If required, the operator can arrange such training to be carried out by the manufacturer/supplier. The operator must also ensure that the instruction manual is fully understood by the personnel.

### 2.3 Dangerous practices - non-observance of safety instructions

Non-compliance with the safety instructions can endanger people's lives, the environment and the pumps. Non-observance will negate any warrenty daims.
In detail, non-compliance could, for example, cause the following:

## - Failure of pump/plant to operate

- Failure of servicing and maintenance methods
- Endangering people by contact with electrical, mechanical and chemical matters
- Contamination of the environment by leakage of dangerous substances.


### 2.4 Safe working methods

The operator must observe all safety instructions outlined in this leaflet, the existing national safety precautions to prevent accidents, and also any inter-company working, operating and safety regulations.

### 2.5 Safety instructions for operators

- If hot or cold machine parts are considered a danger, then these parts must be protected where contact is possible.
- Safety equipment to prevent contact with hot or cold movable parts must not be removed whilst the machine is in operation.
- Leakages (for example at shaft seals) of dangerous media (e.g. explosive, poisonous, hot liquids) must be disposed of in such a manner as to avoid any danger to personnel and environment.
- Danger caused by electric supply must be eliminated (in this respect, see details of any regulations enforced by individual countries of the VDE and/or local power supply stations).


### 2.6 Safety instructions during maintenance, inspection and installation

The operator bears the responsibility to ensure that all service, inspection and maintenance work is carried out by authorised and fully trained personnel, who have read and are familiar with the operating instructions.
Basically, all work to the plant should only be carried out when the machine is not operating. The operating instructions relating to the method of switching off the equipment must be adhered to without fail.
Pumps or plants pumping dangerous media must be decontaminated.
Once maintenance work is completed, all safety equipment must be reinstated again and checked to ensure they function correctly. Read and follow the point listed in the paragraph "First commissioning" prior to installation.

### 2.7 Unauthorised modifications to the pump and fitting of spare parts

Modifications to the pump can only be carried out after authorisation has been obtained from the manufacturer. Original spare parts and ancillary equipment supplied by the manufacturer provide safety. Installation of any other equipment cancels the guarantee for any pump failure which occurs as a result of installing non-manufacturer's parts.

### 2.8 Impermissible modes of operation

Operating safety of the equipment is only guaranteed if all operating instructions as outlined in paragraph 1 - General - are observed. The limits given in the data sheet must under no circumstances be exceeded.

## 3

## Transport and interim storage



The chain or lifting wire which is supplied must only be used for lifting the appropriate pump unit. General use for lifting heavy loads is not permitted.

Do not lift the pump by the motor cable.


The pump must be handled carefully during transport. The chain or lifting wire must be attached securely at the pump and crane end. Personnel can be injured and the pump unit damaged should the pump slip out of the chain/guide wire.

### 3.1 Transport

The motor housing/cover of the pump has been prepared for attaching the chain supplied with the unit. For lifting the unit during unpacking only this prepared fixing should be used for attaching the lifting chain.


### 3.2 Storage/conservation

The procedure has been outlined in the paragraph 6.3 "Shutdown"

## 4. Description of pump <br> 4.1 General description

KSB submersible pumps are submersible, close-coupled units which are non-self-priming. The impellers in these pumps can vary, depending on the impeller type required by the customers to suit a particular application. Usually, the pumps are operated fully submerged. For short periods, they may run dry until the minimum filling level is reached.

### 4.2 Identification data

Identification can be found on the data plate, which is fitted to the motor. Illustration data plate for non-flameproof and flameproof design see appendix: "General pump outline" Fig 1.


### 4.3 Construction <br> 4.3.1 Driver

KSB submersible pump sets are supplied with three-phase asynchronous motors complete with connecting cable. Electrical data in compliance with data plate. Starting method standard: direct or Y $\Delta$.

### 4.3.1.1 . Motors in explosionproof design

In accordance with EN 50014/ EN 50018;
Protection type EEx d IIB T3 or T4.

### 4.3.2 Shaft seal

The shaft seal consists of a mechanical seal which is independent of the direction of rotation at pump and motor end. The oil chamber which is fitted between the two mechanical seals ensures cooling and lubrication.

### 4.3.3 <br> Bearing assembly

All sizes are fitted with grease-lubricated, maintenance-free deepgroove anti-friction bearings.

### 4.3.4 Impeller types



Cutter (S) for faeces, domestic sewage and sewage containing long fibrous admixtures.


Free-flow impeller (F-impeller) for pumping liquids containing larger solid particles and fibres liable to twist and bunch and also gas and air inclusions.


Single-vane impeller (E-impeller) for pumping. liquids containing larger solid particles and fibres liable to twist and bunch, and also for the damage-free transport of solids.


Open, diagonal single vane impeller
(D-impeller) for sewage with solid and long fibrous admixtures and with coarser solids.


Closed non-clogging impeller (K-impeller) for contaminated, non-gaseous liquids containing solids; without fibres liable to twist and bunch.

### 4.3.5 Installation methods

- stationary wet-well installation
- transportable installation

For detailed installation description, see item 5.6.

### 4.3.6 Dimensions

Information regarding dimensions and weight can be found in Appendix 4 "Dimension Tables".

### 4.4 Ancillary equipment

Suitable KSB switchgears are available to ensure trouble-free functioning of the monitoring equipment. Recommended equipment is described in Appendix "Electrical connection diagram"
Any information relating to other ancillary equipment will be given by our Sales Office.

## 5 Assembly/Installation

### 5.1 Safety regulations



It is not permitted for any person to enter the tank during operation of the pump unless special safety precautions have been taken in accordance with current safety regulations.

### 5.2 Checking procedure prior to commencement of the installation

Construction lay-out must be in accordance with measurements set out on the table of dimensions.
The construction of the concrete foundations should be sufficiently strong (Min. B25 in accordance with DIN 1045) to ensure a secure and functionally correct installation in compliance with DIN 1045 or equivalent standard. Concrete foundations must have set before installation of the unit. Its surface must be level and even.

### 5.3 Installation

Examine the unit carefully prior to commencement of installation regarding any damage incurred to the unit and cabling during transport. Before installation of the pump all items listed in paragraph 6.1 have to be checked in sequence. A separate data plate stating pump and motor data is supplied within the scope of supply. This data plate must be fixed in a clearly visible position outside the tank (for example switch panel, pipework, mounting bracket).

### 5.3.1 Checking of operating data

A check must be carried out to ensure that the details stated on the data plate correspond to the order and pump data (for example operating voltage, frequency and pumped media temperature etc.).

### 5.3.2 Oil level control

The oil chambers of our submersible pumps were filled with environmentally friendly non-toxic paraffin oil at works.
The oil level must be checked prior to initial operation of the unit.
Procedure see item 6.1.1

### 5.3.3 Checking of the direction of rotation

Before starting with the installation, make sure that the direction of rotation is the correct one, acc. to para. 5.5.6.

### 5.4 Connection of the pipeline

(Appendix "General arrangement of installation sets" Fig 1) The discharge pipe must be connected to the pump without tension.

## Attention

Under no circumstances must the pump be used as an anchoring point for the pipeline.

Any expansion of the pipes caused by high temperatures must be adjusted by taking appropriate corrective measures, to ensure that the pump does not come under undue stress due to pipeline forces and torques.


Excessive pipeline forces can cause leakages of pumped media for example.
Toxic and hot media can endanger life.
When emptying objects on a lower level, a non-return valve must be fitted into the discharge pipe to avoid backflow from the channel, which could be led via the backflow level (road level) upwards and only then into the sewage channel.

Screwed pipeline joints where plastic parts were

## Attention

 used, must not be damaged by careless handling of tools during the installation of pump and pipeline.Fitting of a non-return valve is also essential for longer rising pipes to avoid excessive backflow when the pump is turned off. Ensure that ventilation is taken into account when fitting a non-return valve.

### 5.5 Electrical connection

General


The electrical connection must be carried out by a trained electrician and in compliance with loca regulations.
The voltage must comply with the voltage indicated on the data plate.

Electrical installation must be in accordance with the annexes "Electrical installation" and "Performance lay-out" for the appropriate motor sizes. The pump is delivered with cable.

## Attention

Do not remove the protective cover, which is situated at the cable gland until immediately before installation.

The individual cores of the cable ends bear marking tapes (e.g. $\mathrm{U}(\mathrm{T} 1) . \quad \mathrm{V}(\mathrm{T} 2), \mathrm{W}(\mathrm{T} 3), 21,22$, or $10,11, \ldots$ ) If cables have to be shortened, take care of the core index or colour imprints. In such a case, remove the core marking and reaffix it afterwards.

## Attention

When laying an earth cable between the pumping station and the electrical switchgear an additional multi-core control cable (min. $1.5 \mathrm{~mm}^{2}$ ) must be installed for motor monitoring equipment and float switch control. Adjust cores to suit requirement.

### 5.5.1 Monitoring equipment

The unit has been supplied with monitoring equipment to prevent overloading. Installation, description and functioning of the monitoring equipment can be taken from Appendix "Electrical connections diagrams/circuit diagrams".

### 5.5.2 Frequency inverter operation

The given motor capacity of $P_{2}$ can only be used up to $85 \%$. Other special characteristics for this method of operation can be taken from Appendix "Electrical connections diagram/circuit diagram".

### 5.5.3 Fitting of electric cabling

## Attention

After installing the unit, it is advised to position the motor cable straight upward in order not to have it affected by the swirl created by the pumped liquid.

For correct installation of the electric cabling within the pump sump (Appendix "General pump outline" Fig. 5) we recommend to use cable socks, which can be supplied as an additional extra (paragraph 4.4). Slack installation of cables could cause damage to the electric cabling because of vibrations when the pump is operating.

## Attention

Fitting of cable protection sheath

If a protection sheath is included in the scope of supply for the electric cabling, it has to be fitted according to the instructions given in the supplementary operating manual "Assembly of protection sheath".

### 5.5.4 Overcurrent relay

The motor is protected against overloading by a thermally retarded overcurrent relay to comply with VDE 0660 / IEC 947 and regulations which are in accordance with local requirements. This should be adjusted to the nominal motor current indicated on the data plate

### 5.5.5 Level control switch

Pumping stations with automatic pump operation should be fitted with a level control switch. The cut-off point should be set as ' $R$ ' in accordance with Appendix "Table of dimensions".
This prevents an interruption of the delivery by the pump which would cause dry running.

### 5.5.6 Checking of the direction of rotation

Once the electrical connections are complete, the following should be checked:

## Attention

The pump cannot reach its duty point if the direction of rotation is incorrect. Nonobservance can lead to damaging the pump set.


Prior to carrying out any tests check that there are no foreign objects within the pump casing. Never put hands or any objects into the pump.

The running time should be as short as possible (max 3 minutes).

## Correct direction of rotation:

If the phase sequence of the circuit is known, the correct direction of rotation will occur automatically, providing the instructions in 5.5 have been carried out correctly (rotating of the motor to the left). The direction of rotation is checked by short starts and observations of the impeller.
When looking at the pump mouth, the impeller must move to the left (with some pumps, the direction of rotation is marked by an arrow).
(compare Annexe "General Pump Outline" Fig. 6).
If the direction of rotation is incorrect, interchange 2 of the 3 phases in the switch cabinet.

### 5.5.7 : Connection of a potential equaliser

For potential equalisation, follow the instructions to EN 60204.
The potential-equalising conductor is connected to the external connection terminal at the cable entry.
(Annexe "General Pump Outline")
Special requirements for chemically corrosive media
Do not use the outside terminal if the unit is used for chemically corrosive media and with a flameproof pump.
Instead, the potential equaliser should be fitted to a flange at the discharge pipe, which does not come into contact with the media. Please ensure that there is an electrical connection between the newly created potential equaliser and the pump.
(Appendix "General pump outline" Fig. 5).

### 5.6 Assembly kit installation

The following assembly kits are available for assembly/installation of the KRT pump unit.

- 5.6.1 Stationary wet-well installation
- 5.6.2 Transportable installation


### 5.6.1 Stationary installation/guide wire

### 5.6.1.1 Description

## (Appendix "General outline installation set" Fig. 1).

Stationary installation provides the facility to insert and lift out the pump unit at any time regardless of liquid level within the sump by means of a double guide wire.

Guided securely by two parallel, previously tightened stainless steel wires the pump slides into the well or tank and attaches itself to the duckfoot bend which has been fitted to the bottom.
The weight of the pump acts as seal between pump and duckfoot bend. A profile joint between pump and duckfoot bend achieves a pressure-proof elastic connection. Walking on the well is not permitted during inspection and maintenance work.

### 5.6.1.2 Scope of supply for stationary wet-well installation

Please refer to the Appendix "Wet-well installation with parts list".

### 5.6.1.3 Installation of pump with claw connection

 Use appendix "Wet-well installation" with parts list for guidance.1. Prior to lowering the pump fit claw 732 to the discharge flange of the pump housing.
Screws have to be tightened in accordance with the instructions. This is described under item 7.5.1 in the table "Bolt tightening torque".
2. Fit profile seal 410.35 or $99-6$ into the groove of the claw/pump casing flange. This profile seal will serve to seal the duckfoot bend during installation

### 5.6.1.4 Fitting of the mounting bracke ${ }^{2}$ duckfoot bend/guide wire

Construction of the base/concrete foundations should be sufficiently strong (min. B 25 in accordance with DIN 1045) to ensure a functionally correct fixing of guide wire equipment and duckfoot bend.

Refer to the drawing as illustrated in Appendix "Wet-well installation with parts list' for all installation tasks outlined below.

1. Secure mounting bracket 894 using anchor bolt $90-3.37$ at the sump opening rim. Borehole diameter and depth for the anchor bolt have to be taken from Appendix "Table of dimensions". Bolt tightening instructions are outlined in the table below. Bolt tightening torque for steel anchor bolts or foundation bolts".

As for the hole pattern of the mounting bracket refer to Appendix "Table of dimensions".
2. Fit threaded bolt 904 with clamping piece 553 / support piece 572 to the mounting bracket. Do not unscrew hexagonal nut 920.36 too much, just enough to allow sufficient play for tightening the wire subsequently. Ensure that the two clamping pieces 553 are fitted correctly to a support piece.
3. The duckfoot bend should be positioned and secured to the base of the sump so that the tightened wire will run vertically later on.
Should construction/pipework etc. require the wire to run off the vertical, then a maximum angle of $5^{\circ}$ should be adhered to, thus ensuring safe fitting function. Securing of the duckfoot bend is carried out by using bolts or foundation bolts regardless of pump size or material variation. Units larger than approx. $2,000 \mathrm{~kg}$ in weight are supplied complete with foundation slide rails. Refer to Appendix "Dimension Table" and Appendix "Wet-well installation with parts list" for details relating to appropriate fitting instructions and hole dimensions.
4. Insertion of wire and fitting. Lift thrust plug and clamp and insert one end of the wire. Lead the wire around the duckfoot bend 72-1 and back again towards the guide bracket and insert into clamp of thrust plug. Manually tension the wire and secure by using hex. nuts 920.37 .
5. Tighten the wire by fastening the hexagonal nut 920.36 situated on top of the mounting bracket(s). Tighten the hexagonal nut with a torque of $M_{A}$ as outlined in the table Appendix "Guide wire tension" to achieve sufficient wire tension. Subseqently secure by using a second hexagonal nut.
6. The loose end of the wire at the clamp 572 can either be twisted into a ring or the end can be cut off. After length adjustment, seal off ends to avoid fraying.
7. Place shackle $59-18$ into the mounting bracket 894 to enable the lifting chain to be attached at a later stage.
Please observe the filting instructions for steel bolts given in Appendix "Stationary wet-well installation with guide wire".

Table Bolt tightening torque "Steel anchor bolt"

| Size $(\sigma)$ | Torque $(\mathrm{Nm})$ |
| :---: | :---: |
| 10 | 10 |
| 18 | 80 |

Table Bolt tightening torque "Foundation bolt"

| Size ( $\boxed{)}$ | Torque (Nm) |
| :---: | :---: |
| 12 | 25 |
| 16 | 65 |
| 20 | 125 |

Table "Guide wire - tension"

| Size |  |  | $\mathbf{M}_{\mathbf{A}}$ <br> $(\mathbf{N m})$ |
| :---: | :---: | :---: | :---: |
| $40-250$ | $100-315$ | 14 | $\mathbf{( N})$ |
| $80-250$ | $150-315$ |  | 6000 |
| $80-315$ | $200-280$ |  |  |
| $100-240$ | $200-281$ |  |  |
| $100-250$ | $200-315$ |  |  |
| $150-251$ |  |  |  |

$\mathrm{M}_{\mathrm{A}}=$ tightening torque
$\mathrm{P}=$ wire tension

### 5.6.1.5 Fitting of chain/lifting wire stationary wet well installation

Installation of this equipment should be carried out in accordance with the "General pump outline", Fig. 2a by inserting the chain/lifting wire into the loop opposite the outlet branch. Further details can be found in "Wet-well installation with parts list".

This type of fixing achieves a forward inclination of the pump towards the outlet branch and permits the fitting of the pump to the duckfoot bend

### 5.6.1.6 Installation of the pump

(Appendix "General outline installation set" Fig. 1)
The pump is lowered into the sump by guiding it from above over the clamp 572. It is then attached to the guide wire and slowly lowered into the sump. Once the pump is lowered, it will attach itself to the duckfoot bend 72-1 and is then securely fixed to the outlet pipe ready for use. Finally, attach the chain or wire to the shackle 59-18 on the mounting bracket

### 5.6.1.7 Connection of the pipeline

(Appendix "General outline installation set ", Fig. 1)
For procedure, see para. 5.4.

### 5.6.2 : Transportable installation

### 5.6.2.1 Description

Pumps for transportable installation are supplied with a pump stand. The outlet branch with DIN connections lends itself for fitting either rigid or flexible piping. Examples for typical installation possibilities can be taken from Appendix "General arrangement of installation parts" Fig. 2. Ancillary equipment can be requested and purchased from our sales offices.

### 5.6.2.2 Components/extent of supply for transportable installation

For parts supplied and detailed illustration, see Appendix "Wetwell transportable installation with parts list"

### 5.6.2.3 Assembly kit installation

Please refer to drawing in Appendix "Wet-well transportable installation with parts list" for assembly.

1. The base plate or the pump stand must be fitted prior to installing the pump. All screws must be tightened according to instructions. Refer to table "Bolt tightening torque" paragraph 7.4.1 for instructions.

### 5.6.2.4 Assembly chain/lifting wire / transportable installation

Fitting of chain/lifting wire should be carried out as outlined in Appendix "Wet-well installation transportable with parts list".
For Pumps with a motor capacity of 4 kW , always use the loop which is fitted on the discharge side, see Appendix "General pump outline" Fig. 2b.

### 5.6.2.5 Installation of pump

Transportable installation permits to operate the pumps in different locations.
For example, they can be used for:
draining mines
the emergency draining of canals pumping water out of rivers etc.

For such applications the pump must be installed in a vertical position with the motor on the top and fitted to a firm base.

## 6 Start up/shut down

## Attention

It is important to fulfil the following requirements. Any damage incurred as a result of noncompliance is not covered by the guarantee.

Attention Do not pump any media which is unsuitable for the material outlined in the technical documentation.

### 6.1 Initial start up of pump

Prior to starting the pump it has to be ascertained that the following points have been checked and executed

- Operating data must be checked to comply with paragraph 5.3.1,Oil level, paragraph 6.1.1 and Direction of rotation, paragraph 5.5.6
- Check that the installation of the electrical supply was carried out correctly in accordance with Appendix: "Electrical connection diagram / operating plans"


## Attention

Temperature monitoring in the winding protects the motor in case of insufficient cooling conditions (e.g. if pump is partially not submerged). Reliable operation and explosion protection can only be guaranteed if the circuits for temperature monitoring function properly.

- Ensure that the pump has been installed correctly to comply with installation kit paragraph 5.6.
- Should the pump have been out of service for a long period, then the steps outlined in paragraph 6.3 must be carried out


### 6.1.1 Oil level check

Procedure acc. to Appendix „General Pump outline" Fig. 3.
Remove screwed plug 903.03 with joint ring 411.03. The minimum oil level must not fall short of measure " $M$ ". If it is lower, fill the oil chamber via feed opening until overflow. Regarding oil quality and quantity, see point 7.2.5 (Oil change).
Tighten screwed plug with joint ring again:

### 6.2 Limitations of the operating range

6.2.1 Minimum liquid level

The pump is ready for operation when the liquid level has reached measuring mark "R".

This minimum liquid level also applies to pumping stations with automatic pump operation.
(Appendix "General pump outline" Fig. 7)

> "R" = Lowest switch-off point for automatic operation
> "M" = Minimum liquid level for constant operation

Built-in temperature controls within the winding will protect the motor from overheating. If the motor overheats (for example during long operation with a completely exposed motor), the built-in temperature controls will switch off the motor and turn it on again automatically after cooling down.
The control system must provide a protection against dry running by stopping the pump automatically (cut-off contact, see 5.5.5).

Attention
Dry running leads to increased wear and should be avoided.

### 6.2.2 Temperature of pumped media and surroundings

| KRT .... type $\mathrm{X}, \mathrm{Y}$ | explosionproof version | $40^{\circ} \mathrm{C}$ |
| :--- | :--- | :--- |
| KRT .... type $U^{1)}$ |  | $40^{\circ} \mathrm{C}$ or |
|  |  | as indicated <br> on data plate |
| KRT .... type $W^{1)}$ |  | $60^{\circ} \mathrm{C}$ or |
|  |  | as indicated <br> on data plate |

1) Can be operated up to $80^{\circ} \mathrm{C}$ for a limited period (3-5 min. or until the thermal protection equipment is activated)

## Attention

Do not operate the equipment at temperatures higher than those indicated above, unless the manufacturer has given written consent. Damage caused due to non-observance of this warning will not be covered by the guarantee.

### 6.2.3 Switching frequency

In order to avoid intolerably high temperature rises within the motor and excessive overtoading of motor, seals and bearings, the following number of switching operations per hour (S) should not be exceeded:

| Motor capacity <br> $(\mathrm{kW})$ | max. S <br> (Switching operations/h) |
| :---: | :---: |
| up to 7.5 | 30 |
| above 7.5 | 10 |

### 6.2.4 Operating voltage

The maximum admissible deviation of the operating voltage amounts to $\pm 10 \%$, with explosionproof versions to $\pm 5 \%$ of the rated voltage. The maximum admissible voltage difference between the single phases amounts to $1 \%$.

### 6.2.5 Density of pumped media

Power input of the pump increases proportionally to the density of the pumped medium. To avoid overloading of the motor this density must comply with the data stated in the order.

### 6.2.6 Abrasive media

When pumping media containing abrasive particles, increased wear of hydraulic and mechanical seals must be expected. The maintenance intervals must be halved compared to those usually recommended (as outlined in paragraph 8). In addition, it is recommended to limit the flow velocity in relation to the rising main to $>1.5 \mathrm{~m} / \mathrm{sec}<5 \mathrm{~m} \mathrm{sec}$ in order to achieve the maximum operating periods possible.

### 6.3 Shutdown/storage/preservation

If operation is not required until some time after delivery, we recommend the following steps for storage of the pump:

### 6.3.1 Storage of new pumps

- Spray the inside of the pump housing with oil by paying special attention to the area around the impeller gap. Spray oil through inlet and outlet branches. It is then recommended to protect the branches (with plastic caps or similar).
- Store the pump in an upright position in a dry place. Support all electrical cables at cable entry points to avoid permanent distortion.
- Electric connecting cables are capped securely for protection purposes prior to delivery. This protection must not be removed.


### 6.3.2 Measures for prolonged shutdown periods

1. The pump remains installed ready for operation when required.

In order to secure pump availability as and when required and to avoid formation of deposits within the pump and the immediate pump surroundings, the plant should be switched on for brief periods (approx. 5 minutes) once every month or every three months as required. It is essential that there is enough pumped media in the inlet area or that enough liquid can be fed into the pump.

## 2. The pump is dismantled and stored

Prior to storage the pump should be checked and maintained in accordance with paragraph 7.1 and 7.2. Subsequently, the preservation outlined in paragraph 6.3.1 must be carried out.

### 6.4 Re-starting pump after storage

Prior to re-starting the pump, all checks and maintenance steps outlined in paragraphs 7.1 and 7.2 have to be carried out.


Always disconnect all electricity supplies prior to working at the pump. Safeguard the pump from being started accidentally. Otherwise, there will be danger to life.


In addition, free-running of the impeller should be checked. This can be done by putting one hand into the pump casing and manually turning the impeller.
When restarting the pump the items outlined in "Initial operation" paragraph 6.1 and "Operating limits" paragraph 6.2 have to be observed.


Immediately after completion of the maintenance work, all safety and protection equipment has to be installed expertly and must be set working.

## 7. Service and maintenance <br> 7.1 General instructions

The operator must ensure that all maintenance, inspection and repair work is carried out by qualified, authorised staff who are familiar with the equipment and who have read the operating instructions.
By compiling a maintenance plan it is possible to cut maintenance expenses and avoid extensive repair costs, thus achieving troublefree and reliable operating of the pump.


Always disconnect all electricity supplies prior to working on the pump. Safeguard the pump from being started accidentally. Otherwise, there will be danger to life.

If the pumped media are harmful, the pump must be decontaminated. Special care should be taken to prevent an endangering of personnel and environment when draining leakage liquid/oil. All official regulations must be adhered to.

### 7.2 Service/Inspection

The following points must be observed to ensure reliable operation:

This work must only be carried out by experienced personnel!

| Item | Maintenance tasks | Maintenance to be carried out at following intervals |
| :---: | :---: | :---: |
| 7.2.1 | Insulation resistance check | every <br> 4,000 hours <br> but at least <br> once a year |
| 7.2.2 | Visual inspection of electric cables |  |
| 7.2 .3 | Check of monitoring equipment |  |
| 7.2.4 | Oil change |  |
| 7.2.5 | Bearings and lubrication |  |
| 7.2.6 | Visual check of lifting chain / rope |  |
|  | General overhaul | every 5 years |

### 7.2.1 Insulation resistance check

The insulation resistance of the motor winding has to be checked every 4,000 hours but at least once a year during general maintenance.

Measurements should be taken at the cable ends (disconnected at the starting panel). The measurement should be taken by using a megger.

- Measuring voltage: $\max 1,000 \mathrm{~V}$ d.c. voltage

The insulation resistance of the motor winding with cable ends tied together must not be less than 5 megohm. If measurements are less, then cable and motor must be checked separately. During the measurement procedure the supply cable must be disconnected from the motor.

The measurements to be taken are:
a) Winding against earth

- All winding ends connected with each other
b) Winding temperature sensor against earth
- All cable ends of the winding temperature sensors should be connected to one another and all winding ends be connected to earth


## Ambient and pumped liquid temperature

If the insulation resistance for the electric supply cable is less than 5 megohm, this indicates damage and needs replacement.

Low reading of the insulation resistance values of the motor indicates that there is a fault in the winding. If this is the case, contact either the manufacturer or the nearest KSB Agent/Distributor.

### 7.2.2 - Inspection of the electric cable

Visual inspection of the electric cable.
Whenever the pump is inspected, the electrical supply cables should also be checked with regard to damage such as cracks or bubbles, due to either mechanical or chemical causes. If such damage is detected, then all electric cables must be replaced.

- Checking the protection cable. Measurement of the resistance between the cores should be R < 1 Ohm.


### 7.2.3 Checking the monitoring equipment

The performance tests should form part of general periodic maintenance work, carried out every $\mathbf{4 , 0 0 0}$ hours or at least annually.
a) Temperature switch - Check resistance between the connection ends 21 and $22: R<1 \Omega$
b) PTC-resistor sensor- resistance measuring resistance between connection ends 10 and 11:
$10 \Omega<R<750 \Omega$
If the given tolerances are exceeded, disconnect the electric supply/control cable at the unit and check again directly at the terminals of the unit. If tolerances are exceeded here, too, the winding must be replaced.
c) Moisture protection electrode - Insulation resistance check

The motor area is being monitored by. a leakage detector which is fitted into the motor area. It is fitted as standard.

Instructions relating to performance and techinical data can be found in Appendix "Moisture protection monitoring".

The moisture monitoring electrode is okay if the insulation resistance measured at the electrode is $>1 \mathrm{M} \Omega$. Lower values indicate moisture or even intrusion of water into the motor. In such cases, the motor needs to be opened and overhauled.
A NEW MOISTURE PROTECTION ELECTRODE MUST BE FITTED IN THE EVENT OF DAMAGE.

### 7.2.4 Oil change

The oil chamber of our submersible pump has been filled with environmentally friendly, non-toxic paraffin oil of medical quality on the pump end.

However, the oil should be changed after 4,000 operating hours, but at least annually.


Pumped liquid might enter the oil chamber when it is warm after operation, which can cause a pressure rise within the chamber. It is, therefore, advisable to cover the filling plug 903 (with a cloth) during the opening process to avoid hot liquid (squirting out) escaping.

Procedure
(Appendix 1 - "General pump arrangement").
Erect the pump as shown in Fig. 8 and put a suitable container under the plug. Remove filling plug 903.03 with gasket 411 and drain the oil.

The oil is light in colour and transparent in appearance. Slight discolouring, caused by running in of new mechanical seal or small leakage of dirt via the pumped media will have no adverse effect. Severe contamination of the oil by the pump media, however, indicates damaged mechanical seals. In this case, replace the mechanical seal.

## Refilling

Erect the pump as demonstrated in Fig. 3 and fill the oil chamber with oil until overflow (see also paragraph 6.1.1). Replace the plug 903.03 and fit a new gasket 411.03.

## Quantity of oil:

Details regarding the quantity of oil can be taken from the table in paragraph 7.2.4.1 "Lubricating instructions"

## Recommended quality of oil:

Trade name:
Paraffin oil, free-flowing, Messrs. Merck No. 7174; With-oil
Merkur Pharma 40 Messrs. DEA or equivalent, non-toxic.
This quality is harmless and as such complies with the regulations applicable to food.

## Alternative:

All non-alloyed and alloyed motor oils of classes SAE 10 W can be used for lubrication of the mechanical seals. With regard to disposal all general Government regulations must be observed.
Attention Regional regulations have to be observed to the extent that the oil does not contaminate the pumped media (for example drinking water) and that safe disposal is guaranteed. Otherwise, it is. not permitted to fill the pump with oil, but paraffin oil must be used for this purpose.

### 7.2.4.1 Table "Lubricating instructions"



For recommended quality of oil, see paragraph 7.2.4

### 7.2.5 Bearing and lubrication

The pump/motor shaft is supplied with grease-lubricated ball bearings.

### 7.2.6 Visual check of lifting chain/lifting wire

Maintenance checks to the pump should also include the lifting chain/lifting wire inclusive of fitting to the pump with regard to possible damage - caused either mechanically or chemically. Damaged parts must be replaced by manufacturer's original spare parts.
This also refers to the correct fixing of the lifting chain/lifting wire to the pump.

### 7.3 Dismantling and re-assembly

If the pump has been used to pump hazardous media, care must be taken that, when draining the leakage liquid/oil filling, personnel and environment are not endangered. All government regulations have to be observed.

### 7.4.1 Basic guidelines and instructions

All repair and maintenance work to the pump must only be carried out by especially trained straff, and original replacement parts must be used.
The safety precautions as outlined in paragraph 7.4.4 have to be observed.

Dismantling and re-assembly may only be carried out in line with the appropriate sectional drawing. The sectional drawing and other instructions are detailed in the appendix. The dismantling sequence should be carried out as outlined in the sectional drawing.
If there are any problems, please contact our service department for advice.

### 7.4.2 Preparing for dismantling

Prior to dismantling the oil chamber is to be emptied.

### 7.4.3 Dismantling the pump section

Dismantling the pump section is carried out as illustrated in the drawing (Appendix "Sectional drawing with part list"). Special tools are not required. The only exceptions relate to the impeller dismantling/assembly process for the following sizes.
7.4.3.1 Special points relating to the dismantling of the impeiler

- Size: KRT S 40-250
see Appendix "Impeller dismantling/assembly with cutter".


The impeller/shaft connection is made by using a cone seat/tapered seat. Appendix "Impeller dismantling / assembly with taper connection".

## - Remaining sizes:

The impeller/shaft connection is achieved by a parallel seat with locating key. The impellers have been prepared to accept a special impeller with drawing device. This can be purchased as a special tool from KSB.

Further details relating to procedures and references relating to special tools are outtined in the assembly instructions Appendix "Impeller fitting/with drawing device".

### 7.4.3.2 Dismantling of mechanical seal

Exact instructions relating to fitting positions of the mechanical seals, either motor side or pump side, are outlined in Appendix "Mechanical seal arrangement with parts list".

### 7.4.4 Dismantling the motor component

Please ensure, when dismantling the motor part and the electric connecting cabling, that core identifications are clearly marked for future reference during re-assembly.
-Special points for versions " $X, Y$ " eplosionproof


All other work affecting the explosionproofness, such as new windings and mechanical repairs at the motor section, require a subsequent acceptance test by an approved engineer or have to be carried out at the premises of the manufacturer.

## $7.5 \quad$ Re-assembly

### 7.5.1 General instructions

Assembly of the pump must be carried out in accordance with the current mechanical engineering regulations. All parts which were dismantled must be cleaned and tested with regard to wear. Damaged or worn parts must be replaced by using manufacturer's spare parts. Ensure that all sealing surfaces are clean and the O-rings or flat seals fit perfectly. We recommend the use of O-rings/seals at all times.O-rings made from continuous strips which were glued together must not be used.

Assembly of the pump takes place in reverse order of dismantling. The drawing combined with the individual parts index should be used as a guide. All screws must be tightened during assembly as outlined in the instructions. General instructions in this respect are outlined in the table below "bolt tightening torque" and special points are stated in the installation instructions.

Table „Bolt tightening torque"

| Thread | Torque (Nm) |
| :---: | :---: |
| A4-70/1.4462 |  |$|$| M 5 | 7 |
| :---: | :---: |
| M 6 | 7 |
| M 8 | 17 |
| M 10 | 35 |
| M 12 | 60 |
| M 16 | 150 |
| M 20 | 290 |

### 7.5.2 Special points relating to components for re-assembly

### 7.5.2.1 Mechanical seal

In principle, we recommend to use new manufacturer's spare parts for mechanical seals. In this respect it should be noted:

To achieve perfect performance, it is important to ensure that all parts are immaculately clean and that greatest care is taken during the fitting of the mechanical seal. Protectors of the moving surfaces must not be removed until immediately before fitting the part. The surface of the shaft must be perfectly clean and undamaged.

In principle to assist with the fitting of the bellows mechanical seal, the inside of the bellows to avoid any damage to the mechanical seal should be wetted with soapy water (do not use oil).

Attention: : Fitting of the bellows mechanical seal at the motor end.
To avoid damage to the rubber bellows by a keyway or shaft recess, the shaft stub should be covered with a thin sheet of foil (approx. 0.1...0.3 mm thick). Push the rotating unit over foil cover and place into filting position. Then remove the foil.

### 7.5.2.2 Impeller assembly

Instructions and procedures are outlined in Appendix "Impeller dismantling/fitting". Paragraph 7.4.3 outlines appropriate size.

### 7.5.2.2.1 KRT D-Wear plate

The clearance between impeller 230 and wear plate 135 must be set to $0.4+0.2 \mathrm{~mm}$ (measured approx. 5 cm from the vane tip). Use screws 914.12 and 914.24 for initial adjustment and readjustment of the clearance.

### 7.5.2.3 Checking seals/oil level

After assembly the mechanical seal part/oil chamber should be tested for leaks.
Procedure:
(Appendix 1 "General pump outline" Fig. 9).
The oil inlet tapping should be used to test for leaks.
Securely screw the testing device into the oil inlet opening.
Test media: $\left.\quad \begin{array}{l}\text { Compressed air } \\ \text { Test pressure: } \\ \text { Test duration: max. } 0.5 \text { bar } \\ 2 \text { min. }\end{array}\right)$

Make sure that the pressure does not decrease during the test. Afterwards, the oil level is to be checked (compare para. 7.2.4).

### 7.5.2.4 Motor/electrical connections

Ensure prior to re-assembly of explosionproof motors that all the special points outlined in paragraph 7.4 .4 were observed. All motors must be tested electrically in line with paragraph 6.1, 6.2 and 7.2.

### 7.6 Stockkeeping of spare parts

Always quote the following data when ordering spare parts:

Pump type:e.g. KRTF100-240/172X1G-190
Works-No./Identity-No.
Motor-No.
This data can be taken from the data plate ( appendix "General pump diagram" Fig. 1)

### 7.6.1 Recommended stock of spare parts for a two-year operation in accordance with VDMA 24296 <br> (applicable for continuous operation)

| Part No. | Part description | Number of pumps (including stand-by pumps) |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | \| 3 | 14 | 5 | 16 | 18 | 10 and more |
| 80-1 | Part motor | - | - | - | 1 | 1 | 2 | 3 |
| 834 | Cable entry | 1 | 1 | 2 | 2 | 2 | 3 | 40\% |
| 818 | Rotor | - | - | - | 1 | 1 | 2 | 3 |
| 230 | Impeller | 1 | 1 | 1 | 2 | 2 | 3 | 30\% |
| 502 | Wear ring | 2 | 2 | 2 | 3 | 3 | 4 | 50\% |
| 433.01 | Mechanical seal motor side | 2 | 3 | 4 | 5 | 6 | 7 | 90\% |
| 433.02 | Mechanical seal pump side | 2 | 3 | 4 | 5 | 6 | 7 | 90\% |
| $\begin{aligned} & \hline 321.01 \\ & / 322 . \end{aligned}$ | Grooved ball bearing motor side | 1 | 1 | 2 | 2 | 3 | 4 | 50\% |
| $\begin{aligned} & \hline 320 / \\ & 321.02 \end{aligned}$ | Grooved ball bearing pump side | 1 | 1 | 2 | 2 | 3 | 4 | 50\% |
|  | Set of seals motor | 4 | 6 | 8 | 8 | 9 | 10 | 100\% |
|  | Set of seals hydraulic | 4 | 6 | 8 | 8 | 9 | 10 | 100\% |

Amarex KRT

8 Trouble-shooting


Attention: . . If working inside the pump is necessary whilst the pump is under warranty, then contact your nearest authorised KSB agent prior to commencement of work. Non-observance will negate any warrenty daims.

## General survey of annexes

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## General pump outline

DN 40...DN 200
Motor
52... 232 2; $\quad 54 . . .294 ;$
$46 . .126$

## Diagram data plate

Works No. I Identity No.


## Important information for ordering spare parts

## explosionproof version

Works No. I Identity No.


Fig. 1


Fig. 2a


Fig. 3


Fig. 4


B



Fig. 6


Motor:
232
234,294


Motor:
52,62,82,122,172
$54,74,114,164$
46,66,96,126


Fig. 8


Fig. 9

General arrangement drawing

## Motor:

40-250
$52 \ldots 232 \quad 54$... 294
4 6... 126


OW 382 436-00



Amarex KRT

Installation plan - mechanical seal
Motor:
$52 . .172$
40-250, 80-250
$54 . .164$
100-240, 100-250

| Part No. | Part description |
| :--- | :--- |
| 433 | Mechanical seal |
| 515 | Clamping ring |

## G, GH, C1



- Standard
- Standard-Varianten

Installation plan - mechanical seal

## Motor:

$52 . .232$
80-315/100-315/150-315
$54 . . .294$
200-280/200-281
$46 . .126$
D 150-251/150-315/200-315


H, C2


- Standard
- Standard-Varianten

Amarex KRT

## Maßtabelle / Dimension table / Tableau de dimensions

Stationäre Aufstellung / Stationary installation / Installation stationnaire Seilführung / Guide wire / Guidage du cáble
Baugröße / Size / Taille: KRT 40-250
Werkstoffausführung / Material variant / Exécution matériaux: G, G1, G2, GH, H, C1, C2


1) Mindestwasserstand

Min. water level
Niveau d'eau mini.

| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur |  |  |  | Gewicht / Weight / Poids [kg] |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | G | H, C1, C2 |
| $\begin{array}{\|l} \hline \mathrm{S} \\ \mathrm{~K} \end{array}$ | 40-250 | 52 | 65* | 50 | . 545 | 125 | 167 |
|  |  | 62 |  |  |  | 133 | 175 |
|  |  | 82 |  |  |  | 142 | 184 |
|  |  | 122 |  |  | 575 | 157 | 204 |
|  |  | 172 |  |  |  | 168 | 215 |
|  |  | 54 |  |  | 545 | 136 | 178 |
|  |  | 74 |  |  |  | 150 | 192 |

[^0]Maßtabelle / Dimension table / Tableau de dimensions
Stationäre Aufstellung / Stationary installation / Installation stationnaire
Seilführung / Guide wire / Guidage de câble
Baugröße / Size / Taille : KRT 80-250; 80-315
Werkstoffausführung / Material variant / Exécution matériaux: G, G1, G2, GH, H, C1, C2


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## Maßtabelle / Dimension table / Tableau de dimensions

Stationäre Aufstellung / Stationary installation / Installation stationnaire
Seilführung / Guide wire / Guidage de câble
Baugroße / Size / Taille: KRT 80-250; 80-315 mit Obergangshalterung DN 80/100
with adapter claw DN 80/100 / avec griffe d'adaptation DN 80/100
Werkstoffausführung / Material variant / Exécution matériaux : G, G1, G2, GH


| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur | DN |  |  |  |  | $\mathbf{e}_{1}$ |  | g | $\mathrm{h}_{1}$ | $\mathrm{k}_{1}$ |  |  | $\ddots$$\ddots$$\mathbf{N}_{\text {min }}$ | $O_{\min }\left\|P_{\min }^{\prime}\right\|$ |  |  | Gewicht / Weight/ Poids [kg]$\mathbf{G}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | $\mathrm{R}_{1}$ |  |  |  |  |  |  |  |  |  |  |  |  |
| E | 80-250 | 54 | 100 | 100 | 596 <br> 626 |  | 625 | 382 | $\mathbf{4 3 7}$ $\mathbf{2 4 0}$ <br> $\vdots$  <br> $\ddots$  <br> $\ddots$ $\ddots$ |  | 430 | 116 | 745 | 865 | 202 | 665 | 665 | 500 | 340 | 136 |
|  |  | 74 |  |  |  | 150 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 114 |  |  |  | 165 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 164 |  |  |  | 175 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E | 80-315 | 52 | 80 | 100 | 610 | 620 | 355 | $520$ | 240 | 430 | 127 | 740 | 860 | 180 | 655 | 655 | 450 | 340 | 134 |
|  |  | 62 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 142 |
|  |  | 82 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 151 |
|  |  | 122 |  |  | 640 |  |  |  |  |  |  |  |  |  |  |  |  |  | 166 |
|  |  | 172 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 177 |
|  |  | 232 |  |  | 780 | 655 | 400 |  |  |  |  | 775 | 895 | 200 | 775 | 775 | 500 |  | 254 |

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## Maßtabelle / Dimension table / Tableau de dimensions

Stationäre Aufstellung / Stationary installation / Installation stationnaire Seilführung / Guide wire / Guidage de câble
Baugrổe / Size / Taille: KRT 100-240; 100-250
Werkstoffausführung / Material variant / Exécution matériaux : G, G1, G2, GH, H, C1, C2


1) Mindestwasserstand

Min. water level
Niveau d'eau mini.

| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur | DN | $\therefore$$\because$DN | $\mathrm{a}_{1}$ | $\mathrm{b}_{1}$ | d | $\therefore$$\mathbf{e}_{1}$ | $\because$$\vdots$$h_{1}$ | $\begin{array}{r} \\ \\ \mathbf{k}_{1} \\ \hline\end{array}$ | $l_{1}$ | m | $N_{\text {min }}$ $O_{\text {min }}$ $P_{\text {min }}$ $R_{1}$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| F | 100-240 | 114 | 100 | 100 | 630 | 580 | 388 | 485 | 112 | 705 | 830 | 205 | 610 | $610$ | 500 | 365 | 165 | 225 |
|  |  | 164 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 175 | 235 |
| $\begin{array}{\|l} \hline \mathrm{E} \\ \mathrm{~F} \\ \mathrm{~K} \end{array}$ | 100-250 | 54 | 100 | 100 | 600 | 580 | 388 | 485 | 112 | 705 | $830$ | $205$ | $610$ | 610 | 500 | 365 | 141 | 205 |
|  |  | 74 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 155 | 219 |
|  |  | 114 |  |  | 630. |  |  |  |  |  |  |  |  |  |  |  | 170 | 234 |
|  |  | 164 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 180 | 244 |

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## Maßtabelle / Dimension table / Tableau de dimensions

Stationäre Aufstellung / Stationary installation / Installation stationnaire
Seilführung / Guide wire / Guidage de cáble
Baugröße / Size / Taille: KRT 100-315
Werkstoffausführung / Material variant / Exécution matériaux : G, G1, G2, GH, H, C1, C2


1) Mindestwasserstand

Min. water level
Niveau d'eau mini.

| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur | $\begin{array}{l\|l\|l\|l\|l\|l\|l\|l\|l\|l} D N_{1} & D N_{3} & a_{1} & b_{1} & d & e_{1} & h_{1} & k_{1} & l_{1} & m \\ \hline \end{array}$ |  |  |  |  |  |  |  |  |  | $\mathbf{N}_{\text {min }}$ $\mathrm{O}_{\text {min }}$ $\mathrm{P}_{\text {min }}$ $\mathrm{R}_{\mathbf{1}}$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| EFK | 100-315 | 114 | 100 | 100 | 710 | 695 | 500 | 570 | 96 | 820 | 945 | 265 | 800 | 800 | 550 | 420 | 198 | 275 |
|  |  | 164 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 208 | 285 |
|  |  | 234 |  |  | 845 | 700 |  |  |  | 825 | 950 |  |  |  |  |  | 277 | 320 |
|  |  | 294 |  |  | 815 |  |  |  |  |  |  |  |  |  |  |  | 295 | 338 |

## Maßtabelle / Dimension table / Tableau de dimensions

## Stationäre Aufstellung / Stationary installation / Installation stationnaire

 Seilführung / Guide wire / Guidage de câbleBaugröße / Size / Taille: KRT 150-315
Werkstoffausführung / Material variant / Execution matériaux : G, G1, G2, GH, H, C1, C2



Maßtabelle / Dimension table / Tableau de dimensions
Stationäre Aufstellung / Stationary installation / Installation stationnaire
Seilführung / Guide wire / Guidage de cáble
Baugröße / Size / Taille: KRT D 150-251; D 150-315
Werkstoffausführung / Material variant / Exécution matériaux : Grauguß / Cast iron / Fonte grise


\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{|l}
\hline Hydraulik \\
Hydraulics \\
Hydraulique
\end{tabular}}} \& \multirow[t]{2}{*}{Motor Motor Moteur} \& \multirow[t]{2}{*}{DN} \& \multirow[t]{2}{*}{-} \& \multirow[t]{2}{*}{\begin{tabular}{l} 
a \\
\\
\\
\(a_{1}\) \\
\\
\hline
\end{tabular}} \& \multirow[t]{2}{*}{\(\therefore\)

$b_{1}$} \& \multirow[b]{2}{*}{d} \& \multirow[b]{2}{*}{$\mathrm{e}_{1}$} \& \multirow[t]{3}{*}{$\because$

$h_{1}$

214} \& \multirow[t]{3}{*}{$$
\frac{k_{1}}{910}
$$} \& \multirow[t]{3}{*}{\[

\frac{t_{1}}{1075}

\]} \& \multirow[b]{3}{*}{m 303} \& \multirow[b]{3}{*}{\[

\frac{N_{min}}{850}
\]} \& \multirow[b]{2}{*}{$\mathrm{O}_{\text {min }}$} \& \multirow[b]{2}{*}{$P_{\text {min }}$} \& \multirow[t]{2}{*}{Gewicht Weight Poids [kg]} <br>

\hline \& \& \& \& \& \& \& \& \& \& \& \& \& \& \& \& <br>

\hline D \& \multirow[t]{4}{*}{150-251} \& 54 \& \multirow[t]{4}{*}{150} \& \multirow[t]{4}{*}{$$
150
$$} \& \multirow[t]{2}{*}{680} \& \multirow[t]{4}{*}{\[

761
\]} \& \multirow[t]{4}{*}{525} \& \multirow[t]{4}{*}{652} \& \& \& \& \& \& \multirow[t]{4}{*}{850} \& \multirow[t]{4}{*}{600} \& 195 <br>

\hline \& \& 74 \& \& \& \& \& \& \& \multirow{3}{*}{214} \& \multirow{3}{*}{$$
910
$$} \& \multirow[t]{3}{*}{} \& \multirow{3}{*}{303.} \& \multirow{3}{*}{\[

850
\]} \& \& \& 210 <br>

\hline \& \& 114 \& \& \& \multirow[t]{2}{*}{711} \& \& \& \& \& \& \& \& \& \& \& 225 <br>
\hline \& \& 164 \& \& \& \& \& \& \& \& \& \& \& \& \& \& 235 <br>
\hline \multirow[t]{7}{*}{D} \& \multirow[t]{7}{*}{150-315} \& 114 \& \multirow[t]{7}{*}{150} \& \multirow[t]{7}{*}{150} \& \multirow[t]{2}{*}{770} \& \multirow[t]{7}{*}{835} \& \multirow[t]{7}{*}{600} \& \multirow[t]{7}{*}{680} \& \multirow[t]{7}{*}{160} \& \multirow[t]{7}{*}{980} \& \multirow[t]{7}{*}{1145} \& \multirow[t]{7}{*}{350} \& \multirow[t]{7}{*}{950} \& \multirow[t]{7}{*}{950} \& \multirow[t]{7}{*}{700} \& 315 <br>
\hline \& \& 164 \& \& \& \& \& \& \& \& \& \& \& \& \& \& 325 <br>
\hline \& \& 234 \& \& \& 910 \& \& \& \& \& \& \& \& \& \& \& 390 <br>
\hline \& \& 294 \& \& \& 885 \& \& \& \& \& \& \& \& \& \& \& 410 <br>
\hline \& \& 46 \& \& \& \multirow[t]{2}{*}{740} \& \& \& \& \& \& \& \& \& \& \& 290 <br>
\hline \& \& 66 \& \& \& \& \& \& \& \& \& \& \& \& \& \& 300 <br>
\hline \& \& 96 \& \& \& 770 \& \& \& \& \& \& \& \& \& \& \& 320 <br>
\hline
\end{tabular}

MaBtabelle / Dimension table / Tableau de dimensions
Stationäre Aufstellung / Stationary installation / Installation stationnaire
Seilführung / Guide wire / Guidage de cáble
Baugröße / Size / Taille: KRT 200-280; 200-281; D 200-315
Werkstoffausführung / Material variant / Exécution matériaux : G, G1, G2, GH, H, C1, C2


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Amarex KRT

## Maßtabelle / Dimension table / Tableau de dimensions

Transportable Aufstellung / Transportable installation / Installation transportable
Baugroße / Size / Taille: KRT 40-250; 80-250; 80-315; 100-240; 100-250
Werkstoffausführung / Material variant / Exécution matériaux : G, G1, G2, GH, H, C1, C2


DIN EN 1092.2. PN 16

| $D_{2}$ | $g_{f}$ | $K_{\mathbf{f}}$ | $D_{f}$ | $z_{f}$ | $\varnothing f_{\mathbf{f}}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 40 | 88 | 110 | 150 | 4 | 18 |
| 80 | 138 | 160 | 200 | 8 | 18 |
| 100 | 158 | 180 | 220 | 8 | 18 |

1) Mindestwasserstand

Min. water level
Niveau d'eau mini.

| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur | $\mathrm{DN}_{1}$ |  | $a_{2}$ |  | $\dot{e}_{2}$ | $\frac{f_{2}}{240}$ | $\mathrm{R}_{\mathbf{2}}$ | $\varnothing T$ $V$ |  | Gewicht / Weight / Poids [kg] |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  | G | H, C1, C2 |
| $\begin{array}{\|l\|} \hline K \\ S \end{array}$ | 40-250 | 52 | $65^{*}$ | 40 | 685 | 445 |  |  | 300 | $\begin{gathered} 400 \\ C 1: 540 \end{gathered}$ | $\begin{gathered} 200 \\ C 1: 270 \end{gathered}$ | 125 | 167 |
|  |  | 62 |  |  |  |  |  |  |  |  |  | 133 | 175 |
|  |  | 82 |  |  |  |  |  |  |  |  |  | 142 | 184 |
|  |  | 122 |  |  | 715 |  |  |  |  |  |  | 157 | 204 |
|  |  | 172 |  |  |  |  |  |  |  |  |  | 168 | 215 |
|  |  | 54 |  |  | 685 |  |  |  |  |  |  | 136 | 178 |
|  |  | 74 |  |  |  |  |  |  |  |  |  | 150 | 192 |
| $\begin{aligned} & \mathrm{F} \\ & \mathrm{E} \end{aligned}$ | 80-250 | 54 | 100 | 80 | 717 | 475. | 255 | 225 | 325 | 400 | 200 | 136 | -- |
|  |  | 74 |  |  |  |  |  |  |  |  |  | 150 | -- |
|  |  | 114 |  |  | 747 |  |  |  |  |  |  | 165 | -- |
|  |  | 164 |  |  |  |  |  |  |  |  |  | 175 | -- |
| $\begin{aligned} & \mathrm{F} \\ & \mathrm{E} \\ & \mathrm{~K} \end{aligned}$ | 80-315 | 52 | 80 | 80 | 715 | 470 | 250 | 220 | 320 | $\begin{gathered} 400 \\ \mathrm{C} 1: 540 \end{gathered}$ | $\begin{gathered} 200 \\ C 1: 270 \end{gathered}$ | 134 | 210 |
|  |  | 62 |  |  |  |  |  |  |  |  |  | 142 | 218 |
|  |  | 82 |  |  |  |  |  | $\because$ |  |  |  | 151 | 227 |
|  |  | 122 |  |  | 745 |  |  |  |  |  | $\because$ | 166 | 242 |
|  |  | 172 |  |  |  |  |  |  |  |  |  | 177 | 253 |
|  |  | 232 |  |  | 885 | 505 |  |  |  |  |  | 254 | 300 |
| F | 100-240 | 114 | 100 | 100 | 755 | 475 | 255 | 255 | 380 | $\begin{gathered} 400 \\ \text { C1:540 } \end{gathered}$ | $\begin{gathered} 200 \\ \text { C1: } 270 \end{gathered}$ | 165 | 225 |
|  |  | 164 |  |  |  |  |  |  |  |  |  | 175 | 235 |
|  | 100-250 | 54 | 100 | 100 | 725 | 475 | 255 | 255 | 380 | $\begin{array}{r} 400 \\ C 1: 540 \end{array}$ | $\begin{array}{r} 200 \\ C 1: 270 \end{array}$ | 141 | 205 |
|  |  | 74 |  |  |  |  |  |  |  |  |  | 155 | 219 |
|  |  | 114 |  |  | 755 |  |  |  |  |  |  | 170 | 234 |
|  |  | 164 |  |  |  |  |  |  |  |  |  | 180 | 244 |

[^1]MaBe in mm / Dimensions in mm/Cotes en mm
32

Maßtabelle / Dimension table / Tableau de dimensions
Transportable Aufstellung / Transportable installation / Installation transportable
Baugröße / Size / Taille: KRT 100-315; 150-315; 200-280; 200-281
Werkstoffausführung / Material variant / Exécution matériaux : G, G1, G2, GH, H, C1, C2


DIN EN 1092-2

| $\mathrm{DN}_{2}$ | $\mathrm{~g}_{\mathrm{f}}$ | $\mathrm{K}_{\mathrm{f}}$ | $\mathrm{D}_{\mathbf{f}}$ | $\mathrm{z}_{\mathrm{f}}$ | $\varnothing \mathrm{I}_{\mathbf{f}}$ | PN |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 100 | 158 | 180 | 228 | 8 | 18 | 16 |
| 150 | 212 | 240 | 285 | 8 | 22 | 16 |
| 200 | 268 | 295 | 340 | 8 | 22 | 10 |

1) Mindestwasserstand

Min. water level
Niveau d'eau mini.

| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur | $\mathrm{DN}_{1}$ $\mathrm{DN}_{2}$ $\mathrm{a}_{2}$ $\mathrm{~b}_{2}$ $\mathrm{e}_{2}$ $\mathrm{f}_{2}$ |  |  |  |  |  | $\mathrm{R}_{\mathbf{2}}$ $\varnothing \mathrm{T}$ V |  |  | Gewicht / Weight / Poids [kg] |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  | G | H, C1, C2 |
| F | 100-315 | 114 | 100 | $100$ |  | 590 | 340 | $280$ |  |  |  | $460$ | 550 | 275 | 198 | 275 |
| K |  | 164 |  |  |  |  |  |  | 208 | 285 |  |  |  |
|  |  | 234 |  |  | 980 | 595 |  |  | 277 | 320 |  |  |  |
|  |  | 294 |  |  | 950 |  |  |  | 295 | 338 |  |  |  |
| $\begin{array}{\|l\|} \hline \mathbf{F} \\ \mathrm{E} \\ \mathrm{~K} \end{array}$ | 150-315 | 74 | 150 | 150 | 855 | 640 | 370 | 310 | 455 | 660 | 275 | 231 | 303 |  |
|  |  | 114 |  |  | 885 |  |  |  |  |  |  | 146 | 318 |  |
|  |  | 164 |  |  |  |  |  |  |  |  |  | 256 | 328 |  |
|  |  | 234 |  |  | 1025 |  |  |  |  |  |  | 325 | 386 |  |
|  |  | 294 |  |  | 995 |  |  |  |  |  |  | 343 | 403 |  |
|  |  | 46 |  |  | 855 |  |  |  |  |  |  | 226 | 298 |  |
|  |  | 66 |  |  |  |  |  |  |  |  |  | 236 | 308 |  |
|  |  | 96 |  |  | 885 |  |  |  |  |  |  | 246 | 318 |  |
|  |  | 126 |  |  |  |  | . |  |  |  |  | 156 | 328 |  |
| K | $\begin{aligned} & 200-280 \\ & 200-281 \end{aligned}$ | 46 | 200 | 200 | $\begin{array}{r} 935 \\ \hline 965 \\ \hline \end{array}$ | 840 | 450 | 400 | 550 | 900 | 390 | 310 | 385 |  |
|  |  | 66 |  |  |  |  |  |  |  |  |  | 320 | 395 |  |
|  |  | 96 |  |  |  |  |  |  |  |  |  | 330 | 405 |  |
|  |  | 126 |  |  |  |  |  |  |  |  |  | 340 | 415 |  |

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## Maßtabelle / Dimension table / Tableau de dimensions

## Transportable Aufstellung / Transportable installation / Installation transportable

Baugrobße / Size / Taille : KRT D 150-251; D 150-315; D 200-315
Werkstoffausführung / Material variant / Execution matériaux: Grauguß / Cast iron / Fonte grise


DIN EN 1092-2

| $D N_{2}$ | $g_{f}$ | $K_{f}$ | $D_{f}$ | $z_{f}$ | $\varnothing_{\mathrm{f}}$ | $P N$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 150 | 212 | 240 | 285 | 8 | 22 | 16 |
| 200 | 268 | 295 | 340 | 8 | 22 | 10 |

1) Mindestwasserstand

Min. water level
Niveau d'eau mini.

| Hydraulik Hydraulics Hydraulique |  | Motor Motor Moteur | $D N_{1}$ $D N_{2}$ $a_{2}$ $b_{2}$ $e_{2}$ $f_{2}$ |  |  |  |  |  | $R_{2}$ $\varnothing T$ V |  |  | Gewicht Weight Poids. [kg] |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| D | 150-251 | 54 | 150 | 100 | 832 | 630 | 370 | 318 | 455 | 540 | 270 | 195 |
|  |  | 74 |  |  |  |  |  |  |  |  |  | 210 |
|  |  | 114 |  |  | 863 |  |  |  |  |  |  | - 225 |
|  |  | 164 |  |  |  |  |  |  |  |  |  | 235 |
| D | 150-315 | 114 | 150 | 150 | 925 | 700 | 400 | 370 | 500 | 540 | 270 | 315 |
|  |  | 164 |  |  |  |  |  |  |  |  |  | 325 |
|  |  | 234 |  |  | 1065 |  |  |  |  |  |  | 390 |
|  |  | 294 |  |  | 1040 |  |  |  |  |  |  | 410 |
|  |  | 46 |  |  | 895 |  |  |  |  |  |  | 290 |
|  |  | 66 |  |  |  |  |  |  |  |  |  | 300 |
|  |  | 96 |  |  | 925 |  |  |  |  |  |  | 320 |
| D | $200-315$ | 164 | 200 | 200 | 1010 | 850 | 500 | 410 | 570 | 900 | 390 | 375 |
|  |  | 234 |  |  | 1150 |  |  |  |  |  |  | 445 |
|  |  | 294 |  |  | 1125 |  |  |  |  |  |  | 465 |
|  |  | 46 |  |  | 980 |  |  |  |  |  |  | 345 |
|  |  | 66 |  |  |  |  |  |  |  |  |  | 355 |
|  |  | 96 |  |  | 1010 |  |  |  |  |  |  | 365 |
|  |  | 126 |  |  |  |  |  |  |  |  |  | 375 |

OW 382528
MaBe in mm / Dimensions in mm / Cotes en mm


Amarex KRT
Wet-well installation with guide wire

## DN

Motor:
$52 \ldots . .23$ 2, 5 4... 29 4, 46 6... 126
40/80/100/150/200


Standard
Standard variants

OW 360 T72-00

| Part No. | Part description |
| :--- | :--- |
| $59-17$ | Shackle |
| $59-18$ | Hook |
| $59-24.01 / 02$ | Rope |
| $72-1$ | Flanged bend |
| $90-3$ | Dowel |
| $99-6$ | Round cord |
| 410 | Profile joint |
| 550 | Washer |
| 571 | Clamp |
| 572 | Clamp |
| 732 | Holder |
| 885 | Chain |
| 894 | Bracket |
| 900 | Screw |
| 902 | Stud |
| 904 | Threaded pin |
| 914 | Socket head cap screw |
| 920 | Nut |
| 970 | Plate |

Amarex KRT

Wet-well installation transportable
Motor:
$52 \ldots . .23$ 2, $54 \ldots 294,46$... 126

40/80/100/150/200


## Epoxy resin tar coating



Standard
Standard variants OW 309308-00


| Part <br> No. | Part description |
| :--- | :--- |
| 182 | Foot |
| 183 | Support foot |
| $59-17$ | Shackle |
| $59-24$ | Rope |
| 595 | Buffer |
| 885 | Chain |
| 892 | Foot plate |
| 901 | Hexagon head bolt |
| 902 | Stud |
| 914 | Socket head cap screw |
| 920 | Nut |
| 932 | Circlip |




## Electrical diagram

Motor:
$52 \ldots . .23$ 2, 5 4... 29 4, $46 . . .126$

## Description - Thermal cutout Amarex KRT, explosionproof

With explosionproof motors, the windings are protected by two independent temperature monitoring circuits.
Two bimetal switches F4, F5 (identification tape 21,22) serve as temperature monitoring devices which, as soon as the max. winding temperature is reached, switch off the pump and automatically on again after the windings have cooled down.
This requires that the conductors are directly connected to the control circuit of the motor contactor.
Three PTC thermistors R1, R2, R3 (identification tape 10, 11) are fitted as additional temperature controlslimiters which, in the event of temperature switch failure, shut down the pump before the temperature permissible for explosionproof applications is exceeded. Automatic reset is not allowed.
A thermistor control unit „ $\mathrm{T}^{\mathbf{*}}$ with manual reset must be installed in the control circuit of the motor contractors.
This equipment is of a commercial brand, which can also be purchased via KSB.

For operation with frequency converter, a release device bearing the test mark „PTB 3.53-PTC/A" must be used.

If the pump has been shut down by thermistors, it is necessary to overhaul it.
In urgent cases the reset may be used after the motor has cooled down. The thermistor must not be shut off at any time.


Explosionproof requirements for the pumps are only met if the builtin temperature monitoring devices (bimetal switches and thermistors) including conductors 21, 22, 10, and 11 are connected.

## Temperature switch

F4, F5 = Monitoring circuit $=\mathbf{2}$ bimetal switches in the motor winding
Identification tape 21, 22
max. operating voltage of switch: 250 V max. current: 2 A
R1,R2,R3 = Temperature control circuit = 3 PTC thermistors in the motor windifing

Identification tape: 10, 11
max. operating voltage on terminals
$\mathrm{U}_{\max }=30 \mathrm{~V}_{4}=$
resistance between terminals 10/11.

- at ambient temperature R 10-750
- at shutdown temperature $R>4000 \Omega$


## Attention Do not test monitoring circuits by means of a

 hand megger. Use an ohmmeter.Description - thermal cutout Amarex KRT, non-explosionproof
The winding is protected by one temperature monitoring circuit.
Bimetal switches F4, F5 (identifications tape 21,22 ) are used for temperature monitoring. It switches off the pump as soon as the max. winding temperature is reached, and automatically switches it on again after the winding has cooled down.

The bimetal switch must be directly connected to the control circuit of the motor contactor.
Conductors 10 and 11 (used for explosionproof version only) will be connected to dummy terminals.
Power $\Delta$ Connected
Brown LI - U1 + W2
Black $L 2-V 1+U 2$
Grey $L 3-W 1+V 2$

## Function chart - moisture detection



B2

Function chart - moisture detection
(see also wiring diagram)
The motor chamber of the pump is fitted with a moisturesensitive electrode, which is to be monitored by means of a electrode relay. In case of moisture penetrating in the motor interior, a current will flow from terminal 9 to earth via the moisture electrode.

B2 = electrode in motor chamber
Core identification: 9
K1 = . electrode relay
Sensor circuit 10-30 V
Release current 0,5-3 mA.
KSB can provide you with an appropriate electrode relay. This relay needs a power supply 230V~.

Tripping of the electrode relay K1 must result in a shutdown of the motor. Subsequently a revision of the motor will be necessary.

## Check of moisture-sensitive electrode

An insulation resistance measurement has to be effected in conformity with para 7.2.1. If the measured insulation resistance is $<1 \square \Omega$ the motor has to be opened and overhauled

Assembly instructions-Impeller dismantling/fitting with tapered connection
40-250, 80-250,100-240/250
150-251
80/100/150-315
200-280/281/315

| Size | Jacking screw | Ident-No. |
| :---: | :---: | :---: |
|   <br> S,F,K $40-250$ <br> F, E $80-250$ <br> F $100-240$ <br> F,E,K $100-250$ | M16x60 | $11197135$ |
| F,E,K 80-315 |  |  |
| F,E,K 100-315 |  |  |
| F,E,K 150-315 | M20x95 | 11197784 |
| K 200-280 |  |  |
| K 200-281 | . |  |
| D 150-251 | M16x95 | 11305849 |
| D 150-315 | M20x155 | 11305959 |
| D 200-315 | M20x180 | 11306084 |




## Removing impellers with taper fit

The following sequence of operations must be observed whenremoving the impeller:

1. Remove impeller screw 914.10.
2. Use jacking screw to pull off impeller
(Tight taper fit-impeller may be firmly locked on shaft).
Screw jacking screw either directly into the impelier 230 or into locking sleeve 531, see drawing details opposite and relevant sectional drawing.

## Installation of S/F/E/KID-Impeller (without locking sleeve

1. Having installed the pump-side mechanical seal 433.02, push the impeller 230 (S/F/E/K/D-impeller) onto the shaft end

For D 150-251, screw threaded coupling 852 into the shaft first.
2. Apply Loctite 243 to the thread of impeller screw 914.10.

Observe Loctite handling instructions. Screw in impeller screw 914.10 and tighten with a torque wrench.

| S/K/F | 40-250 | (M10) | 50 Nm |
| :---: | :---: | :---: | :---: |
| F/E | 80-250 | (M10) | 50 Nm |
| F | 100-240 | (M10) | 50 Nm |
| F/K/E/D | 100-250 | (M10) | 50 Nm |
| F/K/E | 80-315 | (M16) | 150 Nm |
| F/K/E/D | 100-315 | (M16) | 150 Nm |
| D | 150-251 | (M10) | 50 Nm |
| F/K/E | 150-315 | (M16) | 150 Nm |
| K | 200-280/281 | (M16) | 150 Nm |
| D | 200-315 | (M16) | 150 Nm |

3. . Mount pump casing 101 with bolts 901.14 , square nuts 920.01 with lockwasher 931 and O-rings 412.15. Use torque wrench to tighten hex. head bolts 901.14 For data, see installation of E/K-impellers, para 2.


## Adjustment of axial clearance

If an axial casing wear ring is fitted at the pump casing, the clearance between the casing and the impeller should be adjusted to 0.5 mm ( $\mathrm{K} 40-2500.2 \mathrm{~mm}$ ) by tightening the bolts 901.14. For the Amarex KRT 200-280/281 (radial clearance) an adjustment is not necessary.

Assembly instruction - Cutter


Dismantling of the S-impeller (Amarex KRT S 40-250)

1. After fitting the pump-side mechanical seal 433.02, push impeller 230 .onto the shaft, fit grooved pin 561.01 into the impeller.
The impeller body 23-7 is fitted onto the centering device. Then fit impeller screw 914.10 and tighten it by using a torque wrench.
Tightening torque: $\mathrm{M} \mathrm{10;} \mathbf{5 0} \mathrm{Nm}$
2. Fit pump casing with joint O-ring $\mathbf{4 1 2 . 1 6}$ using hex. screws 901.14 and tighten it by a torque wrench. Tightening torque: $\mathrm{M} 12 ; 60 \mathrm{Nm}$.
3. Insert joint O-ring 412.16 into suction cover 162 and mount ring 500.02 with cylindrical pin 914.07 in the suction cover.Insert suction cover into the pump casing until it borders on the impeller blades (cylindrical pin 914.15 must not protrude from the threads of the suction cover!) - but do not yet tighten!
4. Measure the distance between pump casing and suction cover and shift the suction cover with cylindrial pin 914.15 by $\mathrm{S}=0,2 \pm 0,1 \mathrm{~mm}$ vis-à-vis the pump casing. Tightening torque: $\mathrm{M} \mathrm{12;} 30 \mathrm{Nm}$
5. Make sure that the impeller is running smoothly by turning itsbody (sliding between suction cover and impeller is not admissible).

Dismantling of the S-impeller (Amarex KRT S 40-250)

Dismantling takes place in reserve order. The impeller can be pulled off from the shaft by means of the same forcing screws used for the Amarex KRT K 40-250 (Attention: tight cone seat!)

Pay attention to assembly instruction "Impelier dismantling I assembly with tapered connection".
Supplement


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### 4.0 VALVES

## SUPPLIER:

Tyco Northgate
88 Frederick Street Virginia, QLD 4014

Ph: (07) 32662255
Fax: (07) 32605221

## MODEL:

150 d.f. RS Check Valve 150 d.f. RS Sluice Valve 100 d.f. RS Sluice Valve

# OPERATION AND MAINTENANCE MANUAL 

## CONTENTS

| 1.00 .00 | Description of DN100 \& DN150 Flanged Class 14 Swing Check Valves |
| :--- | :--- |
| 1.01 .00 | Operating Instructions |
| 1.02 .00 | Maintenance Instructions |
| 2.00 .00 | Spare Parts List |
| 3.00 .00 | Troubleshooting Guide |
| 4.00 .00 | Address for Queries |

# OPERATION AND MAINTENANCE MANUAL 

1.00.00 DESCRIPTION
1.00.01 Operation and maintenance instructions for DN100 \& DN150 flanged class 14 swing check valves. Free acting and lever and weight versions.
1.00.02 Reference drawing number 04-16-03-002 typical.

### 1.01.00 OPERATING INSTRUCTIONS

1.01.01 The operation of the swing check valve is automatic. The valve opens in response to flow velocity and closes in response to cessation or reversal of flow in the forward direction.
1.01.02 Valves are supplied either free acting or with extended hinge pin for fitting of lever and weight.
1.01.03 Lever and weighs are often applied to swing check valves to assist the closing action and to make the valve more responsive to flow reversal and thus reducing disc slam with resulting water hammer effects.
1.01.04 When lever and weight is applied it should be positioned on the hinge pin to maximise its effect on closure ie. with valve positioned horizontally, the lever should move through an arc $45^{\circ}$ below the centre line.
1.01.05 Through trials the weight should be positioned along the lever at a point where the smallest valve action is obtained under cessation of flow.
1.01.06 Where a valve is fitted with extended hinge pin it should also be fitted with lever and weight. When a valve is fitted with extended hinge pin it necessarily has to have seals fitted. The seals increase friction which in turn retards the action of the disc, increasing the tendency toward valve slam and thus more severe water hammer effect.
1.01.07 To minimise wear and increase the valve performance life, ensure the valve is correctly sized and the disc is fully open under normal flowing conditions.
1.02.00 MAINTENANCE INSTRUCTIONS
1.02.01 No external maintenance either preventative or otherwise can be applied external to the valve under operating conditions other than adjustments to lever and weight assemblies etc.
1.02.02 Major maintenance involving complete de-watering of the valve may be necessary once or twice throughout the product's life, depending on severity of service conditions. The usual reasons for such a service are:

- Worn hinge components needing replacement.
- Degradation of seat seal requiring refacing.
- Severely retarded valve action requiring cleaning and freeing of all hinge bearing areas.
1.02.03 To obtain access to internal components, first remove both hinge seal plugs, RH screwed. In free-acting valve hinge pin, can be drifted from bearings from either side releasing disc sub-assembly for removal through the cover opening.
For the extended hinge pin version, drift hinge pin from the non-extended side, the bronze hinge pin bush interference fitted, will be removed with the hinge pin thus releasing the disc assembly.


### 2.00.00 SPARE PARTS LIST

2.00.01 It is not usual to carry spare parts for this product as they are major components used very infrequently.

Refurbishment is usually carried out in conjunction with major planned outages. The reason for the work has usually been identified well prior to the shutdown allowing for specific components to be obtained from the manufacturer if necessary.
3.00.00 TROUBLE SHOOTING GUDE
3.00.01 There are a number of malfunctions which can occur within the generic type.

- $\quad$ Seat leakage - replace body and disc seats
- Increasing tendency for valve slam (increasing water hammer) - hinge components binding, clean and free.
- Disc hanging up (not closing) - worn hinge components replace.


### 4.00.00 ADDRESS FOR QUERIES

4.00.01 Should there by any queries or additional information required,
please contact:
Tubemakers Water
63 Curnumbin Creek Road
CURRUMBIN QLD 4223
Ph: (07) 55342522
Fax: (07) 55347079

|  |  | bramay | matima | Sata | neca, |  | COASTLINE FOUMDRY |  |
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|  |  |  | $\cdots-$ | Lums meres | Enor | State: | DN. 150. CL:I6 FREE-AC | cting |
|  |  |  | SUPFACE TREATMENT! $\because \quad$ RED $O X I D E$ | Comme | - | . | $06-16-03-01$ | 3 |

## tyco Flow Control

## Tyco Water

## Features

- Ductile Iron body and bonnet for high strength and impact resistance.
- Ductile Iron gate fully encapsulated in EPDM rubber to ensure drop tight sealing.
- Grade 431 Stainless Steel spindle for high strength and corrosion resistance.
- Gunmetal dezincification resistant top casting incorporating dual O-ring seals and wiper ring for long life operation.
- Back seal facility to allow for replacement of seals under full operating pressure.
- Rilsan ${ }^{\bullet}$ Nylon 11 coating for long life corrosion protection.
- Straight through full bore to avoid debris traps.
- Isolated fasteners for corrosion protection.
- Anti-friction thrust washer for low operating torques.
- Integral cast in feet for safe and easy storage.
- Integral lifting lugs for installation convenience.
- Anticlockwise closing or clockwisє closing available.
- Key, hand wheel or gearbox operation available.

Figure 500 resilient seated gate valves are designed and manufactured to AS 2638-2.

Resilient Seated Gate Valves - Figure 500
DN80 - DN600


End Connections


Flange


Socket


Spigot


| Dimensions (mm) |
| :--- |

Note: For compatability with Series 1 PVC (white) pipe, PLASTYT gaskets may be used in TYTON sockets.

* Flange to Polydex socket available.
$\dagger$ Flange to TrTON socket available.


## Available Range



Coating


Options


## Recommended Specification

- Gate valves shall be resilient seated conforming to AS2638.2.
- The allowable operating pressure shall be 1600 kPa .
- Operation shall be by means of a key/handwheel.
- The direction of closing shall be anticlockwise/clockwise.
- The valve body and bonnet shall be cast in Ductile Iron and coated with a thermally applied polymeric coating to AS/NZS 4158.
- The gate shall be cast in Ductile Iron and fully encapsulated in EPDM rubber partially coated wedges are not acceptable.
- The spindle shall be Grade 431 Stainless Steel incorporating a failsafe thrust collar.
- The spindle seal retainer shall be manufactured from a dezincification resistant copper alloy to AS1565.
- The spindle seal shall be affected by a minimum of two O-rings, which can be replaced under full operating pressure.
- Fasteners shall be completely isolated from the external environment.
- Valves shall be manufactured under a product certification scheme and each valve marked in accordance with the certification body's requirements.



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"G:\SERVIC~1\CALIBR~1\INTERS~1\QLD\JP
RICH~1\MAGFILE\5484681.MAG"
Program v1.00 (30/08/1999) (WIN-PC)
File Produced : 20/06/2005 11:55:55
AM
** Display Menu **
------------------
Display Mode = 0
Display Resolution = 2
** Flow Menu **
Elow Range = 50.00000
Flow Units = Ltr
Flow Multiplier = xl
Flow Time = s
Flow Response = 3
Flow Probe Ins = 1.00000
Flow Probe Prof = 1.00000
Flow Cutoff = 3
** Analog Menu **
Analog ESD = 20
Analog Zero = 4
Analog Dir Fwd = 1
Analog Dir Rev = 0
Analog No. 2 = 100.00000
** Pulse Menu **
Pulse Factor = 0.09999
Pulse Cutoff = 0
Pulse Max = 800
Pulse Idle = 1
Pulse Size = 0
** Totaliser Menu **
---------------------
Totaliser Units = Ltr
Totaliser Multiplier = k
Totaliser Clear Enab = 0
** Alarm No.l Menu **
---------------------
Alarm No.1 Idle = 1
Alarm No.1 Enable = 1
Alarm No.1 Fault = 1
Alarm No.l Forward = 0
Alarm No.1 Reverse = 0
Alarm No.l Cutoff=0
Alarm No.1 MtSensor = 1
Alarm No.1 Hi = 0
Alarm No.1 Lo =0
Alarm No.1 Analog = 0
Alarm No.1 Pulse = 0
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ABB Automation

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### 6.0 ELECTRICAL EQUIPMENT TECHNICAL INFORMATION

NHP

## Technical data and ratings chart

SIRCOVER SCO 125 to 630 A

Ratings to AS 3947-3 and IEC 60947-3

|  |  |  | 125A | 160 A | 200 A | 250 A | 400 A | 500 A | 1630 A |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rated insulation voltage and rated operation voltage AC 20/DC 20 |  | v | $\begin{array}{\|c} 800 \\ +8 \end{array}$ | 800 | $5800$ | 800 | $\left[\begin{array}{c}1000 \\ \hline\end{array}\right.$ | 1000 | 11000 |
| Rated impulse withstand voltage |  | kV | [8. ${ }^{\text {a }}$ ] | 8 | 4,83) | 8 | Lex | 12 | 1812 |
| Rated operational current AC 21A |  |  | C, mbl |  | Exals |  | Kmam |  | - |
|  | 400 V | A | (125 | 160 | 12.200 | 250 | \|6400 \% | 500 | / 630 |
|  | 500 V | A | \|125 | 160 | E.200 | 250 | +315 | 400 | 500 |
|  | 690 V | A | -125 ${ }^{\text {a }}$ | 160 | 1-200 | 250 | 315 | 400 | 500 |
| AC 22A | 400 V | A | E 125 | 160 | P. 200 | 250 | 400 | 500 | 630 |
|  | 500 V | A | E. 125 \% | 125 | 4 125 | 250 | [250 ${ }^{2}$ ] | 400 | 500 |
|  | 690 V | A | [125. | 125 | \| 125 | 160 | , 160 \| | 400 | $500 \cdots$ |
| AC 23A | 400 V | A | 125 | 160 | 160 | 250 | - 250 | 500 | 500 |
|  | 500 V | A | 100 | 100 | 124100 | 250 | - 250 | 315 | 315 |
|  | 690 V | A | 1.80 8 . | 80 | 180 | 125 | 125 | 200 | 200 |
| Rated operational current DC 21A |  |  | W4\% |  | 15.2\% |  | [ $3^{3}$ |  |  |
|  | 220 V | A | \% 125 | 160 | 1200 | 250 | [. $400 \times$ | 500 | \%630 |
|  | 440 V | A | E 125 ] | 125 | 125 | 200 | [200. ${ }^{\text {a }}$ ] | 400 | , 500 |
| DC 22A | 220 V | A | \% 125 ] | 160 | 1F160 | 250 | - 250 / | 400 | 500 |
|  | 440 V | A | 425 | 125 | $125$ | 200 | P200 | 315 | 500 |
| DC 23A | 220 V | A |  | 125 | 125 | 200 | 200 | 400 | 500 |
|  | 440 V | A | 125 | 125 | +125 | 200 | 200 | 400 | 500 |
| Operational power AC 23A |  |  | $\mathrm{E}^{*} \mathrm{~F}$ |  | Wera |  | Ex, |  | $\cdots$ |
|  | 400 V | kW | E. 63 \% | 80 | [880w | 132 |  | 280 | 280 |
|  | 500 V | kW | [ 63. | 63 | 1463 | 160 | 1 l 160 | 220 | 220 |
|  | 690 V | kW | 8, 75 . | 75 | 1875 | 110 | 110 | 185 | 185 |
| Overload capacity <br> Short time withstand current $\text { Icw (RMS 1s) } 690 \mathrm{~V}$ |  |  | F- |  | 15ter |  | W\% |  |  |
|  |  | kA |  | 7 |  | 9 | $\|92\|$ | 13 | ${ }^{13}$ |
| Breaking capacity AC 23A | 400 V | A | y-4 | - | $\sqrt{y}+2 x+$ | - | $\text { F } 6$ | $\bullet$ | - |
| Fuse protected short circuit withstand AC (kA RMS prospective) | 400 V | kA | 100 | 100 |  | 50 | [18) | 100 | 70 |
|  | Fuse | A | $125$ | 160 | 200. | 250 | K400. | 500 | 630 |
| Rated capacitor power |  | kVAr | W 55. | 75 | + $90 \times 1$ | 115 | 185 | 230 | 290 |
| Mechanical endurance |  | Ops | 10000 | 10000 | 10000 | 10000 | 14 10000 | 5000 | 5000 |
| Weight (3 pole) |  | Kg | 1.52 | 1.6 | 1.8 | 2 | 13 | 3.5 | 3.5 |
| Min. tightening torque |  | Nm | 9 | 9 | 9, | 20 | 20 | 20 | 20 |
| Connection cable size |  | $\mathrm{mm}^{2}$ | 35/50 | 50/95 | 50/95 | 95/150 | 185/240 | 240/240 | 2x150/2×300 |

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

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## Technical data and ratings chart <br> SIRCOVER SCO 800 to 3150 A

Ratings to AS 3947-3 and IEC 60947-3

|  |  |  | 800 A | 1250 A | $1600 \mathrm{~A}_{8}$ | 2000 A | 2500 A | 3150 A |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rated insulation voltage and rated operation voltage AC 20/DC 20 |  | V | $\square$ | 1000 | 1000 ${ }^{2}$ | 1000 | 1000 | 1000 |
| Rated impulse withstand voltage |  | kV | 12 \% | 12 | 12 | 12 | 12 | 12 |
| Rated operational current AC 21A |  |  | B-4 |  | ¢ $<$ |  | है |  |
|  | 400 V | A | 800 - | 1250 | 1600 \% | 2000 | 2500 | 3150 |
|  | 500 V | A | $8800{ }^{\text {20 }}$ |  | 1600 \% | 2000 | 2000 | 2000 |
|  | $690 \mathrm{~V}^{\text {1 }}$ ) | A | 800 \% | - | 1600 | 2000 | 2000 | 2000 |
| AC 22A | 400 V | A | 800 ) | 1250 | 1250 | 2000 | 2000 | 2000 |
|  | 500 V | A | 800, | 1250 | 1250 | 2000 | 2000 | 2000 |
|  | $690 \mathrm{~V}^{\text {I }}$ ) | A | 6630 |  | 800 | 1000 | 1000 | 1000 |
| AC 23A | 400 V | A | 800 - | 1000 | 1000 | 1250 | 1250 | 1250 |
|  | 500 V | A | 1800 ${ }^{\text {a }}$ | 1000 | $1000 \times$ | 1000 | 1000 | 1000 |
|  | $690 \mathrm{~V}^{\text {I }}$ ) | A | [ta | - | 500 | 800 | 800 | 800 |
| Rated operational current/poles in series |  |  | 34mers |  | Prer |  | 3 m |  |
| DC 21A | 220 V | A | 800 | 1250 | 1600 | 2000 | 2000 | 2000 |
|  | 440 V | A | $800 / 2$ ] | 1250 | 1250 - | 1250 | 1250 | 1250 |
| DC 22A | 220 V | A | 800 \% | 1250 | 1250 - | 1250 | 11250 | 1250 |
|  | 440 V | A | 4800/2 | 1250/2 | 1250/2 | 1250/2 | $1250 / 2$ | 1250/2 |
| DC 23A | 220 V | A | 800 - | 1250/2 | 1250/2 | 1250/2 | 1250/2 | 1250/2 |
|  | 440 V | A | 800/2 | 1250/2 | 1000/2. | 1000/2 | 1000/2 | 1000/2 |
| Operational power AC 23A |  |  | Hextymy |  | Wramel |  | 1里 |  |
|  | 400 V | kW | $450{ }^{3}$ | 560 | 560 , | 710 | 710 - | 710 |
|  | 500 V | kW | [560 \% | 710 | 710 | 710 | 710 | 710 |
|  | 690 V | kW | 220 | 475 | 400 | 750 | 750 \% | 750 |
| Overload capacity Short time withstand current$\text { Icw (RMS 1s) } 690 \mathrm{~V}$ |  |  | Wexemat |  | betme |  | H, |  |
|  |  | kA |  | 50 | $50$ | 50 | 50 ${ }^{5}$ | 50 |
| Breaking capacity AC 23A | 400 V | A | $\left\lvert\, \begin{gathered} 4 \\ \hline \end{gathered}\right.$ | - |  | - |  | - |
| Fuse protected short circuit withstand $A C$ (kA RMS prospective) | 400 V | kA |  | 100 |  | 100 | $100$ | - |
|  | Fuse | A | $800$ | 1250 | $2 \times 800$ | $2 \times 1000$ | 2×1250 | - |
| Rated capacitor power |  | kVAr | 365 | 575 | - 4 | - | - | - |
| Mechanical endurance |  | Ops | $4000 \times 8$ | 4000 | 4000 | 3000 | 3000 | 3000 |
| Weight (3 pole) |  | Kg | 88.4 | 10.5 | 10.5 | 16 | 17. | 31 |
| Min. tightening torque |  | Nm | - m | 20 | 40 | 40 | 40 | 40 |
| Connection cable size |  | $\mathrm{mm}^{2}$ | 2(185/300) | $2240 / 4185$ | 4185 max | 6240 max | - | - |

Notes: ${ }^{1}$ ) With terminal shrouds.
240/415 V ratings suitable for use on $230 / 400 \mathrm{~V}$ in accordance with AS 60038 : 2000 .

## NH

## Din-T6 series 6kA MCB

Standards AS3111, IEC 898.

- Approval No. N13374.

Current range 2-63 amps 1, 2 and 3 pole.

- Sealable and lockable handle.

Available in curve type $C$ and $D$.

- Mounts on CD chassis (250A \& 355A).

1 pole 1 module

| In (A) | C-Curve <br> 5-10In |
| :--- | :--- |
| 2 | DIN-T6102C |
| 4 | DIN-T6104C |
| 6 | DIN-T6106C |
| 10 | DIN-T6110C |
| 16 | DIN-T6116C |
| 20 | DIN-T6120C |
| 25 | DIN-T6125C |
| 32 | DIN-T6132C |
| 40 | DIN-T6140C |
| 50 | DIN-T6150C |
| 63 | DIN-T6163C |

2 pole 2 modules

| 2 | DIN-T6202C |
| :--- | :--- |
| 4 | DIN-T6204C |
| 6 | DIN-T6206C |
| 10 | DIN-T6210C |
| 16 | DIN-T6216C |
| 20 | DIN-T6220C |
| 25 | DIN-T6225C |
| 32 | DIN-T6232C |
| 40 | DIN-T6240C |
| 50 | DIN-T6250C |
| 63 | DIN-T6263C |

3 pole 3 modules

| 2 | DIN-T6302C |
| :--- | :--- |
| 4 | DIN-T6304C |
| 6 | DIN-T6306C |
| 10 | DIN-T6310C |
| 16 | DIN-T6316C |
| 20 | DIN-T6320C |
| 25 | DIN-T6325C |
| 32 | DIN-T6332C |
| 40 | DIN-T6340C |
| 50 | DIN-T6350C |
| 63 | DIN-T6363C |

D - Curve 10-20In

|  | DIN-T6102D |
| :--- | :--- |
| $\therefore$ | DIN-T6104D |
|  | DIN-T6106D |
|  | DIN-T6110D |
|  | DIN-T6116D |
|  | DIN-T6120D |
|  | DIN-T6125D |
|  | DIN-T6132D |
|  | DIN-T6140D |
|  | DIN-T6150D |
|  | DIN-T6163D |


|  | DIN-T6202D |
| :---: | :---: |
|  | DIN-T6204D |
|  | DIN-T6206D |
|  | DIN-T6210D |
|  | DIN-T6216D |
|  | DIN-T6220D |
|  | DIN-T6225D |
|  | DIN-T6232D |
|  | DIN-T6240D |
|  | DIN-T6250D |
|  | DIN-T6263D |


| ITDIN-T6302D |
| :---: |
| iDIN-T6304D |
| BDIN-T6306D |
| DIN-T63100 |
| DIN-T6316D ${ }^{\text {\% }}$ |
| DIN-T6320D |
| DIN-T6325D |
| DIN-T6332D |
| DIN-T6340D |
| DIN-T6350D |
| \| DIN-T6363D |



Short circuit capacity 6000 amps

| $\ln (A)$ | $2-63$ |
| :--- | :--- |
| $1 P$ | 240 VAC |
| $2 P$ | 240 V AC |
| $3 P$ | $240-415 \mathrm{VAC}$ |

DC use

|  | $1 P$ | $\left.2 P^{\prime}\right)$ |
| :--- | :--- | :--- |
| Short circuit | 6000 A | 6000 A |
| Max.voltage (DC) | $24 / 48 \mathrm{~V}$ | 110 V |

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

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 ( $\ln X, Y, Z$ directions).
3 g in frequency range 10 to 55 Hz (operating time at least 30 min ).
According to IEC 7716.3 and DIN 40046 part 8.
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 approximately VDE 0664 parts 1 and 2.

## Use at 400 Hz

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

## Accessories

Add on RCD
Auxiliary/alarm
Shunt trip
Padlockable bracket
Link bars \& terminals
Enclosures
Busbar chassis

Notes: ') 2 poles in series (not $2 \times$ single poles). The line side is the "OFF" (bottom) side of the MCB.Available on indent only.

## Din-T6 series 6kA MCB (cont)

Technical data

| Number of poles |  | 1 | 2 | 3 |
| :--- | :--- | :--- | :--- | :--- |
| Width | $(\mathrm{mm})$ | 18 | 36 | 54 |
| Depth | $(\mathrm{mm})$ | 68 | 68 | 68 |
| Rated voltage | $(\mathrm{V} \mathrm{AC})$ | 240 | 240 | 415 |
| Highest rated current | $(\mathrm{A})$ | 63 | 63 | 63 |
| Terminal capacity | Line side | $\left(\mathrm{mm}^{2}\right)$ | 25 | 25 |
|  | Load side | $\left(\mathrm{mm}^{2}\right)$ | 25 | 25 |

Number of switching operations

| Operations 240V AC, In $\operatorname{Cos} \varphi=0.9$ | 10000 | 10000 | 10000 |  |
| :--- | :--- | :---: | :--- | :---: |
| $D C @ I_{n}$ |  | 4000 | 4000 | 4000 |
| Insulation resistance | $(\mathrm{M} \Omega)$ | $>10^{\circ}$ | $>10^{\circ}$ | $>10^{\circ}$ |
| Dielectric strength | $(\mathrm{kV})$ | 2.5 | 2.5 | 2.5 |



Ambient temperature influence
The thermal calibration of the Din-T6 series was carried out at $30^{\circ} \mathrm{C}$. Temperatures above or below will alter the trip characteristics controlled through the bi-metal.
See curve below


| Voltage drop and energy loss |  |  |  |
| :--- | :--- | :--- | :--- |
| Voltage |  |  |  |
| In (A) | drop $(\mathbf{V})$ | Internal <br> Energy <br> loss $(\mathbf{W})$ | resistance <br> $(\mathrm{m} \Omega)$ |
| 2 | 0.82 | 1.6 | 410 |
| 4 | 0.57 | 2.3 | 142.5 |
| 6 | 0.21 | 1.3 | 35 |
| 10 | 0.13 | 1.3 | 13 |
| 16 | 0.11 | 1.8 | 6.9 |
| 20 | 0.14 | 2.8 | 7.0 |
| 25 | 0.10 | 3.0 | 4.0 |
| 32 | 0.09 | 3.0 | 2.8 |
| 40 | 0.08 | 4.7 | 2.0 |
| 50 | 0.090 | 4.5 | 1.8 |
| 63 | 0.088 | 5.56 | 1.4 |

Catalogue number structure for Din-T MCB's (6, 10, 10H \& 15)


| X X |  |
| :---: | :---: |
| I |  |
| In (A) |  |
| 05 | 0.5 |
| 01 | 1 |
| 02 | 2 |
| 04 | 4 |
| 06 | 6 |
| 10 | 10 |
| 16 | 16 |
| 20 | 20 |
|  | Etc. |


| $X$ |
| :--- |
| Curve <br> type <br> B <br> C <br> $D \ln -5 \ln$ | Miniature circuit breakers

## Din-T6 and Din-T10 series MCB's

Magnetic release
An electromagnet striker ensures instantaneous tripping in case of short circuit. IEC 898 describes the following types

| Curve type | Test current | Tripping time | Applications |
| :---: | :---: | :---: | :---: |
| C | $\begin{aligned} & 5 \ln \\ & 10 \mathrm{ln} \end{aligned}$ | $\begin{aligned} & t \geq 0.1 \mathrm{~s} \\ & \mathrm{t}<0.1 \mathrm{~s} \end{aligned}$ | Usual loads such as: |
|  |  |  | - lighting |
|  |  |  | - socket outlets |
|  |  |  | - small motors') |
| $\overline{\text { D }}$ | 10 ln | $\pm 0.1 \mathrm{~s}$ | Control and protection of cir- |
|  | 20 In | $t<0.1$ s | cuits having high transient |
|  |  |  | inrush currents (large |
|  |  |  | motors, ${ }^{2}$ ) transformers etc). |

Note: ') C curve MCBs are suitable for general motor starting applications, see motor starting tables section 10.
${ }^{2}$ ) D curve MCBs may be selected in more arduous starting applications or may allow a lower current rating MCB to ber selected. Refer NHP.

## Thermal release

The release is initiated by a bimetal strip in case of overload. IEC 898 defines the range of release for specific overload values. Reference ambient temperature is $30^{\circ} \mathrm{C}$.

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

( I > 32A)

Tripping characteristics according to IEC 898 (time-current tables)

Wrararaler
Din-T6: from 2 to 6A Din-T10: from 0.5 to 6A



Din-T6: from 2 to 6A Din-T10: from 0.5 to 6 A


Din-T6 (2-40A)


Din-T6 (50-63A)
Din-T10 and Din-T15 (0.5-63A)


Din-T10H (80-125A)


Miniature circuit breakers and fuse fault current limiters co-ordination chart
For fault current levels up to 50 kA at 415 V


Notes: ${ }^{1}$ ) Minimum fuse size is based on grading under overfoad of one MCB with one set of fuses. Where a single set of fuses protects more than one MCB, the minimum fuse size shall be increased to allow for load biasing effects.
${ }^{2}$ ) Maximum fuse size based on testing to AS 3439.1 clause 8.2.3.

Tables based on the following maximum pre-arching $I^{2} t$ for both BS 88 and DIN fuses:
$160 \mathrm{~A}-0.62 \times 10^{5}, \quad 200 \mathrm{~A}-1.2 \times 10^{5}, 250 \mathrm{~A}-2.1 \times 10^{5}$.
Suitable fuses include NHP, GEC, Siemens and Brovara-Crady.
Fuses with higher current ratings may be used providing $I^{2}$ t values are equal to, or less than the levels above. Semi-conductor fuses have very low $1^{2} t$ values and may suit some applications.
Attention is also drawn to AS 3000 clause 7.10 .4 . 4 regarding the use of fault current limiters in installations containing fire and smoke control equipment, evacuation equipment and lifts.

## TemBreak MCCB's and Safe-T/Din-T MCB's - Selectivity and Cascade tables at 415 V



Selectivity Cascade
Upstream MCCB

| Downstream MCB | kA (rms) | $\begin{gathered} \text { XS125CJ } \\ 18 \end{gathered}$ | $\begin{gathered} \text { XS125NJ } \\ 30 \end{gathered}$ | $\begin{gathered} \text { XH125NJ } \\ 50 \end{gathered}$ | $\begin{gathered} \text { XS250NJ } \\ 35 \end{gathered}$ | $\begin{gathered} \text { XH250NJ } \\ 50 \end{gathered}$ | $\begin{gathered} \text { XS400CJ } \\ 35 \end{gathered}$ | $\begin{gathered} \text { XS400SE } \\ \text { XS400NJ } \\ 50 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Din-T6 (2-25A) |  |  |  |  |  |  |  |  |
| Din-T6 (32-63A) |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| DRCBH (32A) , (k) 10, 18/18 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Safe-T (16-63A) |  |  |  |  |  |  |  |  |
| SRCB (16-20A) |  |  |  |  |  |  |  |  |

Note: ') Dependant on the number of poles. Refer to NHP.

## Motor circuit application table for DOL starting General applications

High fault range


Notes: These motor circuit application tables are to be used as a selection guide for average 3 phase, 4 pole 415 V motors for standard applications only. The table is based on holding $125 \%$ of full load current (FLC) continuously and 600\% of FLC for at least 10 seconds. Lower circuit breaker ratings are possible in some applications. Refer NHP.
${ }^{1}$ ) 80,100 and 125 amp refers to Din-T10H type.
${ }^{2}$ ) Type 'SE' TemBreak MCCB only.
${ }^{3}$ ) Use magnetic-only TemBreak MCCB. Refer NHP.
Adjustable magnetic trips set to high. Thermal magnetic TemBreak adjustable $63 \%-100 \%$ of NRC (nominal rated current). Din-T MCB's are calibrated to IEC 898 Curve 'C' \& 'D'. Selected sizes of 'D' Curve are available from stock. Refer NHP.

## Application data

## Motor circuit application table for reduced voltage starting General applications

Breaker type and current rating, star delta, auto transformer resistor or reactance starting


[^2]

## Detailed specifications for ERICO's

## TRANSIENT DISCRIMINATING FILTER, TDF-10A SERIES

## Applications

-ightning transients and surges are a major cause of expensive electronic quipment failure and business disruption. Damage may result in loss of :omputers, data commmunications, loss of revenue, and loss of profits. The new Transient Discriminating Filter ${ }^{\mathrm{TM}}$ family of TVSS devices offer :conomical and reliable protection from power transients with the convenence of easy installation on 35 mm DIN rail mountings.

The TDF series has been specifically designed for process control applicaions to protect the switched mode power supply units on devices such as ?LC controllers, SCADA systems and motor controllers. Units are availtble for 3A, 10A and 20A loads and in a range of clamping voltages ncluding $30 \mathrm{~V}, 150 \mathrm{~V}, 275 \mathrm{~V}$. The range is intended for use in conjunction with ERICO's Universal Transient Barrier UTB's to provide a coordinated ıpproach to protection of both the power and data control circuits.

The TDF is a series connected single phase surge filter providing an iggregate surge capacity of $50 \mathrm{kA}(8 / 20 \mu \mathrm{~s})-20 \mathrm{kA} \mathrm{L-N} \& \mathrm{~L}-\mathrm{G}$ and 10 kA V-G. The space efficient low pass filter, provides some 65 dB of attenuaion to voltage transients. Not only does this reduce the residual let hrough voltage, but it helps further reduce the steep rates of rise of voltıge and current providing superior protection for sensitive electronic :quipment.

## Features

- Compact design fits into most distribution boards and motor control centres
- High efficiency filtering - ideal for the protection of switched mode power supplies from large $\mathrm{dv} / \mathrm{dt}$ and $\mathrm{di} / \mathrm{dt}$ transients
- Three modes of protection L-N, L-G, N-G
- 35 mm DIN rail mount - DIN 43880 profile matches common MCB's
- LED indication and opto-isolated output for remote status monitoring
- Transient Discriminating Technology ensures safe operation during abnormal over-voltage events
- UL1449 Edition 2 recognized
- Large 50 kA surge capacity provides a high level of protection and long operational life
- 5 year limited warranty

CNTIE
Sunte proterilow onvices

ERICD'

## PROCESS CONTROL TVSS PROTECTION

SPECIFICATIONS<br><br>Operation:<br>Models available<br>Nominal line voltage<br>Max Continuous Operating Voltage MCOV<br>Max Load Current<br>Input frequency<br>Earth leakage current Protection:<br>Max aggregate surge rating<br>Protection modes<br>Max surge current/mode L-N<br>L-G $\quad 20 \mathrm{kA} 8 / 20 \mu \mathrm{~s}$<br>N-G $10 \mathrm{kA} 8 / 20 \mu \mathrm{~s}$<br>SPD circuit description<br>Series low pass LC filter<br>Transient Discriminating Technology<br>Thermal fusing<br>Filter:<br>Inductor<br>Capacitor type<br>Ferrite cored<br>$\mathrm{X} \& \mathrm{Y}$ grade interference suppression polypropylene film<br>65 dB<br>Performance:<br>UL1449 SVR L-N $500 \mathrm{~V} \quad 700 \mathrm{~V}$<br>ANSI/IEEE C62.41 Cat B3-500A ringwave<br>Cat Cl-3kA, $8 / 20 \mu \mathrm{~s}$<br>Alarms and Indicators:<br>Protection status indication<br>Physical Data:<br><br>Due to a policy of comimual product development, specifications are subject to change without notice. © Copyright 1999<br>Part Number Description<br>TDF-10A-120V 120V 1 phase, $50 \mathrm{kA} 8 / 20 \mu \mathrm{~s}$, 10A series TVSS protector TDF-10A-240V 240 V 1 phase, $50 \mathrm{kA} 8 / 20 \mu \mathrm{~s}$, 10A series TVSS protector

| Hobart | ph: 613 6237-3200 | fax +613 6273-0399 | Adelaide | ph:*61 8 8366-655s | fax $+6188366-6556$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Sydney | ph:+61 2 9479-8500 | faxt 612 9980-5092 | Perth | ph:461 8 3358-1233 | faxter $89358-1404$ |
| Melboume | ph:+61 3 9894-2677 |  | Singapore | phit 65-763-2477 | fax+65 763-2397 |
| Canbera | ph:+61 2 6257-3055 | fax+61 2 6257-3127 | Thalland | ph:+ 662 627-9037-8 | 1ax+662 627-9168 |

## AC contactors <br> 3 pole open type with AC coil



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 3497415 V
O For CA 7 contactors with coil terminals on line side, add ...V AC to Catalogue No. Eg-CA 7-9-10-240V AC ${ }^{3}$ )
O For CA 7 contactors with coil terminals on load side, add ...V AC-U to Catalogue No. Eg - CA 7-9-10-240V AC-U


## AC $1^{\text {g }}$ ) $A C 1{ }^{6}$ ) Auxiliary contacts



Notes: ${ }^{1}$ ) 1000 volt ratings ( ).
${ }^{2}$ ) Add control voltage to Cat. No. when ordering: $24,32,110,240,415,440 \mathrm{~V} 50 \mathrm{~Hz}$. Standard voltages for CA 6-105-EI...250-EI are 24, 48, 110, 240 and 415V 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).
$\left.{ }^{5}\right) \quad 55^{\circ} \mathrm{C}$ enclosed.
${ }^{8}$ ) Contact NHP for recommended cable size.

## 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 extraordinary 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.



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

Coil terminals are always in the correct position<br>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.<br>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.


## CA 7 contactors provide improved wiring terminals

The 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.


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



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


Standard thermal overloads type CT 7

$2^{2} \cdot 4$

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

## DOL starting <br> 50/65 kA @ 415V

| Motor <br> size <br> kW | Approx. <br> amps <br> @ 415V | Sprecher + <br> Schuh <br> circuit breaker | Setting <br> range <br> amps | Magnetic <br> amps | Sprecher + Schuh <br> contactor | IAC-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 |
|  |  |  |  |  | 9 |  |

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 $\infty 0$-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.

## TERASAKI

Refer Catalogue C-CO
TemBreak or fuse DOL starting
$50 / 65 \mathrm{kA} @ 415 \mathrm{~V}$ to AS 3947.4 .1

## TemBreak or fuse

| Motor size $\mathbf{k W}$ | Approx. amps | Terasaki circuit or breaker | NHP HRC fuse | 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 | 0.6-1.6 |
| 0.55 | 1.5 | XM30PB/2 | NTIA-6 | CA 7-9 | CT 7-24 | 0.6-1.6 |
| 0.75 | 1.8 | XM30PB/2.6 | NTIA-10 | CA 7-9 | CT 7-24 | 1.6-2.6 |
| 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 | CT 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 ${ }^{\text {² }}$ ) | NTF-160 | CA 6-85 | CT 7-100 | 70-90 |
| 55 | 100 | XH125NJ/125 ${ }^{\text {² }}$ ) | NTF-200 | CA 6-105-(EI) | CT 6-110 | 85-110 |
| 75 | 130 | XH250NJ/250 | NTKF-250 | CA 6-140-(EI) | CT 6-150 | 105-150 |
| 90 | 155 | XH250NJ/250 ${ }^{\text {² }}$ ) | NTKF-250 | CA 6-170-EI | CT 6-200 | 140-200 |
| 110 | 200 | XH250NJ/250 ${ }^{\text {² }}$ ) | 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-EI/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: $\quad$ Fuses 65 kA . XH125NJ circuit 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. <br> ${ }^{1}$ ) Use 'magnetic only' breaker. |  |  |  |  |  |  |

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

| Motor <br> size kW | Approx. amps <br> @ 415V | NHP HRC <br> fuse to BS88 | Sprecher + Schuh <br> contactor | Sprecher + Schuh <br> overload relay $\left.\left.{ }^{2}\right)^{3}\right)$ | Setting range <br> 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 | 250 | NTMF-355 | CA 6-210-EI | CEF 1-41/42 ${ }^{4}$ ) |
| 150 | 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 ${ }^{4}$ ) | $160-400$ |
| 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: $\quad{ }^{1}$ ) 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.

Refer Catalogue C-CO
TemBreak circuit breakers DOL starting 50kA @ 415V 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 | ХM30РВ/2.6 | CA 7-9 | CT 7-24-2.4 | 1.6-2.4 |
| 1.1 | 2.6 | XM30PB/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 | XM30PB/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 ${ }^{2}$ ) | 45-60 |
| 37 | 66 | XH125NJ/100 | CA 6-85 | CT 7-75 ${ }^{2}$ ) | 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 | XS400NE/400 | CA 6-210-EI | CEF 1-41/42 | 160-400 |
| 150 | 250 | XS400NE/400 | CA 6-250-EI | CEF 1-41/42 | 160-400 |
| 160 | 270 | XS400NE/400 | CA 6-300-EI | CEF 1-41/42 | 160-400 |
| 200 | 361 | XS400NE/400 | CA 6-420-EI | CEF 1-41/42 | 160-400 |
| 200 | 361 | XS400NE/400 | CA 5-450 | CEF 1-22 ${ }^{2}$ ) | 160-400 |
| 250 | 425 | XS630NE/630 | CA 5-700 | CEF 1-52 ${ }^{2}$ ) | 160-630 |
| 320 | 538 | XS630NE/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.
${ }^{1}$ ) 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.


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

| Motor <br> size <br> kW | Approx. <br> amps @ <br> 415V | Sprecher + <br> Schuh <br> isolator | Terasaki <br> circuit breaker | Sprecher + <br> Schuh <br> current limiter | Sprecher + <br> Schuh <br> contactor | Sprecher + <br> Schuh <br> thermal <br> O/L relay | Thermal <br> overload <br> range |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{0 . 3 7}$ | 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 | $30-45$ |

Number of switching operations

| Mechanical | ［Mill］ | 13 | 13 | 13 | 13 | 13 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Electrical AC 3 （400V） | ［Mill］ | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Weight with AC coil（DC coil） | ［kg］ | 0.39 （0．6） | 0.39 （0．6） | 0.39 （0．6） | 0.39 （0．73） | 0.48 （0．85） |
| Terminal for main contacts |  | 哭 | 哭 | 哭 | 哭 | 蜀 |
| Terminal size to IEC 947－1 |  | $2 \times \mathrm{A} 4$ | $2 \times$ A4 | $2 \times \mathrm{A} 4$ | $2 \times$ A4 | $2 \times 86$ |
| Flexible wire with sleeve 둡 | 1 wire［ $\mathrm{mm}^{2}$ ］ | 1．．． 4 | 1．．． 4 | 1．．． 4 | 1．．． 4 | 2．5．．． 10 |
|  | 2 wire［ $\mathrm{mm}^{2}$ ］ | 1．．．4 | 1．．． 4 | 1．．． 4 | 1．．． 4 | 2．5．．． 10 |
| Stranded／solid core \＆ | 1 wire［ $\mathrm{mm}^{2}$ ］ | 1．5．．． 6 | 1．5．．． 6 | 1．5．．． 6 | 1．5．．． 6 | 2．5．．． 16 |
|  | 2 wire［ $\mathrm{mm}^{2}$ ］ | 1．5．．． 6 | 1．5．．． 6 | 1．5．．． 6 | 1．5．．． 6 | 2．5．．．16 |
| Tightening torque | ［ Nm ］ | 1．．．2．5 | 1．．．2．5 | 1．．． 2.5 | 1．．．2．5 | 1．5．．．3．5 |
| Contactor |  | CA 7－37 | CA 7－43 | CA 7－60 | CA 7－72 | CA 7－85 |
| Number of switching operations |  |  |  |  |  |  |
| Mechanical | ［Mill］ | 13 | 12 | 10 | 10 | 10 |
| Electrical AC 3 （400V） | ［Mill］ | 1.3 | 1.3 | 1 | 1 | 1 |
| Weight with AC coil（DC coil） | ［kg］ | 0.49 （0．85） | 0.51 （1．0） | 1.45 （1．47） | 1.45 （1．47） | 1.45 （1．47） |
| Terminal for main contacts |  | 界 | 置 | 䍖 | 䍖 | 䍖 |
| Terminal size to IEC 947－1 |  | $2 \times 86$ | B7＋B6 | B9＋ $\mathrm{B}_{7}$ | B9＋ $\mathrm{B}_{7}$ | B9＋B7 |
| Flexible wire with sleeve | 1 wire［ $\mathrm{mm}^{2}$ ］ | 2．5．．． 10 | 2．5．．． 16 | 2．5．．． 35 | 2．5．．． 35 | 2．5．．． 35 |
| ET 9 | 2 wire［ $\mathrm{mm}^{2}$ ］ | 2．5．．．10 | 2．5．．． 10 | 2．5．．． 25 | 2．5．．． 25 | 2．5．．． 25 |
| Stranded／solid core | 1 wire［ $\mathrm{mm}^{2}$ ］ | 2．5．．16 | 2．5．．． 25 | 2．5．．50 | 2．5．．50 | 2．5．．．50 |
| － 7 | 2 wire［ $\mathrm{mm}^{2}$ ］ | 2．5．．．16 | 2．5．．．16 | 2．5．．． 35 | 2．5．． 35 | 2．5．．． 35 |
| Tightening torque | ［ Nm ］ | 1．5．．．3．5 | 1．5．．．3．5 | 2．．． 6 | 2．．． 6 | 2．．． 6 |
| Control circuit |  | CA 7－9 | CA 7－12 | CA 7－16 | CA 7－23 | CA 7－30 |
| Operating limits |  |  |  |  |  |  |
| AC $50 / 60 \mathrm{~Hz}$ | Pick－up［ $\mathrm{xU}_{\text {s }}$ ］ | 0．85．．．1．1 | 0．85．．．1．1 | 0．85．．．1．1 | 0．85．．．1．1 | 0．85．．．1．1 |
|  | Drop－out［ $\mathrm{x} \mathrm{U}_{\mathrm{s}}$ ］ | 0．3．．．0．6 | 0．3．．．0．6 | 0．3．．．0．6 | 0．3．．．0．6 | 0．3．．．0．6 |


| Pick－up and hold power |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AC $50 / 60 \mathrm{~Hz}$ | Pick－up［VAW］PF | 70／50／0．71 | 70／50／0．71 | 70／50／0．71 | 70／50／0．71 | 80／60／0．75 |
|  | Hold［VAW］PF | 8／2．60／0．33 | 8／2．6／0．33 | 8／2．6／0．33 | 9／3／0．33 | 9／3／0．33 |
| Operating times |  |  |  |  |  |  |
| AC $50 / 60 \mathrm{~Hz}$ | Make［mS］ | 15．．． 30 | 15．．． 30 | 15．．． 30 | 15．．． 30 | 15．．． 30 |
|  | Break［mS］ | 10．．． 60 | 10．．． 60 | 10．．． 60 | 10．．． 60 | 10．．． 60 |
| Control circuit |  | CA 7－37 | CA 7－43 | CA 7－60 | CA 7－72 | CA 7－85 |
| Operating limits |  |  |  |  |  |  |
| AC $50 / 60 \mathrm{~Hz}$ | Pick－up［ $\mathrm{XU}_{\text {s }}$ ］ | 0．85．．．1．1 | 0．85．．．1．1 | 0．85．．．1．1 | 0．85．．．1．1 | 0．85．．．1．1 |
|  | Drop－out［ $\mathrm{XU}_{s}$ ］ | 0．3．．．0．6 | 0．3．．．0．6 | 0．3．．．0．6 | 0．3．．．0．6 | 0．3．．．0．6 |


| Pick－up and hold power <br> AC 50／60Hz |  |  |  |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  | Pick－up［VAW］PF | $80 / 60 / 0.75$ | $80 / 60 / 0.75$ | $200 / 110 / 0.55$ | $200 / 110 / 0.55$ | $200 / 110 / 0.55$ |
|  | Hold［VAW］PF | $9 / 3 / 0.33$ | $10 / 3.2 / 0.32$ | $16 / 4.5 / 0.28$ | $16 / 4.5 / 0.28$ | $16 / 4.5 / 0.28$ |
| Operating times |  |  |  |  |  |  |
| AC $50 / 60 \mathrm{~Hz}$ | Make［mS］ | $15 \ldots . .30$ | $15 \ldots .30$ | $18.5 \ldots 30$ | $18.5 \ldots 30$ | $18.5 \ldots 30$ |
|  | Break［mS］ | $10 \ldots 60$ | $10 \ldots 60$ | $10 \ldots 60$ | $10 \ldots 60$ | $10 \ldots 60$ |


| General data | CA 7-9...CA 7-85 |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rated insulation voltage $U_{i}$ |  |  |  |  |  |  |  |  |  |  |
| IEC |  |  |  |  | 690 V |  |  |  |  |  |
| UL, CSA |  |  |  |  | 600 V |  |  |  |  |  |
| Rated impulse voltage withstand Uimp |  |  |  |  | 8 kV |  |  |  |  |  |
| Test voltage |  |  |  |  |  |  |  |  |  |  |
| 1 minute (to IEC 947-4) |  |  |  |  | 2500V |  |  |  |  |  |
| Rated voltage $\mathrm{U}_{\boldsymbol{\theta}}$ |  |  |  |  |  |  |  |  |  |  |
| AC |  |  |  |  | 110, 240, 415, 500, 690V |  |  |  |  |  |
| DC |  |  |  |  | 24, 48, 110, 220, 440V |  |  |  |  |  |
| Rated frequency of coil |  |  |  |  | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |
| Ambient temperature |  |  |  |  |  |  |  |  |  |  |
| Storage |  |  |  |  | $-55 . . .+80^{\circ} \mathrm{C}\left(-67 . . .176{ }^{\circ} \mathrm{F}\right)$ |  |  |  |  |  |
| Operation at nominal current |  |  |  |  | $-25 . .+60^{\circ} \mathrm{C}\left(-13 . . .140^{\circ} \mathrm{F}\right)$ |  |  |  |  |  |
| Maximum with $15 \%$ AC 1 current reduction $>60^{\circ} \mathrm{C}$ |  |  |  |  | $-25 . .+70^{\circ} \mathrm{C}$ ( $-13 . . .158^{\circ} \mathrm{F}$ ) |  |  |  |  |  |
| Climatic withstand |  |  |  |  | Cyclicly changing humid atmosphere to IEC 68-2-30 and DIN 50 016, 56 |  |  |  |  |  |
| Maximum altitude |  |  |  |  | 2000 m NN , to IEC 947-4 |  |  |  |  |  |
| Protection class |  |  |  |  |  |  |  |  |  |  |
| IP 2LX (IEC 529 and DIN 40050) |  |  |  |  | In connected condition |  |  |  |  |  |
| Protection against contact |  |  |  |  | Touch protection to VDE 0106, Part 100 |  |  |  |  |  |
| Standards |  |  |  |  | IEC 947-1/4; VDE 0660, Part 100/104; UL 508; CSA 22.2. Part 14 |  |  |  |  |  |
| Compliance |  |  |  |  | CE; UL; CSA |  |  |  |  |  |
| Short time withstand |  |  |  |  |  |  |  |  |  |  |
| $1 \mathrm{~s}(\mathrm{~A})$ | 210 | 210 | 290 | 380 | 480 | 525 | 650 | 1100 | 1150 | 1250 |
| 4s (A) | 140 | 150 | 220 | 280 | 360 | 390 | 480 | 820 | 860 | 910 |
| 10s (A) | 100 | 120 | 175 | 220 | 290 | 310 | 375 | 640 | 680 | 710 |
| 15s (A) | 90 | 100 | 150 | 200 | 250 | 270 | 325 | 560 | 600 | 620 |
| 60s (A) | 60 | 60 | 90 | 125 | 170 | 175 | 200 | 350 | 370 | 380 |
| 240s (A) | 40 | 40 | 50 | 60 | 100 | 100 | 120 | 190 | 190 | 200 |
| 900s (A) | 30 | 30 | 38 | 38 | 54 | 60 | 76 | 108 | 108 | 120 |
| Minimum cooling time at zero current [Min] | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |



|  |  | Built-in auxiliary contacts CA 7-9... 85 |  |  |  |  | Front moun |  |  |  |  | Side mount |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Switching DC loads |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $L / R<1 \mathrm{~ms}$, resistive loads at: | (V] | 24 | 48 | 110 | 220 | 440 | 24 | 48 | 110 | 220 | 440 | 24 | 48 | 110 | 220 | 440 |
|  | [A] | 12 | 9 | 3.5 | 0.55 | 0.2 | 12 | 9 | 3.5 | 0.55 | 0.2 | 6 | 3.2 | 0.45 | 0.18 | 0.1 |
| UR<15ms, inductive loads with |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| economy resistor in series at: | (V) | 24 | 48 | 110 | 220 | 440 | 24 | 48 | 110 | 220 | 440 | 24 | 48 | 110 | 220 | 440 |
|  | [A] | 9 | 5 | 2 | 0.4 | 0.16 | 9 | 5 | 2 | 0.4 | 0.16 | 2 | 1.6 | 0.3 | 0.12 | 0.05 |
| DC-13, switching electro |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| magnets at: | [ V | 24 | 48 | 110 | 220 | 440 | 24 | 48 | 110 | 220 | 440 | 24 | 48 | 110 | 220 | 440 |
|  | [A] | 5 | 2 | 0.7 | 0.25 | 0.12 | 5 | 2 | 0.7 | 0.25 | 0.12 | 3 | 1.5 | 0.6 | 0.3 | 0.2 |

## ACS contactórs CA 7 Technical data

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
AC1 resistive load
switching 3~
Ambient temperature $40^{\circ} \mathrm{C}$

| $\left.l_{e}{ }^{\prime}\right)$ | $[\mathrm{A}]$ | 32 | 32 | 32 | 32 | 50 | 50 | 85 | 100 | 100 | 100 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 240 V | $[\mathrm{~kW}]$ | 10 | 10 | 13 | 13 | 18 | 20 | 25 | 36 | 36 | 40 |
| 415 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 $60^{\circ} \mathrm{C}$

| $\left.\boldsymbol{e}_{\boldsymbol{e}}\right)$ | $[\mathrm{A}]$ | 32 | 32 | 32 | 32 | 45 | 45 | 63 | 100 | 100 | 100 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 240 V | $[\mathrm{~kW}]$ | 8 | 8 | 10 | 10 | 14 | 16 | 20 | 29 | 29 | 34 |
| 415 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

| 240 V | $[\mathrm{~A}]$ | 11.5 | 14.5 | 20 | 26.5 | 34 | 37 | 42 | 62 | 70 | 85 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 415 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 |
| 240 V | $[\mathrm{~kW}]$ | 3 | 4 | 5.5 | 7.5 | 10 | 11 | 13 | 18.5 | 22 | 25 |
| 415 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

| $I_{o} A C 4,50 \mathrm{~Hz}$ | max. $690 \mathrm{~V}[\mathrm{~A}]$ | 135 | 180 | 240 | 345 | 450 | 555 | 645 | 900 | 1080 | 1275 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Rated breaking capacity |  |  |  |  |  |  |  |  |  |  |  |
| $I_{\theta} A C 4$ | max. $460 \mathrm{~V}[\mathrm{~A}]$ | 135 | 180 | 240 | 345 | 450 | 555 | 645 | 900 | 1080 | 1275 |
|  | $\max .690 \mathrm{~V}[\mathrm{~A}]$ | 75 | 105 | 140 | 140 | 255 | 300 | 375 | 510 | 630 | 735 |

Short circuit protection
without protection relay
fuse gG 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 <br> [m $\Omega$ ] | 2.7 | 2.7 | 2.7 | 2 | 2 | 2 | 1.5 | 0.9 | 0.9 | 0.9 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Power dissipated by all 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 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... 70 | 40...70 | 40... 70 | 40... 70 | 50... 80 | 50... 80 | 50... 80 | 20... 40 | 20... 40 | 20... 40 |
| Break (ms) | 7... 15 | 7... 15 | 7... 15 | 7... 15 | 7... 15 | 7... 15 | - | - | - | - |

Note: ${ }^{1}$ ) Contact NHP for recommended cable size.


## Contactor (AC control)

| Type | a | b | c | c1 | c2 | ød | d1 | d2 $\left.{ }^{\prime}\right)$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CA 7-9...CA 7-23 ${ }^{2}$ ) | 45 | 81 | 80.5 | 75.5 | 6 | 4.5 | 60 | 35 |
| CA 7-30...CA 7-37 | 45 | 81 | 97.5 | 92.6 | 6.5 | 4.5 | 60 | 35 |
| CA 7-43 | 54 | 81 | 100.5 | 95.6 | 6.5 | 4.5 | 60 | 45 |
| CA 7-60...CA 7-85 | 72 | 122 | 117 | 111.5 | 8.5 | 5.4 | 100 | 55 |

(DC control)

| Type | a | b | c | c1 | c2 | cd | d1 | d2') |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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) <br> $(\mathrm{mm})$ | (DC control) <br> $(\mathrm{mm})$ |
| :--- | :--- | :--- | :--- |
| Front mounting auxiliary contact | 2 or 4 pole | $\mathrm{cc1+39}$ | $\mathrm{dc1+39}$ |
| Side mounting auxiliary contact | 1 or 2 pole | $\mathrm{a}+9$ | $\mathrm{a}+9$ |
| Pneumatic timing module |  | $\mathrm{dc} 1+58$ | - |
| Electronic timing module | coil mounting | $\mathrm{b}+24$ | $\mathrm{~b}+24$ |
| Mechanical interlock | mounts between contactors | $\mathrm{a}+9$ | $\mathrm{a}+9$ |
| Mechanical latch |  | $\mathrm{c} 1 \mathrm{c} 1+61$ | - |
| Interface | coil mounting | $\mathrm{b}+9$ | - |
| Suppressor | coil mounting | $\mathrm{b}+3$ | $\mathrm{~b}+3$ |
| With inscriptions ${ }^{3}$ ) | labels | +0 | +0 |
|  | label support system V4N5 | +5.5 | +5.5 |

Notes: 1) DIN Rail mounting 35mm to EN 50022
${ }^{2}$ ) 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


Cat. No.

| CA 7-9/12/16/23 with CEP 7 or CEP 7S | 45 | 131 | 86 | 88.5 | 16.5 | 69 | 60 | 35 | 86.5 | 2 | 4.2 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CA 7-9/12/16/23 with CEP 7-B | 54 | 137 | 97 | 90.7 | 5.1 | 59 | 60 | 35 | 85.1 | 2 | 4.2 |
| CA 7-30/37 with CEP 7 or CEP 7S | 45 | 136.5 | 91.5 | 92 | 16.5 | 69 | 60 | 35 | 104 | 2 | 4.2 |
| CA 7-30/37 with CEP 7-B | 54 | 137 | 97 | 92.1 | 5.2 | 59 | 60 | 35 | 104.7 | 2 | 4.2 |
| CA 7-43 with CEP 7, CEP 7S or CEP 7-B | 54 | 136.5 | 91.5 | 93 | 22 | 69 | 60 | 45 | 107 | 2 | 4.2 |
| CA 7-60/72/85 with CEP 7, CEP 7S or CEP 7-B | 72 | 188.5 | 120 | 120 | 18 | 84.5 | 100 | 55 | 125.5 | 2 | 5.5 |

CEP 7 with separate mounting bracket



| General | CT 7-24 | CT 7-45 | CT 7-75 | CT 7-100 |
| :--- | :--- | :--- | :--- | :--- |
| Weight | $[k g] ~$ | 0.13 | 0.21 | 0.21 |

Standards IEC 947, EN 60 947, DIN VDE 0660, UL, LRS, GUS, CSA damp/heat, constant, to DIN, IEC 68, Part 2-3 damp/heat, cyclic, to DIN, IEC 68, Part 2-30

| Ambient temperature | open | $-25 \ldots+60^{\circ} \mathrm{C}$ |
| :--- | :---: | :--- |
|  | enclosed | $-25 \ldots+50^{\circ} \mathrm{C}$ |

Temperature compensation
continuous temperature range $-5 \ldots+40^{\circ} \mathrm{C}$ to IEC 947 , EN 60947; PTB: $-5 . . .+50^{\circ} \mathrm{C}$
Shock resistance (sinusoidal 10 ms ) [G]
10

| Protection | IP 00 IP 2LX |
| :--- | :---: |
| Protection | touch proof (VDE 0106, Part 100) |

Contactor, timer and overload selection chart for auto transformer starters

| ATS kW | Line <br> contactor | Trans <br> contactor | Star <br> contactor | Timer | Overload |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{1 1}$ | CA 7-23-10 | CA 7-16-10 | CA 7-9-10 | RZ7 FSY2D | CEP 7-M32-32-10 |
| 15 | CA 7-30-00 | CA 723-10 | CA 7-12-10 | RZ7 FSY2D | CEP 7-M37-37-10 |
| 18.5 | CA 7-37-00 | CA 7-30-00 | CA 7-16-10 | RZ7 FSY2D | CEP 7-M37-37-10 |
| 22 | CA 7-43-00 | CA 7-30-00 | CA 7-23-10 | RZ7 FSY2D | CEP 7-M45-45-10 |
| 30 | CA 7-60-00 | CA 7-37-00 | CA 7-30-00 | RZ7 FSY2D | CEP 7-M85-85-10 |
| 37 | CA 7-72-00 | CA 7-43-00 | CA 7-30-00 | RZ7 FSY2D | CEP 7-M85-85-10 |
| 45 | CA 7-85-00 | CA 7-60-00 | CA 7-37-00 | RZ7 FSY2D | CEP 7-M85-85-10 |
| 55 | CA 6-85-11 | CA 7-60-00 | CA 7-43-00 | RZ7 FSY2D | CT 6-110 |
| 75 | CA 6-105-11 | CA 7-85-00 | CA 7-60-00 | RZ7 FSY2D | CT 6-150 |
| 90 | CA 6-140EI-11 | CA 6-85-11 | CA 7-72-00 | RZ7 FSY2D | CT 6-200 |
| $\mathbf{1 1 0 ~}$ | CA 6-170EI-11 | CA 6-105-11 | CA 7-85-00 | RZ7 FSY2D | CEF 1-41 |
| 132 | CA 6-210EI-11 | CA 6-140EI-11 | CA 6-105-11 | RZ7 FSY2D | CEF 1-41 |
| 150 | CA 6-250EI-11 | CA 6-140EI-11 | CA 6-105-11 | RZ7 FSY2D | CEF 1-41 |
| 185 | CA 6-300EI-11 | CA 6-210EI-11 | CA 6-140EI-11 | RZ7 FSY2D | CEF 1-41 |
| 220 | CA 6-420EI-11 | CA 6-210EI-11 | CA 6-140-EI-11 | RZ7 FSY2D | CEF 1-41 |

Contactor, timer and overload selection chart for star delta starters

| SDSkW | Line <br> contactor | Delta <br> contactor | Star <br> 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 6-140EI-11 | CA 6-140EI-11 | CA 7-85-00 | RZ7 FSY2D | CT 6-150 |
| 150 | CA 6-170EI-11 | CA 6-170EI-11 | CA 6-85-00 | RZ7 FSY2D | CTA 6-200 |
| 185 | CA 6-210EI-11 | CA 6-210EI-11 | CA 6-105-11 | RZ7 FSY2D | CEF 1-41 |
| 220 | CA 6-210-EI-11 | CA 6-210-EI-11 | CA 6-140-EI-11 | RZ7 FSY2D | CEF 1-41 |



CT 7-24, CT 7-45, CT 7-75

| Type | For contactor | a | b | b1 | c | c1 | c2 | c3 | c4 | c5 | ød | d1 | d2 | e1 | e2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CT 7-24 | CA 7-9... 23 | 45 | 127 | 83 | 96 | 91 | 15 | 51 | 39 | 5 | 4.5 | 60 | $35^{1}$ ) | 16.5 | 51 |
|  | CA 7-30... 37 | 45 | 127 | 83 | 105 | 99 | 6.5 | 51 | 39 | 9.5 | 4.5 | 60 | $35^{\text {1 }}$ ) | 16.5 | 51 |
| CT 7-45 | CA 7-30... 37 | 60 | 140 | 97 | 105 | 99 | 6.5 | 51 | 39 | 6.5 | 4.5 | 60 | $35{ }^{\text {I }}$ ) | 16.5 | 57 |
|  | CA 7-43 | 60 | 140 | 97 | 107 | 103 | 6.5 | 51 | 39 | 8.5 | 4.5 | 60 | 45 ) | 16.5 | 57 |
| CT 7-75 | CA 7-60... 85 | 72 | 185 | 120 | 125 | 120 | 8.5 | 51 | 39 | 28.5 | 5.4 | 100 | $55^{1}$ ) | 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 | $35^{\text { }}$ ) | 16 | 3 |
| CT 7-75 | 60 | 90 | 44 | 117 | 112 | 15 | 51 | 5.4 | 74 | $50^{\text { }}$ ) | 16 | 0 |
| CT 7-90 | 100 | 120 | - | 135 | - | 5 | 51 | 6.2 | 74 | $80^{1}$ ) | 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

## Pump Seal Failure <br> Protection Control

ADDITIONAL DATA
SUPPLY VOLTAGE $110 \mathrm{v} / 240 \mathrm{~V}-20+10 \%$
ELECTRODE VOLTAGE B volts A.C. (4v eally type)
frequency electrode voltage Nominal 50 Hz
TEMPERATURE RANGE $0-55 C$
SENSITIVITY 40 K ohms.
relay contact data
R.T. 1
R.T. 1 b. LIFE $\quad 0^{\circ}$ Operations $10^{\circ}$ Operations
The R.T. 1 has one only single change over contact.
The R.T. 1.b has one normally closed and one nomally opened electrically isolated contact. Contact isolation voltage 2000 A.C. (Contacts 1 \& 2)
WARFANTY: TWENTY-FOUR MONTHS FROM furchase date
PIN OUT

## TYPE R.T. 1

| Pin 1 | Supply in | Supply in |
| :---: | :---: | :---: |
| Pin 2 | Earth/Frame | EarthFrame |
| Fin 3 | Electrode | Electrode |
| Pin 4 | Latch | N/Open Relay (1) |
| Pin 5 | Common Relay | N/Closed Relay (2) |
| Pin 6 | N:Open Relay | N/Open Relay (1) |
| Pin 7 | NiClosed Rolay | N/Closed Relay (2) |
| Pin 8 | Supply in | Supply in |

(Snon 2\& 4 to latch R.T. 1 only)

## DIMENSIONS



## GENERAL DESCRIPTION

The R.T. 1 is a specially modified Liquid Level Control whose sensitivity and response time have been modified to detect seal failures, primarily in submersible electric pumps. The intrusion of fluids from the pump chamber into the intermediate oil chamber changes the conductivity of the insulating oil, therefore allowing early detection of lower seal failure.

## FEATURES

Special allowance has been made for the fact that the detector electrode cable is often run internally with the mains cable causing heavy induction to occur. The R.T. 1 has the necessary protection to minimise this effect. Latching is incorporated in the R.T. 1 only and this allows indication to remain even when small amounts of fluid are intermittently moving around in the oil. (Join Pin 2 \& 4.)

## ELECTRODE CHARACTERISTICS

The electrode should be mounted approximately 1 cm above the floor of the oil chamber and should be constructed of a non-corrosive material. The electrical leakage caused by the conductive fluid in the oil will form a minute circuit between the electrode and earth.

## ELECTRODE VOLTAGES

A.C. voltage is used on the detection electrode. This is to stop electrolysis of the pump casing which would occur if D.C. was used.

## SENSITIVITY

Sensitivity is a fixed value and cannot be altered. This setting was developed after extensive field testing and was carried out in conjunction with a large pump manufacturer.
Special sensitivity settings can be obtained at factory level for a particular application, however, inquiries of this nature should be directed to our agents for further information.

## RESPONSE TIME

The R.T. 1 has a slow response time, typically greater than 200 ms . This allows small globules to float under the electrode in the oil chambers without detection. This feature is invaluable for alleviating false trips due to weeping of the lower seal which would not have any detrimental effect to the pumps performance.


## Operating Instructions

 VEGAWELL 72 - 4 ... 20 mA/HART ${ }^{\text {® }}$

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## 1 About this document

### 1.1 Function

This operating instructions manual gives you all the information you need for quick set-up and safe operation of VEGAWELL 72. Please read this manual before you start set-up.

### 1.2 Target group

This operating instructions manual is directed to trained specialist staff. The contents of this manual should be made available to these personnel and put into practice by them.

### 1.3 Symbolism used



Information, tip, note
This symbol indicates helpful additional information.


Caution
This symbol informs you of a dangerous situation that could occur. Ignoring this cautionary note can impair the person and/or the instrument.

## Ex applications

This symbol indicates special instructions for Ex applications.

- List

The dot set in front indicates a list with no implied sequence.
-> Action
This arrow indicates a single action.

## 1 Sequence

Numbers set in front indicate successive steps in a procedure.

## 2 For your safety

### 2.1 Authorised personnel

All operations described in this operating instructions manual must only be carried out by trained and authorised personnel. For safety and warranty reasons, any internal work on the instruments must only be carried out by VEGA personnel.

### 2.2 Appropriate use

VEGAWELL 72 is a suspension pressure transmitter for level and gauge measurement.

### 2.3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system parts through incorrect mounting or setting.

### 2.4 General safety instructions

VEGAWELL 72 is a high-tech instrument requiring the strict observance of standard regulations and guidelines. The user must take note of the safety instructions in this operating instructions manual, the coun-try-specific installation standards (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

### 2.5 CE conformity

VEGAWELL 72 pressure transmitter is CE conform to EMVG (89/336/EWG) and NSR (73/23/EWG) and fulfils the NAMUR recommendation NE 21.

Conformity has been judged acc. to the following standards:

## - EMVG

- Emission EN 61326: 1997/A1: 1998 (class B)
- Immission EN 61326: 1997/A1: 1998
- NSREN61010-1: 1993.


### 2.6 Safety instructions for Ex areas

Take note of the Ex-specific safety instructions for Ex applications. These are part of the operating instructions manual and come with Ex-approved instruments.

### 2.7 Environmentally responsible behaviour

Protection of the environment is one of our most important duties. That is why we have introduced an environmental management system with the goal of continuously improving company environmental protection. The environmental management system is certified acc. to DIN EN 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual.

## 3 Product description

### 3.1 Configuration

## Scope of delivery

The scope of delivery encompasses:

- VEGAWELL 72 pressure transmitter with suspension cable
- optional straining clamp, screwed connection or plastic housing with cable locking
- documentation
- this operating instructions manual
- test protocol
- Ex-specific safety instructions (with Ex versions) and if necessary further certificates.

Components
VEGAWELL 72 consists of the following components:

- transmitter
- suspension cable

The components are available in different versions. By combining them in various ways in the order code, a great variety of instrument versions can be created (see technical data in the supplement).


Fig. 1:
Example of a VEGAWELL 72 with screwed connection

### 3.2 Principle of operation

## Area of application

## Physical principle

VEGAWELL 72 is used for level and gauge measurement in wells, basins and atmospherically open vessels, especially in drinking water and waste water treatment.

The sensor element is a CERTEC ${ }^{\oplus}$ measuring cell with a flush ceramic diaphragm. The hydrostatic pressure induces a capacitance change in the measuring cell via the ceramic diaphragm. This capacitance change is converted into a $4 \ldots 20 \mathrm{~mA}$ output signal.


Fig. 2:
The CERTEC ${ }^{\circledR}$ measuring cell is mounted flush in the pressure transmitter

Power supply
The VEGAWELL 72 has a two-wire $4 \ldots 20 \mathrm{~mA} / \mathrm{HART}^{\oplus}$ electronics requiring a power supply unit with :

- $12 \ldots 36$ V DC (non-Ex instrument)
- 12 ... 29 V DC (EEx ia instrument).

[^3]
### 3.3 Adjustment

VEGAWELL 72 with $4 \ldots 20 \mathrm{~mA} / \mathrm{HART}{ }^{\oplus}$ electronics can be adjustd with three different adjustment media:

- adjustment module with external connection housing VEGADIS 12
- with PACTware ${ }^{\text {TM }}$ or another adjustment software acc. to FDT/DTM standard and PC
- HART ${ }^{\oplus}$-handheld.

The entered parameters are generally saved in VEGAWELL 72 , if you adjust with VVO they can also be saved in the PC.

### 3.4 Storage and transport

Packaging

## Climatic conditions

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test acc. to DIN 55439.

The packaging consists of environmental-friendly, recyclable cardboard. Dispose of the packing material via specialised recycling companies.

- Storage and transport temperature $-50^{\circ} \mathrm{C}$ up to ${ }^{1)}$
- Relative humidity $20 \ldots 85 \%$.

1) See technical data, product temperature under process conditions.

## 4 Mounting

### 4.1 Selecting the installation position

Keep the following points in mind when selecting the installation position:

- Lateral movements of the transmitter can cause measurement errors.
$\rightarrow$ Mount VEGAWELL in a calm area or in a suitable protective tube.
- The suspension cable contains a capillary tube for atmospheric pressure compensation.
-> Lead the cable end to a dry environment or into a suitable terminal housing.

i
VEGA recommends VEGADIS 12 for this purpose. It contains connection terminals and a filter element for pressure compensation. For outdoor mounting, a suitable protective cover is available. The version with plastic housing includes terminals and filter elements in the plastic housing.

- The measuring cell cover prevents mechanical damage to the measuring cell. It may only be removed when the instrument is used in extremely dirty water.


Fig．3：
Mounting example for deep well measurement

### 4.2 Mounting procedure with straining clamp



Fig. 4:
straining clamp
Mount VEGAWELL 72 with straining clamp as follows:
1 Hang the straining clamp on a suitable wall hook
2 Lower VEGAWELL to the requested measuring height
3 Move the clamping brackets upward and push the suspension cable between the clamping brackets
4 Hold the suspension cable, shift the clamping brackets downward and fix with a light blow.

Dismounting is carried out in reverse order.

### 4.3 Mounting procedure with screwed connection



Fig.5:
Screwed connection
Mount VEGAWELL 72 with screwed connection as follows:
1 Weld mounting boss G1 $1 / 2$ A or $11 / 2$ NPT into the vessel top

We recommend the following VEGA mounting accessory:

- Mounting boss G1½A of stainless steel 1.4571, article no. 2.21 993.

2 Lower VEGAWELL through the mounting boss to the requested height
3 Slide the seal ring ${ }^{11}$ for the screwed connection over the suspension cable
4 Lead the suspension cable from below through the opened screwed connection
5 Slide the seal cone and cone bushing over the suspension cable, fasten manually with the seal screw
6 Turn the screwed connection into the socket, fasten with SW 30, then fasten seal screw with SW 19

1) only with $G 11 / 2 A$

Height correction:
1 Loosen seal screw with SW 19
2 Slide seal cone and cone bushing to the requested position on the cable
3 Fasten seal screw
Dismounting is carried out in reverse order.

### 4.4 Mounting procedure with plastic housing



Fig. 6:
Plastic housing with socket G1½A
Mount VEGAWELL 72 with plastic housing as follows:
1 Weld mounting boss G112A into the vessel top


We recommend the following VEGA mounting accessory:

- Mounting boss G1½A of stainless steel 1.4571, article no. 2.21993

2 Slide the seal ring over the screwed connection
3 Slide the transmitter through the mounting boss
4 Screw the mounting boss G11/2A into the socket, the fasten with SW 46.

Dismounting is carried out in reverse order.

## 5 Connecting to power supply

### 5.1 Preparing the connection

Note safety instructions tions for Ex applications

Always observe the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltages are expected, overvoltage arresters for the power supply side should be installed.

We recommend VEGA overvoltage arresters ÜSB 6236G.X.

In hazardous areas you should take note of the appropriate regulations 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.

Provide a reliable separation between the supply circuit and the mains circuits acc. to DIN VDE 0106 part 101. The VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as all VEGAMETs meet this requirement. When using one of these instruments, protection class III is ensured for VEGAWELL 72.

Bear in mind the following factors regarding supply voltage:

- Reduction of the output voltage of the power supply unit under nominal load
- Influence of additional instruments in the circuit (see load values in Technical data).

[^4]
## Select connection cable

VEGAWELL 72 is connected with standard two-wire cable. When connecting to VEGADIS 12, the cable must have an outer diameter of 5 ... 9 mm to ensure the seal effect of the cable entry.


Fig. 7:
Connection to the power supply
Middle: via VEGADIS 12
Bottom: direct (with plastic housing)
If strong electromagnetic interference is expected, shielded cable is recommended. The screen should be grounded on both ends ${ }^{11}$.

Select connection cable for Ex applications

Take note of the corresponding installation regulations for Ex applications.

## 5．2 Connection procedure

## Direct connection to power supply

Proceed as follows：
1 Lay the suspension cable ${ }^{1)}$ up to the terminal compartment．The bending radius must be at least 25 mm
2 Connect the individual wires to the terminals acc． to the wiring plan．

Proceed as follows：
1 Snap VEGADIS 12 into carrier rail or screw onto mounting plate
2 Loosen cover screws and detach cover
3 Lead suspension cable through the cable entry into VEGADIS 12²
4 Loosen terminal screws with a screwdriver
5 Insert wire ends into the open terminals acc．to the wiring plan
6 Tighten terminal screws with a screwdriver
7 Check the hold of the wire ends in the terminals by lightly pulling on them
8 Tighten the compression nut of the cable entry， the seal ring must encircle the cable completely
9 Connect supply cable acc．to steps 3 to 8
10 Screw the housing cover back on
The electrical connection is finished．

Connection to power supply via plastic housing

Proceed as follows:
1 Loosen cover screws and detach cover
2 Lead the connection cable through the cable entry into the plastic housing
3 Loosen terminal screws with a screwdriver
4 Insert wire ends into the open terminals acc. to the wiring plan
5 Tighten terminal screws with screwdriver
6 Check the hold of the wire ends in the terminals by lightly pulling on them
7 Tighten the compression nut of the cable entry, the seal ring must encircle the cable completely
8 Screw the housing cover back on.
The electrical connection is finished.

### 5.3 Wiring plans

## Direct connection

Fig. 8:
Wire assignment, suspension cable

## Connection via

 VEGADIS 12

Fig. 9:
Terminal assignment VEGADIS 12

## Connection via plastic housing



Fig. 10:
Terminal assignment of the plastic housing

1) Connect screen to $\equiv$ terminal. Connect ground terminal on housing exterior to ground as prescribed. The two terminals are galvanically connected.

## 6 Set-up

After mounting and electrical connection, VEGAWELL 72 is ready for operation.
-> Switch on power supply
The electronics carries out a self-test for approx. 2 s . Then VEGAWELL 72 delivers a current of $4 \ldots 20 \mathrm{~mA}$ according to the actual level.

### 6.1 With VEGADIS 12

Scope of adjustment

Adjustment elements

- zero - beginning of the measuring range
- span - end of the measuring range
- ti- integration time


Fig. 11:
Adjustment elements of VEGADIS 12

## Adjustment system

Set-up procedure

- Select the requested function with the rotary switch
- With the [+] and [-] key you set the signal current or the integration time
- Finally, the rotary switch is set to position „OPERATE".

The set values are transferred to the EEPROM memory and remain there even in case of voltage failure.

To adjust with VEGADIS 12, proceed as follows:
1 Open housing cover
2 Connect handheld multimeter to terminals 10 and 12
3 Beginning of the meas. range: Set rotary switch to „zero"
4 Empty the vessel/basin or pull out VEGAWELL completely
5 Set a current of 4 mA with the [+] and [-] keys
6 End of the meas. range: Set rotary switch to "span"
7 Fill the vessel/basin or lower VEGAWELL completely
8 Set a current of 20 mA with the [+] and [-] keys
9 Operation: Set the rotary switch to "OPERATE"
10 Close the housing cover.
The adjustment data are effective, the output current 4 ... 20 mA corresponds to the actual level.

### 6.2 With PC and PACTware ${ }^{\text {TM }}$

## Connect the PC



Fig. 12:
Connection of the PC to VEGADIS 12 or to the communication resistance
Required components:

- VEGAWELL 72
- PC with PACT ware ${ }^{T M}$
- VEGACONNECT 3
- Communication resistance $\geq 250$ Ohm
- Power supply unit.

The individual setup steps are described in the online help texts of PACT ware ${ }^{T M}$.

Take note of the appropriate installation regulations for Ex applications.

## 7 Maintenance and fault rectification

## 7．1 Maintenance

In standard operation，VEGAWELL 72 pressure trans－ mitter is maintenance－free．

When the instrument is being cleaned externally，care should be taken to avoid mechanical damage，espe－ cially to the diaphragm．Cleaning detergents should corrode neither the seal nor other components of VEGAWELL 72.

## 7．2 Fault rectification

？ $4 \ldots 20 \mathrm{~mA}$ signal not stable
－level fluctuations
－＞set integration time via VEGADIS 12 or PACTware ${ }^{\text {TM }}$
－no atmospheric pressure compensation
－＞check capillaries，if necessary cut them clean
－＞check pressure compensation of VEGADIS 12， if necessary clean filter element
？ 4 ．．． 20 mA signal missing
－incorrect connection to power supply
－＞check connection acc．to chapter 5.3 and cor－ rect if necessary acc．to chapter 5.2
－no power supply
－＞check cables for line break and repair if neces－ sary
－power supply voltage too low or load resist－ ance too high
－＞check and adapt if necessary

For Ex applications the regulations for the wiring of intrinsically safe circuits must be observed．

### 7.3 Shortening the suspension cable

The suspension cable of all versions of VEGAWELL 72 can be shortened to any length. For the plastic housing version, proceed as follows:
1 Loosen cover screws and detach cover
2 Loosen screw terminals and remove the wire ends of the suspension cable from the screw terminals
3 Loosen the screws of the mounting plate and remove the mounting plate completely
4 Hold the hexagon on the screwed connection with spanner SW 46 and loosen seal screw SW 22

## Caution:

The seal screw is protected with Loctite rosa, take note of the breakaway torque.


Fig. 13: Step 4
5 Pull out the suspension cable from the screwed connection and slide the pressure screw, the cone bush and the seal cone off the cable
6 Remove filter attachment and stainless steel tube from the transparent capillary line


Fig. 14: Step 6 and 8
7 Shorten the suspension cable to the required length with a pair of pliers
8 Remove approx. 10 cm of cable mantle, strip approx. 1 cm insulation from wire ends, insert stainless stainless steel tube into capillary line and fasten filter attachment
9 Slideseal screw, cone bush and seal cone onto the suspension cable and lead the cable into the screwed connection, lead wire ends through opening in mounting plate
10 Tighten screws of the mounting plate and fasten wire ends in the screw terminals.

The cable shortening is finished.

### 7.4 Repairing the instrument

If it is necessary to repair VEGAWELL 72, please send the instrument to the following address: VEGA Grieshaber KG
Repair department
Am Hohenstein 1.13
77761 Schiltach

## 8 Dismounting

### 8.1 Dismounting procedure

Take note of chapters 4 „Mounting" and 5 "Connecting to power supply" and carry out the listed steps in reverse order.

### 8.2 Disposal

VEGAWELL 72 consists of materials which can be recycled by specialised recycling companies. We have purposely designed the electronic modules to be easily separable. Mark the instrument as scrap and dispose of it according to government regulations.

Materials: see technical data
If you cannot dispose of the instrument properly, please contact us about disposal methods or return.

## Supplement

## Technical data

## General data

Materials, wetted parts

- transmitter
- diaphragm
- suspension cable
stainless steel 1.4435, PVDF
sapphire-ceramic ${ }^{\circledR}$ (99.9 \% oxide
ceramic)
- meas. cell seal protective cover

PE, FEP, PUR

Materials, non-wetted parts

- straining clamp
stainless steel 1.4301
- closing screw
- plastic housing and external connection housing VEGADIS 12

PA

## Weights

- basic weight
- suspension cable
- straining clamp
- screwed connection
- plastic housing
stainless steel 1.4435
plastic PBT (Polyester)


## Input variable

Zero
Span
adjustable between $-20 \ldots+95 \%$ of nominal range
adjustable between $3.3 \ldots+120 \%$ of nominal range

| Nominal measuring range (gauge/absolute | Gauge pressure resistar | Low pressure resistance |
| :--- | :--- | :--- |
| $0 \ldots 0.1 \mathrm{bar} / 0 \ldots . \ldots \mathrm{kPa}$ | $15 \mathrm{bar} / 1500 \mathrm{kPa}$ | $-0.2 \mathrm{bar} /-20 \mathrm{kPa}$ |
| $0 \ldots 0.2 \mathrm{bar} / 0 \ldots . \mathrm{kPa}$ | $20 \mathrm{bar} / 2000 \mathrm{kPa}$ | $-0.4 \mathrm{bar} /-40 \mathrm{kPa}$ |
| $0 \ldots 0.4 \mathrm{bar} / 0 \ldots 40 \mathrm{kPa}$ | $30 \mathrm{bar} / 3000 \mathrm{kPa}$ | $-0.8 \mathrm{bar} /-80 \mathrm{kPa}$ |
| $0 \ldots 1.0 \mathrm{bar} / 0 \ldots 100 \mathrm{kPa}$ | $35 \mathrm{bar} / 3500 \mathrm{kPa}$ | $-1.0 \mathrm{bar} /-100 \mathrm{kPa}$ |
| $0 \ldots 2.5 \mathrm{bar} / 0 \ldots 250 \mathrm{kPa}$ | $50 \mathrm{bar} / 5000 \mathrm{kPa}$ | $-1.0 \mathrm{bar} /-100 \mathrm{kPa}$ |
| $0 \ldots 5.0 \mathrm{bar} / 0 \ldots 500 \mathrm{kPa}$ | $65 \mathrm{bar} / 6500 \mathrm{kPa}$ | $-1.0 \mathrm{bar} /-100 \mathrm{kPa}$ |
| $0 \ldots 10.0 \mathrm{bar} / 0 \ldots 1000 \mathrm{kPa}$ | $90 \mathrm{bar} / 9000 \mathrm{kPa}$ | $-1.0 \mathrm{bar} /-100 \mathrm{kPa}$ |
| $0 \ldots 25.0 \mathrm{bar} / 0 \ldots .2500 \mathrm{kPa}$ | $130 \mathrm{bar} / 13000 \mathrm{kPa}$ | $-1,0 \mathrm{bar} /-100 \mathrm{kPa}$ |

1) Absolute pressure up from 0 ... 1.0 bar.

Output variable

| Output signal | $4 \ldots 20 \mathrm{~mA} / \mathrm{HART}^{\circledR}$ |
| :--- | :--- |
| Resolution | $6 \mu \mathrm{~A}$ |
| Fault signal | $22 \mathrm{~mA}, 3.6 \mathrm{~mA}$ (adjustable) |
| Current limitation without fault | 20.5 mA |
| Integration time ${ }^{2)}$ | $0 \ldots 10 \mathrm{~s}$, adjustable |
| Rise time | 70 ms (ti : $0 \mathrm{~s}, 0 \ldots 63 \%$ ) |
| Fulfilled Namur recommendation | NE 43 |

## Accuracy ${ }^{3)}$

Reference conditions acc. to IEC 61298-1

- temperature
- relative moisture $45 \ldots 75 \%$
- air pressure $860 \ldots 1060 \mathrm{mbar}(86 \ldots 106 \mathrm{kPa}$ )

Determination of characteristics limit point adjustment acc. to DIN 16086 Characteristics linear

Deviation in characteristics ${ }^{4)}$

| Accuracy class | Turn down | Deviation in character |
| :--- | :--- | :--- |
| 0.25 | $1: 1$ | $<0.25 \%$ |
|  | up to $1: 5$ | $<0.3 \%$ |
|  | up to $1: 10$ | $<0.4 \%$ |
| 0.1 | $1: 1$ | $<0.1 \%$ |
|  | up to $1: 5$ | $<0.1 \%$ |
|  | up to $1: 10$ | $<0.2 \%$ |

## Influence of the ambient temperature

| Accuracy class | Turn down | Average temperature <br> coefficient of the zero <br> signal5) |
| :--- | :--- | :--- |
| 0.25 | $1: 1$ | $<0.15 \% / 10 \mathrm{~K}$ |
|  | up to $1: 5$ | $<0.225 \% / 10 \mathrm{~K}$ |
| 0.1 | up to $1: 10$ | $<0.3 \% / 10 \mathrm{~K}$ |
|  | $1: 1$ | $<0.05 \% / 10 \mathrm{~K}$ |
|  | up to $1: 5$ | $0.075 \% / 10 \mathrm{~K}$ |

2) The time required by the output signal to reach $63 \%$ of the actual height after a jump. After the triple integration time, the output signal has reached $95 \%$ of the height.
3) Similar to DIN 16086, DIN V 19259-1 and IEC 60770-1.
${ }^{4}$ Incl. hysteresis and repeatability relating to the nominal measuring range.
4) In the compensated temperature range of $0 \ldots 80^{\circ} \mathrm{C}$, reference temperature $20^{\circ} \mathrm{C}$.

## Long-term stability

Long-term drift of the zero signal ${ }^{6)} \quad<0.1 \%$ per 2 years

## Ambient conditions

Ambient temperature $\quad-40 \ldots+85^{\circ} \mathrm{C}\left(\mathrm{PE}+60^{\circ} \mathrm{C}\right)$

Storage and transport temperature $-40 \ldots+100^{\circ} \mathrm{C}$

## Process conditions

Product temperature depending on material
Suspension cable/Meas. cell seal

- PE/Niton
- PURNiton
$-20 \ldots+60^{\circ} \mathrm{C}$
- FEP/Kalrez

Calibration position
Influence of the installation position
Vibration resistance
$-20 \ldots+80^{\circ} \mathrm{C}$
$-10 \ldots+80^{\circ} \mathrm{C}$
upright, diaphragm points downward < $0.2 \mathrm{mbar} / 20 \mathrm{~Pa}$
mechanical vibrations with 4 g and $5 \ldots 100 \mathrm{~Hz}{ }^{7}$ )

## Electromechanical data

Suspension cable

- configuration
- wire cross-section
- wire resistance
- tensile load
- max. length
- min. bending radius
- diameter
- colour
- PE non-Ex/Ex
- PUR non-Ex/Ex
-FEP non-Ex/Ex
cable entry plastic housing and external connection housing VEGADIS 12

Screw terminals
four wires, one suspension cable one breather capillary screen braiding, foil, cover
$0.5 \mathrm{~mm}^{2}$
$\leq 0.036 \mathrm{Ohm} / \mathrm{m}$
$\geq 1.200 \mathrm{~N}$
1000 m (with VEGADIS 12: 200 m )
25 mm (with $25^{\circ} \mathrm{C}$ )
approx. 8 mm
black/blue
blue/blue
blue/blue

- $1 \times$ cable entry $\mathrm{M} 20 \times 1.5$ (cable-ø 5 ... 9 mm )
- $1 \times$ blind stopper M20x1.5
for cable cross-section $2.5 \mathrm{~mm}^{2}$, screen with $4 \mathrm{~mm}^{2}$

[^5]External energy

| Power supply | $12 \ldots 36 \vee$ DC |
| :---: | :---: |
| Permissible residual ripple |  |
| - <100 Hz $\mathrm{U}_{\text {ss }} \leq 1 \mathrm{~V}$ |  |
| $-100 \mathrm{~Hz} \ldots 10 \mathrm{kHz} \quad \mathrm{U}_{\mathrm{ss}}^{\text {ss }} \leq 10 \mathrm{mV}$ |  |
| ${ }^{\Omega}$ |  |
| 900 $\qquad$ voltage limit non-Ex sensor |  |
| HART® load |  |
|  |  |
| $0 \varliminf_{12} \overbrace{\text { is }}$ | power supply |

## Integrated overvoltage protection

| Nominal leakage current $(8 / 20 \mu \mathrm{~s})$ | 10 kA |
| :--- | :--- |
| Min. response time | $<25 \mathrm{~ns}$ |

## Electrical protective measures

Protection

- transmitter IP 68 (25 bar)
- plastic housing IP 65
- VEGADIS 12

IP 65
protection class
III
Overvoltage category
III

## Approvals ${ }^{8)}$

ATEX II 2G EEx ia IIC T6, ship approval
8) Deviating data for Ex applications see separate safety instructions

## Dimensions



From the left side: standard version, version for deep wells, version with PE coating, standard version with housing

## CE conformity declaration



## Konformitätserklärung

Declaration of conformity Déclaration de conformité


VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach
erklärt in alleiniger Verantwortung, daß das Produkt / declare under our sole responsibility that our product / déclare sous sa seule responsabilité que le produit

VEGAWELL 72
auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt / to which this declaration relates is in conformity with the following standards / auquel se réfère cette déclaration est conforme aux normes

EN 61326 : 1997 / A1 : 1998 (Klasse B) EN 61326 : 1997 / A1 : 1998 EN 61010-1: 1993
gemäß den Bestimmungen der Richtlinien / following the provision of Directives / conformément aux dispositions des Directives

> 73/23 EWG
> 89/336 EWG

Schiltach, 16.09.2002


Josef Fehrenbach Entwicklungsleitung

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www.vega.com

\section*{| ISO 9001 |
| ---: | ---: | <br> ( $\epsilon$ <br> Cx}

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and and processing systems correspond to the latest information at the time of printing.

## Thermistor protection relay Type RT 3 - ordering information

Refer catalogue 2263


Cat. No. RT 3-A


Cat. No. RT 3-M


Cat. No. RT 3-U

Application
The RT 3 used in conjunction with PTC - Sensors, provides for protection and full utilisation of motors in all duty conditions, such as overload, intermittent duty, high switching frequency, single phasing and under and over-voltage.

Description
The Sprecher + Schuh thermistor motor protection relay has been designed for reliable overload protection of squirrel cage motors, but is equally suited to other thermal protection duties.

Thermistor protection relay RT 3
O For surface mounting
O With inadvertent contact protection to IP 20.
O Output relay (with $1 \mathrm{~N} / \mathrm{O}$ and 1 N/C contacts) in closed circuit connection.

Model / features
RT 3-A RT 3-M RT 3-U

| Thermal overload protection | $O$ | $O$ | $O$ |
| :--- | :--- | :--- | :--- |
| Short-circuit and open-circuit protection for sensor | $O$ | $O$ | $O$ |

measuring circuit

| Trip indicator (red LED) | $O$ | $O$ | $O$ |
| :--- | :---: | :---: | :---: |
| Automatic reset | $O$ | $O$ | $O$ |
| Manual reset |  | $O$ | $O$ |
| Remote reset (external button) N/O | $O$ | $O$ |  |

Storage of status due to power failure

| more than 3 hours at $\pm 25^{\circ} \mathrm{C}$ | O |
| :--- | :---: |
| unlimited (Not temperature - dependent) | O |
| «Test» -button | O |
| Power-on indication (green LED) | O |



Ordering information Model Cat. No.

| Thermistor protection relay | RT 3-A | ReRT 3-A =i. V...] |
| :---: | :---: | :---: |
|  | RT 3-M | \|RRT 3-MM\&.V... |
|  | RT 3-U | $[\mathbf{R T} 3$-U $=. . \mathrm{V} \ldots]$ |
| Order number supplement | AC 24, 48, 110, 240, 415, 440V |  |
| Extra for DC supply voltage | DC 24, 48V | $\text { KKrm }-., \mathrm{V} \text { DC }$ |



Technical data

| Supply | Rated sup | ply volta | $\mathrm{U}_{5}$ |  | AC |  | 24, 4 | 0,24 | , 440V |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | DC |  | 24, 4 |  |  |
|  | Permiss | le fluctu | ons |  | AC |  | 0.8.. | $\mathrm{J}_{\mathrm{s},} 5$ |  |
|  |  |  |  |  | DC |  | 0.9.. |  |  |
|  | Power | nsumption |  |  | AC |  | 1.5 | 2W) | 2 W |
| Output relay contact data | contacts | lectrica | isola |  |  |  | 1 ma | nd 1 |  |
| Operating voltage |  |  | M] | 24 | 48 | 110 | 240 | 415 | 440 |
| Continuous thermal current |  |  | [A] | 4 | 4 | 4 | 4 | 4 | 4 |
| Rated operational current with | with $A C$ | AC 15 | [A] | 4 | 4 | 4 | 3 | 2 | 1.5 |
| Rated operational current with | with DC |  |  |  |  |  |  |  |  |
| With protection circuit ${ }^{1}$ ), UR | $=100 \mathrm{~ms}$ |  | [A] | 0.6 | 0.6 | 0.5 | 0.5 | - | - |
| Max. perm. make/break curr | rent |  | [A] | 44 | 44 | 44 | 33 | 22 | 16.5 |
| Rated current of back-up | Max. fas | acting (D) | 16A |  |  |  |  |  |  |
| fuse | Slow-blow | (DT) | 10A |  |  |  |  |  |  |
| Ambient temperature | Normal | peration |  |  | $-25^{\circ}$ | $+60^{\circ} \mathrm{C}$ |  |  |  |
|  | Storage | in dry room |  |  | $-40^{\circ}$ | $+60^{\circ} \mathrm{C}$ |  |  |  |
| Terminals | open ter | inals |  |  | (cap |  |  |  |  |
|  | connecti | n wire cros | s-sec |  | 2× | $\mathrm{m}^{2} \sin$ | wire or |  |  |
|  |  |  |  |  | $2 \times$ | $\mathrm{m}^{2}$ with | ferru |  |  |
| Sensor measuring circuit | O Max | cold resis | of PT | sor c |  |  | 1500 |  |  |
|  | O Max. sens | No. of ser rs acc. to | $\begin{aligned} & \text { es cor } \\ & \text { IEC } / \end{aligned}$ |  |  |  | 6 |  |  |
|  | O Resp | nse leve |  |  |  | C... +6 | 3300 | $00 \Omega$ |  |
|  | $\bigcirc$ Res | level |  |  | $v A=$ | .... + | 1800 | $00 \Omega$ |  |
|  | O Resp sens | nse leve circuit | with | ircuit | $v A=$ | ...+6 | $\leq 15 \Omega$ |  |  |
|  | O Mea | ring vol | ge acc | EC 34 |  |  | DC |  |  |
|  | Measur | g line |  |  |  |  |  |  |  |
|  | Min. cros | s-sectio |  | [mm | 0.5 | 0.75 | 1 | 1.5 | 2.5 |
|  | Max. len |  |  | [m] | 200 | 300 | 400 | 600 | 1000 |

RT3 to motor. Installation; up to 20 m parallel, up to 300 m twisted, longer than 300 m , screened.

| Reset | RT 3-A | automatic |
| :--- | :--- | :--- |
|  | RT 3-M | manual or automatic ${ }^{1}$ ) |
|  | RT 3-U | manual or automatic ${ }^{1}$ ) |


|  | PTC sensor characteristics acc. to IEC/TC2 proposal |  | TNF: Rated response temperature |
| :---: | :---: | :---: | :---: |
| Trip memory | Storage time | RT 3-M | at $25^{\circ} \mathrm{C}>3 \mathrm{~h}$ |
| in event of power supply |  |  | at $40^{\circ} \mathrm{C}>1 \mathrm{~h}$ |
| failure (zero-voltage |  |  | at $60^{\circ} \mathrm{C}>15 \mathrm{~min}$ |
| safeguard) |  | RT 3-U | unlimited (not temperature-dependent) |
| Remote reset with RT 3-M, RT 3-U | External contact at r1-r2 ${ }^{2}$ ) |  | potential-free make contact |
|  | Max. line length for remote |  | up to 300 m twisted |
|  | reset |  | up to 1000 m screened |

[^6]Electronic motor protection relay
Type RT 3 - technical information

Refer catalogue 2263

## Hole plan RT 3



Sensor measuring circuit


Terminals r 1 and r 2 only available on the RT 3-M \& U


Installation
The thermistor protection relay RT 3 is designed for surface mounting with screw fixing according to hole plan EN 50002 or for snap-on fixing to a DIN rail EN 50 022-35×7.5.
Arrangement, assignment and marking of terminals in accordance with EN 50 005. The mounting position of the RT 3 does not influence its function.
Testing thermistor relays RT 3
The thermistors are connected to terminals T1 and T2. If they are removed the RT 3 relay will trip. (Open circuit protection built in).
If the terminals $T 1, T 2$ are shorted the RT 3 relay still trips. (Short circuit protection built in).
The relay should be checked using a variable resistor.
$3.3 \mathrm{k} \Omega=\operatorname{trip}( \pm 300 \Omega)$
$1.8 \mathrm{k} \Omega=\operatorname{reset}( \pm 300 \Omega)$
$<15 \Omega=$ trip (shorted thermistor)
normal operation $50 \ldots 200 \Omega$ (max. 1500 2 ).

Control circuit
Impulse contact control


The contacts 13-14 and 21-22 of the output relay are drawn in their power-off position A1-A2.


ABB

# ABB AUTOMATION 

## The Company

ABB Automation is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.
The NAMAS Calibration Laboratory (No. 0255) is just one of ten flow calibration plants operated by the Company, and is indicative of ABB Automation's dedication to quality and accuracy.

Lenno, Italy - Cert. No. 9/90A


Stonehouse, U.K.

## Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

## Caution.

An instruction that draws attention to the risk of damage to the product, process or surroundings.

Note.
Clarification of an instruction or additional information.

## Information.

Further reference for more detailed information or technical details.

Although Warning hazards are related to personal injury, and Caution hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all Warning and Caution notices.

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of Marketing Communications Department, ABB Automation.

## Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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## 1 INTRODUCTION

```
MagMasterm is a range of high performance
electromagnetic flowmeters for the
measurement of electrically conductive fluids
and slurries, and is normally supplied as a
calibrated system, with the transmitter, factory
configured, to a supplied full-bore or insertion
probe sensor.
A wide range of options is available to suit most applications, including:
Integral or remote transmitter.
Glass loaded polypropylene or aluminium transmitter housing.
Combined Hart \({ }^{\text {TM }}\) and Keypad support in the aluminium housing transmitter.
Flanged or wafer style sensors.
Insertion Probes.
Approved Versions, including: Hazardous area operation. Hygienic. HART \({ }^{\text {TM }}\) communication protocol.
```


## Warning.

For MagMaster Approved /Hazardous Versions see the full installation manual.

## Warning.

- Installation and maintenance must only be carried out by suitably trained personnel.
- All relevant sections of this manual must be read before selecting a location.
- Safety requirements of this equipment, any associated equipment and the local environment must be taken into consideration.
- The installation and use of this equipment must be in accordance with relevant national and local standards.


## 2 MECHANICAL INSTALLATION

### 2.1 Unpacking



Fig. 2.1 Unpacking

### 2.2 Installation Conditions



Fig. 2.2 Spillage


Fig. 2.3 Lagging (High Temperature)



Fig. 2.5 Vibration


Fig. 2.6 Localised Heat


Fig. 2.7 Straight Pipe Requirements


Fig. 2.9 Within Temperature Limits


Fig. 2.10 Cable Routing


Fig. 2.11 Within Environmental Rating


Fig. 2.12 Underground


Fig. 2.13 Above Ground


Fig. 2.14 Temperature Difference


Fig. 2.15 Shade

## .. 2 MEĊHANICAL INSTALLATION

### 2.3 Mechanical Installation

### 2.3.1 Transmitters



Fig. 2.16 Dimensions

### 2.3.2 Sensors

## Caution

- Do NOT exceed the maximum working pressure marked on the equipment.
- Use stainless steel (austenitic) bolts, studs and nuts for flanged sensors below 200 mm .


Fig. 2.17 Gasket Fitting


Fig 2.18 Wafer Type Sensors

## 3 ELECTRICAL INSTALLATION

### 3.1 Grounding (Fig. 3.1, 3.2)



Fig. 3.1 Pipelines


Fig. 3.2 Pipelines with Cathodic Protection

## ... 3 ELECTRICAL INSTALLATION

### 3.2 Cables

### 3.2.1 Cable (Remote Versions only)



### 3.2.2 Cable (Alternative Type - North American Wiring Practice)



Fig. 3.5 Cable Identification (North American Wiring Practice)


Fig. 3.6 Cable Preparation (North American Wiring Practice)

### 3.2.3 Cable Glands (IEC Installation Practice)



Warning.

- Rigid conduit must not be fitted to the transmitter.
- Transmitter conduit adaptors must incorporate a face seal.


## ... 3 ELECTRICAL INSTALLATION

### 3.2.4 Conduit Adapters and Cable Glands (North American - 0.5in)



Fig. 3.8 Conduit Adapters and Cable Glands


Fig. 3.9 Connection Requirements

### 3.3 Connection Requirements

The transmitter and sensor are supplied as a matched system. Check serial numbers to ensure they are matched.

### 3.3.1 Sensors

Remote sensors are usually supplied with an integral cable and potted connections. If the sensor has been supplied unpotted, connections must also be made to the sensor terminal box and then potted on completion with the supplied potting material - See Appendix A.

## Caution. (Remote versions)

- Remove any exposed black conductive layer from under coaxial screens.
- Make connections only as shown.
- Sleeve all bare wiring.
- Twist RED and YELLOW cores lightly together.
- Twist WHITE and GREY coaxial cables lightly together.
- Maintain Environmental Protection at all times.
- Conduit connections must provide cable entry sealing.

ii
Information. (Remote versions)

- Refer to ENVIRONMENTAL PROTECTION (Appendix A).
- Internal appearance of Terminal Box may vary from that shown.


Fig. 3.10 Sensor Terminal Box Connections (Remote version)

## North American Wiring Practice



## ... 3 ELECTRICAL INSTALLATION

### 3.3.2 Transmitters (All versions)



Fig. 3.12 Transmitter Connection Terminal access

## Caution.

- Remove any exposed black conductive layer from the inner insulation of both coaxial cables.
- Substitute sensor cable of any kind is not acceptable.
- Do not make connections except as shown.
- Twist cable pairs together as shown.
- Sleeve ALL bare wires.
- Sensor cable may only be joined using company supplied junction box available separately.


Fig. 3.13 Sensor Cable Connections at the Transmitter (Remote version)

## North American Wiring Practice



Fig. 3.14 Sensor Cable Connections at the Transmitter (North American Wiring Practice)

### 3.3.3 MagMaster-CalMaster Adapter

When a MagMaster Transmitter is fitted with an adaptor board for use with a CalMaster Verification Unit, wiring from the sensor to this adaptor board is shown in the following diagram.

To wire the adaptor plug, carefully pull off the plug from the adaptor board, connect the wires, using only a screwdriver with a 2.5 mm blade to tighten the terminal screws, and replace the plug.


Fig 3.15 Fitting the Sensor Wiring onto the Adaptor

## .. 3 ELECTRICAL INSTALLATION

### 3.4 Input/Output Connections

## Caution.

- Refer to SPECIFICATION SHEET for Input/Output ratings.
- Inductive loads must be suppressed or clamped to limit voltage swings
- Capacitive loads must be inrush current limited.
- Hazardous area requirements are not considered in the following pages.

Note. The connection terminal markings in the metal housed transmitter are identical to those in the standard transmitter as shown in this section. However, the supply connection in the former is made using a non-reversible plug (provided).
3.4.1 Frequency Outputs - Fig. 3.16


Fig. 3.16 Frequency Output Connections

### 3.4.2 PLC Interface - Fig. 3.17



Fig. 3.17 Frequency Output Connections

## 3 ELECTRICAL INSTALLATION

### 3.4.3 Alarm Outputs - Fig. 3.18

Information.

- Inductive loads may be suppressed by diodes (D) - 1N4004 or similar.
- Inrush currents are limited to 1 Amp by resistor R - e.g. $27 \Omega 1 \mathrm{~W}$ for 24 V systems.
- Operation of outputs is programmable - see Configuration Manual for details.
- Frequency and Alarm outputs share a common return with contact input.
- External isolators not normally required, as the pulse, alarm and contact circuits are electrically separated from all other Magmaster connections.


Fig. 3.18 Alarm Output Connections

### 3.4.4 Contact Input - Fig 3.19



## ... 3 ELECTRICAL INSTALLATION

### 3.4.5 Current Output - Fig. 3.20 and 3.21



## Information.

- Output is fully programmable - see Programming Guide.
- Output is electrically separated from all other MagMaster connections.
- External isolators are not normally required and may significantly limit accuracy if used.


Fig. 3.20 Current Output Connections: Standard


Fig. 3.21 Current Output Connections: Dual Current Option

## 3 ELECTRICAL INSTALLATION...

### 3.4.6 Computer Connection - Fig. 3.22 and 3.23

Information. RS422/423 option is electrically isolated from all other MagMaster connections.


Fig. 3.22 RS 422 Connections (Balanced)


Fig. 3.23 RS 423 Connections (Single Ended or RS 232)

## ... 3 ELECTRICAL INSTALLATION

### 3.4.7 Power Supply Connections - Fig. 3.24 and 3.25

## Warning.

- DISCONNECT THE SUPPLY FROM ANY CABLES BEING TERMINATED ON THE TRANSMITTER.
- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- Ensure that the cover of the metal housed transmitter is never cross threaded. The threads are greased (as supplied).
- Ensure that the grease is in good condition when fitting the cover, and replenish as required with a grease suitable for aluminium threads.


Fig. 3.24 Power Supply Connections (A.C. Version Transmitter)


Fig. 3.25 Power Supply Connections (D.C. Version Transmitter)

## 4 STARTUP AND OPERATION

## Warning.

- Ensure Plant Safety while configuring, at all times.
- The 9-way D-Type Serial Link is not isolated. Ensure that it is NOT connected to power earth (ground), with cathodically protected systems.


### 4.1 Startup

Switch on the power supply to the flowmeter, and if a transmitter with display has been ordered, the flow rate will be shown on the display as shown in Fig. 4.1 or 4.2.

Sequential application of the provided magnetic wand to the left hand icon in the transmitter display area, or by pressing the $\square$ button on the keypad versions or the remote display, steps the display through the following sequence:

| $\%$ | (Flow Rate \% of Range) |
| :--- | :--- |
| $>$ | (Forward flow total value) |
| $<$ | (Reverse flow total value) |
| $*$ | (Net flow total value) |
| Alm | (Active alarms) |
| Vel | (Flow Velocity in $\mathrm{m} / \mathrm{s}$ or $\mathrm{ft} / \mathrm{s}$ ) |

$\begin{array}{cl}\% & \text { (Flow Rate \% of Range) } \\ > & \text { (Forward flow total value) } \\ < & \text { (Reverse flow total value) } \\ * & \text { (Net flow total value) } \\ \text { Alm } & \text { (Active alarms) } \\ \text { Vel } & \text { (Flow Velocity in } \mathrm{m} / \mathrm{s} \text { or } \mathrm{ft} / \mathrm{s} \text { ) }\end{array}$
Any alarms are displayed sequentially if more
than one alarm is present.
$\begin{array}{cl}\% & \text { (Flow Rate \% of Range) } \\ > & \text { (Forward flow total value) } \\ < & \text { (Reverse flow total value) } \\ * & \text { (Net flow total value) } \\ \text { Alm } & \text { (Active alarms) } \\ \text { Vel } & \text { (Flow Velocity in } \mathrm{m} / \mathrm{s} \text { or } \mathrm{ft} / \mathrm{s} \text { ) }\end{array}$
Any alarms are displayed sequentially if more
than one alarm is present.

Application of the wand to the right hand icon, or pressing the keypad $\square$ button, resets the totaliser display, if this facility is enabled.
$i$ Information.

- For the use of local or remote serial communication, and configuration, see the Quick Reference Programming Guide or the main MagMaster manual.
- For all versions supporting HART ${ }^{T M}$, see the main MagMaster manual.


Fig. 4.2 Location of Controls (Keypad Versions)

## APPENDIX A - ENVIRONMENTAL PROTECTION

## Warning.

- Potting materials are toxic - use suitable safety precautions.
- Read the manufacturers instructions carefully before preparing the potting material.
- The remote sensor terminal box connections must be potted immediately on completion to prevent the ingress of moisture.
- Check all connections before potting - see ELECTRICAL INSTALLATION.
- Do not overfill the terminal box or allow the potting material to come into contact with the ' $O$ ' ring or groove.
- Do not let potting material enter conduit, if used.


# PRODUCTS \& CUSTOMER SUPPORT 

## Products

## Automation Systems

- for the following industries:
- Chemical \& Pharmaceutical
- Food \& Beverage
- Manufacturing
- Metals and Minerals
- Oil, Gas \& Petrochemical
- Pulp and Paper

Drives and Motors

- AC and DC Drives, $A C$ and DC Machines, AC motors to 1 kV
- Drive systems
- Force Measurement
- Servo Drives


## Controllers \& Recorders

- Single and Multi-loop Controllers
- Circular Chart , Strip Chart and Paperless Recorders
- Paperless Recorders
- Process Indicators


## Flexible Automation

- Industrial Robots and Robot Systems


## Flow Measurement

- Electromagnetic Magnetic Flowmeters
- Mass Flow Meters
- Turbine Flowmeters
- Wedge Flow Elements


## Marine Systems \& Turbochargers

- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Referbishment


## Process Analytics

- Process Gas Analysis
- Systems Integration


## Transmitters

- Pressure
- Temperature
- Level
- Interface Modules


## Valves, Actuators and Positioners

- Control Valves
- Actuators
- Positioners

Water, Gas \& Industrial Analytics Instrumentation

- pH, conductivity, and dissolved oxygen transmitters and sensors
- ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.
- Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.


## Customer Support

ABB Automation provides a comprehensive after sales service via our Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom<br>ABB Automation Limited<br>Tel: +44 (0) 1453-826-661<br>Fax: +44 (0) 1453-827-856

## United States of America

ABB Automation Inc.
Instrumentation Division
Tel: +1 215-674-6000
Fax: +1 215-674-7183

## Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition.
In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of operating and maintenance records relating to the alleged faulty unit.

The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice

ABB Automation Inc
125 E. County Line Road Warminster, PA 18974 USA Tel: +1 215-674-6000
Fax: +1 215-674-7183

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www.abb.com


## PARAMETER CHANGES

When a parameter is selected, which holds one or more
variable units e.g. 'Flow Unit parameler which can be
Liters, Cubic meters, Gallons etc., proceed as follows to change the units: ('Flow Rng' selected).


Press $\square^{\circ}$ or switch to change the units.
$*$
depression of the existing units will flash at the first
switch depressions will change the tyith, and further displayed.
epressing the switch will now enter the nem
epressing the
his type of action is similar for all variable units. Where numerical values are to be changed, initial depression of the $\triangle \rightarrow$ or $\sigma$ switches cause the first of the value with the $a$ and switches, the particular igit with the switch, and enter the final selection with the switch.

## PROGRAMMING

The correct security level MUST be selected - see SECURT ACCESS.
Select the parameter to read the value, or to change it as ecessary. All 'ive' data displayed is updated each
se the [t] key to move between pages.
Use the key to move between parameters,
The $\square$ and $\sigma$ keys change displayed values and units. The key will accept the chosen value or unit.

| FLOW MEASUREMENT |  |  |
| :---: | :---: | :---: |
| PARAMETER Flow Range | DESCRIPTION |  |
|  | Enter main full scale ( $100 \%$ ) flow range (Upper Range Value) in selected flow units. \# |  |
| Flow Unit | Select Units as required. |  |
|  | $\mathrm{m}^{\wedge} 3$ (Cubic Meters) |  |
|  | 1 lal (Imp Gals) |  |
|  | ${ }_{\text {UGal }}{ }^{\wedge}$ (Cubic. Gals) |  |
|  |  |  |
| Flow Mult | Select multiplier as required. m (0.001) |  |
|  | c $\mathrm{C}(0.01)$ |  |
|  |  |  |
|  | $\mathrm{h}(100)$ |  |
|  | $\mathrm{k}(1000)$$M(1000000)$ |  |
|  |  |  |
| Flow Time | Select time units as required. <br> $s$ (Second) |  |
|  |  |  |
|  | Min (Minute) |  |
|  |  |  |
|  | Dy (Day) |  |
|  | Nominal Time Constant for output. Enter Display Setting from table below for time constant required. |  |
| Flow Resp |  |  |
|  | Display Sertiog |  |
|  |  |  |
|  |  | ${ }_{3}^{2}$ |
|  |  | ${ }_{4}^{4}$ |
| - | ${ }^{5}$ | 15 |
|  | $\stackrel{7}{8}$ |  |
|  | Present flow as \% of range. Probe Insertion Factor. |  |
| Flow \% |  |  |
|  | Probe Insertion Factor. <br> Probe Profile Factor |  |
| $4^{\text {Flow Cutoff }}$ | Flow velocity in $\mathrm{mm} / \mathrm{sec}$. below |  |
|  | which flow set to 0 | [9] |


| PARAMETER Anlg Fsd | DESCRIPTION <br> Enter output current in mA for 100\% <br> flow ( $0 \leq F S D \leq 21$ ) |
| :---: | :---: |
| Anlg Zero | Enter output current in mA for $0 \%$ flow ( $0 \leq Z E R O \leq 21$ ) |
| Anlg No2 | Full scale flow range for 2 nd analog range, as \% of main flow range. |
| Anlg mA Anlg Dir Fwd | Present output current (mA) Output responds to forward flow if set to ' 1 '. § |
| Anlg Dir Rev | Output responds to reverse flow if set to '1'. § |


| OUTPUT PULSE |  |
| :---: | :---: |
| PaRAMETER | DESCRIPTION |
| Pls Fact | Enter required output pulses per flow volume unit" |
| Pls Cutoff | Flow rate (\%) below which pulse |
| PIs Max | Maximum output trequency in Hz . |
| Pls Hz | Display of present output frequency in Hz (live value). |
| PIs Idle | Idle stale for Pulse Output with no output pulse (e.g. at zero flow). $0=$ Low (output transistor ON ) $1=$ High (output transistor OFF) |
| Pls Size | Enter output pulse width in msecs. (Value will be rounded up to nearest |
| 4 | 10 ms ). Set to ' 0 ' for square wave |


| TOTALIZER |  |
| :---: | :---: |
| Parameter | DESCRIPTION |
| Tot Unit | Select totaliser measurement units. |
| Tot Mult | Select multiplier units required. |
| 4 Tot ClrEn | Enter '1' 'o enable totalis |
|  | function to be used |
|  |  |
|  |  |
| ALARMS |  |
| PARAMETER Alarm No1 Idle | DESCRIPTION |
|  | Idle state for alarm output. |
|  | With no alarm active: |
|  | $0=\mathrm{Low}$ ( $\mathrm{O} / \mathrm{P}$ transistor ON ) <br> $1=$ High (O/P transistor OF |
| Alm No1 En | $0=$ Allarm output disabled (set to idle state). |
|  | 1 - Alarm output enabled. |
| Alm No1 Fault Alm No1 Fwd Alm No1 Rev Alm No1 Cutoff | Alarm occurs for System fault. |
|  | Alarm occurs for forward flow. |
|  | Alarm occurs for reverse flow. |
|  | Alarm occurs for Pulse Output |
|  | Cutoff |
| Alm No1 Mtsnsr Alm No1 Hi | Alarm occurs for empty sensor. |
|  | Alarm occurs for Flow ${ }^{\text {'Alm Thip Hi' }}$ |
| Alm No1 Lo | Alam occurs for Flow $\leq$ 'Alm Tip Lo'. |
| Alm No1 Anlg | Alarm occurs for Analogue Outpu over range. |
| 4 Alm No1 Pls | Alarm occurs for Pulse Output over range.' <br> [8] |



| TEST MODE |  |
| :---: | :---: |
| PARAMETER | DESCRIPTION |
| Test Mode | Set to ' 1 ' to enable. |
| Test Flow | Displays present flowrate. |
|  | If in 'Test Mode', any value may be entered manually $\dagger$ |
| Test \% | Flowrate as a percentage |
| Test Hz | Output Frequency |
| Test mA | Output Current |
| Test Vel | Flow Velocity in sensor |
| Test Alm | Shows present active alarms sequentially. ('Clr' indicates no |
| ATest Txv | alarms are active). $\varnothing$ |
|  | sensor calibration). |
|  |  |
| DISPLAY RESOLUTION |  |
| PARAMETER Disp Res | DESCRIPTION <br> Enter number of decimal places required on flow display (0 to 5 ). |
|  |  |
| Disp Mode | Serial Communication display mode (Read Only) - attempts to edit this parameter result in display of 'Keypad Version No.' with eventual return to normal operation. |
|  |  |
|  |  |
|  |  |
|  |  |
| SECURITY PASSWORD |  |
| ineer. |  |
|  |  |  |
|  |  |  |
|  |  |  |
| $\begin{aligned} & \text { Login Key } 1 \\ & \text { Login Key 2 } \\ & \hline \end{aligned}$ | Set Level 1 security passwor |
|  |  |
|  | Set Level 2 security password. |

\# The maximum which can be entered must not exceed 21000. The value entered may be displayed with a small 21000 . The value entered may be displayed with a small
eror in the decimal digits e.g. 1.900 may be displayed as 1.899. This is a display characteristic and the value 1.90 will be used by the MagMaster
§ Select both parameters for bidirectional operation (e.g. is always $0 \%$.
$\ddagger$ On performing a Rapid ResetEscape to return to
are
$\varnothing$ If the sensor is empty or disconnected, the alarms
'MiSnss' and 'Coil' will be displayed as appropriate.

# FRENIC 5000611S/P11S 

## INSTRUCTION MANUAL

High-Performance, Low-Noise Inverter

Generat-Purpose lndu stral Machines
200V Series
$0.2 \mathrm{kWIFRNO} 2 \mathrm{G} 11 \mathrm{~S}-2 \mathrm{JE}$
to $90 \mathrm{KWFFRNOOG11S} 2 \mathrm{JE}$

400 V Saries
0.4 KW /FRNO.4G11S4.4E
to $400 \mathrm{KW} / \mathrm{FRN400G11S} 4 \mathrm{JE}$

Fans and Pumps
200 V Series
5.5 KW IFRN5.5P1 1 S 2 JE
to $110 \mathrm{WW/FRN110PAS}$ 2JE

```
400V Senes.
5.5kW IFRN5.5P11S 4 4E TO 500 KWW RN 500 R 11 S SJE
```



INRHF51299

## Preface

Thank you four purchasing our FRENIC5000G11S or FRENIC5000P1'S señes invertar This product is used to dive a 3phase electic motor at variable speed. As incorrect use of this product may result in personal injury and dor propery) damagep read al operating instuctions before: using
As this nanual does not cover the use of option cards, etc, refer to relevant manuals for opton operations:

## Saffty Instructions

Read tis manual canefuly before installing connecting (wintigloperaing, semicing or inspecting the inverter.
Familarze yoursef with allsatey features before using the inverter:
xIn tiis manual safey messanes arecclassified as follows:

| $\triangle$ WARNING | Improper operation may result in senous personal injury or deäth. |
| :---: | :---: |
| $\triangle$ CAUTION | Improper $\delta$ peration may result in slight to medium personal injury or property idamage: |

Situations more senious than those covered by CAUTION will depend on prevaling circumssances: Awrys follow instructions.
Instructions on use
3


## Instructions on linstallation.



## CCAUTION

TDo not thod or cary this inverer by the suiface coverinvertermgy beidropped causinginfuy: - Ensure that the inverter and heat sin's surfaces are kept fiee of foreign matter (Oints, paper dust small chips of wood or metal, and dust), as fire or accident may resuit:

- Do not install or operate a damaged inverter or an inverter with missing parts, as injuy may rasult
Only use specified screws as fire or accldent may result.
instructions on wining

| AWARWINE |
| :---: |
| Connecr the inverter to power va alline-protection moded case cricut breaker or tuse: tasfiromay result. <br> - Aways connect a gound wie, as electric ehock or fire may resuit. <br> A licensed specialist must perform the wiring, works, as electrce sock may result. <br> - Tumoft the power before starting the wing work as dectricstiock mayrostlt. <br> - Wire the inverter after instalation is complete, as eloctic diock or linu uy may occur. |



Instructions on operation:

## $\triangle$ WARNING

- Be sure toinstall the surface cover before turingionthe power (cosed mbo not remove the covery while power to the inverter ls bimed on
Electric shock may occur.
- Do not operate sumches with we hands, as electric shock may result
- When the rethy tunction is selocted, the inventer mey restartautomatically aftur tipping
(Design the machine to ensure personal sately in the event of restain)
Accadent may resuile.
- When the tompue limiting function is setected, operating condifions may differ from preset conditions
(acceleratondeceleration time or speed) In this case personal sofoty must be assured. Accldent may rasulk
- As the STOP key is éfective only when a function setting has been established installan emergeng switch independenty and when an operation via tie extemal signaltterminal is
selected the STOP key on the keypad parpe will be disabled:
Accident may resutt
 signa is input before reseting alam.
Accident may result
- Do not tuct inverter terminals when energized even it invertier has stopped.

Electric stiock moviesult


Instructions on maintenance, inspection, and replacement

## $\triangle$ WARNING

- Wait a minimum of five minutes ( 22 kW or less) or ten minutes ( 30 kW or more) after power has been tumed off(open) before starting inspection. (Also confirm that the charge lamp is off and that DC voltage between terminals $P(+)$ and $N(-)$ do not exceed 25 V .)
Electrical shock may result.
- Only authorized personnel should perform maintenance, inspection, and replacement operations. (Take off metal jewelry such as watches and rings. Use insulated tools.)

Electric shock or injury may result.

Instructions on disposal

| $\widehat{\text { CAUTION }}$ |
| :--- |
| Treat as industrial waste when disposing it. |

Other instructions

| - Never modify the product. |
| :--- |
| Electric shock or InJury may result. |

## Conformity to Low Voltage Directive in Europe

## $\triangle C A U T I O N$

- The contact capacity of alarm output for any fault (30A, B, C) and relay signal output (Y5A, Y5C) is 0.5 A at 48 V DC.
-The ground terminal Should be connected to the ground.
Use a crimp terminal to connect a cable to the main circuit terminal or inverter ground terminal.
-Where RCD( Residual-current protective device) is used for protection in case of direct or indirect contact, only RCD of type $B$ is allowed on the supply side of this EE(Electric equipment).
Otherwise another protective measure shall be applied such as separation of the EE from the environment by double or reinforced insulation or isolation of EE and supply system by the transformer.
- Use a single cable to connect the $G$ inverter ground terminal. (Do not use two or more inverter ground terminals.)
- Use a molded-case circuit breaker (MCCB) and magnetic contactor (MC) that conform to EN or IEC standards.
- Use the inverter under over-voltage category III conditions and maintain Pollution degree 2 or better as specified in IEC664. To maintain Pollution degree 2 or more, install the inverter in the control panel (IP54 or higher level) having structure free from water, oil, carbon, dust, etc.
- For the input-output wiring of the inverter, use cable (diameter and type) as specified in Appendix C in EN60204.
- To ensure safety, install an optional AC reactor, DC reactor, or external braking resistor as follows:

1) Install inside an IP4X cabinet or barrier if electrical parts are exposed.
2) Install inside an IP2X cabinet or barrier if electrical parts are not exposed.
dt is necessary to install the inverter in appropriate method using an appropriate RFI fitter to conform to the EMC directive. It is customer's responsibility to check whether the equipment, the inverter is installed in, conforms to EMC directive.

Conformity to Low Voltage Directive in Europe


Note: The type of wire is $70^{\circ} \mathrm{C} 600 \mathrm{~V}$ Grade heat-resistant polyvinyl chloride insulated wires (PVC). The above-mentioned wire size are the recommended size under the condition of the ambient temperature $50^{\circ} \mathrm{C}$ or lower.

Conformity to Low Voltage Directive in Europe


Note: The type of wire is $70^{\circ} \mathrm{C} 600 \mathrm{~V}$ Grade heat-resistant polyvinyl chloride insulated wires (PVC).
The above-mentioned wire size are the recommended size under the condition of the ambient temperature $50^{\circ} \mathrm{C}$ or lower.

Compliance with UL/cUL standards [ Applicable to products with UL/cUL mark]

## $\triangle C A U T I O N$

- [CAUTION Hazard of electrical shock. Disconnect incoming power before working on this control.
- [CAUTION Dangerous voltage exists until charge lights is off.
- WARNNG
- More than one live parts inside the inverter.
- Type 1 "INDOOR USE ONLY"

The inverter is approved as a part used inside a panel. Install it inside a panel.

- Use $60 / 75^{\circ} \mathrm{C}$ copper wire only.
- AClass 2 circuit wired with class1 wire.
- Field wiring connection must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. connector must be fixed using the crimp tool specified by the connector manufacturer.
- Connect the power supply to main power supply terminals via the Molded-case circuit breaker(MCCB) or the earth leakage circuit breaker(ELCB) to apply the UL Listing Mark.
(See Instruction Manual basic connection diagram Fig.2-3-1).
- In case of using auxiliary controt-power input (RO,TO), connect it referring to Basic connection diagram Fig.2-3-1
- Solid state motor overload protection is provided in each model.


Compliance with UL/cUL standards [Applicable to products with UL/cUL mark]

- "Suitable for use on a clrcult capable or delvering not more than $5,000 \mathrm{~ms}$ symmetrical amperes, 240 V maxdmum for 22 kW or less models, $100,000 \mathrm{rms}$ symmetrical amperes, 230 V maximum for 30 kW or more models". rated for 200 V class input.
- "Suitable for use on a circuit capable or delivering not more than $5,000 \mathrm{mss}$ symmetrical amperes, for $\mathbf{2 2 k W}$ or less models, $100,000 \mathrm{rms}$ symmetrical amperes, for 30 kW or more models, 480 V maximum". rated for 400 V class input.
- Use the following power supply in the inverter

| $\triangle$ CAUTION |  |  |
| :---: | :---: | :---: |
| - Use the following power supply in the Inverter. |  |  |
| Inverter type | Maximum input voltage | Input source current |
| $\begin{aligned} & \text { FRNO.2G11S-2 to FRNN2GIS-2JE } \\ & \text { FRN5.5P11S-2 to FRN22P11S-2UE } \end{aligned}$ | AC240V |  |
|  | AC230V | Not more than 5,000 A (4p to 22kW) |
| FRNO.4G11S-4 to FRN22G11S-4NE <br> FRN5.5P11S-4 to FRN22P11S-4JE | AC480V | Not more than 100,000 A (30kW or more ) |
| FRN30G11S-4 to FRN400G11S-4JE <br> FRN30P11S-4 to FRN500P11S-4JE |  |  |

## General instructions

Although figures in this manual may show the inverter with covers and safety screens removed for explanation purposes, do not operate the device until all such covers and screens have been replaced.


## 1. Before Using This Product

1-1 Receiving Inspections
Unpack and check the product as explained below.
If you have any questions about the product, contact the nearest Fuji sales office or your local distributor where you purchased the unit.
©Check the ratings nameplate to confirm that the delivered
product is the ordered one.
TYPE : Inverter type



Ratings nameplate
(2Check for damaged and/or missing parts upon delivery.
(3) n addition to the inverter unit and this manual, the package contains rubber bushing (for products with 22 kW or less) and a terminating resistor ( $1 / 2 \mathrm{~W}, 120 \Omega$ ). This terminating resistors for products with 22 kW or less is packed in a sack. The terminating resistors for products with 30 kW or more is connected to the control terminal of the inverter unit. This terminating resistor is required for RS485 communication. The terminating resistor need not be removed regardless of RS485 communication status.


## 1-3 Handling the Product

## (1) Removing the surface cover

For the inverter of 22 kW or less, loosen the mounting screws of the surface cover, then remove the cover by pulling the top (see Figure 1.3.1).


Fio. 1-3-1 Removing the surface cove (for inverter of 22 KW or less)
For the inverter of 30 kW or more, remove the mounting screws of the surface cover, then remove the surface cover.


Fig. 1-3-2 Removing the surface cover (for inverter of 30kW or more)
(2)Removing the keypad panel

After removing the surface cover as explained in (1), toosen the mounting screws of the keypad panal and remove as shown in Figure 1.3.3.


Fig, 1-3-3Removing the keypad panel
Loosen the mounting screws of the keypad panel and remove using the finger holds on the keypad panel case.


Eig.1-3-4Removing the keypad panel (for inverter of 30 kW or more)

## 1-4 Carrying

Carry the product by the main unit.
Do not carry the product while holding the cover or parts other than the main unit.
Use a crane or hoist to carry a product equipped with hanging holes.

## 1-5 Storage

"
Temporary storage of this product must meet those conditions listed in Table 1-5-1.
Table 1-6-1 Storage environment

| Item | Specifications |  |
| :---: | :---: | :---: |
| Ambient temperature | -10 to $+50{ }^{\circ} \mathrm{C}$ | Condensation or freezing must not occur as a result of sudden emperature changes. |
| $\begin{gathered} \text { Storage } \\ \text { temperature } \\ \hline \end{gathered}$ | -25 to +65 |  |
| Relative humidity | 5 to 95\% ${ }^{\text {mom }}$ |  |
| Atmosphere | Pollution degree 2 |  |
| Air pressure | Operation/storage : 88 to 106 kPaTransport$: 70$ to 106 kPa |  |

Note1: The storage temperature applies only to short periods such as transport.
Note2: As a large change in temperature within this humidity range may result in condensation or freezing, do not store where such temperature changes may occur.
(1Do not place this product directly on a floor.
(2) 0 store the product in an extreme environment, pack in vinyl sheet, etc.
(3if the product is stored in a high-humidity environment, insert a drying agent (e.g., silica gel) and pack the product in vinyl sheet.

If the product is to be stored for an extended period after purchase, the method of storage depends primarily on storage location.
The general long-term storage method is as follows:
(1The above conditions for temporary storage must be satisfied.
When the storage period exceeds three months, the upper limit of ambient temperature must be reduced to $30^{\circ} \mathrm{C}$ to prevent the deterioration of the electrolytic capacitors.
(2)Pack the product thoroughly to eliminate exposure to moisture and include a drying agent to ensure a relative humidity of about $70 \%$ or less.
(3)f the product is mounted on a unit or control panel and is left unused and exposed to the elements like moisture or dust (particularly on a construction site), remove the product and store in a suitable environment.
(1)Electrolytic capacitors not provided with power for an extended period will deteriorate. Do not store electrolytic capacitors for one year or longer without providing power.
2. Installation and Connection

2-1 Operating Environment
Install this product in a location that meets those conditions listed in Table 2-1-1
Table 2-1-1 Operating environment

| Item | Specifications |
| :---: | :---: |
| Location | Indoor |
| Ambient temperature | -10 to $+50^{\circ} \mathrm{C}$ (For products of 22 kW or less, the ventilating covers must be removed if ambient temperature exceeds $+40^{\circ} \mathrm{C}$ ) |
| Relative humidity | 5 to 95\% (No condensation) |
| Atmospher $\theta$ | Pollution degree 2 |
| Air pressure | 88 to 106 kPa |
| Vibration | 3 mm : from 2 to less than $9 \mathrm{~Hz}, 9.8 \mathrm{~m} / \mathrm{s}^{2}$ : from 9 to less than $20 \mathrm{~Hz}, 2 \mathrm{~m} / \mathrm{s}^{2}$ : from 20 to less than 55 Hz <br> ( 90 kW or more : $2 \mathrm{~m} / \mathrm{s}^{2}$ : from 10 to less than 55 Hz ) <br> $1 \mathrm{~m} / \mathrm{s}^{2}$ : from 55 to less than 200 Hz |


(2) As heat is generated during inverter operation, the spaces shown in Fig. 2-2-1 are required to ensure sufficient cooling. As heat radiates upward, do not install the product beneath a device sensitive to heat.
(3) As the heat sink may reach a temperature of $90^{\circ} \mathrm{C}$ during inverter operation, ensure that the material surrounding the product can withstand this temperature.

## $\triangle$ WARNING $\quad$ Install this product on nonflammable material such as metal.

(4) When installing this product in a control panel, consider ventilation to prevent ambient temperature of the inverter from exceeding the specified value. Do not install the product in an area from which heat cannot be sufficiently released.
(5) If two or more inverters must be installed in the same device or control panel, arrange the units horizontally to minimize the effect of heat. If two or more inverters must be installed vertically, place an insulated plate between the inverters to minimize the effect of heat.
(6) When shipped from the factory, inverters are internal cooling type inside panel. An inverter of 22 kW or less can be converted to an external cooling type simply by adding an optional mounting adapter. An inverter of 30 kW or more can be converted simply by moving mounting adapter.
In an external cooling system, a heat sink radiating about 70\% of total inverter heat (total loss) can be placed outside the device or control panel.
Ensure that heat sink surfaces are kept free of foreign matter (lint, moist dust particles etc.).


Fig.2-2-2 Extemal cooling system

| $\triangle$ WARNING | - In case of extemal cooling system, cover the inverter rear side in order not to <br> touch the main capacitor and braking resistor. Electric shock may result. <br> - Ensure that the inverter and heat sink surfaces are kept free of foreign matter <br> such as lint, paper dust, small chips of wood or metal, and dust. <br> Fire or accident may result. |
| :--- | :--- |

An inverter of 30 kW or more can be converted to an external cooling type simply by moving upper and lower mounting brackets as shown in Fig. 2-2-3. Remove the bracket screws, move the brackets, then secure the brackets using the case mounting screws except in some inverter type. (The bracket screws are no longer required after changing the bracket mounting position.)

(1) For inverters of 22 kW or less, remove the ventilating covers if ambient temperature exceeds $+40^{\circ} \mathrm{C}$.
(1) Removing the ventilating covers

One ventilating cover is mounted on top of the inverter and two or three are mounted at the bottom. Remove the surface cover, then remove ventilating covers by popping out the cover inserts as shown in Fig. 2-2-4.


Fig. 2-2-4 Removing the ventilating cover

## 2-3 Connection

Remove the surface cover before connecting the terminal blocks as follows.

## 2-3-1 Basic connection

(1) Always connect power to the L1/R, L2/S, and L3/T main circuit power terminals of the inverter. Connecting power to another terminal will damage the inverter. Check that the power voltage is within the maximum allowable voltage marked on the nameplate, etc.
(2) Always ground the ground terminal to prevent disasters such as fire or electric shock and to minimize noise.
(3Use a reliable crimp terminal for connection between a terminal and a cable.
(4) After terminating the connection (wiring), confirm the following:
a. Confirm that the connection is correct.
b. Confirm that all necessary connections have been made.
c. Confirm that there is no short-circuit or ground fault between terminals and cables.
(5) Connection modification after power-on

The smoothing capacitor in the direct current portion of the main circuit cannot be discharged immediately after the power is turned off. To ensure safety, use a multimeter to check that the voltage of the direct current (DC) is lowered to the safety range ( 25 V DC or less) after the charge lamp goes off. Also, confirm that the voltage is zero before short-circuiting. The residual voltage (electric charge) may causesparks.

|  | - Always connect a ground wire. <br> Electric shock or fire may result. <br> - Ensure that a licensed specialist performs all wiring works. <br> - Confirm that the power is turned off (open) before commencing wiring <br> operations. <br> Electrical shock may result. |
| :--- | :--- |



2-3-2 Connecting the main circuit and ground terminals
Table 2-3-1 Functions of main circuit terminals and ground terminals

| Symbol | Terminal name | Description |
| :---: | :---: | :---: |
| L1/R,L2/S,L3/T | Main circuit power terminal | Connects a 3-phase power supply. |
| U,V.W | Inverter output terminal | Connects a 3-phase motor. |
| R0,T0 | Auxiliary controt-power input terminal | Connects a backup AC power supply to the control circuit. (Not supported for inverter of 0.75 kW or less) |
| P1, P( + ) | DC reactor connecting terminal | Connects the optional power-factor correcting DC reactor. |
| $\mathbf{P ( + ) , D B}$ | External braking resistor connecting terminal | Connects the optional external braking resistor. (For inverter of 7.5 kW or less) |
| $\mathbf{P}(+), N(-)$ | DC link circuit terminal | Supplies DC link circuit voltage to the external braking unit (option) or power regeneration unit (option). |
| OG | Inverter ground terminal | Grounds the inverter chassis (case) to the earth. |

(1) Main circuit power terminals (L1/R, L2/S, L3/T)
(1) Connect these terminals to the power supply via a molded-case circuit breaker or earth-leakage circuit breaker for circuit (wiring) protection. Phase-sequence matching is unnecessary.
(2) To ensure safety, a magnetic contactor should be connected to disconnect the inverter from the power supply when the inverter protective function activates.
(3) Use control circuit terminal FWD/REV or the RUNSTOP key on the keypad panel to start or stop the inverter. The main circuit power should be used to start or stop the inverter only if absolutely necessary and then should not be used more than once every hour.
(1) Do not connect these terminals to a single-phase power supply.
(2) Inverter output terminal (U, V, W)
(1) Connect these terminals to a 3-phase motor in the correct phase-sequence. If the direction of motor rotation is incorrect, exchange any two of the $U, V$, and $W$ phases.
(2) Do not connect a phase-advance capacitor or surge absorber to inverter output.
(3) If the cable from the inverter to the motor is very long, a high-frequency current may be generated by stray capacitance between the cables and result in an overcurrent trip of the inverter, an increase in leakage current, or a reduction in current indication precision. To prevent this, the cable must not exceed 50 meters (for 3.7 kW or less) or 100 meters (for 5.5 kW or more). If the cable must be long, connect an optional output circuit fitter (OFL filter)

| Without output circuit filter connected | With output circuit filter connected |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :---: | :---: | :---: |

Note: When a motor protective thermal O/L relay is inserted between the inverter and the motor, the thermal O/L relay may malfunction (particularty in the 400 V series) even when the cable length is 50 meters or less. To resolve, insert an OFL filter or reduce the carrier frequency of the inverter operation noise. (Use function code "F26 Motor sound".)

## Driving 400V series motor by inverter

When a motor is driven by a PWM-type inverter, the motor terminals may be subject to surge voltage generated by inverter element switching. When the cable of the motor (the 400 V series motor, in particular) is particularly long, surge voltage will deteriorate motor insulation. To prevent this when driving the 400 V series motor using the inverter, ensure one of the following:
(1) Use a well-insulated motor. (Fuji Electric's standard motors are well insulated.)
(2) Connect an optional OFL filter to the output terminal of the inverter.
(3) Minimize the length of the cable between the inverter and the motor (10 to 20 meters or less).
(3) Auxiliary control-power input terminals (RO and TO) The inverter operates even if power is not provided to these terminals If a protective circuit operates and the magnetic contactor on the inverter power side is opened (off the inverter control circuit power, the alarm output (30A, B, and C), and the keypad panel display goes off. To prevent this, the same AC power as the main circuit AC power must be supplied (as auxiliary control power) to the auxiliary control-power input terminals ( RO and TO ).
(1To ensure effective noise reduction when using a radio noise filter, the output power from the fitter must go to the auxiliary control-power input terminals. If these terminals are connected to the input side of the filter, the noise reduction effect deteriorates.
(4) DC reactor connecting terminals ( P 1 and $\mathrm{P}(+)$ )
(1) Before connecting a power-factor correcting DC reactor (optional) to these terminals, remove the factory-installed jumper.
(2) If a DC reactor is not used, do not remove the jumper.

Note:For inverter of 75 kW or more, the DC reactor is provided as a separate standard component and should always be connected to the terminals.
(5) External braking-resistor connecting terminals ( $\mathbf{P ( + )}$ and DB ) (G11S: 7.5kW or less)

For the G11S of 7.5kW or less, a built-in braking resistor is connected to terminals $\mathrm{P}(+)$ and DB .
If this braking resistor does not provide sufficient thermal capacity (e.g., in highly repetitive operation or heavy inertia load operation), an extemal braking resistor (option) must be mounted to improve braking performance.
(1) Remove the built-in braking resistor from terminals $P(+)$ and DB. Insulate the resistor-removed terminals with adhesive insulation tape, etc.
(2) Connect terminals $\mathrm{P}(+)$ and DB of the external braking resistor to terminals $P(+)$ and DB of the inverter.
(33) The wiring (cables twisted or otherwise) should not exceed 5 meters.
(6) DC link circuit terminals $(P(+)$ and $N(-))$ The G11S inverter of 11kW or more does not contain a drive circuit for the braking resistor. To improve braking performance, an external braking unit (option) and an extemal braking resistor (option) must be installed.
(1) Connect terminals $P(+)$ and $N(-)$ of the braking unit to terminals $P(+)$ and $N(-)$ of the inverter. The wiring (cables twisted or otherwise) should not exceed 5 meters.
(2) Connect terminals $\mathrm{P}(+)$ and DB of the braking resistor to terminals $\mathrm{P}(+)$ and DB of the braking unit.
The wiring (cables twisted or otherwise) should not exceed 10 meters. When terminals $\mathrm{P}(+)$ and $\mathrm{N}(-)$ of the inverter are not used, leave terminals open. If $P(+)$ is connected to $N(-)$ or the braking resistor is connected directly, the resistor will break.
(3) Ausiliary contacts 1 and 2 of the braking unit have polarity. To connect the power regeneration unit, refer to the "Power Regeneration Unit Instruction Manual".


Fig. 2-3-4 Connection (G11S : 7.5kW or less)


Fig. 2-3-5 Connection (G11S : 11kW or more)
(7) Inverter ground terminal

To ensure safety and noise reduction, always ground the inverter ground terminal . Also, metal frames of electrical equipment must be grounded as specified in the Electric Facility Technical Standard.
The connection procedure is as follows:
(1) Ground metal frames to a ground terminal (Ground resistance: $10 \Omega$ or less).
(2) Use a suitable cable (short and thick) to connect the inverter system to the ground terminal.
(8) Auxiliary power switching connector (CN UX) (for inverter of 30kW or more)

When an inverter of 30 kW or more requires a main circuit power voltage as unlisted in Table 2-3-2, disconnect auxiliary power switching connector CN UX from U 2 and connect to U 1 . For the switching method, see Fig. 2-3-8

Table 2-3-2 Main circuit power voltage requiring auxiliary power switching connector switching

| Frequency [Hz] | Power voltage range <br> VAC] |
| :---: | :---: |
| 50 | $380-398$ |
| 60 | $380-430$ |


| $\triangle$ CAUTION | - Check that the number of phases and rated voltage of this product match those of the <br> AC power supply. <br> - Do not connect the AC power supply to the output terminats (U, V, W). <br> Injury may result. <br> - Do not connect a braking resistor directly to the DC terminals ( $\mathrm{PI}+\mathrm{]}$ and $\mathrm{N}[-\mathrm{J}$ ). <br> Fire may result. |
| :--- | :--- |

(9) Fan power switching connector (CN RXTX) (for inverter of 30kW or more)

G11S without options supports DC power input via DC common connection by connecting the power regeneration converter (RHC series) as shown in Fig. 2-3-7.
For details, refer to technical documentation.
The inverter of 30 kW or more contains an AC-powered component (e.g., AC cooling fan).
To use the inverter using DC power input, switch the fan power switching connector (CN RTXT) inside the inverter to the RO-TO side and provide AC power to the RO and TO terminals. (See Fig. 2-3-6.)
For the switching method, see Fig. 2-3-8.

## Note:

In the standard state, the fan power switching connector (CN RXTX) is connected to the L1/R-L3/T side.
When DC power input is not used, do not switch this connector.
The same AC voltage as the main circuit power voltage must be supplied to the auxiliary controf-power input terminals (RO and TO). If not supplied, the fan does not rolate and the inverter will overheat (OHI).


Fig. 2-3-6 Fan power switching


Fig. 2-3-7 Example of connection by combination with power regeneration converter

## Note:

To connect the power regeneration converter to an inverter of 22 kW or less, do not connect the power supply directly to the auxiliary controt-power input terminals ( $R 0$ and $T 0$ ) of the inverter. However, if such a connection is required, insulate these input terminals from the main power of the power regeneration converter with an insulation transformer. The connection example of a power regeneration unit is provided in the "Power Regeneration Unit Instruction Manual".

The switching connectors are mounted on the power PCB above the control PCB as shown on the right.


## Note:

To remove a connector, unlock the connector (using the locking mechanism) and pull. To mount a connector, push the connector until it click locks.


FRNTSGS1S-2JE to FRNSOG11S-2JEFRWNOP11S-2JE to FRN110P11S-2JE FRN132G11S-4J to FRN400G11S-4JE/FRN160P113-4NE to FRN500Pi1s-4JE


When shipped from the factory, CN UX is connected to the U2 side and CN RXTX is connected to the $1 / R-L 3 /$ side.
<Oblique view of part A>


Fig. 2-3-8 Power switching connectors (only for 30kW or more)

## 2-3-3 Connecting the control terminals

Table 2-3-3 lists the functions of the control circuit terminals. A control circuit terminal should be connected according to the setting of its functions.
Table 2-3-3


(1) Analog input terminals (13, 12, C1, and 11)
(1These terminals receive weak analog signals that may be affected by external noise. The cables must be as short as possible ( 20 meters or less), must be shielded, and must be grounded in principle. If the cables are affected by external induction noise, the shielding effect may be improved by connecting the shield to terminal [11].
(2) If contacts must be connected to these circuits, twin (bifurcated type) contacts for handling weak signals must be used. A contact must not be connected to terminal [11].
(3) If an external analog signal output device is connected to these terminals, it may malfunction as a result of inverter noise. To prevent malfunction, connect a ferrite core or capacitor to the external analog signal output device.


Fig. 2-3-10 Example of noise prevention
(2) Digital input terminals (FWD, REV, X1 to X9 and CM)
(1) Digital input terminals (e.g., FWD, REV, X1 to X 9 ) are generally tumed on or off by connecting or disconnecting the line to or from the CM terminal. If Digital input terminals are turned on or off by switching the open collector output of PLC using an external power supply, a resulting bypass circuit may cause the inverter to malfunction.
To prevent a malfunction, connect the PLC terminal as shown in Fig. 2-3-11.
(2) When using a contact input, a relay having highly reliable contact must be used.
Example: Fuji Electric Control Relay: HH54PW


Fig. 2-3-11
Connection for Extemal power supply
(3) Transistor output terminals (Y1 to Y4, CME)
(1) To connect a control relay, connect a surge absorbing diode to both ends of its exciting coil.
(4) Others
(1) To prevent a malfunction as a result of noise, control terminal cables must be placed as far as possible from the main circuit cables.
(2) The control cables inside the inverter must be secured to prevent direct contact with live section
(e.g., main-circuit terminal block) of the main circuit.

| $\triangle$ WARNING | Control lines generally do not have enhanced insulation. If the insulation of a <br> control line is damaged, the control signals may be exposed to high voltage in <br> the main circuit. The Low Voltage Directive in Europe also restricts the exposure <br> to high voltage. <br> Electric shock may result |
| :--- | :--- |
| $\triangle$ CAUTION | The inverter, motor, and cables generate noise. <br> Check that the ambient sensors and devices do not maffunction. <br> Accident may result. |

(5) Wiring of control circuit
(5)-1 FRN30G11S-2 to FRN55G11S-2, FRN30P11S-2 to FRN75P11S-2

FRN30G11S-4 to FRN110G11S-4, FRN30P11S-4 to FRN132P11S-4
(1) Pull out the control circuit wiring along the left panel as shown in Fig. 2-3-12.
(2) Secure the cable to cable binding hole A (on the left wall of the main circuit terminal block) using a cable-tie (e.g., Insulock). The cable-tie must not exceed 3.5 mm in width and 1.5 mm in thickness.
(3) When the optional PC board is mounted, the signal lines must be secured to cable binding holeB.


Fig. 2-3-13 The securing positions of the control-circuit line of inverter
(5)-2 FRN132G11S-4JE to FRN160G11S-4JE, FRN160P11S-4JE to FRN200P11S-4JE (1)As shown in Fig. 2-3-14, pull out the cables along the left panel
(D) Secure cables to holes of cable-tie holder (on the way of wiring) using cable-ties (e.g., Insulok). The cable-ties must not exceed 3.8 mm in width and 1.5 mm in thickness.


Fig. 2-3-14 The wiring route of the control unit Fig. 2-3-15 The securing points of the cables
(5)-3 FRN75G11S-2JE to FRN90G11S-2JE, FRN90P11S-2JE to FRN110P11S-2JE FRN200G11S-4JE to FRN220G11S-4JE, FRN220P11S-4JE to FRN280P11S-4JE
©As shown in Fig. 2-3-16, pull out the cables along the left panel
(2)Secure cables to holes of cable-tie holder (on the way of wiring) using cable-ties (e.g., Insulok). The cable-ties must not exceed 3.8 mm in width and 1.5 mm in thickness.


Fig. 2-3-16 The wiring route of the control unit Fig. 2-3-17 The securing points of the cables
(5)-4 FRN280G11S-4JE to FRN400G11S-4JE, FRN315P11S-4JE to FRN500P11S-4JE ©As shown in Fig. 2-3-16, pull out the cables along the left panel (2)Secure cables using the coating clip above the main circuit terminal :LI/R.

2-3-4 Terminal arrangement
(1) Main circuit terminals


## 2-3-5 Applicable equipment and wire size for main circuit



Note: The type of wire is $75^{\circ} \mathrm{C}$ 600V Grade heat-resistant polyvinyl chloride insulated wires (HIV). The above-mentioned wire size are the recommended size under the condition of the ambient temperature $50^{\circ} \mathrm{C}$ or lower.

Applicable equipment and wire size for main circuit


Note: The type of wire is $75^{\circ} \mathrm{C} \quad 600 \mathrm{~V}$ Grade heat-resistant polyvinyl chloride insulated wires (HIV). The above-mentioned wire size are the recommended size under the condition of the ambient temperature $50^{\circ} \mathrm{C}$ or lower.

## 3. Operation

## 3-1 Inspection and Preparation before Operation

 Check the following before operation:(1) Check that the connection is correct.

In particular, check that the power supply is not connected to any of the $\mathrm{U}, \mathrm{V}$, and W output terminals and that the ground terminal is securely grounded.
(2) Check for short-circuits and ground faults between the terminals and live sections.
(3) Check for loose terminals, connectors, or screws.
(4) Check that the motor is separated from mechanical equipment.
(5) Turn off switches before turning power to ensure that the inverter will not start or operate abnormally at power-on.
(6) Check the following after power-on:
a. Check that no alarm message is displayed on the keypad panel (see Figure 3-1-2).
b. Check that the fan inside the inverter is rotating. (For inverters with 1.5 kW or more)

| We sure to put on the surface cover before tuming <br> on the power (close). Never remove the cover <br> while the power is applied to the inverter. <br> To ensure safety, do not operate switches with wet <br> hands. <br> Electric shock may result |
| :--- | :--- |

## 3-2 Operation Method

There are various methods of operation. Select a method of operation according to operating purpose and specifications by referring to Section 4-2, "Operating the Keypad Panel," and Chapter 5, "Explanation of Functions." Table 3-2-1 lists general operation methods

## 3-3 Trial Run

Upon confirming that inspection results are normal (see Section 3-1), proceed with a trial run. The initial operation mode (set at factory) is using the keypad panel.
(1) Tum power on and confirm that frequency display 0.00 Hz is blinking on the LED monitor.
(2) Set the frequency to about 5 Hz using : key.
(3) To start the run, press F\%id key (for forward rotation) or nev key (for reverse rotation). To stop, press ster key.
(4) Check the following items:
a. Is the rotating direction correct ?
b. Is the rotation smooth? (no buzzing or abnormal vibration)
c. Is acceleration and deceleration smooth?

| Operation command | Frequency setting | Operation command |
| :---: | :---: | :---: |
| $\begin{aligned} & \text { Operation } \\ & \text { ussing keypad } \\ & \text { panel } \end{aligned}$ | $\left.\begin{array}{lll}\text { Keys } \\ \text { panel } & \text { on } & \text { keypad } \\ & & \\ & & \end{array}\right)$ | F\%e REw |
| Operation <br> using external <br> signal <br> terminals | Freq Seting POT(VR), aratog voliage analogourrert | Cortactinput (swbly) Terminat FWD-CMand REVCM |

If no abnormality is detected, increase the frequency and check the above items again.
If the results of the trial run are normal, start a formal run.
Notes: - If an error is detected in the inverter or motor, immediately stop the operation and attempt to determine the cause of error referring to Chapter 7, "Troubleshooting."

- As voltage is still applied to the main circuit terminals (L1/R, L2/S, L3/T) and auxiliary control-power terminals ( $\mathrm{RO}, \mathrm{TO}$ ) even when the output from the inverter is terminated, do not touch the terminals. The smoothing capacitor in the inverter is being charged after the power is turned off and it is not discharged immediately. Before touching an electric circuit, confirm that the charge lamp is off or a multimeter is indicating a low voltage at the terminals.


## 4. Keypad Panel

The keypad panel has various functions for specifying operations such as keypad operation (frequency setting, run/stop command), confirming and changing function data, confirming status, and copying.
Review the use of each function before commencing running.
The keypad panel can also be removed or inserted during running. However, if the keypad panel is removed during a keypad panel operation (e.g., run/stop, frequency setting), the inverter stops and outputs an alarm.

## 4-1 Appearance of Keypad Panel



LED monitor:
Four-digit 7-segment display
Used to display various items of monitored data such as setting frequency, output frequency and alarm code.
Auxiliary information indication for LED monitor:
Selected units or multiple of the monitored data (on the LED monitor) are displayed on the top line of the LCD monitor. The symbol indicates selected units or multiple number. The symbol $\Delta$ indicates there is an upper screen not currently displayed.

## LCD monitor:

Used to display such various items of information as operation status and function data. An operation guide message, which can be scrolled, is displayed at the bottom of the LCD monitor.
Indication on LCD monitor:
Displays one of the following operation status: FWD: Forward operation REV: Reverse

STOP: Stop
Displays the selected operation mode:
Control keys (valid during keypad panel operation):
Used for inverter run and stop
FWD
: Forward operation command
REV : Reverse operation command
STOP : Stop command
REM: Terminal block LOC: Keypad panel COMM: Communication terminal JOG: Jogging mode
The symbol $\nabla$ indicates there is a lower screen not currently displayed.

## RUN LED:

Indicates that an operation command was input by pressing the FWD or REV key.

Operation keys:
Used for screen switching, data change, frequency setting, etc.

Table 4-1-1 Functions of operation keys

| Operation key | Main function |
| :---: | :---: |
| PRG | Used to switch the current screen to the menu screen or switch to the initial screen in the operationtrip mode. |
| FUNC | Used to switch the LED monitor or to determine the entered frequency, function code, or data. |
| $\because$ | Used to change data, move the cursor up or down, or scroll the screen |
| $\stackrel{\text { SHIF T }}{\gg}$ | Used to move the cursor horizontaily at data change. When this key is pressed with the up or down key, the cursor moves to the next function block. |
| RESET | Used to cancel current input data and switch the displayed screen. If an alarm occurs, this key is used to reset the trip status (valid only when the alarm mode initial screen is displayed). |
| STOP + $\quad$ \% | Used to switch normal operation mode to jogging operation mode or vice versa. The selected mode is displayed on the LCD monitor. |
| STOP + RESET | Switches operation mode (from keypad panel operation mode to terminal block operation mode or reverse). When these keys are operated, function F01 data is also switched from 0 to 1 or from 1 to <br> 0 . The selected mode is displayed on the LCD indicator. |

## 4-2 Keypad Panel Operation System (LCD screen, Level Structure)

## 4-2-1 Normal operation

The keypad panel operation system (screen transition, level structure) is structured as follows:


## 4-2-2 Alarm occurrence

If an alarm is activated, operation is changed from normal keypad panel operation to an alarm mode operation. The alarm mode screen appears and alarm information is displayed.
The program menu, function screens, and supplementary screens remain unchanged as during normal operation, though the switching method from program menu to alarm mode is limited to PRG


Table 4-2-1 Overview of contents displayed for each level

| No. | Level name |  | Content |
| :---: | :---: | :---: | :---: |
| 1 | Operating mode | This screen is for normal operation. Frequency setting by keypad panel and the LED monitor switching are possible only when this screen is displayed. |  |
| 2 | Program menu | Each function of the keypad panel is displayed in menu form and can be selected. Selecting the desired function from the list and pressing displays the screen of the selected function. The following functions are available as keypad panel functions (menus). |  |
|  |  | No. Menu <br> name | Outline |
|  |  | 1 DATA SET | The code and name of the function are displayed. Selecting a function displays a data setting screen for checking, or modifying data. |
|  |  | 2 DATA CHECK | The code and name of the function are displayed. Select a function to display a screen for checking data. Modifying data is possible as described above by going to the data setting screen. |
|  |  | 3 OPR MNTR | Can check various data on the operating status. |
|  |  | 4 VO CHECK | Can check the status of analog and digital input/output for the inverter and options as an I/O checker. |
|  |  | 5 MAINTENANC | Can check inverter status, life expectancy , communication error status, and ROM version information as maintenance information. |
|  |  | 8 LOAD FCTR | Can measure maximum and average current and average breaking force in load rate measurement. |
|  |  | 7 ALMINF | Can check the operating status and input/output status at the latest alarm occurrence. |
|  |  | 8 ALM CAUSE | Can check the latest alarm or simultaneously occurred alarms and alarm history. Selecting the alarm and pressing displays the contents of alarm as troubleshooting. |
|  |  | 9 DATA COPY | Places the function of one inverter in memory for copying to another inverter. |
| 3 | Screen for each function | The function screen selected on the program menu appears, hence completing the function. |  |
| 4 | Supplementa ry screen | Functions not completed (e.g., modifying function data, displaying alarm factors) on individual function screens are displayed on the supplementary screen. |  |

## 4-3 Operating Keypad Panel

## 4-3-1 Operation Mode

The screen for normal inverter operation includes a screen for displaying inverter operating status and an operation guide and a screen for graphically displaying the operating status in the form of a bar graph. Switching between both screens is possible using the E45 function.

1) Operation guide ( $\mathbf{E} 45=0$ )


4-3-2 Setting digital frequency
On the operation mode screen, press or to display the set frequency on the LED. Data is initially incremented and decremented in the smallest possible unit. Holding down $\square$ or increases or decreases the speed of increment or decrement. The digit to change data can be selected using ${ }^{5 \cdots \cdots ;}$; and then data can be set directly. To save the frequency settings, press Press Ercsil and PRG to retum to the operation mode.
If keypad panel settings are not selected, the present frequency setting mode appears on the LCD. When selecting the PID function, PID command can be set with a process value. (Refer to technical documentation for details).

1) Digital (keypad panel) settings ( $\mathrm{FO1}=0$ or $\mathrm{C} 30=0$ )

2) Other than digital setting


4-3-3 Switching the LED monitor
On the normal operation, press
to switch to LED monitor display.
When power is turned on, the monitor contents set by the function (E43) are displayed on the LED.

|  | When stopping |  | When running | Unit | Remarks |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E43 | ( $\mathrm{E} 44=0$ ) | (E44 = 1) | $(E 44=0,1)$ |  |  |
| 0 | Setting frequency | Output trequency 1 (before slip compensetion) |  | Hz |  |
| 1 | Setting frequency | Ouput froquency 2 (after silp compensetion) |  |  |  |
| 2 | Setting frequency | Setting frequency |  |  |  |
| 3 | Output current | Output current |  | A |  |
| 4 | Output voltage (specified value) | Output voltage (specified value) |  | V |  |
| 5 | Synchronous speed setting value | Synchronous speed |  | r/min. | For 4 digits or more, the last digits are cut, with $\times 10, \times 100$ marked on the indicator. |
| 6 | Line speed setting value | Line speed |  | $\mathrm{m} / \mathrm{min}$. |  |
| 7 | Load rotation speed setting value | Load rotation speed |  | r/min. |  |
| 8 | Torque calculation value | Torque calculation value |  | \% | $\pm$ indication |
| 9 | Power consumption | Power consumption |  | KW |  |
| 10 | PID setting value | PID setting value |  | - | Displayed only when P.ID is |
| 11 | PID remote setting value | PID remote setting value |  | - | eflective in PID operation selection. |
| 12 | PID feedback value | PID feedback value |  | - |  |

## 4-3-4 Menu screen

The "Program menu" screen is shown below. Only four items can be displayed simultaneously. Move the cursor with or $\square$ to select an item, then press to display the next screen.


## 4-3-5 Setting function data

On the "program menu" screen, select "1. DATA SET" then the "Function Select" screen appears with function codes and names on it. Select the desired function.


The function code consists of alphanumeric characters. Unique alphabetical letters are assigned for each function group.
Table 4-3-1

| Function code | Function | Remarks |
| :---: | :---: | :---: |
| F00-F42 | Fundamental Functions |  |
| E01-E47 | Extension Terminal Functions |  |
| C01-C33 | Control Functions of Frequency |  |
| P01-P09 | Motor Parameters |  |
| H03-H39 | High Performance Functions |  |
| A01-A18 | Alternative Motor Parameters |  |
| 001-055 | Optional Functions | Can be selected ondy with an option connected |

To scroll "Function Select" screen rapidly, use $\quad . .+\square$ or $\square \ldots+\square$ to move the screen in a unit grouped by alphabet.


Select the desired function and press to switch to the "data setting" screen. On the "data setting" screen, the data values on the LCD can be increased or decreased in the smallest possible unit by pressing - or $\square$. Holding down $\square$ or $\square$ expands the rate of change, thereby enabling values to be modified more rapidly. Otherwise, select the digit to be modified using , then set data directly. When data is modified, the value before modification will be displayed at the same time for reference purpose. To save the data, press Erati Pressing [ESET cancels the changes made and returns to the "Function Select" screen. The modified data will be effective in inverter operation after the data is saved by . The inverter operation does not change only if data is modified. When data setting is disabled in the case of "Data protected" or "Data setting invalid during inverter running," make necessary change s. Data cannot be modified for the following reasons :

Table 4-3-2

| Display | Reason for no modification | Release method |
| :--- | :--- | :--- |
| LINK ACTIVE | Currently writing from RS-485/ink <br> option to Function is being made. <br> - | Send a cancel command of function <br> writing from RS-485. Stops a <br> "Write" <br> operation from the link |
| NO SIGNAL(WE) | The edit enabling command function <br> is selected using a general-purpose <br> input terminal. | Among functions E01 to E09, turn <br> the terminal of data 19 (edit enabling <br> command selection) ON. |
| DATA PRTCTD | Data protection is selected for <br> function Fo0. | Change function F00 to 0. |
| INV RUNNING | An attempt is made to change a <br> function that cannot be changed <br> during inverter operation. | Stop inverter operation. |
| FWD/REV ON | An attempt is made to change a <br> function <br> that cannot be changed with the <br> FWD/REV command on. | Tum FWD/REV command off. |

4-3-6 Checking function data
On the "Program menu" screen, select "2. DATA CHECK". The "Function Select" screen then appears with function codes and names.


Select the desired function and press to check the function data. By pressing $\because: \%$, the screen switches to the "Data setting" screen, to modify data.

## 4-3-7 Monitoring operating status

On the "Program menu" screen, select "3. OPR MNTR" to display the present operating status of inverter. Use $\quad$ and $\quad$ to switch between the four operation monitor screens.


4-3-8 I/O check
On the "Program menu" screen, select "4. VO CHEK" to display analog and digital input/output signal status for the inverter and options. Use $\square$ and $\square$ to switch between the seven screens of data.


4-3-9 Maintenance information
On the "Program menu" screen, select "5. MAINTENANCE" to display information necessary for maintenance and inspection. Use and to switch between the five screens of data.


4-3-10 Load rate measurement
On the "Program menu" screen, select "6. LOAD FCTR". On the "Load rate measurement" screen, the maximum current, average current, and average breaking power during the set measuring time are measured and displayed.


4-3-11 Alarm information
On the "Program menu" screen, select "7. ALM INF". Various operating data when the latest alarm occurred is displayed. Use $\quad$ and $\quad$ to switch between the nine screens of alarm information data.


4-3-12 Alarm history and factors
On the "Program menu" screen, select "8. ALM CAUSE" to display the alarm history.
Press $\because:=$ to display troubleshooting information for the alarm selected.


## 4-3-12 Data copy

On the "Program menu" screen, select "9. DATA COPY" to display the data copy read screen. A copy operation is then performed in the following order ; reading inverter function data, removing the keypad panel, attaching the keypad panel to another inverter, and writing the data to the inverter.
The "verify" feature also makes it possible to compare and check differences in the data stored in the keypad panel and the data stored in the inverter.



PRG:PRG
MENU

| EID $=\angle E D$ SHIFT |
| :---: |
| $\downarrow$ PRG |
| 60.00 |



## Error processing

1) Change disabled during operation If a write operation is attempted during an inverter operation, or vice verse, the error message below will appear.
After stopping the inverter and pressing RESET, retry the write operation.

2) Memory error

If a write operation is attempted while data has not been saved (i.e., no data) in the keypad panel data memory during the read mode or when the inverter type of data read by keypad panel is different from the inverter type to which data is to be written, the following error message will appear:

3) Verity error

During a data check (verify) operation, if data stored in the keypad panel differs from data stored in the inverter, the following error message is displayed to indicate the function No. The data check is suspended.
continue the data check, and check for other mismatching data, press $\therefore \therefore \therefore$. To stop the deta check and switch to another operation, press 2 ESET .

4-3-14 Alarm mode
If an alarm occurs, the "Alarm screen" indicating the alamm contents is displayed. Use and display alarm history and multiple alarms (if more than two alarms occur simultaneously).

Alarm detection order


Alarm detection order

| Operation method | $\begin{gathered} \text { LED } \\ \text { display } \end{gathered}$ | $\begin{gathered} \text { LCD } \\ \text { display } \end{gathered}$ | Description |
| :---: | :---: | :---: | :---: |
|  | 5. | 5 | No. 5 alarm |
|  | 4. | 4 | No. 4 alarm |
|  | 3. | 3 | No. 3 alarm |
| 4 | 2. | 2 | No. 2 alarm |
|  | 1. | 1 | No. 1 alarm (more than two alarms occurred) |
|  | Blank | 0 | Latest alarm (only one alarm occurred/alarm roloased) |
|  | Blank | -1. | Previous alarm history |
|  | Blank | -2 | Alarm history before previous alarm |
|  | Blank | 3 | Alarm history two times before previous alarm |

Alarm code: See Table 6-1-1
5. Function select

5-1 Function select Ilst



C:Control Functions of Frequency



A:Alternative Motor Parameters

| Func | NAME | LCD Display |  | Setting range | Unit | $\begin{array}{\|l} \hline \text { Min. } \\ \text { Unit } \end{array}$ | Factory soting |  | $\begin{aligned} & \text { Change } \\ & \text { during op } \end{aligned}$ | $\begin{aligned} & \text { User } \\ & \text { Set value } \end{aligned}$ | remark |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | -22kW |  |  | 30 W - |  |  |  |
| A01 | Mavimum frequency 2 | A01 | Maxtere |  | $\begin{aligned} & \text { G11S: } 50 \text { to } 400 \mathrm{H} \text { \| } \\ & \text { P11S: } 50 \text { to 1201t } \end{aligned}$ | H2 | 1 | 60 |  | NM |  |  |
| A02 | Base frequency 2 | A02 | BASE PR-2 | G11S: 25 to 400 tt <br> P11S: 25 to 1201t | 't | 4 | 50 |  | M |  |  |
| A03 | Ratad voltage 2 (at Base trequency 2) | A03 | RATED V-2 | $0:$ 80 to $240 \mathrm{~V}:(200 \mathrm{~V}$ class) 320 to $480 \mathrm{~V}:(400 \mathrm{~V}$ ctass) | V | 1 | $\begin{aligned} & 200 \mathrm{~V} \text { class: } 220 \\ & 400 \mathrm{~V} \text { class: } 380 \end{aligned}$ |  | M |  |  |
| A04 | maximum volagee 2 (at Base frquency 2 ) | A04 | maxv-2 | $\begin{aligned} & 8000240 \mathrm{~V}:(200 \mathrm{~V} \text { ctess) } \\ & 320 \mathrm{~m} 0480 \mathrm{~V}: 400 \mathrm{~V} \text { (ctess) } \end{aligned}$ | V | 1 | $\begin{aligned} & 200 \mathrm{~V} \text { ctass:220 } \\ & 400 \mathrm{~V} \text { chass:380 } \end{aligned}$ |  | M |  |  |
| ADS | Torque boost2 | A05 | TRO BCOST2 | 0.0, 0.1 to 20.0 | - | - | $\begin{aligned} & \hline \text { G115:0.0 } \\ & \text { P11S:0.1 } \end{aligned}$ |  | A |  |  |
| A06 | Electronic $\quad$ (Seleca) thermal ovatoed rolay for motor 2 | A06 | ELCTRNO2 | 0, 1,2 | - | - |  |  | A |  |  |
| A07 | (Thermal trie corstenc) | A07 | OLLEVEL2 | NW ratad current 20\%10135\% | A | 0.01 | Motor rated curront |  | A |  |  |
| A08 |  | A08 | TME CNSTT2 | 0.5 0.75 .0 mm | min | 0.1 | 5.0 | 10.0 | A |  |  |
| A09 | Torque vector control 2 | nog | TROVECTOR | 0,1 | $\cdot$ | - | 0 |  | M |  |  |
| A10 | Number of motro-2 polos | A10 | M2 POLES | 2 to 14 polos | ploe | 2 |  |  | M |  |  |
| A11 |  | A11 | M2-CAP | $\begin{aligned} & \text { Wp to 22kW:0.01 10 45kW } \\ & 30 \mathrm{~kW} \text { and above:0.01to500kW } \end{aligned}$ | KW | 0.01 | Motor capeciky |  | M |  |  |
| A12 |  | A 12 | M $2-\frac{1}{7}$ | 0.005020004 | A | 0.01 | Motor reatad curriert |  | M |  |  |
| A13 |  | A13 | M2 TUN1 | 0, 1,2 | - | - | 0 |  | M |  |  |
| A14 |  | A14 | M2 TUN2 | 0.1 | - | $\bullet$ | 0 |  | M |  |  |
| A15 |  | A15 | M2 to | 0.00to 20000 | $A$ | 0.01 | Fut stmoderd mind value |  | M |  |  |
| A18 |  | A16 | M2-\%R1 | 0.00 to 50.00\% | $\%$ | 0.01 | Fufi standard ratod value |  | A |  |  |
| A17 |  | A17 | M2-\%X | 0.00 to 50.00\% | \% | 0.01 | Fuif stinderd rated value |  | A |  |  |
| A18 |  | A18 | SLPP CONP2 | 0.00 01515.001 t | H2 | 0.01 | 0.00 |  | A |  |  |

## 5-2 Function Explanation




- Seliting can be made so that a set value cannof be changed by
keypad panel operation.

(Setting procedure)
0 w 1: Press the STOP and $\wedge$ lays simulianeousty to change the value from 0 to 1 , then press

1 to 0 : Press the STOP and $V$ meys simultaneousty to change the value from 1 to 0 , then press the iutio
wey to valisate the change.
 - This function selectis the frequency sefting method.


0: Setting by kejped panel operation ( $A$,
1: Setting by voltage input (ferminal (12] ( 0 to +10 V ). )
2. Setting by current input (termmal( C 11 ) ( 4 to 20 mA ).
3. Setling by voltoge input + current input ferminal [12] * torminal (C1) ( -10 to $+10 \mathrm{~V}+4$ to 2 mm ).
The setting frequency is determined by ediding input terminats [12] and[C1] is cet as the frequercy.
4. Setting by polarked vollage input (turminal [12]) (-10 to +10V
5. Setting by potarized voltage input (turninal (12]) + vollage cormmand asodihary input (optlonal terminal (VI)) $(-10$ to +10 V ) The seting trequency is determined by adding inputs to terminals [12] and [V1].

- Polarized inpula allows operation in the direction opposite that of an operation command.

6. Setting by voluge input reverse operation (torminal (12l) ( +10 to $0 V)$
7. Setting by current input reverse operation (lerminal (Ci]) (20 to 4mA)

8. Setting by UPIOOWN cortiol mode 1 (initial value $=0$ ) (terminats [UP] and (DOWN))
9. Setting by UP/DOWN control mode 2 (initial value $=$ last final vaime) (terminats [UP】 and (DOWN]) See the function explanation of EO1 to EO9 for detaits.
10. Selling by pattern operation See the function explanation C 21 to C 23 for detaiks.
11. Seting by digiver input or puse train

- mple Optional. For detalis, see the instruction manual on options.


- This function sets the operation cormmand inpeut method.

| $F$ | 0 | 2 | $\mathbf{O}$ | $\mathbf{P}$ | $\mathbf{R}$ |  | $M$ | $\mathbf{E}$ | $\mathbf{T}$ | $\mathbf{H}$ | $\mathbf{O}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Set value $O$. Key pad operation


PTess the F WDD ley for forward operation.
Press the REV key for reverse operation.
Press the STUF kay for decaleration to a stop.
input from trominels [FWD) and [REV] is lynored.

1: Operation by external input (verminats [FWD】 and (REVI).

-     - This function can only be chenged when terminals FWD and REV are open.
- REMOTEЛOCAL switching from the keypad panel autornaticaly changes the sel value of this furiction.


Frequency setting block diagram

## 

- This function sets the maxirnum output frequency for motor 1.


Setting a value higher than the rated value of the dovice to be driven may damage the motor or machina. Match the rating of the device.

## 

- This function sets the maximum output frequency in the constant-torque range of motor 1 or tha output frequency at the rated output voltage. Watch the rating of the motor.

Setting range G11S: 25 to 400H2
P11S: 25 to 120H2
Note: When the set value of base frequency 1 is hisher than that of maximum output frequency 1, the outpert voltage does not increase to the rated voltage because the maxirnum frequency limits the output fraquancy.


- This function sets the rated value of the voltege output to motor 1. Note that a voltage ereater than the supply (input) voltage cannot be output

400 V series: 0,320 to 480 V
Valus 0 teminates operation of the voltage regutation function thereby resulting in the output of a voltage proportional to the supply voltage.

Nota: When the set value of rated voltage 1 exceeds maximum output voliage 1 , the output voltage does not increase to the rated voltage because the maximum output voltase limits the output voltage.


- This function sets the maximum value of the voltage output for moter 1. Note that a voltage hicher than the supply (input) voltage cannot be output.


- This function sets the acceleration time for the output frequency from statup to maximum frequency and the doceleration time from maximum frequancy to operation stop.


Setting range Acceleration time 1: 0.01 to 3,600 seconds Deceloration tine 1: 0.01 to 3,600 seconds

Acceleration and deceleration times are represented by the three most significant digits, thereby the settins of three hidr-order dizits can be set.
Sat acceloration and deceleration times with respect to maxirum frequancy. The relationship between the set frequency value and accoleration/deceleration times is as followa:

Sot frequency $=$ maximum frequency
The actual operation time matches the sot value.


Sot frequency < maximum frequency
The ectual operation time differs from the set value. Acceleration *daceleration operation time $=$ set value $x$ (set frequency/maximum frequancy)


Note: if the set acceleration and decaleration times are too short even though the resistance torque and morment of inertia of the load are ereat, the torque limiting function or stall provention function becomes activated, thereby prolonging the operation time beyond that stated above.

|  |  |  |  |
| :---: | :---: | :---: | :---: |
|  |  |  |  |

- This is a motor 1 function. The following can be selected:

- Selection of load characteristics such as automatic
torque boost, square law reduction torque load, proportional torque load, constant torque load.
- Enhancement of torque (VIf characteristics), which is lowered during low-speed operation. Insufficient magnetic flux of the motor due to a voltage drop in the low-frequency range can be compensated.

| Setting <br> range | Characteristics selected |
| :--- | :--- |
| $\mathbf{0 . 0}$ | Automatic torque boost characteristic <br> where the torque boost value of a <br> constant torque load ( liliear change) <br> is autornatically adjusted. |
| $0.1 \sim 0.9$ | Square law reduction torque for fan <br> and pump loads. |
| $1.0 \sim 1.9$ | Proportional torque for middle class <br> loads between square law reduction <br> torque and constant torque (linear <br> change) |
| $2.0 \sim 20.0$ | Constant torque (linear change) |

- Torque characteristics
<Square bew moduction torque> <Proportional berqua> Output voitage $V$

Output voltage $V$


Note: As a large torque boost value creates overexcitation in the low-speed range, continued operation may cause the motor to overheating. Check the characteristics of the driven motor.


The eiectronic thermal $O /$ relay manages the output frequency, output current, and operation time of the inverter to prevent the motor from overheating when $\mathbf{1 5 0 \%}$ of the set current value flows for the time set by F12 (thermal time constant).

This function specifies whether to operate the electronic thermal $O /$ relay and selects the target motor. When a general-purpose motor is selected, the operation level is lowered in the low speed range according to the cooling characteristics of the motor.


Sef value 0: Inactive
1: Active (for general-purpose motor)
2. Active (for inverter motor)

This function sets the operation level (current value) of the electronic thermal. Enter a value from 1 to 1.1 times the current rating value of the motor.


The setting range is 20 to $\mathbf{1 3 5 \%}$ of the rated current of the inverter.


- The time from when 150\% of the operation level current flows comtinuously to when the electronic thermal OA. relay activates can be set.



This function controls the frequent use and continuous operating time of the braking resistor to prevent the resistor from overheating.


| Inverter capacity | Operation |
| :---: | :---: |
| G115: 7.5NW or less | 0: Inactive <br> 1: Active (bukinh breling rescietion) <br> 2 Active (external braking resistor) |
| P115: 11kW or less | 0 : Inactive <br> 1: Inactive <br> 2: Active (edternas braking resistor) |
| G11S: 11 kW or more <br> P11S: 15 KW or more | O: mective |

## .

- This function selects operation if momentary power faikre occurs.

The function for detecting power failure and activating protective operation (i.e., alarm output, alerm display, inverter output cutoff) for undervoltage can be selected. The automatic restart function (for automatically restarting a coestine motor without stopping) when the supply valtage is recovered cen also be selected.


The following teble listes the function details.


Function coden H13 to H16 ero provided to control a restarting operation after momentary power faikre. These functions ahould be understood and used. The pick-up (speed search) function can also be selacted as a mothod of restarting when power is recovered following a mornentary frimere. (For settins details, cee function code H09.)
The pick -up function searches for the speed of the cosasting motor to restant the motor without subjectine it to excessive shock. In a hish-inertis system, the raduction in motor speed is minimal oven when the motor is cosstine. A speed searching time is required when the pick-up function is active. In such a case, the original froquency may be recovered sooner when the function is inactive and the operation restantad with the frequency prior to the momentary power failure.
The pick-up function works in the range of 5 to $\mathbf{1 2 0 ~ H z}$. If the detected spead is outside this ranse. restart the motor using the regular restert function.



Note : Dotted-dashed lines indicate motor speed.


- This function sets the upper and lower limits for the setting frequency.


Set values: 0 to $\mathbf{4 0 0} \mathrm{Hz}$ (P11S: 0 to 120 H (2)

\% The inverter autput starts with the start frequency when operation begins, and stops with the stop frequancy when operation ends.
\% If the upper linit value is leas than the lower linit value, the upper frinit value overrides the lower limit value.


- This function sets the rate of the set frequancy value to unslog input

Operation followe the fizure below.


Kh Th
This function adds a bias frequancy to the set frequancy vatue to araloe input.

## $\because 1$ 3 $\because \mathbf{F}|\mathbf{R}| E|\mathbf{E}| \bar{B}|\mathbf{B}| \mathbf{A}|\mathbf{S}|$

The operation follows the figure below.
When the tias frequancy is higher than the maximum frequency or lower than the - maximum frequency, it is limited to the maximum or - maximum frequency.


- Sturting frequency. This function sets the frequency with which to stert a DC injection brake to decelerate the motor to a stop.

| 1 | $O$ | $\mathbf{D} \mid \mathbf{C}$ |  | $\mathbf{B}$ | $\mathbf{R}$ | $\mathbf{K}$ |  | $\mathbf{H}$ | $\mathbf{Z}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Set values: 0 to eortz

- Operation hevet This furction sets the output current heval when a DC injection brake is applied. Set a percentage of inverter rated output current in 18, etepe.

Sot values: 0 to 100\% (P11S: 0 to 80\%)
- Time: This function sete the time of a DC injection prake operation


| CAUTION 30.0 seconds |  |  |  |
| :--- | :--- | :---: | :---: |
| Do not use the inverter brake function for <br> mechanical holding. <br> Injury may result. |  |  |  |


|  | Standighmequency (kequency |
| :---: | :---: |
|  | Start frequency (folding Gmofis |
| W203 | Stopirequency |

The starting frequency can be set to reserve the torque at startup and can be sustained until the magnetic flux of the motor is being established.
-Frequency: This function sets the trequency at startup.


Set values: 0.1 to 60 Hz
-Holding time: This function sets the holding time during which the start frequency is sustained at startup. F:2 4 HOLID IN IN: it:
Set values: 0.1 to 10.0 seconds
*The holding time does not apply at the time of switching between forward and reverse.
*The holding time is not included in the acceleration time.
*The holding time also applies when pattern operation (C21) is selected. The holding time is included in the timer value.
$\bullet$ This function sets the frequency at stop.


Set values: $\quad 0.0$ to 6.0 Hz


The operation does not start when the starting frequency is less than the stopping frequency or when the setting frequency is less than the stopping frequency.

-This function adjusts the carrier frequency, correct adjustment of which prevents resonance with the machine system, reduces motor and inverter noise, and also reduces leakagercurrent from output circuit wiring.
F. 2 G MIT:R SIOUINID:

| Series | FNominal applied <br> motor | Setting range |
| :---: | :--- | :--- |
| G11S | 55 kW or less | 0.75 to 15 kHz |
|  | 75 kW or more | 0.75 to 10 kHz |
| P11S | 22 kW or less | 0.75 to 15 kHz |
|  | $30 \sim 75 \mathrm{~kW}$ | 0.75 to 10 kHz |
|  | 90 kW or more | 0.75 to 6 kHz |


| Carrier frequency | Low | High |
| :--- | :---: | :---: |
| Motor noise | High | Low |
| Output current waveform | Bad | Good |
| Leakage current | Small amount | Large amount |
| Noise occurrence | Exremefy low | High |

## Notes:

1. Reducing the set value adversely affects the output current waveform (i.e., higher harmonics), increases motor loss, and raises motor temperature. For example, at 0.75 kHz , reduce the motor torque by about $15 \%$.
2 Increasing the set value increases inverter loss and raises inverter temperature.


- The tone of motor noise can be altered whien the carrier frequency is 7 kHz or lower. Use this function as required.


Monitor data (e.g.,output frequency, output current) can be output to terminal FMA as a DC voltage. The amplitude of the output can also be adjusted.
-This function adjusts the voltage value of the monitor itern selected in F 31 when the monitor amount is $100 \%$. A value from 0 to $200(\%)$ can be set in $1 \%$ steps.

-This function selects the monitor item to be output to terminal FMA.


| Set value | Monitor item | Definition of $100 \%$ monitor amount |
| :---: | :---: | :---: |
| 0 | Output frequency 1 (before slip compensation) | Maximum output trequency |
| 1 | Output frequency 2 (atter stip compensation) | Maximum output frequency |
| 2 | Output current | Rated output current of inverter $\times 2$ |
| 3 | Output voltage | 200V series: 250V 400 V series: 500 V |
| 4 | Output torque | Rated torque of motor $\times 2$ |
| 5 | Load rate | Rated load of motor $\times 2$ |
| 6 | Power consumption | Rated output of inverter $\times 2$ |
| 7 | PID feedback amount | Feedback amount of 100\% |
| 8 | PG feedback amount (only when option is instalied) | Synchronous speed at maximum frequency |
| 9 | DC link circuit voltage | 200 V series: 500 V <br> 400 V series: $1,000 \mathrm{~V}$ |
| 10 | Universal AO | 0 to 10 V output through communication and not related to inverter operation. |


|  |  |
| :---: | :---: |
| Ester |  |
| Esis |  |

Monitor derta (o.e.output froquency, output current) can be output to terminal FMP es putse voltage. Monitor data can also be sent to an enalog meter as average voltage.
When sending data to a digital counter or other instrument as pulse output, set the pulse rate in F33 to any value and the voltage in F34 to $0 \%$.
When data is sent to an analog meter or other instrument as average voltage, the voltage value set in F34 dotermines the everage voltage and the pulse rate in F33 is fixed to 2670 ( $p / 8$ ).

- This function sots the pulse frequency of the monitor item selected in F35 within a range of 300 to $6000(\mathrm{p} / \mathrm{s})$ in 1 p/a steps.

$$
\begin{array}{|lll|l|l|l|l|l|l|l|l|l|}
\hline 1 & 3 & 3 & \mathbf{F} & \mathbf{M} & \mathbf{P} & & \mathbf{P} & \mathbf{U} & \mathrm{~L} & \mathbf{S} & \mathbf{E} \\
\hline
\end{array}
$$

Set valuas: 300 to $0,000 \mathrm{p} / \mathrm{e}$


Putse frequency $(p / s)=1 / T$
Duty ( K ) $=\mathrm{T} 1 / \mathrm{T} \times 100$
Average voltage $(V)=15.6 \times \mathrm{T} 1 / \mathrm{T}$

- This furnction sets the average voltage of pulse output to terminal FMP.


## 13 i F $1 \mathbf{M}|\mathbf{P}| \quad|\mathbf{V}|-|\mathbf{A}| \mathbf{D}|\mathbf{U}|$

Set valuo
0\%:
The pulse frequency varies dependins on the monitor emount of the monitor item selected in F35. (The maximum value is the value set in F33.)
1 to 200\%: Puse frequency (1) is fixed at $2,670 \mathrm{p} / \mathrm{s}$. The average voltage of the monitor item selected in F35 when the monitor amount is $100 \%$ is adiusted in the 1 to $200 \%$ range ( $1 \%$ steps). (The pulse duty varies.)

- This function selecta the monitor item to be output to tarminal FMP.


The set value and monitor items are the same as those of F3I.

## 

- This function specifies whether to activate (excite) the alarm output relay (30Ry) for any fautt at normal or alarm status.

- When the sot value is 1 , contacts 30 A and 30 C are connected when the inverter control voltage is established (about one second after power on).


The torque linit operation calculates motor torque from the output voltage, current and the primery resistance value of the motor, and controls the frequency so the calculated value does not exceed the linit. This operation enables the inverter to continuse operation under the limit oven if a sudden change in load torque occurs.

- Seloct limit values for the driving torque and braking torque.
- When this function is activated, acceloration and deceleration operation times are longer than the set values.



## 

- To obtain the motor torque most efficiently. the torque vector control calculates torque accordins to load, to adiust the voltage and current vectors to optimum values based on the calculated value.

\section*{| 1 a | 2 | $\mathbf{T}$ | $\mathbf{R}$ | $\mathbf{a}$ | $\mathbf{V}$ | $\mathbf{E}$ | $\mathbf{C}$ | $\mathbf{T}$ | $\mathbf{O}$ | $\mathbf{R}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |}


| Set value | Operation |
| :---: | :---: |
| 0 | Inective |
| 1 | Activo |



When 1 (Activa) is set, the sot values of the following functions differ from the written values:
(1) F09 Torque boost 1

Automatically set to 0.0 (entomatic torqua boosting).
(2)09 Slip compensution amount

Slip compensation is mutomatically activated.
When 0.0 is set the amount of slip compensation for the FUA standerd 3-phase motor is applied Otherwise. the written value is appliod

Use the torque vector control function under the following conditions:
(1) There must be only one motor.

Connection of two or more motors makes scourate control difficult
(2) The function data (rated current P03, no-lond current P08, WR1 P07, and $\$ X$ P08) of motor 1 must be correct Whon the standard FUNI 3-phnee motor is used, sattins the eapacity (function P02) ensures entry of tho above data. An atto turing operation should be performed for other motors.
(3) The rated current of the motor muast not be significantly loss than the rated current of the inverter. A motor two ranks lower in capacity then the nominel applied motor for the inverter should be used at the smallest (dopendine on the modal).
(4)To provent leakage current and ensure accurate controh the longth of the amble between the inverter and motor should not exceed 50 m .
(5) When a resector is connected between the inverter and the motor and the impedance of the wiring cannot be diaregarded, use PO4, "Auto tuning," to rewrite datn.

If these conditions are not satiafied, set 0 (lnectiva).



- Each function of digital input terminals X1 to X9 can be sot as codes.

| [ | 0 | 1 | $x$ | 1 | $F$ | U | $N$ | C |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| E | 0 | ? | X | 2 | $F$ | U | N | C |  |  |  |
| E | 0 | 3 | X | 3 | $F$ | U | N | C |  |  |  |
| E | 0 | 4 | X | 4 | F | U | N | C |  |  |  |
| F | 0 | 5 |  | 5 | $F$ | U | $N$ | C |  |  |  |
| f | 0 | 6 | $\times$ | 6 | $F$ | U | N | C |  |  |  |
| F | 0 | 7 | $x$ | 7 | $F$ | U | N | C |  |  |  |
| 「 | 0 | 8 | $\times$ | 8 | F | U | N | C |  |  |  |
| t | 0 | 9 | $\times$ | 9 | F | U | N | C |  |  |  |


| Set value | Function |
| :---: | :---: |
| 0, 1, 2, 3 | Multistep frequency selection (1 to 15 steps) |
| 4,5 | Acceforation and deceleration time selection (3 steps) |
| 6 | Self-hold seloction (HLD) |
| 7 | Coast-to-stop command (BX) |
| 8 | Alarm reset (RST) |
| 9 | Extarnal alarm (THR) |
| 10 | Jogeing (JOG) |
| 11 | Frequancy setting $2 /$ frequency setting 1 ( $\mathrm{Hz} 2 / \mathrm{Hz1}$ ) |
| 12 | Motor 2/motor 1 (M2/M1) |
| 13 | DC injaction brake command (DCBRK) |
| 14 | Torque limit 2/torque limit 1 (TL2/TL1) |
| 15 | Switching operation from line to inverter ( 50 Hz ) (SW50 |
| 16 | Switching operation from line to inverter ( $60 \mathrm{H}+\mathrm{t}$ ) (SW60) |
| 17 | UP command (UP) |
| 18 | DOWN cormmend (DOWN) |
| 19 | Edit permission command (data change permission) (WE-KP) |
| 20 | PiD control cancellation ( $\mathrm{H} / \mathrm{/PiD}$ ) |
| 21 | Forward/reverse switching (terminals 12 and C1) (IVS) |
| 22 | Interiock (52-2) (L) |
| 23 | Torque control cancellation (Hz/TRQ) |
| 24 | Link operation selection (StandardRS485, Option: BUS) (LE) |
| 25 | Universal DI (U-DD |
| 26 | Start cheracteristics solection (STM) |
| 27~ | For aptions |


| Combination of set vakus input signals |  |  |  | Frequancy selected |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} 3 \\ \text { (SSX } \end{gathered}$ | $\begin{gathered} 2 \\ \operatorname{css} \theta \end{gathered}$ | $\begin{gathered} 1 \\ (s s y) \end{gathered}$ | $\int_{(\operatorname{ssi})}^{0}$ |  |  |
| off | off | off | 0 \% | C05 MULTI Hz-1 |  |
| off | off | on | off | C06 MULTI Hz-2 |  |
| off | off | $0 \cdot 7$ | in | C07 MuLTI Hz-3 | \%6x \% \% |
| off | 37 | off | off | COB MLLTI H2-4 |  |
| off | 3n | off | U11 | COS MLLT Hz-5 |  |
| off | 2n | un | off | CIO MLIT Hz-6 | Setting rango |
| off | on | UH1 | on | C11 Mnlt He-7 |  |
| on | off | off | off | C12 MLIT Hz-8 | G115.0.00 |
| on | off | off | on | C13 MLLTI Hz-9 | 400.00\%tz |
| ว, | off | on: | off | C14 MaLTI Hz-10 |  |
| จก | off | טr: | \% | C15 MULTI Hz-11 |  |
| Or | วn | off | off | C16 MMLTI H2-12 |  |
| on | 27 | off | on | C17 MMLTI Hz-13 |  |
| on | $9: 1$ | on | off | C18 MMLTI Hz-14 |  |
| - | 0: | 3 | orr | C19 MULTI Hz-15 |  |

Accelarintion ard riaceipriation t.tion simientinn
The acceleration and deceleration time can be switched to a preset time in function codes E10 to E15 by siwitching the external digital input signal. Assign vahues 4 and 5 to the tareot digital input terminal. The combination of input signals dotermines the acceloration and decolaration times.

| Combination of set value input signals |  | Acceleration and deceleration times selected |  |
| :---: | :---: | :---: | :---: |
| $\begin{gathered} 5 \\ \text { (RT2) } \end{gathered}$ | $4$ |  |  |
| off | off | F07 ACC TMEI <br> F08 DEC TME1 | (4) 41 , <br>  <br>  <br>  |
| off | on | E10 ACC TIME2 E11 DEC TME2 |  |
| on | off | E12 ACC TINE3 E13 DEC TLME3 | Setting range$0.01 \sim 3600 \mathrm{~s}$ |
| on | 50 | E14 ACC TINEA E15 DEC TAME4 |  |

S.if-hrod :\% ecturi • HLD:

This selection is used for 3-wire operation. The FWD or REV signal is self-treld when HLD-CM is on, and the self-hold is cheared when HLD-CM is turned off. To use this HLD terminal function assign 6 to the target digital input terminal.


## Corast-:0 stu0 command $8 \times$ i

When $B X$ and CM are connected, inverter output is cut off immediately and the motor starts to coast-to-stop. An alarm signal is neither output nor self-held. If BX and CM are disconnected when the operation command (FWD or REV) is on, operation starts at the start frequency. To use this $8 X$ terminal function, mssien value ${ }^{\circ} 7{ }^{7 \prime}$ to the target digital input terminal.


## A arm retaci iRST:

When an inverter trip occurs, connecting RST and CM clears the alarm output (for any fault) ; disconnecting them clears trip indication and restarts operation. To use this RST torminal function, assign value " 8 " to the target digital input terminal

## Frourna: ularm (THR)

Discommecting THR and CM dering operation cuts off inverter output (i.e., motor starts to coast-to-stop) and outputs alarm OH2, which is self held internally and cleared by RST input. This function is used to protect an external brake resistor and other components from ovarheating. To use this THR terminal function, assien vake " 9 " to the target digital input terminal ON input is ascumed when this terminal function is not set.

## Joeriny: JOG:

This function is used for jogeins (inching) oparation to position a work piece. When JOG and CM are connected. the operation is performed with the jogging frequency set in function code C20 while the operation commend (FWD-CM or REV-CM) is on To use this JOG terminal function, assien value ${ }^{-10-}$ to the targot digital input terminal.

## 「raciaticy settime ? frenimesiov seiting 1

This function switches the frequency setting mothod set in function codes F01 and C30 by an external digital input signal.

| Sot value input <br> signal | Frequency setting mothod seloctod |
| :---: | :--- |
| 11 |  |
| off | F01 FREQ CMD1 |
| in | C30 FREO CND2 |

Ma: ar 2. mutur 1
This function switches motor constants using an external digital input signal.
This input is effective only when the operation command to the inverter is off and operation has stopped and does not apply to the operation at Oftz

| Set valuse input signal | Motor selected |  |
| :---: | :---: | :---: |
| 12 |  |  |
| off | Motor 1 |  |
| $0 n$ | Motor 2 |  |

When the external digital input signal is on. DC injection braking starts when the inverter's output frequency drops below the frequency preset in function code F20 after the operation command goes off. (The operation command coes off when the SIDP key is pressed at keypad panol operation and when both terminals FWD and REV go on or off at terminal block operation.) The DC injection braking continues while the dieital input siennal is on. In this caso, the longer time of the following is selected.

- The time set in function code F22.
- The time which the input signal is set on.

| Set vabue inpert <br> signal | Operation selected |
| :---: | :---: |
| 13 | No DC injection brake commend is <br> eiven. |
| off | ADC injection brake command is given. |
| rr |  |

## Iorgate lime: ? :urada urrit 1

This firnction switches the torquolmit value set in function codes F40 and F41, and E16 and E17 by an external disital input siennal.

| Set value input signal | Torque limit value selected |  |  |
| :---: | :---: | :---: | :---: |
| 14 |  |  |  |
| off | F40 ORVTRO1F41 BRK TRQ1 |  | Fxw |
| on |  | DRV | Setting range DRV 20~200\% , 899 |
|  | E17 <br> TRQ2 | BRK | $\begin{array}{lrll} \begin{array}{llll} \text { BRKK } & \text { O, } & 20 & \sim \\ 2006,999 \end{array} & & \end{array}$ |


Motor operation can be switched from 50 Hz commercial power operation to inverter operation without stopping the motor by switching the external digital input signal.

| Sat value <br> input signal | Function |
| :---: | :---: |
| 15 | Inverter operation to line operation <br> (50Hz) |
| off $\rightarrow$ on | Line operation to inverter operation <br> $(50 / 42)$ |
| on $\rightarrow$ off |  |

Switchine noriation fone lime inverter if0lt: ! SWEO:
Motor operation can be switched from $\mathbf{6 O H z}$ commercial power operation to inverter operation without stopping the motor by switchins the external digital input signel.

| Set value input simal | Function |
| :---: | :---: |
| 16 |  |
| off $\rightarrow$ on | Inverter oparation to line operation ( $60 \mathrm{H}_{2}$ ) |
| on $\rightarrow$ off | Line operation to inverter operation ( $60 \mathrm{H}+2$ ) |

When the disital input signel goes off, 50 or 60 Hz is output eccording to the set value input signal after the restart waiting time following a momentary power faikure (function code H13). The motor is then directed to inverter operation.

| When an operation command is input (on), the output frequency can be increased or decreased by an external digital input signal <br> The change ranges from 0 to maximum trequency. Operation in the opposite direction of the operation command is not allowed. |  |  |  |
| :---: | :---: | :---: | :---: |
| Combi valuo |  | Function selocted <br> (when operation command is on) |  |
| 18 | 17 |  |  |
| off | off | Holds the output frequancy. |  |
| off | on | Lncreases the output froquency according to the acceleration time. |  |
| on | off | Decreases the output frequency accorcing to the deceleration time. |  |
| un | On | Holds the cutput frequency. |  |

There are the two types of UP/DOWN operations as shown
below. Set the desired type by settins the frequency (FO1 or C30)

| Frequency setting (f01 or C30) | Initial vake at power input on | Operation cormmand reentry churing deceleration |
| :---: | :---: | :---: |
| $8$ <br> (UP/DOWN1) | OH2 | Operates at the frequency at reentry. <br> Frequency |
| $\begin{gathered} 9 \\ \text { (UP/DOWNR) } \end{gathered}$ | Previous frequency | Returns to the frequency before deceleration <br> Frequency $\operatorname{PND}_{\text {PREV }}$ |

Foit permission camerand idata chiomes permission: i
This function allows the data to be changed only when an oxternal signal is being input, thereby making it difficult to change the data.

| 19 | Function selocted |
| :---: | :---: |
| off | Inhibit data changes. |
| or | Allow data chanses. |

Nota:
If a terminal is set to value 19, the data becomes unable to be changed. To change the data, turn on the terminal and change the terminal setting to another number.
PID coritrol samcellation ! ! : PID:
The PiD control can be disabled by an oxternal dieital input simal

| Set value input sienal | Function selected |
| :---: | :---: |
| 20 |  |
| off | Enabla P1 control |
| on | Disable PID control (frequency setting from keypad panal). |

forwad aseration rewerse
The analos input (terminals 12 and C1) can be switched between forward and reverse operations by an external diepital input signal.

| Set value input signal | Function selected |
| :---: | :---: |
| 21 |  |
| off | Forward operation when forward operation is set and vice versa |
| - ${ }^{1}$ | Reverse operation when forward operation is set and vice verse |

## irieriosti5? ?

Whan a contactor is installed on the output side of the inverter, the contactor opens at the time of a momentery power faikre, which hinders the reduction of the DC circuit voltage and may prevent the detection of a power faikre and the correct restart operation when power is recovered. The restart operation at monentary power faikure can be performed offectively with power faikre information provided by an external digital input signal.

| Set value <br> input signal | Function |  |  |
| :---: | :--- | :--- | :---: |
| 22 | $\cdot$ |  |  |
| off | No momentary power taikure detection <br> operation by diaital input |  |  |
| on | Momentary power failure detection <br> operation by digital input |  |  |

Targue ronntrol rancellation : He.'TRQ)
When function code H 18 (torque control function selection) is set to be active (value 1 or 2), this operation can be canceled externally
Assign value " 23 " to the target digital input terminal and switch between operation and no operation in this input signal state.

| Set value <br> input signal | Function selected |
| :---: | :--- |
| 23 | Torque control function active <br> off <br> The input voltage to terminal 12 is the <br> torque command value. |
|  | Torque control function inactive <br> The input voltage to terminal 12 is the <br> on <br> frequency command valus. <br> PID feedback amount when PID control <br> operation is selected (H20=1 or 2). |

Linit oneration selection !RS485 standard BUS
Frequency and operation commands from the link can be enabled or disabled by switching the external digital input signal. Select the command source in H3D, "Link function." Assign value " 24 " to the target digital input terminal and enable or disable commands in this input signal state.

| Set value input signal | Function selected |
| :---: | :---: |
| 24 |  |
| off | Link command disabled. |
| ยn | Link command enabled. |

Univarsat Dl'U-DI)
Assigning value " $25^{\prime \prime}$ to a digital input terminal renders the terminal a universal DI terminal. The ON/OFF state of signal input to this terminal can be checked through the RS485 and BUS option.
This input terminal is only used to check for an incoming input signal through communication and does not affect inverter operation.
Start characteristics selection (STM)
The start characteristics function (pick-up moda) in function code H 09 can be enabled or disabled by switching the external digital input signal. Assign valuo " 26 " to the target digital input terminal and enable or disable the function in this input signal state.

| Set value <br> input signal <br> 26 | Function selected |
| :---: | :---: |
| off | Start characteristic function disabled |
| on | Start characteristic function enabled |

Settings when shipped from the

| Digital input | Setting et factory shipment |  |
| :---: | :---: | :---: |
|  | Set value | Description |
| Terminal $\times 1$ | 0 | Multistep frequency selection (SS1) |
| Termiral $\times 2$ | 1 | Multistep frequency selection (SS2) |
| Terminal $\times 3$ | 2 | Multistep frequancy selection (SS4) |
| Terminal X $^{4}$ | 3 | Multistep frequancy selection (SS8) |
| Terminal $\mathrm{X5}$ | 4 | Aoonderation and decoluration selection (RT1) |
| Terminal $\mathrm{X6}$ | 5 | Aceoleration and deceleration telection (RT2) |
| Terminal $\times 7$ | 6 | Solf-hold selection (HLD) |
| Terminal $\times 8$ | 7 | Coast-to-stop command (BX) |
| Torminal $\times 9$ | 8 | Alarm reset (RST) |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  <br>  |  |

Acceleration time 1 (FO7) and deceleration time 1 (FOS) as woll as three other types of acceleration and deceleration time can be selected.
The pperation and setting rances are the same as those of acceleration time 1 and deceleration time 1 . See mxplanations for F07 and F08.

- For switching acceleration and deceleration times, select any two torminats from terminal X1 (function selection) in E01 to terminal $X 9$ (function selection) in E09 as switching signal input terminals. Set "4" (acceloration and deceleration time 1) and " 5 " (eoceloration and deceloration time 2) to the selected terminals and input a sienal to each terminal to switch accaleration and deceleration times. Switchins is possible during accularation, deceleration, or constant-speed operation.
Example: When 4 and 5 are set to terminals $X_{2}$ and $X_{3}$ :


- This function is used to switch the torque limit bevel set in F40 and F41 by an external control sienal. Input an external signal by selecting any of the control input terminats ( $X 1$ to

- Some control and monitor signals can be selectad and output from terminats $[\mathrm{Y} 1$ ] to $(\mathrm{Y} 5$ ]. Terminals $[\mathrm{Y} 1$ ] to [ Y 4 ] use transistor outputi terminals[Y5A) and [Y5C]uso relay contacts.


| Set vidue | Output signal |
| :---: | :---: |
| 0 | Oparating (RUN) |
| 1 | Frequency arrival (FAR) |
| 2 | Frequency dotection (FDT) |
| 3 | Stopping due to undervoltage (LV) |
| 4 | Torque polarity detection (B/D) |
| 5 | Torque limiting (TL) |
| 6 | Restarting after momemtary power failure ( PPF) |
| 7 | Overloed earty waming (OL) |
| 8 | During hoypad panel operation (KP) |
| 9 | Imvertor stopping (STP) |
| 10 | Ready for oporation (ROY) |
| 11 | Operation switching between line end inverter (SWB8) |
| 12 | Operation switching betwoen line and invortor (SW52-2) |
| 13 | Operation switching between line und imwter (SW5\%-1) |
| 14 | Motor 2 switching (SWM2) |
| 15 | Terminal AX function (AX) |
| 16 | Pattern operntion stage change (TU) |
| 17 | Pattem operation cyclo operation completed (TO) |
| 18 | Pattern oporation stage number (STG1) |
| 19 | Pattern operation stage number (STG2) |
| 20 | Pattem oporation stage number (STC4) |
| 21 | Alarm detain (AL1) |
| 22 | Alarm dotai (AL2) |
| 23 | Abrm detail (AL4) |
| 24 | Alarm detellil (ALB) |
| 25 | Cooing fan operating (FAN) |
| 28 | Retry function operating (TRY) |
| 27 | Universal DO (1-DO) 汭 |
| 28 | Heat sink ovarheat early waming (OH) |
| 29 |  |

Note: For output signals marked 涊. rafer to instruction manuals for RS485 communication and the synchronous operation card.
liverter rumnrg, IRUSN
"Rumning" means that the inverter is outputtine a frequency. "RUN" signal is output as when there is output speed
(frequency). When the DC injection brake function is active, "RUN" signal is off.

## Frequericy arr val : TAR:

See the explanation of function code E30 (frequency arrival [detection width].
Freauency detecion . ADT :
See the explanation of function codes E31 and E32
(frequency detaction).

## Stopirite due to undervolt.age :LV:

If the undervoltage protectiva function activates, ie. when the main circuit DC voltage falls below the undervoltage detection level, an ON signal is ortput The sienal zoes off whan the voltuge recovers and increases above the detection lovel. The ON signal is retained whito the undervoltage protective function is activating.
Undervaltage detection level
200V series: 200V : 400 V series: 400 V
Iorgue poisativ cetection i\& I):
This function determines the torque polarity calculated in the inverter and outputs a signal indicating driving or braking torque. An OFF sienal is output for driving torque; an ON sienal is outpurt for braking torque.

## Torgue: marerp 111:

When the torque limitins activatos, the stall provention function is automatically activated to change the output frequency. The torque limiting siensl is output to lighten the load, and atso used to display overload conditions on the monitor device. This ON sigral is output durine the current or torgus is limited or pomer resensertion is prevented. Restuet after mometentury uower iulde! ! PF:
Following a momentary power failurs, this function reports the start of the restart mode. the occurrence of an automatic pull-in, and the completion of the recovery operation
Following a momentary power failure, an ON siznal is output when power is recovered and a synchronization (pulb-in) operation is performed. The siennal goes off when the frequancy (before power failure) is recovered.
For Oftz resturt at power recovery, no signal is output because synchronization ends when power is recovered The frequency is not recovered to the frequency before the power failure occurence.

## Querinat early warmis, 10 ll .

Before the motor stops by the trip operation of an eloctronic thermal $O /$ relay, this function outputs an $O N$ sienal when the load reaches the overload early warnins loval.
Either the electronic tharmal O/L relay early waming or output curvent overioad early warning can be salacted.
For setting procedure, see "E33 Overload earty warning (oparation selection)", and "E34 Overioad early warning (operation level)."
Note: This function is effective for motor 1 only.
Keypurs watel operating \{KP!
An ON signal is output when operation commend keys ( wo , -ty and stax) ) on the keypad panel can be used (i.e., 0 set in "F02 Operation") to issue operation and stop commands.

## Stopprie iSTOP!

This function outputs an inverted signal to Running (RUN) to indicate zero sposed. An ON signal is output when the DC injection brake function is operating.

Ready for operation ifDV：
This function outputs an ON signal when the inverter is ready to operate．The inverter is ready to operate when the main circuit and control circuit power is establishod and the inverter protective function is not activating． About one second is required from power－on to ready for operation in normal condition．

## Onetatiun wituh ng tixweer．ine and inverser Swe ：Siwsp－p：SWS？1？

To perform switching operation between the line and the inverter，the sequence prepared in the inverter can be used to select and output signals for apening and closing the magnetic contactors connected to the inverter．As the operation is complox，rofor to technical documantation for the FRENIC5000G11S／P11S series when usine this function．
As the sequence will operate automatically when SWB8 or SW52－2 is solected，do not select when not using the soquance．

## 

Whon a sienal for switching to motor 2 is input from the terminal solocted by terminals \X1】 to 【X9】．this function selocts and outputs the signal for switching the magnotic contactor for the motor．As this switching signal is not output during running inchudins when the DC injection braking function is operating a sienal must be re－input after output stops．
Fermial $A X$ funct an $A, A x$ ：
When in operation（forward or reverse）command is entered． this function outputs an ON signal．When a stop command is entered，the siegnal soes off after inverter output stops． When a coast－to－stop command is entered and the inverter protective function operates，the sienal $20 e s$ off immediately．
Pation overation stabe charge，T13：
When the pattern operation stage chanses，this function outbuts a ono－shot（ 100 ms ）ON sienol to report a stage chans：．

When the seven stages of a pattern operation are comploted this function outputs a one－shot（ 100 ms ） ON siznal to report the complation of all stayes．

Durine pattem operation，this function reporte the stage （operation process）beine operated．

| Pattern <br> operation <br> stage Na． | Output termiral |  |  |
| :---: | :---: | :---: | :---: |
|  | STG 1 | STG 2 | STG 4 |
| Stage 1 | on | off | off |
| Stage 2 | off | on | off |
| Stage 3 | on | on | off |
| Stage 4 | off | off | on |
| Stage 5 | on | off | on |
| Stage 6 | off | on | on |
| Stage 7 | on | on | on |

When pattern operation is not activated（ie．，no stage is selected，the terminals do not ourtput a sienal．

This function reports the operating stantus of the inverter protective function．

| Alarm detail （inverter protectiva function） | Output terminal |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | ALI | A2 | AL4 | ALB |
| Overcurrent，pround fauli，fuse blown | on | off | off | off |
| Overvoltage | off | on | off | off |
| Undervoltage shortage，implut phase faikure | on | on | off | off |
| Motors 1 and 2 overload | off | off |  | off |
| Unverter overload | on | off | or | off |
| Heat sink overheating，inverter inside overheating | off | ח\％ | an | off |
| External alarm input，braking resistor overheasting | on | on | on | off |
| Memory error，CPU arror | off | off | off |  |
| Keypad parel communication arror． option communication error | Or | off | off | on |
| Option error | off | on | ff | on |
| Output wiring error | off | off | on | on |
| RS485 communication error | an | off | or | on |
| Overspeed，PG disconnection | off | or | on | on |

In normal eperation terminals do not output a siernal
Coolng ！an uperature it AN：
When used with＂HOS Cooling fan ONOFF control＂this function outpurte a signal while the cooling fan is operating． Retri，iunction oceratime
When a value of 1 or brger is set to＂H04 Retry operatinge＂ the signed is output while retry operation is activatine when the inverter protective function is sectivated．
Univeras DO．U－DD
Assigning value＂ $\mathbf{2 7} \mathbf{7}^{\prime}$ to a transistor output terminel renders the terminal a universal DO terminal．
This function enables ONOFF through the RSA85 and BUS option．
This function surves only to tum on and off the transistor output through communication and is not rolitiod to inverter oparation．
Heal sari overheat earls warire． OH ）
This function outputes early warning cienal when hoat sink temperature is（overheat detection lovel $-10^{\circ} \mathrm{C}$ ）or hidher．


| Dieital input | Setting at factory shipment |  |
| :--- | :---: | :--- |
|  | Set <br> valuo | Description |
| Terminal Y1 | 0 | Operating（RUND |
| Terminal Y2 | 1 | Frequancy arrival（FAR） |
| Terminal Y3 | 2 | Frequancy detection（FDT） |
| Terminal Y4 | 7 | Ovarload aarly warnine <br> （OL） |
| Terminal Y5 | 15 | Terminal AX function（AX） |

## SEM N

－This function adiusts the detection width when the output frequency is the same as the set frequency（operating
－frequency）．The detection width can be adiusted from 0 to $\pm 10 \mathrm{~Hz}$ of the setting frequency．

## F 3 JF｜A｜R｜｜H｜Y｜S｜T｜R｜

Setting range： 0.0 to 10.0 Hz
When the frequency is within the detection width an ON signal can be selected and output from terminals 【Y1】to【Y5】．


－This function detarmines the operation（detection）level of the output frequency and hysteresis width for operation ralease．When the output frequency exceesds the set operation lovel an ON signal can be selectad and output from terminale 【Y1】 to［Y5）．


| Settine range（Operation lovel）$:$ | G11S：0 to 400 Hz |
| ---: | :--- |
|  | P11S：0 to 120 Hz |
| （Hysteresie width）： 0.0 to 30.0 Hz |  |


－Select one of the following two types of overload early waming：early warning by electronic thermal O／L rolay function or early warning by output current．

－This function determines the operation bevel of the electronic thermel $0 / 2$ relay or output current
Sotting rage G11Sinvertor rated output currentux（20 to 200\％） P1isinverter reted output currenter（20 to 150n）

The operation release bovel is $90 \%$ of the sot valua．

－This function is used when 1 （output current）is set to ＂E33 Overtosd early warrings（operation seloction）．＂

## E 3 s O｜L｜TT｜ITM｜E｜R｜ $\mid$

Satting renge： 0.1 to 60.0 seconde
－Set the time from when the operation loval is attained untia the overload early warning function is ectivated．
 515 Wix
－These coofficients are conversion coefficients which are used to determine the load and line speed and the target value and feadback arrount（process mount）of the PID controller diaplayed on the LED monitor．
Sottine range
Disphery coofficient A－ 999.00 to 0.00 to +999.00 Display coefficient B：－999．00 to 0.00 to $\mathbf{8 9 9 . 0 0}$


Loed and line speed
Use the display coefficient $A$ ．
Displayed value $=$ output frequancy $\times(0.01$ to 200．00）
Although the setting range is $\pm 999.00$ ，the offective value range of display data is 0.01 to 200.00 ．Therefore，values smaller or berger than this range are limitod to a minimum value of 0.01 or a maximem value of 200.00 ．
－Targot value and feachack amount of PID controiler
Sat the maxinum value of display data in E40．＂Display coefficient $A^{\prime \prime}$ and the minimum value in E41，＂Display coefficient $B$ ．＂
Displayed value $=$（target value or faedbeck mount） $x$（display coufficient $A-B$ ）$-B$ Displayed



- Among data in "E43 LED monitor (display selection)." some date need not be displayed instantaneously when the data chenges. For such data, a flickering suppression fiteor can be used

Setting range: 0.0 to 5.0 seconds
- Monitored items in "E43 LED monitor (display seloction)"

| Set value | Display item | Set value | Display item |
| :---: | :---: | :---: | :---: |
| 3 | Output <br> current | 8 | Calculated <br> torque value |
| 4 | Output <br> voltase | 9 | Power <br> consumption |


|  |  |
| :---: | :---: |
|  |  |

- The data during inverter operation, during stoppinge at frequency setting, and at PD setting is displayed on the LED. -Disptyy durins ruming and stoppine
Durine running, the itsms selected in "E43 LED monitor (display selection)," are displayed in "E44 LED monitor (display at stoppind." specify whether to displey some items out of the set values or whether to display the same items as durine numine.


| Valus set to E43 | $E 44=0$ |  | E44=1 |  |
| :---: | :---: | :---: | :---: | :---: |
|  | At stopping | Durine running | At stcpping | Durins rurning |
| 0 | Set frequency value ( H 2) | Output frequency (before slip compensation) (Hz) |  |  |
| 1 | Set frequency value $(H 2)$ | Output frequency (after slip compensation) ( $\mathrm{H}_{2}$ ) |  |  |
| 2 | Sot frequency value ( H ) |  |  |  |
| 3 | Output current (A) |  |  |  |
| 4 | Output voltage (commend value) (V) |  |  |  |
| 5 | Synchronous speed set value ( $\mathrm{r} / \mathrm{min}$ ) | Synchronous speed (r/min) |  |  |
| 6 | Line speed set valvo $(\mathrm{m} / \mathrm{min}$ ) | Line speed ( $\mathrm{m} / \mathrm{min}$ ) |  |  |
| 7 | Land speed set value ( $\mathrm{r} / \mathrm{min}$ ) | Load speed (r/min) |  |  |
| 8 | Caloutated torque value (\%) |  |  |  |
| 8 | Output power (kW) |  |  |  |
| 10 | PID target value 1 (direct input from koypad panel) |  |  |  |
| 11 | PD target value 2 (input from "FO2 Frequency 1") |  |  |  |
| 12 | PDD faedback amount |  |  |  |

Note: For the valuas 10 to 12 set to E43, the data is displayed only when selected in "H20 PBD control (operntion selection)."


## 

- Display at frequency setting

When a set frequancy is checked or chansed by the keypad panel, the set valke shown below is displayed.
Select the display item by using "E43 LED monitor (display seloction)." This display is not affected by "E44 LED monitor (diaplay at stopping)."

| Vabue set to E43 | Frequency setting |
| :---: | :--- |
| $0,1,2,3,4$ | Set value of frequency $(\mathrm{H} 2)$ |
| 5 | Set vahe of synchronous speed $(\mathrm{r} / \mathrm{min})$ |
| 6 | Set value of line speed $(\mathrm{m} / \mathrm{min})$ |
| 7 | Set value of losed speed $(\mathrm{r} / \mathrm{min})$ |
| 8,9 | Set value of frequency $(\mathrm{H} 2)$ |
| $10,11,12$ | Sat value of frequency $(\mathrm{H} 2)$ |

Note: For the values 10 to 12 sett to E43, the dista is displayed only when selected in "HZO PDD control (operation selection)."
-This function selects the item to be displayed on the LCD monitor in the operation mode.

| Set valus | Disploy item |
| :---: | :---: |
| 0 | Operation status, rotuting drection, operation anide |
| 1 | Output froquency (bsfore ship compensantion) output current, calculeted torque value in ber eraph |

Set value: 0

When stopping

| 60.00 |
| :--- |
| STOP |
| PRGGPRG MENU |
| F/D=LED SHIFT |

PRGOPRG MENU F/D=LED SHIFT

Set value: 1

Full-acale value of bar graph

| Display item | Full-scalo |
| :--- | :--- |
| Output frequency | Maximum frequency |
| Output curron | $200 \%$ of inverter rated value |
| Calculated torqua valee | $200 \%$ of motor rated value |

Nota: The scale cannot be adjusted.

-This function selects the language for date display on the LCD monitor.


| Set value | Languege <br> displayed | Ser value | Languaes <br> displayed |
| :---: | :---: | :---: | :---: |
| 0 | Japanese | 3 | French |
| 1 | English | 4 | Spanish |
| 2 | Germen | 5 | Halan |

Note: English languangs is used for all LCD screens in this manual. For other languages, refore to the relevent instruction manual.

This function edjusts the LCD contrast Increese the set vahu to raise contrast and decrease to lower contrast.

| Set value | 0. 1, 2 …..... 8, 9, 10 |
| :---: | :---: |
| Screen |  |


-This function makes the set frequency jump so that the inverter's output frequency does not match the mechenical resonance point of the load

- Up to three jump points can be set.
-This function is ineffective when jump frequencies 1 to 3 are sot to OHE.
- A jump does not occur during acceleration or decolaration. When a jump frequency settine range overlaps another rance. both ranges are added to determine the actualjump area.

Sot valuo
0 to 400Hz (P11S: 0 to 120 Hz )
In 1 Hz steps (min)
Set valus


0 to 3012
In $1 H_{2}$ steps ( min )



- Multistep frequencies 1 to 15 can be switched by turning on and off terminal functions SS1, SS2. SS4, and SS8. (See E01 to E09 for terminal function definitions.)
- OfF input is assumed for amy undefined terminal of SSI, SS2. SS4, and 558 .

| C | 0 | 5 | M | U | L | $T$ | 1 | H | 2 | - | 1 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| c | 0 | 6 | M | U | 2 | $T$ | 1 | H | $z$ | - | 2 |  |
| c | 0 | 1 | M | U | $L$ | T | 1 | H | 2 | - | 3 | 5ax ${ }^{\text {a }}$ |
| c | 0 | 8 | M | U | L | T | 1 | H | 2 | - | 4 | HETH |
| C | 0 | 9 | M | U | L | T | 1 | H | 2 | - | 5 |  |
| C | 1 | 0 | M | U | L | T | 1 | H | 2 | - | 6 |  |
| C | 1 | 1 | M | U | L | $T$ | 1 | H | $z$ | - | 7 |  |
| C | 1 | $?$ | M | U | L | T | 1 | H | z | - | 8 |  |
| C | 1 | 3 | M | U | L | T | 1 | H | 2 | - | 9 |  |
| c | 1 | 4 | M | U | L | T | 1 | H | 2 | 1 | 0 |  |
| c | 1 | 5 | M | U | L | T | 1 | H | 2 | 1 | 1 |  |
| c | 1 | 6 | M | U | L | $T$ | 1 | H | 2 | 21 | 2 |  |
| C | 1 | 7 | M | U | 1 | T | 1 | H | 2 | 21 | 3 |  |
| C | 1 | 8 | M | U | L | $T$ | 1 | H | z | 21 | 4 |  |
| c | 1 | 9 | M | 0 | L | T | 1 | H | $\underline{2}$ | 21 | 5 |  |

Set value
0 to 400Htz (P11S: 0 to 120H2)
In 0.01Hz steps (min.)



- This function sets the frequency for jogging operation of motor, which is different from the normal operation.

$$
\begin{aligned}
& \begin{array}{lll|l|l|l|l|l|l|l|}
\hline C \text { ? } 0[J|O| G \mid & H|z| & & \mid \\
\text { Setting range } 611 \mathrm{~S}: 0.00 \text { to } 400.00 \mathrm{~Hz}
\end{array} \\
& \text { P11S : O. } 00 \text { to 120. } 00 \mathrm{~Hz}
\end{aligned}
$$

-Starting with the jogging frequency is combined with jogeing salect sienel input from the keypad panel or control terminal. For detaiks see the explanations of "E01 Terminal X1," to "E09 Terminal $\times 9$."
Whex
-Pattern operation is ansutomatic operation according to preset operation time, direction of rotation, acteleration and deceleration time, and frequency.
When using this function, set 10 (pettem operation) to "F01
Frequency settine"


The following operation patterns can be selected

| Sot vative | Operation pattern |
| :---: | :--- |
| 0 | Perform a pattern oparation cycle, then <br> stop operation. |
| 1 | Perform pattern operation repeatedly. <br> Stop operation usins a stop command. |
| 2 | Perform a pattom operation cycle, then <br> continue operation with the lest <br> frequency set. |




- Seven stages aro operated in order (of function codes) according to the values set in "C22 Pattern operation (atenge 1)." to "C28 Pattern operation (stage 7)." Each hunction sets the operation time and the rotating direction for each stage and assiens set values of the acceleration and deceleration time.


| Set or assign itom | Value rance |
| :---: | :---: |
| Operation time | 0. 00 to 6000s |
| Rotation direction | F: Forward (counterclockwisa) <br> R: Rovarse (clockwise) |
| Accelaration | 1: Accelaration time 1 (F07) decederation time 1 (F40) |
|  | 2 Acceloration time 2 (EFO), dectieration tinn 2 (E11) |
| deceleration | \% Accorvation tins 3 (E12), deateration tinn 3 (EI3) |
| time | 4. Acsuluration time 4 (E14), decteration time 4 (E15) |

Note: The operation time is represented by the three most
significant digits, hence, can be set with only three high-order disits.

## -Setting examplo



Set the operation time to 0.00 for stages not used, which are skipped in operation.
With regard to the met frequancy valus, the multistep frequency function is assigned as listed in the table below. Set frequancies to "CO5 Multistep frequency 1." to "C11 Mellisistep frequency 7."

| Stage No. | Operation frequency to be set |
| :---: | :---: |
| Stage 1 | Multistep frequency 1 (CO5) |
| Stage 2 | Multistep frequency 2 (C06) |
| Stage 3 | Multistep frequency 3 (C07) |
| Stage 4 | Multistep froquency 4 (CO8) |
| Stage 5 | Multistep frequency 5 (CO9) |
| Stage 6 | Multistep froquency 6 (C10) |
| Stage 7 | Multistep froquancy 7 (C11) |

Pattem operation setting example

| Function | $\begin{gathered} \text { Set } \\ \text { value } \end{gathered}$ | Operation freavency to be sat |
| :---: | :---: | :---: |
| C21（operation selection） | 1 | － |
| C22（stage 1） | 60．0F2 | Mehistep froquency 1 （cos） |
| C23（stage 2） | 100 F 1 | Metistep froquency 2 （coo） |
| C24（stage 3） | 65.584 | Mutistep frequency 3 （con） |
| C25（stage 4） | 55．083 |  |
| C26（stang 5） | 50.0 F2 | Muntistep frowency 5 （COS） |
| C27（stage 6） | 72074 | Mutitistep froquency 8 （C10） |
| C28（stare 7） | 35．0F2 | Matistep froquency 7 （C11） |

The following diagrem shows this operation．


## Notes：

1．The direction of rotation cannot be reversed by a command issuad from the ALV key on the koypad panel or terminal 【REV】．Any reverse rotation commends entered are canceled．Select forward or reverse rotution by the date in each stage．When the control terminals are used for operation， the saif－hold furction of operation command also does not work．Select an alternato type switch whon usine．
2．At the and of a cycle，the motor deceloratas－to－stop according to tha value set to＂FO8 Deceleration time 1．＂

## 

－This function selects the frequency setting method．


| $\begin{array}{l}\text { C } \\ \text { For the eetting method，see the explanstion for F01．}\end{array}$ |
| :--- |



－This function sets the offast of the analog input（terminals ［12】 and（C1】）．
The setting range is $\mathbf{- 5 . 0}$ to $+5.0 \%$（in $0.1 \%$ steps）of the

maximum output frequency．


Terminal【12】


Terminal（C1）

## 

- Analoe sienale input from control terminal 12 or C1 may contain noise, which renders control unstable. This function adjusts the time constant of the input filter to remove the effects of noise.

\section*{| 0.3 | 3 | $R$ | $E$ | $F$ | IF | I | L | $\mathbf{T}$ | $E$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | $\mathbf{R}$}

Setting range: 0.00 to 5.00 seconds

- An sot value too large delays control response though stabizizins control A set value too smell speeds up control response but renders control unstable.

If the optimum value is not known, change the settine when control is unstable or response is delayed.

Note:
The set value is commonly applied to torninala 12 and C1.
For input of PED feedback amount, the PID control feedback fiker (set in H25) is used.

## 



- This function sets the number of poles of motor 1 to be driven. If this setting is not made, an incorrect motor speed (synchronous speed) is displayed on the LED.

- The nominal applied motor capacity is set at the factory The setting should be changed when driving a motor with a different capacity.


## 

Sef value for modets with nominal applied motor of 22kW or less: 0.01 to 45 kW
Models with nominal applied motor of 30kW or more: 0.01 to 500 kW

- Set the nominal applied motor capacity listed in 9-1. "Standard Specifications." Also set a value in the range from two ranks lower to one rank higher than the nominal applied motor capacity. When a value outside this range is set, accurate control cannot be guaranteed. If a value between two nominal applied motor capacities is set, data for the lower capacity is automatically written for related function data.
- When the setting of this function is changed, the values of the following related functions are automatically set to data of the FUll 3-phase standard motor.
- P03 Motor 1 (rated current)
- P06 Motor 1 (no-load current)
- P07 Motor 1 (\% R1)
- P08 Motor 1 (\% X1)

Note:
The set values for the FUA1 3-phase standard motor are $200 \mathrm{~V}, 50 \mathrm{~Hz} .4$ poles for the 200 V series; 400 V .50 Hz .4 poles for the 400 V series.

## 等 4nqu

- This function sets the rated current value of motor 1.


Set value: 0.00 to 2,000A

This function measures and automatically wites motor data.


| Set <br> value | Operation |
| :---: | :--- |
| 0 | Inactive |
| 1 | Measure the primary resistance (\%R1) of the <br> motor and leakage reactance (\%X) of the base <br> frequency when the motor is stopping and <br> automatically write both values in P07 and P08. |
| 2 | Measure the primary resistance (\%R1) of the <br> motor and leakage reactance (\%X) of the base <br> frequency when the motor is stopping, measure <br> the no-load current (lo) when the motor is <br> running, and automatically write these values in <br> P06, P07, and P08. |

-Perform auto tuning when data written beforehand in "P06 No-load current," "P07 \%R1," and "P08 \%X," differs from actual motor data. Typical cases are listed below. Auto tuning improves control and calculation accuracy.

- When a motor other than the FUJI standard 3-phase motor is used and accurate data is required for close control. - When output-side impedance cannot be ignored as when cable between the inverter and the motor is too long or when a reactor is connected.
- When \%R1 or \%X is unknown as when a non-standard or special motor is used.


## 

1. Adjust the voltage and frequency according to motor characteristics. Adjust functions "F03 Maximum output frequency," "FO4 Base trequency." "F05 Rated voltage," and "F06 Maximum output voltage."
2. Enter untunable motor constants first. Set functions "P02 Capacty," "P03 Rated current," and "P06 No-load current," (input of no-load current not required when $P O 4=2$, for running the motor at tuning, is selected).
3. When tuning the no-load current, beware of motor rotation
4. Set 1 (motor stop) or 2 (motor rotation) to function "P04 Auto tuning." Press the ... key to write the set
value and press the 1 wr key or : " koy then start tuning simultaneously.
Tuning takes several seconds to several tens of seconds (when 2 is set. As the motor accelerates up to half the base frequency according to acceleration time, is tuned for the no-foad current, and decelerates according to the deceleration time, the total tuning time varies depending an set acceteration and deceleration times.)
5. Press the $\because \because \ldots .$.
6. End of procedure

Note:
Use function "A13 Motor 2 (auto tuning)," to tune motor 2. In this case, set values described in 1 and 2 above are for the function (AO1 - ) of motor 2.

| WRANING | When the auto tuning value is set to 2 , the <br> motor rotates at a maximum of half the <br> base frequency. Beware of motor rotation. <br> as injury may result. |
| :--- | :--- |

(")
-Long-time operation affects motor temperature and motor speed. Online tuning minimizes speed changes when motor temperature changes.


| Set value | Operation |
| :--- | :--- |
| 0 | Inactive |
| 1 | Active |

## FR

- This function sets the no-toad current (exciting current) of motor 1.
Set value: 0.00 to 2,000A

 (V)
-Write this date when using a motor other than the FUJI standard 3-phase motor and when the motor constant and the impedance between the inverter and motor are known.

- Calculate \%R1 using the following formula:
$\% R 1=\frac{R 1+\text { CableR }}{V /(\sqrt{3} \cdot 1)} \times 100$ [\%]
R1: Primary coil resistance value of the motor [ $Q$ ]
Cable R : Output-side cable resistance value [Q]
V:Rated voltage [V] I: Motor rated current [A]
- Motor rated current
$\% x=\frac{x_{1}+x_{2} \cdot x 1 /\left(x_{2}+x_{11}\right)+C a b l e x}{V /(\sqrt{3} \cdot 1)} \times 100[\%]$

X1: Primary leakage reactance of the motor [Q]
$\times 2$ : Secondary leakage reactance (converted to a primary value) of the motor [Q]
$\mathbf{X M}$ : Exciting reactance of the motor [Q]
Cable X: Output-side cable reactance [8].
V: Rated voltage [V] I: Motor rated current [A]

## Note:

For reactance, use a value in the data written in "F04 Base frequency 1."
-When connecting a reactor or filter to the output circuit, add its value. Use valua 0 for cable values that can be ignored.

## 1

- Changes in load torque affect motor slippage, thus causing variations in motor speed. The slip compensation control adds a frequency (proportional to motor torque) to the inverter output frequency to minimize variations in motor speed due to torque | $P$ | 0 | 9 | $\mathbf{S}$ | $L$ | 1 | $P$ |  | $C$ | 0 | $M$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |$|\mathbf{P}| 1$ changes.

Set value: 0.00 to 5.00 Hz
Calculate the amount of slip compensation using the following formula:
Slip compenssation anount
$=$ Base frequency $\times \frac{\text { Slippage }[\mathrm{r} / \mathrm{min}]}{\text { Synchronous speed }[r / \text { min] }}[\mathrm{Hz}]$
Slippage $=$ Synchronous speed - Rated speed



- This function returns all function data changed by the customer to the factory setting data. (initialization).

-When the inverter protective function which invokes the retry operation is activated, this function releases operation of the protective function and restarts operation without issuing an alarm or terminating output

$$
\begin{array}{|lll|l|l|l|l|l|l|l|l|l|}
\hline H & 0 & A & A & U & \mathbf{T} & \mathbf{O} & - & R & E & \mathbf{S} & \mathbf{E} \\
\hline
\end{array}
$$



Set the protective function release count and waiting time from its operation startup to release.
Setting range (Count) : 0, 1 to 10
( Waiting time ) : 2 to 20 seconds
To not use the retry function, set 0 to "H04 Retry (count)."

- Inverter protective functions that can invoke retry function.

| OC1. OC2. OC3 <br> : Overcurrent | dBH <br> :Braking resistor overheating |
| :---: | :---: |
| OV1. OV2, OV3 <br> : Overvoltage | OLI <br> : Motor 1 overload |
| OH1 <br> : Heat sink overheating | 02 <br> : Motor 2 overload |
| OH3 Inverter inside : Inerheating ov | OLU <br> : Inverter overload |

- When the value of "H04 Retry (count)." is set from 1 to 10, an inverter run command is immediately entered following the waik time sel in H05, "Retry (wait time)," and the startup of the retry operation. If the cause of the alarm has been removed at this time, the inverter starts without switching to alarm mode. If the cause of the alarm still remains, the protective function is reactivated according to the wait time set in "H05 Retry (waiting time)." This operation is repeated until the cause of the alarm is removed. The restart operation switches to alarm mode when the retry count exceeds the value set in "H04 Retry (count)."
The operation of the retry function can be monitored from terminals Y 1 to Y 5 .

| WARNING | When the retry function is selected, <br> operation automatically restarts <br> depending on the cause of the trip <br> stop. (The machine should be <br> designed to ensure safety during a <br> restart) |
| :--- | :--- |

## When retry succeeded


-This function specifies whether cooling fan ONOFF control is automatic. While power is applied to the inverter, the automatic fan control detects the temperature of the cooling fan in the inverter and turns the fan on or off.
When this control is not selected, the cooling fan rotates continually.

| $H$ | 0 | 6 | $F$ | $A$ | $N$ |  | $S$ | $\mathbf{T}$ | $\mathbf{O}$ | $\mathbf{P}$ |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Set value 0: ONOFF control disabled.
1: ONOFF control enabled.
The cooling fan operating status can be monitored from terminals Y 1 to Y 5 .

## 

This function selects the acceleration and deceleration pattern.
Set value 0 : Inactive (linear acceleration and deceleration)


1: S-shape acceleration and deceleration (mild)
2: S-shape acceleration and deceleration (sharp)
3: Curvilinear acceleration and deceleration

【 S－shape acceleration and deceleration 】
This pattern reduces shock by mitigating output frequency changes at the beginning／end of acceleration and deceleration．

＜Pattern constants＞

|  | When 1 is <br> selected in HO7 <br> （mild S－shape  <br> pattern）   | When 2 is selected in HO7（sharp S－shape pattern） |
| :---: | :---: | :---: |
| Range of S－shape $(\alpha)$ | $0.05 \times$ maximum output frequency （ Hz ） | $0.10 \times$ maximum <br> output  <br> （Hzequency  |
| Time for <br> S－shape ot <br> acceleration <br> （ $B$ acc） | $\begin{array}{lr} \hline 0.10 & x \\ \text { acceleration time } \end{array}$ (s) | $0.20 \times$ acceleration time（s） |
| Time for S－shape at decoleration （ $\beta \mathrm{dac}$ ） | 0.10 deceleration time （s） | $0.20 \times$ deceteration time（s） |

\％When acceleration and deceleration times are very long or short，acceleration and deceleration are rendered linear．

【Curvilinear acceleration and deceleration】
This function is used to minimize motor acceleration and deceleration times in the range that includes a

－When accidental reversing is expected to cause a malfunction，this function can be set to provent reversal．

This function provents a reversing operation resulting from a connection between the REV and CM terminais， inadvertent activation of the＂．．．key，or negative analog input from terminal 12 or VI

468id
Set value 0：Inactive
1：Active
This function smoothly starts the motor which is coasting after a momentary power failure or atter the motor has been subject to external force，without stopping motor． At startup，this function defects the motor speed and outputs the corresponding frequency，thereby enabling a shock－free motor startup．Although the normal startup method is used，when the coasting speed of the motor is 120 Hz or more as an inverter frequency and when the value set to＂F03 Maximum frequency，＂exceeds the value set to＂F15 Frequency limiter（upper limit）．＂


Explanation of set values
-1 ：This function is effective when 3,4 ，or 5 is set to ＂F14 Restart after momentary power failure（operation selection）．＂This function is also effective when operation is switched from the line to the inverter．The motor is started with the same frequency as the current coasting speed．
－ 2 ：in addition to restarting following a momentary power failure and switching between the line and the inverter，this function detects the coasting speed of the motor and starts the motor at the same frequency as all startups（including when an ON operation command is entered）．
－By assigning value＂ 26 ＂（start characteristics selection）to terminals $X_{1}$ to $X 9$ ，this function can be externally selected as the normal startup method when an ON operation command is entered．


Note：The dotted－dashed line indicates motor speed．

## 210

- When the output frequency is fixed (constant-speed operation) at light loads and except for " $0,0^{\circ}$ is set to F09, "Torque boost 1 ," this function automatically reduces the output voltage, while minimizing the product (power) of voltage and current.

| $H: 0[E\|N\| E\|R\| G\|Y\| T\|S\| A \mid V$ |
| :---: |

Notes:
-Use this function for square law reduction torque loads (e.g., fans, pumps). When used for a constant-torque load or rapidly changing foad, this function causes a delay in control response.
-The energy-saving operation automatically stops during acceleration and deceleration and when the torque limiting function is activated.

## 

- This function selects the inverter stopping method when a stop command is entered.


This function is effective only when a stop command is entered and, therefore, is ineffective when the motor is stopped by lowering the set frequency.

## 

- An overcurrent trip generally occurs when current nows above the inverter protective level following a rapid change in motor load. The instantaneous overcurrent limiting function controls inverter output and prohibits the flow of a current exceeding the protective level even when the load changes.
- As the operation level of the instantaneous overcurrent limiting function cannot be adjusted, the torque limiting function must be used.
- As motor generation torque may be reduced when instantaneous overcurrent limiting is applied, set this function to be inactive for equipment such as elevators, which are adversely affected by reduced motor generation torque, in which case an overcurrent trip occurs when the current how exceeds the inverter protective level. A mechanical brake should be used to ensure safety.

- Instantaneous switching to another power line (when the power of an operating motor is cut off or power failure occurs) creates a large phase difference between the line voltage and the voltage remaining in the motor, which may cause electrical or mechanical failure. To rapidly switch power lines, write the remaining voltage attenuation time to wait for the voltage remaining in the motor to attenuate. This function operates at restart after a momentary power failure.

-When the momentary power failure time is shorter than the wait time value, a restart occurs following the wait
time. When the power failure time is longer than the wait time value, a restart occurs when the inverter is ready to operate (after about 0.2 to 0.5 second).


## 

- This function determines the reduction rate of the output frequency for synchronizing the inverter output frequency and the motor speed. This function is also used to reduce the frequency and thereby prevent stalling under a heavy load during normal operation.


## H I 4 F|A|L|L| |R|A|T|E|

Setting range: $0.00,0.01$ to $100.00 \mathrm{~Hz} / \mathrm{s}$

- When 0.00 is set, the frequency is reduced according to the set deceleration time.
Note:
A too large frequency reduction rate is may temporarily increase the regeneration energy from the load and invoke the overvoltage protective function. Conversely, a rate that is too small extends the operation time of the current limiting function and may invoke the inverter overload protective function.


## 

- This function is for when 2 (deceleration-to-stop at power failure) or 3 (operation continuation) is set to "F14 Restart after momentary power failure (operation selection)." Either function starts a control operation if the main circuit DC voltage drops below the set operation continuation level.
 400 V series: 400 to 800 V
-When power supply voltage to the inverter is high, control can be stabilized even under an excessive load by raising the operation continuation level. However, when the level is too high, this function activates during normal operation and causes unexpected motion. Please contact Fuji electric when changing the initial value.

$\checkmark$ As the power to an external operation circuit (relay sequence) and the main power to the inverter is generally cut off at a power failure, the operation command issued to the inverter is also cut off. This function sets the time an operation command is to be held in the inverter. If a power failure lasts beyond the self-hotd time, power-oll is assumed, automatic restart mode is released, and the inverter starts operation at normal mode when power is applied again.. (This time can be considered the allowable power fallure time.)


When 999 is set, an operation command is held (i.e., considered a momentary power failure) while control power in the inverter is being established or until the main circuOt DC voltage is about 0 .


- This function controls motor torque according to a command value.


Torque control block diagran


The torque command value is $+200 \%$ when the vollage at terminal $\mathbf{1 2}$ is +10 V and is $-\mathbf{2 0 0 \%}$ when the voltage is -10V.

- In torque control, the torque command value and motor load determine the speed and direction of rotation.
When the torque is controlled, the upper limit of frequency refers to the minimum value among the maximum frequency, the frequency limiter (upper limiter) value. and 120 Hz . Maintain the trequency at least one-tenth of the base frequency because torque control performance deteriorates at lower frequencies.
- If the operation command goes ofi during a torque control operation, the operation is switched to speed control and the motor decelerates-to-stop. At this time, the torgue control function does not operate.

-This function automatically exdends accelerating time against acceleration operation of 60 seconds or longer to prevent an inverter trip resulting from a temperature rise in inverter due to overcurrent.

Sef value 0: Inactive
1: Active
(When the active drive function is activated, the acceleration time is three times the selected time.)


- PID control detects the amount of control (feedback amount) from a sensor of the control target, then compares it with the target value (e.g., reference temperature). If the values differ, this function performs a control to eliminate the deviation. In other words, this control matches the feedback amount with the target value.
This function can be used for flow control, pressure control, temperature control, and other process controls.


Feedback amount
© Forward or reverse operations can be selected for PID controller output. This enables motor revolutions to be faster or lower according to PID controller output



- The target value can be entered using F01. "Frequency setting 1, " or directly from the keypad panel. Select any terminal of Terminals X1 (E01) to X9 (E09) and set value 11 (frequency setting switching).
For entry from F01, "Frequency setting 1 "" input an OFF signal to the selected terminal. For direct entry from the keypad panel, turn on the selected terminal.
-For the target value and feedback amount, the process amount can be displayed according to the values set in E40. "Display coefficient A," and E41, "Display coefficient B."

This function selects the feedback amount input terminal and electrical specifications of the terminal. Select a value from the table betow according to sensor specifications.


| Set value | Descriptions |
| :--- | :--- |
| 0 | Control terminal 12, forward operation (0 <br> to 10 V voltage input) |
| 1 | Control terminal C1, forward operation (4 <br> to 20mA current input) |
| 2 | Control terminal 12, reverse operation (10 <br> to 0V vollage input) |
| Control terminal C1, reverse operation (20 <br> to 4 mA current input) |  |



Only positive vahess can be input for this feadbeck smount of PID control. Negative values (o.e. 0 to $-10 \mathrm{~V},-10$ to OV ) camot be input, thereby the function cannot be used for a roverte operation by en analog sianal.



- These functions are not generally used alone but are combined like P control, PI control, PD control, and PID control.


## - Poperation

Operation using an operation amount (output frequancy) proportional to deviation is called $P$ operation, which outputs an operation amount proportional to deviation, though it cannot eliminate deviation alone.


Setting range: 0.01 to 10.0 times
$\mathbf{P}$ (gain) is the parameter that determines the response lovel for the deviation of P operation. Although an increase in gain speeds up response, an excessive gain causes vibration, and a decrease in gain delays response


I operation
An operation where the change speed of the operation amount (output frequency) is proportional to the deviation is called an I operation. An I operation outputs an operation amount as the integral of deviation and, therefore, has the effect of matching the control amount (feedback amount) to the target value (e.g., set frequency), though it deteriorates response for significant changes in deviation.


| $H$ | 2 | 3 | 1 | $-\|G\| A\|I\| N \mid$ | $\mid$ |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

"H23 l-gain" is used as a parameter to determine the effect of I operation. A longer integration time delays response and weakens resistance to external elements. A shorter integration time speeds up response, but an integration time that is too short causes vibration.

## - D operation

An operation where the operation amount (output frequency) is proportional to the deviation differential is called a D operation, which outputs an operation amount as the deviation differential and, therefore, is capable of responding to sudden changes.

"H24 D-gain" is used as a parameter to determine the effect of a D operation. A longer differentiation time causes vibration by $\mathbf{P}$ operation quickly attenuating at the occurrence of deviation. Excessive differentiation time could cause vibration. Shortening the differentiation time reduces attenuation at the occurrence of deviation.

## - PI control

P operation alone does not remove deviation completely. $P+I$ control (where I operation is added to $P$ operation) is normally used to remove the remaining deviation. PI control always operates to eliminate deviation even when the target value is changed or there is a constant disturbance. When I operation is strengthened, however, the response for rapidly changing deviation deteriorates. $P$ operation can also be used individually for loads containing an integral element.

PD control
If deviation occurs under PD contral, on operation amount larger than that of $D$ operation alone occurs rapidly and prevents deviation from expanding. For a small deviation, $\mathbf{P}$ operation is restricted. When the load contains an integral element, $P$ operation alone may allow responses to vibrate due to the effect of the integral element, in which case PD control is used to attenuate the vibration of $P$ operation and stabilize responses. In other words, this control is applied to loads in processes without a braking function.

- PID control

PID control combines the $P$ operation, the 1 operation which removes deviation, and the D operation which suppresses vibration. This control achieves deviation-free, accurate, and stable responses.

- Adjusting PID set value

Adjust the PID value white monitoring the response waveform on an oscilloscope or other instrument if possible. Proceed as tollows:

- Increase the value of "H22 P-gain" without generating vibration.
— Decrease the value of "H23 L-gain" without generating vibration.
- Increase the value of "H24 D-gain" whthout generating vibration.

Adjust the response waveform as follows:

- To remove the overshoot, increase the value of " H 23 Hgain," then decrease the value of "H24 D-gain."

- To stabilize response quickly (i.e., allowing for a little overshoot).
: decrease the value of "H23 1-gain," or increase the value of "H24 D-gain."

- To suppress vibration with a period longer than the value of "H23 l-gain," increase the value of H23.

－To suppress vibration with a frequency roughly equivalent to the value＂H24 D－gain，＂decrease the value of H24．If there is residual vibration with 0.0 ．decrease the value of＂H22 P－gain．＂


－This filter is for feedback signal input from terminal［12］ or 【C1】．This filter stabilizes operation of the PID control system．A set value that is too large，however， deteriorates response．

| $H$ | 2 | 5 | $F$ | $\mathbf{B} \mid$ | $F$ | $\mathbf{I}$ | $\mathbf{L}$ | $\mathbf{T}$ | $\mathbf{E}\|\mathbf{R}\|$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Selting range： 0.0 to $\mathbf{6 0 . 0}$ seconds
－Sef this function active when the motor has a PTC thermistor for overheat protection

－Connect the PTC thermistor as shown in the figure below．The protective operation uses the trip command（external faux）input to terminals［X1］to［X9］ when selected．Hence，the trip mode is activated by ＂OH2：External thermal relay tripped．＂

－The voltage input to terminal［C1］is compared to the set voltage（Level）．When the input voltage is equal to or greater than the set voltage（Level），＂H26 PTC thermistor（Mode select），＂starts．
at the alarm temperature．The operation（voltage）level is set using this change in the resistance value．


The figure in＂H26 PTC thermistor（Mode select），＂shows that resistor 250 Q and the thermistor（resistance value Rp）are connected in paralled．Hence，vollage Vc1 （Level）at terminal【C1】 can be calculated by using the following formula．

$$
\mathrm{Vc}_{1}=\frac{\frac{250 \cdot R_{p}}{250+\mathrm{Rp}_{p}}}{1000+\frac{250 \cdot R_{p}}{250+R_{p}}} \times 10[\mathrm{~V}]
$$

The operation level can be set by bringing Rp in the Vct calculation formula into the following range．

$$
R p 1<R p<R p 2
$$

To obtain Rp easily，use the following formuta．

$$
\mathbf{R p}_{\mathbf{p}}=\frac{\mathbf{R}_{p_{1}}+\mathbf{R}_{p_{2}}}{2}[\mathrm{Q}]
$$


When two or more motors drive a single machine，a higher load is placed on the motor rotating the tastest．Droop operation achieves a good load balance by applying drooping characteristics to speed against load variations．
Calculate the droop amount using the following formuka： Oroop mount＝Base frequency

$$
\times \frac{\text { Speed droop at rated torque }[\mathrm{r} / \mathrm{min}]}{\text { Synchronous speed }[\mathrm{r} / \text { min] }}[\mathrm{Ht}]
$$



Sel value ：-9.8 Hz to 0.0 Hz


Setting range： 0.00 to 5.00 V
－The PTC thermistor has its own alarm temperature．The internal resistance value of the thermistor largely change


- The link function (communication function) provides RS4B5 (provided as standard) and bus connections (optional).
The serial link function includes:

1) Monitoring (data monitoring, function data check)
2) Frequency setting
3) Operation command
(FWD, REV, and other commands for digital input)
4)Write function data
 Setting range: 0 to 3

Communication can be enabled and disabled by a digital input. This function sets the serial link function when communication is enabled.

| Set value | Frequency <br> command | Operation <br> command |
| :---: | :---: | :---: |
| 0 | Disabled | Disablod |
| 1 | Enabled | Disabled |
| 2 | Disabled | Enabled |
| 3 | Enabled | Enabled |

The data monitoring and function data write functions are always enabled. Disabling communication using digital input brings about the same result as when 0 is set to this function. When the bus option is installed, this setting selects the function of the option and the RS485 interface is restricted to monitoring and writing function data. When the option is not installed, this setting selects the RS485 function.

|  |  <br>  |
| :---: | :---: |
| \$ | S |
|  |  2 4 等 |

Thesse functions set the conditions of RS495 communication. Sed the conditions according to the upstream dovice. Refer to technical manuel for the protecol.

- This function sets the station address of RS485.

Setting range: 1 to 34
- This function sets processing at communication error and sets the enor processing timer value.

- This function sets the baud rate.

- This function sets data length.


| Set value | Data length |
| :---: | :---: |
| 0 | 8 bit |
| 1 | 7 bit |

- This function sets the parity bit


| Set value | Parity bit |
| :---: | :---: |
| 0 | None |
| 1 | Even |
| 2 | Odd |

- This function sets the stop bit


| Set value | Stop bit |
| :---: | :---: |
| 0 | 2 bit |
| 1 | 1 bit |

- In a system where the local station is always accessed within a specific time, this function detects that accoss was stopped due to an open-circuit or other fault and invokes an Er 8 trip.


This function sets the time from when a request is issued from the upstream device to when a response is returned.


Setting rence: 0.00 to 1.00 second

|  |  |
| :---: | :---: |

- This function sets the maximum frequency for motor 2 output by the inverter. This function operates the same as "F03 Maximum frequency 1." For details, soe the explanation for FO 3.

- This function seta the maximum output frequency in the constment-tortue area of motor 2 (i.e., output frequency at rated output voltage). This function oparates the same as "FO4 Base frequency 1." For details, see the explanation for FO4.

- This function sets the rated value of voltage outbut to motor 2. This function operates the same as "FOS Rated voltage 1." For details, see the explanation for $F 05$.

- This function sets the maximum value of the inverter output voltage of motor 2 . This function operates the same as "FO8 Maximum voltage 1." For details, soe the

- This function sots the torque boost function of motor 2. This function operates the same as "FOS Torqu boost 1."
For datails, see the explanation for F09.

> | $A$ | 0 | 3 | $T$ | $R\|O\|$ | $B$ | 0 | 0 | $S$ | $\mid$ |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |





- This function sets the function of the electronic thermal overfond relay for motor 2 . This function operates the same as F10 to F12, "Electronic thermal overloid relay 1."


For detaik, see the explanations for F10 to F12.

## 

- This function sets the torque vector function of motor 2. This function operates the same as "F42 Torque vector control 1." For details, ste the explanation for F42.

\section*{| $A$ | 0 | 3 | $\mathbf{T}$ | $\mathbf{R}$ | 0 | $\mathbf{V}$ | E | C | T | $\mathbf{O}$ | R | $\mathbf{2}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |}

秋) M M

- This function sets the number of poles of motor 2 to be driven. This function operates the same as "PO1 Number of motor-1 poles." For details, see the explanation for PO1.


## 

- This function sots the capacity of motor 2. This function operratas the same as "P02 Motor 1 (Copacity)." For detaits, see the explanstion for P02. However, the related motor data functions change to "A12 Motor 2 (Ratod current)," "A15 Motor 2 (No-load current)," "A16 Motor 2 (KR1 settine)," and "A17 Motor 2 ( $\$ X$ setting)."



## 

- This function setes the rated current of motor 2. This function operates the same as "P03 Motor 1 (Rated current)." For details, see the explenation for P03.


##  <br> 

- This function sets the outo tuning of motor 2 . This function operates the sume as "PO4 Motor 1 (Tuning)." For dataile, see the explenation for P04.



## 

- This function setse the online tumins of motor 2. This function operates the same as "POS Motor 1 (On-line tuming)." For detaits, sees the explanation for POS.



## 

- This function sets the no-loed current of motor 2 This function operates the cerne as "P08 Motor 1 (No-load current)." For details, see the explanation for PO6.


W7x


- This function sets $\mathbb{R} 1$ and $\mathbb{X}$ of motor 2. This function operates the same as "P07 Motor 1 (WR1 settina)", and "POB Motor 1 (\$X setting)." For detaik, see the explanations for PO7 and P08.



## 

- This function sots the amount of elip componsation for motor 2. This function operates the same as "POS Slip compensation control" For detaile, see the explanation for PCO.


## 6. Protective Operation

## 6-1 List of Protective Operations

In the event of an abnormality in the inverter, the protective function will activate immediately to trip the inverter, display the alarm name on the LED monitor, and the motor coasts-to-a stop. For alarm contents, see Section 6.1.1.
Tabie 6.6.1 List of alarm displays and protective functions

| Alarm Name | Keypad pariel display |  | Contents of operation |
| :---: | :---: | :---: | :---: |
|  | LED | LCD |  |
| Over current protection | OC1 | OC DURING ACC | If the inverter output current momentarily exceeds the overcurrent detection level due to an overcurrent in the motor, or a short-circuit or a ground fault in the output circuit, the protective function is activated. |
|  | OC2 | OC DURING DEC |  |
|  | OC3 | OC AT SET SPD |  |
| Ground faul | EF | GROUND FAULT | If a ground fault in the inverter oupui crouli is debected, the protective function is activated (for 30 WW or more only). Ha ground faull occurs in an inverter rated at 2axW or less, the inverter is protected by the overcurrent protection. II protection against personal injury or propety dernage is required, install a ground-tault protective ralay or earth-beakige circult breaker separatey. |
|  | 041 | OV DURING ACC | W the DC And circuit voltage of the main cirail wecreods the overvollage delection leved (200V series: 400 V DC or more, 400 V series: BOOV DC or more) dve to an increase in the regenerating current from the motor, the outpit is shut down. <br> Howiver, protection eginat inadvatert overvolige apply (e.g., ingt-voltege fine) may mot be provided. |
| Overvoltage protection | OU2 | OV DURING DEC |  |
|  | OU3 | OV AT SET SPD |  |
| Undervotioge protection | LU | UNDERVOLTAGE | If the DC link circuit voltage of the main circuit falis below the undervoltage detection level (200V series: 200V DC or less, 400 V series: 400 V DC or less) due to a lowered power supply, the output is shut down. If function code F14 (Restart after momentary power failure) is selected, an alarm is not displayed. In addition, if the supply voltage falls to a level unable to maintain control power, an alarm may not be displayed. |
| $\begin{aligned} & \text { linput phase loss } \\ & \text { protection } \end{aligned}$ | Lin | PHASE LOSS | If the inverter is diven with any one of the three phases cornectad to LI/R, LI/S and L3TT of the main circuit power suppty "open," or if there is a significant detaparty benween the pheses, the rectifing diodes or smooting capaciors may be damaged, at such time an atarm is lesued and the trwerter is tipped. |
| $\begin{aligned} & \text { Overhein } \\ & \text { profection } \end{aligned}$ | OH1 | FIN OVERHEAT | If the temperature of the heat sink rises due to a cooling fan failure, etc., the protective function is activated. |
| External atrm | OH2 | EXT ALARM | If the external alarm contacts of the braking unit, braking resistor, or external thermal ON relay are connected to the control circuit terminals (THR), the contacts will be actuated according to contact signals. |
| trverter intermal overteatin? | OH 3 | HIGH AMB TEMP | If the temperature inside the inverter rises due to poor ventilation, etc., the protective function is activated. |
| Overnexting of braking ressistor | dbH | DBR OVERHEAT | If electronic thermal O/L relay (for braking resistor) function code F13 is selected, the protective function is activated to prevent the resistor from burning due to overheating following frequent use of the braking resistor. |
| Mctor 1 Overicad | OLI | MOTOR1 OL | The protocive function is activited of the motor current exceeds the preset invel, provided that eloctronic thermal OL retey 1 function code FIO hes been selfected. |
| Motor 2 Overioad | OL2 | MOTOR2OL | If the second motor current exceeds the preset level when the operation is switched to drive the second motor, the protective function is activated, provided that electronic thermal OR relay 2 of function code AO4 is selected. |
| Inverim overiond | OLU | INVERTER OL | If the output current exceeds the rated overload current, the protective function is activated to provide thermal protection against semiconductor etement overheating in the inverter main circuit. |
| Blown fuse | FUS | DC FUSE OPEN | It the fuse in the inverter is blown out following an stoptchrcull or damage to the internal circuik, the protective function is activated (for 30 WW or more only). |
| Memory error | Ef1 | MEMORY ERROR | If a memory error occurs, such as missing or invalid data, the protective function is activated. |
| Keypad paneal communication error | ER2 | KEYPD COM ERR | If a communication error or interrupt between the keypad panel and control circuit is detected, the protective function is activated. |
| CPU error | Er3 | CPU ERROR | If an CPU error occurs due to noise, etc., the protective function is activated. |
| Option eror | Er4 | OPTN COM ERR | Error when using an optional unit |
|  | Er5 | OPTION ERROR |  |
| Forced stop | Er6 | OPR PROCD ERR | Error when using the forced stop command |
| Outpu: wing error | Er7 | TUNING ERROR | If there is an open circuit or a connection error in the Inverter output wiring during performing auto-tuning, the protective function is activated. |
| $\begin{aligned} & \text { RS485 } \\ & \text { communication } \\ & \text { error } \\ & \hline \end{aligned}$ | Er8 | RS495 COM ERR | If an error occurs when using Modbus-RTU, the protective function is activated. |



| A. WARNING | If the alarm reset is activated with the operation signal ON, the inverter will restart suddenly, which <br> may be dangerous. To ensure safety, disable the operating signal when refeasing the trip status. <br> as accident may result. |
| :--- | :--- |

## 7.Trouble shooting

7.1 Protective function activation

(2) Ground faut


Note:The eround failt protoctive function is provided only for inverter for nominal applied motore rated at 30 kW or more.
(3)Fuse brown
Fuse brown

FUS $\rightarrow$| Possible short-cirouit |
| :--- |
| within the invertor. |
| Contact Fuiji Electric. |

(4)Overvohage

(5)Low vohage


(9) Memory error Er1.

Keypad panal communication error Er2. CPU error Er3


## 7-2 Abnormal motor rotation

(1) If motor does not rotate


The motor does not rotate if the following commands are issued.

- An operation command is issued while the coast-to-stop or DC braking command is output
- A reverse operation command is issued with the "HO8 Rev. phase sequence lock" value set to 1.
(2) If the motor rotates but the speed does not change


In the following cases, changing the motor speed is also restricted:

- Signals are input from control terminals both 12 and C1 when "F01 Frequency command 1 "and "C30 Frequency command $2^{\circ}$ are set to3, and there is no significant change in the added value
- The load is excessive, and the torque limiting and current limiting functions are activated
(3) If the motor stalls during acceleration

(4) If the motor generates abnormal heat


8. Maintenance and Inspection

Proceed with daily inspection and periodic inspection to prevent malfunction and ensure long-term reliability. Note the following:

8-1 Daily Inspection
During operation, a visual inspection for abnormal operation is completed externally without removing the covers
The inspections usually cover the following:
(1) The performance (satisfying the standard specification) is as expected.
(2) The environment satisfies standard specifications.
(3) The keypad panel display is normal.
(4) There are no abnormal sounds, vibrations, or odors.
(5) There are no indications of overheating or no discoloration.

## 8-2 Periodical Inspection

Periodic inspections must be completed after stopping operations, culting off the power source, and removing the surface cover.
Note that after turning off the power, the smoothing capacitors in the DC section in the main circuit take time to discharge. To prevent electric shock, confirm using a multimeter that the voltage has dropped below the safety value ( 25 V DC or below) after the charge lamp (CRG) goes off.

| - Start the inspection at least five minutes after turning off the power supply for |
| :--- | :--- |
| inverter rated at 22 kW or less, and ten minutes for inverter rated at 30 kW or |
| more. (Check that the charge lamp (CRG) goes off, and that the voltage is 25 V |
| DC or less between terminals $P(+$ ) and N(-). Electric shock may result. |
| - Only authorized personnel should perform maintenance and component |
| replacement operations. (Remove metal jewelry such as watches and rings.) |
| (Use insulated tools.)) |
| - Never modity the inverter. |
| Electric shock or injury may result. |

Table 8-2-1 Periodical inspection list

|  | Check parts | Check items | How to inspect | Evaluation Criteria |
| :---: | :---: | :---: | :---: | :---: |
| Environment |  | 1) Check the ambient temperature, humidity, vibration, atmosphere (dust, gas, oil mist, water drops). <br> 2) Is the area surrounding the equipment clear of foreign objects. | 1) Conduct visual inspection and use the meter. <br> 2) Visual inspection | 1) The specified standard value must be satisfled. <br> 2) The area is clear. |
| Keypad pana |  | 1) Is the display hard to read? <br> 2) Are the characters complete? | 1),2)Visual inspection | 1),2) The display can be read and is not abnormal. |
| Structure such as a frame or cover |  | 1) Is there abnormal sound of vibration? <br> 2) Are nuts or bolits loose? <br> 3) Is there deformation or damage? <br> 4) Is there discoloration as a result of overheating? <br> 5) Are there stains or dust? | 1) Visual and aural inspection <br> 2) Tighten. <br> 3).4),5) Visual inspection | $\begin{aligned} & \text { 1), 2), 3), 4), 5) Not } \\ & \text { abnormal } \end{aligned}$ |
| $\begin{aligned} & \text { 空 } \\ & \frac{.4}{3} \\ & \frac{C}{6} \\ & \frac{C}{20} \end{aligned}$ | Common | 1) Are there loose or missing nuts or bolts? <br> 2) Are there deformation, cracks, damage, and discoloration due to overheating or deterioration in the equipment and insulation? <br> 3) Are there stains and dust? | 1) Tighten. <br> 2),3)Visual inspection | 1), 2). 3) Not abnormal Note: Discotoration of the bus bar does not indicate a problem. |
|  | Conductor and wire | 1) is there discoloration or distortion of a conductor due to overheating? <br> 2) Are there cracks, crazing or discoloration of the cable sheath? | 1),2) Visual inspection | 1), 2) Nat abnormal |


|  | Terminal block | Is there damage? | Visual inspection | Not abnormal |
| :---: | :---: | :---: | :---: | :---: |
|  | Smoothing capacitor | 1) Is there electrolyte leakage, discoloration. crazing, or swelling of the case? <br> 2) Is the safety valve not protruding or are valves protruding too far? <br> 3) Measure the capacitance if necessary. | 1). 2) Visual inspection <br> 3) * Estimate Iffe expectancy from mairtenance information and from measurements using capecitance measuring equipment. | 1). 2) Not abnormal <br> 3) Capacitance Z initial value $\times 0.85$ |
|  | Resistor | 1) Is there unusual odor or damage to the insulation by overheating? <br> 2) Is there an open circuit? | 1) Visual and olfactory inspection <br> 2) Conduct a visual Inspection or use a multimeter by removing the connection on one side. | 1) Not aboromal <br> 2) Less than about $\pm 10 \%$ of the incicated resistance value |
|  | Transformer and reactor | Is there abnormal buzzing or an unpleasant smell? | Aural, offactory, and visual inspection | Not abnormal |
|  | Magnetic conductor and rełay | 1) Is there ratting during operation? <br> 2) Are the contacts rough? | 1) Aural inspection <br> 2) Visual inspection | 1),2/Not abnormal |
|  | Control PC <br> board and <br> connector  | 1) Are there any loose screws or connectors? <br> 2) Is there an unusual odor or discoloration? <br> 3) Are there cracks, damage, deformation, or excessive rust? <br> 4) Is there electrolyte leakage or damage to the capacitor? | 1) Tygtien <br> 2) Vistial and offectory inspection <br> 3) Visual inspection <br> 4)* Estimate 战e expectancy by visual inspection and maintenance information | 1),2),3), 4) Not abnormal |
|  | Cooling fan | 1) Is there abnormal sound or vibration? <br> 2) Are nuts ar bolts loose? <br> 3) Is there discoloration due to overheating? | 1) Aural and visural inspection. Tum manuriny (contron the power is 0ili. <br> 2) Tightion <br> 3) Visual inspection <br> 4) * Estimate fite expedancy by maintenance information | 1) The fan must rotate smoothly. <br> 2). 3) Not abnormal |
|  | Ventilation | Is there foreign matter on the heat sink or intake and exhaust ports? | Visual inspection | Not abnormad |

Note: If equipment is stained, wipe with a clean cloth. Vacuum the dust.
*Estimation of life expectancy based on maintenance information
The maintenance information is stored in the inverter keypad panel and indicates the electrostatic capacitance of the main circuit capacitors and the life expectancy of the electrolytic capacitors on the control PC board and of the cooling fans.. Use this data as the basis to estimate the life expectancy of parts.

1) Determination of the capacitance of the main circuit capacitors

This inverter is equipped with a function to automatically indicate the capacitance of the capaciors installed in the main circuit when powering up the inverter again after disconnecting the power according to the prescribed conditions.
The initial capacitance values are set in the inverter when shipped from the factory, and the decrease ratio (\%) to those values can be displayed.
Use this function as follows:
(1) Remove any optional cards from the inverter. Also disconnect the DC bus connections to the main circuit $P(+)$ and $N(-)$ terminals from the braking unit or other inverters if connected. The existing power-factor correcting reactor (DC reactor) need not be disconnected.
A power supply introduced to the auxiliary input terminals (RO, TO) that provides control power should be isolated.
(2) Disable all the digital inputs (FWD, REV, X1-X9) on the control terminals. Also disconnect RS485 communication if used.
Turn on the main power supply. Confirm that the cooling fan is rotating and that the inverter is not operating. (There is no problem if the "OH2 Extemal thermal relay tripped" trip function is activated due to the digital input terminal setting off.)
(3) Turn the main power off.
(4) Tum on the main power again after verifying that the charge lamp is completely off.
(5) Open the maintenance information on the keypad panel and confirm the capacitance values of the built-in capacitors.
2) Life expectancy of the control PC board

The actual capacitance of a capacitor is not measured in this case. However, the integrated operating hours of the control power supply multiplied by the life expectancy coefficient defined by the temperature inside the inverter will be displayed. Hence, the hours displayed may not agree with the actual operating hours depending on the operational environment.
Since the integrated hours are counted by unit hours, power input for less than one hour will be disregarded.
3) Life expectancy of cooling fan

The integrated operating hours of the cooling fan are displayed. Since the integrated hours are counted by unit hours, power input for less than one hour will be disregarded.
The displayed value should be considered as a rough estimate because the actual life of a cooling fan is influenced significantly by the temperature.

Table 8-2-2 Rough estimate of life expectancy using maintenance information

| Parts | Level of judgment |
| :--- | :--- |
| Capacitor in main circuit | $85 \%$ or less of the initial value |
| Electrolytic capacitor on <br> controt PC board | 61,000 hours |
| Cooling fan | 40,000 hours ( 3.7 kW or less), 25,000 hours (Over 5.5 kW ) <br> $(־ 1)$ |
| Estimated life expectancy of a ventilation-fan at inverter amblent temperature of $40^{\circ} \mathrm{C}$ |  |

## 8-3 Measurement of Main Circuit Electrical Quantity

The indicated values depend on the type of meter because the harmonic component is included in the voltage and current of the main circuit power (input) and the output (motor) side of the inverter. When measuring with a meter for commercial power frequency use, use the meters shown in Table 8.3.1.

The power-factor cannot be measured using power-factor meters currently available on the market, which measure the phase difference between voltage and current. When power-factors must be measured, measure the power, voltage, and current on the input side and output side, then calculate the power-factor using the following formula:

Power - factor $=\frac{\text { Power [W] }}{\sqrt{3} \times \text { Vottagr[ }] \times \text { Current }[\mathrm{A}]} \times 100[\%]$

Table 8-3-1 Meters for measuring main circuit

| Hem | Input (power supply) side |  |  | Output (motor) side |  |  | DC link circuit voltage$(P(t)-N(-1)$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |
| Moter name | Arnmeter Ar.s.t | $\begin{gathered} \hline \text { Voltmeter } \\ \text { VR,S.T } \end{gathered}$ | Powermeter Wr.s.t | Ammeter Au,v.w | Vollmeter Vu.v.w | $\begin{gathered} \text { Powermeter } \\ \text { Wu,v,w } \end{gathered}$ | $\begin{gathered} \hline \text { DC voltmeter } \\ V \end{gathered}$ |
| $\begin{aligned} & \text { Meter } \\ & \text { type } \end{aligned}$ | Moving-iron type | Rectifier or moving-iron type | Digital power meter | Mowing-iron type | Rectifier type | Digital power meter | Moving-coil type |
| Symbol | $E$ |  |  | $\frac{F}{F}$ | H |  | (1) |



Fig 8-3-1 Connection of the meters

## 8-4 Insulation Test

Avoid testing an inverter with a megger because an insulation test is completed at the factory. If a megger test must be completed, proceed as described below. Use of an incorrect testing method may result in product damage.
If the specifications for the dielectric strength test are not followed, the inverter may be damaged. If a dielectric strength test must be completed, contact your local distributor or nearest Fuji Electric sales office.
(1) Megger test for the main circuit
o Use a 500V DC type megger and isolate the main power before commencing measurement.
I If the test voltage is connected to the control circuit, remove all connection cables to the control circuit.
$\square$ Connect the main circuit terminals using common cables as shown in Fig. 8-4-1.
$\square$ Execute the megger test only between the common cables connected to the main circuit and the ground (terminal- $G$ ).
DA megger indicating $5 \mathrm{M} \Omega$ or more is normal. (This is the value measured with an inverter only.)

(2) Insulation test in the control circuit

Fig. 8-4-1
Megger test
A megger test and a dielectric strength test must not be performed in the control circuit. Prepare a high resistance range multimeter for the control circuit.
oRemove all external cables from the control circuit terminals.
$\square$ Conduct a continuity test between grounds. A result of $1 \mathrm{M} \Omega$ or more is normal.
(3) Exterior main circuit and sequence control circuit

Remove all cables from inverter terminals to ensure the test voltage is not applied to the inverter.

## 8-5 Parts Replacement

The life expectancy of a part depends on the type of part, the environment, and usage conditions. Parts should be replaced as shown in Table 8-5-1.

## 8-6 Inquiries about Products and Product Guarantee

(1) Inquiries

Table 8-5-1 Part replacement

If there is damage, a fault in the product, or questions conceming the product, contact your local distributor or nearest Fuji Electric sales office:
a) Inverter type
b) Serial No. (equipment serial number)
c) Purchase date
d) Inquiry details (e.g., damaged part, extent of damage, questions, status of fault)

## (2) Product guarantee

The product guarantee term is one year after purchase or 18 months from the year and month of manufacture on the nameplate, whichever expires first.
However, the guarantee will not apply in the following cases, even if the guarantee term has not expired:
oDamage was caused by incorrect use or inappropriate repair and modification.
TThe product was used outside the standard specified range.
DDamage was caused by dropping the product after purchasing or damage during transportation.
DDamage was caused by an earthquake, fire, flooding, lightning, abnormal voltage or other natural calamities and secondary disasters.

## 9．Specifications

## 9－1 Standard Specifications

（1）Three－phase 200V series

| $\begin{aligned} & \text { Nominal } \\ & \mathrm{lWW}] \end{aligned}$ | applied motor | 0.2 | 0.4 | 0.75 | 1.5 | 2.2 | 37 | 5.5 | 7.5 | 11 | 15 | 185 | 22 | 30 | 37 | 45 | 55 | 75 | 80 | 110 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| G11 | $\begin{aligned} & \text { Type } \\ & \text { FRNMOG11S-2.JE } \end{aligned}$ | 0.2 | 0.4 | 0.75 | 1.5 | 2.2 | 37 | 5.5 | 7.5 | 11 | 15 | 185 | 22 | 30 | 37 | 45 | 55 | 75 | 90 |  |
|  | $\begin{aligned} & \text { Rated output } \\ & \text { capacily ('1) [kVA] } \end{aligned}$ | 0.57 | 1.1 | 1.9 | 3.0 | 4.2 | 6.4 | 9.5 | 12 | 17 | 22 | 28 | 33 | 43 | 55 | 68 | 81 | 107 | 131 |  |
|  | $\begin{aligned} & \text { Rated output } \\ & \text { current ('Z) }\|A\| \end{aligned}$ | 1.5 | 3.0 | 5.0 | 8.0 | 11 | 17 | 25 | 33 | 48 | 59 | 74 | 87 | 15 | 145 | 180 | 215 | 283 | 346 |  |
|  | Overload capabilly | 150\％of rated outpux current for 1 min． $200 \%$ of rated output current for 0.5 s |  |  |  |  |  |  |  |  |  |  |  | 150\％of rated output current for 1 min． $180 \%$ of rated output current for 0.58 |  |  |  |  |  |  |
|  | Starting torque | $200 \%$ or more（under torque vector control） |  |  |  |  |  |  |  |  |  |  |  | 180\％or more（under torque vector control） |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Braking torque } \\ & (-3) / \%] \end{aligned}$ | 150\％or more |  |  | 100\％or more |  |  |  |  | Approw．20\％ |  |  |  | Approx． 10 to 15\％ |  |  |  |  |  |  |
|  | Braking time［8］ | more |  |  | 5 |  |  |  |  | No Hmin |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Braking duty cycle } \\ & \text { (\%ED) } \end{aligned}$ | 10 | 5 | 3 | 5 | 3 | 2 | 3 | 2 | No Himit |  |  |  |  |  |  |  |  |  |  |
|  | Mass fikel | 2.2 | 2.2 | 2.5 | 3.8 | 3.8 | 3.8 | 6.1 | 6.1 | 10 | 10 | 10.5 | 40.5 | 29 | 36 | 44 | 46 | 70 | 115 | － |
| P11 | $\begin{aligned} & \text { Type } \\ & \text { FRNMIP11S-2.JE } \end{aligned}$ | － | － | － | － | － | － | 5.5 | 7.5 | 11 | 15 | 185 | 22 | 30 | 37 | 45 | 55 | 7 | 90 | 440 |
|  | $\begin{aligned} & \text { Rated capacily } \\ & \left({ }^{\circ} 1\right) \\ & (\mathrm{KVA}) \end{aligned}$ | － | － | － | － | － | － | 8.3 | 11 | 16 | 20 | 25 | 29 | 43 | 55 | 68 | 81 | 107 | 131 | 158 |
|  | $\begin{aligned} & \begin{array}{l} \text { Rated oupul } \\ \text { current } \\ \text { ('2) }\|A\| \end{array} \end{aligned}$ | $\square$ | $\square$ | $\bullet$ | $\bullet$ | $\bullet$ | $\cdot 1$ | 22 | 29 | 42 | 55 | 67 | 78 | 115 | 145 | 180 | 215 | 283 | 346 | 415 |
|  | Overload capability | 110\％of rated outpul current for 1 min ． |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Starting torque | 50\％or more |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Braking torque } \\ & (-3)[\%] \end{aligned}$ | Apprax．20\％ |  |  |  |  |  |  |  |  |  |  |  | Approx． 10 to 15\％ |  |  |  |  |  |  |
|  | Braking time［s］ | No timit |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Braking duty cycle } \\ & \text { [\$ED] } \end{aligned}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Mass［kgl | － | － | － | － | － | － | 5.7 | 5.7 | 5.7 | 10 | 10 | 10.5 | 29 | 29 | 38 | 44 | 46 | 70 | 115 |
| 空最 | Rated output vollage（ㄴ4）M | 3－phase，200V／50Hz，200V，220V，230V／60Hz |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Rated outpu： frequency［ Hz ） | 50，60Hz |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { 费 } \\ & \text { 苞 } \\ & \text { 豆 } \end{aligned}$ | $\begin{aligned} & \text { Phases, voltage, } \\ & \text { trequency } \end{aligned}$ | 3－phese， 200 to 230V，50\％60 Hz |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { 3-phase, } 200 \text { to } 220 \mathrm{~V}, 220 \text { to } 230 \mathrm{~V} / 50 \mathrm{~Hz} \\ & 3 \text {-phase, } 200 \text { to } 230 \mathrm{~V} / 60 \mathrm{~Hz} \end{aligned}$ |  |  |  |  |  |  |
|  | Voltagelfirequency varations | Voltage：$+10 \%$ to－15\％（Imbalance rato between phases：3\％or less（＂6）．Frequency．$+5 \%$ to $-5 \%$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Momentary voltage dip capabilly（ ${ }^{(7)}$ | Operation will contimue with 165 V or more．If vollage drops betow 165 V ，operation will continue for up to 15 ms ． <br> If＂Continuous operation＂is selected，the output frequency will be lowered to withstand the load undil normal vollage its resumed． |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Required power } \\ & \text { supply } \\ & \text { capaciyr } 8 \text { ) } \\ & \hline \end{aligned}$ | 0.4 | 0.7 | 1.3 | 2.2 | 3.1 | 5.0 | 7.2 | 9.7 | 15 | 20 | 24 | 29 | 38 | 47 | 56 | 69 | 93 | 111 | 134 |

(2) Three-phase 400 V series

| $\begin{gathered} \text { Nom } \\ \text { [KM } \end{gathered}$ | inal applied motor M | 0.4 | 0rs | 15 | 22 | 37 | 55 | 75 | 11 | 15 | 103 | 22 | 30 | 37 | 45 | 5 | 75 | m | 110 | 120 | 100 | 20 | 200 | 280 | 315 | 388 | 40 | 40 | 50 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| G11 | $\begin{aligned} & \text { Type } \\ & \text { FRNIIIKG11S-4JE } \end{aligned}$ | 04 | 078 | 1.5 | 22 | 37 | 55 | 7.5 | 11 | 45 | 12.5 | 22 | 30 | 37 | 8 | 55 | 75 | m | 110 | 152 | 120 | 200 | 20 | 230 | 35 | 38 | 40 |  |  |
|  | $\begin{aligned} & \text { Rated output } \\ & \text { capacily (*1) [kVAl } \end{aligned}$ | 1.1 | 1.0 | 28 | 41 | as | 09 | 13 | 18 | 22 | 20 | 34 | 4 | 5 | $\boldsymbol{\omega} \boldsymbol{\theta}$ | 85 | 14 | 134 | 180 | 4 | 231 | 287 | 318 | 358 | 45 | 45 | 583 |  |  |
|  | $\begin{aligned} & \text { Rated output } \\ & \text { current ("2) }\|A\| \end{aligned}$ | 15 | 25 | 37 | 35 | 9 | 13 | 18 | 24 | 30 | 30 | 45 | 00 | 75 | 91 | 12 | to | 170 | 200 | 253 | 304 | 377 | 45 | 500 | 585 | 650 | 740 |  |  |
|  | Overtoad capability | $150 \%$ of rated output current for 1 min . $200 \%$ of rated output current for 0.58 |  |  |  |  |  |  |  |  |  |  | $150 \%$ of rated outpul current for 1 mln . $180 \%$ of rated output current for 0.5 s |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Starting torque. | 200\% or more (under torque vector contro) |  |  |  |  |  |  |  |  |  |  | 180\% or more (under torque vector control) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Braking torque } \\ & \left({ }^{\circ} 3\right) \text { [\%] } \end{aligned}$ | $\begin{array}{\|l\|} \hline 50 \% \text { or } \\ \text { more } \\ \hline \end{array}$ |  | 100\% or more |  |  |  |  | 20\% or more |  |  |  | 10 to 15\% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Braling time [s] | 5 |  | 5 |  |  |  |  | No tin' |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Braling duty cycle [5ED] | 5 | 3 | 5 | 3 | 2 | 3 | 2 | No limit |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Mass flk? | 22 | 25 | 38 | 38 | 38 | as | 6.5 | 10 | 10 | 10s | nem | 29 | 34 | 30 | © | 48 | 70 | 70 | 800 | 100 | 140 | 10 | 20 | 250 | 500 | 30 |  |  |
| P11 | $\begin{aligned} & \text { Type } \\ & \text { FRN!IIPP115-4 } \\ & \hline \end{aligned}$ | - |  | - | - | - | 35 | 75 | 41 | 45 | * | 22 | 30 | 37 | 4 | 58 | 7 | $\infty$ | 120 | 238 | 400 | 20 | 20 | 200 | 315 | 585 | 40 | 40 | 500 |
|  | Rated capacily <br> ("1) <br> (KVA) | $\bullet$ | - | - | - | - | 0.5 | Es | 73 | 21 | 21 | 3 m | 4 | 5 | 0 | 85 | 14, | 25 | \%00 | 20 | 21 | 20 | 910 | $\cdots$ | 46 | 48 | 503 | 0.0 | 31 |
|  | $\begin{aligned} & \text { Rated output } \\ & \text { current ( }{ }^{\circ} 2 \text { \|A\| } \end{aligned}$ | - |  |  | - |  | 123 | 105 | 23 | 30 | 3 | 4 | $\boldsymbol{\omega}$ | 75 | 0 | 12 | 40 | T7 | 20 | 203 | 2004 | 87 |  | 50 | 505 | 680 | 740 | 000 | 900 |
|  | Overload capability | 110\% of rated cuapul current for 1 min . |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Starting torque | 50\% or more |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Braldng torque } \\ & \text { (3) [\%] } \end{aligned}$ | Apprex. 20\% |  |  |  |  |  |  |  |  |  |  | Approx. 10 to 15\% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Braking time [s] | No timit |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Braling duty cycle (\% ED] | Notimit |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Mass [kg] |  | - | - | - | - | 81 | 61 | 11 | 10 | 10 | 105 | 23 | 20 | 30 | 30 | 40 | 43 | 70 | 70 | 100 | 100 | 10 | 10 | 20 | 230 | 230 | 30 | 300 |
| 旁霉 | $\begin{aligned} & \text { Rated output } \\ & \text { voliage }(4) /(1) \end{aligned}$ | 3-phase, 380V, 400V, 415V(440V)/50Hz, 360V, 400V, 440V, 460V/60\%tz |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\left\{\begin{array}{l}\text { Rated output } \\ \text { frequency (Hz) }\end{array}\right.$ | 50,60Hz |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Phases, voltage, frequency | 3-phase, 380 to $480 \mathrm{~V}, 50160 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |  | 3-phase, 380 to $440 \mathrm{~V} / 50 \mathrm{Htz} \quad{ }^{*} 5$ )3-phase, 380 to $480 \mathrm{~V} / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Voltagefrequancy variations | Vollage: $+10 \%$ to $-15 \%$ (limbalance rate between phases: $3 \%$ or leas ("6). Frequency. $45 \%$ to $-5 \%$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Mornentary voltage dip capability ("7) | Operation wili continue with 310 V or more. If volitage drops below 310 V , operation will continue for up to 15 ms . If "Continuous operation" is selected, the output frequency will be lowered to withstand the load until normal voltage is resumed. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $\begin{aligned} & \text { Required power } \\ & \text { supply } \\ & \text { capacily ("8) } \end{aligned}$ | 07 | 1.2 | 22 | 31 | 50 | 72 | 97 | 15 | 20 | 24 | 22 | 30 | 4 | 57 | 7 | 00 | 111 | 15 | 17 | 20 | pm | 20 | 301 | 308 | $\omega$ | 4 | 50 | 610 |

("1) Indicated capacities are at the reted output vollage 220 V for the 200 V series and 440 V for the 400 V series. The rated capectly wifl be lowered if the supply voltage is lowered.
$(2)$ In the cese of a low mpectance load, such as a high-frequancy motor, the current may drop below the rated current.
(3) Indicates when a nominal appliad motor is used (the average torque when decelerated to stoppege from 60 Hz , which verles depending on motor loss).
(4) An cutput voliage exceeding the supply voltage cannot be generated.
("5) The taps within the inverter must be changed for a power supply rated at 380 to $398 \mathrm{~V} / 50 \mathrm{~Hz}$ or 380 to $430 \mathrm{~V} / 60 \mathrm{~Hz}$.
("6) If the imbalance belween phases exceeds 3\%, use a power-factor correcting DC reactor (DCR).

Imbalance rate between phases [\%]

$$
\frac{(\text { Max. Voltage }[\mathrm{V}] \text { - Min. Voltage }[\mathrm{M})}{\text { 3-phase average voltage }[\mathrm{V}]} \times 100[\%]
$$

("7) Test was conducted under the standard load condtions stipulated by the JEMA committee (at the load equivalent to 85\% of the nominal applied motor).
("8) Indicates the values required when using a power-factor correcting DC resctor (DCR) (optional for inverters of 55 KW or less) with a loaded nominal applied motor.

9-2 Common Specifications

| Item |  |  | Explanation |
| :---: | :---: | :---: | :---: |
| Control method |  |  | Sinusoidal wave PWM control (with V/F control, torque vector control, PG feedback vector control (option)) |
|  | $\begin{aligned} & \frac{7}{6} \\ & \frac{9}{9} \\ & \frac{6}{6} \\ & \frac{7}{5} \\ & \frac{6}{5} \end{aligned}$ | Maximum frequency | G11S: 50 to 400 Hz variable setting P11S: $50-120 \mathrm{~Hz}$ varlable setting |
|  |  | Base frequency | G11S: 25 to 400Hz varlable setting P11S: $25-120 \mathrm{~Hz}$ variable setting |
|  |  | Starting frequency | 0.1 to 60 Hz variable selting Holding time: 0.0 to 10.08 |
|  |  | Carrier frequency | G11: 0.75 to 15 kHz ( 55 kW or less) 0.75 to 10 kHz ( 75 kW or more) <br> P11: 0.75 to 15 kHz ( 22 kW or less) 0.75 to 10 kHz ( 30 to 75 kW ) 0.75 to 6 kHz ( 90 kW or more) |
|  |  | Accuracy (stabilily) | Analog setting: $+1-0.2 \%$ or less of the max. Frequency (at $25+1-10^{\circ} \mathrm{C}$ ) Digikal setting: $+1-0.01 \%$ of less of the max. Frequency $\left(-10\right.$ to $\left.+50^{\circ} \mathrm{C}\right)$ |
|  |  | Setting resolution |  Digital setting: 0.01 Hz ( 99.99 Hz or less), 0.1 Hz ( 100.0 Hz or more) |
|  | Voltaga/frequency characteristics |  | Output voltage at base frequency can be adjusted separatety, such as 80 to 240 V ( 200 V serfes) or 320 to 480 V (400V serles). <br> Output voltage at max. frequency can be adjusted separately, such as 80 to $\mathbf{2 4 0 V}$ ( 200 V series) or 320 to 480 V ( 400 V series). |
|  | Torque boost |  | Alto: Optimum control corresponding to the load torque. <br> Marual: 0.1 to 20.0 code setting (energy saving reduced torque, constant torque (strong), etc.) |
|  | Accelerating/deceleraking time |  | 0.01 to 36003 <br> Four accelerating and decelorating time settings are possible independent of each other by selecting digital input signals. <br> In addition to Inear acceleration and deceleration, ellither S-shaped acceleration/deceleration (weakistrong) or curvilineer acceloration/deceleration can be selocted. |
|  | DC injection braking |  | Starting frequency: 0.0 to 60.0 Hz , brading time: 0.0 to 30.03 , Braking level: 0 to $100 \%$ (G11S), $0-80 \%$ (P11S) |
|  | Function equipped |  | Frequency upper and lower liniter, bias frequency, frequency gain, jump frequency, plck-up operation, reaturt after mornentary power faibure, switching operation from line to inverter, sip compensation control, automstic energy saving operation, regeneration avoiding control, droop control, torque liniting ( 2 -etep), torque corkrol, PID control, second motor switching, cooling fan ONOFF control. |
| $\begin{aligned} & 8 \\ & 8 \\ & 8 \\ & 8 \\ & \hline \end{aligned}$ | Operation method |  | Keyped panel: Run by FWID . REV keys, stop by sTOP Key Terminal input: Fonward/stop command, reverselatop command, coast-to-stop command, atamm resel, acceleration/deceleration selection, mulitstep frequency selection, etc. |
|  | Frequency setting |  | Keypad panel: Setting by $\sim, ~$, K keys <br> External potentiometer: External freq.setting POT (VR) (1 to $5 k \Omega$ ) <br> Aralog input: 0 to $+10 \mathrm{~V}(0$ to $+5 \mathrm{Y}), 4$ to 20mA, 0 to +1 10V (FWD/REV operation) <br> +10 V to 0 (reverse operation), 20 to 4 mA (reverse operation) <br> UP/DOWN controt: Frequency increases or decreases as long as the digital input signal is turned on. <br> Multistep frequency selection: Up to 15 steps are selectable by a combination of digital input sigrals (four kinds). <br> Link operation: Operation by RS485 (standerd). <br> Program operation: Pattern operation by program <br> Jogging operation: Jogging operation by FWD REV key or digteal input signats |
|  | Operation status signal |  | Transistor output (4 signalis): Running, frequency artival, frequency detection, overicad early warning, etc. Rebay output (2 signats): Atarm output (for any faut), muli-purpose relay output signals <br> Analog ouput (1 signal): Output frequency, output current, output voltage, output torque, power censumption, etc. <br> Pukse output (1 signal): Output frequency, output current, output power, outpult torque, power consumption, etc. |
|  | Digital display (LED) |  | Output frequency, setting frequency, output current, output voltage, motor synchronous speed, ine speed, load rotation speed, calcukated torqua value, power consumption, calculated PID value, PID command value, PID feecback valke, alarm code |
|  | Liquid crystal display (LCD) |  | Operation information, operationas gulde, functional codernamersetting data, alarm mformation, testor function, motor load rate measuring function (Maximumaverage current (ms) during meesuring period, maintenance information (integrated operation hours, capacitance measurement for main ctroult capacitors, heat sink temperature, etc.)) |
|  | Language |  | Six languages (Japanese, Engilsh, German, French, Spanish, and Itallan) |
|  | Lamp display |  | Charging (voltage residual), operation indication |
| Protective functions |  |  | Overcurrent, short-circuit, ground faulk, overvoliage, undervoltage, overloed, overheatthg, blown fuse, motor overload, external alarm, input open-phase, output open-phase (when tuning), braking resistor protection, CPU and memory error, keypad panel communication error, PTC thermistor protection, surge protection, stall provention, etc. |
|  | Instalation location |  | Indoor, alatude less than 1000 m , free from corrosive gas, dust, and direct sunjigid (Polution degree 2). |
|  | Amblerd temperature |  | -10 to $+50^{\circ} \mathrm{C}$ (ventilating cover must be removed under conditions exceeding $+40^{\circ} \mathrm{C}$ for models rated at 22 NW or less) |
|  | Ambient humidity |  | 5 to 95\%RH (no condensation) |
|  | Alr pressure |  | Operationstorage: :86 to 106 kPa Transport $: 70$ to 106 kPa |
|  | Vibration |  | 3 mm at from 2 to less than $9 \mathrm{~Hz}, 9.8 \mathrm{~m} / \mathrm{s}^{2}$ at from 9 to less than 20 Hz , <br> $2 \mathrm{~m} / \mathrm{s}^{2}$ at from 20 to less than $55 \mathrm{~Hz}\left(2 \mathrm{~m} / \mathrm{s}^{2}\right.$ at from 9 to less than 55 Hz :G11S 90 KW , P11S 110 kW or more) <br> $1 \mathrm{~m} / \mathrm{s}^{2}$ at from 55 to less than 200 Hz , |
|  | Storage | Ambient temperature | -25 to +659 |
|  |  | Amblent humidity | 5 to 95\%RH (no condensation) |

## 9-3 Outline Dimensions

## - Outtine Dimensions (22kW or less)

Fig. 1

| Trpe | - | DI | 02 | D3 | 04 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| FROM.2011S-2 to FRON0.4011S-2 FFONO.4G115-4 | 130 | 36.5 | 80 | 94 | 71.5 |
| Fran .75an118-2 <br> FRu0.750:19-4 | 145 | 51.5 | 98 | 100 | ac. 5 |



Fig. 2

Fig. 3


- Outline Dimensions (G115 : 30 kW to 220 kW, P11S : 30 kW to 280 kW )




■Outline Dimensions (G11S :280kW or more ,P11S :315kW or more)


400V Series


| Nominal <br> appliod <br> motorkW\| | Inverter type |  | Dimension Unit ${ }^{\text {a }}$ mm |  |  |  |  |  | Mounting boll |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | FRN-G11S series | FRN-P11S series | D2 | D3 | D4 | D5 | D8 | C |  |
| 280 | FRN280G115-4JE |  | 8.4 | 50 | 100 | 35 | 115 | 15 | M12 |
| 315 | - | FRN315P11S-4JE |  |  |  |  |  |  |  |
|  | FRN315G11S-4JE | - |  |  |  |  |  |  |  |
| 355 | - | FRN355P11S-4JE |  |  |  |  |  |  |  |
| 400 | - | FRN400P11S-4JE |  |  |  |  |  |  |  |
| 355 | FRN355G11S-4JE | - - |  |  |  |  |  |  |  |
| 400 | FRN400G11S-4JE | - |  |  |  |  |  |  |  |
| 450 | - | FRN450P11S-4JE |  |  |  |  |  |  |  |
| 500 | - | FRN500P11S-4JE |  |  |  |  |  |  |  |

## Outine Dimensions (Reactor; Accessories for 75 kW or more)



200 V Series

| Inverter type | DC Reactor type | Fig. | Dimension |  |  |  |  |  |  |  |  | Un* ${ }^{\text {mam] }}$ |  |  |  | $\begin{gathered} \text { Mass } \\ {[\mathrm{kg}]} \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | A | B | C | D | E | F | G | H | 1 | $J$ | K | L | Terminal hole size |  |
| FRN75G11S/P11S-2JE | DCR2-75B | Fig. A | 200 | 170 | 100 | 141 | 110 | 70 |  | 210 | 270 |  |  |  | M12 | 18 |
| FRN90G11S/P11S-2JE | DCR2-90B |  | 180 | 150 | 110 | 151 | 140 | 75 | 10 | 240 | 280 | 25 |  |  |  | 20 |
| FRN110P11S-2JE | DCR2-110B |  | 190 | 160 | 120 | 181 | 150 | 80 |  | 270 | 330 | 5 |  |  | ¢ 15 | 25 |

## 400 V Series

| Inverter type | DC Reactor type | Fig. | Dimension Unity |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Mass } \\ {[\mathrm{kg}]} \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | A | B | c | D | E | F | G | H | 1 | $J$ | K | L | Terminal hole size |  |
| FRN75G11S/P11S-4JE | DCR4-75B | Fig. A | 190 | 160 | 115 | 151 | 100 | 75 | 10 | 240 | 270 | - |  | - | M10 | 20 |
| FRN80G11S/P11S-4JE | DCR4-90B | Fig. B |  |  | 125 | 161 | 120 | 80 |  | 250 | 280 | 25 | - |  | ¢ 12 | 23 |
| FRN110G11S/P11S-4JE | DCR4-110B |  |  |  | 125 |  |  |  |  | 250 |  |  |  |  | 25 |  |
| FRN132G11S/P11S-4.JE | DCR4-132B |  | 200 | 170 |  | 171 |  | 85 |  | 260 |  | 30 | - |  |  | 28 |
| FRN160G11S/P11S-4JE | DCR4-160B |  | 210 |  | 135 |  |  |  |  | 290 | 320 |  |  |  | 32 |  |
| FRN200G11S/P11S-4JE | DCR4-200B |  | 210 | 180 | 135 |  | 140 | 90 |  | 295 | 330 |  |  |  | 35 |  |
| FRN220G11S/P11S-4E | DCR4-220B |  | 220 | 190 |  |  | 140 | 90 |  | 300 | 350 |  |  |  |  |  | 40 |
| FRN280611S/P11S-4JE | DCR4-2808 |  |  |  | 145 | 181 | 150 |  |  |  | 370 |  |  | - |  |  | 45 |
| FRN315G11S/P11S-4JE | DCR4-315B | Fig. C |  |  |  |  | 150 |  | 12 | 320 | - | 40 | 41 | 215 |  |  | 52 |
| FRN355G11S/P11S-4JE | DCR4-355B |  |  |  |  |  | 160 | 95 |  |  | - |  | 41 | 215 | ¢ 15 | 55 |
| FRN400G11S/P11S-4JE | DCR4-400B |  | 240 | 210 |  |  |  |  |  |  | - |  |  |  |  | 60 |
| FRN450P11S-4JE | DCR4-450B |  | 260 | 225 |  |  |  |  |  | 340 | - | 50 | 45 | 225 |  | 67 |
| FRN500P11S-4JE | DCR4-500B |  | 260 | 225 |  |  | 185 | 100 |  |  | - | 50 |  |  |  | 70 |

## 9-4 RS485 Communication

When connected to host equipment such as a personal computer or PLC, the inverter can be monitored or made to operate, stop or change the program by receiving commands from the host. For details concerning communication, refer to technical documentation.

Table 9-4-1 Transmission specifications

| Item | Specifications |
| :---: | :---: |
| Applicable model | Fuii Electric generat-purpose inverter 11 series |
| Physical level | EIA RS485 |
| Maximum length of cable | 500m |
| Number of units connected | One host and 31 inverters (Station No. 1 to 31) |
| Transmission speed | 19200,9600,4800,2400,1200 [BPS] |
| Synchronization method | Start-stop transmission (Asynchronous) |
| Transmission form <br> (data <br> method) | Half-duplex method |
| Transmission protocol | Polling/selecting, broadcast |
| Character system | ASCII 7 bit |
| Character length | 8bit, 7bit |
| Stop bit length | 1 bit 2 bit |
| Frame length | 16-byte fixed for general transmission; 8- or 12-byte for high-speed transmission |
| Parity | even, odd, none |
| Error check method | Check sum |

10. Options

10-1 Built-in Options
The following are optional cards that can be stored in the inverter.

| Name | Function |
| :--- | :--- |
| Relay output card <br> (OPC-G11S-RY) | - Relay output card <br> The transistor output from the inverter control output terminals Y1 to Y4 <br> is converted to the relay output (1SPDT). |
| Digital interface card <br> (OPC-G11S-DIO) | - Frequency setting by binary code (max. 18 bits) <br> - Monitoring (8 bits) of frequency, output current, and output voltage |
| Analog interface |  |
| card |  |
| (OPC-G11S-AIO) |  | | - Awoiliary inpun for analog frequency setting (0 to +/-10 V) |
| :--- |
| - Monitoring of inverter output frequency, current, and torque in analog |
| voltage |

10-2 Separately Installed Options


## 11. Electromagnetic compatibility (EMC)

11-1 General
In accordance with the provisions described in the European Commission Guidelines Document on Council Directive 89/336/EEC,Fuji Electric Co., Ltd. has chosen to classify the FRENIC 5000G11S/P11S range of Inverters as "Complex Components".
Classification as a "Complex Components" allows a product to be treated as an "apparatus", and thus permits compliance with the essential requirements of the EMC Directive to be demonstrated to both an integrator of FRENIC Inverters and to his customer or the installer and the user.
FRENIC Inverters is supplied 'CE-marked', signifying compliance with EC Directive 89/336/EEC when fitted with specified filter units installed and earthed in accordance with this sheet. This Specification requires the following performance criteria to be met.

## EMC product standard EN61800-3/1997

Immunity : Second environment (Industrial environment)
Emission : FIrst environment ( Domestic environment ) ;22kW or less
Second environment (Industrial environment) ;30kW or more
Finally, it is customer's responsibility to check whether the equipment conforms to EMC directive.
11-2 Recommended Installation Instructions
It is necessary that to conformed to EMC Directive, these instructions must be followed.
Follow the usual safety procedures when working with electrical equipment. All electrical connections to the filter, Inverter and motor must be made by a qualified electrical technician.

1) Use the correct fitter according to Table 11-1.
2) Install the Inverter and filter in the electrically shielded metal wiring cabinet.
3) The back panel of the wiring cabinet of board should be prepared for the mounting dimensions of the filter. Care should be taken to remove any paint etc. from the mounting holes and face area of the panel. This will ensure the best possible earthing of the filter.
4) Use the screened cable for the control, motor and other main wiring which are connected to the Inverter, and these screens should be securely earthed.
5) It is important that all wire lengths are kept as short as possible and that incoming mains and outgoing motor cables are kept well separated.
" To minimize the conducted radio disturbance in the power distribution systems, the length of the motor-cable should be as short as possible."
6) In case of a ferrite ring is provided with the fitter, fit a ferrite ring to conductors passing through the center of the ferrite. Wire the cable according to Fig.11-6 or Fig.11-7 , paying attention to the applied inverter type

Table 11－1 RFI filters

| Applied Inverter | Filter Type | Rated Current | Max． Rated Voltage | RFI filter |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Dimensions } \\ & \text { LXWxH [mm) } \end{aligned}$ | $\begin{aligned} & \text { Mount Dims } \\ & Y \times X(\mathrm{~mm}] \end{aligned}$ | Ferite Ring | Note |
| FRNO2G11S－2JE FRNO．4G11S－2JE FRN0．75G11S－2JE | ㅈat－0．75SR2 | 6A | $\begin{gathered} 3 \mathrm{ph} \\ 230 \mathrm{Vac} \end{gathered}$ | 243x85x93 | $228 \times 59$ | $\begin{aligned} & \text { OF1 } \\ & \text { (1) } \end{aligned}$ | $\begin{gathered} \text { Fig. } \\ \text { 11-1 } \end{gathered}$ |
| FRN1．5G11S－2JE FRN2．2G11S－2JE FRN3．7G11S－2JE | ⿴囗十－3．7SR2 | 25A |  | 233×105×136 | 215×80 | $\begin{aligned} & \text { OF2 } \\ & \text { (1) } \end{aligned}$ |  |
| FRN5．5G11S－2P11S－2IE | Ar－7．5SP2 | 50A |  | 273×120×158 | 254x95 | $\begin{aligned} & \text { of2 } \\ & \text { (1) } \end{aligned}$ |  |
| FRN11G11S－2P11S－2JE <br> FRN15G11S－2P11S－2UE | （9R－15SP2 | 100A |  | 513x205x193 | 487x160 | $\begin{aligned} & 10{ }^{0} \mathbf{3} \\ & \text { (1) } \end{aligned}$ |  |
| FRN18．5G11S－2P11S－2JE <br> FRN22G11S－2P11S－2JE | 因－22SR－2 | 150A |  | 513x205×193 | 487x160 | $\begin{aligned} & \text { ofs } \\ & \text { (1) } \end{aligned}$ |  |
| FRN30G11S－2P11S－2JE | RF3180－F11 | 180A |  | $495 \times 200 \times 160$ | 468x166 | － | $\begin{array}{\|c\|} \hline 199 \\ 11-3 \end{array}$ |
| $\begin{array}{\|l\|} \hline \text { FRN37G11S-2P11S-2JE } \\ \hline \text { FRNA5G11S-2P11S-2PE } \\ \hline \end{array}$ | RF3280－F11 | 280 A |  | $250 \times 587 \times 205$ | 560×85 | － | $\begin{gathered} \mathrm{Fg} \\ \text { 14-4 } \end{gathered}$ |
| FRN55P11S－2P11S－21E | RF3400－F11 | 400A |  | 250x587×205 | 560x85 | － |  |
| FRN110P11S－2JE |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { FRNO.4G11S-4NE } \\ & \text { FRNO.75G11S-4NE } \end{aligned}$ | ER－0．75611－4 | 5A | $\begin{gathered} 3 \mathrm{ph} \\ 480 \mathrm{Vac} \end{gathered}$ | 320x116x42 | 293x90 | － | $\begin{gathered} \mathrm{Flg} \\ 11-2 \end{gathered}$ |
| FRN15G11S－4JE FRN22G11S－4JE FRN3．7G11S－4JE | Ex－4．0G11－4 | 12A |  | 320x155x45 | 293x105 | － |  |
| FRN5．5G111－4P11S－4NE FRNT5G11S－4P11S－4JE | 바－7．5G11－4 | 35A |  | $341 \times 225 \times 47.5$ | $311 \times 167$ | － |  |
| FRN11G11S－4P11S－4E FRN15G11S－4P11S－4JE | Er－15G11－4 | 50A |  | 500x250x70 | 449x185 | － |  |
| FRN18．5G11S－4P11S－4JE FRNR2G11S－4P11S－4JE | 日R－22G11－4 | 72A |  | 500×250×70 | 449x185 | － |  |
| FRN300G11S－4P11S－4JE | RF3100－F11 | 100A |  | 435 $\times 200 \times 130$ | $408 \times 166$ | － |  |
| FRN37G11S－4P11S－4JE FRNA5G11S－4P11S－4JE FRNESG11S－4P11S－4JE FRNT5G11S－4P11S－4JE FRNGOG11S－4P11S－4NE FPRYOGG11S－4P P1S－4NE | RF3180－F11 | 180A |  | 495x200x160 | 468x166 | － | $\begin{gathered} \text { Fig } \\ 11-3 \end{gathered}$ |
| FPN110G11S－4／P11S－4JE FRN132G11S－4P11S－4JE | RF3280－F11 | 280A |  | $250 \times 587 \times 205$ | 560x85 | － |  |
| FRN160G11S－4／P11S－4JE FRNE200G11S－4P11S－4JE FRN220311S－4P11S－4JE | RF3400－F11 | 400A |  | 250×587×205 | 560x85 | － | $\begin{aligned} & \text { Fig. } \\ & 11-4 \end{aligned}$ |
| FRNESOPH 1S－4JE |  |  |  |  |  | － |  |
| FRN280G11S－4 <br> FRN315G11S－4P11S－4JE FRN355G11S－4P11S－4JE FRN400G11S－4P11S－4JE FRN450P11S－4JE FRNSOOP11S－4JE | RF3880－F11 | 880A |  | $688 \times 364 \times 180$ | $648 \times 150$ | F200160 <br> （3） | $\begin{aligned} & \mathrm{Fg} \mathrm{~g} . \\ & 11-5 \end{aligned}$ |

Note ：For detall，refer to the instruction manual that came with the RFI filters．


Fig. 14-1


Fig.11-2


| Filter Type | Dimensions (mm) |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  | W | W1 | H | H1 | D |  |
| RF3100-F11 | 200 | 168 | 435 | 408 | 130 |  |
| RF3180-F11 | 200 | 166 | 495 | 468 | 160 |  |

Fig.11-3 Outline Dimensions (RF3100-F11, RF3180-F11)


Fig.11-4 Outline Dimensions (RF3280-F11, RF3400-F11)


Fig.11-5 Outline Dimensions, (RF3880-F11)


Fig.11-6
FRNO.2G11S-2JE to FRN90G11S-2JE , FRN5.5P11S-2JE to FRN110P11S-2JE FRN0.4G11S-4JE to FRN220G11S-4JE , FRN5.5P11S-4 JE to FRN280P11S-4JE


Fig. 11-7
FRN280G11S-4JE to FRN400G11S-4JE FRN315P11S-4JE to FRN500P11S-4JE

## SUPPLEMENT SHEET

## FOR INSTRUCTION MANUAL (INR-HF51299)

This supplement sheet is mentioned about the latest content for Compliance with UUCUL standards. Keep the content of this supplement sheet, if you apply to products with ULcUL mark.

Compliance with UL/CUL standards [ Applicable to products with ULCUL mark]

## ACAUTION

- RCAUTION Hazard of electrical shock. Disconnect incoming power before working on this control.
- [CAUTON Dangerous voltage exists until charge lights is off.
- WARNNG
- More than one live parts inside the inverter.
- Type 1 "INDOOR USE ONLY"

The inverter is approved as a part used inside a panel. Install it inside a panel.

- Use $60 / 75^{\circ} \mathrm{C}$ copper wire only.
- AClass 2 circuit wired with class1 wire.
- Field wiring connection must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. connector must be fixed using the crimp tool specified by the connector manufacturer.
- Connect the power supply to main power supply terminals via the Molded-case circuit breaker(MCCB) or the earth leakage circuit breaker(ELCB) to apply the UL Listing Mark.
(See Instruction Manual basic connection diagram Fig.2-3-1).
- In case of using auxiliary control-power input (R0,T0), connect it referring to Basic connection diagram Fig.2-3-1
- Solid state motor overload protection is provided in each model.

Compliance with ULcUL standards [ Applicable to products with ULCUL mark]


Compliance with ULCUL standards [Applicable to products with ULcUL mark]

- "Suitable for use on a circuit capable or delivering not more than $5,000 \mathrm{rms}$ symmetrical amperes, 240 V maximum for 22 kW or less models, $100,000 \mathrm{~ms}$ symmetrical amperes, 230 V maximum for 30 kW or more models". rated for 200 V class input.
- "Suitable for use on a circuit capable or delivering not more than $5,000 \mathrm{~ms}$ symmetrical amperes, for 22 kW or less models, $100,000 \mathrm{~ms}$ symmetrical amperes, for 30 kW or more models, 480 V maximum". rated for 400 V class input.
- Use the following power supply in the inverter

| $\triangle$ CAUTION |  |  |
| :---: | :---: | :---: |
| - Use the following power supply in the Inverter. |  |  |
| Inverter type | Maximum input voltage | Input source current |
| FRNO.2G11S-2 to FRN22G11S-2EE | AC240V |  |
| FRN30G11S-2 to FRN90G11S-2E | AC230V | (up to 22kW) |
| FRNO.4G11S-4 to FRN22G11S-4JE <br> FRN5.5P11S-4 to FRN22P11S-4JE | AC480V | Not more than 100,000 A (30kW or more ) |
| FRN30G11S-4 to FRN400G11S-4JE <br> FRN30P11S-4 to FRN500P11S-4JE | AC480V |  |

## General instructions

Athough figures in this manual may show the inverter with covers and safety screens removed for explanation purposes, do not operate the device until all such covers and screens have been replaced.

# Fuji Electric Co.,Ltd. <br> ED\&C and Drive Systems Group 

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome
Shinagawa-ku, Tokyo 141-0032, Japan
Phone: 3-5435-7139 Fax: 3-5435-7460

### 7.0 SWITCHBOARD WORKS TEST RESULTS

## J.\& P. RICHARDSON INDUSTRIES RTY LTD

114 Campbell Arenue, ViACOL QLD 4076.
Ph: (07) 32712911 -Fax: (07) 32713623
E-mail: jpr@ipr.com.au

## SWITCHBOARD \& SHEETMETAL INSPECTION REPORT



## J. \& P. RICHARDSON INDUSTRIES PRY. LTD.

114 Campbell Avenue, WACOL QLD 4076
Ph: (07) 32712911 - Fax: (07) 32713623
Email: jpr@pr.coman
SWITCHBOARD / SHEETMETAL
INSPECTION CHECKLIST


114 Campbell Avenue, WACOL QLD 4076
Ph: (07) 32712911 - Fax: (07) 32713623
E-mail: jpr@jpr.com.au
SWITCHBOARD ELECTRICAL INSPECTION \& TEST REPORT


## SWITCHBOARD CONTINUITY \& INSULATION TEST REPORT



## SWITCHBOARD ELECTRICAL INSPECTION \& TEST REPORT VFD \& SOFT STARTER SETUP



Drive Setup Details:


All other parameters are default settings.
Comments:

## JOB SAFETY ANALYSIS

## LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES

APPROVED BY: • Eric McCulloch (WHSO)
LOCATION: WACOL WORKSHOP
DATE: 1.3.1.9.1.9.5


## JOB SAFETY ANALYSIS

## LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES

APPROVED BY: Eric McCulloch (WHSO)
LOCATION: WACOLWORKSHOP DATE: 14.1.9.0.5


## 8.0 "ASCONSTRUCTED" DRAWINGS





SP369 Karalee.BSPS - Pump Station B-Flectrical Switchbeard- OM Manual




SP369 Karalee B SPS - Pump Sfation B - Electrical Swifchboard-OM Manual.

| Item | Oty | Make \& Number | Description |
| :---: | :---: | :---: | :---: |
| 01 | , | SOCOMEC SCO 1603 3P | CHANGE OVER SWIICH |
| x1 | 1 | MARECHAL 368017 | GENERATOR SUPPLY INLET PLUG |
|  |  | c/w Marechal 316 GA26 | inlet plug cap |
|  |  | 8 MARECHAL 51 DA058 | InLET PLUG WALL BOX |
| X2 | 1 | CLIPSAL $2015 \mathrm{c} / \times 4.49 \mathrm{~A}$ | TELLMETRY GPO \& MOUNTING BLOCK |
| 1.201 | 2 | FUNS FRN30P115-4, | VARIABLE FREQuency dive |
|  |  | c/w Refino-Fil | KEYPAD |
|  |  | $2 \mathrm{CB111-108-25}$ | RFI Flliter |
| 1,201 | 2 | TERASAKI OIN T 10 H 3100 C | PUMP No. 1,2 CIRCUUT BREAKERS |
| 04 | 1 | TERASAKI DTCCB6306C | CIRCUIT BREAKER |
| 02 | 1 | TERASAKI DSRCBH-16-30A | RCD CIRCUIT BREAKER |
| 03.5 | 2 | TERASAKI DTCB6110C | CIRCUIT BREAKERS |
| 1,2,4,505 | 4 | TERASAKI OTCB6104C | CIRCUIT BREAKERS |
| 305 | 1 | TERASAKI DTCB6106C | Circuit breakers |
| 6.805 | 2 | TERASAKI DTCB61022 | CIRCUIT BREAKER |
| 705 | 1 | TERASAKI OTCB6106C | CIRCUIT BREAKER |
| SRF | 1 | CRITEC TOF-20A-240V | SURGE REDUCTION FlLTER |
| PFR | 1 | CARLO GAVAZZI DPA-01-0-M48 | Phase fallure relay |
| F1-1,2,3 | 3 | SC32H $\mathrm{C} / \mathrm{W}$ NS 32 | FUSES |
| F1-4 | 1 | Sc32H $\mathrm{c} / \mathrm{w}$ N56 | FUSE |
| THR1,2 | 2 | SPRECHER \& SCHUH RTT-E2 | THERMISTOR RELAYS |
| HR1. 2 | 2 | IME R R 4.0 240V | Hour run meters |
| S01-4 | 4 | CRITEC TOS 140-25277 | 40 kA SURGE DIVERTERS |
| NL | 1 | $165 \mathrm{~N} 12 \mathrm{c} / \mathrm{w} 2 \times \mathrm{E} / \mathrm{N}$ FEET | Neutral bar |
| EL | 1 | 1.65 EF+14 | EARTH BAR |
| 1,2k2 | 2 | SPRECHER \& SCHUH CA7-43-00-240V | CONTACTORS |
| 1.2k1,3,4 | 6 | FINOER 55.34.8.240 $\mathrm{c} / \mathrm{M} 94.04$ BASE | 240V Relays |
| K5A | 1 | MUL Titrode mirz | level relay |
| K5B | 1 | MULTITRODE MTR6 | level relay |
|  | 3 | MULTITRODE 0.2/1 | Level probes |
| H10 | 1 | AMALGAMATED PMG-LP-LC | Level display |
| 1.2K50, K10 | 3 | FINDER $55.34 .8 .12 \mathrm{VDC} \mathrm{C} / 1 \mathrm{l} 94.04$ BASE | IzV RELAYS |
| R1,3,4 | 3 | FIINER 55.34.0074.24VDC $\tau / 494.04$ BASE | aux. level relays |
| 1.28R | 2 | FINOER 55.34.0054.24.0VAC $/ 1 \mathrm{w} 94.04$ BASE | backup relays |
| T1,2 | 2 | CARLO GAVAZZI DBB-01-D-M24 | Off delay timer relays |
| T3 | 1 | CARLO GAVAZ21 DAA-S1-C-M24 | ON DELAY TMMER RELAY |
| KT4 | 1 | CARLO GAVAZZI DCB-01-GM24 | FLASHER TIMER |
| 1.2k8 | 2 | TRITRONCS RT1 240 V | WATER IN OIL ReLays |
| P1 | 1 | ime ranze-vac 500V | Vol tmeter |
| vss | 1 | SPRECHER \& SCHUH LE2-12-8271 C/w LFC2-A-4 827 KN08 | VOLTMETER SELECTOR SWIITH |
| 1.251 | 2 | SPRECHER \& SCHUH LE2-12-3503 c/w LfC2-A-4-350R | M-O-A SELECTOR SWITCH |
| 1.252 | 2 | SPRECHER \& SCHUH DSP-F402W3LX01 | STOP PUSHBUTTONS |
| 1.253 | 2 | SPRECCER \& SCHUH DSP-F301W3LX10 | StaRt Pushbuttons |
| 1.254 | 2 | SPRECHER \& SCHUH DSP-F607W3LX10 | RESET PUSHBUTTONS |
| 55 | 1 | SPRECHER \& SCHUH LE2-12-3503 c/w LFC2-A-4-350R | M-O-A SELECTOR SWITCH |
| FAN1.2 | 2 | COSMOTEC CNV2501220 | fans |
|  | 2 | Cosmotec Gnf2 | vents |
| SRF LINK | 1 | CLIPSAL 7 HOLE NEUTRAL LINK | SRF NEUTRAL LINK |
| PS 1 | 1 | Puls 50102 | 12VOC POWER SUPPLY |
| PS2 | 1 | PULS MLT7.500 | 24VOC POWER SUPPLY |
| PS3 | 1 | MEANWELL SD25A24 $\mathrm{C} / \mathrm{w}$ DRP-02 | 12VOC/24VDC POWER SUPPLY |
| ES 1,2 | 2 | SPRECHER \& SCHUH DSP-MTS443LX01 $\mathrm{C} / \mathrm{W}$ 05-15YE112 LABEL | EMERGENCY STOPS |
| H1,2 | 2 | SPRECHER \& SCHUH DSP-P3 $\mathrm{C} / \mathrm{W}$ DS-3NL7 G | RUN INOICATORS |
| H3, 4 | 2 | SPRECHER \& SCHUH DSP-PL C/w D5-3NL7 R | Fault inoicators |
| 1.2 213 | 2 | SPRECHER \& SCHUH DSP-P5 c/w D5-3NL7 A | WATER IN OIL INOICATORS |
| H5 | 1 | HPM 610 RED $\mathrm{C} / \mathrm{W}$ 60W LAMP | FAULT INOICATOR |
| H8 | 1 | SPRECHER + SHUH DTP-PS-PNTY | Inolcator light |
| DS1,2 | 2 | BURGESS 053 | OOOR SWITCHES (TAMPER ALARM) |
| E1, ${ }^{2}$ | 2 | BikiN B801135W | FLUorescent lights |
| 12 | 1 | VEGAWELL 72 | WET WELL Level inoicator |
| FM | 1 | ABB MAGMASTER MF/E10124410ASER13011 | FLOWMETER |
|  | 37 | PHOENIX UKK5-MTK-P/P (2800004) | KNIFE/THROUGH TERMINALS |
|  | 1 | PHoENXX E810-6 [0201139] | INSERTION BRIOGE |
|  | 2 | PHOENXX 0-UK4/10 (3003020) | END Covers |
|  | 3 | PHOENX UBE (10800310) | TERMINAL STRIP MARKERS |
|  | 4 | PHOENX E-UK (12014, 21 | End bracket |
| 053,4 | 2 | BURGESS DS2 | O00R SWITCHES (LIGHTS) |






## "AS CONSTRUCTED"







$\square$


[^0]:    - bei / only / pour KRT K 40-250

    0W 382529

[^1]:    * bei / only / pour KRT K 40-250

    OW 382528

[^2]:    Notes: These motor circuit application tables are to be used as a selection guide for average 3 phase, 4 pole 415 V motors for standard applications only. The table is based on holding 125\% FLC continuously and $350 \%$ FLC for at least 20 seconds.
    ${ }^{1}$ ) 80,100 and 125 amp refers to Din-T10H type.
    ${ }^{2}$ ) Type 'SE' TemBreak MCCB only.
    ${ }^{3}$ ) TL100NJ up to 100A only.

[^3]:    1) For use in atmospherically closed vessels under vacuum, VEGAWELL 72 is available with absolute pressure ranges.
[^4]:    1) VEGAWELL 72 has an integrated overvoltage protection.
[^5]:    6) According to IĖC 60770-1 related to the nominal measuring range
    $n$ Tested acc. to the regulation of the German Lloyd, GL directive 2
[^6]:    Notes: ') With varistor link CRV 3 (DC 220... 250 V ) or RC link CRC 3 (DC 24... 240 V ). refer catalogue 2202.
    ${ }^{2}$ ) For automatic reset: connect r1-r2.

