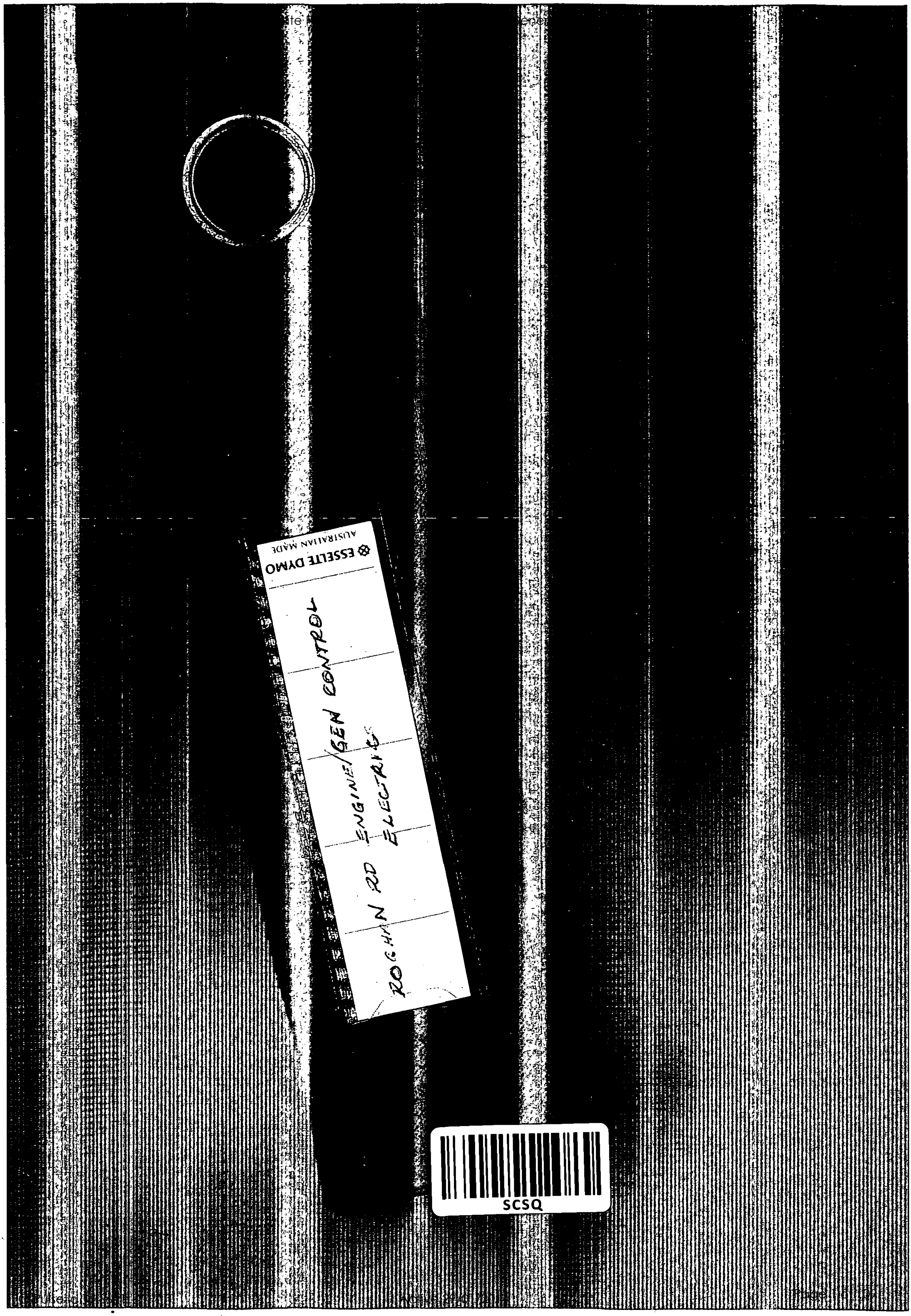

ESSELTE DYMO
AUSTRALIAN MADE
ROGHAN RD ENGINE/GEN CONTROL
ELECTRIC
SCSQ

ROGHAN ROAD GAS EXTRACTION
ENGINE START UP AND SHUT DOWN PROCEDURE

PETER TRANTER
29/07/92

START UP

1. Follow Roghan Road Gas Extraction Plant start up and shut down procedure up to the step prior to plant start up.
2. Open coalescing Filter supply. V3
3. Open coalescing Filter delivery. V25
4. Drain and close coalescing Filter valves. V26, V27
5. Open engine fuel supply in line valve. V28
6. Open methane seperator supply valve. V29
7. Open engine fuel supply valve. V30
8. Open engine oil make up valve. V31
9. Check engine oil (dip stick) level.
10. Observe gas engine alternator alarm panel and reset if required.
11. Switch radiator 3 phase isolator to ON.
12. Switch Gas Engine Alternator (GEA) control panel engine selector to ON.
13. Complete Roghan Road Extraction plant start up and shut down procedure.
14. Ensure Blower bypass selector is OFF.
15. Engine should automatically start 5 minutes after the blower starts up.
16. Complete engine check list and log.

SHUTDOWN

Complete system:
1. Follow shut down procedure of Roghan Road Extraction plant start up and shut down procedure.
2. Reverse engine start up procedure.

Engine only:
1. Switch engine selector to OFF
   NOTE: Emergency stop should only be used for emergency stop of engine.
2. Reverse start up procedure.

ROGHAN ROAD GAS ENGINE ALTERNATOR SET
OPERATIONAL PARAMETERS & SUPPLIERS

GEA CONTROL PANEL:

Phase failure/rotation/imbalance relay EMAIL 2P740 sensitivity 10%.
SUPPLIER: BCC STOCK

Genaust AVR 380 series

SUPPLIER: Genaust Power P/L
6 La Salle St
DUDLEY PARK SA 5008
(08) 269 7000

Overload	>55 amps <80 amps
Underspeed	48HZ
Volts	240 volts AC
Stability	Maximum

Alternator
Thermocouple relay SHIMADEN SR41

SUPPLIER: Control Equipment
Commercial Rd
FORTITUDE VALLEY 4006
852 1936

Thermocouple type	"K"
Temperature alarm	70°C

High speed fan Thermal overload	5 amps
Low speed fan Thermal overload	2.2 amps

SUPPLIER: Klockner-Moeller
Eagle Farm

Woodward 2301A speed controller

SUPPLIER: Dynamic (Governors)
Turbo Charger Services
32 Raynham St
SALISBURY
275 1499

Start fuel limit	3
Actuator compensation	0
Reset Rate	10
Gain	0
Ramp time	0
Low idle	3
Rated speed	1000 RPM

Delta Electronics Speed Sensor Mode DE097

SUPPLIER: AS ABOVE OR
Delta Electronics
Cnr Cavan &
Grand Junct Rds
GEPPS CROSS SA 5084
(08) 260 2522

No. of teeth (actual 190)	192
Starter cut out	200
Underspeed	950
Overspeed	1100

Gas Engine Waukesha F817G

KIM Hot start lube oil heater OL61523

Power rating	150W

Danfoss KPS 79-060 L 3-121
Temperature controller

SUPPLIER: Danfoss P/L
1/32 Billabong St
STAFFORD 4053
356 7911

Temperature setting	70°C

Danfoss RT107 temperature switches 2 metre capillary

SUPPLIER: AS ABOVE

Lube oil temperature alarm	95°C
Water temperature alert	95°C
Water temperature alarm	100°C

ROGHAN ROAD GAS ENGINE ALTERNATOR SET
OPERATIONAL PARAMETERS & SUPPLIERS

Danfoss RT103 pressure switches

SUPPLIER: Danfoss P/L
1/32 Billabong St
STAFFORD 4053
356 7911

Low fuel pressure	3Kpa
High fuel pressure	10Kpa

Murphy safety vibration switch Model V8-2 2g

Engine fuel pressure pre start up requirement

Throttled flare delivery valve back pressure 0Kpa

Battery charger Delta Electronics DE001

SUPPLIER: Delta Electronics
Cnr Cavan &
Grand Junct Rd
GEPPS CJROSS SA 5084
(08) 260 2522

Type	Cyclic Lead-Acid
Cyclic Voltage cut in	26 volts
Cyclic Voltage cut out	28.5 volts
Constant potential	27.6 volts
Cyclic charger current	6-7 amps
Under voltage inhibit	18 volts
Under voltage alarm	24 volts
Over voltage alarm	29 volts
Extra low voltage	21 volts

Remote Radiator

Thermo switch (for low speed fan start) 93°C

ROGHAN RD REFUSE TIP GAS ENGINE CHECK LIST/LOG

P. TRANTER 29-6-92

DATE:.....				
SEQEB HOURS RUN				
ALTERNATOR HOURS RUN				
ALT. THERMOCOUPLE TEMP C				
ENGINE FUEL PRESSURE KPA				
ENGINE REG.FUEL PRESS INS WG				
COOLING WATER TEMP. C				
LUBE OIL TEMP C				
LUBE OIL PRESS KPA				
OILCOOLER OUTLET WATER TEMP C				
ENGINE TACHOMETER RPM				
ENGINE EXHAUST TEMP CYL 1 C				
ENGINE EXHAUST TEMP CYL 2 C				
ENGINE EXHAUST TEMP CYL 3 C				
ENGINE EXHAUST TEMP CYL 4 C				
ENGINE EXHAUST TEMP CYL 5 C				
ENGINE EXHAUST TEMP CYL 6 C				
CYCLIC BATTERY VOLTS				
BATTERY CURRENT AMPS				
SLOW FLOW OIL MAKE UP METER L				
SEPERATER WATER LEVEL %				
MAKE UP OIL LEVEL %				
RADIATOR MAKE UP WATER LEVEL L				
RADIATOR WORKING LEVEL %				
TOTAL SITE CURRENT AMPS				
CHECK LIST				
FORCED AIR FAN				
OIL LEAKS				
UNUSUAL ENGINE NOISES				
UNUSUAL ALTERNATOR NOISES				
UNUSUAL RADIATOR FAN NOISES				
SHUT DOWN/ ALTERNATOR HEATER				
SHUT DOWN/ LUBE OIL HEATER				
COMMENT:.....				
SIGNED.....				

BRISBANE CITY COUNCIL

MEMORANDUM

To	Ref. No.
From	Date
Subject	

Waukesha Engines

AETCO 02-6844666

Maurice Duffield

alternator

KATO Reliance

A2 3008 0000

50KW 62.5KVA

900 44-13

Gear Teeth = 190 on Ring gear

1000 RPM

12 Pole alternator

Governor is EG3P

Woodward Hydraulic/electric

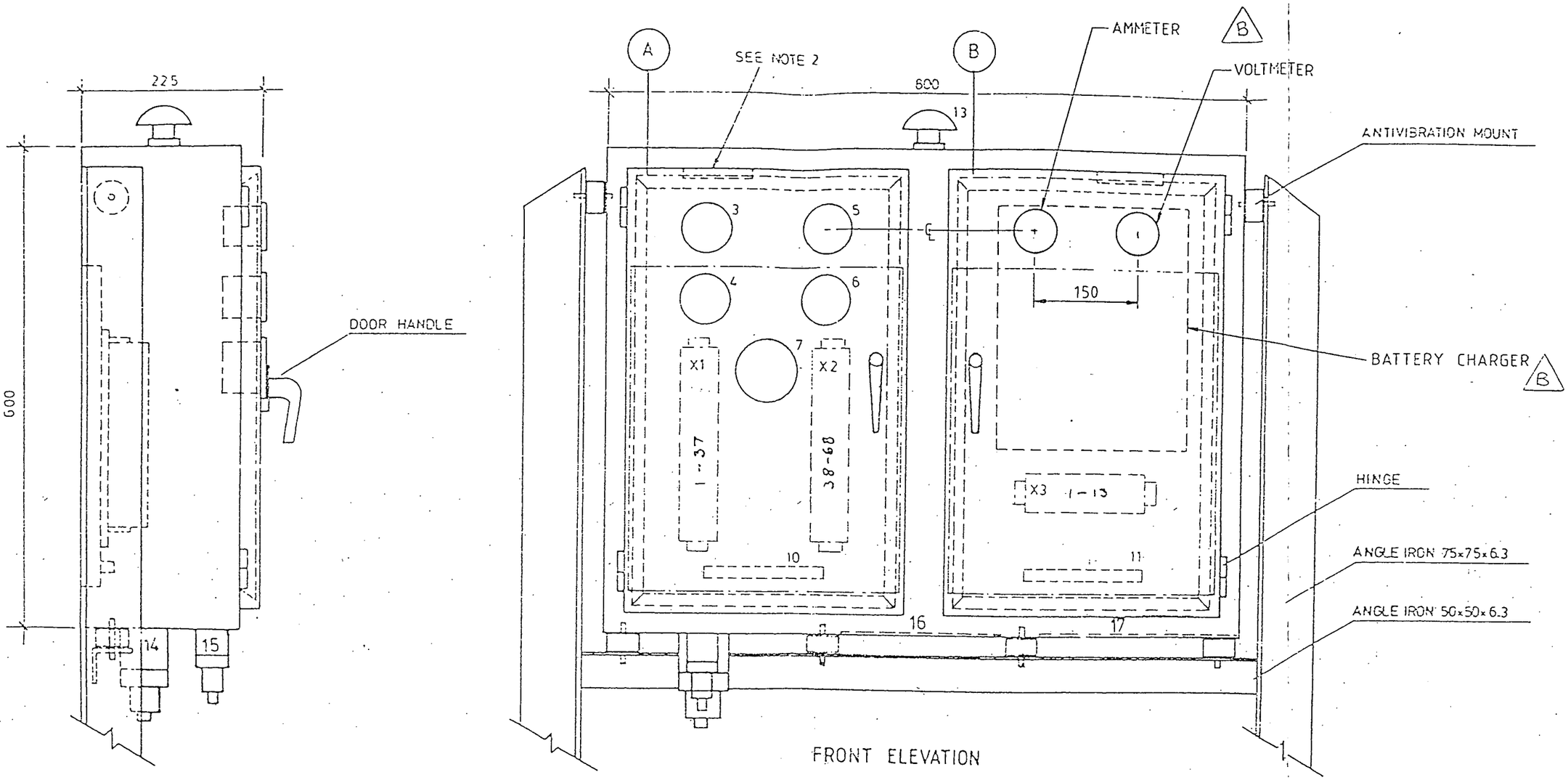
200 mA = full throttle

BOSCH Magnetic Pick ups

CC132S (m) (J1 4/86)

Service Co. Gas Drive Systems. (02) 748 7100 (Sydney)

Albert Stevens.



FRONT ELEVATION

REV.	DESCRIPTION	ORG.	DATE	ASSEMBLY GROUP REF DRG No.	SHEET	ITEM
B	45kW UPGRADE. & TITLE CHANGE	P.T.	06/88	45755-E2GA-041	1	A, B

WINSLADE & CO. PTY. LTD.

45755 - E2GA - 067

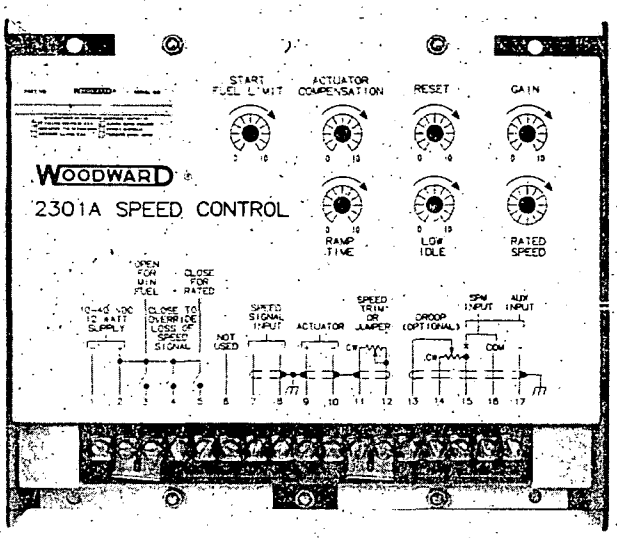
DRG. N°

TITLE

45kW GEA
ENGINE INSTRUMENT PANEL
GENERAL ARRANGEMENT

WOODWARD

2301A SPEED CONTROL



Installation, Operation, and Troubleshooting

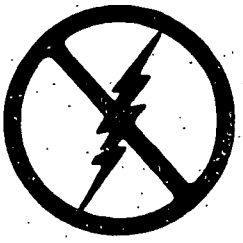
WOODWARD GOVERNOR COMPANY

MANUAL 82020A

WARNING

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s), that operates totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the controlled device(s) fail.



CAUTION

CONTENTS SUBJUCT TO DAMAGE BY
STATIC ELECTRICITY
DO NOT OPEN
EXCEPT AT APPROVED
STATIC-FREE WORK STATION

CAUTION

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- *Discharge body static before handling the control (contact a grounded surface and maintain contact while handling the control).*
- *Avoid all plastic, vinyl, and styrofoam (except antistatic plastics) around printed circuit boards (PCBs) or modules (modular PCBs).*
- *Do not touch a PCB with your hands or with conductive devices. Do not touch any part of a module except the faceplate handle.*

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Table of Contents

Illustrations

NOTES

Supply Voltage	Actuator Current	PART NUMBER	
		Forward	Reverse
88-131 ac or 90-150 dc	0-200 mA (tandem)		9905-138
10 to 40 dc	0-200 mA (tandem)		9905-137
88-132 ac or 90-150 dc	0-200 mA (tandem)	9905-136	
10 to 40 dc	0-200 mA (tandem)	9905-135	
88-132 ac or 90 to 150 dc	0-200 mA		9905-134
10 to 40 dc	0-200 mA		9905-133
88-132 ac or 90 to 150 dc	0-200 mA		9905-132
10 to 40 dc	0-200 mA	9905-131	

Chapter 1
General Information

INTRODUCTION

The manual has seven chapters: General Information, Static Discharge Awareness, Installation, Operation and Adjustment, Description of Operation, Troubleshooting, and Repair and Replacement Procedures.

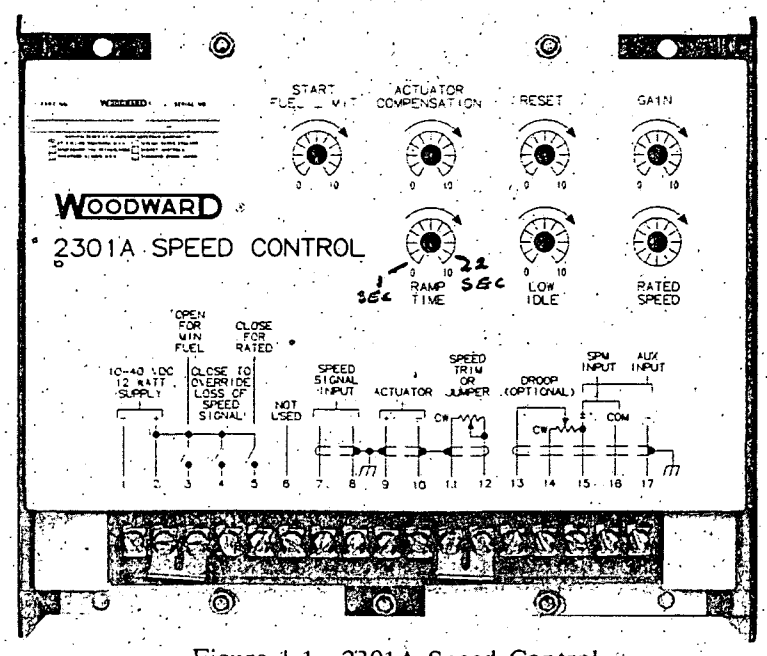
DESCRIPTION

The 2301A Speed Control controls the speed or load of diesel or gas engines, or steam or gas turbines. These power sources are referred to as "prime movers" throughout this manual.

The control is housed in a sheet-metal chassis and consists of a single printed circuit board. All potentiometers are accessible from the front of the chassis.

The 2301A Speed Control provides control in the isochronous mode with droop available through an externally wired potentiometer.

The isochronous mode is used for constant speed of the controlled prime mover as long as it is able to provide the load. Isochronous is also used when load sharing with a Woodward load sensor.



82000-A-24

Figure 1-1. 2301A Speed Control

External droop is used for speed control as a function of load when a prime mover is operating on an infinite bus or when two or more prime movers are in parallel operation.

The 2301A system for a prime-mover includes:

- A 2301A electronic speed control,
- An external power source,
- A speed-sensing device (MPU), and
- A proportional actuator to position the fuel- or steam-metering device.

APPLICATIONS

2301A Speed Controls are available for forward- or reverse-acting applications for use with single or tandem actuators. High voltage models accept 88 to 132 Vac or 90 to 150 Vdc. Low voltage models accept 10 to 40 Vdc supply.

A listing of 2301A Speed Controls and applications is provided on page iv of this manual.

Speed range is set on an internal dip switch, available inside the steel cover of the control. Speeds are set according to the sensor output frequency. The relationship between prime-mover speed and sensor-output frequency is expressed in the formula: Sensor Frequency in Hz equals the number of teeth on the speed-sensing gear times the revolutions per minute of the sensing gear, times the ratio of the engine speed to the sensing gear speed, divided by 60.

192
x 1000 x 1
÷ 60
= 3200 Hz

Reverse Acting

Most reverse acting 2301A Speed Controls will operate Woodward EGB governor/actuators. In reverse-acting systems, the actuator calls for more fuel when the actuator current decreases. Complete loss of signal to the actuator will drive the actuator to full fuel. This allows a backup mechanical ballhead governor to take control rather than shut down the prime mover as would a direct-acting system.

External wiring connections for reverse-acting controls are identical to those for direct-acting controls. However, changes must be made to the printed circuit board should a control need to operate the opposite type of actuator. Contact Woodward should it be necessary to change the type of 2301A Speed Control. Changing the supply voltage rating requires exchanging the unit for the properly rated control.

REFERENCES

The following Woodward publications contain additional product or installation information on speed controls and related components. Publication ordering information is provided on the back cover of this manual.

Manual Title	Product Specification
25070 Electric Governor Installation	82516 EG-3P Actuators
82510 Magnetic Pickups Governors	82575 EGB-2P Governor/Actuator
82514 Speed Setting Potentiometers	
82343 Digital Reference Unit	

Woodward Governor Company Application Engineers will assist you in the selection of the correct control and answer questions.

Chapter 2
Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

1. Before performing maintenance on the electronic control, discharge the static electricity on your body to ground.

   - Discharge body static by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

   - Avoid the built-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these fabrics resist static electric charges more than synthetics.

2. Do not remove the cover from the printed circuit board except as absolutely necessary. If it is necessary to handle the printed circuit board follow these instructions:

   - Touch only the edges of the board.

   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.

   - When replacing a board keep the new board in the antistatic protective plastic bag it comes in until you are ready to install it. After installing the new board, place the old board in the antistatic protective bag for storage or for return to Woodward Governor Co.

3. Keep all plastic, vinyl, and styrofoam away from the control, the board, and the work area. These materials tend to generate and store static electric charges.

   - These materials include plastic or styrofoam cups, cellophane packaging material, vinyl books or folders, and plastic ash trays, tape dispensers, or calendar holders.

Chapter 3
Installation

INTRODUCTION

This section contains general installation instructions for the 2301A Speed Control. Power requirements, environmental precautions, and location considerations are included to determine the best location for the control. Additional information includes unpacking instructions, electrical connections, and an installation check-out procedure.

UNPACKING

Before handling the control, read Chapter 2, "Electrostatic Discharge Awareness". Be careful when unpacking the electronic control. Check the control for signs of damage such as bent or dented panels, scratches, and loose or broken parts. Notify the shipper of any damage.

SELECTION OF SPEED RANGE

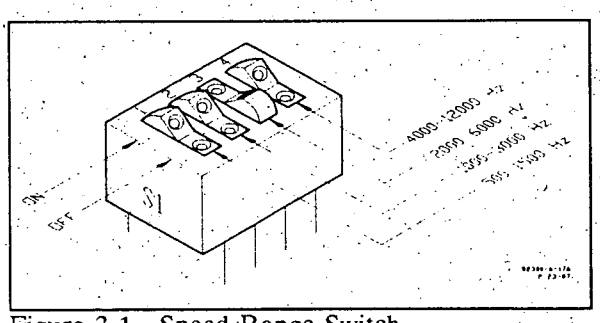


Figure 3-1. Speed Range Switch

A 4-pole mini-switch is located on the lower left-hand quarter of the printed circuit board. This switch sets the controlling speed range as sensed by the MPU. The speeds are related to the MPU frequency, which is proportional to engine RPM. The control is shipped with Switch 3 on for 2000 to 6000 Hz. Switch 1 provides 500 to 1500 Hz, Switch 2 provides 1000 to 3000 Hz, and Switch 4 provides 4000 to 12000 Hz. Select only one switch on to match the control to the MPU frequency.

POWER REQUIREMENTS

High and low voltage models of 2301A Speed Controls are available.

Low voltage models require a supply of 10 to 40 Vdc, 12 watts.

High Voltage models require a supply of 88 to 120 Vac or 90 to 150 Vdc., 12 watts. AC supply may be 50 to 400 hz.

If a battery is used for operating power, an alternator or other battery charging device is necessary to maintain a stable supply voltage.

CAUTION

To prevent damage to the control, make sure that the alternator or other battery-charging device is not connected to the control when the battery is disconnected from the control.

LOCATION CONSIDERATIONS

Consider these requirements when selecting the mounting location:

- Adequate ventilation for cooling
- Space for servicing and repair
- Protection from direct exposure to water or to a condensation-prone environment.
- Protection from high-voltage or high-current devices, or devices which produce electromagnetic interference.
- Protection from excessive vibration.
- An ambient operating temperature range of -40 degrees C (-40 degrees F) to +85 degrees C (+185 degrees F).

Do not mount the control on the engine.

ELECTRICAL CONNECTIONS

External wiring connections and shielding requirements for a typical control installation are shown in the Plant Wiring Diagram, Figure 3-2. These wiring connections and shielding requirements are explained in the balance of this section.

SHIELDED WIRING

All shielded cable must be twisted conductor pairs. Do not attempt to tin the braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields to the grounding lug on the chassis plate below Terminal 9. Keep grounding connections under 6 inches

(15 centimeters) length. A solid ground connection must be made from "earth" or ground to the grounding lug to provide proper chassis grounding. Refer to local wiring codes for proper grounding methods.

Wire exposed beyond the shield should be as short as possible, not exceeding 6 inches. The other end of the shields must be left open and insulated from any other conductor. Do not run shielded signal wires with other wires carrying large currents. See Application Note 50532 "EMI Control for Electronic Governing Systems" for more information.

Where shielded cable is required, cut the cable to the desired length and prepare the cable as instructed below and shown in Figure 3-1.

1. Strip outer insulation from both ends, exposing the braided or spiral wrapped shield. Do not cut the shield on the control end. Cut off the shield on the end away from the 2301A control.

2. Use a sharp, pointed tool to carefully spread the strands of the shield.

3. Pull the inner conductors out of the shield. Twist braided shields to prevent fraying.

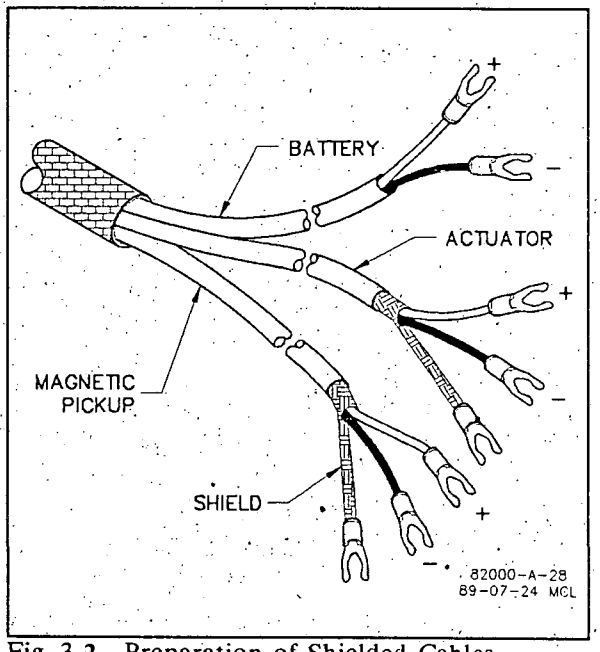


Fig. 3-2. Preparation of Shielded Cables

4. Connect lugs to the shield and to the control wires. Number 6 slotted or round crimp-on terminals are used for most installations. Connect the wires to the appropriate terminals on the control and the shield to the grounding lug below terminal 9.

Installations with severe electromagnetic interference (EMI) may require shielded wire run in conduit, double shielded wire, or other precautions. Contact Woodward Governor Company for additional information.

EXTERNAL ADJUSTMENTS

SPEED TRIM

A speed trim potentiometer or digital reference unit is connected to terminals 11 and 12. Use a high quality 100 ohm, 10-turn potentiometer (Woodward part 1657-537 or equivalent) to provide about +/- 5 percent speed adjustment. Terminals 11 and 12 must be jumpered if the speed trim potentiometer or digital reference unit is not used. The 2301A Speed Control will have a jumper installed in the factory and this must be removed if a speed-trim device is used.

DROOP POTENTIOMETER

A 2K potentiometer may be connected to provide a maximum of about 8 percent droop. Connect the potentiometer (ccw) to terminal 15, (cw) to terminal 14, and wiper to terminal 13. If droop is not desired make no connections to terminals 13 and 14.

SWITCH OPTIONS

MINIMUM FUEL CONTACT

The minimum-fuel contact between terminals 2 and 3 on the low-power models and 3 and 6 on the high-power models is intended as an optional means for a normal shutdown of the prime mover. The contact is connected as shown on the plant wiring diagram for the particular control. If a minimum fuel contact is not used, the terminals must be permanently jumpered.

WARNING

Do NOT use the minimum-fuel contact as a part of any emergency stop sequence. The emergency may be caused by a governor malfunction which would also cause a malfunction of the minimum-fuel feature. Use of the minimum-fuel contact for an emergency stop sequence could cause overspeed of the prime mover and mechanical damage and personal injury, including death.

FAILED SPEED SIGNAL OVERRIDE

Circuits in the 2301A Speed Control constantly monitor the signal from the MPU. Should this signal be below a minimum threshold the control sends a minimum fuel signal to the actuator (maximum fuel signal on a reverse acting control).

Before start-up of the prime mover, the speed signal is nonexistent, activating the failed speed signal' circuit. On units with cranking motors, the cranking speed is usually sufficient to provide a speed signal, so an override contact is not needed for starting. On some steam turbine systems, the Close for Override of Failed Speed Signal contact must be closed to allow the actuator to open and provide steam for starting.

The failed speed-signal override switch should be a momentary switch so the failed-speed-sensor circuit will be enabled after start up.

IDLE/RATED RAMP CONTACT

Close for rated OPEN for IDLE

Connect a single-pole, single throw switch to terminal 5 as shown on the appropriate plant-wiring diagram. Close the contact for rated, open for idle. Oil pressure is often used to close this contact. When closed, 10 to 40 Vdc is applied to terminal 5, and the prime mover can be operated at a speed higher than idle. When the contact is open, the voltage is removed from terminal 5, and the prime mover's speed decelerates to idle. The ramp rate applies only to the acceleration mode. When the ramp time potentiometer is full CW the ramp time from idle to rated is 22 +/-4 seconds. When the ramp time potentiometer is fully CCW the ramp rate is less than 1 second from idle to rated.

The ramp time from rated to idle is always less than 1 second, regardless of the setting of the ramp-time potentiometer.

ACTUATOR OUTPUT

The actuator wires connect to terminals 9 (+) and 10 (-). Use shielded wires with the shield connected to the grounded post on the panel. Do not connect the shield to the actuator or to any other point. The shield must have continuity the entire distance to the actuator and must be insulated from all other conductors.

Some 2301As may be used to operate prime movers in tandem by wiring the two actuators in series as shown in detail A of the wiring diagram. Tandem operation with a single 2301A control requires that the two engines provide identical power response to identical current signals to each of the actuators.

NOTE

Electro-Magnetic Interference (EMI) can be an intermittent condition. Improperly shielded installations can provide good control for a while and then cause problems. For this reason it is important to be sure all shields are properly installed.

EXTERNAL SPEED TRIM

A jumper must be connected between terminals 11 and 12 unless an optional remote Speed Trim potentiometer is used. If a Speed Trim potentiometer is used, connect it as shown in the Plant Wiring Diagram, using shielded wire. A 100 ohm multiturn potentiometer will provide +/-5 percent speed adjustment. Potentiometers of smaller values may be used if less adjustment is desired.

SPEED AND PHASE MATCHING WITH AN SPM-A SYNCHRONIZER

Connect the SPM-A (optional equipment) wires to terminals 15 (+/-) and 16 (com). Use shielded wire and connect the shield to the ground.

AUXILIARY INPUT

Terminals 17 (-) and 15 (+) are used for auxiliary input from a load sensor. Use of the load sensor and parallel lines allow the 2301A Speed Control to be used in isochronous load-sharing circuits. If the load sensor is not used, droop must be used to share load. (An exception is a multiple engine installation in which one engine is operated isochronously and all other engines are operated in droop.)

SPEED SENSOR

Connect a speed-sensing device (a magnetic pickup (MPU) is normally used) to terminals 8 and 7. No polarity is observed. Use shielded wire and connect the shield only at the 2301A control. The shield must have continuity the entire distance to the MPU. The shield is to be insulated from all other conductors and from the MPU.

Installation Check-Out Procedure

When the installation is completed perform the following check-out procedure before beginning the start-up adjustments in Chapter 4.

1. Visual Inspection:

   a. Check the linkage between the actuator and the prime mover for looseness or binding. Refer to the appropriate actuator manual, and Manual 25070 "Electric Governor Installation Guide" for additional information on linkage.

WARNING

The actuator lever should be near, but not at, the minimum position when the fuel or steam rack is at the minimum position. This could avoid a dangerous condition caused by an engine which will not shut down.

   b. Check for correct wiring according the plant wiring diagram.

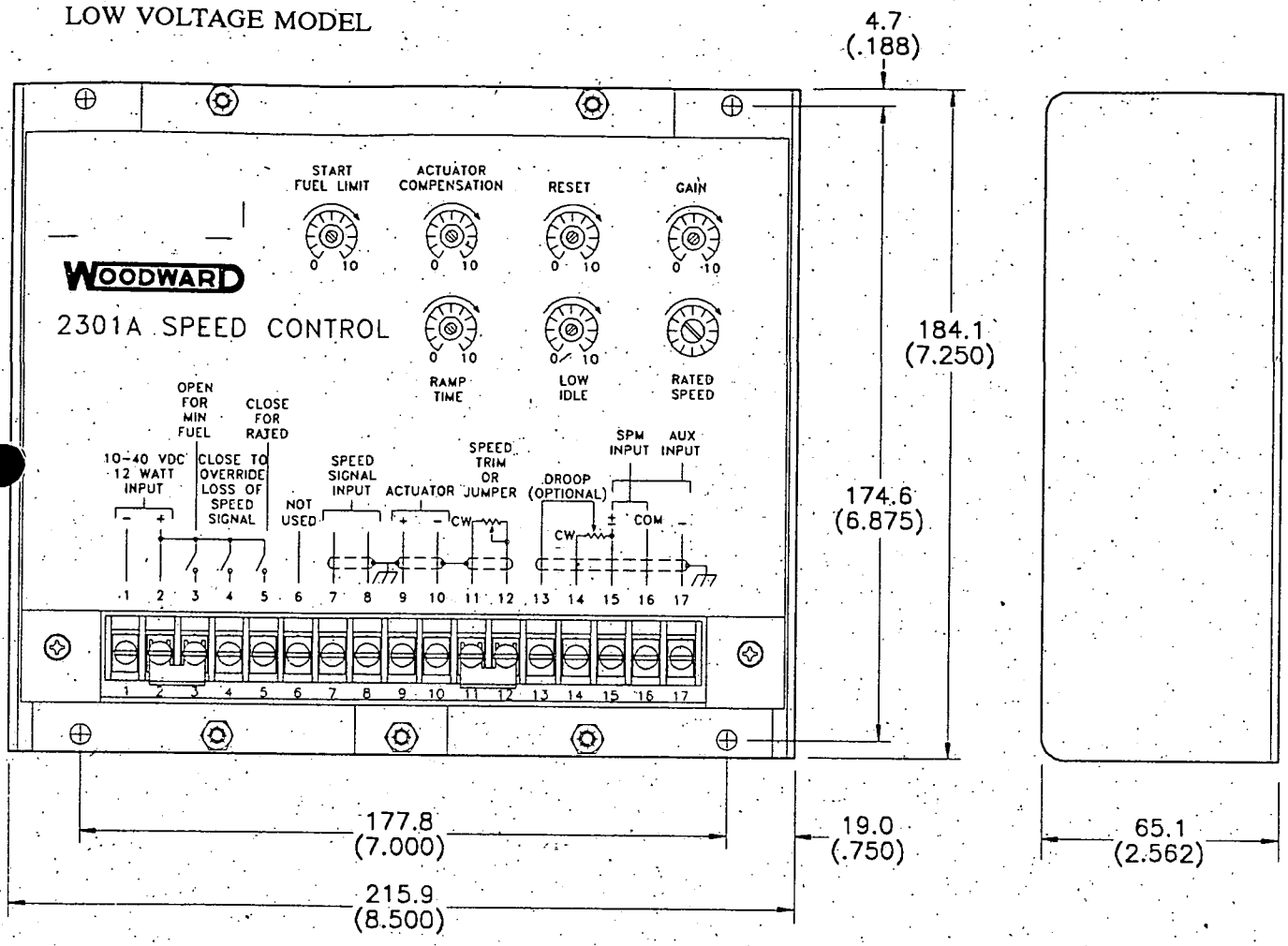
   c. Check for broken terminals and loose terminal screws. Make sure all terminal lugs are carefully and correctly installed. (Incorrectly installed crimp-on terminals can cause governor failure.)

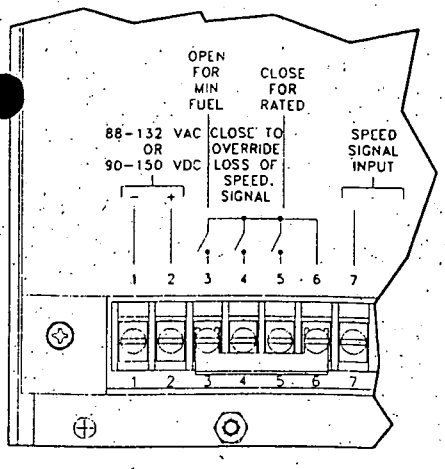
   d. Check the speed sensor (MPU) for visible damage. Check the clearance between the gear and the sensor, and adjust if necessary. See Manual 82510 "MPUs for Electric Governors."

2. Check for Grounds.

With the power off, check for grounds by measuring the resistance between each terminal and the grounding bolt located below terminal 9. Terminals 1 and 2 are power-input terminals. Either of these terminals may be grounded in accordance with local codes or through other equipment powered from the same supply. If either is grounded, a high resistance to ground will be evident at terminals 1 through 5 on low voltage models and terminals 1 through 4 on high voltage models. grounds present on these terminals will not normally affect operation, unless they interfere with the input power or switching logic. Grounds on terminals 7 through 17, detected by readings other than infinity, should be located and removed.

LOW VOLTAGE MODEL





NOTE: INCHES SHOWN IN PARENTHESES

82000-A-25
89-7-21 GA

HIGH VOLTAGE
MODLE

82000-A-26
89-7-21 GA

Figure 3-3. Outline Drawing of 2301A Speed Control

Heat in the circuit will open a circuit breaker in the 2301A. Circuit beaker will automatically reset after a cooldown.

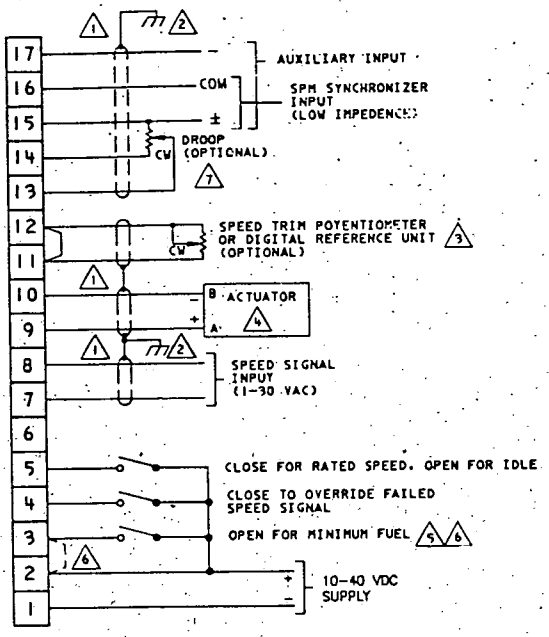
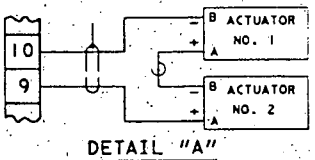


Figure 3-4. Low Voltage Plant Wiring Diagram

NOTES:

1. SHIELDED WIRES TO BE TWISTED PAIRS OR TRIPLETS WITH SHIELD GROUNDED AT CONTROL END ONLY.
2. GROUND SHIELDS AT GROUNDING LUG ON THE CHASSIS PLATE BELOW TERMINAL 9. KEEP GROUNDING CONNECTIONS UNDER 6 INCHES (15 CENTIMETERS) LENGTH.
3. REMOVE JUMPER BETWEEN TERMINALS 11 &12. IF SPEED TRIM POTENTIOMETER OR DIGITAL REFERENCE UNIT IS USED. IF SPEED TRIM POTENTIOMETER IS USED, A HIGH QUALITY 100 OHM, 10 TURN, POTENTIOMETER SIMILAR TO WOODWARD P/N 1657-537 IS RECOMMENDED. 100 OHMS WILL GIVE APPROXIMATELY ±5% SPEED ADJUSTMENT.
4. FOR SERIES OR TANDEM OPERATION, SEE DETAIL "A".



DETAIL "A"
CONNECTION FOR SERIES OR TANDEM OPERATION

5. WARNING: DO NOT USE FOR EMERGENCY SHUTDOWN. THE PRIME MOVER SHOULD BE EQUIPPED WITH A SEPARATE OVERSPEED, OVERTEMPERATURE OR OVERPRESSURE SHUT-DOWN DEVICE(S), TO PROTECT AGAINST RUNAWAY OR DAMAGE TO THE PRIME MOVER WITH POSSIBLE PERSONAL INJURY, OR LOSS OF LIFE.
6. REMOVE JUMPER IF MINIMUM FUEL SWITCH IS USED.
7. USE A 2K POTENTIOMETER FOR UP TO 7.5% DROOP WHEN USING 2/3 ACTUATOR TRAVEL FOR 0 TO 100% LOAD. MAKE NO CONNECTION TO TERMINALS 13 AND 14 IF DROOP IS NOT REQUIRED.
8. GROUND AS REQUIRED BY LOCAL WIRING CODE.
9. A SOLID GROUND CONNECTION MUST BE MADE FROM "EARTH" OR "GROUND" TO THE GROUNDING LUG ON THE CHASSIS PLATE BELOW TERMINAL 9 TO PROVIDE PROPER CHASSIS GROUNDING. REFER TO LOCAL WIRING CODES FOR PROPER GROUNDING METHODS.

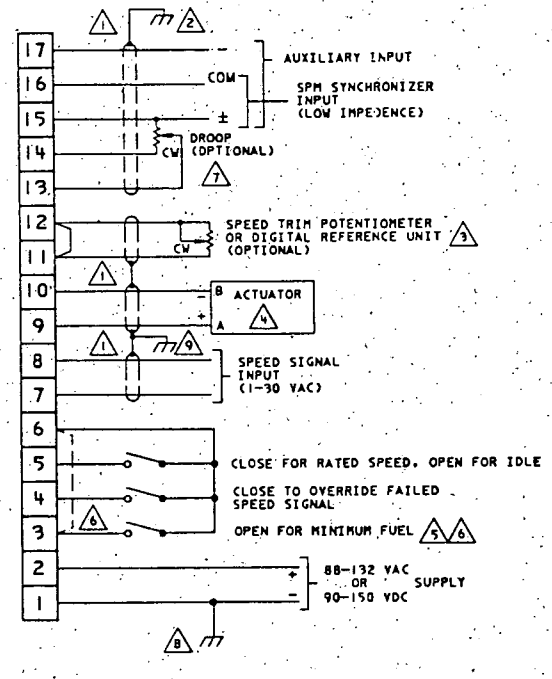


Figure 3-5. High Voltage Plant Wiring Diagram

Notes

Chapter 4
Operation and Adjustment

INTRODUCTION

This chapter contains information on control calibration. It includes initial prestart-up and start-up settings and adjustments.

WARNING

Overspeed with resultant equipment damage, personal injury, or death is possible when setting up a control system. Read this entire procedure before starting the prime mover for the first time.

INITIAL PRE-START SETTINGS

1. RATED SPEED

   a. Set the RATED SPEED potentiometer to minimum (fully counterclockwise).

   b. Set the external SPEED TRIM, if used, to mid-position.

2. RESET--Set at mid-position.

3. GAIN--Set at mid-position.

4. RAMP TIME--Set at minimum (fully counterclockwise).

5. LOW IDLE SPEED--Set at maximum (fully clockwise).

6. DROOP--Set optional external droop (if used) at minimum (fully counterclockwise).

7. ACTUATOR COMPENSATION

   a. DIESEL, GAS TURBINE, FUEL-INJECTED GASOLINE PRIME MOVERS: Set the ACTUATOR COMPENSATION potentiometer at 2 on the 0 to 10 scale.

b. CARBURETED GAS OR GASOLINE or STEAM TURBINE PRIME MOVERS: Set the ACTUATOR COMPENSATION potentiometer at 6 on the 0 to 10 scale.

9. START FUEL LIMIT--Set at maximum (fully clockwise).

10. Be sure the actuator is connected to terminals 9 (+) and 10 (-).

START-UP ADJUSTMENTS

1. Complete the installation checkout procedure in Section 3, and the initial prestart settings above.

2. Close the Close for Rated contact. If the external droop feature is being used it should already be set at isochronous, fully ccw.

NOTE

This is for initial prime mover start-up only. For normal start-up, the Close for Rated contact should be open if the prime mover is to start at idle.

3. Apply input power to the control.

4. Preset rated speed.

If a signal generator is not used, set the RATED SPEED potentiometer at minimum (fully counterclockwise).

If a signal generator is used set the signal for the frequency of the speed sensor at rated speed, and connect it to terminals 28 and 29. (The rated speed frequency in Hz equals the rated engine speed in RPM times the number of teeth on the speed sensing gear, times the ratio of engine speed to speed-sensing-gear speed, divided by 60.) Put the Close For Rated contact in rated (closed) position. Set the speed trim potentiometer (if used) to mid-position. Connect a dc analog voltmeter to terminals 9 (+) and 10 (-) to read actuator voltage.

If the actuator voltage is at minimum (about 0 volts) slowly turn the RATED SPEED potentiometer clockwise (counterclockwise for reverse acting controls) until the voltage just begins to move toward maximum.

If the actuator voltage is at maximum, slowly turn the RATED SPEED potentiometer counterclockwise (clockwise for reverse-acting controls) until the voltage just begins to move toward minimum.

Signal Generator only

Continue to very slowly adjust the RATED SPEED potentiometer in the appropriate direction, trying to stop the actuator voltage between the minimum and maximum voltages. Because it is not possible to stop the motion, cease adjusting when the voltage changes very slowly. The RATED SPEED potentiometer is now set very close to the desired speed. A slight adjustment when the engine is running will achieve the exact speed.

5. Check the speed sensor.

FOUND TO BE ~550 Hz ON CRANK

Minimum voltage required from the speed sensor to operate the electronic control is 1.0 volts RMS, measured at cranking speed or the lowest controlling speed. For this test, measure the voltage while cranking, with the speed sensor connected to the control. Before cranking, be sure to prevent the prime mover from starting. At 5 percent of the lower value of the control's speed range, the failed speed sensing circuit is cleared. For example 100 Hz is required on the 2000 to 6000 Hz speed range (2000 Hz x .05 = 100 Hz).

WARNING

TO PROTECT AGAINST POSSIBLE PERSONAL INJURY, LOSS OF LIFE, and/or PROPERTY DAMAGE WHEN STARTING the engine, turbine, or other type of prime mover, BE PREPARED TO MAKE AN EMERGENCY SHUTDOWN to protect against runaway or overspeed should the mechanical-hydraulic governor(s), or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the control devices fail.

START ENGINE

ADJUST FOR STABLE OPERATION

If prime-mover operation is stable, go to the "speed setting adjustment" procedure.

If the prime mover is hunting at a rapid rate, slowly decrease the gain (turn the potentiometer counterclockwise) until performance is stable. Adjusting the gain may cause a momentary speed change which can be minimized by turning the gain potentiometer slowly.

If the prime mover is hunting at a slow rate, increase the RESET setting (turn the potentiometer clockwise) until the prime mover stabilizes. If increasing the RESET potentiometer setting does not stabilize the prime mover, it also may be necessary to either:

- Slowly decrease the GAIN (turn the potentiometer counterclockwise) or
- Slowly decrease the GAIN and increase the ACTUATOR COMPENSATION.

SPEED SETTING ADJUSTMENT

With the prime mover operating stably, and the external speed trim potentiometer (if used) set at mid-position, adjust the RATED SPEED potentiometer to bring the prime mover to the desired operating speed. 1000 RPM

DYNAMIC ADJUSTMENT

The object of the GAIN AND RESET potentiometer adjustments is to obtain the optimum, or desired, stable prime-mover-speed response.

NOTE

Adjusting the GAIN may cause momentary changes in speed which can be minimized by turning the GAIN potentiometer slowly.

Increasing the setting of the GAIN potentiometer provides faster transient response (decreases the magnitude of the speed change from a sudden change in load). To achieve optimum response, slowly increase the GAIN (turn the potentiometer clockwise) until the actuator becomes slightly unstable, then slowly turn the GAIN back counterclockwise as necessary to stabilize the actuator. Step load the generator, or bump the actuator terminal shaft, to make sure that the prime mover returns to the proper speed with little overshoot or undershoot of the speed setting. To reduce overshoot, increase the RESET setting (turn the potentiometer clockwise).

When the RESET potentiometer is in the lower part of its adjustment (0 to 3 on the scale), increasing the RESET clockwise may require decreasing the GAIN (turning the GAIN potentiometer counterclockwise) to maintain stable operation.

If the prime mover is slow in returning to the proper speed, decrease the RESET by turning the potentiometer counterclockwise.

Figure 4-1 illustrates prime mover starts with the RAMP TIME potentiometer fully counterclockwise (no ramp), step loadings at four different RESET potentiometer settings, and stable, steady-state running conditions. These are typical performance curves on a naturally aspirated (nonturbocharged) diesel engine.

NOTE

Optimum performance is not necessarily obtained with the GAIN potentiometer at the maximum stable clockwise position. In some cases, the gain must be reduced slightly to ensure stability under widely varying conditions.

ACTUATOR COMPENSATION ADJUSTMENT

If the ACTUATOR COMPENSATION is set as described under INITIAL PRESTART SETTINGS, no further adjustment is normally required. If a slow, periodic instability remains, slightly increase the ACTUATOR COMPENSATION (turn the potentiometer clockwise) and repeat the GAIN and RESET adjustments. Continue to increase the ACTUATOR COMPENSATION and readjust the GAIN and RESET until stability is achieved.

If a fast instability or extremely active actuator is evident, slightly decrease the ACTUATOR COMPENSATION (turn the potentiometer counterclockwise). If necessary, the ACTUATOR COMPENSATION may be set fully counterclockwise. This may be required when engine torsionals cause excessive fuel-linkage movement.

LOW IDLE SPEED ADJUSTMENT

900 RPM = 45HZ

1. The prime mover should be at rated speed with the LOW IDLE SPEED potentiometer set at maximum (fully clockwise). Open the external CLOSE FOR RATED contact.

2. Decrease the LOW IDLE SPEED (turn the potentiometer counterclockwise) until the recommended idle speed is reached.

If the RATED SPEED setting is changed, LOW IDLE SPEED will also be changed and may require readjustment. Changing the LOW IDLE SPEED does not change the RATED SPEED setting.

NOTE

Make certain that the prime-mover speed is controlled by the LOW IDLE SPEED potentiometer in a range above the minimum-fuel position (mechanical stop) of the actuator or prime-mover fuel rack.

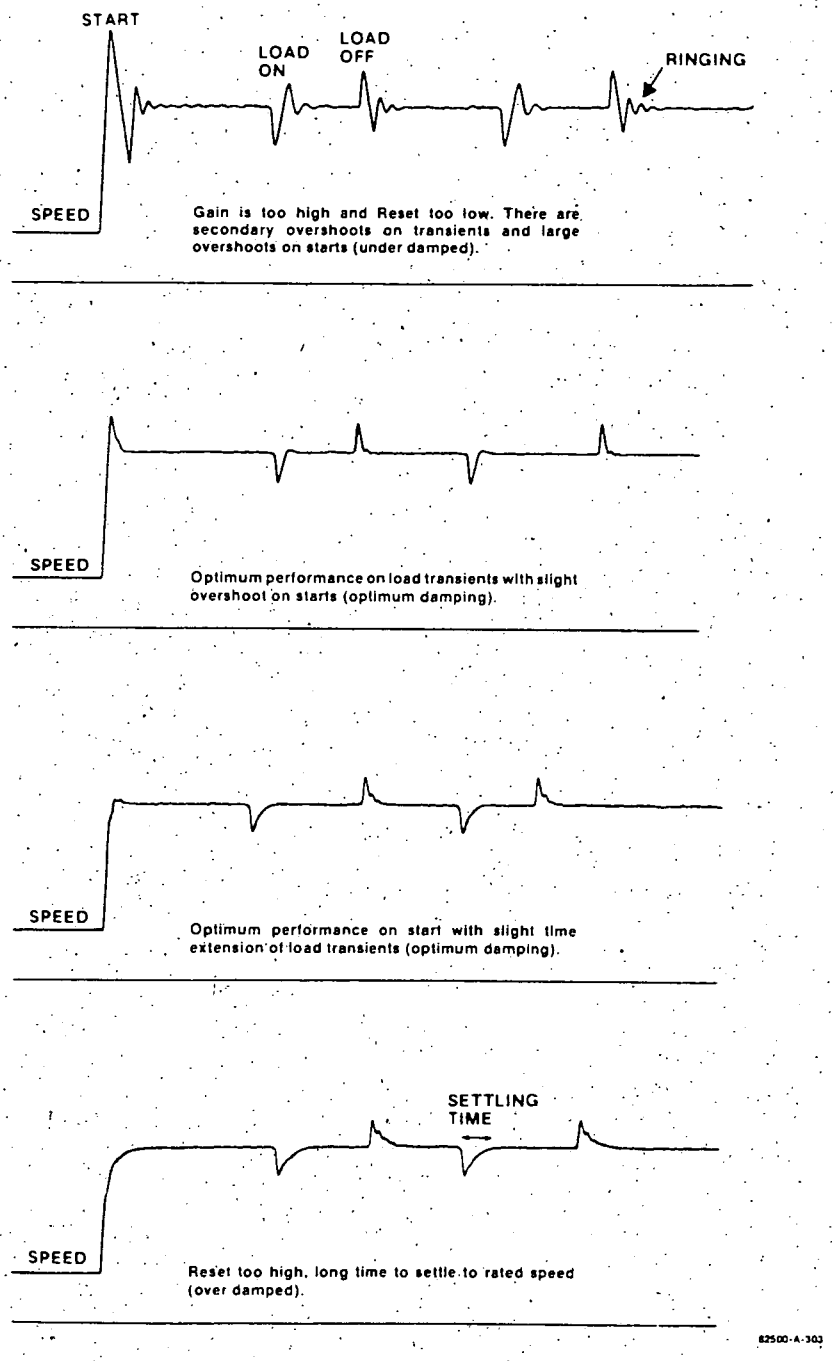


Figure 4-1. Diesel Engine Performance Curve

RAMP TIME ADJUSTMENT

Adjust the RAMP TIME potentiometer to achieve satisfactory prime mover acceleration to rated speed with minimum overshoot. First start at the fully clockwise (maximum ramp time) position and work back in the counterclockwise direction until the unit ramps as rapidly as desired. (Ramp time will be adjustable from 1 to 22 seconds from idle to rated.

START FUEL LIMIT ADJUSTMENT

NOTE

Start-fuel limit is not recommended for use with reverse-acting controls. With loss of speed signal, the reverse acting control will position the actuator at the start-fuel level if the failed-speed-signal override is activated. Reverse-acting systems normally require the control to demand full fuel on loss of speed signal to allow the mechanical backup governor to control the system. The Start Fuel Limit can be deactivated by turning the potentiometer fully clockwise.

N/A

With the prime mover operating at rated speed and no load, record the voltage across the actuator terminals 9 (+) and 10 (-). Shut down the prime mover and activate the Failed Speed Signal Override by closing the override contact. The voltage to the actuator should now be adjustable by the START FUEL LIMIT potentiometer. Set the actuator voltage about 30 percent higher than the voltage obtained at rated speed for forward-acting controls and 30 percent lower than rated speed voltage for reverse-acting controls. Remove the Failed Speed Signal Override contact if not required to start the prime mover.

V = 450 mV
@ [illegible] mA
30

Start calc = 1.50 + 30%
= [illegible] V
= 1.95 V
@ 43 mA

Start the prime mover and observe the start time, overshoot of speed setting, and exhaust smoke obtained. If the prime mover does not start, turn the START FUEL LIMIT potentiometer slightly clockwise until the prime mover starts. The START FUEL LIMIT may be adjusted as required to optimize the prime-mover starting characteristics. The fuel-limiting function is turned off automatically when the speed control takes over.

ie controller calls for less than start fuel value set.

NOTE

For prime movers not requiring start-fuel limiting, the START FUEL LIMIT function can be deactivated by turning the potentiometer fully clockwise.

Refer page 27

SPEED SENSOR CHECK

If the sensor is a magnetic pickup, measure the voltage across terminals 7 and 8 to be sure there is a minimum of 1.0 volts at cranking speed, and a maximum of 30 volts RMS at rated speed. If the voltage exceeds 30 volts, increase the gap of the speed sensor, and be sure that there is still a minimum of 1.0 volts at cranking speed.

N/A DROOP ADJUSTMENT

The amount of droop is not critical in many installations. If the engine needs to run in droop but the amount is not critical set the droop potentiometer in mid-position, then adjust load with the speed-setting potentiometer.

When paralleled with an infinite bus, the generator frequency cannot change, and unless a load- sensing module is being used, the control must be in droop to maintain stable operation. With the droop potentiometer at mid-position, parallel the generator, then increase the Rated Speed potentiometer until the desired amount of load on the engine is achieved.

N/A

Too much droop will cause the engine to overspeed should the load be suddenly lost. Excessive droop will also cause the engine to be sluggish in response to load changes.

Too little droop will cause instability, similar to that experienced with improperly adjusted GAIN and RESET.

Units running against an isolated bus often need droop set to a particular level, to prevent excessive off speed when load changes. Droop is usually expressed as a percentage and calculated by the following formula:

$$\% \text{ Droop} = \frac{\text{No Load Speed-Full Load Speed}}{\text{No Load Speed}} \times 100$$

To set a specified amount of droop using an isolated bus for the load:

1. Set the droop potentiometer to mid-position. (Use a 2K potentiometer, connected to terminal 14 (cw), 13 (wiper) and 15 (ccw).
2. Start the prime mover and adjust the RATED SPEED potentiometer for rated speed with no load.
3. Apply full load.*
4. Adjust the droop potentiometers to give desired speed.

5. Remove the load and repeat Steps 2 thorugh 4 until engine speed returns to 60 Hz when the load is removed.

Example: Operating at 60 hz, 57 hz at full load indicates 5 percent droop.

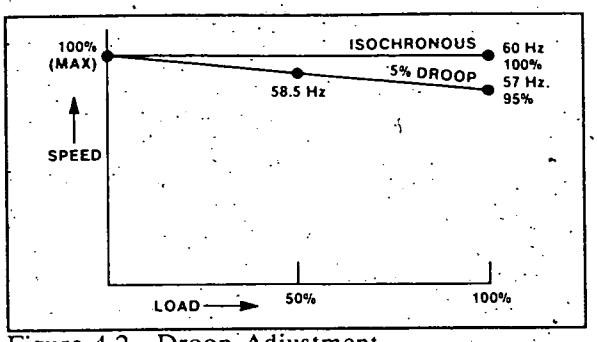


Figure 4-2. Droop Adjustment

* If only 50 percent loading is possible, 58.5 Hz would indicate 5 percent droop. See Figure 4-3.

To set a specified amount of droop on an infinite bus load:

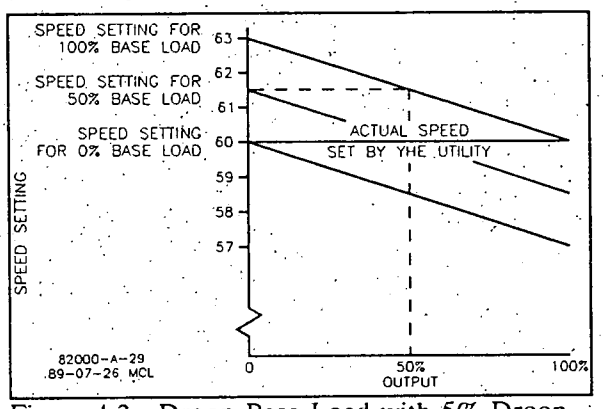


Figure 4-3. Droop Base Load with 5% Droop.

1. With the generator not paralleled, adjust the RATED SPEED (or speed trim) potentiometer to give a speed setting above 60 Hz by the percent of droop required.

   Example: Droop of 5 percent would require raising the speed to 63 Hz.

2. Mark the potentiometer position and re-adjust the RATED SPEED (or speed trim) potentiometer for 60 Hz.

3. Turn the external droop potentiometer full CW for maximum droop.

4. Synchronize the generator with the bus and close the tie-breaker.

5. Return the RATED SPEED potentiometer to the mark made in Step 2.

6. Load the generator by turning the droop potentiometer counterclockwise until full load is achieved..

7. Unload the generator by turning the RATED SPEED (or Speed Trim) potentiometer ccw until no load is achieved.

8. Open the tie-breaker and repeat steps 1 though 6 until no further adjustment of the external droop is required in Step 6.

NOTE

Droop is 10 percent per volt.
Auxiliary is 3 percent per volt.
Syncronizer Input is 0.667 of 1 percent per volt.
Speed Trim is 10 percent per volt.

Chapter 5
Description of Operation

The 2301A Speed Control monitors prime-mover speed and maintains it at the correct operating level. With the addition of a load sensor the system will share the load with other generators when two or more systems are running in parallel.

SPEED CONTROL

The system, as shown in Figure 5-1, consists of:

1. A magnetic pickup (MPU), to sense the speed of the prime mover.
2. A frequency to voltage converter, to convert MPU frequency to a voltage for use in the 2301A internal circuits.
3. A speed reference to which the prime mover speed is compared. (Idle and Rated speed references are provided by the 2301A Speed Control. The speed reference being used is selected by the operator with an external switch.)
4. A speed summer/amplifier with an output proportional to the amount of fuel or steam required to maintain the reference speed at any given load.
5. An actuator to position the fuel or steam mechanism (injector rack or steam valve) of the prime mover.

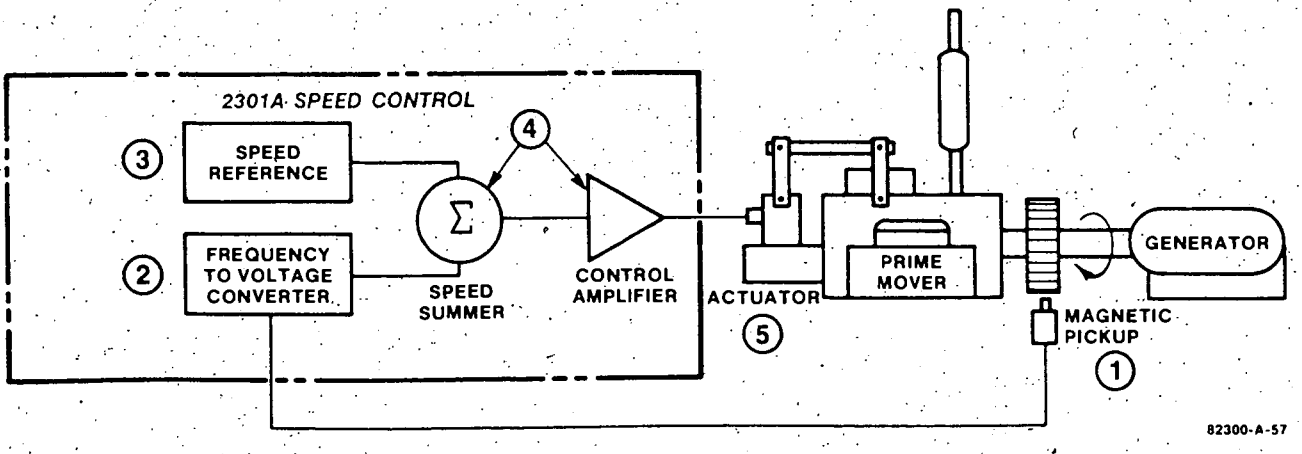


Figure 5-1. Speed Control System

The MPU generates an ac signal with a frequency proportional to prime-mover speed.

The frequency-to-voltage converter receives the MPU frequency signal and changes it to a proportional dc voltage.

The speed-reference circuit generates a dc reference voltage to which the speed signal voltage is compared.

The speed-signal voltage is compared to the reference voltage at the summing point. If the speed-signal voltage is lower or higher than the reference voltage, a signal is sent by the control amplifier calling for an increase or decrease in speed. The actuator is controlled by this signal, repositioning the fuel valve or rack until the speed-signal voltage and the reference voltage are equal.

AUXILIARY INPUTS

Terminals 11 through 17 are used for auxiliary inputs which change the reference voltage and thus the output of the speed control. These inputs include speed trim, droop, SPM synchronizer, and the auxiliary input, (usually from a load sensor and parallel lines).

Failed Speed Signal Circuit

A failed-speed-signal circuit monitors the speed-signal input. When no signal is detected, it calls for minimum fuel. The minimum-fuel signal is sufficient to cause the actuator to go to the minimum position. Incorrect linkage adjustments or other restrictions in the external system may prevent prime-mover shutdown.

For controls with actuator current of 20 to 160 mA, minimum fuel is defined as:

- Actuator current of less than 10 mA for forward-acting controls.
- Actuator current greater than 180 mA for reverse-acting controls.

For controls with actuator current of 40 to 320 mA, minimum fuel is defined as:

- Actuator current of less than 20 mA for forward acting controls.
- Actuator current of more than 360 mA for reverse-acting controls.

A contact to override the failed-speed-signal circuit can be connected in series with terminal 4 and low voltage dc power. (This power is available on terminal 2 for units supplied with 10 to 40 Vdc power and from terminal 6 on those units supplied with about 120 V ac or dc power.) Temporarily closing the contact overrides the failed-speed-signal circuit as required for start-up.

The control must be tuned to each system for optimum performance. The potentiometers for setting and adjusting these circuits are located in the upper right corner of the control as shown in Figure 5-2. They include:

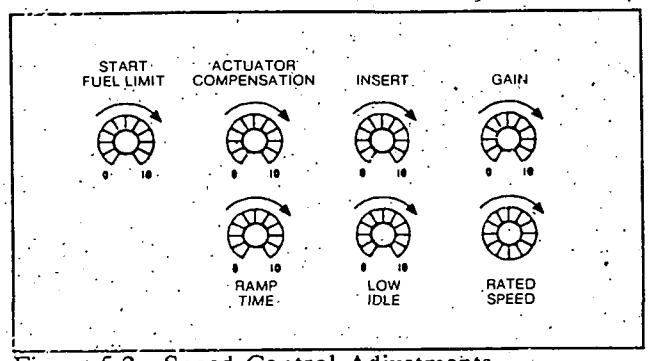


Figure 5-2. Speed Control Adjustments.

- The RATED SPEED potentiometer, adjusted so the converter-speed voltage and the reference-speed voltage are equal at the desired operating speed.
- The LOW IDLE potentiometer, adjusted so the reference voltage is correct for the desired idle speed.
- The START FUEL LIMIT potentiometer to provide a means of limiting the fuel-rack position when starting diesel engines. Adjustment of the potentiometer sets the maximum actuator position from no speed until the speed control calls for a fuel setting lower than the setting of the start-fuel limit. The limit is automatically placed in the circuit whenever the speed monitor input declines below the Failed Speed Signal level. Setting the Start Fuel Limit potentiometer full CW will raise the limit above the maximum fuel position, making the limit non-effective.
- RESET, GAIN, and ACTUATOR COMPENSATION potentiometers adjust the control amplifier to accommodate various types of prime-movers. Reset adjustment affects reaction time when recovering after a sudden load change. The magnitude of the speed change resulting from a sudden change in load is controlled by adjusting the Gain potentiometer. Actuator Compensation compensates for the time the actuator and prime-mover system take to react to signals from the control.
- The RAMP TIME potentiometer sets the time required for the prime mover to accelerate from idle to rated speed.

NOTE

Droop and Speed Trim settings change at 10 percent of the existing reference per volt. The Auxiliary input causes a 3 percent speed change per volt. The Synchronizer input causes a 0.666 percent change of reference speed per volt.

ACTUATOR CIRCUIT PROTECTION

The speed control is protected from shorts or overloads in the actuator circuit at terminals 9 and 10 by an automatic circuit breaker. The circuit breaker will reset automatically after the short or overload is corrected and the control has a few minutes to cool down.

REVERSE ACTING CONTROLS

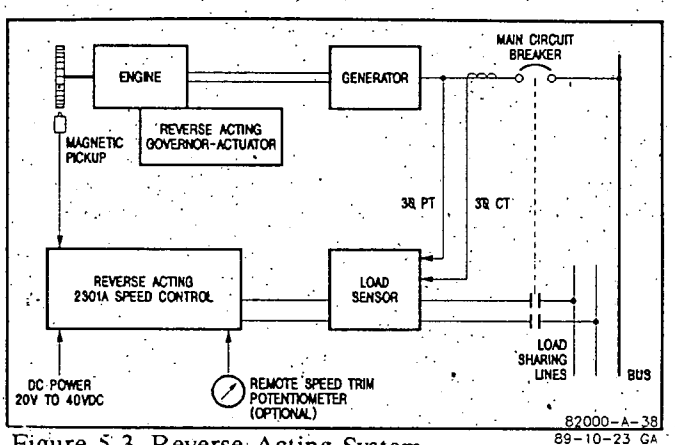


Figure 5-3. Reverse Acting System

The reverse-acting 2301A Speed Control and its actuator are designed so that zero voltage to the actuator corresponds to maximum fuel to the prime mover. The actuator usually used with a reverse-acting control has a mechanical governing mechanism included (see Figure 5-3). The speed setting of this mechanical governor is slightly higher than the speed setting of the 2301A. Should the electronics fail, the actuator will try to go to maximum fuel but will be stopped when it gets to the speed setting of the mechanical governor, providing continued operation of the prime mover, although at a speed which is slightly higher than the electronic control speed reference.

Chapter 6
Troubleshooting

The following trouble-shooting guide is an aid in isolating trouble to the control box, actuator, plant wiring, or elsewhere. The guide assumes that the system wiring, soldering connections, switch and relay contacts, and input and output connections are correct and in good working order. Make the checks in the order indicated.

NOTE

The wrong voltage can damage the control. When replacing a control, check the power supply, battery, etc., for the correct voltage as indicated on the name tag on the control. Both high-voltage and low-voltage models of 2301A speed controls are available. The low-voltage model will be damaged if connected to a high-voltage supply. The high-voltage model will not operate with a low-voltage supply.

SYMPTOM	CAUSE	REMEDY
Prime mover will not start. Actuator not moving to start-fuel position.	DC supply voltage polarity reversed, no supply voltage, or supply voltage is low.	Check for supply voltage within limits indicated on control name tag. Reverse leads if dc polarity is incorrect.
	Actuator not responding to input signal from control. NOTE: Hydraulic actuators must have oil pressure and either gear rotation or oil motor rotation to operate.	If there is a voltage output at terminals 9 and 10, but the actuator does not move, the wiring to the actuator should be checked for opens or shorts. With the EG3P actuator, remember that terminals C and D of the mating plug must be jumpered. Coil resistance in a Woodward actuator with terminals 9 and 10 disconnected, is about 35 ohms.

SYMPTOM	CAUSE	REMEDY
Prime mover will not start. Actuator not moving to start-fuel position.	Start fuel limit set too low.	Turn start fuel limit cw until prime mover starts.
		Check actuator and linkage for proper installation and operation. Problems may be oil supply, direction of rotation, insufficient drainage, linkage, worn actuator components, or improper adjustment.
	No actuator voltage at terminals 9 and 10 while cranking.	Stop cranking. Check for shorted or grounded actuator leads by removing wires to terminals 9 and 10. Close terminal 4, short terminal 11 to 12. Check for 18 to 22 volts at terminals 9 and 10 for forward acting controls and 0 to 1 volts for reverse acting controls. While cranking, check for at least 1 V RMS at terminals 7 and 8, and at least 30 to 80 Hz. If these readings are not available close terminal 4 to override failed-speed signal while cranking. MPU sensor spaced too far from gear. Make sure there are no metal chips on end of pickup. Check MPU wiring and shields.

SYMPTOM	CAUSE	REMEDY
Prime mover will not start. Actuator not moving to start-fuel position.		Speed setting too low on initial start. Control may be set for the wrong speed range. Check speed sensor frequency versus control part number. Speed setting may be lower than cranking speed. Control should be set for rated speed. Increase RATED SPEED setting clockwise (cw). **Be sure and return rated speed setting full ccw if adjusting cw does not produce the correct output.**
	LOW IDLE SPEED setting may be too low.	Adjust LOW IDLE SPEED potentiometer cw.
	Minimum Fuel contact open. See "MINIMUM FUEL CONTACT" in Chapter 3. If voltage exceeds 3 volts, the switch or wiring is faulty.	Check switch at terminal 3. Minimum-fuel contact must be closed for normal operation. Check for 0 to 3 Vdc from terminal 2 (+) to 3 (-) on low-voltage controls. (Between terminals 6 (+) and 3 (-) on high-voltrage controls.
	MPU not supplying signal to control.	Check MPU wiring for proper connection, check shields for proper installation. Magnetic pickup may be open-circuited or shorted. Check resistance with the leads disconnected from the control. Resistance should be about 100 to 300 ohms.

SYMPTOM	CAUSE	REMEDY
Prime mover will not start. Actuator not moving to start-fuel position.	Terminals 11 and 12 are open.	Verify that terminals 11 and 12 are jumpered if optional external speed trim is not used. Check the voltage from terminal 11 (+) to 12 (-). It should be less than 2 volts.
	Faulty speed trim potentiometer.	With power OFF, check speed-trim potentiometer with an ohmmeter.
	Faulty 2301A Speed Control.	Replace unit.
Prime mover overspeeds only on starts.	Ramp adjustment.	Increase RAMP TIME (cw). This decreases acceleration rate (from low idle to rated.)
	RATED SPEED setting too high.	Set RATED SPEED as described in Chapter 4.
	Amplifier adjustment.	2301A may be adjusted for sluggish operation, causing overspeed on start. Slowly adjust GAIN for fastest stable response. RESET may be adjusted too low. Increase RESET setting.

SYMPTOM	CAUSE	REMEDY
Prime mover overspeeds only on starts.	Engine is malfunctioning.	Verify that the fuel rack is not binding and the linkage is properly adjusted. Determine if the fuel rack is quickly following the actuator input voltage. Verify proper operation of overspeed protection devices to determine if a shutdown is occurring without an overspeed condition.
	2301A Speed Control.	If the control does not cut back the actuator voltage when the speed setting is completely ccw the 2301A control may be faulty, or may have the wrong speed range. If the voltage is cut back, (increased on reverse acting controls) look for a problem in the linkage or actuator.
Prime mover overspeeds after operating at rated speed for some time.	Prime mover.	Check for proper operation of prime-mover fuel system. If actuator moves toward minimum fuel during overspeed, problem is in fuel system.
	MPU and 2301A control.	Check MPU voltage at speeds above idle (at least 1.0 V rms). If MPU fails and the switch at terminal 4 is closed, the 2301A will call for maximum fuel.

SYMPTOM	CAUSE	REMEDY
Prime mover overspeeds after operating at rated speed for some time.	2301A dynamics adjustment.	Control the prime mover manually at rated speed and adjust the RATED SPEED setting fully ccw. If the output voltage is not zero, replace the control. (Voltage should be about 7 volts for 0-200 mA reverse acting controls or maximum current time actuator resistance for controls of other ratings.)
Prime mover has momentary speed change when adjusting GAIN.	GAIN adjustment made too quickly.	Make GAIN adjustment slowly. Momentary speed change when adjusting GAIN is normal.
Low speed is not regulated by LOW IDLE SPEED potentiometer.	NOTE *On carbureted prime movers, the mininum fuel stop rpm setting will vary with prime mover temperature. An improper cold setting may interfere with the Low Idle Speed Setting when the prime mover is hot.*	The Low Idle Speed setting may be below the min-fuel position of the actuator or prime-mover fuel stop. In this case, the output voltage to the actuator will be zero (maximum for reverse acting controls). The engine will be maintained at the min-fuel position by the actuator or the prime mover min-fuel stop. The conditions indicate that the min-fuel position should be decreased by linkage adjustment (diesel) or low-idle set screw (gas engine), or the LOW IDLE SPEED setting should be raised. If this does not correct the problem, the 2301A control may be faulty.

SYMPTOM	CAUSE	REMEDY
Low speed is not regulated by Low Idle Speed potentiometer.	LOW IDLE SPEED potentiometer.	If adjustment of the LOW IDLE SPEED potentiometer causes erratic behavior, replace the control.
Prime mover does not decelerate when Close for Rated contact is open.	Faulty Close for Rated contact or wiring.	The voltage from terminal 5 (-) to 2 (+) on low voltage controls or 5 (-) to 6 (+) on high voltage controls must be less than 2 volts. Replace the contact or wiring as necessary.
	LOW IDLE SPEED set fully cw.	Turn LOW IDLE SPEED setting ccw with terminal 5 open.
	2301A ramp circuitry. **CAUTION** **The speed-setting controls have sufficient range to override the ramp and bring the prime-mover speed up to rated while still in the low-idle mode (because of control or switching defect. A Close for Rated contact that is intermittent may cause the prime mover to overspeed if the RATED SPEED setting is adjusted for rated speed with terminal 5 open.**	A faulty Close for Rated contact may remain in the accelerate position with the contact open. If the Close for Rated contact is operative, loss of idle control may be due to a faulty circuit. In general, adjustment of LOW IDLE SPEED will vary the speed of the prime mover with the Close for Rated contact in the decelerate (open) position. Adjustment of LOW IDLE SPEED should not affect prime mover speed when the Close of Rated contact is closed.

SYMPTOM	CAUSE	REMEDY
Prime mover will not stabilize at rated no-load speed. The instability may occur at no load or it may vary with load. Control may be erratic.	2301A Speed Control.	Adjust GAIN, RESET, and ACTUATOR COMPENSATION as described in "Adjust for Stable Operation" and "Dynamic Adjustment" in Chapter 4.
	Speed setting controls.	If adjustment of external speed trim causes instability, check potentiometer with ohmmeter for erratic behavior. (Turn power off). Use nonlubricating electrical cleaner if necessary. If internal potentiometer is faulty, replace control.
	Improper linkage adjustment.	Make sure the actuator moves about 2/3 of its travel from no load to full load. Be sure linkage provides a proportional change in power for every change in actuator terminal-shaft position. Refer to the actuator manual for more detailed linkage instructions.
	Necessary wires not properly shielded.	Electrical noise, caused by wiring carrying an ac voltage or stray magnetic fields, can be picked up by improperly shielded wire. Noise will cause instability. See "Shielding" in the installation chapter.

SYMPTOM	CAUSE	REMEDY
Prime Mover will not stabilize.	Prime mover not receiving fuel as called for by the actuator.	Check actuator linkage to fuel-controlling mechanism for lost motion, binding, or excessive loading. Check for a steady fuel pressure of proper value.
	Prime mover not operating properly.	Prime mover may be causing speed variations. Control engine manually to determine if instability is in prime mover or governor/actuator control.
	Input voltage low.	Check voltage supply.
Prime mover unstable or will not accept full load.	EGB governor/actuator.	Verify that mechanical speed setting of EGB governor/actuator is above the set electronic speed reference at full load. Mechanical droop can cause speed setting of ballhead governor to be below electronic speed setting at full load.

Chapter 7
Repair and Replacement Procedures

INSTRUCTIONS FOR RETURNING EQUIPMENT FOR REPAIR

If any part of the electronic control is to be returned to Woodward Governor Company for repair, attach a tag to the part with the following information:

- Name and location where the control is installed.
- Complete Woodward Governor Company part number(s) and serial number(s).
- Description of the problem.
- Instructions describing the desired type of repair.

NOTE

Before handling any electronic component, read Manual 82715, "Guide for Handling and Protection of Electronic Controls."

Use the following materials when returning a complete control:

- Antistatic packing materials that will not damage the surface of the unit.
- At least four inches of tightly packed, industry-approved packing material.
- A packing carton with double walls.
- A strong tape around the outside of the carton for increased strength.

REPLACEMENT PARTS INFORMATION

When ordering replacement parts for electronic controls, include the following information:

- The part number (9905-XXX) from the enclosure nameplate.
- The unit serial number, which is also on the nameplate.

For more information on replacement parts, contact Woodward Governor Company, Engine and Turbine Controls Division, PO 39ox 1519, Fort Collins, Colorado 80522, USA. Telephone (303)-482-5811, or contact your nearest Woodward Governor Company service facility.

ORDERING MANUALS

TO ORDER MANUALS, WRITE TO:

Woodward Governor Company
Attention: Technical Services
P.O. Box 1519
Fort Collins
Colorado 80522-1519

PLEASE INCLUDE THE FOLLOWING INFORMATION:

- Your name
- The name and address of your company
  (write on letterhead or include business card if available)
- The address where you want the manuals sent (if different from above)
- The quantity wanted of each manual
- The manual number(s) of the manual(s) you are ordering
  — OR —
  The part number and serial number from the nameplate on your Woodward Equipment

THERE IS NO CHARGE FOR MANUALS ORDERED IN SMALL QUANTITIES.

WOODWARD GOVERNOR COMPANY

CORPORATE HEADQUARTERS • AIRCRAFT CONTROLS DIVISION • 5001 North Second St. • P.O. Box 7001 • Rockford IL 61125-7001, U.S.A
• **Phone:** (815) 877-7441 • **Telex:** 25-7410
ENGINE & TURBINE CONTROLS DIVISION • 1000 East Drake Rd. • P.O. Box 1519 • Fort Collins, CO 80522-1519, U.S.A.
• **Phone:** (303) 482-5811 • **Telex:** 4-5691
INTERNATIONAL OPERATIONS DIVISION • 1000 East Drake Rd. • P.O. Box 1519 • Fort Collins, CO 80522-1519, U.S.A.
• **Phone:** (303) 482-5811 • **Telex:** 4-5691

INTERNATIONAL DIVISIONS
Woodward Governor (U.K.) Ltd. • P.O. Box 15 • 664 Ajax Ave. • Slough, SL1 4DD, England • **Phone:** 44-753-26835 • **Telex:** 848181
Woodward Governor Nederland B.V. • P.O. Box 34, 2130 AA Hoofddorp • Hoofdweg 601, 2131 BA Hoofddorp, The Netherlands
• **Phone:** 31-2503-13241 • **Telex:** 74508
Woodward Governor (Japan) Ltd. • Tomisato P.O. Box 1 • Inba-gun, Chiba-ken, 286-02, Japan • **Phone:** 81-476-93-4661 • **Telex:** 3762-164
Woodward Governor Company • Kobe Service Station • 86-1, Edayoshi 4-chome • Nishi-ku, Kobe-shi • Hyogo-ken, 673, Japan
• **Phone:** 81-78-928-8321
Woodward Governor Company • P.O. Box 319 • Unit 1-1 Wirega Ave. • Kingsgrove, N.S.W. 2208, Australia
• **Phone:** 61-2-758-2322 • **Telex:** 24175
Woodward Governor Company (Reguladores) Ltda. • Caixa Postal 1785 • Rua Fernao Pompeo De Camargo, 1306 • 13100 Campinas, S.P., Brazil
• **Phone:** 55 (192) 31-4977 • **Telex:** 191844
HYDRAULIC TURBINE CONTROLS DIVISION • 2301 Country Club Drive • P.O. Box 287 • Stevens Point, WI 54481-0287, U.S.A.
• **Phone:** (715) 344-2350 • **Telex:** 671-4868

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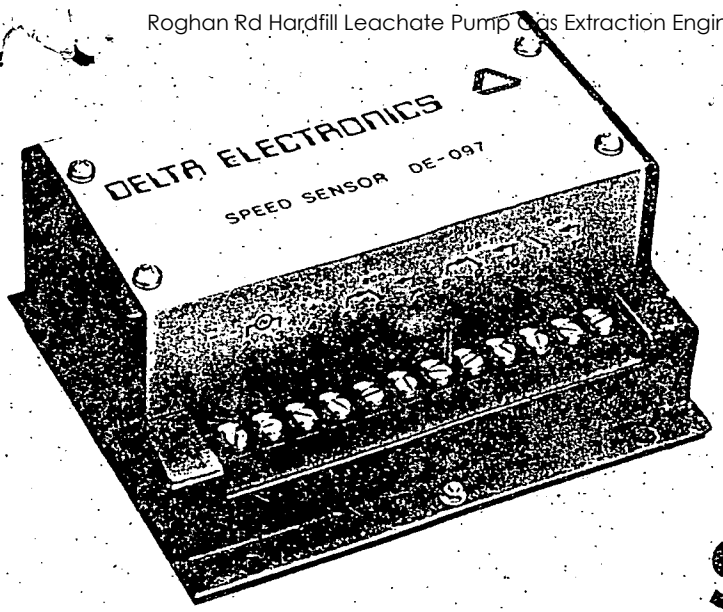


DE-097 SPEED SENSOR

INTRODUCTION

The Delta DE-097 Speed Sensor is a solid state speed detection module designed for use with constant speed diesel engines. In operation, three relays within the Sensor switch at factory preset speeds providing functions normally related to starter motor cut-out (SCO), engine underspeed (US), and engine overspeed (OS). Signal source for the Speed Sensor may be either an electromagnetic pickup on the engine flywheel ring gear, or the Delta DE-064 tacho generator.

SPECIFICATIONS

Operating Voltage:	12 to 24 volts D.C.
Supply Current:	175mA with all relays energised.
Starter Cut-out Setting:	Factory preset to 0-30% of nominal running speed. Typical setting 20%, i.e. 300 R.P.M. for a 1500 RPM system. Relay state is preset to be either:— (A) energised with engine stationary and power on, de-energised on rising speed, or— (B) de-energised at rest, operating at set-point.
Underspeed Setting:	70-100% of nominal running speed. Typical setting—90%
Overspeed Setting:	100-130% of nominal speed. Typical setting—110%. The overspeed relay may be either locking or non-locking.
Switch Repeatability:	± 2% of nominal speed.
Relay Contacts:	Single changeover for SCO and US. Single make contact for OS.
Contact Rating:	5 Amps resistive. Inductive loads must have diode suppression for good contact life. SCO relay should interrupt circuit to pilot solenoid only.
Operating Temperature:	0-70°C Ambient.
Finish:	Front panel—Anodized aluminium. Black legends. Case—Delta grey hammertone stove enamel.
Weight:	0.9kg
Dimensions:	152mm L x 125mm W x 65mm D
Insulation:	10 M above case.

OPERATION

Non-latched OS condition—
On rising speed the relays operate at their preset points. the SCO makes or breaks according to type; the US and OS relays make if speeds are attained. On falling speed the relays will return to their initial state

Latched OS condition—
Similar to above but if overspeed occurs all relays remain latched. Reset is achieved by removing the D.C. power supply.

ORDERING INFORMATION

Input from: a) Electromagnetic Pickup.
No. of teeth on ring gear:
b) Delta DE-064 Tacho-generator.

Nominal speed:	RPM
Starter cut-out:	RPM
SCO type A or B	
Underspeed Setting:	RPM
Overspeed Setting:	RPM
OS type Latching	or Non-Latching

NUMBER OF TEETH – 192
STARTER CUT OUT – 200
UNDER SPEED – 950
O/SPEED – 1100

Delta Electronics
Head office & plant:

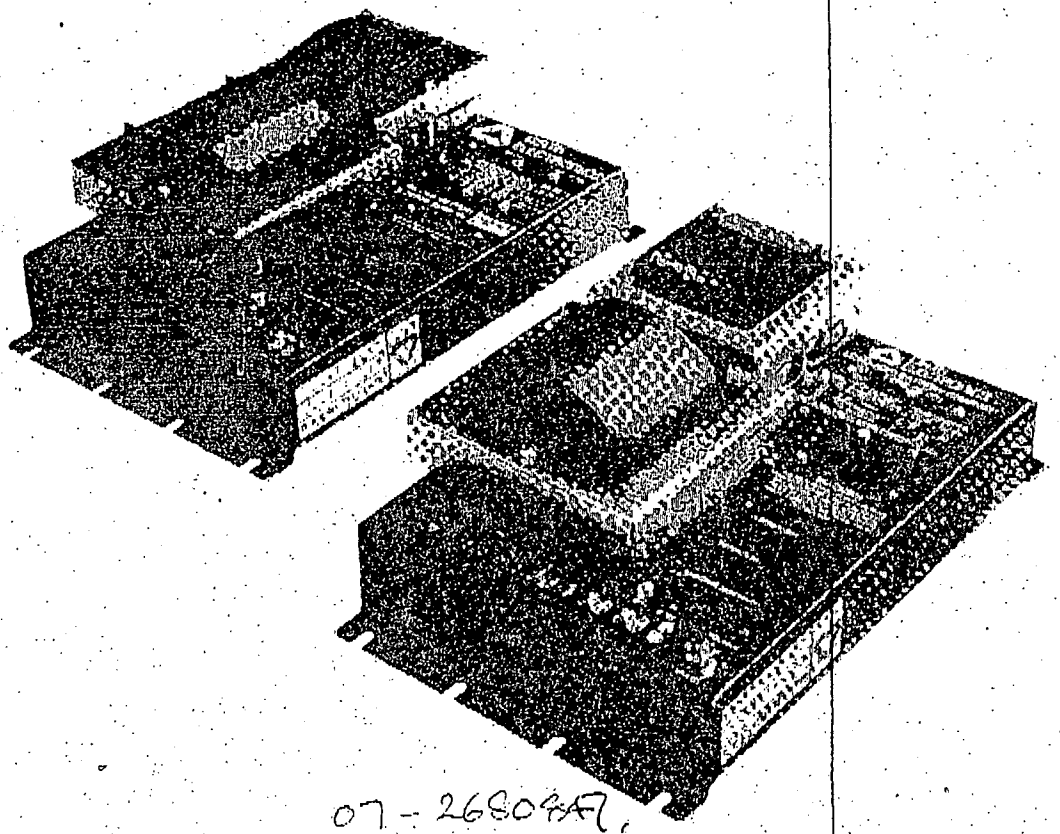
Corner Cavan & Grand Junction Roads
Gepps Cross
South Australia 5084
Telephone (08) 260 2522 Telex AA82427

DELTA ELECTRONICS

Automatic Battery Chargers

DE001
for Lead-acid batteries

DE009
for Nickel-cadmium batteries



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The DE001 and DE009 Automatic Static Battery Chargers are compact, robust units which, although similar in function and appearance, are intended for different applications. The DE001 provides charging characteristics to suit lead-acid accumulators while the DE009 provides the characteristics required by nickel-cadmium cells.

Both units provide similar controls and features, deliver 10 amps of current and incorporate generous protection features. They offer fully automatic operation; regulating their charging voltage and current to maintain battery capacity. They are identical in size and are intended for panel mounting inside electrical switchboard cubicles.

The DE001 and DE009 are designed and manufactured to withstand the rigours of heavy industrial use in harsh environments where less sturdy equipment may not provide the same long-term reliability. They feature heavy-duty construction, use conservatively rated components throughout and their printed circuit board assemblies are protected with a heavy conformal coating to offer lasting protection against the effects of vibration and extremes of temperature and humidity.

These many reasons make them an ideal choice in all industrial applications where the need for high operational reliability (at reasonable cost) is paramount: for power generation control supplies; for stand-by batteries supplying emergency lighting, fire, burglar alarm and communication systems; for emergency engine starting and many other simila applications.

The DE001 is normally supplied with a "Cyclic" charging characteristic which is particularly suitable for use with stand-by batteries in which sulphating may occur during long periods of inactivity. The output cycles on and off, supplying periodic bursts of current at the charger's full output capacity. The battery voltage thus cycles between upper and lower limits which may be independently adjusted. Models with conventional "Constant Potential" charging are also available.

The DE001 provides a "Boost" mode which allows charging to continue above the normal voltage setting. Occasional periods of Boost will ensure that the battery is always at full charge.

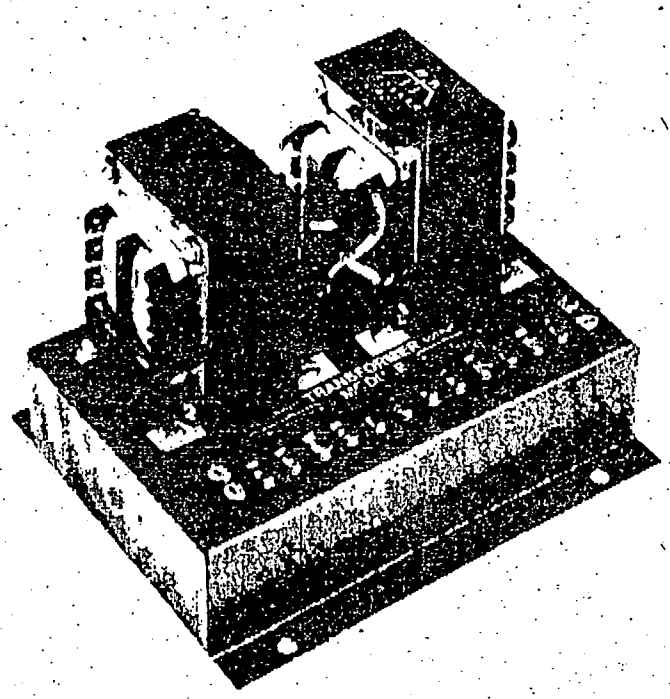
The DE001 also features a temperature compensation circuit which reduces its output voltage at high temperatures in order to match the temperature characteristic of lead-acid cells.

The DE009 uses a Constant Potential characteristic to provide the "Float" and "Boost" charging usually required by nickel-cadmium cells. Boost mode allows the voltage to be raised to an adjustable higher level.

DELTA ELECTRONICS

MANUFACTURERS AND SUPPLIERS OF ELECTRONIC CONTROL, MONITORING, ALARM AND PROTECTION EQUIPMENT.

30 amp versions of these units, the DE069 and DE071, are also available. Refer to Brochure No. DE000135



DE-010 TRANSFORMER MODULE

DESCRIPTION

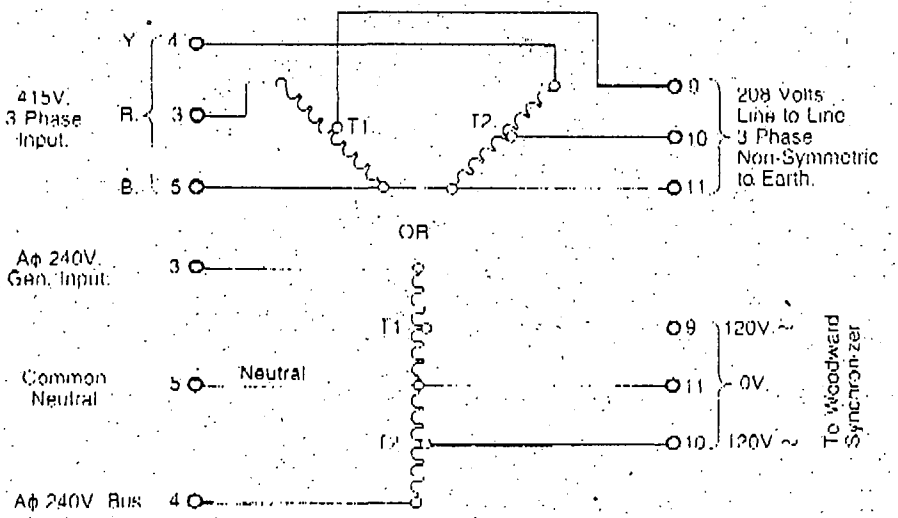
The DE010 Transformer Module is a voltage matching unit, containing two transformers, used for interfacing Australian Standard to American Standard Voltages. Suitable for 415 to 208 Volts, 3 phase conversion for inputs to Woodward and Barber Colman load sharers, also 240 to 120 volts conversion to match input to synchronisers.

SPECIFICATIONS

Peak voltage rating: 500 Volts A.C. 50/60Hz. Terminals 3 to 5.
Power: 30 Watts per transformer, maximum.
finish: Grey hammer tone stoved enamel.
Approx. Dimensions:

L	x	B	x	H
155mm (6")		128mm (5")		105mm 4⅛"

Weight: 5 lb./2.25 kg.
Ambient Operating Temperature Range: 0°C—70°C.



(Specifications subject to change without notice)

Delta Electronics
Head office & plant:

Corner Cavan & Grand Junction Roads,
Gepps Cross,
South Australia 5084.

DELTA ELECTRONICS

DE001/DE009 Automatic Battery Chargers

FEATURES

- 10 amps continuous charging current
- A Boost charging facility
- *Charger On* indicator output
- Available with 12 or 24 volt output
- Current smoothing choke helps extend battery plate life
- Generous overload protection — a current limiting circuit backed up by an internal fuse and the choke
- *Undervoltage Inhibit* circuit turns off charger if output is short circuited or when an engine's starter motor is operating
- Temperature compensated output voltage on the DE001
- DE001 models available with Cyclic or Constant Potential output
- Cyclic charging mode is ideal for stand-by applications
- Adjustable Boost voltage on the DE009 caters for the exacting requirements of nickel-cadmium cells
- Wide operating temperature range with no current derating
- Heavy-duty construction on sturdy steel chassis
- Conformal coating on control circuit enhances reliability in harsh environments
- Robust *Voltage Adjust* control with locking facility
- Remote voltage sensing facility on DE001 units
- Adjusted at the factory to suit common batteries
- Full 12-month warranty
- Designed, manufactured and supported in Australia

SPECIFICATIONS*

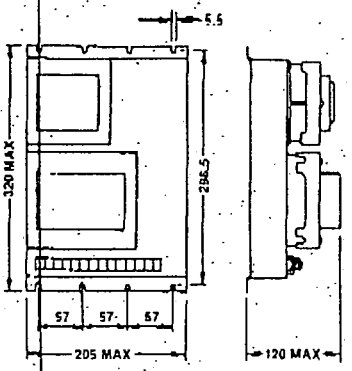
Supply voltages:	208, 240 or 254 VAC, ±10%; 48 to 62Hz.
Charging current:	Normally 9 A; 10 A maximum (adjustable).
DE001 output voltage: (Cyclic)	24 volt models — cut-in at 26 V, cut-out at 28.5 V. 12 volt models — cut-in at 13 V, cut-out at 14.3 V (both levels are adjustable).
DE001 output voltage: (Constant Potential)	Normally 27.6 V for 24 volt models, 13.8 V for 12 volt models (adjustable).
DE001 Boost level:	Approximately 30 V for 24 volt models, 15 V for 12 volt models.
DE009 output voltage:	9 cells — 13.05 V, 10 cells — 14.50 V, 18 cells — 26.10 V, 19 cells — 27.55 V, 20 cells — 29.00 V (adjustable).
DE009 Boost level:	Normally 0.1 V per cell increase over the above voltages (adjustable).
Charge On indication:	Approximately 23 VAC on 24 volt units and 11 VAC on 12 volt units. Maximum load is 200 mA. Indication is lost if the internal fuse fails.
Remote voltage sensing: (DE001 units only)	Sense terminals are provided for use on Cyclic models, and are usually linked on the charger for Constant Potential models.
Controls:	*Voltage Adjust*, *Current Limit*, *Undervoltage Inhibit*, *Differential* (DE001 models only), *Boost Level* (DE009 models only).
Ambient temperature:	Range 0 to 70°C.
Terminations:	12 screw terminals which accept 3.5 mm fork or ring lugs.
Dimensions (L × B × D):	320 × 205 × 120 mm maximum.
Weight:	8.3 kg (shipping weight 9 kg).
Finish:	Grey hammertone stoved enamel with white silk-screened labelling.

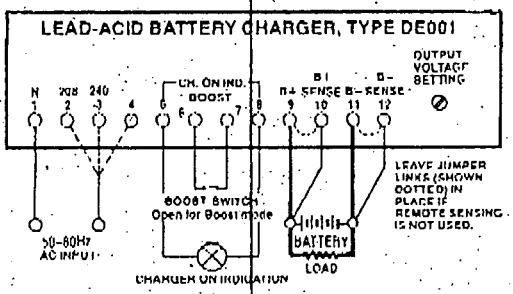
Note: output voltages are quoted for an ambient temperature of 20°C.

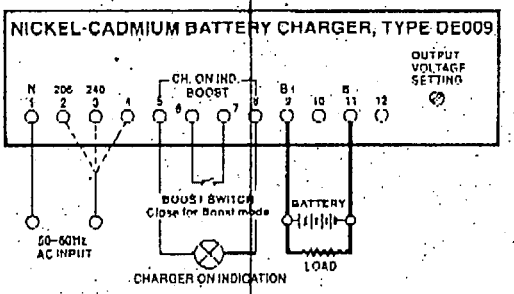
INSTALLATION DETAILS*

CAUTION

These units must be installed and wired in accordance with Handbook DE000124 in order to ensure reliable operation.







ORDERING INFORMATION

To order a new DE001 or DE009 Battery Charger quote the appropriate Model/Part number:

Part No.	Description
DE00100201	Lead-acid charger, 12 volts, Cyclic
DE00100202	Lead-acid charger, 24 volts, Cyclic†
DE00100203	Lead-acid charger, 12 volts, Constant Potential
DE00100204	Lead-acid charger, 24 volts, Constant Potential
DE00900201	Nickel-cadmium charger, 12 volts, Constant Potential
DE00900202	Nickel-cadmium charger, 24 volts, Constant Potential†

Units can be burned in for either 100 or 200 hours at 50°C for use in high-reliability applications specify when ordering. (A nominal charge applies.)

†These models will be supplied if an incomplete part number or specification is quoted.

DELTA ELECTRONICS

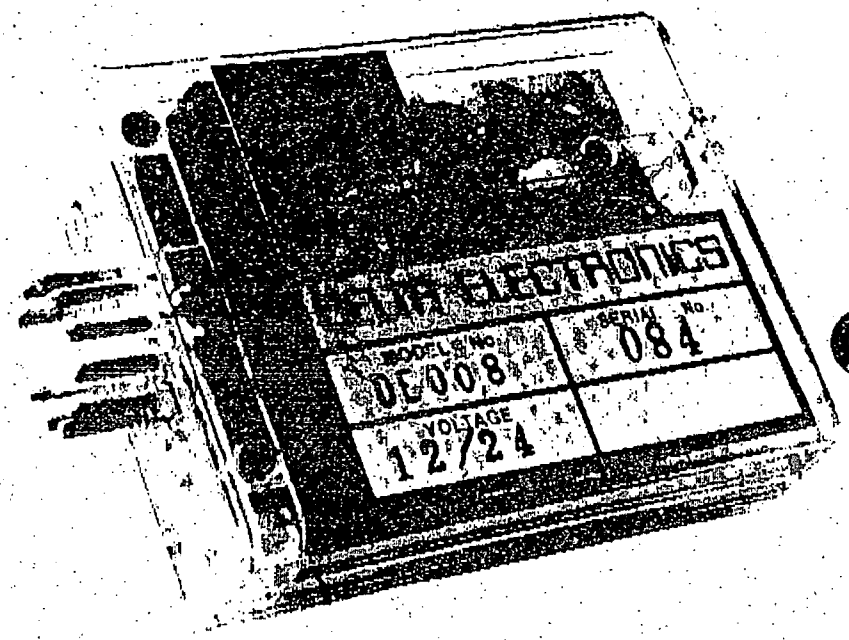
A DIVISION OF BOWATER TUTT INDUSTRIES PTY. LTD. (Incorporated in Victoria)

***ABRIDGED INFORMATION ONLY.** For design purposes refer to Handbook DE000124 for complete specifications and application information.

BROCHURE No. DE000134A, October '87.

CORNER OF CAVAN AND GRAND JUNCTION ROADS, GEPPS CROSS, SOUTH AUSTRALIA, 5094

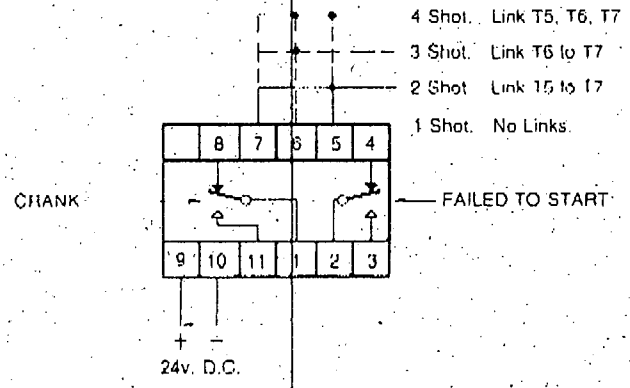
POSTAL ADDRESS:
P.O. BOX 308, BLAIR ATHOL, S.A., 5084
TELEPHONE: (08) 260 2522
FACSIMILE: (08) 349 4142



DE-008 CRANK CYCLE TIMER

PHYSICAL DESCRIPTION

The Crank Cycle timer is a small unit intended for use as a starter motor cranking timer in auto start standby alternators. It is housed in an impact resistant polystyrene case with connections brought out as an 11 pin base to plug into a conventional relay socket. On appliction of a 24 volts D.C. signal, an internal relay will function for a preset time, then release. Up to four cycles may be programmed. A "failed to start" signal will be activated if the input voltage is not removed before the end of the last crank cycle. The unit must be de-energised externally when the engine comes up to speed.



SPECIFICATIONS

Timer. Adjustable 4 to 20 seconds.
Number of cycles: 1, 2, 3 or 4 externally programmable.
On/Off Ratio: Fixed at 1:1.
Supply Voltage: 24 volts D.C.
Relay Contacts: One changeover on crank relay. One changeover on failed to start.
Contact Rating: 24 Volts 4 Amp. D.C. resistive load.
Programming: Terminals 5, 6 and 7 allow selection of number of start attempts.
1 Cycle: No linking required.
2 Cycle: Link T5 to T7.
3 Cycle: Link T6 to T7.
4 Cycle: Link T5 to T6 and T7.

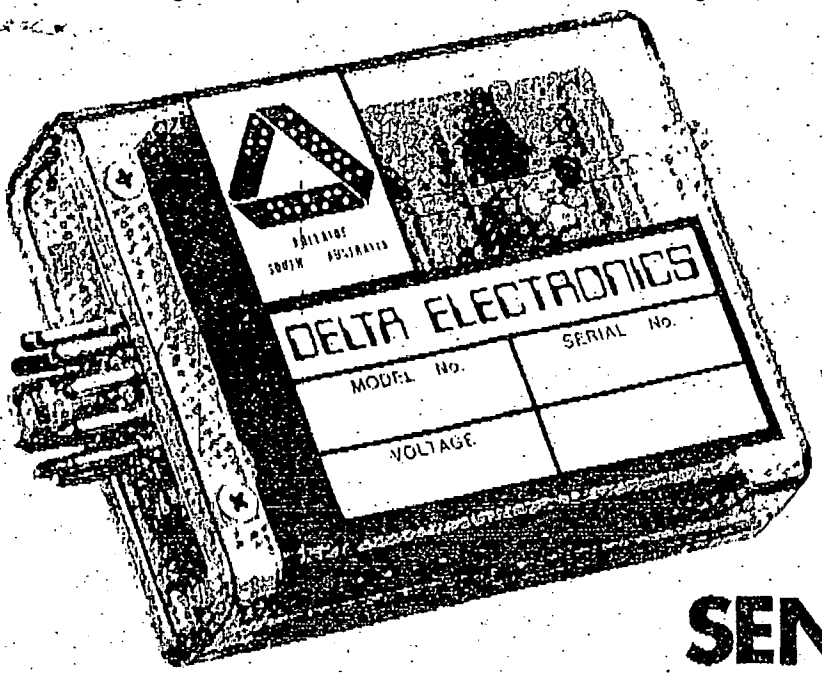
12 Volts D.C. operation is possible when used in conjunction with DE-042 Auxiliary Power Supply.

Approx. dimensions: 93 mm x 74 mm x 27 mm.
Weight: 50g.
Ambient Operating Temperature Range: 0°C–70°C.

Warning: Do not megger internal circuits as damage to semiconductors may result.

(Specifications subject to change without notice).

Delta Electronics
Head office & plant:
Corner Cavan & Grand Junction Roads,
Gepps Cross,

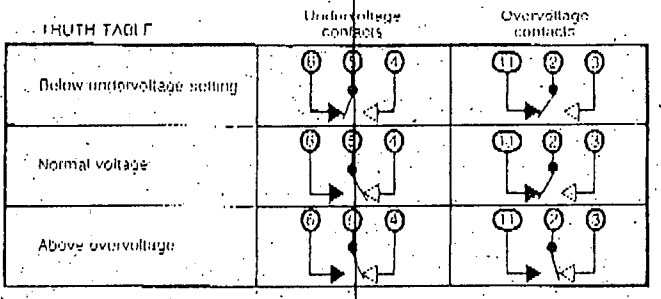


DE 023 BATTERY VOLTAGE SENSING RELAY

PHYSICAL DESCRIPTION

The Battery Voltage Sensing Relay is used as an alarm module to detect deviation of the battery voltage beyond preselfable limits. Two alarm levels are incorporated in the Relay Module. Typical utilization is in monitoring the battery voltage of standby diesel generators or fire pumps, giving indication of undervoltage or overvoltage. An input signal during engine cranking disables the undervoltage alarm preventing nuisance tripping.

The Relay is housed in a polystyrene case with connections brought out to an 11 pin base for mating to a standard relay socket. Sensing Relays are available for 12 and 24 volt systems. Alarm settings are adjustable.

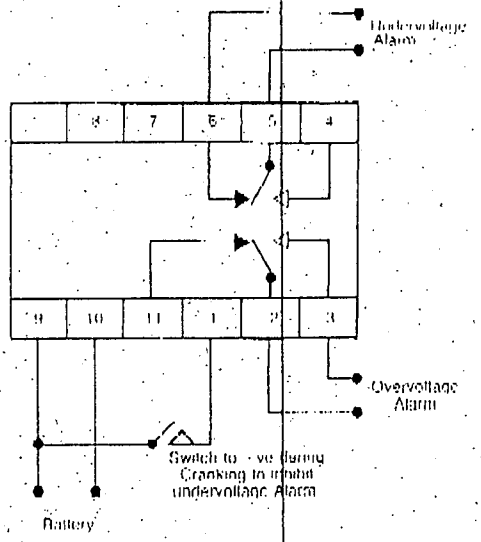


SPECIFICATIONS:

	12 Volts D.C.	24 Volts D.C.
Undervoltage Range	8-16 volts	12-28 volts
Undervoltage Factory Setting:	11.5 volts	23 volts
Overvoltage Range:	12-17 volts	24-34 volts
Overvoltage Factory Setting	16 volts	32 volts
Undervoltage inhibit pin 1	Greater than 5 volts	
Relay Contacts	1 c/o undervoltage 1 c/o overvoltage	
Contact Rating:	4 amp D.C. resistive load.	

Approx. dimensions: 93 mm x 74 mm x 27 mm.
Weight: 50g.
Ambient Operating Temperature Range: 0°C—70°C.

Warning: Do not megger internal circuits as damage to semiconductors may result.



(Specifications subject to change without notice)

Delta Electronics
Head office & plant:

Corner Cavan & Grand Junction Roads,
Cepps Cross,
South Australia 5084.

DELTA ELECTRONICS

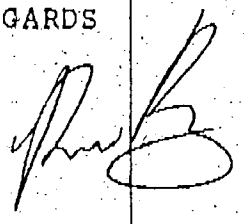
DETROIT ENGINE AND TURBINE CO.
569, GRAND JUNCTION RD.
GEPPS CROSS. SA 5094
PO BOX 188, BLAIR ATHOL, 5084.
TEL. 61-8-260-2299.
FAX. 61-8-349-4151.
ACN. 004 322 123.

FACSIMILE MESSAGE

TO:	PETER TRANTER	FROM:	BRIAN KING
COMPANY:	BRISBANE CITY COUNCIL	LOCATION:	ELECTRONIC SERVICE DEPT.
FAX:	07-2680847	REF:	BK010
CC:		DATE:	8/7/92
SUBJECT:	DE001 BATTERY CHARGER .		PAGE 1 OF 5

PETER,
AS REQUESTED , HERE IS THE INFO ON OUR DE001 BATTERY CHARGER I HAVE ALSO INCLUDED INFO ON THE RELAY MODULES THAT I THINK YOU MAY HAVE .

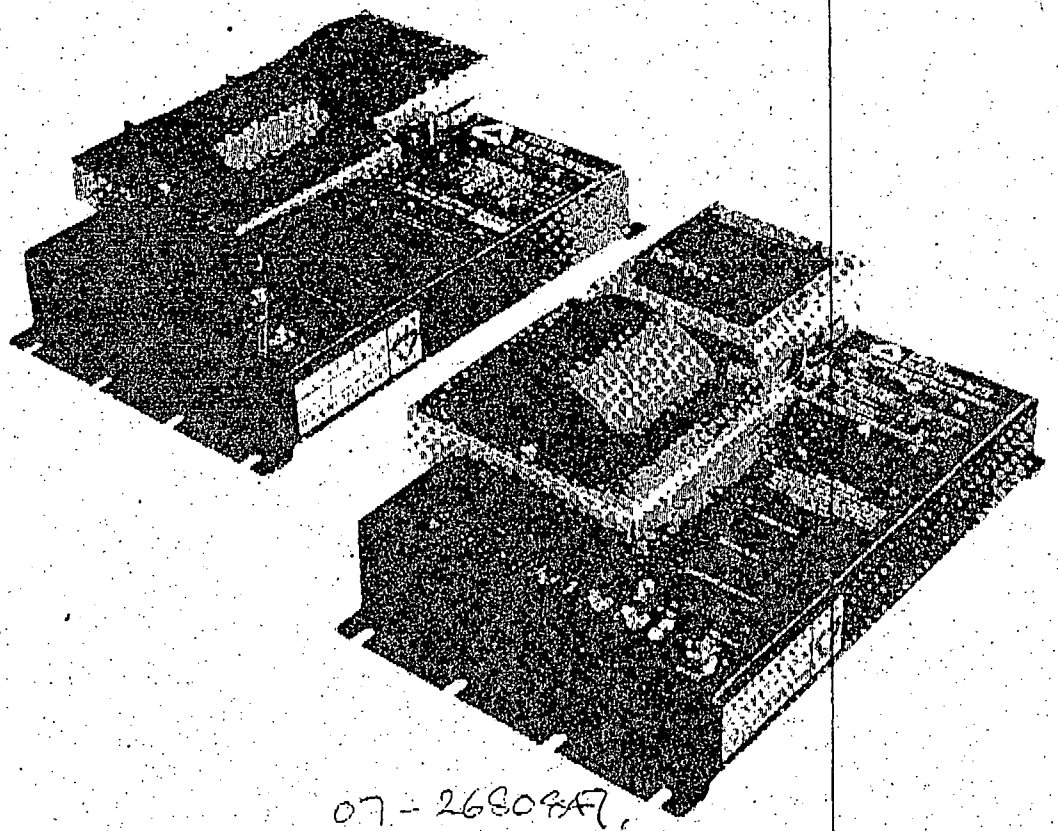
REGARDS



Automatic Battery Chargers

DE001
for Lead-acid batteries

DE009
for Nickel-cadmium batteries



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The DE001 and DE009 Automatic Static Battery Chargers are compact, robust units which, although similar in function and appearance, are intended for different applications. The DE001 provides charging characteristics to suit lead-acid accumulators while the DE009 provides the characteristics required by nickel-cadmium cells.

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The DE001 is normally supplied with a "Cyclic" charging characteristic which is particularly suitable for use with stand-by batteries in which sulphating may occur during long periods of inactivity. The output cycles on and off, supplying periodic bursts of current at the charger's full output capacity. The battery voltage thus cycles between upper and lower limits which may be independently adjusted. Models with conventional "Constant Potential" charging are also available.

The DE001 provides a "Boost" mode which allows charging to continue above the normal voltage setting. Occasional periods of Boost will ensure that the battery is always at full charge.

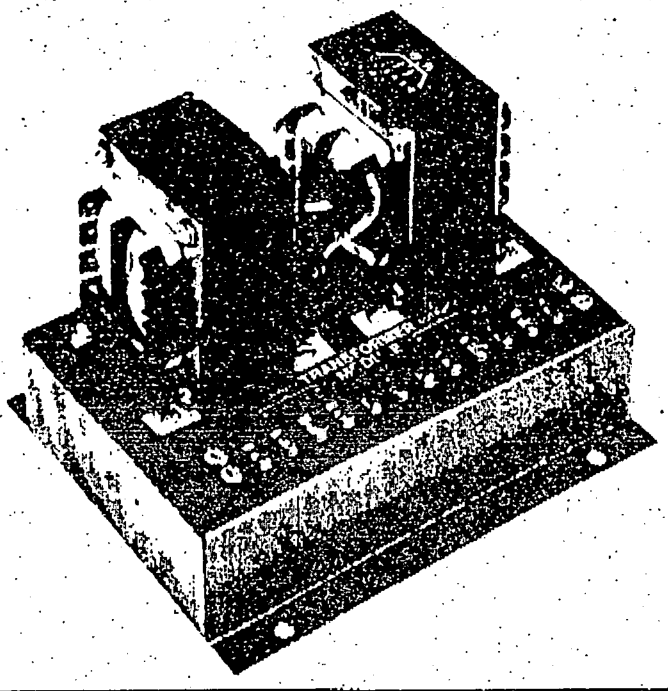
The DE001 also features a temperature compensation circuit which reduces its output voltage at high temperatures in order to match the temperature characteristic of lead-acid cells.

The DE009 uses a Constant Potential characteristic to provide the "Float" and "Boost" charging usually required by nickel-cadmium cells. Boost mode allows the voltage to be raised to an adjustable higher level.

30 amp versions of these units, the DE069 and DE071, are also available.

DELTA ELECTRONICS

MANUFACTURERS AND SUPPLIERS OF ELECTRONIC CONTROL, MONITORING, ALARM AND PROTECTION EQUIPMENT



DE-010 TRANSFORMER MODULE

DESCRIPTION

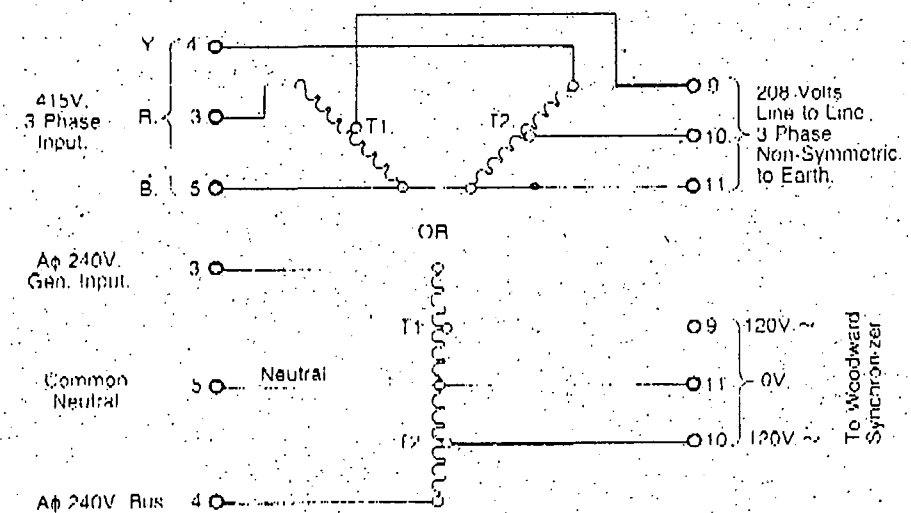
The DE010 Transformer Module is a voltage matching unit, containing two transformers, used for interfacing Australian Standard to American Standard Voltages. Suitable for 415 to 208 Volts, 3 phase conversion for inputs to Woodward and Barber Colman load sharers, also 240 to 120 volts conversion to match input to synchronisers.

SPECIFICATIONS

Peak voltage rating: 500 Volts A.C. 50/60Hz. Terminals 3 to 5.
Power: 30 Watts per transformer, maximum.
finish: Grey hammer tone stoved enamel.
Approx. Dimensions:

L	x	B	x	H
155mm (6")		128mm (5")		105mm 4⅛"

Weight: 5 lb./2.25 kg.
Ambient Operating Temperature Range: 0°C—70°C.



(Specifications subject to change without notice)

Delta Electronics
Head office & plant:

Corner Cavan & Grand Junction Roads,
Gepps Cross,
South Australia 5084.

DELTA ELECTRONICS

DE001/DE009 Automatic Battery Chargers

FEATURES

- 10 amps continuous charging current
- A Boost charging facility
- *Charger On* indicator output
- Available with 12 or 24 volt output
- Current smoothing choke helps extend battery plate life
- Generous overload protection — a current limiting circuit backed up by an internal fuse and the choke
- *Undervoltage Inhibit* circuit turns off charger if output is short circuited or when an engine's starter motor is operating
- Temperature compensated output voltage on the DE001
- DE001 models available with Cyclic or Constant Potential output
- Cyclic charging mode is ideal for stand-by applications
- Adjustable Boost voltage on the DE009 caters for the exacting requirements of nickel-cadmium cells
- Wide operating temperature range with no current derating
- Heavy-duty construction on sturdy steel chassis
- Conformal coating on control circuit enhances reliability in harsh environments
- Robust *Voltage Adjust* control with locking facility
- Remote voltage sensing facility on DE001 units
- Adjusted at the factory to suit common batteries
- Full 12-month warranty
- Designed, manufactured and supported in Australia

SPECIFICATIONS*

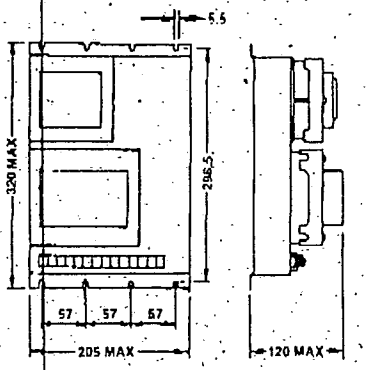
Supply voltages:	208, 240 or 254 VAC, ±10%; 48 to 62Hz.
Charging current:	Normally 9 A; 10 A maximum (adjustable).
DE001 output voltage: (Cyclic)	24 volt models — cut-in at 26 V, cut-out at 28.5 V. 12 volt models — cut-in at 13 V, cut-out at 14.3 V (both levels are adjustable).
DE001 output voltage: (Constant Potential)	Normally 27.6 V for 24 volt models, 13.8 V for 12 volt models (adjustable).
DE001 Boost level:	Approximately 30 V for 24 volt models, 15 V for 12 volt models.
DE009 output voltage:	9 cells — 13.05 V, 10 cells — 14.50 V, 18 cells — 26.10 V, 19 cells — 27.55 V, 20 cells — 29.00 V (adjustable).
DE009 Boost level:	Normally 0.1 V per cell increase over the above voltages (adjustable).
Charge On indication:	Approximately 23 VAC on 24 volt units and 11 VAC on 12 volt units. Maximum load is 200 mA. Indication is lost if the internal fuse fails.
Remote voltage sensing: (DE001 units only)	Sense terminals are provided for use on Cyclic models, and are usually linked on the charger for Constant Potential models.
Controls:	*Voltage Adjust, Current Limit, Undervoltage Inhibit, Differential* (DE001 models only), *Boost Level* (DE009 models only).
Ambient temperature:	Range 0 to 70°C.
Terminations:	12 screw terminals which accept 3.5 mm fork or ring lugs.
Dimensions (L × B × D):	320 × 205 × 120 mm maximum.
Weight:	8.3 kg (shipping weight 9 kg).
Finish:	Grey hammertone stoved enamel with white silk-screened labelling.

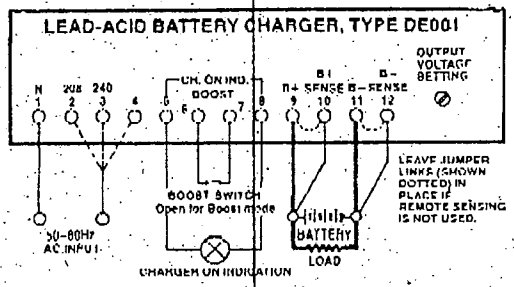
Note: output voltages are quoted for an ambient temperature of 20°C.

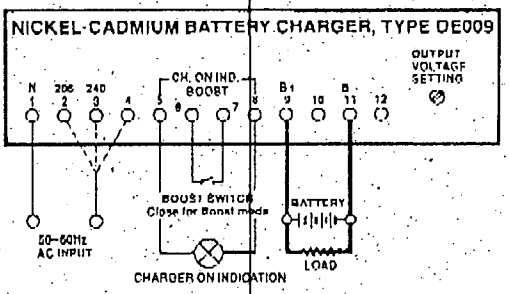
INSTALLATION DETAILS*

CAUTION

These units must be installed and wired in accordance with Handbook DE000124 in order to ensure reliable operation.







ORDERING INFORMATION

To order a new DE001 or DE009 Battery Charger quote the appropriate Model/Part number:

Part No.	Description
DE00100201	Lead-acid charger, 12 volts, Cyclic
DE00100202	Lead-acid charger, 24 volts, Cyclic†
DE00100203	Lead-acid charger, 12 volts, Constant Potential
DE00100204	Lead-acid charger, 24 volts, Constant Potential
DE00900201	Nickel-cadmium charger, 12 volts, Constant Potential
DE00900202	Nickel-cadmium charger, 24 volts, Constant Potential†

Units can be burned in for either 100 or 200 hours at 50°C for use in high-reliability applications — specify when ordering. (A nominal charge applies.)

†These models will be supplied if an incomplete part number or specification is quoted.

DELTA ELECTRONICS

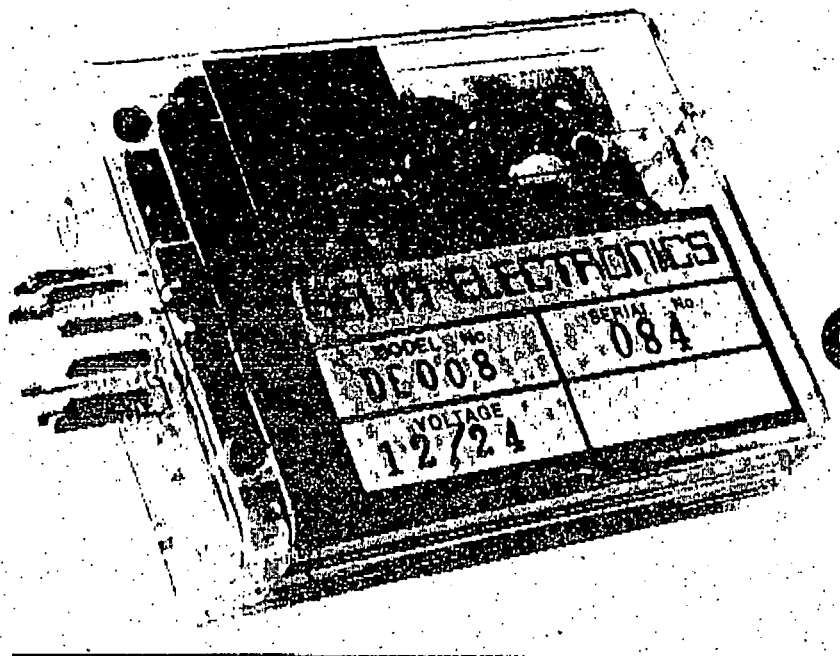
A DIVISION OF BOWATER TUTT INDUSTRIES PTY. LTD. (Incorporated in Victoria)

***ABRIDGED INFORMATION ONLY.** For design purposes refer to Handbook DE000124 for complete specifications and application information.

BROCHURE No. DE000134A, October '87.

CORNER OF CAVAN AND GRAND JUNCTION ROADS, GEPPS CROSS, SOUTH AUSTRALIA, 5094

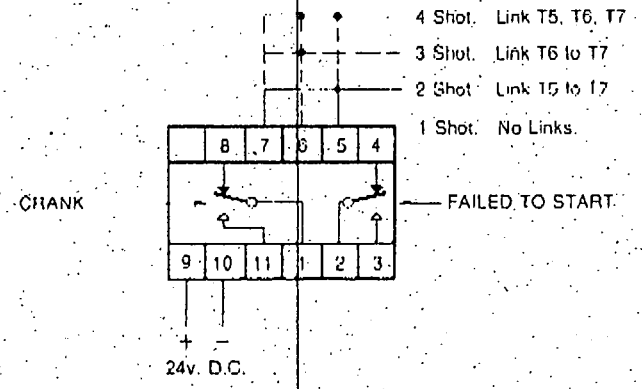
POSTAL ADDRESS:
P.O. BOX 308, BLAIR ATHOL, S.A., 5084
TELEPHONE: (08) 260 2522
FACSIMILE: (08) 349 4142
TELEX: AA82427, DETCO



DE-008 CRANK CYCLE TIMER

PHYSICAL DESCRIPTION

The Crank Cycle timer is a small unit intended for use as a starter motor cranking timer in auto start standby alternators. It is housed in an impact resistant polystyrene case with connections brought out as an 11 pin base to plug into a conventional relay socket. On appliction of a 24 volts D.C. signal, an internal relay will function for a preset time, then release. Up to four cycles may be programmed. A "failed to start" signal will be activated if the input voltage is not removed before the end of the last crank cycle. The unit must be de-energised externally when the engine comes up to speed.



SPECIFICATIONS

Timer. Adjustable 4 to 20 seconds.
Number of cycles: 1, 2, 3 or 4 externally programmable.
On/Off Ratio: Fixed at 1:1.
Supply Voltage: 24 volts D.C.
Relay Contacts: One changeover on crank relay. One changeover on failed to start.
Contact Rating: 24 Volts 4 Amp. D.C. resistive load.
Programming: Terminals 5, 6 and 7 allow selection of number of start attempts:
1 Cycle: No linking required.
2 Cycle: Link T5 to T7.
3 Cycle: Link T6 to T7.
4 Cycle: Link T5 to T6 and T7.

12 Volts D.C. operation is possible when used in conjunction with DE-042 Auxiliary Power Supply.

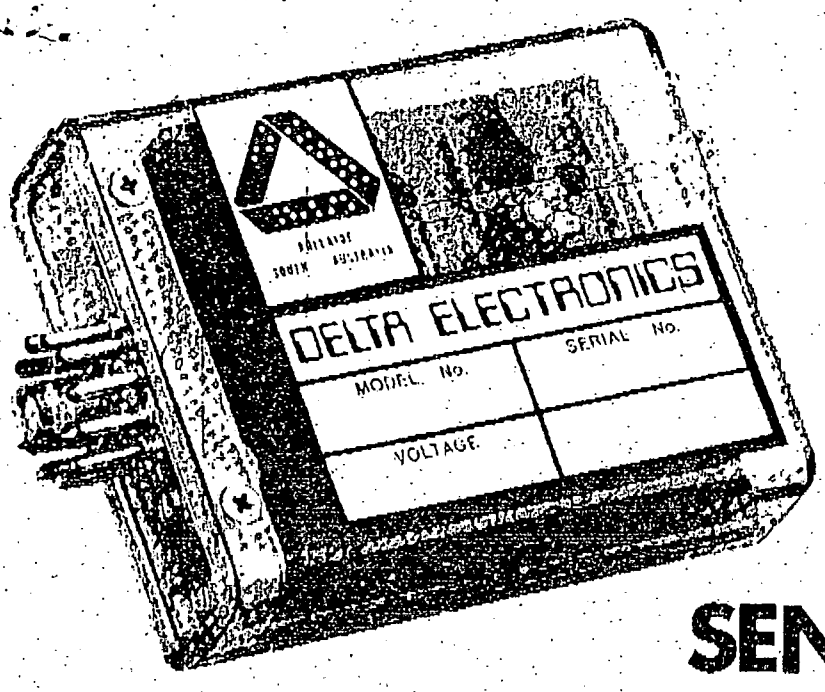
Approx. dimensions: 93 mm x 74 mm x 27 mm.
Weight: 50g.
Ambient Operating Temperature Range: 0°C–70°C.

Warning: Do not megger internal circuits as damage to semiconductors may result.

(Specifications subject to change without notice)

Delta Electronics
Head office & plant:

Corner Cavan & Grand Junction Roads,
Gepps Cross,
South Australia 5094

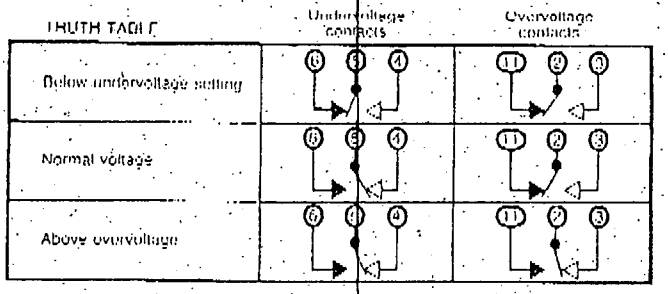


DE 023 BATTERY VOLTAGE SENSING RELAY

PHYSICAL DESCRIPTION

The Battery Voltage Sensing Relay is used as an alarm module to detect deviation of the battery voltage beyond presettable limits. Two alarm levels are incorporated in the Relay Module. Typical utilization is in monitoring the battery voltage of standby diesel generators or fire pumps, giving indication of undervoltage or overvoltage. An input signal during engine cranking disables the undervoltage alarm preventing nuisance tripping.

The Relay is housed in a polystyrene case with connections brought out to an 11 pin base for mating to a standard relay socket. Sensing Relays are available for 12 and 24 volt systems. Alarm settings are adjustable.

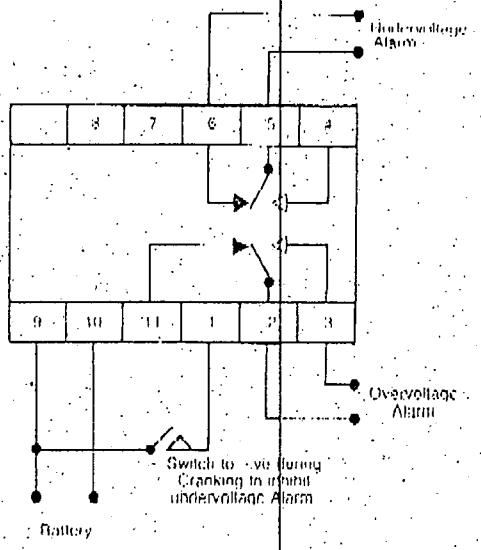


SPECIFICATIONS:

	12 Volts D.C.	24 Volts D.C.
Undervoltage Range	8-16 volts	12-28 volts
Undervoltage Factory Setting:	11.5 volts	23 volts
Overvoltage Range:	12-17 volts	24-34 volts
Overvoltage Factory Setting	16 volts	32 volts
Undervoltage Inhibit pin 1	Greater than 6 volts	
Relay Contacts	1 c/o undervoltage 1 c/o overvoltage	
Contact Rating:	4 amp D.C. resistive load.	

Approx. dimensions: 93 mm x 74 mm x 27 mm.
Weight: 50g.
Ambient Operating Temperature Range: 0°C—70°C.

Warning: Do not megger internal circuits as damage to semiconductors may result.



(Specifications subject to change without notice)

Delta Electronics
Head office & plant:
Clarke Green & Grand Junction Roads.
Gepps Cross.

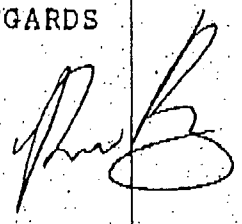
DETROIT ENGINE AND TURBINE CO.
569, GRAND JUNCTION RD.
GEPPS CROSS. SA 5084
PO BOX 188, BLAIR ATHOL, 5084.
TEL. 61-8-260-2299.
FAX. 61-8-349-4151.
ACN. 004 322 123.

FACSIMILE MESSAGE

TO:	PETER TRANTER	**FROM:**	BRIAN KING
COMPANY:	BRISBANE CITY COUNCIL	**LOCATION:**	ELECTRONIC SERVICE DEPT.
FAX:	07-2680847	**REF:**	BK010
CC:		**DATE:**	9/7/92
SUBJECT:	DE001 BATTERY CHARGER		PAGE 1 OF 5

PETER,
AS REQUESTED , HERE IS THE INFO ON OUR DE001 BATTERY CHARGER I HAVE ALSO INCLUDED INFO ON THE RELAY MODULES THAT I THINK YOU MAY HAVE .

REGARDS



elephone: 268 6733
ax: 268 6097

ACTION AUTO ELECTRICS PTY LTD

A.C.N. 010 009 462

156 LAVARACK AVE., EAGLE FARM 4009
P.O. BOX 1015, EAGLE FARM

Queensland Distributors -
Ingersoll-Rand Air Starters
Prestolite-Leece-Neville
Load Handler Trek Star
R.C.P. Automotive Products

INVOICE TO:

BRISBANE CITY
COUNCIL
G.P.O. BOX 1434
BRISBANE Q.
4001

DELIVER TO:

INVOICE No.: 10FFX
Date: 13/07/92

DELIVERY DOCKET

ISTOMER No.	ORDER No.	SALES TAX No.	DELIVERY DETAILS
75	529816	EXEMPT	PICK-UP

DUCT CODE	DESCRIPTION	Quantity Supplied	Quantity B/O	LIST PRICE	NETT PRICE	Tax Code	TOTAL
1150	BATTERY 12V 23P	2	0	151.20	302.40	C	302.4
** THIS INVOICE IS DUE FOR PAYMENT BY 30TH AUGUST 1992 **							

Beco
12V 23 N150 850 Amps Rated I

TERMS OF SALE

1. NETT 30 DAYS.— PLEASE PAY ON INVOICE
2. All claims for credit must be made within 7 days after Receipt of goods.
3. Invoice No. must be quoted on all claims paper work.
4. Bought in or special purchase components will **not** be subject to credit returns.
5. A handling charge will be made on credit returns. 14 days — Nil, 15 - 30 days — 10%, 30 days & over — 15%.
6. Goods are subject to prices and conditions ruling at the time of delivery.

SALES TAX CODES

Q	=	A
	=	B
20%	=	C
30%	=	D
Exempt	=	E

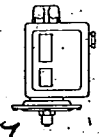
SUB TOTAL	302.4
SALES TAX	
FREIGHT	0.00
TOTAL	302.40

The list price set out or referred to herein is a recommended price only and there is no obligation to comply with the recommendations

INSTRUCTIONS

PRESSURE range 0-30 KPA PT

RT 113



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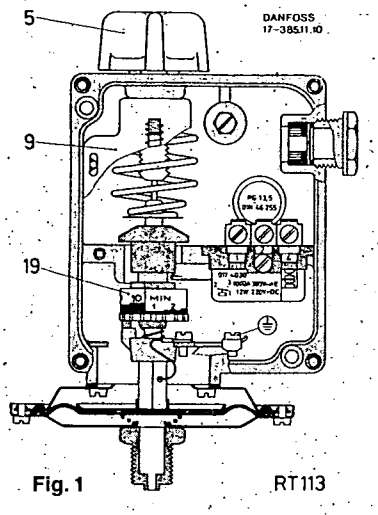
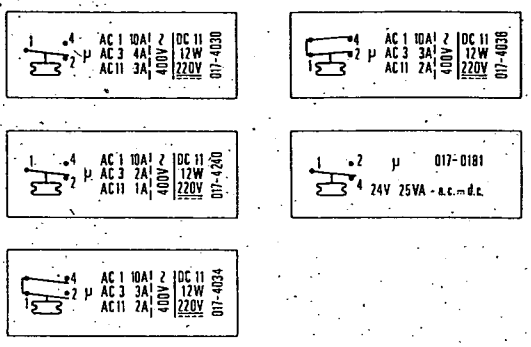


Fig. 1 RT113



A = Områdeindstilling/Range setting/Bereichseinstellung/Réglage de la plage/Ajuste de gama/Instelling regelbereik/Alueasettelu

B = Opnået differens/Differential obtained/Erreichte Differenz/Différentiel obtenu/Diferencial obtenida/Verkregen differentie/Saavutettu eropaine

C = Differensindstilling/Differential setting/Differenzeinstellung/Réglage du différentiel/Ajuste diferencial/Instelling differentie/Eroasettelu

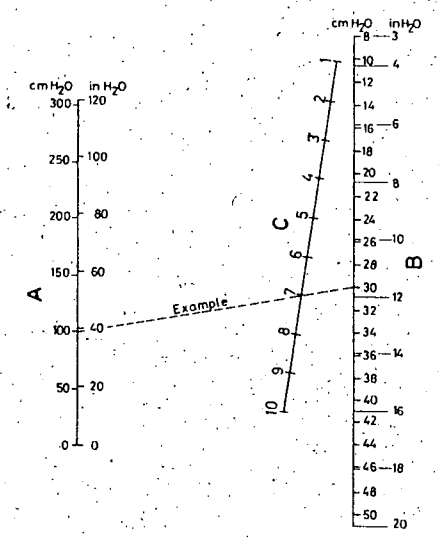


Fig. 3

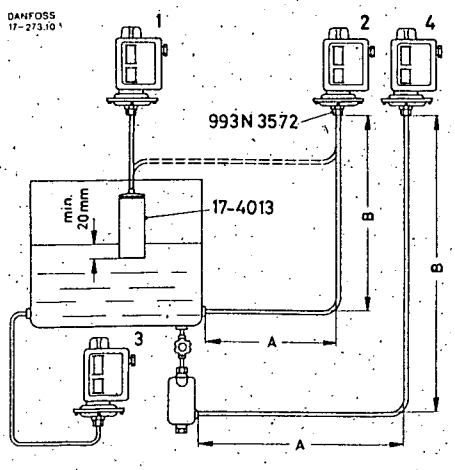


Fig. 4

Højde fra beholderstuds til pressostat
Height from tank connection to pressure controller
Höhe vom Behälterstutzen zum Pressostat
Hauteur du raccord du réservoir au pressostat
Altura desde la conexión del depósito al presostato
Vertikale afstand van de tankaansluiting naar de pressostat
Korkeus säiliöliitoksesta pressostaattiin

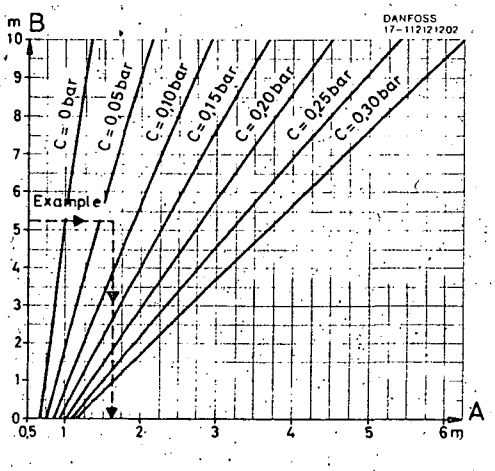
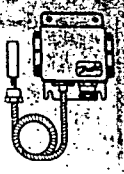


Fig. 5

Mindste vandrette rørlængde
Minimum horizontal tube length
Mindestlänge der waagerechten Rohrstrecke
Longueur minimale du tuyau horizontal
Longitud mínima del tubo horizontal
Minimum horizontale lengte van de leiding
Lyhyin vaakasuora putkipituus

INSTRUCTIONS

KPS 76-83



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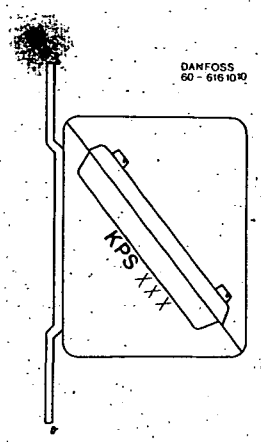
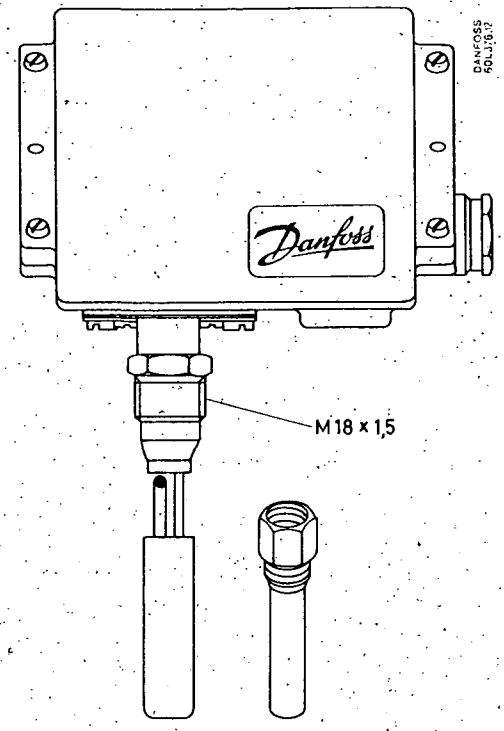
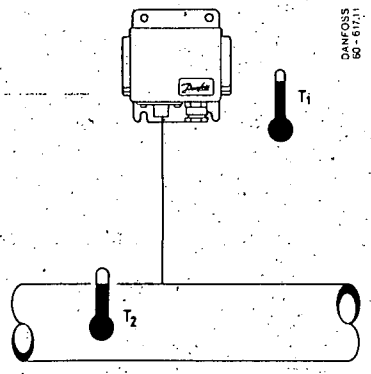
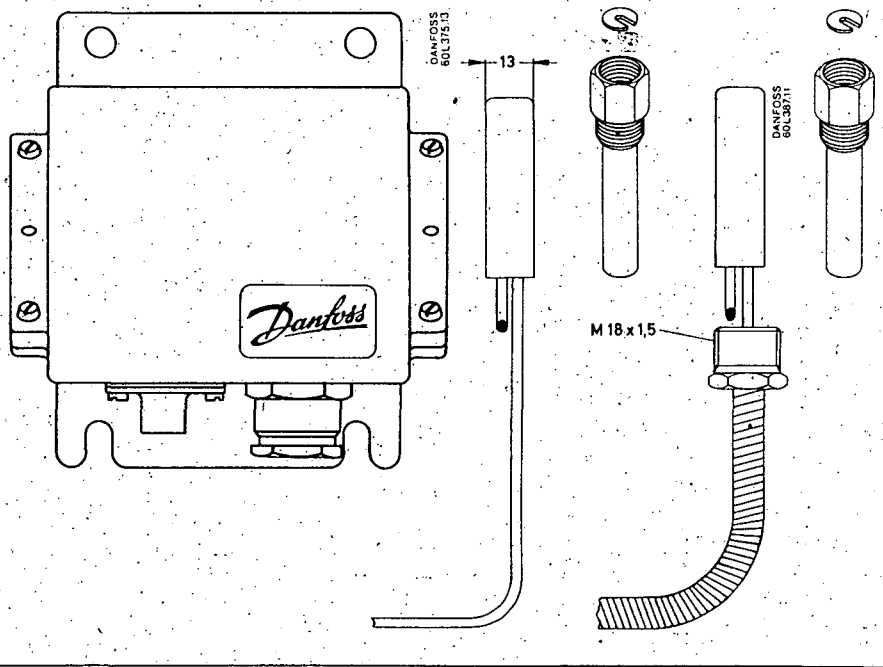
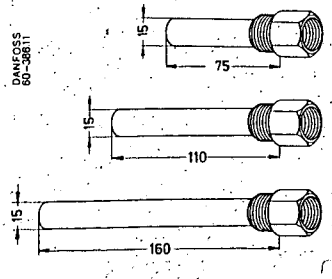




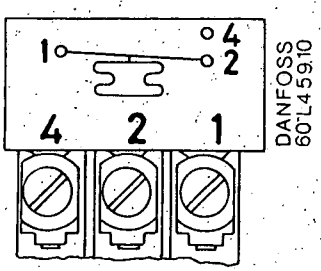




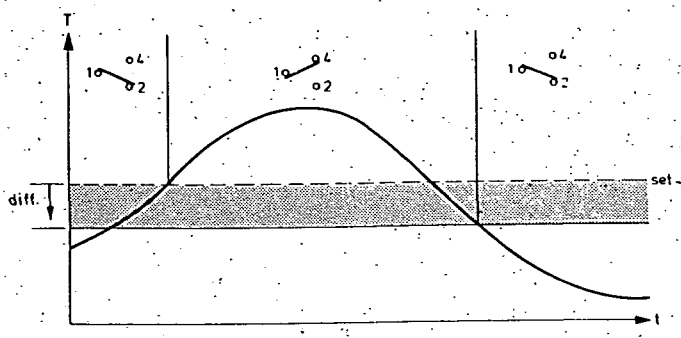
	T_2 max. (°C)	T_1 min. (°C)	T_1 max. (°C)
KPS 76	80		
KPS 77	130		
KPS 79	200		
KPS 80	220	−40	70
KPS 81	250		
KPS 83	300		

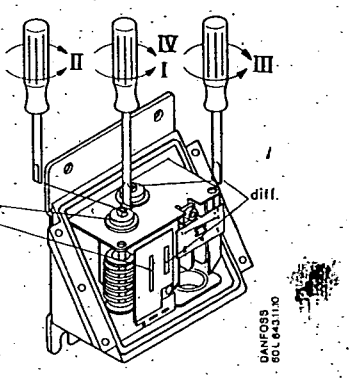


L (mm)	Ms	St. 18/8
75	060L3326	060L3328
110	060L3330	060L3331
160	060L3327	060L3329

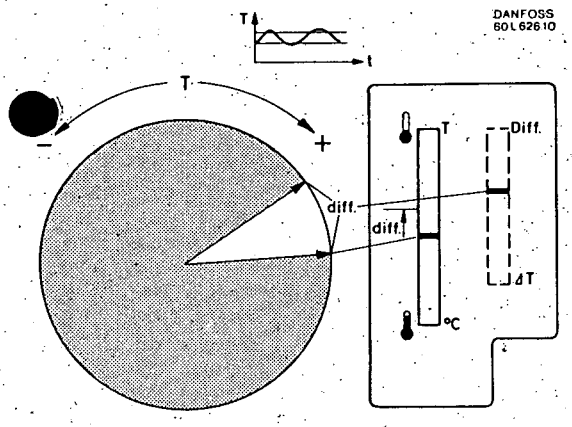


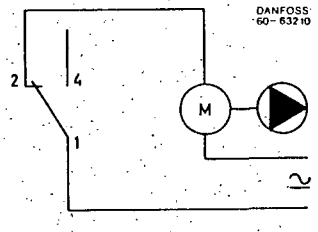
10 (6) A, 440 V ~ L.R. 50 A
220 V, 12 W ⎓ PILOT

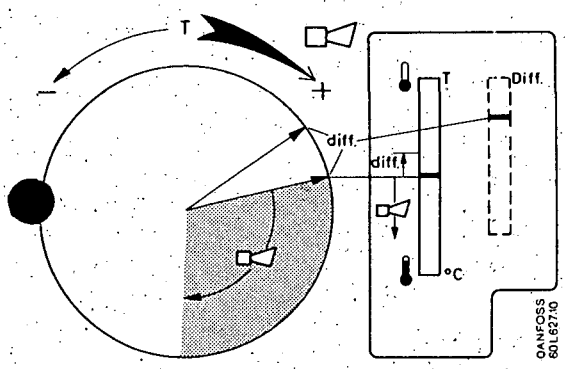


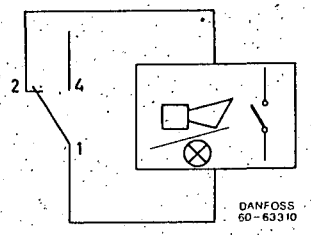


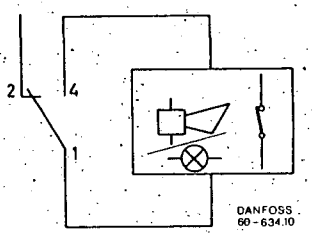
	Diff. (°C)
KPS 79 (060L3141)	9
KPS 83 (060L3139, 060L3140)	18

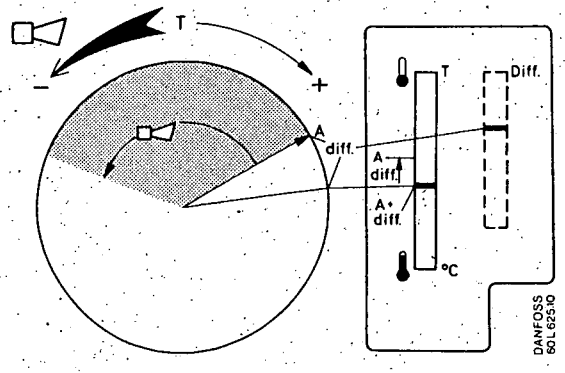


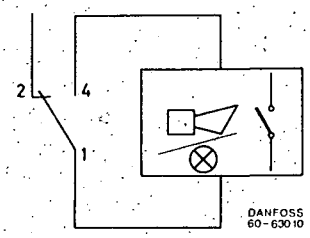


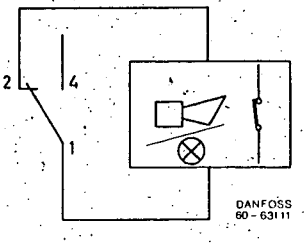












D1047-2

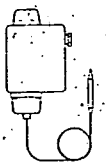
INSTRUCTIONS

TEMPERATURE

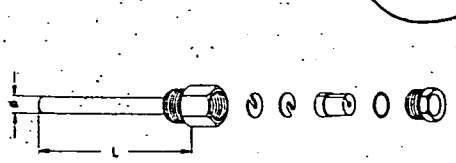
Range 70-150 °C

p4

RT 107, 108, 120, 123, 124



017R932.



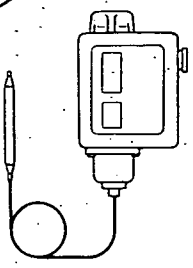


Fig. 1

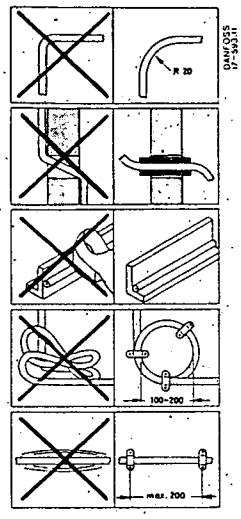


Fig. 2

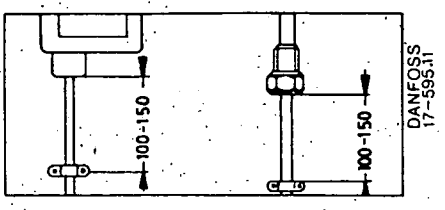


Fig. 3

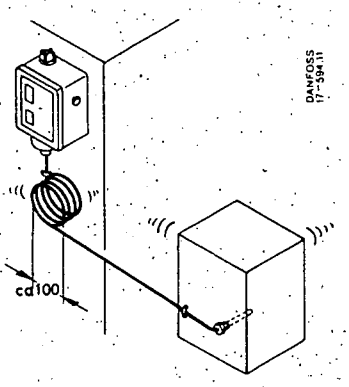
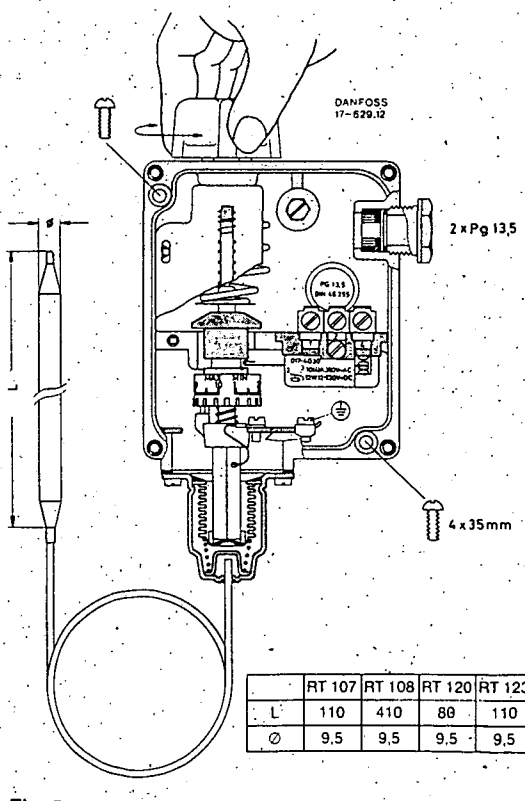


Fig. 4



	RT 107	RT 108	RT 120	RT 123	RT 124
L	110	410	80	110	110
∅	9,5	9,5	9,5	9,5	11

Fig. 5

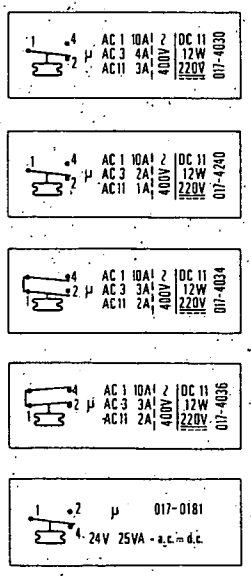


Fig. 6

017R9321

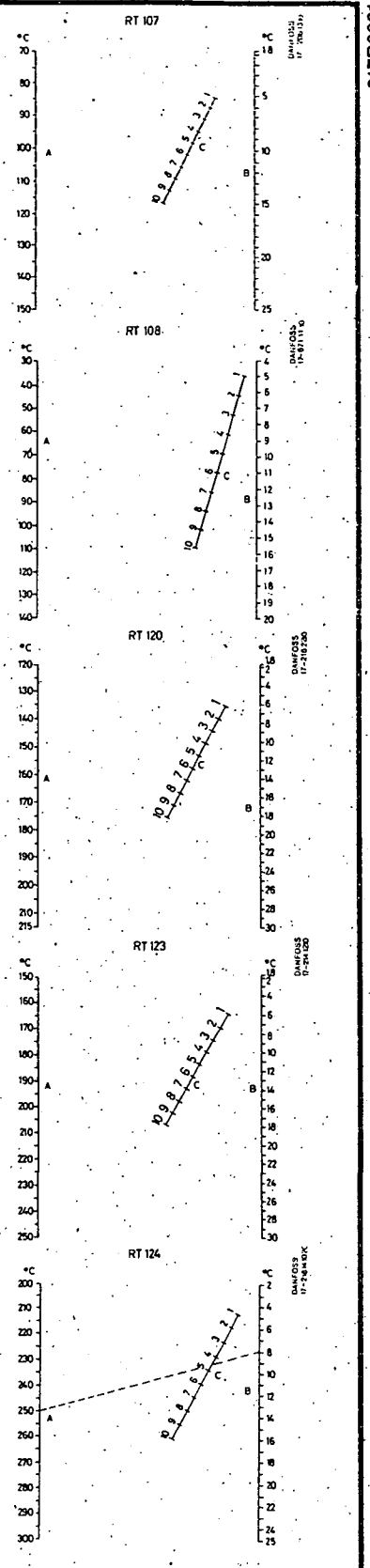


Fig. 7

A. Områdeindstilling/Range setting/Bereichseinstellung/Réglage de la plage/Настройка диапазона
B. Opnået differens/Differential obtained/Erreichte Differenz/Différentiel obtenu/Получ-сянный дифференциал
C. Differensindstilling/Differential setting/Differenzeinstellung/Réglage du différentiel/Настройка дифференциала

DI000423-1

017R9321

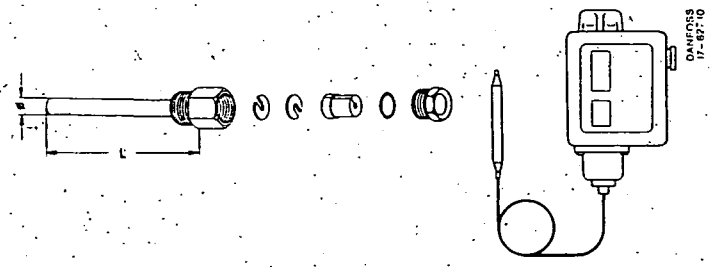


Fig. 1

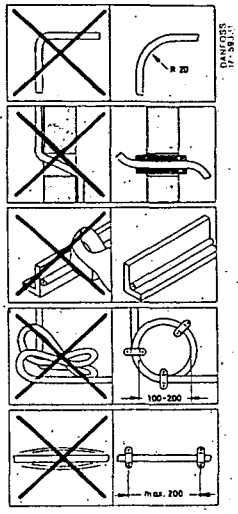


Fig. 2

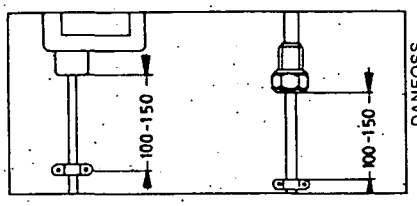


Fig. 3

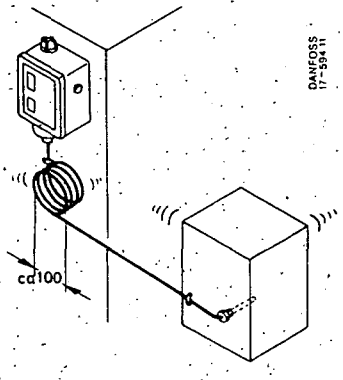
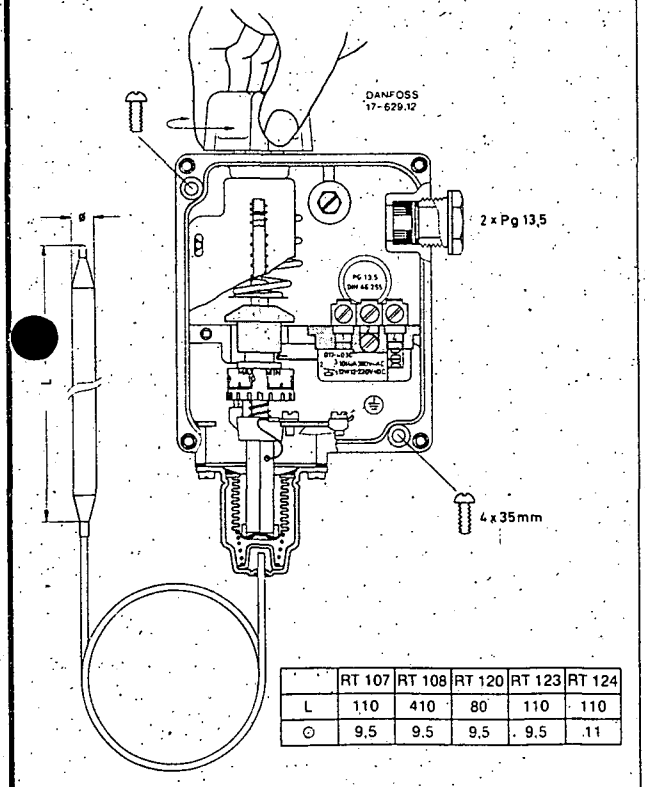


Fig. 4



	RT 107	RT 108	RT 120	RT 123	RT 124
L	110	410	80	110	110
⊙	9,5	9,5	9,5	9,5	11

Fig. 5

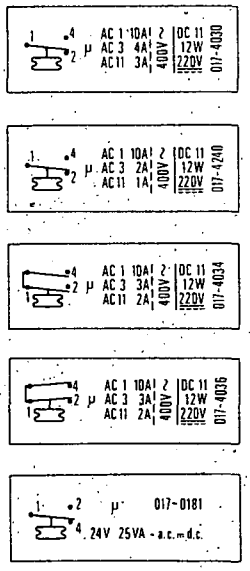


Fig. 6

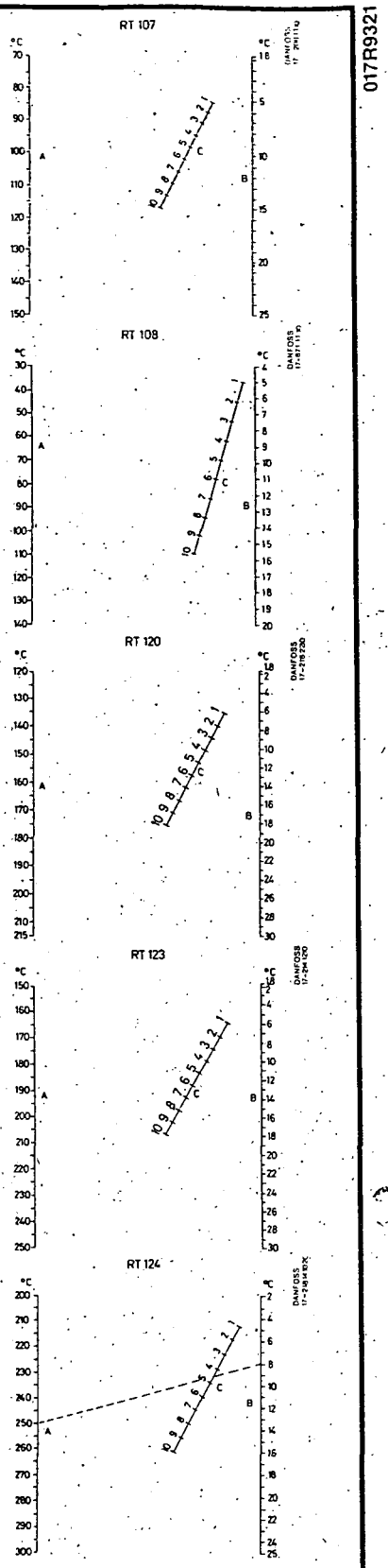


Fig. 7

A. Områdeindstilling/Range setting/Bereichseinstellung/Réglage de la plage/Настройка диапазона
B. Opnået differens/Differential obtained/Erreichte Differenz/Differentiel obtenu/Полученный дифференциал
C. Differensindstilling/Differential setting/Differenzeinstellung/Réglage du differentiel/Настройка дифференциала

DANSK

RT 107, 108, 120, 123, 124

Tekniske data
Kontaktbelastning: kontaktsystem 17-4030 se fig. 6.
Tæthed: IP 66 i henhold til IEC 144 og DIN 40050. For udførelser med max. eller min. reset IP 54.
Tilladelig omgivelsestemperatur: −50°C til +70°C.

Montage
RT-apparaterne kan monteres vilkårligt med hensyn til position. Korrekt montage af føler i følerlomme se fig. 1.
Ved udendørsmontage, bør apparatet beskyttes mod direkte nedbør. Dette kan fx ske ved anbringelse under halvtag.

Indstilling
Indstil termostaten (se fig. 5) til den funktion – slutte eller bryde – som ønskes ved faldende temperatur. Aflæs indstilling på hovedskala (se fig. 5).

Eksempel
Temperaturen i en tørreovn ønskes reguleret af en RT 123. Max. temperatur 188°C. Min. temperatur 180°C. Differens 188 − 180 = 8°C.
1. Tilslut varmelegemet til termostatens klemmer 2-1.
2. Indstil termostaten på 180°C med håndknappen (se fig. 5).
3. Indstil differensrullen (fig. 5) på tallet 3 som fremkommer ved aflæsning af nomogrammet for RT 123 i fig. 7.

DEUTSCH

RT 107, 108, 120, 123, 124

Technische Daten
Kontaktbelastung: Kontaktsystem 17-4030 siehe Fig. 6.
Schutzart: IP 66 gem. IEC 144 und DIN 40050. Für Ausführungen mit max. oder min. Wiedereinschaltung IP 54.
Zulässige Umgebungstemperatur: −50°C bis +70°C.

Montage
Die RT-Geräte können in beliebiger Stellung montiert werden. Die korrekte Montage des Fühlers in die Fühlerhülse ist für Geräte ohne Kapillarrohrbewehrung in Fig 1.
Bei Montage im Freien sollte das Gerät gegen Niederschläge geschützt werden, z.B. durch Anbringen unter einem Dachvorsprung.

Einstellung
Der Thermostat (siehe Fig. 5) ist auf die Funktion – Ein oder Aus – einzustellen, die bei abfallender Temperatur gewünscht wird. Die Einstellung ist an der Hauptskala (siehe Fig. 5) abzulesen.

Beispiel
Die Temperatur in einem Trockenofen soll von einem RT 123 geregelt werden. Max. Temperatur 188°C. Min. Temperatur 180°C. Differenz 188 − 180 = 8°C.
1. Der Heizkörper ist an die Klemmen 2-1 des Thermostats anzuschliessen.
2. Der Thermostat ist mit dem Einstellknopf (siehe Fig. 5) auf 180°C einzustellen.
3. Die Differenzrolle (Fig. 5) ist auf die Zahl 3 einzustellen, die auf dem Nomogramm für RT 123 in Fig. 7 abzulesen ist.

ESPAÑOL

RT 107, 108, 120, 123, 124

Características técnicas
Carga de los contactos: conmutador 17-4030 véase figura 6.
Caja de protección: IP 66 según IEC 144 y DIN 40050. Para versiones con rearme máx. o mín., IP 54.
Temperatura ambiente máxima admisible: −50°C a +70°C.

Instalación
Las unidades RT pueden montarse en cualquier posición. Para el montaje correcto de los bulbos situados en protectores, véase figura 1.
En el caso de instalación al exterior, será preciso proteger la unidad contra la acción directa de la lluvia. Por ejemplo, podría situarse debajo de una cubierta.

Ajuste
Ajustar el termostato (figura 5) para la función deseada (cierre o abertura) cuando la abertura disminuye. La lectura del punto de ajuste se efectúa en la escala principal (figura 5).

Ejemplo
Se desea regular con un RT 123 la temperatura de un horno de secado. La temperatura máxima es de 188°C. El diferencial es de 188 − 180 = 8°C.
1. Conectar el elemento de calentamiento con los terminales 2-1 del termostato.
2. Ajustar el termostato en 180°C por medio del botón (figura 5).
3. Fijar el diferencial ajustando la tuerca (figura 5) sobre el número 3 que puede encontrarse en el nomograma del RT 123 de la figura 7.

ENGLISH

RT 107, 108, 120, 123, 124

Technical data
Contact load: switch 17-4030 see fig. 6.
Enclosure: IP 66 to IEC 144 and DIN 40050. For versions with max. or min. reset, IP 54.
Permissible ambient temperature: −50°C to +70°C.

Installation
RT units can be fitted in any position. For correct fitting of bulbs in bulb pockets, see fig. 1.
With outdoor installation, the unit should be protected against direct rainfall. It could, for example, be placed under a lean-to roof.

Setting
Set the thermostat (fig. 5) to the function required (make or break) on falling temperature. Read off the setting on the main scale (fig. 5).

Example
An RT 123 is required to regulate the temperature in a drying oven. Max. temperature 188°C. Min. temperature 180°C. Differential 188 − 180 = 8°C.
1. Connect the heating element to thermostat terminals 2-1.
2. Set the thermostat on 180°C with the knob (fig. 5).
3. Set the differential adjusting nut (fig. 5) on number 3 which can be found by reading off the nomogram for the RT 123 in fig. 7.

FRANCAIS

RT 107, 108, 120, 123, 124

Caractéristiques techniques
Charge des contacts: système de contact 17-4030. Voir fig. 6.
Étanchéité: IP 66 selon IEC 144 et DIN 40050. Pour modèles avec réarmement max. ou min.: IP 54.
Température ambiante admissible: −50°C à +70°C.

Montage
Les appareils RT peuvent être montés dans n'importe quelle position.
Pour montage correct de l'élément sensible dans la poche: voir figure 1.
En cas de montage à l'extérieur, l'appareil doit être abrité contre les chutes directes de pluie et de neige, ce qui peut être réalisé, par exemple, en le placant sous un auvent.

Réglage
Régler le thermostat (voir fig. 5) pour la fonction désirée – fermeture ou ouverture du circuit – à température décroissante. Relever le réglage sur l'échelle principale (voir figure 5).

Exemple
On désire régler, à l'aide d'un thermostat RT 123, la température d'un four à sécher.
Température maximale: 188°C. Température minimale: 180°C. Différentiel: 188 − 180 = 8°C.
1. Connecter le corps de chauffe aux bornes 2-1 du thermostat.
2. Régler le thermostat sur 180°C au moyen du bouton (voir figure 5).
3. Régler le rouleau de différentiel (figure 5) sur le chiffre 3 relevé sur le nomogramme du RT 123 de la figure 7.

NEDERLANDS

RT 107, 108, 120, 123, 124

Technische gegevens
Contactbelasting: kontactsysteem 17-4030 zie fig. 6.
Dichtheidsklasse: IP 66 volgens IEC 144 en DIN 40050. Voor uitvoeringen met max. of min. reset: IP 54.
Max. toelaatbare omgevingstemperatuur: −50°C tot +70°C.

Installatie
De RT thermostaten kunnen in elke positie worden gemonteerd.
Voor de juiste montage van voelers in dompelbuizen, zie fig. 1.
Bij installatie in de buitenlucht, dient de thermostaat te worden beschermd tegen directe regenval door deze bijv. onder een afdak aan te brengen.

Instelling
De thermostaat (fig. 5) moet worden ingesteld op de gewenste functie (maken of breken) bij temperatuurdaling.
Op de hoofdschaal (fig. 5) kan de instelling worden afgelezen.

Voorbeeld
Voor het regelen van de temperatuur in een droogoven wordt een RT 123 toegepast.
Max. temperatuur 188°C.
Min. temperatuur 180°C.
Differentie 188 − 180 = 8°C.
1) Verwarmingselement aansluiten op de thermostaatklemmen 2-1.
2) Thermostaat d.m.v. knop op 180°C instellen (fig. 5).
3) Differentie-instelschijf (fig. 5) afstellen op het getal 3 dat kan worden gevonden in het nomogram voor RT 123 in fig. 7.

DI000423-3

SUOMEKSI

RT 107, 108, 120, 123 ja 124

Tekniset tiedot
Koskettimien kuormitettavuus: kosketinlaite 17-4030 (kuva 6).
Tiiviys: IP 66, IEC 144 ja DIN 40050 mukaan. Maksimi ja minimi palautuspainikkeisilla malleilla IP 54.
Ympäristön sallittu lämpötila –50°C...+70°C.

Asennus
RT laitteet voidaan asentaa vapaasti jokaiseen asentoon. Tuntoelimen asennus upotusputkeen (kuva 1).
Asennettaessa termostaatti ulos, olisi se suojattava sateelta.

Asettelu
Aseta termostaatti lämpötilalle, jossa toiminta (kytkentä/katkaisu) halutaan laskevalla lämpötilalla. Lämpötila luetaan asteikosta, (kuva 5).

Esim
Kuivausuunin lämpötilaa säädetään RT 123 termostaatilla. Maks. lämpötila 188°C ja minimi 180°C.
Erotus 188 – 180 = 8°C.
1. Liitä lämmitysvastus koskettimien 2-1 väliin.
2. Asettele termostaatti 180°C asettelunupista, (kuva 5).
3. Asettele erotusrulla, (kuva 5) asentoon 3 joka saadaan nomokrammista RT 123 (kuva 7).

РУССКИЙ

RT 107, 108, 120, 123, 124

Техническая характеристика
Контактная нагрузка: контактная система 17-4030, см. рис. 6.
Плотность: IP 66 согласно IEC 144 и ДИН 40050. Для выполнения с макс. или мин. возвратом IP 54.
Допустимая температура окруж. среды: –50°C до +70°C.

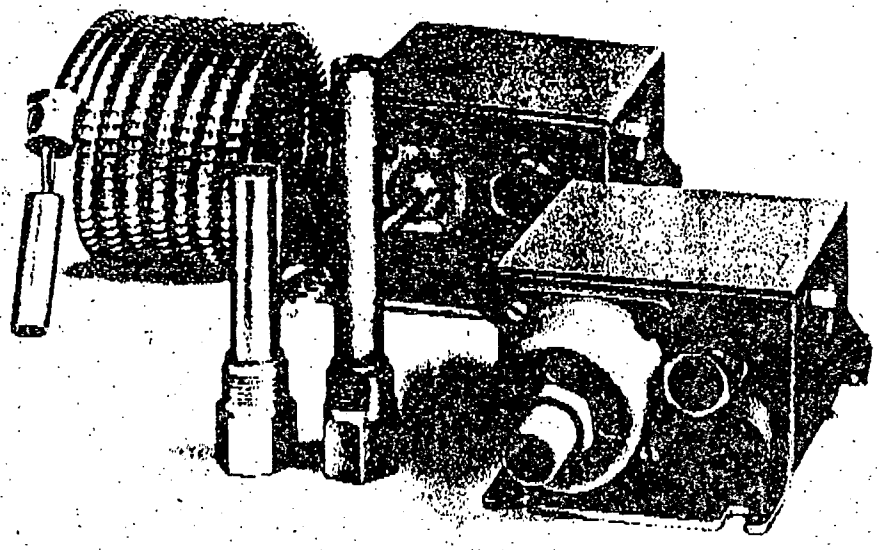
Монтаж:
Приборы-RT можно монтировать произвольно в отношении позиции. Правильный монтаж датчичика в кармане датчика показан на рис. 1.
При монтаже под открытым небом следует защищать прибор от прямых осадков. Это может осуществляться, наиример, помещением прибора навесом.

Настройка
Настраивать термостат (см. рис. 5) на функцию – включать или выключать – желаемую при падающей температуре. Снимать показания главной шкалы (см. рис. 5).

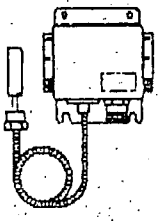
Пример:
Желательно урегулировать температуру в сушилке прибором RT 123. Макс. температура 188°C. Мин. температура 180°C.
Разница 188 – 180 = 8°C.
1. Присоединить термозлемент к зажимам термостата 2-1.
2. Настроить термостат на 180°C нажимной кнопкой (см. рис. 5).
3. Настроить дифференциальный регулировочный ролик (рис. 5) на цифру 3, получаемую при считывании номограммы для RT 123 на рис. 7.

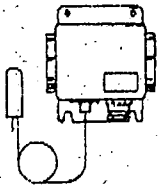
Danfoss

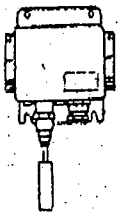
KPS Pressure Controls/Thermostats



Thermostats type KPS





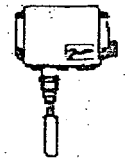
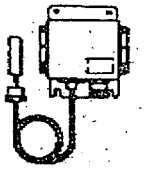
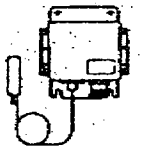
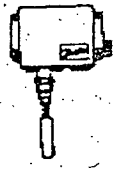
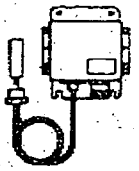
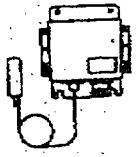
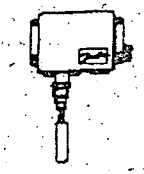


Setting range °C	Adjustable differential, fixed differential °C	Max. sensor temp. °C	Insert length of suitable pocket (see also table below) mm	Cap. tube length m	Code numbers			Type
−10 → 30	3 → 10	80	65, 75, 110, 160	2		060L3112	060L3113	KPS 76
20 → 60	3 → 14	130	– 75 – –	–	060L3118			KPS 77
20 → 60	3 → 14	130	– – 110 –	–	060L3100			KPS 77
20 → 60	3 → 14	130	– – – 160	–	060L3136			KPS 77
20 → 60	3 → 14	130	65, 75, 110, 160	2		060L3101	060L3102	KPS 77
20 → 60	3 → 14	130	– – 110, 160	5		060L3119	060L3120	KPS 77
50 → 100	4 → 16	200	– 75 – –	–	060L3121			KPS 79
50 → 100	4 → 16	200	– – 110 –	–	060L3103			KPS 79
50 → 100	4 → 16	200	– – – 160	–	060L3137			KPS 79
50 → 100	4 → 16	200	65, 75, 110, 160	2		060L3104	060L3105	KPS 79
50 → 100	4 → 16	200	– – 110, 160	5		060L3122	060L3123	KPS 79
50 → 100	4 → 16	200	– – 110, 160	8		060L3124	060L3125	KPS 79
50 → 100	4 → 16	200	– 75, 110, 160	3		060L3143		KPS 79
50 → 100	9	200	– 75 – –	–	060L3141[1]			KPS 79
70 → 120	4.5 → 18	220	– 75 – –	–	060L3126			KPS 80
70 → 120	4.5 → 18	220	– – 110 –	–	060L3127			KPS 80
70 → 120	4.5 → 18	220	– – – 160	–	060L3138			KPS 80
70 → 120	4.5 → 18	220	65, 75, 110, 160	2		060L3128	060L3129	KPS 80
70 → 120	4.5 → 18	220	– – 110, 160	5		060L3130	060L3131	KPS 80
70 → 120	4.5 → 18	220	– – 110, 160	8		060L3132	060L3133	KPS 80
70 → 120	4.5 → 18	220	– 75, 110, 160	3		060L3156		KPS 80
60 → 150	5 → 25	250	65, 75, 110, 160	2		060L3106	060L3107	KPS 81
60 → 150	5 → 25	250	– – 110, 160	5		060L3134	060L3135	KPS 81
100 → 200	6.5 → 30	300	65, 75, 110, 160	2		060L3108	060L3109	KPS 83
100 → 200	16	300	65, 75, 110, 160	2		060L3139[1]	060L3140[1]	KPS 83

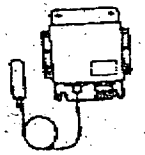
[1] Thermostat with max. reset.

Sensor pockets for KPS thermostats

Insert length mm	Material	Connection NPT	Connection BSP	Code no.	Insert length mm	Material	Connection BSP	Code no.
65	Brass	⅛		060L3265	110	Brass	½	060L3271
75	Brass		¼	060L3266	110	Stainless 18/8	½	060L3268
75	Brass	½		060L3264	160	Brass	½	060L3263
75	Brass		½	060L3262	160	Stainless 18/8	½	060L3269
75	Stainless 18/8		½	060L3267	Cap.tube gland	Brass	¼	003N0155

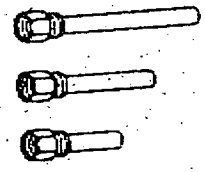
KPS 77	060L3100	**226.00**	1,00	4	range 20→60°C rod-type for sensor pocket 110 mm	
KPS 77	060L3118	**226.00**	1,00	4	range 20→60°C rod-type for sensor pocket 75 mm	
KPS 77	060L3136	**226.00**	1,00	4	range 20→60°C rod-type for sensor pocket 160 mm	
KPS 77	060L3101	**268.00**	1,40	4	range 20→60°C 2m armoured cap. tube	
KPS 77	060L3119	**365.00**	2,00	4	range 20→60°C 5m armoured cap. type	
KPS 77	060L3102	**237.00**	1,20	4	range 20→60°C 2m cap. tube	
KPS 77	060L3120	**272.00**	1,50	4	range 20→60°C 5m cap. tube	
KPS 79	060L3103	**226.00**	1,00	4	range 50→100°C rod-type for sensor pocket 110 mm	
KPS 79	060L3121	**226.00**	1,00	4	range 50→100°C rod-type for sensor pocket 75 mm	
KPS 79	060L3137	**226.00**	1,00	4	range 50→100°C rod-type for sensor pocket 160 mm	
KPS 79	060L3144	**226.00**	1,00	4	range 50→100°C rod-type for sensor pocket 200 mm	
KPS 79	060L3141	**323.00**	1,00	4	range 50→100°C with max reset rod-type for sensor pocket 75 mm	
KPS 79	060L3104	**268.00**	1,45	4	range 50→100°C 2m armoured cap. tube	
KPS 79	060L3143	**308.00**	1,50	4	range 50→100°C 3m armoured cap. tube	
KPS 79	060L3122	**365.00**	2,00	4	range 50→100°C 5m armoured cap. tube	
KPS 79	060L3124	**465.00**	2,50	4	range 50→100°C 8m armoured cap. tube	
KPS 79	060L3105	**237.00**	1,20	4	range 50→100°C 2m cap. tube	
KPS 79	060L3123	**272.00**	1,50	4	range 50→100°C 5m cap. tube	
KPS 79	060L3125	**308.00**	1,80	4	range 50→100°C 8m cap. tube	
KPS 80	060L3126	**226.00**	1,00	4	range 70→120°C rod-type for sensor pocket 75 mm	
KPS 80	060L3127	**226.00**	1,00	4	range 70→120°C rod-type for sensor pocket 110 mm	
KPS 80	060L3138	**226.00**	1,00	4	range 70→120°C rod-type for sensor pocket 160 mm	
KPS 80	060L3157	**226.00**	1,00	4	range 70→120°C rod-type for sensor pocket 200 mm	

KPS 83	060L3109	237.00	1.20	4	range 100→200°C 2m cap. tube
KPS 83	060L3140	342.00	1.20	4	range 100→200°C 2m cap. tube with max reset



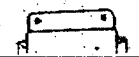
SENSOR POCKETS FOR KPS THERMOSTATS

Type	Code no.	Price $ A	Weight kilos	Content of multipack	Description	Symbol
Sensor pocket of brass without gland						
	060L3265	38.00	0,09	10	65 mm ½" NPT	
	060L3264	38.00	0,08	10	75 mm ½" NPT	
✳	060L3262	38.00	0,08	10	75 mm ½" BSP	
	060L3266	57.00	0,15	10	75 mm ¾" BSP	
	060L3271	41.00	0,09	10	110 mm ½" BSP	
	060L3263	50.00	0,10	10	160 mm ½" BSP	
	060L3206	60.00	0,12	10	200 mm ½" BSP	
Sensor pocket of stainless steel without gland						
	060L3267	87.00	0,08	10	75 mm ½" BSP	
	060L3268	87.00	0,09	10	110 mm ½" BSP	
	060L3270	87.00	0,08	10	110 mm ½" NPT	
	060L3269	100.00	0,10	10	160 mm ½" BSP	
Packinggland for sensor pocket						
✳	060L3273	13.00	0,02	10	Stuffing box	



PRESSURE CONTROLS

Type	Code no.	P	Weight kilos	Content of multipack	Description	Symbol



SR40

Series SR40 MICROPROCESSOR-BASED PID CONTROLLERS
OPERATING INSTRUCTIONS

CONTENTS

1 SPECIFICATIONS

Display

Process Value (PV) and Parameter Type:	Digital display 7-segment red LED, 3 digits LED(SR41, SR42, SR44:10mm high, SR43:14.2mm high)
Set Value (SV) and Parameter Value:	Digital display 7-segment green LED, 3 digits LED(SR41, SR42, SR44:8mm high, SR43:10mm high)
Display Tolerance:	±(0.5% FS+1 digit)at 23°C±5°C
Display Range:	See "Codes for Selectable Measuring Ranges"
Display Resolution:	0.1 or 1(depending on measuring range)
Parameter Displays:	Setting of Set Value (Sv), Auto Tuning (At), Alarm set value (AL), Heater Break Alarm set value (Hb), Proportional Band (P), Integral Time (I), Derivative Time (d), Sensor Compensation (SC), Differential (dF), SV Bias (Sb), Set Value locking (LOC)
Monitor Lamp Displays:	Control output (CONT), Auto Tuning mode (AT), Alarm mode (ALM), Heater Break Alarm mode(HB)

Setting

Setting Method:	By front key switch
Keys for setting:	4 keys - (P)(Parameter selection), (<)(Shift), (v)(Down) and (^)(Up)
Setting Selection:	Set Value setting, Auto Tuning mode, Alarm value, Heater Break Alarm value, Proportional Band, Integral Time, Derivative Time, Sensor Compensation, Hysteresis (in ON-OFF operation), SV Bias and Key Lock

Input

Thermocouple (Multi-Input, Multi-Range):	J, K, L (DIN 43710)
External allowable resistance range:	100 Ω maximum
Input impedance:	500k Ω minimum
Burnout:	Standard feature (Up-scale)
Cold junction temperature compensation range:	5°C ~ 45°C
R.T.D. (Multi-Range):	JIS Pt100/JPt100 internally selectable (JPt100 when shipped)
Amperage:	0.25mA
Lead wire tolerance range:	3 Ω maximum/wire
Voltage (Multi-Range):	0 ~ 10mV DC, 0 ~ 10V DC
Input impedance:	500k Ω minimum
Current (Multi-Range):	4 ~ 20mA DC
Receiving impedance:	250 Ω
Sensor Compensation (PV Bias Range):	−19.9 ~ +19.9°C or °F (only in case of thermocouple input and R.T.D. input)
Sampling Cycle:	0.5 seconds

Control

Control Method:	PID control with Auto Tuning function/ON-OFF control (by internal switch. PID control when shipped)
Proportional band:	0.1 ~ 99.9% FS
Integral time:	1 ~ 999 seconds
Derivative time:	0 ~ 999 seconds (PI control at 0 setting)
Proportional Cycle:	Contact output:20 seconds, SSR voltage output: 2 seconds fixed
Hysteresis:	0.2 ~ 10.0% FS (in ON-OFF mode)

Control Output

Contact:	240V AC 2.5A (resistive load), 1A (inductive load)
Contact configuration:	SR41:1a contact, SR42, 43 & 44:1c contact
SSR Voltage Output:	15V DC±3V (when resistive load is 1.5k Ω), 30mA maximum
Isolation:	Between input and output
DA/RA Mode:	Internally selectable (RA mode when shipped)

Alarm Output (Option)

Alarm Setting Method:	By front panel key
Alarm Action:	ON-OFF
Alarm Sensitivity Adjustment:	0.3% FS fixed
Alarm Output:	Contact 240V 2.5A (resistive load), 1a
Inhibit/Non-inhibit:	Internally selectable (Non-inhibit when shipped)
Alarm Mode Display:	ALM lamp lit

Heater Break Alarm (Option)

Alarm Action:	Heater amperage detection by external CT, Alarm output ON upon detection of break (CT attached)
Heater Amperage Setting Range:	1.5A ~ 30.0A (In "OFF" setting, Alarm mode will not operate. OFF when shipped)
Setting Resolution:	0.1A
Setting Tolerance:	±5% FS + 1-digit
Alarm Mode Display:	HB lamp lit
Break Alarm Output:	Contact 240V AC 2.5A (resistive load)1a (In SR41 and 42, common output with Alarm output. However, if SV Bias function is selected in SR41, this function cannot be selected.)

Set Value Bias (Option)

Mode Input:	Non-voltage contact (Closed input/Bias mode)
Setting Range:	±999 or ±99.9 (0 when shipped)
Setting Resolution:	1 or 0.1 (depending on measuring range) (If SR41 is added with Heater Break Alarm function, this function cannot be selected.)

Others

Memory Protection:	Non-volatile memory
Operating Ambient Temperature:	−10°C ~ 50°C
Operating Ambient Humidity:	90% RH maximum (non-condensing)
Power Supply:	90 ~ 264V AC, 50/60Hz
Consumption:	Approximately 4VA
Insulation Resistance:	20M Ω minimum at 500V DC megger between input/output terminals and power supply terminal
Dielectric Strength:	1 minute at 1000V AC between input terminal and power supply terminal 1 minute at 1000V AC between input terminal and output terminal
Material:	Resin molding
External Dimensions:	SR41: H48 × W48 × D109mm, SR42: H72 × W72 × D102mm SR43: H96 × W96 × D72mm, SR44: H96 × W48 × D112mm
Mounting:	Push in panel (no mounting hardware necessary)
Thickness of Panel:	SR41·SR44: 1.0 ~ 3.5mm, SR42·SR43: 1.0 ~ 4.0mm
Cutting:	SR41: 45 × 45mm, SR42: 68 × 68mm, SR43: 92 × 92mm, SR44: 92 × 45mm
Weight:	SR41: approx.150g, SR42: approx. 230g, SR43: approx. 270g, SR44: approx. 240g

2. CODES FOR ORDERING & CODES FOR SELECTABLE MEASURING RANGES

Codes for Ordering

ITEM	CODE								SPECIFICATIONS
SERIES	SR41-	X	X	X					MPU-Based PID Auto-Tuning Controller, DIN 48 × 48
	SR42-								MPU-Based PID Auto-Tuning Controller, DIN 72 × 72
	SR43-								MPU-Based PID Auto-Tuning Controller, DIN 96 × 96
	SR44-								MPU-Based PID Auto-Tuning Controller, DIN 48 × 96
INPUT		1			X				Thermocouples: J, K, L (DIN43710) Input impedance 500kΩmin., Multi-input, Multi-range
		2							R.T.D. Pt100/JPt100, Amperage: 0.25mA
		3							DC Voltage 0 ~ 10mV, Input impedance: 500k Ω min.
		4							DC Current 4 ~ 20mA, Receiving impedance: 250 Ω
		6							DC Voltage 0 ~ 10V, Input impedance: 500k Ω min.
		9							Others (Please consult before ordering.)
									Multi-range
CONTROL OUTPUT			Y-		X?				Contact, 240V AC 2.5A (resistive load), 1A (inductive load)
			P-						SSR voltage, 15V DC ±3V (under 1.5k Ω load) 30mA maximum
			X-						Others (Please consult before ordering.)
ALARM (OPTION)				00					None
				02					Higher limit absolute value
				21					Lower limit deviation value
				22					Higher limit deviation value
				23					Higher & lower deviation values
				29					Within higher & lower deviation limits value
									If SR41 or SR42 is added with the Alarm and Heater Break Alarm function, their output is common. Contact 240V AC 2.5A (resistive load)
HEATER BREAK ALARM & SV BIAS FUNCTION (OPTION)					0				None
					1				Heater Break Alarm: Heater current value setting range 1.5 ~ 30.0A Alarm output/contact 240V AC 2.5A (resistive load)
					2				Set Value Bias function: ±999 or ±99.9 (depending on setting range)
					3				Heater Break Alarm + SV Bias function (Note: Not available for SR41)
					9				Others (Please consult before ordering.)
LEGEND						X	N		None
							C		Temperature in degrees Centigrade °C
							F		Temperature in degrees Fahrenheit °F
							H		Relative Humidity %RH
							X		Others (Please consult before ordering.)
REMARKS								0	Without
								9	With (Please consult befre ordering.)

Codes for Selectable Measuring Ranges

ITEM	CODE	STANDARD
TYPE OF STANDARD	J	JIS JPt100 and thermocouples
	F	JIS '89/IEC Pt100 (new JIS)
	D	DIN
	X	Others (Please consult before ordering.)

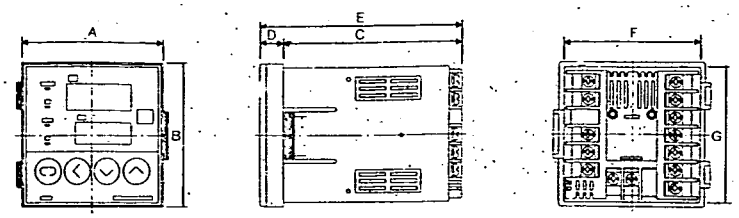
		SET NO.	Type of Input	J	F	D	X	°C/°F
INPUT/ MEASURING RANGE	R.T.D. (MULTI-RANGE)	00	Pt100	○	○	○		0~99.9°C
		01	Pt100	○	○	○		0~200°C
		02	Pt100	○	○	○		0~400°C
		03	Pt100	○	○	○		−19.9~99.9°C
		04	Pt100	○	○	○		−50~50°C
		05	Pt100		○	○		0~800°F
		06	Pt100		○	○		−60~130°F
	THERMOCOUPLE (MULTI-RANGE, MULTI-INPUT)	07	K	○		○		0~400°C
		08	K	○		○		0~999°C
		09	J	○				0~600°C
		10	L (DIN 43710)			○		0~600°C
		11	K	○		○		0~999°F
		12	J	○				0~999°F
	VOLTAGE/CURRENT (MULTI-RANGE)	13	mV, V/mA				○	0~99.9
		14	mV, V/mA				○	0~100
		15	mV, V/mA				○	0~999

* The Series SR40 controllers are designed for user-selectable inputs and user-selectable ranges. Their factory-set ranges are as follows.

	TYPE OF INPUT	MEASURING RANGE	SET NO
THERMOCOUPLE	K	0~400°C/0~999°F	07 / 11
R.T.D.	JPt100	0~99.9°C/0~800°F	00 / 05
VOLTAGE / CURRENT	V, mV/mA	0 ~ 99.9°C	13

3. INSTALLATION

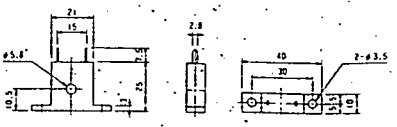
(1) External Dimensions



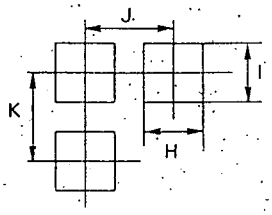
SERIES	A	B	C	D	E	F	G
SR41	48	48	100	9	109	44.8	44.8
SR42	72	72	90	12	102	67.5	67.5
SR43	96	96	60	12	72	91.5	91.5
SR44	48	96	100	12	112	44.5	91.5

Unit : mm

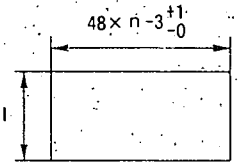
CT (Option)

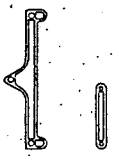


(2) Panel Cutout



When n pieces are installed laterally





SR44 SR41

When the instruments are installed laterally, use the attachment provided.

SERIES	H	I	J	K	PANEL THICKNESS	REMARKS
SR41	45 +0.6 0	45 +0.6 0	—	60 min.	1.0~3.5mm	Can be installed laterally by means of the attachment provided.
SR42	68 +0.7 0	68 +0.7 0	110 min.	100 min.	1.0~4.0mm	——
SR43	92 +0.8 0	92 +0.8 0	130 min.	130 min.	1.0~4.0mm	——
SR44	45 +0.6 0	92 +0.8 0	—	110 min.	1.0~3.5mm	Can be installed laterally by means of the attachment provided.

Unit : mm

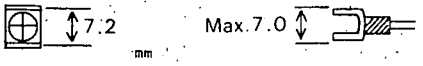
(3) Installation Area

The installation area should:

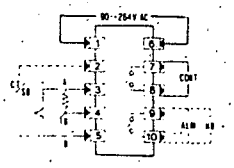
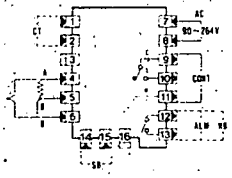
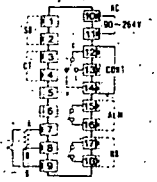
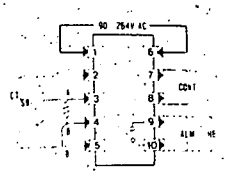
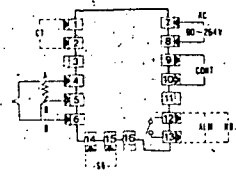
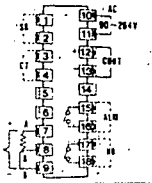
- be free from corrosive gases, soot and dust
- have an ambient temperature of − 10 ° to 50 °C
- have a relative humidity of under 90%
- be free from strong impacts or vibration
- be away from heavy electric circuits and electric fields
- be away from direct sunlight and water vapor

(4) Wiring

- In the case of thermocouple input, use the specified compensating lead.
- In the case of R.T.D. input, use the lead wire where resistance is low and no resistance difference is found between the three wires.
- For connection to the power source, use wire or cable which is equal to or better than 600V vinyl insulated wire (JIS C3307). Use a noise filter in the power source if needed.
- To prevent a noise effect on the input signal line, lay it away from a strong circuit line such as a motor circuit. Do not pass them together through the same conduit or duct. If this cannot be avoided, make sure to use shielded cable.
- For connecting wire to a terminal, the use of a solderless terminal attached with a sleeve (for the 3.5mm terminal screw) is recommended.

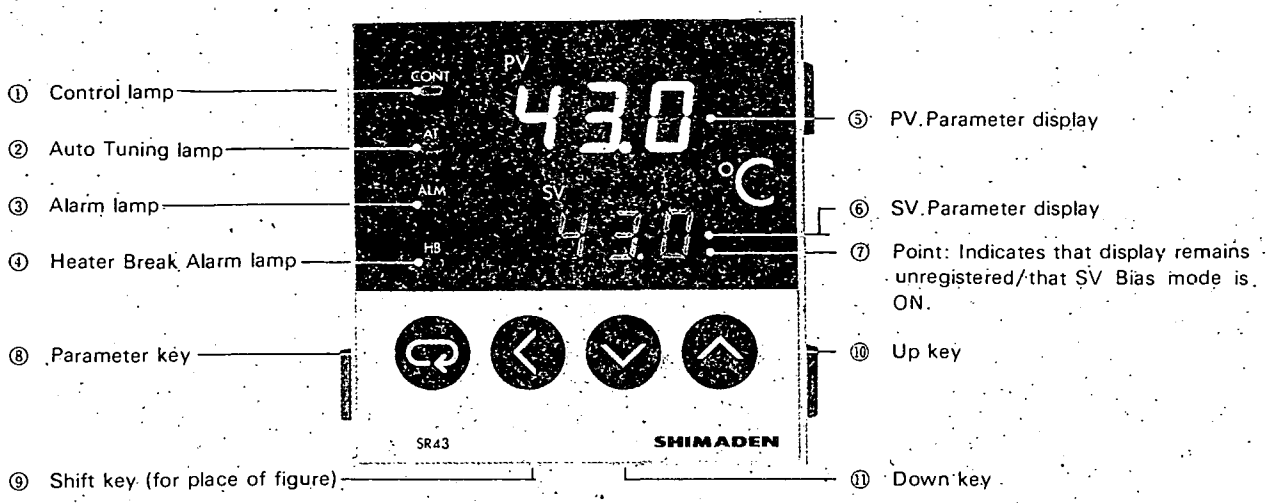


(5) Terminal Arrangement (Those enclosed in dotted lines are terminals to be used when an optional function is added.)

Control Output	SR41	SR42	SR43 & 44
Contact Output Type (Y)			
SSR Voltage Type (P)			

4. NAMES AND FUNCTIONS

(1) Front Panel Information



■ Displays

1. Control lamp: Lit while control output is ON.
2. Auto Tuning lamp: Lit while Auto-Tuning is executed.
3. Alarm lamp: Lit while Alarm output is ON.
4. Heater Break Alarm lamp: Lit while Heater Break Alarm output is ON.
5. PV Parameter Display: Displays the measured temperature. In the SV or parameter setting, types of selectable parameters are displayed.
6. SV Parameter Display: Displays the set temperature. In parameter setting, the value of the parameter is displayed.
7. Unregistration Indicator / SV Bias Mode Indicator: The point flashes when a parameter value is being changed by means of the up key or the down key (before the value is registered), or while the SV Bias input terminal is ON.

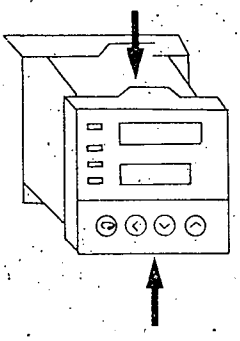
■ Keypad

8. Parameter key: Used to switch a parameter intended to be set or changed and to register a parameter value. Used together with the up key and the down key to select a parameter block.
9. Shift key (for shifting the place of a figure): In setting a parameter value, this moves the place of the figure to be changed.
10. Up key: Increases the value in the SV display. If this key is pressed simultaneously with the parameter key, you can move out from the operation block to the up key block.
11. Down key: Decreases the value in the SV display. If this key is pressed simultaneously with the parameter key, you can move out from the operation block to the down key block.

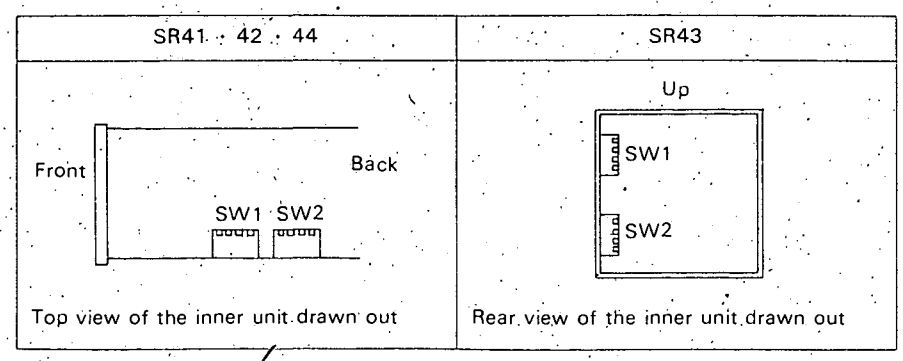
(2) Positions of Internal Switches

The inner unit and the case are connected through a connector. The inner unit can be drawn out while pressing the lock spring under the front panel. To encase the inner unit, push it in slowly until the inner unit and the case are locked together.

Note: Be sure to turn supply to the instrument OFF before drawing out the inner unit. If this is not done, it may cause a problem.



Draw the inner unit out while pressing the lock spring located under the front panel.



Items selectable by SW1 (for setting position, see page 6.)

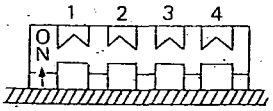
- Input selection for thermocouple input and range selection in case of thermocouple, R.T.D., voltage and current

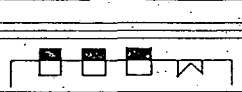
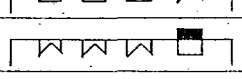
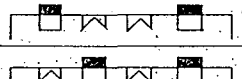
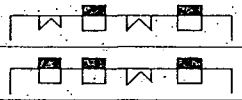
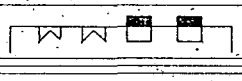
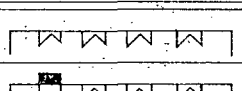
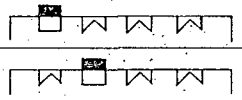
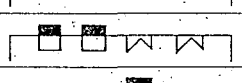
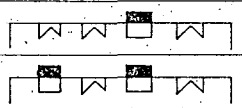
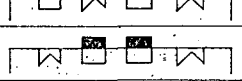
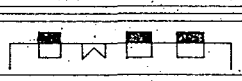
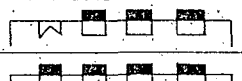
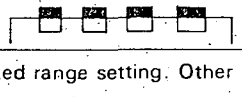
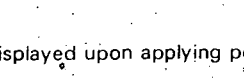
Items selectable by SW2 (for setting position, see page 7.)

- Selection of output characteristics (RA/DA), R.T.D. input standard (JPt100/Pt100 IEC), Alarm (non-inhibit/inhibit) and control method (PID/ON-OFF)

(3) Selection by Internal Switches

· Selection of input type/measuring range by SW1
SR4 △−□△−△△△△△



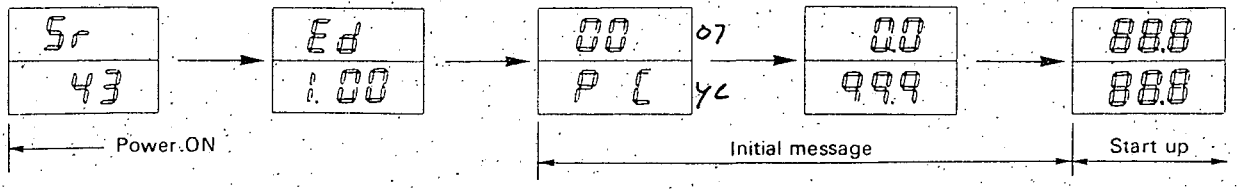
Input Type	Measuring Range	SW1 Setting Position (OFF / ON)	Initial Message: Set No. / Control Output · Legend	Initial Message: Lower Limit of Range, Higher Limit of Range
Thermocouple	K 0 ~ 400 °C *		07 yc	0 400
	K 0 ~ 999 °C		08 P	0 999
	J 0 ~ 600 °C		09 P	0 600
	L 0 ~ 600 °C		10 P	0 600
	K 0 ~ 999 °F		11 P	0 999
	J 0 ~ 999 °F		12 P	0 999
R.T.D. Pt100/JPt100	0 ~ 99.9 °C *		00 P	0.0 999
	0 ~ 200 °C		01 P	0 200
	0 ~ 400 °C		02 P	0 400
	−19.9 ~ 99.9 °C		03 P	-19.9 99.9
	−50 ~ 50 °C		04 P	-50 50
	0 ~ 800 °F		05 P	0 800
	−60 ~ 130 °F		06 P	-60 130
Voltage	0 ~ 99.9 *		13 P	0 99.9
Current	0 ~ 100		14 P	0 100
Voltage	0 ~ 999		15 P	0 999

Note: The instrument is normally supplied with the * marked range setting. Other ranges may be specified when ordering.

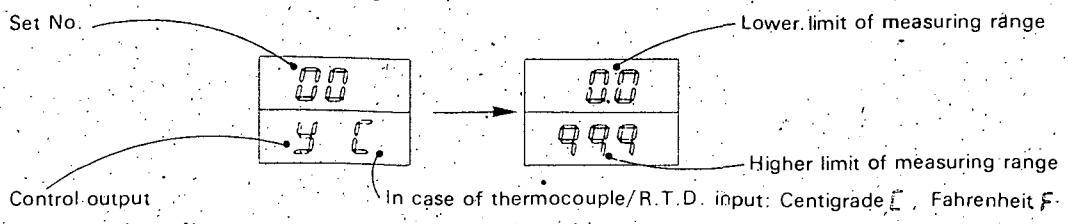
INITIAL MESSAGE

Confirm that the range selected in the initial message which is displayed upon applying power is the intended one.
Initial Message (Upper line: PV display, Lower line: SV display)

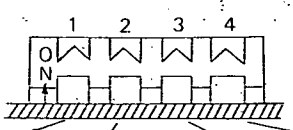
SR 41



Contents of Initial Message



Mode Selection by SW2



Item Selection	Output Characteristics	Input Standard	Alarm Mode	Control Method
OFF 	RA (Reverse action)	JPt 100 (Old JIS)	Non-inhibit	PID
ON 	DA (Direct action)	Pt100/IEC JIS Pt100 (DIN Pt100)	Inhibit	ON-OFF

* All switches are set at "OFF" position when shipped.

OUTPUT CHARACTERISTICS

RA (reverse action): As the Process Value (PV) rises higher above the Set Value (SV), output becomes smaller. In the case of temperature, this is used for the control of heating.

DA (direct action) : As the Process Value (PV) rises higher above the Set Value (SV), output becomes larger. In the case of temperature, this is used for the control of cooling.

INPUT STANDARD

This selection is necessary in the case of R.T.D. input.

JPt100 (old JIS): JIS C1604 1981 Standard

PT100/IEC: JIS C1604 1989 (JIS-'89Pt100) Standard

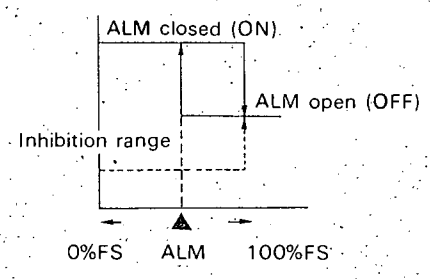
JIS Pt100
(DIN Pt100)

IEC (International Electric Standard) is equivalent to JIS, DIN and ANSI.

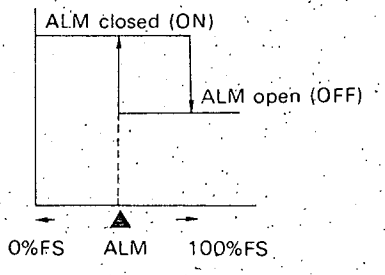
INHIBIT MODE

In the inhibit mode, if the Process Value (PV) is within the alarm output range upon applying power, alarm output is inhibited and alarm is output if it enters the alarm range again after getting out of the range once.

Drawing for output in inhibit mode



Drawing for output in non-inhibit mode



The example shows the lower limit deviation value alarm action.

CONTROL METHOD

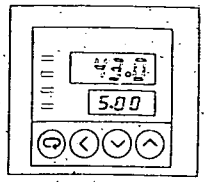
PID: Control is carried out jointly by P (proportional band), I (integral time) and D (derivative time).

ON-OFF: On/Off control

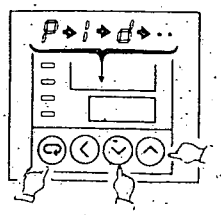
5 Operation and Setting of Front Panel Keys

Follow the procedure of parameter calling, referring to the parameter block diagram and the description of each parameter.

(1) Procedure of Parameter Calling, Value Change and Registration

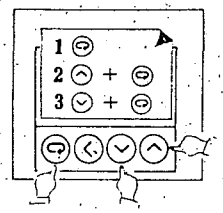


When power is applied, the initial message will be displayed (about 8 seconds), and then PV and SV will be displayed.
(While the initial message is displayed, the operation of the front panel keys is ineffective.)



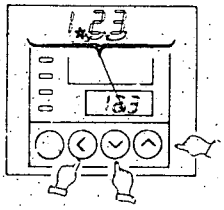
Operate the front panel key while confirming the types of parameters shown in the PV display and numerical data shown in the SV display.

PROCEDURE FOR CALLING A PARAMETER



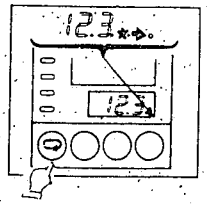
There are three ways of calling a parameter.
1. Press only the (parameter) key.
2. Press the (parameter) key while pressing the (up) key.
3. Press the (parameter) key while pressing the (down) key.

PROCEDURE FOR CHANGING A VALUE



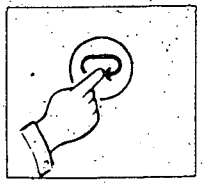
Call up the type of desired parameter in the PV display, and set the desired value of SV displayed value by pressing the (up) key or (down) key.
Pressing the (shift) key moves the place of the figure to be changed.
(When the (up) key, (down) key or (shift) key is pressed, the point beside the figure in the SV display flashes to indicate that the figure can be changed.)

PROCEDURE FOR REGISTERING A VALUE



Confirm that the desired value is displayed and press the (parameter) key to register that value.
Upon pressing the (parameter) key, the point beside the value in the SV display goes out to indicate that the desired value has been registered.
If the (parameter) key is not pressed within 30 seconds, it returns to the value before setting and PV/SV displays are restored.

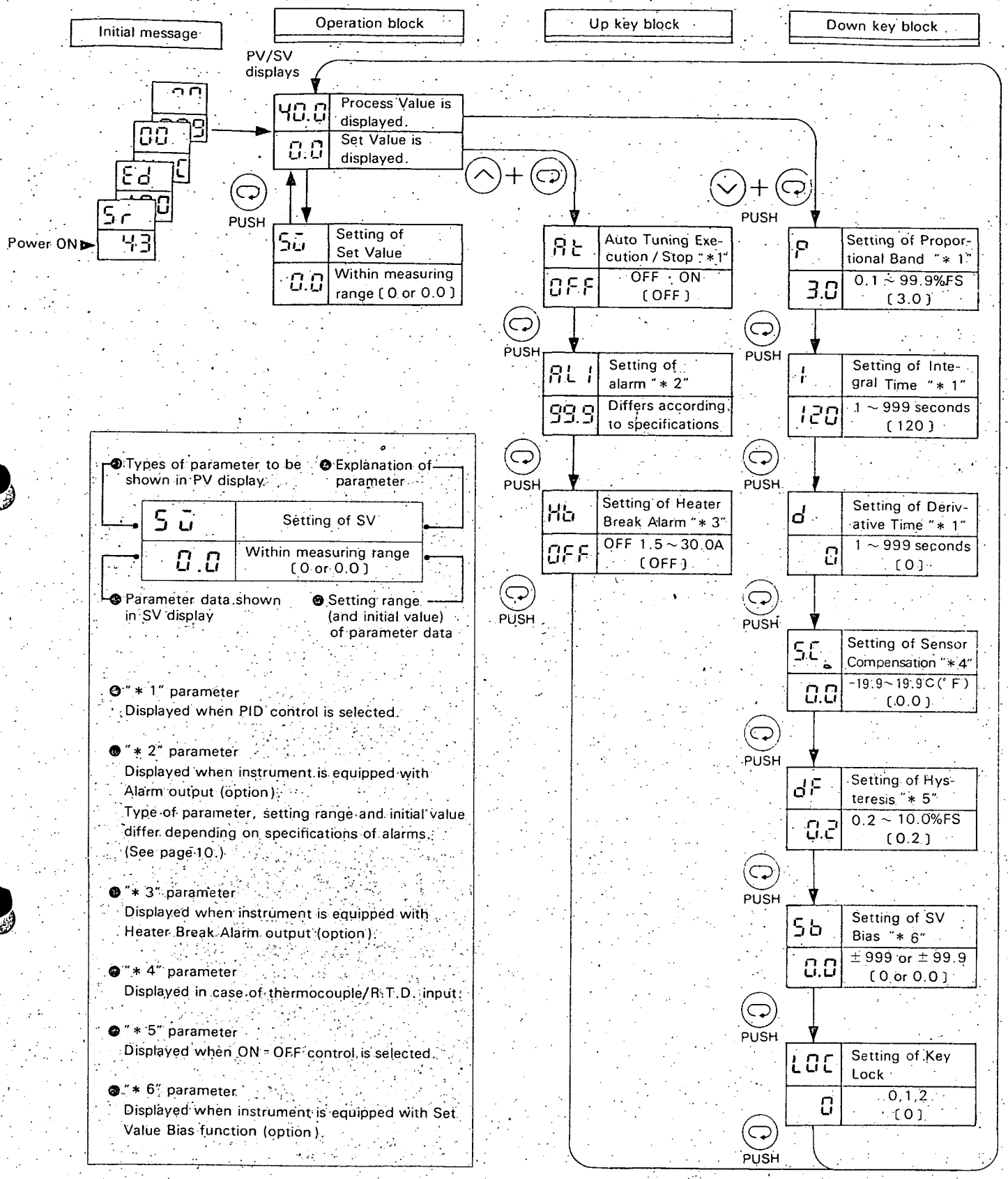
TWO FUNCTIONS OF THE (PARAMETER) KEY



Besides the function to switch types of parameters, the (parameter) key is used for data registration.
(When the (up) key, (down) key or (shift) key is pressed for a change of data, the (parameter) key functions as the data registration key, i.e., by pressing + , + or + .)

Note: Use only your fingers to operate the front panel keys.
Using something hard, such as a screwdriver or a pen, may break a key and put the instrument out of order.
It is not possible to change a setting when Key Lock has been selected or Auto Tuning is being executed.

(2) Parameter Block Diagram



❶ Types of parameter to be shown in PV display
❷ Explanation of parameter
SU Setting of SV
0.0 Within measuring range (0 or 0.0)
❸ Parameter data shown in SV display
❹ Setting range (and initial value) of parameter data

❺ "*1" parameter
Displayed when PID control is selected.

❻ "*2" parameter
Displayed when instrument is equipped with Alarm output (option).
Type of parameter, setting range and initial value differ depending on specifications of alarms.
(See page 10.)

❼ "*3" parameter
Displayed when instrument is equipped with Heater Break Alarm output (option).

❽ "*4" parameter
Displayed in case of thermocouple/R.T.D. input.

❾ "*5" parameter
Displayed when ON - OFF control is selected.

❿ "*6" parameter
Displayed when instrument is equipped with Set Value Bias function (option).

(3) Parameters

Displays in the upper column are shown in the PV display and those in the lower column are shown in the SV display.

· Parameters in the Operation Block

PV/SV displays are only for monitoring, and do not allow values on display to be changed.
Press the ⟲ key to set/change a value. When the ⟲ key is pressed again, it returns to the PV/SV displays.

· Setting of Set Value (SV)
Initial value: 0 or 0.0 (depending on measuring range)
Setting range: Within measuring range

· Parameters in the ⌃ (Up) Key Block

In the PV/SV display, press the ⟲ key while pressing the ⌃ key (⌃ + ⟲). Thereafter, the parameter changes every time the ⟲ key is pressed.

· Auto Tuning (AT) Initial value: OFF
This is displayed when PID control is selected.
Execution of Auto Tuning: On Stop or termination of Auto Tuning: OFF

· Setting of Alarm
This is displayed when the instrument is equipped with the alarm function (option).

Type of Alarm	Parameter Display and Initial Value	Setting Range (differs depending on measuring range)	Alarm Action △: SV (main setting) ▲: ALM (alarm setting)
Higher limit deviation alarm	AL1 / 99.9 or 999	0.0 ~ 99.9 or 0 ~ 999	OFF (ALM open) ← S → ON (ALM closed)
Lower limit deviation alarm *	AL2 / (-)99.9 or (-)999	0.0 ~ −99.9 or 0 ~ −999	ON (ALM closed) ← S → OFF (ALM open)
Higher / lower limit deviation alarm	AL3 / 50.0 or 500	0.1 ~ 50.0 or 1 ~ 500	ON (ALM closed) ← S → OFF (ALM open) ← S → ON (ALM closed)
Alarm within higher lower limits of deviation	AL4 / 0.1 or 1	0.1 ~ 50.0 or 1 ~ 500	OFF (ALM open) ← S → ON (ALM closed) ← S → OFF (ALM open)
Higher limit absolute value alarm	AL5 / Higher limit value of measuring range	Within measuring range	OFF (ALM open) ← S → ON (ALM closed)

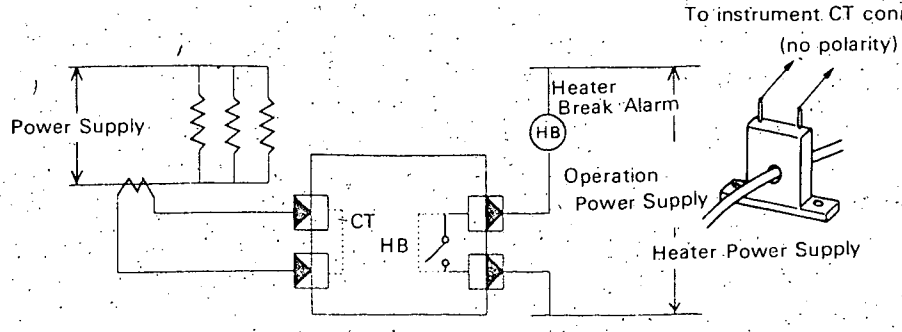
S (Alarm hysteresis): 0.3% fixed

A type of alarm (AL1 ~ AL5) should be designated when ordering.

Note * : The minus code (−) is not shown in numerical data in the SV display.

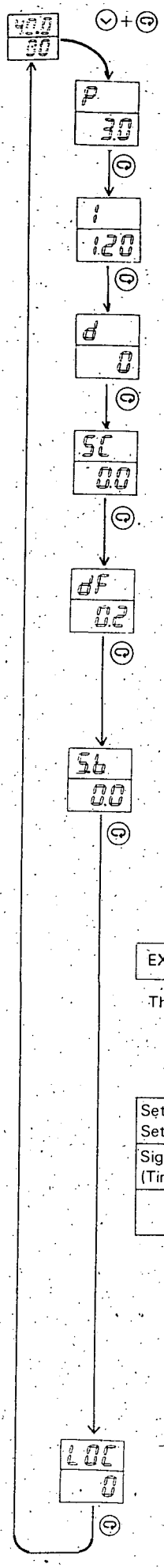
The ALM lamp is lit while the Alarm mode is ON (ALM closed) and goes out when it is turned OFF (ALM open).

· Setting of Heater Break Alarm (HB) Initial value: OFF
This is displayed when the instrument is equipped with the Heater Break Alarm function (option).
Stop of Heater Break Alarm action: OFF Setting range of heater current: 1.5A ~ 30.0A
When the heater is broken and the load current falls below the Set Value of the heater current, the HB terminal is short circuited and the HB lamp lights.
Once a Heater Break Alarm is output, it is maintained as long as the power is ON. To release it, the power should be turned OFF or the Set Value of heater current should be either changed or turned to OFF.



- Use the CT (current trans) provided.
- Lay the CT cable away from the power supply and load cable.
- Heater power line must be wired through the CT as illustrated on the left.

Parameters in the (Down) Key Block



+ In the PV/SV display, press the key while pressing the key. Thereafter, the parameter changes every time the key is pressed.

· Setting of Proportional Band (P)

Initial value: 3.0% FS

This is displayed when PID control is selected.
Setting range: 0.1 ~ 99.9% FS

· Setting of Integral Time (I)

Initial value: 120 sec.

This is displayed when PID control is selected.
Setting range: 1 ~ 999 sec. (0 sec. cannot be set.)

· Setting of Derivative Time (D)

Initial value: 0 sec.

This is displayed when PID control is selected.
Setting range: 0 ~ 999 sec. (PI control is carried out when this is set at 0 sec.)

· Setting of Sensor Compensation (SC)

Initial Value: 0.0°C (°F)

This is displayed in the case of thermocouple/R.T.D. input.
Setting range: − 19.9 ~ 19.9°C (°F)
Examples: If the sensor compensation is set at 5.0°C, PV value becomes input value + 5.0°C.
If the sensor compensation is set at − 5.0°C, PV value becomes input value − 5.0°C.

· Setting of Differential Gap (DF)

Initial value: 0.2% FS

This is displayed when ON-OFF control is selected.
Setting range: 0.2 ~ 10.0% FS
Note: DF means the difference between the positions of the ON and OFF actions. If this is too narrow, the frequency of ON-OFF switching increases and, particularly in contact output, shortens the life of the relay.

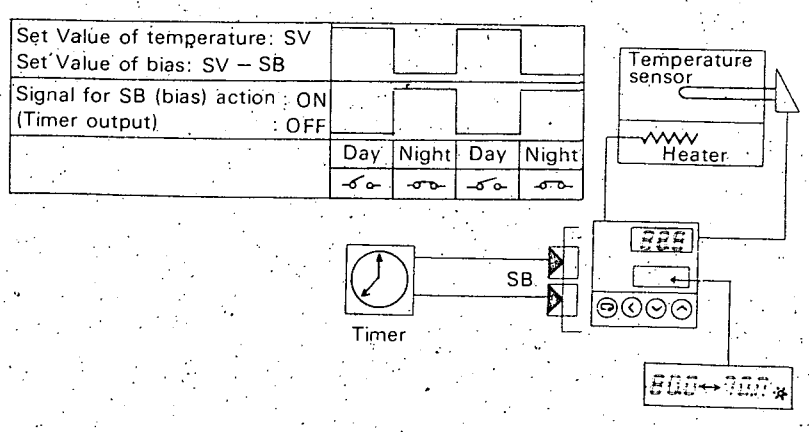
· Setting of Set Value Bias (SB)

Initial value: 0.0 or 0

This is displayed when the instrument is equipped with the SV Bias function (option).
Setting range: − 99.9 ~ 99.9 or − 999 ~ 999 (depending on measuring range)
Examples: If the SV Bias is set at 5.0°C, SV value becomes SV + 5.0°C while the SV Bias is functioning.
If the SV Bias is set at − 5.0°C, SV value becomes SV − 5.0°C while the SV Bias is functioning.
(When a minus figure is set, the minus code is shown on the PV display.)

EXAMPLE OF TEMPERATURE SWITCH BETWEEN DAY AND NIGHT

The Set Value is set at 80.0°C and the SV Bias at − 10.0°C.



Note:
- The SV Bias is put to function when the SB terminal is turned ON (short circuit).
- While the SV Bias is functioning, and the PV/SV display is ON, the point on the lower right side of the SV display flashes.
- When the value added to (subtracted from) the SV Bias gets out of the measuring range, the 100% FS (0% FS) thus limited serves as the Set Value.
- The alarm function continues to be workable even when the SV Bias is functioning.

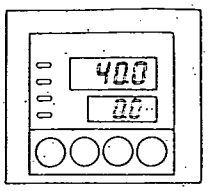
· Setting of Key Lock (LOC)

Initial value: 0

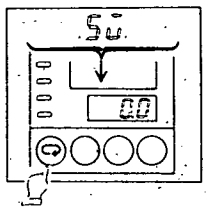
When Key Lock is set at LOC 1, no parameter data can be changed.
When Key Lock is set at LOC 2, no parameter data except Set Value (SV) can be changed.
Key Lock is released by setting at LOC 0.

6 Operation

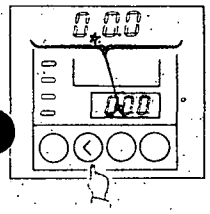
(1) Setting of Set Value (SV)



· Apply power and confirm that the PV/SV displays are on.

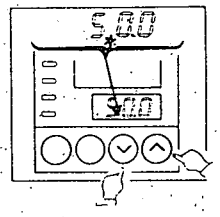


· Press the ⓒ key and change the PV display to the SV setting parameter.

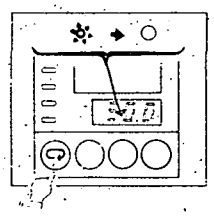


· In the SV display, you can change to the desired value by means of the ⓐ or ⓑ key. When the ⓓ key is pressed, the place of the figure to be changed is moved.

(When the ⓓ key is pressed, the point in the place of the figure that can be changed flashes in the SV display.)



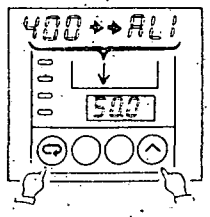
· The example shows that the Set Value (SV) is set at 50.0°C.



· When the figure in the SV display has been changed to the desired value, register the value by pressing the ⓒ key.

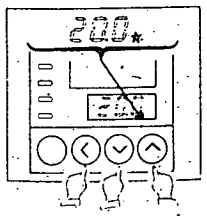
(The point stops flashing and operation is started with the registered value.)

(2) Setting of Alarm (ALM)



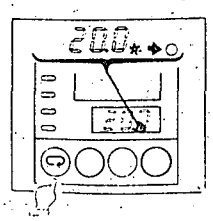
· In the PV/SV display, press the ⓒ key while pressing the ⓐ key to change it to an alarm setting parameter in the up key block.

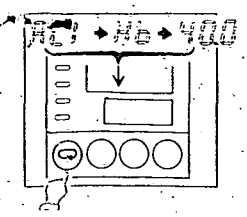
The example shows the setting of higher limit deviation alarm. (A different parameter code is displayed according to the alarm specifications.)



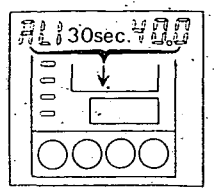
· In the SV display, change the figure to the desired value and register the value by pressing the ⓒ key.

The example shows that the higher limit deviation alarm value is set at 20.0°C. If the Set Value (SV) is 50.0°C, the alarm output level is 50.0°C + 20.0°C = 70.0°C. Therefore, when a Process Value (PV) exceeds 70.0°C, an alarm is output (ALM closed).



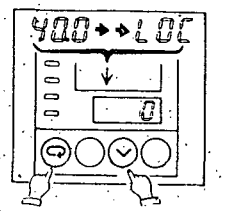


- To return to the PV/SV display, press the ↩ key while watching the parameter codes. (The parameter code changes every time the ↩ key is pressed.)

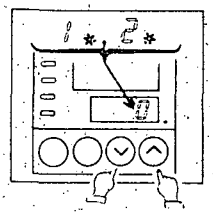


- The PV/SV display is restored automatically if none of the front panel keys is pressed within 30 seconds.

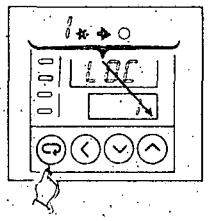
(3) Setting of Key Lock



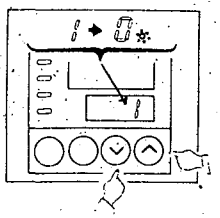
- This is set after all the parameters have been set.
  In the PV/SV display, press the ↩ key while pressing the ∨ key, to bring the Key Lock parameter in the down key block onto display.



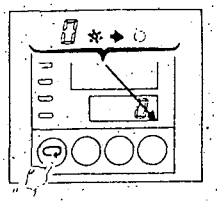
- Select a desired Key Lock condition (see page11) while watching the value in the SV display. When the ↩ key is pressed, the Key Lock condition is set.



The example shows that Key Lock 1 is set.



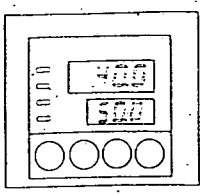
- To release the Key Lock condition, call up the Key Lock parameter display, change the figure on the SV display to 0 and press the ↩ key.



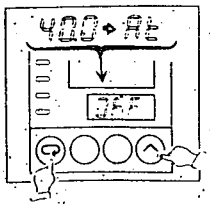
The example shows that Key Lock condition 1 is released.
(The same procedure is applicable to Key Lock condition 2.)

(4) Execution of Auto Tuning

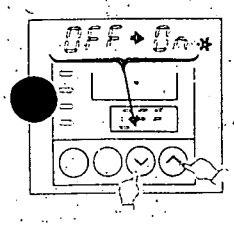
This instrument is built with a microprocessor and has the Auto Tuning function to automatically compute optimum PID values and register them.



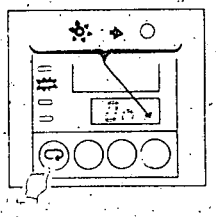
· This is carried out after completing the setting of all the parameters except PID values and Key Lock.



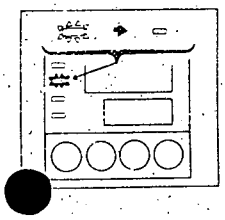
· In the PV/SV display, press the ⟲ key while pressing the ⌃ key to bring the Auto Tuning parameter onto display.



· "OFF" is shown in the SV display. Change the "OFF" code in the SV display to "ON" by pressing the ⌃ or ⌄ key. Then press the ⟲ key to execute Auto Tuning.



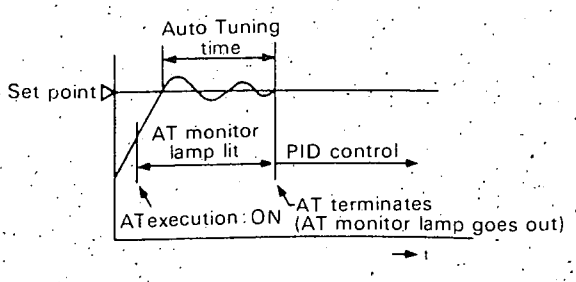
· When the ⟲ key is pressed with "ON" on display, the point on the lower right side in the SV display goes out and Auto Tuning starts.
The AT lamp is lit to indicate that Auto Tuning is being executed.



· The ON-OFF control functions and when it completes a limit cycle, the AT lamp goes out and Auto Tuning terminates. The PID values computed during Auto Tuning are automatically registered with the respective PID.

AT: PID AUTO TUNING FUNCTION

PID Auto Tuning shows the following characteristics.



· In the operation of Auto Tuning, the limit cycle method is used. When Auto Tuning is executed, after the operation is carried out by repeating the ON-OFF action in two cycles if PV / SV during the execution and 1.5 cycles if PV / SV to take data in, PID values are automatically computed. The Auto Tuning time is decided by the time constant of the process.

· If overshoot and undershoot are not allowed, terminate Auto Tuning earlier, or set the PID constant value manually.

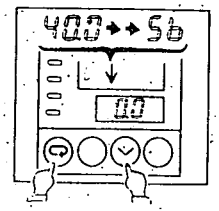
· PID values computed during Auto Tuning are optimum values, or common measures as it were. For some types of processes, better results may be obtained when PID values computed during Auto Tuning are amended manually before their use.

Note: 1. If power failure or overrange occurs during the execution of Auto Tuning, Auto Tuning will be released.
2. If output is at 0% or 100% continuously for more than 2 hours during the execution of Auto Tuning, Auto Tuning will be released automatically and the PID values will return to the previous ones.
3. When ON-OFF control has been selected, operation of Auto Tuning Parameter is not displayed.

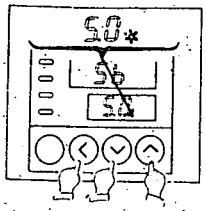
4. While Auto Tuning is functioning, no setting other than its execution and stop can be changed.
5. To release Auto Tuning during operation, select OFF of the Auto Tuning parameter in the SV display and press the ⟲ key. Auto Tuning is released (the AT lamp goes off) and the PID values return to the previous ones.
6. If AT is executed again while Auto Tuning is functioning, AT is not restarted but just continues.
7. When power is turned ON again, operation is resumed with the parameters of the preceding operation with the assistance of the non-volatile memory.

(5) Operation by Set Value Bias

This feature provides the user with the ability to bias the set point figure by plus or minus 'x' amount. This is made operative by closing an external contact.
This feature is useful where two different set points are required and are frequently changed.

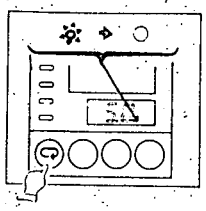


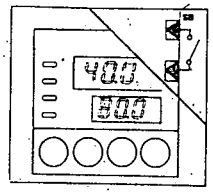
- In the PV/SV display, press the ⟲ key while pressing the ⌄ key to bring the SV-Bias parameter in the down key block onto display.

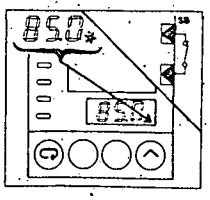


- In the SV display, set the desired value and register it by pressing the ⟲ key.

The example shows that SV Bias is set at 5.0 °C. If the Set Value (SV) is 80.0 °C, the Set Value while SV Bias is functioning (SB closed) will become 80.0 °C + 5.0 °C = 85.0 °C.







- While the SV Bias is functioning, the point on the lower right side in the SV display flashes to indicate that SV Bias is functioning.

The SV Bias function becomes ineffective during the execution of Auto Tuning.

7 Error Display

When the PV (Process Value) exceeds the measuring range, the following will be displayed.

Process Value (PV)	PV Display	Applicable Range
− 5%FS ≧ PV	L L −	All ranges
− 5%FS < PV < 0%FS	L −	− 19.9 ~ 99.9
	PV value on display	All ranges except − 19.9 ~ 99.9
− 100%FS < PV < 105%FS	H − −	0 ~ 99.9 / − 19.9 ~ 99.9 / 0 ~ 999
	PV value on display	All ranges except 0 ~ 99.9 / − 19.9 ~ 99.9 / 0 ~ 999
PV ≧ 105%FS	H H −	All ranges

Note: When L L − or H H − is displayed, control output becomes 0% regardless of the characteristics (RA/DA) and the alarm (option) is output. If Auto Tuning is executed at the time, Auto Tuning will be released.

8 Check Items in Troubleshooting

When something is found to be malfunctioning, check the input and output connections and wiring for a possible error, and check that no terminal is loosened. Then, go through the contents of the settings concerned. If the problem cannot be identified, turn the power OFF and apply power again to make sure.

MALFUNCTION	ITEMS TO BE CHECKED	REFERENCE PAGE
Error is found in PV.	· Check type & standard of input. · Check Sensor Compensation value.	P. 7 P. 11
Output does not change or is in wrong direction.	· Check output characteristics (RA / DA).	P. 7
SV cannot be changed.	· Is procedure in order? · Is Key Lock in effect? · Is Auto Tuning in operation?	P. 8, P. 12 & P. 13 P. 11, P. 12 & P. 13 P. 14
Alarm is not output.	· Check inhibit / non-inhibit. · Check alarm Set Value.	P. 7 P. 10
No operation	· Check power source. · Is inner unit encased properly?	P. 4 P. 5
Part of display (segment) is missing.	· Instrument should be either repaired or replaced.	

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SHIMADEN CO., LTD.
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Phone: (03) 3931-9111 Fax: (03) 3937-1240 Telex: 02722778 SDCL J

USED IN ALTERNATOR

Type K Thermocouples, Chromel /

Temperature in Degrees Celsius (IPTS 1968)

EMF in Absolute Millivolts — Reference Junctions at 0 C

DEG C	0	1	2	3	4	5	6	7	8	9	10	DEG C
	THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS											
-270	-6.458											-270
-260	-6.441	-6.444	-6.446	-6.448	-6.450	-6.452	-6.453	-6.455	-6.456	-6.457	-6.458	-260
-250	-6.404	-6.408	-6.413	-6.417	-6.421	-6.425	-6.429	-6.432	-6.435	-6.438	-6.441	-250
-240	-6.344	-6.351	-6.358	-6.364	-6.371	-6.377	-6.382	-6.388	-6.394	-6.399	-6.404	-240
-230	-6.262	-6.271	-6.280	-6.289	-6.297	-6.306	-6.314	-6.322	-6.329	-6.337	-6.344	-230
-220	-6.158	-6.170	-6.181	-6.192	-6.202	-6.213	-6.223	-6.233	-6.243	-6.253	-6.262	-220
-210	-6.035	-6.048	-6.061	-6.074	-6.087	-6.099	-6.111	-6.123	-6.135	-6.147	-6.158	-210
-200	-5.891	-5.907	-5.922	-5.936	-5.951	-5.965	-5.980	-5.994	-6.007	-6.021	-6.035	-200
-190	-5.730	-5.747	-5.763	-5.780	-5.796	-5.813	-5.829	-5.845	-5.860	-5.876	-5.891	-190
-180	-5.550	-5.569	-5.587	-5.606	-5.624	-5.642	-5.660	-5.678	-5.695	-5.712	-5.730	-180
-170	-5.354	-5.374	-5.394	-5.414	-5.434	-5.454	-5.474	-5.493	-5.512	-5.531	-5.550	-170
-160	-5.141	-5.163	-5.185	-5.207	-5.228	-5.249	-5.271	-5.292	-5.313	-5.333	-5.354	-160
-150	-4.912	-4.936	-4.959	-4.983	-5.006	-5.029	-5.051	-5.074	-5.097	-5.119	-5.141	-150
-140	-4.669	-4.694	-4.719	-4.743	-4.768	-4.792	-4.817	-4.841	-4.865	-4.889	-4.912	-140
-130	-4.410	-4.437	-4.463	-4.489	-4.515	-4.541	-4.567	-4.593	-4.618	-4.644	-4.669	-130
-120	-4.138	-4.166	-4.193	-4.221	-4.248	-4.276	-4.303	-4.330	-4.357	-4.384	-4.410	-120
-110	-3.852	-3.881	-3.910	-3.939	-3.968	-3.997	-4.025	-4.053	-4.082	-4.110	-4.138	-110
-100	-3.553	-3.584	-3.614	-3.644	-3.674	-3.704	-3.734	-3.764	-3.793	-3.823	-3.852	-100
-90	-3.242	-3.274	-3.305	-3.337	-3.368	-3.399	-3.430	-3.461	-3.492	-3.523	-3.553	-90
-80	-2.920	-2.953	-2.985	-3.018	-3.050	-3.082	-3.115	-3.147	-3.179	-3.211	-3.242	-80
-70	-2.586	-2.620	-2.654	-2.687	-2.721	-2.754	-2.788	-2.821	-2.854	-2.887	-2.920	-70
-60	-2.243	-2.277	-2.312	-2.347	-2.381	-2.416	-2.450	-2.484	-2.518	-2.552	-2.586	-60
-50	-1.889	-1.925	-1.961	-1.996	-2.032	-2.067	-2.102	-2.137	-2.173	-2.208	-2.243	-50
-40	-1.527	-1.563	-1.600	-1.636	-1.673	-1.709	-1.745	-1.781	-1.817	-1.853	-1.889	-40
-30	-1.156	-1.193	-1.231	-1.268	-1.305	-1.342	-1.379	-1.416	-1.453	-1.490	-1.527	-30
-20	-0.777	-0.816	-0.854	-0.892	-0.930	-0.968	-1.005	-1.043	-1.081	-1.118	-1.156	-20
-10	-0.392	-0.431	-0.469	-0.508	-0.547	-0.585	-0.624	-0.662	-0.701	-0.739	-0.777	-10
- 0	0.000	-0.039	-0.079	-0.118	-0.157	-0.197	-0.236	-0.275	-0.314	-0.353	-0.392	- 0
0	0.000	0.039	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.357	0.397	0
10	0.397	0.437	0.477	0.517	0.557	0.597	0.637	0.677	0.718	0.758	0.798	10
20	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122	1.162	1.203	20
30	1.203	1.244	1.285	1.325	1.366	1.407	1.448	1.489	1.529	1.570	1.611	30
40	1.611	1.652	1.693	1.734	1.776	1.817	1.858	1.899	1.940	1.981	2.022	40
50	2.022	2.064	2.105	2.146	2.188	2.229	2.270	2.312	2.353	2.394	2.436	50
60	2.436	2.477	2.519	2.560	2.601	2.643	2.684	2.726	2.767	2.809	2.850	60
70	2.850	2.892	2.933	2.975	3.016	3.058	3.100	3.141	3.183	3.224	3.266	70
80	3.266	3.307	3.349	3.390	3.432	3.473	3.515	3.556	3.598	3.639	3.681	80
90	3.681	3.722	3.764	3.805	3.847	3.888	3.930	3.971	4.012	4.054	4.095	90
100	4.095	4.137	4.178	4.219	4.261	4.302	4.343	4.384	4.426	4.467	4.508	100
110	4.508	4.549	4.590	4.632	4.673	4.714	4.755	4.796	4.837	4.878	4.919	110
120	4.919	4.960	5.001	5.042	5.083	5.124	5.164	5.205	5.246	5.287	5.327	120
130	5.327	5.368	5.409	5.450	5.490	5.531	5.571	5.612	5.652	5.693	5.733	130
140	5.733	5.774	5.814	5.855	5.895	5.936	5.976	6.016	6.057	6.097	6.137	140
150	6.137	6.177	6.218	6.258	6.298	6.338	6.378	6.419	6.459	6.499	6.539	150
160	6.539	6.579	6.619	6.659	6.699	6.739	6.779	6.819	6.859	6.899	6.939	160
170	6.939	6.979	7.019	7.059	7.099	7.139	7.179	7.219	7.259	7.299	7.338	170
180	7.338	7.378	7.418	7.458	7.498	7.538	7.578	7.618	7.658	7.697	7.737	180
190	7.737	7.777	7.817	7.857	7.6[illegible]	7.937	7.977	8.017	8.057	8.097	8.137	190
200	8.137	8.177	8.216	8.256	8.296	8.336	8.376	8.416	8.456	8.497	8.537	200
210	8.537	8.577	8.617	8.657	8.697	8.737	8.777	8.817	8.857	8.898	8.938	210
220	8.938	8.978	9.018	9.058	9.099	9.139	9.179	9.220	9.260	9.300	9.341	220
230	9.341	9.381	9.421	9.462	9.502	9.543	9.583	9.624	9.664	9.705	9.745	230
240	9.745	9.786	9.826	9.867	9.907	9.948	9.989	10.029	10.070	10.111	10.151	240
250	10.151	10.192	10.233	10.274	10.315	10.355	10.396	10.437	10.478	10.519	10.560	250
260	10.560	10.600	10.641	10.682	10.723	10.764	10.805	10.846	10.887	10.928	10.969	260
270	10.969	11.010	11.051	11.093	11.134	11.175	11.216	11.257	11.298	11.339	11.381	270
280	11.381	11.422	11.463	11.504	11.546	11.587	11.628	11.669	11.711	11.752	11.793	280
290	11.793	11.835	11.876	11.918	11.959	12.000	12.042	12.083	12.125	12.166	12.207	290
300	12.207	12.249	12.290	12.332	12.373	12.415	12.456	12.498	12.539	12.581	12.623	300
310	12.623	12.664	12.706	12.747	12.789	12.831	12.872	12.914	12.955	12.997	13.039	310
320	13.039	13.080	13.122	13.164	13.205	13.247	13.289	13.331	13.372	13.414	13.456	320
330	13.456	13.497	13.539	13.581	13.623	13.665	13.706	13.748	13.790	13.832	13.874	330
340	13.874	13.915	13.957	13.999	14.041	14.083	14.125	14.167	14.208	14.250	14.292	340
DEG C	0	1	2	3	4	5	6	7	8	9	10	DEG C

Type K Thermocouples *Continued*

Temperature in Degrees Celsius (IPTS 1968)

EMF in Absolute Millivolts — Reference Junctions at 0 C

DEG C	0	1	2	3	4	5	6	7	8	9	10	DEG C
	THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS											
350	14.292	14.334	14.376	14.418	14.460	14.502	14.544	14.586	14.628	14.670	14.712	350
360	14.712	14.754	14.796	14.838	14.880	14.922	14.964	15.006	15.048	15.090	15.132	360
370	15.132	15.174	15.216	15.258	15.300	15.342	15.384	15.426	15.468	15.510	15.552	370
380	15.552	15.594	15.636	15.679	15.721	15.763	15.805	15.847	15.889	15.931	15.974	380
390	15.974	16.016	16.058	16.100	16.142	16.184	16.227	16.269	16.311	16.353	16.395	390
400	16.395	16.438	16.480	16.522	16.564	16.607	16.649	16.691	16.733	16.776	16.818	400
410	16.818	16.860	16.902	16.945	16.987	17.029	17.072	17.114	17.156	17.199	17.241	410
420	17.241	17.283	17.326	17.368	17.410	17.453	17.495	17.537	17.580	17.622	17.664	420
430	17.664	17.707	17.749	17.792	17.834	17.876	17.919	17.961	18.004	18.046	18.088	430
440	18.088	18.131	18.173	18.216	18.258	18.301	18.343	18.385	18.428	18.470	18.513	440
450	18.513	18.555	18.598	18.640	18.683	18.725	18.768	18.810	18.853	18.895	18.938	450
460	18.938	18.980	19.023	19.065	19.108	19.150	19.193	19.235	19.278	19.320	19.363	460
470	19.363	19.405	19.448	19.490	19.533	19.576	19.618	19.661	19.703	19.746	19.788	470
480	19.788	19.831	19.873	19.916	19.959	20.001	20.044	20.086	20.129	20.172	20.214	480
490	20.214	20.257	20.299	20.342	20.385	20.427	20.470	20.512	20.555	20.598	20.640	490
500	20.640	20.683	20.725	20.768	20.811	20.853	20.896	20.938	20.981	21.024	21.066	500
510	21.066	21.109	21.152	21.194	21.237	21.280	21.322	21.365	21.407	21.450	21.493	510
520	21.493	21.535	21.578	21.621	21.663	21.706	21.749	21.791	21.834	21.876	21.919	520
530	21.919	21.962	22.004	22.047	22.090	22.132	22.175	22.218	22.260	22.303	22.346	530
540	22.346	22.388	22.431	22.473	22.516	22.559	22.601	22.644	22.687	22.729	22.772	540
550	22.772	22.815	22.857	22.900	22.942	22.985	23.028	23.070	23.113	23.156	23.198	550
560	23.198	23.241	23.284	23.326	23.369	23.411	23.454	23.497	23.539	23.582	23.624	560
570	23.624	23.667	23.710	23.752	23.795	23.837	23.880	23.923	23.965	24.008	24.050	570
580	24.050	24.093	24.136	24.178	24.221	24.263	24.306	24.348	24.391	24.434	24.476	580
590	24.476	24.519	24.561	24.604	24.646	24.689	24.731	24.774	24.817	24.859	24.902	590
600	24.902	24.944	24.987	25.029	25.072	25.114	25.157	25.199	25.242	25.284	25.327	600
610	25.327	25.369	25.412	25.454	25.497	25.539	25.582	25.624	25.666	25.709	25.751	610
620	25.751	25.794	25.836	25.879	25.921	25.964	26.006	26.048	26.091	26.133	26.176	620
630	26.176	26.218	26.260	26.303	26.345	26.387	26.430	26.472	26.515	26.557	26.599	630
640	26.599	26.642	26.684	26.726	26.769	26.811	26.853	26.896	26.938	26.980	27.022	640
650	27.022	27.065	27.107	27.149	27.192	27.234	27.276	27.318	27.361	27.403	27.445	650
660	27.445	27.487	27.529	27.572	27.614	27.656	27.698	27.740	27.783	27.825	27.867	660
670	27.867	27.909	27.951	27.993	28.035	28.078	28.120	28.162	28.204	28.246	28.288	670
680	28.288	28.330	28.372	28.414	28.456	28.498	28.540	28.583	28.625	28.667	28.709	680
690	28.709	28.751	28.793	28.835	28.877	28.919	28.961	29.002	29.044	29.086	29.128	690
700	29.128	29.170	29.212	29.254	29.296	29.338	29.380	29.422	29.464	29.505	29.547	700
710	29.547	29.589	29.631	29.673	29.715	29.756	29.798	29.840	29.882	29.924	29.965	710
720	29.965	30.007	30.049	30.091	30.132	30.174	30.216	30.257	30.299	30.341	30.383	720
730	30.383	30.424	30.466	30.508	30.549	30.591	30.632	30.674	30.716	30.757	30.799	730
740	30.799	30.840	30.882	30.924	30.965	31.007	31.048	31.090	31.131	31.173	31.214	740
750	31.214	31.256	31.297	31.339	31.380	31.422	31.463	31.504	31.546	31.587	31.629	750
760	31.629	31.670	31.712	31.753	31.794	31.836	31.877	31.918	31.960	32.001	32.042	760
770	32.042	32.084	32.125	32.166	32.207	32.249	32.290	32.331	32.372	32.414	32.455	770
780	32.455	32.496	32.537	32.578	32.619	32.661	32.702	32.743	32.784	32.825	32.866	780
790	32.866	32.907	32.948	32.990	33.031	33.072	33.113	33.154	33.195	33.236	33.277	790
800	33.277	33.318	33.359	33.400	33.441	33.482	33.523	33.564	33.604	33.645	33.686	800
810	33.686	33.727	33.768	33.809	33.850	33.891	33.931	33.972	34.013	34.054	34.095	810
820	34.095	34.136	34.176	34.217	34.258	34.299	34.339	34.380	34.421	34.461	34.502	820
830	34.502	34.543	34.583	34.624	34.665	34.705	34.746	34.787	34.827	34.868	34.909	830
840	34.909	34.949	34.990	35.030	35.071	35.111	35.152	35.192	35.233	35.273	35.314	840
850	35.314	35.354	35.395	35.435	35.476	35.516	35.557	35.597	35.637	35.678	35.718	850
860	35.718	35.758	35.799	35.839	35.880	35.920	35.960	36.000	36.041	36.081	36.121	860
870	36.121	36.162	36.202	36.242	36.282	36.323	36.363	36.403	36.443	36.483	36.524	870
880	36.524	36.564	36.604	36.644	36.684	36.724	36.764	36.804	36.844	36.885	36.925	880
890	36.925	36.965	37.005	37.045	37.085	37.125	37.165	37.205	37.245	37.285	37.325	890
900	37.325	37.365	37.405	37.445	37.484	37.524	37.564	37.604	37.644	37.684	37.724	900
910	37.724	37.764	37.803	37.843	37.883	37.923	37.963	38.002	38.042	38.082	38.122	910
920	38.122	38.162	38.201	38.241	38.281	38.320	38.360	38.400	38.439	38.479	38.519	920
930	38.519	38.558	38.598	38.638	38.677	38.717	38.756	38.796	38.836	38.875	38.915	930
940	38.915	38.954	38.994	39.033	39.073	39.112	39.152	39.191	39.231	39.270	39.310	940
950	39.310	39.349	39.388	39.428	39.467	39.507	39.546	39.585	39.625	39.664	39.703	950
960	39.703	39.743	39.782	39.821	39.861	39.900	39.939	39.979	40.018	40.057	40.096	960
970	40.096	40.136	40.175	40.214	40.253	40.292	40.332	40.371	40.410	40.449	40.488	970
980	40.488	40.527	40.566	40.605	40.645	40.684	40.723	40.762	40.801	40.840	40.879	980
990	40.879	40.918	40.957	40.996	41.035	41.074	41.113	41.152	41.191	41.230	41.269	990
DEG C	0	1	2	3	4	5	6	7	8	9	10	DEG C

Mat 2777844

GENAUST POWER

A.V.R. 380 SERIES

08-269 6976

This unit will replace the following AVR's: Caterpillar, Dunlite, Stamford, Markon-Controlgy, Stone, McColl, Brush, Modra, Arrow, Kato, Artemus, Taiyo, Lister, Newton Derby, Reliance, Marathon, Kubota, Basler and many more.

AVR 380 AUTOMATIC VOLTAGE REGULATOR

1. INTRODUCTION

The AVR 380 is a solid state device, which is designed to give accurate and stable voltage regulation of alternators.

The AVR is suitable for regulating 50 or 60Hz brushless, rotating or stationary field alternators regardless of prime mover type and will replace most electronic regulators with or without separate excitation.

The AVR is suitable for one or three phase alternators and has four selectable voltage sensing ranges available.
i.e. 120, 208, 240 and 415V

The AVR is suitable for parallel operation of alternators with quadrature droop facilities with only an additional standard 5 amp current transformer and resistor being required.

The AVR has several features:-

1. Voltage adjustment ± 10% over each range.
2. Overload sensing and shut down, plus opto isolator for remote indication.
3. Wide range of stability.
4. Underspeed adjustment which will provide voltage droop with large motor starting loads, this feature will provide excellent starting characteristics and prevent unneccessary stalling of the prime mover.
5. Remote voltage adjustment available.
6. Optional overvoltage crow bar protection circuit is available which will blow the fuse, further protecting the load. (Order before delivery from factory.)
7. Transformer isolated voltage sensing.

2. OPERATION

The regulator senses the alternator output and derives excitation power from the 3 phase connections to the alternator output.

Regulation and stability is maintained provided the prime mover speed is within governor class A1 to ISO3046,at any machine load or power factor by comparing the sensed voltage with a reference bridge.

The unit constantly adjusts the field excitation level to compensate for voltage difference between the sensed voltage and reference.

Output voltage of the machine will be held to ± 1.5% including cold to hot variations in ambient conditions of -10 deg. to +60 deg. and engine speed changes of ± 4% from preset nominal.

3. CONSTRUCTION

The assembled PCB is solidly mounted in a folded aluminium housing which provides the necessary mechanical protection and is suitable to mount directly in the alternator terminal box or in the separate control cubicle.

All components used are selected for stable operation in ambients ranging from -10 deg. to 70 deg. and severely capacity derated for high reliability.

The printed circuit board is a 1.5mm reinforced fibreglass with double sided tracks and plated through holes.

4. CONTROLS

There are five standard and one optional control on each AVR.

a. Stability I
This potentiometer adjusts the stability and response of the alternator and should initially be set in a counter-clockwise position and rotate clockwise to give optimum stability and response characteristics. Once set, no further adjustment should be necessary.

Full CCW position gives maximum response, minimum stability.

Full CW position gives minimum response, maximum stability.

b. Voltage Adjust
This potentiometer varies the reference voltage and hence the amount of excitation of the alternator which adjusts the output voltage over a range of ± 10%.

An external 5K potentiometer may be added to terminals P.P. for remote panel voltage adjustment. When this is used the loop on P.P. is removed and the internal pot is turned to maximum.

c. Underspeed
This potentiometer sets the frequency at which voltage drooping with speed will occur.

For example, if set at 48Hz and a large motor is started which temporarily overloads the prime mover on starting, once the speed falls to 48Hz the alternator voltage will decrease and act as an automatic reduced voltage starter and greatly assist in motor starting.

d. Overload
This potentiometer sets the maximum permissable field excitation should the engine speed remain constant whilst the alternator is overloaded. Allowances are made for temporary overload by a non-adjustable built in 15 seconds delay.

Once the overload does trip, the output voltage falls to approximately 50 volts and can only be reset by stopping the engine.

e. Stability II - Located on PBC next to IC.I
This potentiometer widens the range of stability and should always be normally fully anti-clokwise and only adjusted slightly clockwise to counter further stablility should 'Stability I' run out of range particularly on single phase machines.

Set stability II fully anti-clockwise for 3 phase or clockwise for 1 phase.

f. Overvoltage (Optional)

5. ADJUSTMENTS

a. Voltage
The AVR sensing voltage must be first selected for the required sensing voltage. Adjacent to the transformer are four pins connected to the relevant pin to match the available sensing output of the alternator. 120, 208, 240 and 415 volts.

NOTE: If replacing other electronic regulators for convenience use the same sensing connections if possible.

b. Stability
Rotate clockwise to increase stability.

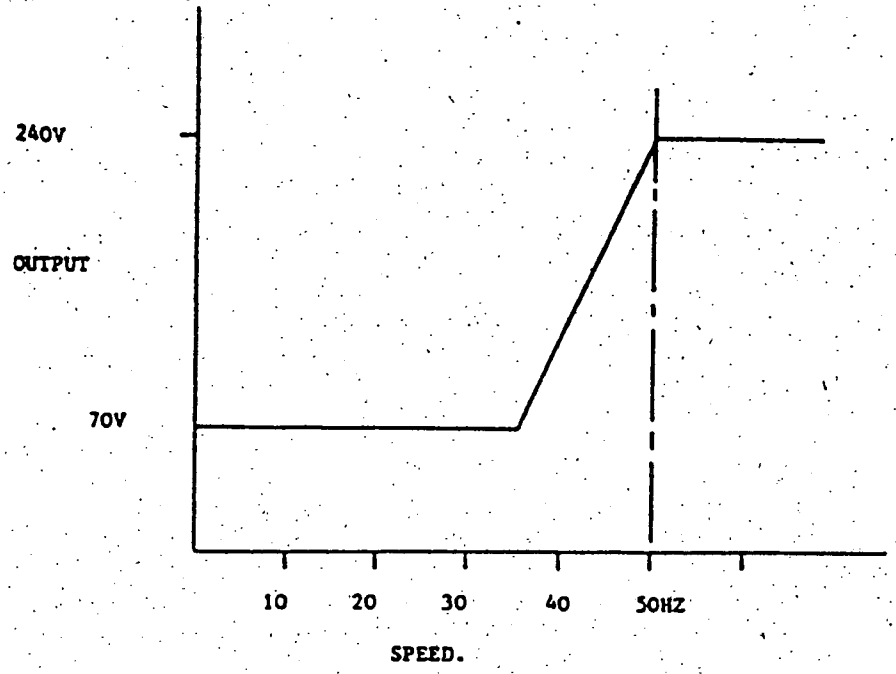
To check, if after sudden load change prolonged fluctuation occurs, turn stability slightly clockwise, or if voltage is very slow to recover from load changes then counter clockwise.

c. Underspeed
To adjust the alternator must be running at the correct speed. i.e. 50Hz ± at no load.

Connect an AC voltmeter across the output of the alternator and slowly turn the underspeed potentiometer clockwise until the voltage just starts to fall, then turn slightly counter-clockwise, approx 30 deg.

To check apply full load if possible and voltage should not droop more than 1%.

Or alternatively lower speed to 48 Hz and voltage should droop.



d. Overload

NOTE: Some alternator manufacturers state maximum field voltage or scoop setting, these will correspond to overload setting.

To adjust correctly connect a 0-50V voltmeter across the field positive and negative.

Run the plant at the correct speed and apply full load, slowly turn the overload potentiometer counter-clockwise until the LED just lights then turn 30 deg. clockwise until LED off.

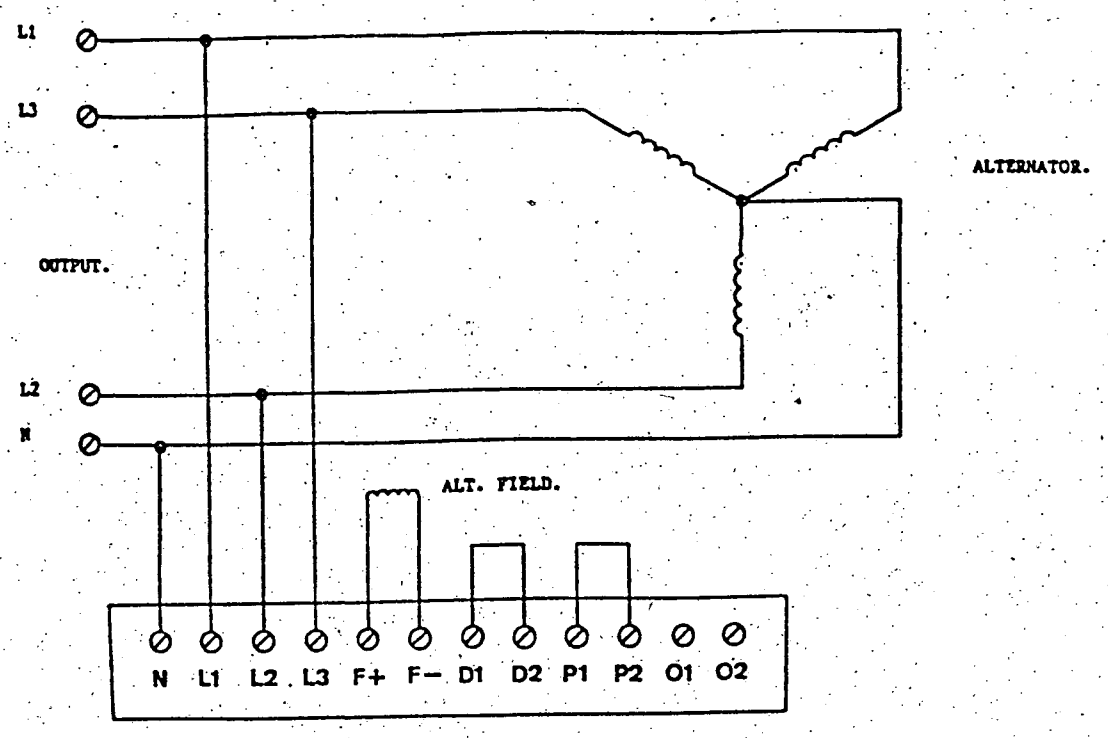
Apply overload, LED should illuminate for 15-20 seconds before output falls to approximately 50-80 volts AC.

Stopping the plant will automatically reset this function.

If load is not available an alternative test is to connect a 50 ohm rheostat in the field circuit (series) and by increasing the resistance this will cause the field voltage to increase until the desired maximum level is reached. (In the absence of any maufacturers detail a maximum field voltage of 46 - 48V can be used.)

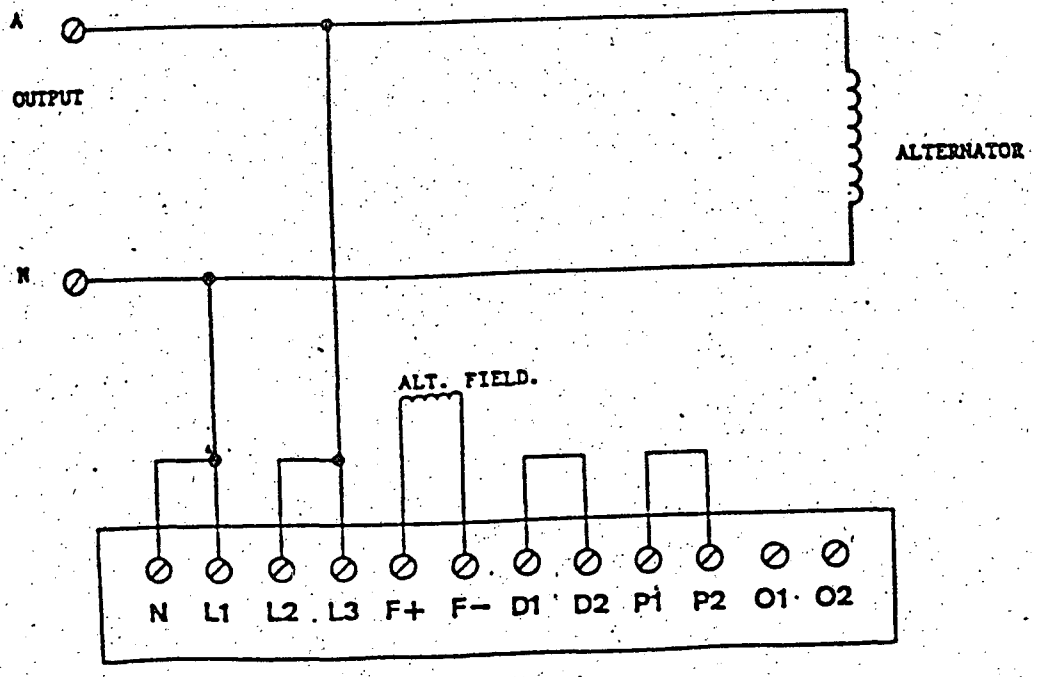
6. CONNECTIONS

a. Standard 3 phase 4 wire



Transformer
Tap Selections
(a) 415/240V - 415 tap
(b) 208/120V - 208 tap

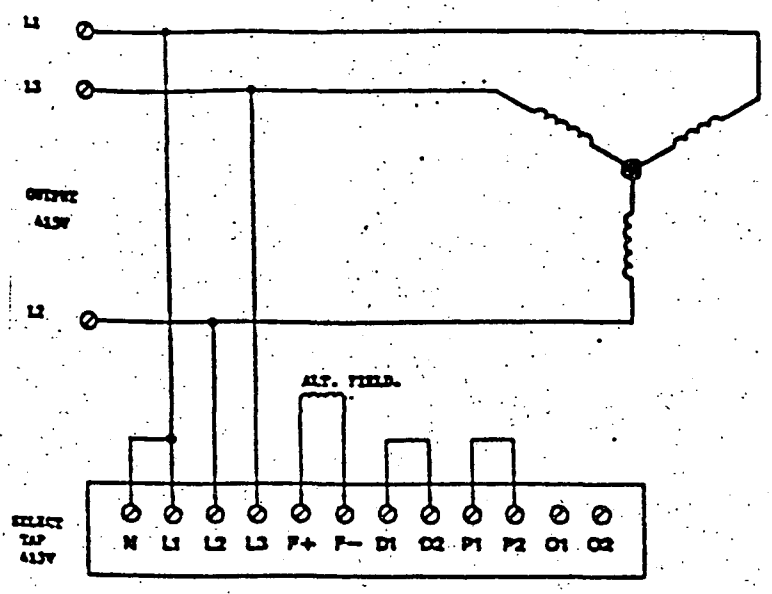
b. Standard 1 phase 2 wire



Transformer
Tap Selections
(a) 240V - 240V tap
(b) 120V - 120V tap

c. Non Standard 3 phase 3 wire

To be used in the event of a machine with field resistance higher than 50 ohms to ensure sufficient field excitation supply voltage is available.



*NOTE! For non standard connection with L1-N and L3 on 415 Volt remove large green 10K resistor, located next to transformer. It may become too hot and damage the PCB. R14

Transformer
Tap Selections
(a) 415/240V - 415V tap
(b) 208/120V - 208V tap

7. RADIO INTERFERENCE

Additional RFI suppression can be achieved by connecting a 0.47MFD capacitor, rated at 250 volt AC between terminals N & L3.

8. DROOP FACILITY

The AVR has quadrature droop facilities for parallel operations.

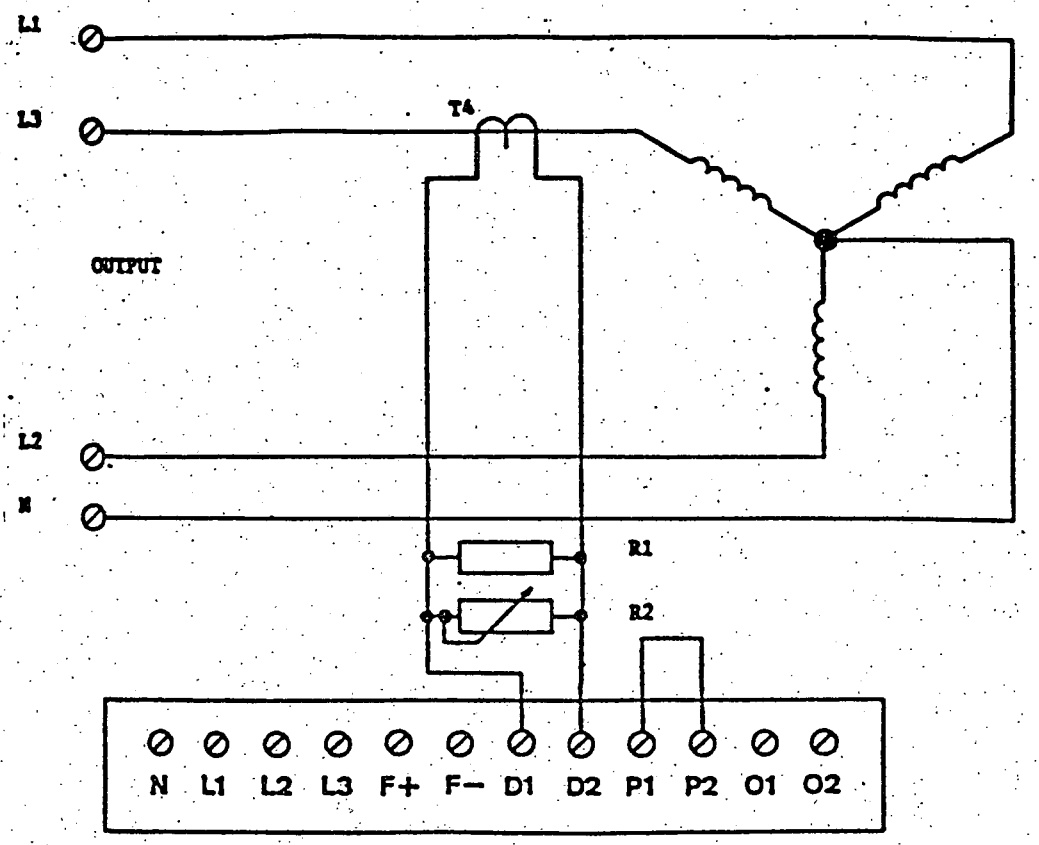
Quadrature droop allows load sharing of reactive load (KVAR) only since KW load is a function of the prime mover.

A current transformer with 5 amp output at 10VA secondary rating and ration of twice the alternator output is required.

When this is used the loop between D1 and D2 must be removed.

Droop Facility

The current transformer must be connected in the nblue phase or L3. It is to be noted that the AVR senses Red L1 and Yellow L2 phase voltage and to achieve quadrature droop, current must be sensed in the blue or L3 phase.



R1 1 ohm 2w
R2 adjustable 30 ohm 2W

NOTE:

1. R2 must be adjusted on both plants to give same voltage drop (approximately 5V/100%) for equal % of load for correct KVAR load sharing.

2. If rising voltage with load is detected the current transformer primary current flow direction must be reversed by reversing the transformer body.
   i.e. Remove the primary turns and rotate transformer 180 deg. and reconnect secondary.

9. SPECIFICATIONS

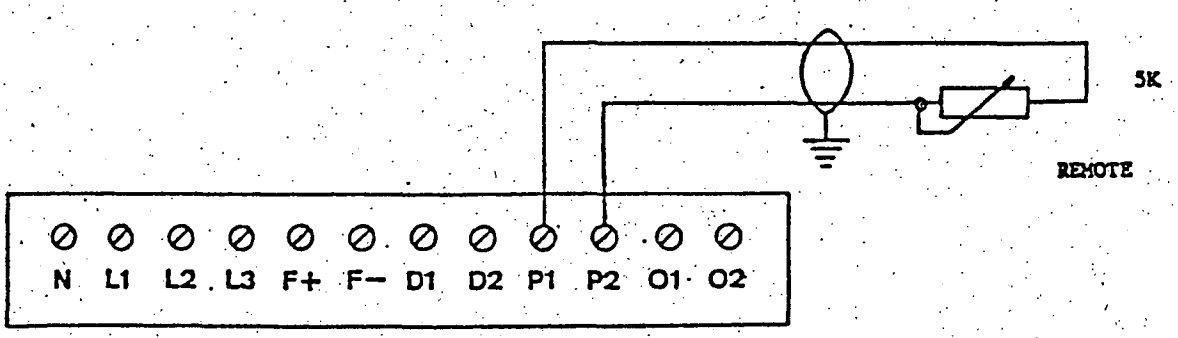
Voltage range 120, 208, 240, 415 volts
Selectable taps ± 10% adjustment on each range
Maximum field current 10 amps
SCR rated at 50 amps 1600 volts
Suitable for single and three phase alternators
Regulation ± 1.5% (1% can be attained on some machines)
Temperature -10 deg. to 60 deg.
Underspeed adjustment 10Hz - 55Hz
Time delay 15 - 20 seconds approximately fixed
Residual voltage required for reliable excitation 3-5 volts
Minimum field resistance 3-5 ohms
Field voltage 50% of input sensing voltage

10. REMOTE VOLTAGE CONTROL

The AVR has remote voltage facilities where the voltage range can be varied up to 10%.

Remove bridge from P.P. and fit external 5K linear 2W potentiometer. Turn the pot on the AVR fully clockwise so as to have maximum voltage range.

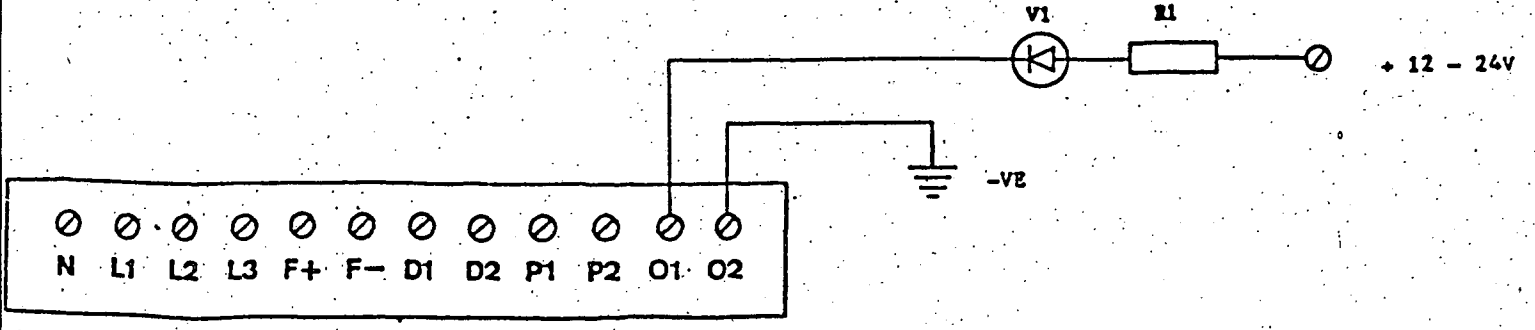
It is necessary to use screened cable for remote control, connect as Figure 5.



11. REMOTE OVERLOAD INDICATION

O1 and O2 terminals are used for remote indication of overload operation.

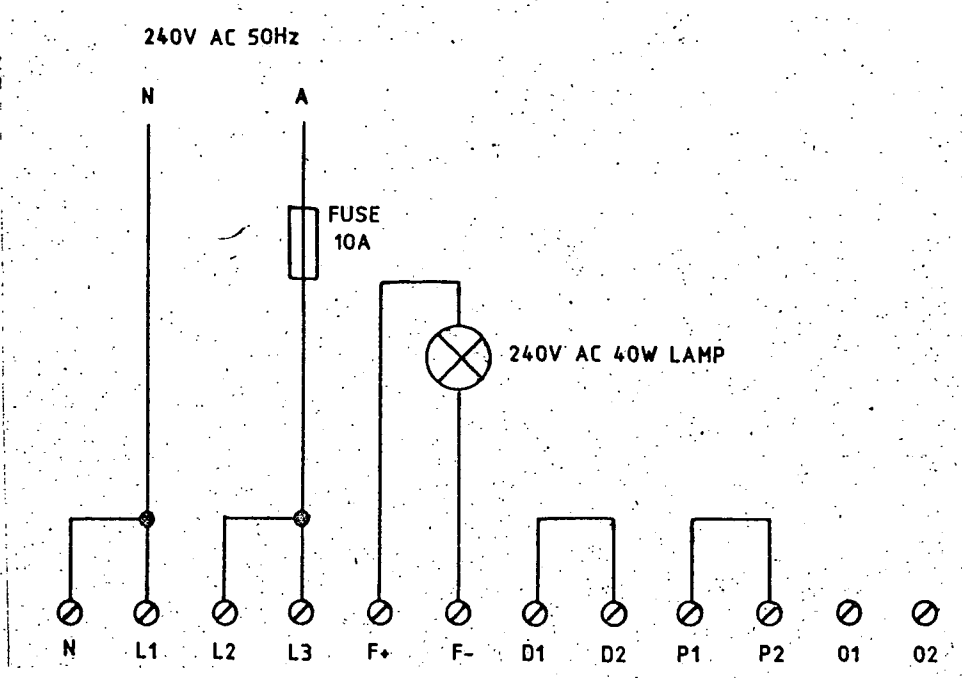
The output is anopto coupled NPN transistor, maximum output is 50ma suitable for LED driver, shut down signal or relay.



12. BENCH TEST

The AVR can be bench tested as follows

a. Test Circuit



b. AVR Test Setup

Transformer
Tap Selections
(a) 240V - 240V tap

c. Test equipment required

1. A 240 Volt 40 Watt globe, complete with holder and wire.
2. 3 pin 240 Volts mains plug and lead.
3. Mains supply.

d. Procedure

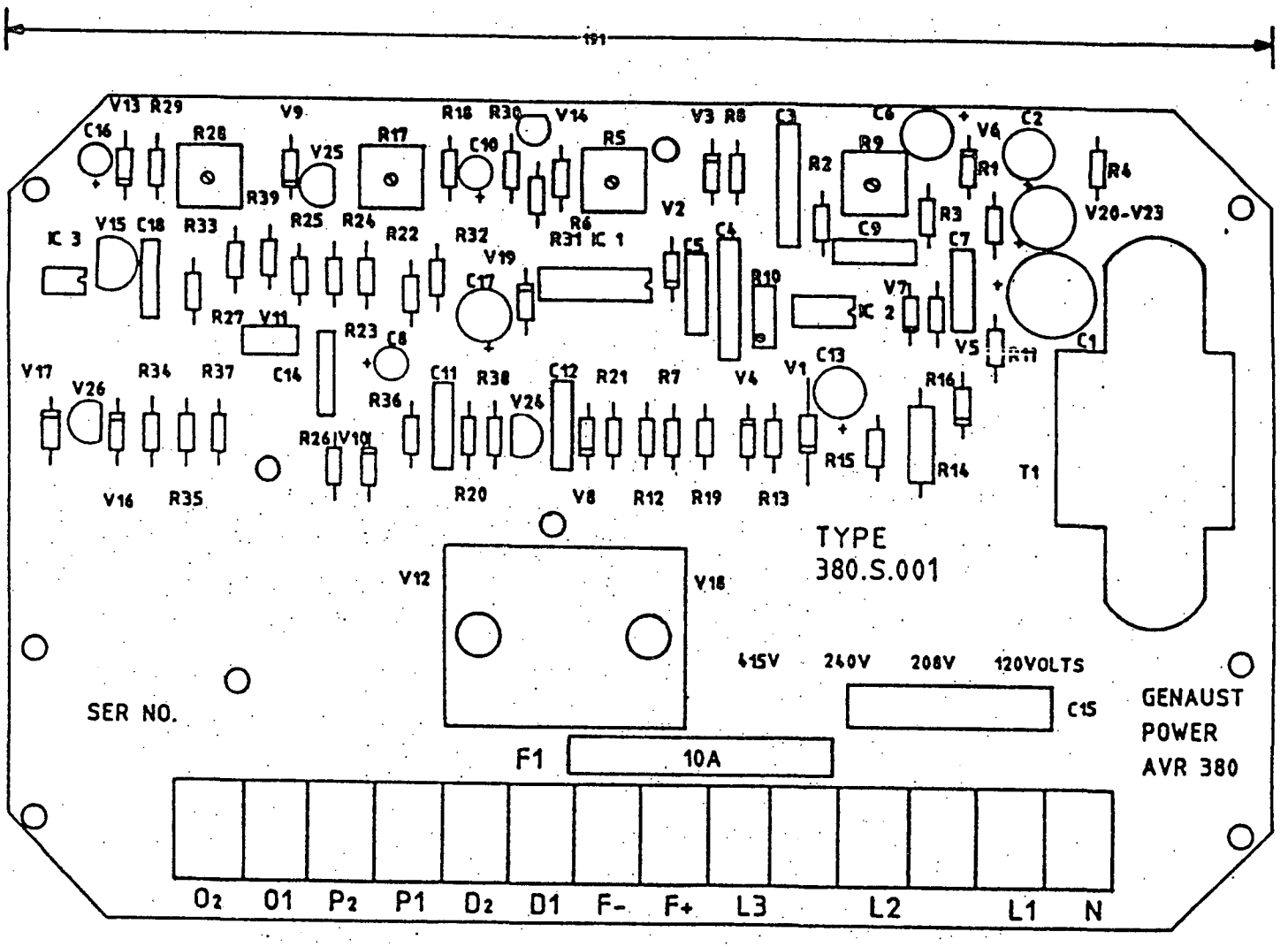
1. Remove AVR from generator.
2. Connect as above and select transformer tap to 240 Volt position. (Note the original sensing voltage tap position)
3. Mark position of voltage adjusting potentiometer with biro or pencil. (This enables the potentiometer to be returned to its original position.)
4. Turn voltage adjusting potentiometer fully clockwise.
5. Turn on the 240 Volt supply.
6. 240 Volt globe should be illuminated and the overload LED should be on for 15-20 seconds, then go off.
7. Turn 240 volt supply off. (Resets the overload)
8. Turn the voltage potentiometer fully anti-clockwise.
9. Turn 240 volt supply on
10. 240 volts globe should just flash and then remain off immediately.

11. Turn the voltage adjusting potentiometer back to the original position or just passed. If the AVR was set to 240 volts as the mains then the light should again come on for 15-20 seconds and go off.
12. If the AVR operates as the test procedure then the fault may be in the alternator.
13. Reconnect to alternator making sure the T/F sensing tap is returned to it's correct position and try again.

MATL.

FINISH
EXTERIOR
INTERIOR

REFERENCE DRAWINGS
ES 0045



CLIENT

DATE 16/2/11
DESIGNED T.A.A
DRAWN B.FURMA
CHECKED
APPROVED

GENAUST POWER PTY. LTD.

COMPONENT LAYOUT
AVR 380

SCALE

PART NUMBER 380.S.001

A2 380.S.001

CONTROL AND PROTECTION UNITS

GENAUST POWER

A.V.R. 400 SERIES

STAB. 1

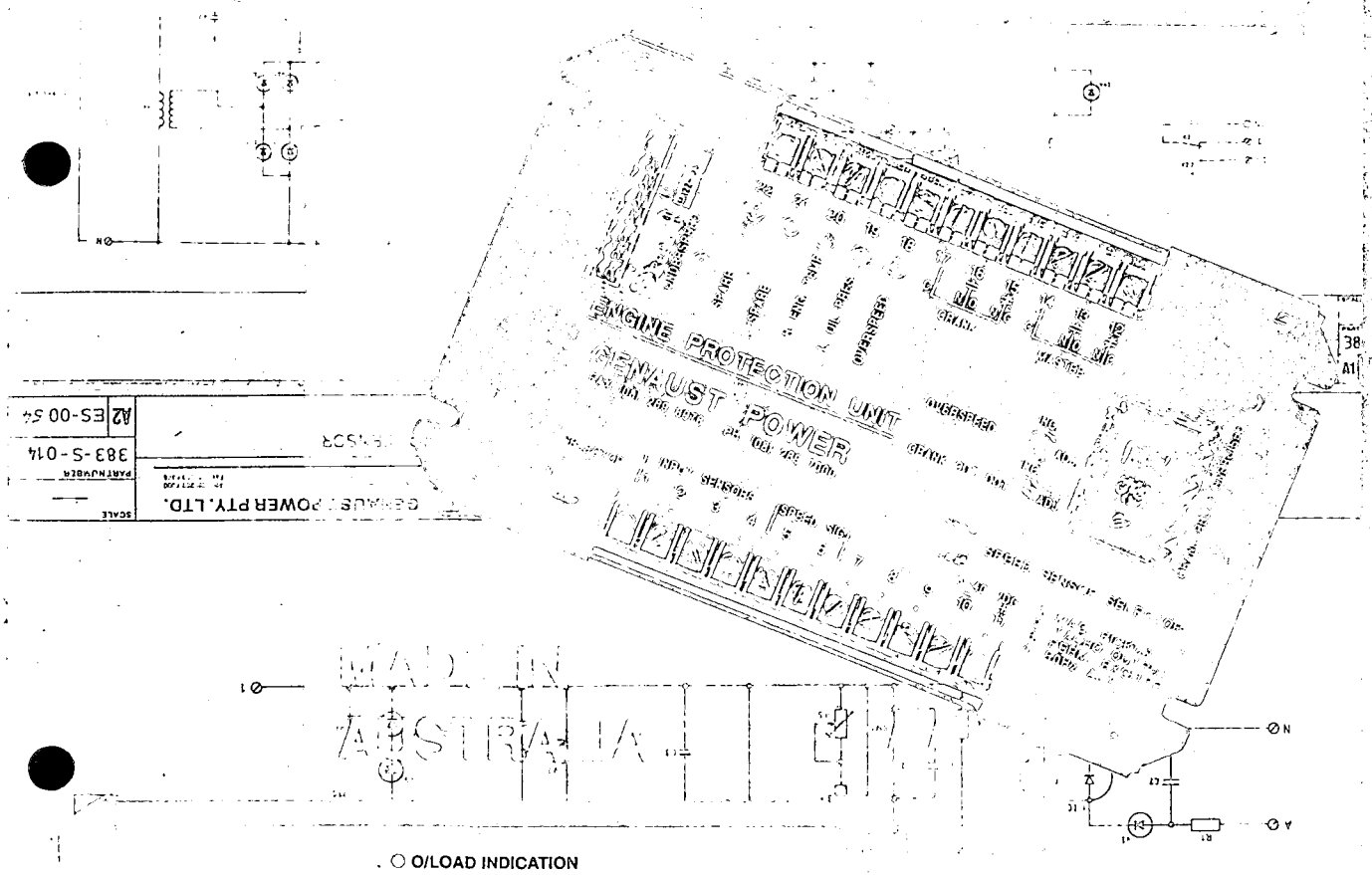
STAB. 2

UNDER SPEED

VOLTS

UNDER SPEED L.E.D.

6 LA SALLE STREET DUDLEY PARK, S.A. 5008 PH. (08) 269 7000 FAX. 269 6976



MADE IN AUSTRALIA

O/LOAD INDICATION

OVERLOAD ADJUST

UNDER SPEED

VOLTS ADJUST

STABILITY

GENAUST POWER

A.V.R. 380 SERIES

DUDLEY PARK, S.A. 5008 PH: (08) 269 7000 FAX: (08) 269 6976

PTY. LTD.

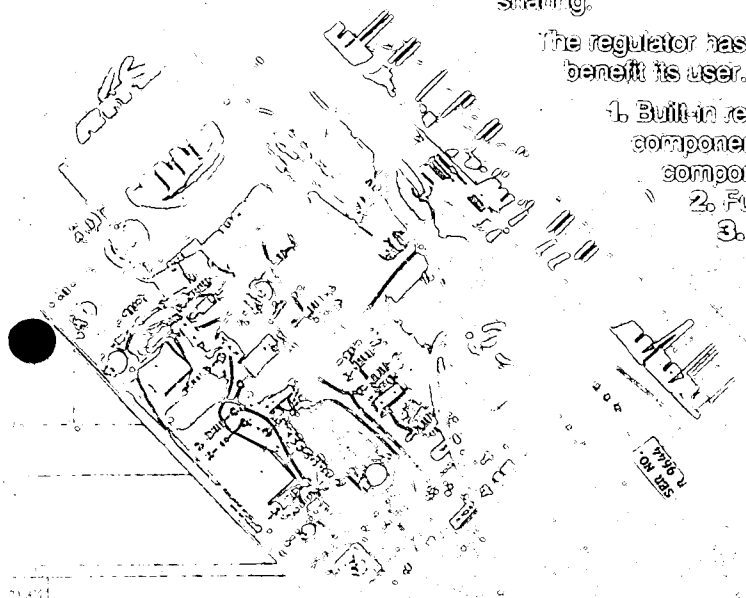
AVR 380

AUTOMATIC VOLTAGE REGULATOR

A solid state device which is designed to provide stable voltage regulation to a wide range of 3 phase or 1 phase brushless rotating or stationary field alternators regardless of prime mover type.

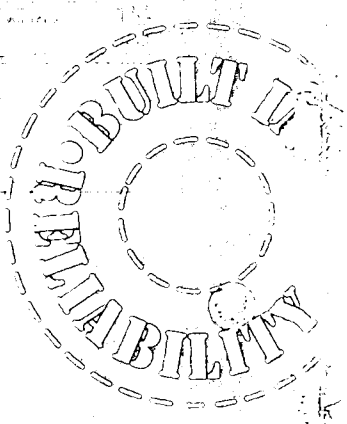
Provision is made for:

- Remote voltage adjustment
- Remote overload indication
- Quadrature droop input for reactive load sharing.



The regulator has many features which benefit its user.

1. Built-in reliability using underated components and plated through component PCB holes.
2. Fully repairable.
3. Adjustable volts/hertz characteristics which assists prime mover recovery on application of large step loads.
4. Input transformer isolation for better circuit protection. With input taps for 120, 208, 240 and 415V sensing. 50 or 60Hz.
5. Wide adjustable stability range to eliminate light flicker especially useful on 1 phase machines. 6. Overload field current sensing which provides protection for both the AVR and the alternator. 7. Voltage adjustment of ± 10% over each sensing range provides setting accuracy down to ± 1% on most machines. 8. 12 months warranty. 9. Comes with detailed operation and connection instructions.



Physical Size:
220mm long
133mm wide
73mm deep
0.71kg weight

Mounting centres:
95 x 210mm via 4 x M4 screws.

GENAUST POWER PTY. LTD.

EPU 300

ENGINE PROTECTION UNIT

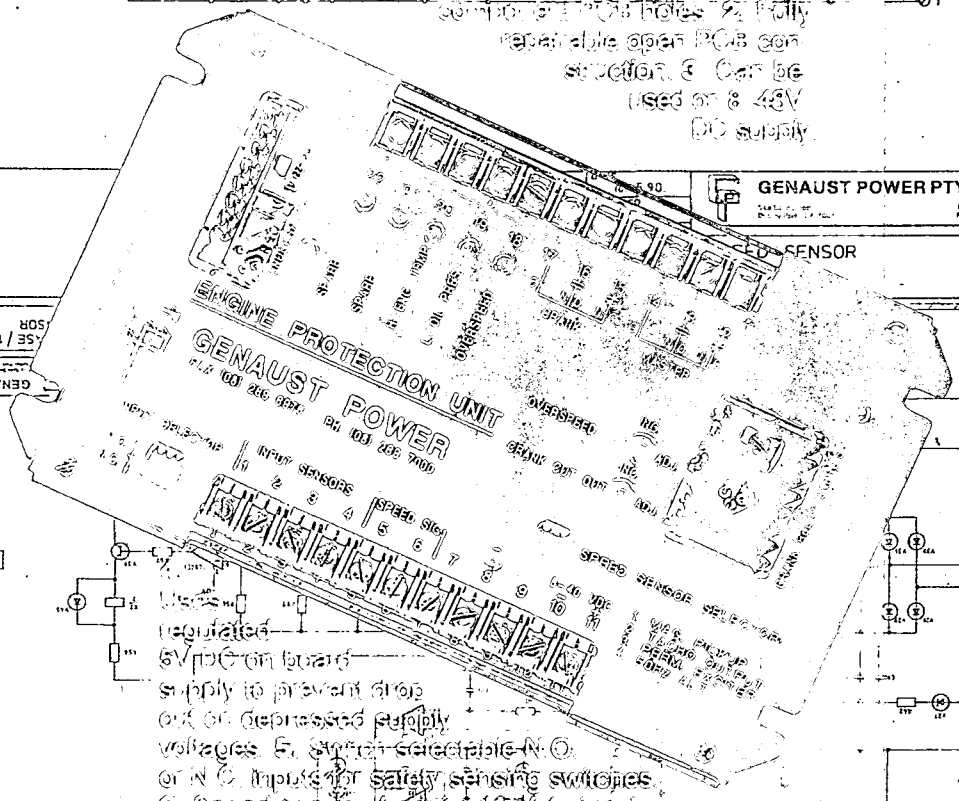
A unit designed with latest CMOS technology to protect any stationary or mobile diesel engine from damage due to such things as:

- High cooling medium temperature
- Low lubrication oil pressure
- Underspeed
- Loss of coolant liquid
- Water contamination of fuel
- High exhaust temperature
- Overspeed

as well as providing starter motor cut out on remote start applications.

Just some of the features which benefit the user are:

1. Built in reliability using underrated components and plated through connection holes 2. Fully repairable open PCB construction 3. Can be used on a 48V DC supply



GENAUST POWER PTY. LTD. | SCALE —— | PART NUMBER 383-S-014 | A2 ES-00 54 | SENSOR

4. Unregulated 6V DC on board supply to prevent drop out on depressed supply voltages. 5. Switch selectable N.O. or N.C. inputs for safety sensing switches. 6. Speed sensing from any 1 of 4 signal sources and switch selectable. 7. Comes with detailed operation and connection instructions. 8. 12 months warranty. 9. Output terminals for remote fault indication. 10. On board potentiometer adjustments for: ◦ crank cut out speed ◦ overspeed ◦ underspeed. 11. On board LED indicators for: ◦ Crank relay energised ◦ Overspeed ◦ Underspeed ◦ Temperature ◦ Pressure ◦ Plus 2 spares. 12. On board crank and fuel solenoid control relays each with a 10A changeover contact.

Physical Size:
225mm long, 138mm wide, 38mm deep, 0.4kg weight.

Mounting centres:
95 x 215mm via 4 x M4 screws.

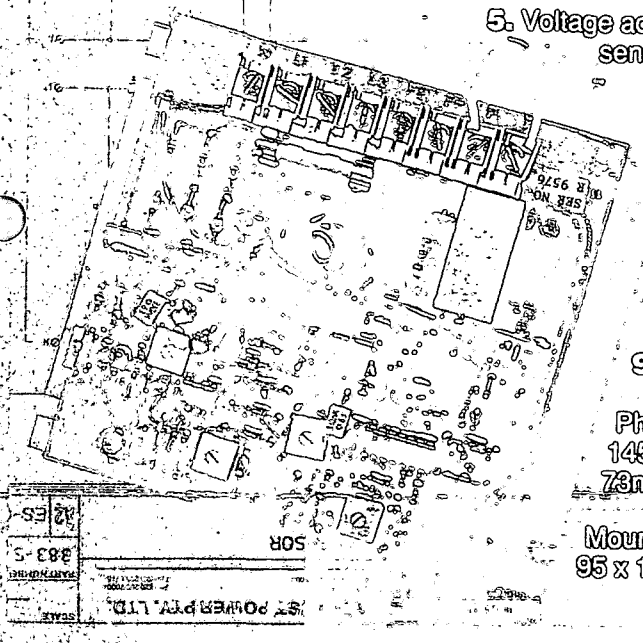
GENAUST POWER PTY. LTD.

AVR 400

AUTOMATIC VOLTAGE REGULATOR

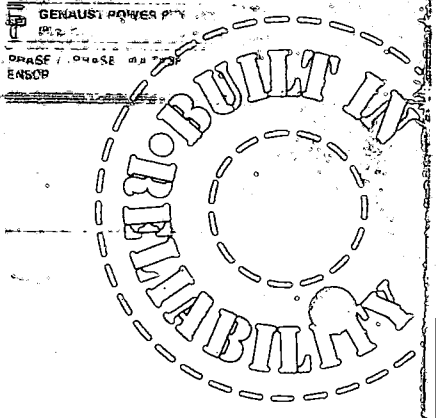
Provides most of the facilities on it's bigger brother the AVR 380. Is more compact, extremely good value by comparison, has many of the AVR 380 features:

1. Built in reliability using underated components and plated through component PCB holes.
2. Fully repairable.
3. Adjustable volts/hertz characteristics which assists prime mover recovery with applications of large step loads.
4. Wide adjustable stability range to eliminate light flicker especially useful on 1 phase machines.
5. Voltage adjustment of ± 10% over each sensing range provides setting accuracy down to ± 1% on most machines.
6. 12 months warranty.
7. Comes with detailed operation and connection instructions.
8. Switch selectable voltage input sensing.
9. Field current protection fuse.



Physical Size:
145mm long, 120mm wide,
78mm deep, 0.39kg weight.

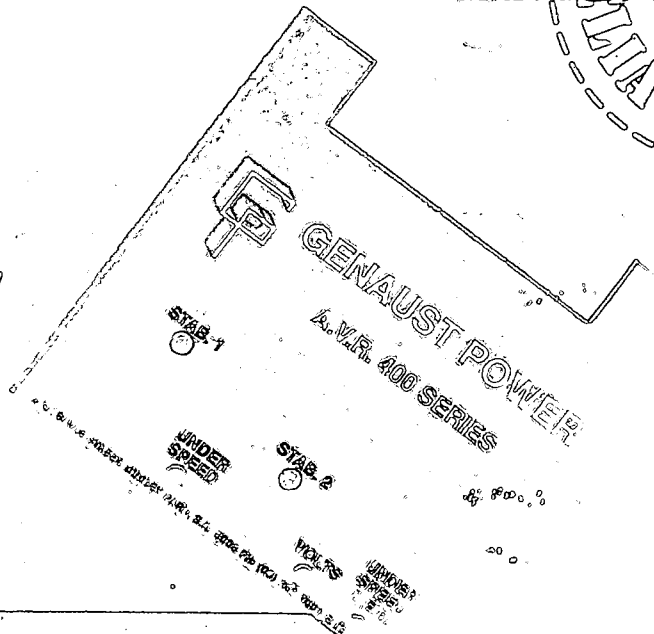
Mounting centres:
95 x 138mm via 4 x M4 screws.



Employing the very latest state-of-the-art technology Genaust Power produces a range of products which are fully designed and fully manufactured in Australia.

Our company is proudly owned and managed by Australians. With a high level of industrial expertise and professional attitudes, we have rapidly gained recognition for the quality of our products and we are now positioned at the forefront of the industry.

Without a doubt, when you purchase Genaust Power products, you will be assured of our renowned value-for-money and built-in reliability.



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