SE POWER EQUIPMENT
ESTABLISHED 1981

OPERATION and MAINTENANCE MANUALS

For

BRISBANE CITY COUNCIL

At

BRISBANE WATER

SEWAGE PUMP STATION

SP019 CENTENARY HIGHWAY

Manuals Prepared by:

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Revision Status

Revision	Date	Initials	Comments
A	26/05/03	JP	Issued for approval
B	30/07/03	JP	

Prepared by: Jim Pringle Date: _____/_____/_____

Reviewed
Project Manager: __________________________ Date: _____/_____/_____

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INSTRUCTIONS FOR USE

1. Units placed on site using "Hook Truck" (Cleanaway Type) over cable pit.
2. Cable pit to be under switchboard section of unit (rear).
3. Attach hold down / anti-theft chains to location points at rear of unit (beside switchboard).
4. Check engine lube oil level.
5. Check engine coolant level.
6. Check the battery is connected and the electrolyte level is correct.
7. Connect cables to plugs via colour-coded sequence.
8. Connect power inlet socket (240V).
9. Connect communication socket.
10. Connect pump station control socket.
11. Check fuel level (mechanical gauge beside fill point).
12. Refer to section 6, Functional Description for start/run and connection procedure.
13. Remember **SAFETY** is important **ALWAYS** wear your Personal Protection Equipment (PPE)

POWER Units for Gensets (Saran) 2.9L/4039/4.5/6.8L (128/008/158/258)

OPERATOR'S MANUAL

John Deere Usine de Saran
OMCD16564 (03JAN00)
Printed in Germany
ENGLISH

Introduction

THIS MANUAL COVERS the following engines for generator sets:

ENGINE FAMILY	ENGINE MODEL
300-SERIES	CD3029DF128
	CD4039DF008
	CD4039TF008
POWERTECH®	CD4045DF158
	CD4045HF158
	CD4045TF158
	CD4045TF258
	CD6068HF158
	CD6068TF158
	CD6068TF258

READ THIS MANUAL carefully to learn how to operate and service your engine correctly. Failure to do so could result in personal injury or equipment damage.

THIS MANUAL SHOULD BE CONSIDERED a permanent part of your engine and should remain with the engine when you sell it.

MEASUREMENTS IN THIS MANUAL are given in metric. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

WRITE ENGINE SERIAL NUMBERS and option codes in the spaces indicated in the Record Keeping Section. Accurately record all the numbers. Your dealer also needs these numbers when you order parts. File the identification numbers in a secure place off the engine or machine.

RIGHT-HAND AND LEFT-HAND sides are determined by standing at the drive or flywheel end (rear) of the engine and facing toward the front of the engine.

SETTING FUEL DELIVERY beyond published factory specifications or otherwise overpowering will result in loss of warranty protection for this engine.

Information relative to emissions regulations
Depending on final destination, this engine can meet the emissions regulations according to the US Environmental Protection Agency (EPA), California Air Resources Board (CARB) and for Europe, the Directive 97/68/EC relating the measures against the emissions of gaseous and particulates pollutants from internal combustion engines. In this case an emission label is stuck on the engine.

Emission regulations prohibit tampering with the emission-related components listed below which would render that component inoperative or to make any adjustment on the engine beyond published specifications. It is also illegal to install a part or component where the principal effect of that component is to bypass, defeat, or render inoperative any engine component or device which would affect the engine conformance to the emissions regulations. To summarize, it is illegal to do anything except return the engine to its original published specifications.

List of emission-related components:

- Fuel injection pump
- Intake manifold
- Turbocharger
- Charge air cooling system
- Piston

CALIFORNIA PROPOSITION 65 WARNING
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

POWERTECH is a trademark of Deere & Company

DPSG,CD03523,1 –19–01JUL99–1/1

112699
PN=2

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All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

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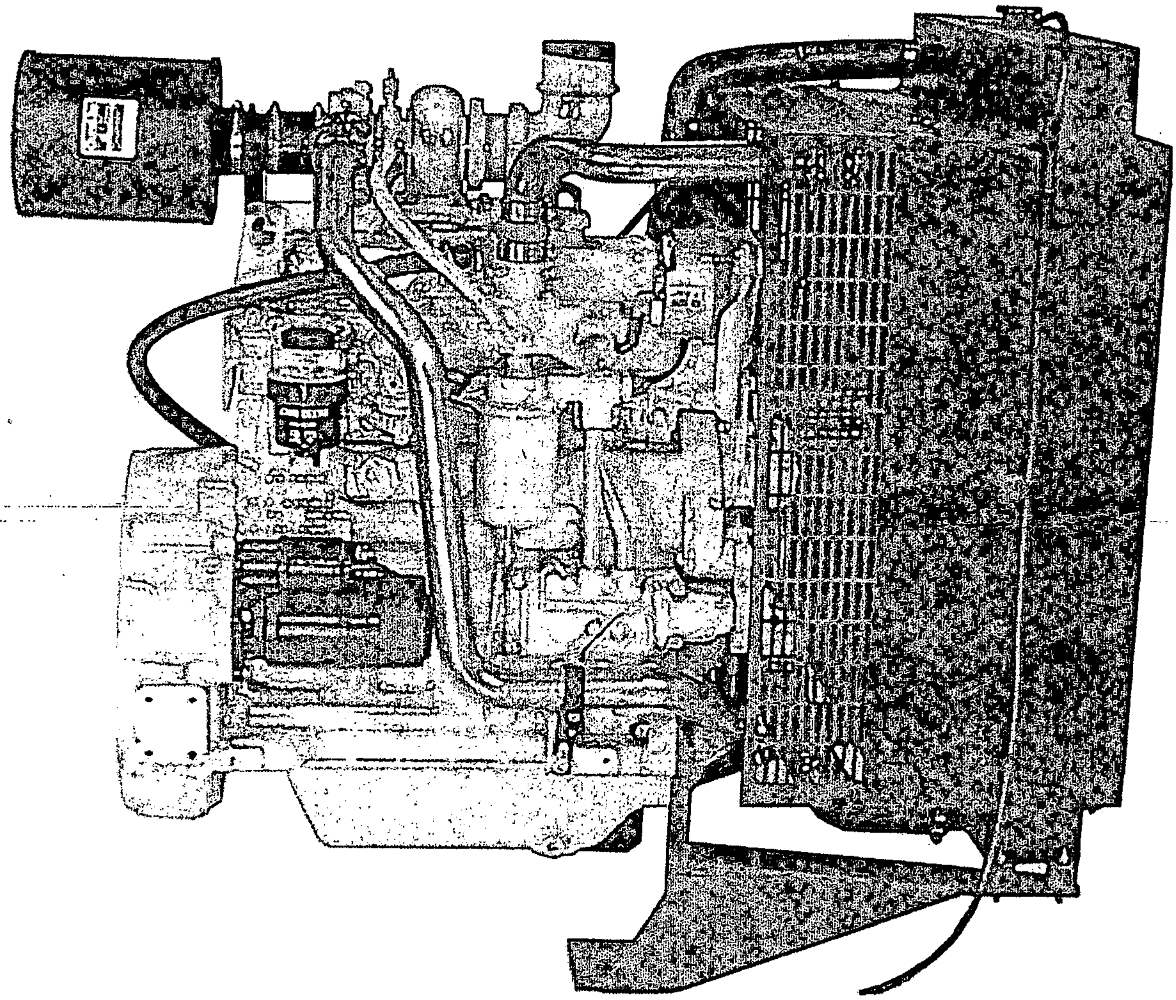
Identification Views

IDENTIFICATION VIEWS

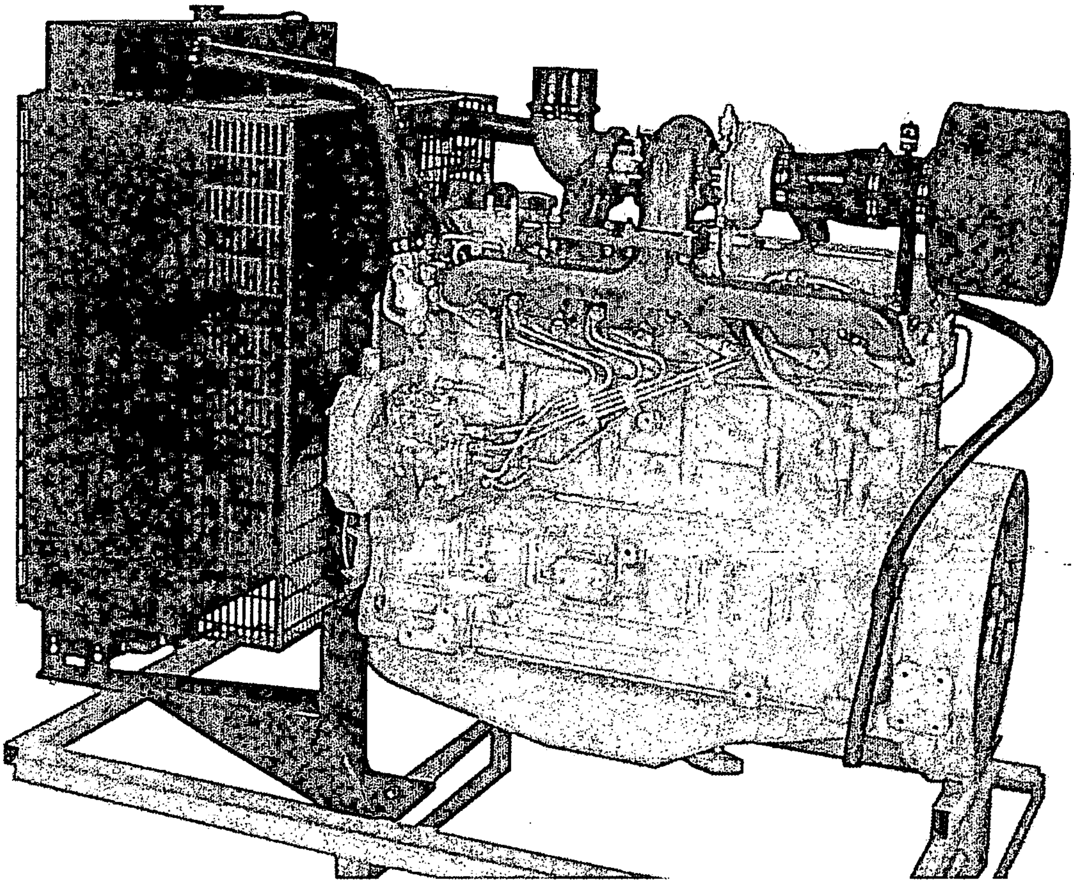


4045HF158

CD30744 –UN–23AUG99

Continued on next page DPSG,CD03523,3 –19–05JUL99–1/2

Identification Views



6068HF158

DPSG,CD03523,3 -19-05JUL99-2/2

Maintenance Records

USING MAINTENANCE RECORDS

To obtain the best performance, economy and service life from your engine, ensure service is carried out according to this present manual and recorded in the following pages. It is recommended that your engine Distributor or your Dealer carry out this service work and stamp the appropriate case.

Keeping an accurate account of all service performed on your engine will give more value to the machine when you resell it.

John Deere oils and coolants have been formulated to give maximum protection and performance to your engine. We recommend only genuine John Deere service products and replacement parts.

To protect your rights under the warranty ensure all scheduled services are carried out and recorded. If your engine is covered by extended warranty, it is important to maintain this record for the duration of the warranty.

DPSG,CD03523,6 –19–05JUL99–1/1

100 HOURS OF OPERATION

❒ Engine oil, replace ❒ Engine oil filter, replace ❒ Hose connections, check	

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,7 –19–05JUL99–1/1

Maintenance Records

500 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❐ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,8 –19–05JUL99–1/1

1000 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Check belt and tensioning system
- ❐ Crankcase vent tube, clean
- ❐ Air intake system, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,9 –19–05JUL99–1/1

Maintenance Records

1500 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❐ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,10 –19–05JUL99–1/1

2000 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Check belt and tensioning system
- Crankcase vent tube, clean
- ❐ Cooling system, drain and flush (if COOL-GARD is not used)
- ❐ Valve clearance, adjust (POWERTech)
- ❐ Air intake system, check
- ❐ Vibration damper, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,59 –19–16AUG99–1/1

Maintenance Records

2500 HOURS OF OPERATION

- ❒ Engine oil, replace
- ❒ Engine oil filter, replace
- ❒ Fuel filter, replace
- ❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❒ Valve clearance, adjust (300-Series)
- ❒ Cooling system, drain and flush (if COOL-GARD is used)

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,60 –19–16AUG99–1/1

3000 HOURS OF OPERATION

- ❒ Engine oil, replace
- ❒ Engine oil filter, replace
- ❒ Fuel filter, replace
- ❒ Check belt and tensioning system
- ❒ Crankcase vent tube, clean
- ❒ Air intake system, check

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,61 –19–16AUG99–1/1

3500 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❐ Valve clearance, adjust (300-Series)

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
›b done by:		

DPSG,CD03523,62 –19–16AUG99–1/1

4000 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Check belt and tensioning system
- Crankcase vent tube, clean
- ❐ Cooling system, drain and flush (if COOL-GARD is not used)
- ❐ Valve clearance, adjust (POWERTech)
- ❐ Air intake system, check
- ❐ Vibration damper, check

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,63 –19–16AUG99–1/1

4500 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❐ Valve clearance, adjust (300-Series)
- ❐ Vibration damper, replace (6 cyl.)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,64 –19–16AUG99–1/1

5000 HOURS OF OPERATION

- ❐ Engine oil, replace
- ❐ Engine oil filter, replace
- ❐ Fuel filter, replace
- ❐ Check belt and tensioning system
- ❐ Crankcase vent tube, clean
- ❐ Injection nozzles, replace
- ❐ Air intake system, check
- ❐ Cooling system, drain and flush (if COOL-GARD is used)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,65 –19–16AUG99–1/1

Maintenance Records

5500 HOURS OF OPERATION

- ▢ Engine oil, replace
- ▢ Engine oil filter, replace
- ▢ Fuel filter, replace
- ▢ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ▢ Valve clearance, adjust (300-Series)

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
b done by:		

DPSG,CD03523,66 –19–16AUG99–1/1

6000 HOURS OF OPERATION

- ▢ Engine oil, replace.
- ▢ Engine oil filter, replace
- ▢ Fuel filter, replace
- ▢ Check belt and tensioning system
- Crankcase vent tube, clean
- ▢ Cooling system, drain and flush (if COOL-GARD is not used)
- ▢ Valve clearance, adjust (POWERTech)
- ▢ Air intake system, check
- ▢ Vibration damper, check

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,67 –19–16AUG99–1/1

6500 HOURS OF OPERATION

- ☐ Engine oil, replace
- ☐ Engine oil filter, replace
- ☐ Fuel filter, replace
- ☐ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ☐ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,68 –19–16AUG99–1/1

7000 HOURS OF OPERATION

- ☐ Engine oil, replace
- ☐ Engine oil filter, replace
- ☐ Fuel filter, replace
- ☐ Check belt and tensioning system
- ☐ Crankcase vent tube, clean
- ☐ Air intake system, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,69 –19–16AUG99–1/1

7500 HOURS OF OPERATION

- ❒ Engine oil, replace
- ❒ Engine oil filter, replace
- ❒ Fuel filter, replace
- ❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❒ Valve clearance, adjust (300-Series)
- ❒ Cooling system, drain and flush (if COOL-GARD is used)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,70 –19–16AUG99–1/1

8000 HOURS OF OPERATION

- ❒ Engine oil, replace
- ❒ Engine oil filter, replace
- ❒ Fuel filter, replace
- ❒ Check belt and tensioning system
- Crankcase vent tube, clean
- ❒ Cooling system, drain and flush (if COOL-GARD is not used)
- ❒ Valve clearance, adjust (POWERTech)
- ❒ Air intake system, check
- ❒ Vibration damper, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,71 –19–16AUG99–1/1

8500 HOURS OF OPERATION

- ❒ Engine oil, replace
- ❒ Engine oil filter, replace
- ❒ Fuel filter, replace
- ❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ❒ Valve clearance, adjust (300-Series)

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,72 –19–16AUG99–1/1

9000 HOURS OF OPERATION

- ❒ Engine oil, replace
- ❒ Engine oil filter, replace
- ❒ Fuel filter, replace
- ❒ Check belt and tensioning system
- ❒ Crankcase vent tube, clean
- ❒ Air intake system, check
- ❒ Vibration damper, replace (6 cyl.)

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,73 –19–16AUG99–1/1

Maintenance Records

9500 HOURS OF OPERATION

- ▢ Engine oil, replace
- ▢ Engine oil filter, replace
- ▢ Fuel filter, replace
- ▢ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)
- ▢ Valve clearance, adjust (300-Series)

Number of hours:	Comments:	Dealer or distributor stamp
Date:		
b done by:		

DPSG,CD03523,74 –19–16AUG99–1/1

10000 HOURS OF OPERATION

- ▢ Engine oil, replace
- ▢ Engine oil filter, replace
- ▢ Fuel filter, replace
- ▢ Check belt and tensioning system
- Crankcase vent tube, clean
- ▢ Air intake system, check
- ▢ Cooling system, drain and flush
- ▢ Valve clearance, adjust (POWERTech)
- ▢ Thermostat, replace
- ▢ Vibration damper, check
- ▢ Injection nozzles, replace

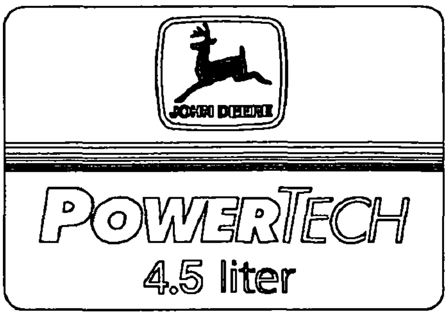
Number of hours:	Comments:	Dealer or distributor stamp
Date:		
Job done by:		

DPSG,CD03523,75 –19–16AUG99–1/1

Record Keeping

POWERTECH® MEDALLION

A medallion is located on the rocker arm cover which identifies each engine as a John Deere POWERTECH® engine.

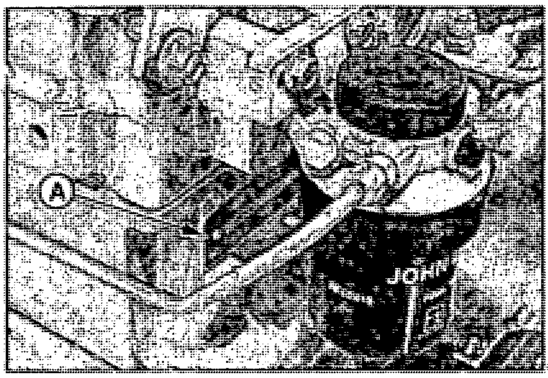


RG8041 –UN–15JAN99

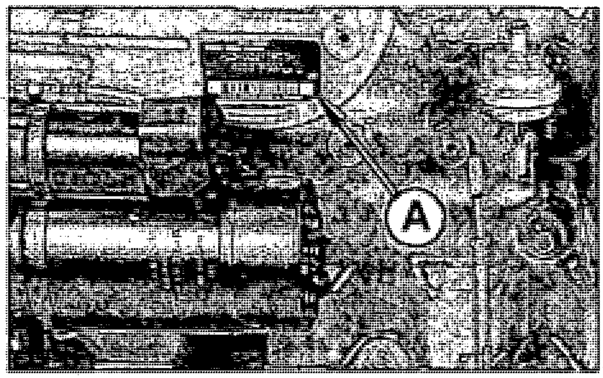
POWERTECH is a trademark of Deere & Company

DPSG,CD03523,11 –19–05JUL99–1/1

ENGINE SERIAL NUMBER PLATE



POWERTech engine



CD30746 –UN–24SEP99

300-Series engine

Each engine has a 13–digit John Deere serial number. The first two digits identify the factory that produced the engine:

"CD" indicates the engines was built in Saran, France.

Your engine's serial number plate (A) is located on the right-hand side of cylinder block behind the fuel filter for POWERTech engines and near the fuel supply pump on 300–Series engines.

DPSG,CD03523,12 –19–05JUL99–1/1

RECORD ENGINE SERIAL NUMBER

Record all of the numbers and letters found on your engine serial number plate in the spaces provided below.

This information is very important for repair parts or warranty information.

Engine Serial Number (B)

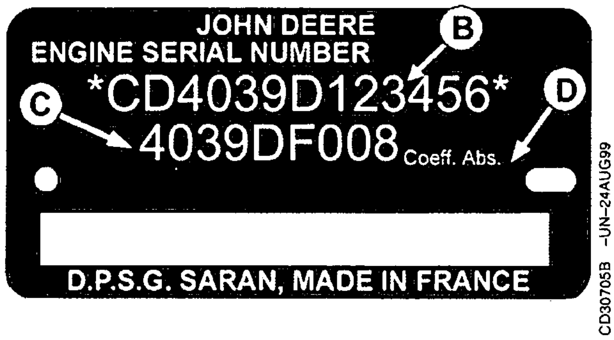
____

Engine Model Number (C)

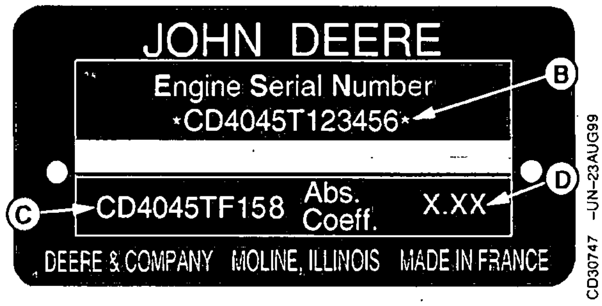
____

Coefficient of Absorption Value (D)

____



300-Series engine plate



POWERTech engine plate

DPSG,CD03523,13 –19–05JUL99–1/1

ENGINE OPTION CODES

CD30748A -UN-26AUG99

Engine option code label

In addition to the serial number plate, OEM engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

An additional sticker may be also delivered (in a plastic bag attached to the engine or inserted in the machine documentation). It is recommended to stick this option code list sticker either:

- On this page of your Operator's manual below this section.

or

- On the "Engine Owner's Warranty" booklet under the title OPTION CODES (Engine manufacturing configuration).

NOTE: *The Machine Manufacturer may have already stuck it at a specific accessible place (inside the enclosure or close to a maintenance area).*

The engine option code label includes an engine base code (A). This base code must also be recorded along with the option codes. At times it will be necessary to furnish this base code to differentiate two identical option codes for the same engine model.

The first two digits of each code identify a specific group, such as alternators. The last two digits of each code identify one specific option provided on your engine, such as a 12-volt, 55-amp alternator.

NOTE: *These option codes are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.*

If an engine is ordered without a particular component, the last two digits of that functional group option code will be 99, 00, or XX. The list on the next page shows only the first two digits of the code numbers. For future reference such as ordering repair parts, it is important to have these code numbers available. To ensure this availability, enter the third and fourth digits shown on your engine option code label in the spaces provided on the following page.

NOTE: *Your engine option code label may not contain all option codes if an option has been added after the engine left the producing factory.*

If option code label is lost or destroyed, consult your servicing dealer or engine distributor selling the engine for a replacement.

Continued on next page

DPSG,CD03523,14 -19-05JUL99-1/2

Record Keeping

Option Codes	Description	Option Codes	Description
Engine Base Code:________			
11____	Rocker Arm Cover	45____	Balancer Shaft
12____	Oil Filler Neck	46____	Cylinder Block With Liners and Camshaft
13____	Crankshaft Pulley	47____	Crankshaft and Bearings
14____	Flywheel Housing	48____	Connecting Rods and Pistons
15____	Flywheel	49____	Valve Actuating Mechanisms
16____	Fuel Injection Pump	50____	Oil Pump
17____	Air inlet	51____	Cylinder Head With Valves
18____	Air cleaner	52____	Auxiliary Gear Drive
19____	Oil pan	54____	Oil heater
20____	Coolant pump	55____	Shipping stand
21____	Thermostat Cover	56____	Paint Option
22____	Thermostat	57____	Coolant Inlet
23____	Fan Drive	59____	Oil Cooler
24____	Fan Belt	60____	Add-on Auxiliary Drive Pulley
25____	Fan	62____	Alternator Mounting
3____	Engine Coolant Heater	64____	Exhaust Elbow
7____	Radiator	65____	Turbocharger
28____	Exhaust Manifold	66____	Temperature Switch
29____	Ventilator System	67____	Electronic Tachometer Sensor
30____	Starting Motor	68____	Damper
31____	Alternator	69____	Engine Serial Number Plate
32____	Instrument Panel	74____	Air Conditioning System Compressor Mounting
35____	Fuel Filter	75____	Air Restriction Indicator
36____	Front Plate	76____	Oil Pressure Switch
37____	Fuel Transfer Pump	86____	Fan Pulley
39____	Thermostat Housing	87____	Automatic Belt Tensioner
40____	Oil Dipstick	88____	Oil Filter
41____	Belt Driven Front Auxiliary Drive	91____	Special Equipment (Factory Installed)
43____	Starting Aid	97____	Special Equipment (Field Installed)
44____	Timing Gear Cover with Gears	98____	Shipping

DPSG,CD03523,14 –19–05JUL99–2/2

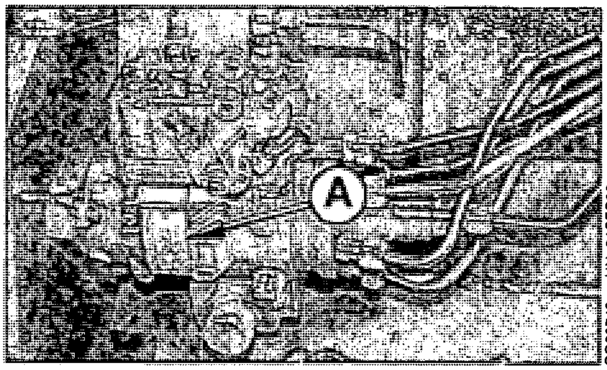
RECORD FUEL INJECTION PUMP MODEL NUMBER

Record the fuel injection pump model and serial information found on the serial number plate (A).

Model No. ____________________ RPM _______

Manufacturer's No. ________________________

Serial No. ______________________________



CD30749 –UN–24SEP99

DPSG,CD03523,15 –19–07JUL99–1/1

Safety

RECOGNIZE SAFETY INFORMATION

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.

T81389 -UN-07DEC88

DX,ALERT -19-29SEP98-1/1

UNDERSTAND SIGNAL WORDS

^ signal word—DANGER, WARNING, or CAUTION—is ed with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

DANGER

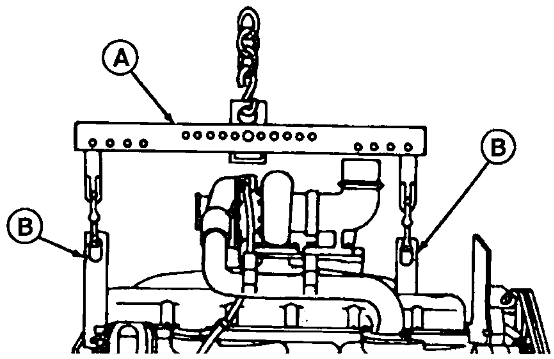
WARNING

CAUTION

TS187 -19-30SEP88

DX,SIGNAL -19-03MAR93-1/1

ENGINE LIFTING PROCEDURE



CAUTION: The only recommended method for lifting the engine is with JDG23 Engine Lifting Sling (A) and safety approved lifting straps (B) that come with engine. Use extreme caution when lifting and NEVER permit any part of the body to be positioned under an engine being lifted or suspended.

Lift engine with longitudinal loading on lifting sling and lifting straps only. Angular loading greatly reduces lifting capacity of sling and straps.

NOTE: If engine does not have lifting straps, universal straps can be procured through service parts under part numbers JD-244-1 and JD-244-2.

1. If not equipped, install lifting straps and torque to 200 N•m (145 lb-ft).

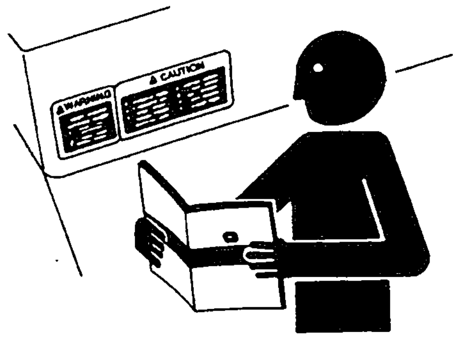
2. Attach JDG23 Engine Lifting Sling (A) to engine lifting straps (B) and overhead hoist.

IMPORTANT: Lifting straps are designed to lift the engine and accessories such as radiator, air filter and other small components. If larger components, such as power take-off, transmission, generator air compressor... etc, are attached to engine, the lifting straps provided with engine or through parts channel are not intended for this purpose. Technician is responsible for providing adequate lifting devices under these situations. See machine manuals for additional information on removing engine from machine.

3. Carefully move engine to desired location.

DPSG,CD03523,95 -19-06OCT99-1/1

FOLLOW SAFETY INSTRUCTIONS



TS201 -UN-23AUG88

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

Learn how to operate the machine and how to use controls properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.

ʼou do not understand any part of this manual and need assistance, contact your John Deere dealer.

DX,READ -19-03MAR93-1/1

PREVENT MACHINE RUNAWAY

TS177 -UN-11JAN89

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start ɜine only from operator's seat, with transmission in utral or park.

DX,BYPAS1 -19-29SEP98-1/1

HANDLE FUEL SAFELY—AVOID FIRES

Handle fuel with care: it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks.

Always stop engine before refueling machine. Fill fuel tank outdoors.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris. Always clean up spilled fuel.

TS202 -UN-23AUG88

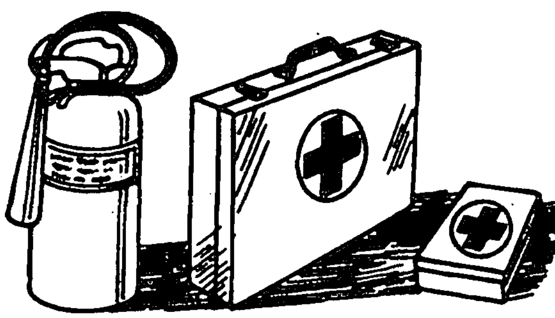
DX,FIRE1 -19-03MAR93-1/1

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 -UN-23AUG88

DX,FIRE2 -19-03MAR93-1/1

HANDLE STARTING FLUID SAFELY

Starting fluid is highly flammable.

Keep all sparks and flame away when using it. Keep starting fluid away from batteries and cables.

To prevent accidental discharge when storing the pressurized can, keep the cap on the container, and store in a cool, protected location.

Do not incinerate or puncture a starting fluid container.

TS1356 -UN-18MAR92

DX,FIRE3 -19-16APR92-1/1

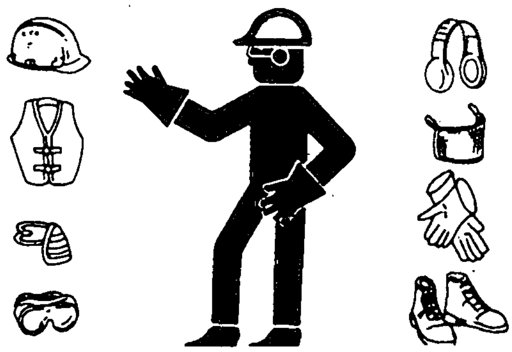
WEAR PROTECTIVE CLOTHING

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



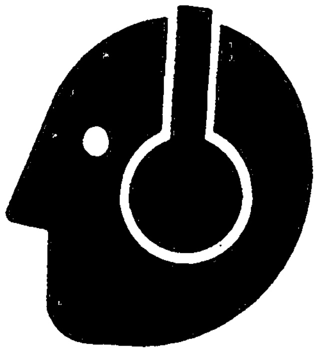
TS206 -UN-23AUG88

DX,WEAR -19-10SEP90-1/1

PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

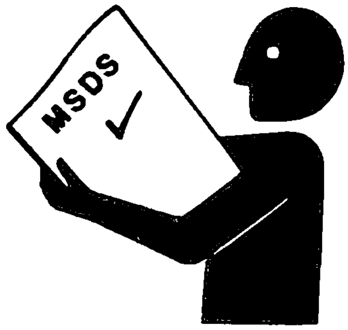
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



TS207 -UN-23AUG88

DX,NOISE -19-03MAR93-1/1

HANDLE CHEMICAL PRODUCTS SAFELY



TS1132 -UN-26NOV90

Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques.

Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

(See your John Deere dealer for MSDS's on chemical products used with John Deere equipment.)

DX,MSDS,NA -19-03MAR93-1/1

STAY CLEAR OF ROTATING DRIVELINES

TS1644 -UN-22AUG95

Entanglement in rotating driveline can cause serious injury or death.

Keep master shield and driveline shields in place at all times. Make sure rotating shields turn freely.

Wear close fitting clothing. Stop the engine and be sure the PTO driveline is stopped before making adjustments or performing any type service on the engine or PTO-driven equipment.

CD,PTO -19-12SEP95-1/1

PRACTICE SAFE MAINTENANCE

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet , and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. ımove any buildup of grease, oil, or debris.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.

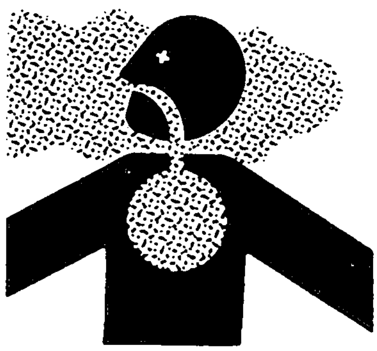
TS218 -UN-23AUG88

DX,SERV -19-17FEB99-1/1

WORK IN VENTILATED AREA

gine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

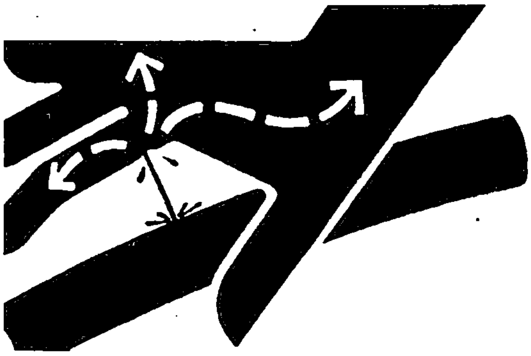
If you do not have an exhaust pipe extension, open the doors and get outside air into the area



TS220 -UN-23AUG88

DX,AIR -19-17FEB99-1/1

AVOID HIGH-PRESSURE FLUIDS



Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

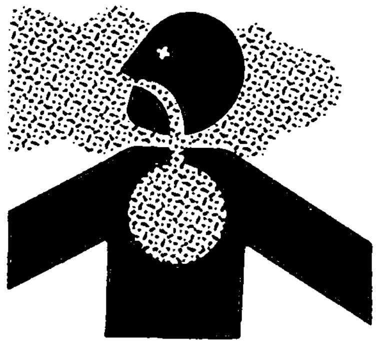
DX,FLUID -19-03MAR93-1/1

AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.

DX,TORCH -19-03MAR93-1/1

REMOVE PAINT BEFORE WELDING OR HEATING



TS220 -UN-23AUG88

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

DX,PAINT -19-03MAR93-1/1

SERVICE COOLING SYSTEM SAFELY

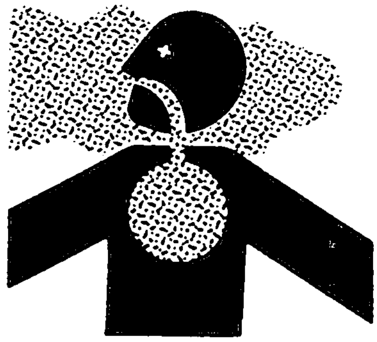
TS281 -UN-23AUG88

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

DX,RCAP -19-04JUN90-1/1

AVOID HARMFUL ASBESTOS DUST



TS220 -UN-23AUG88

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

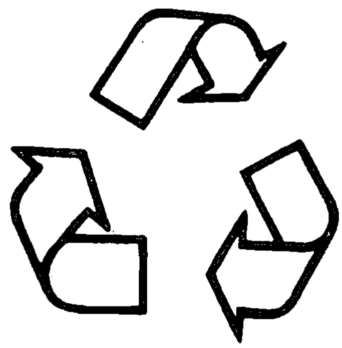
Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos.

Keep bystanders away from the area.

DX,DUST -19-15MAR91-1/1

DISPOSE OF WASTE PROPERLY



TS1133 -UN-26NOV90

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.

DX,DRAIN -19-03MAR93-1/1

Fuels, Lubricants and Coolant

DIESEL FUEL

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended.

In all cases, the fuel shall meet the following properties:

Cetane number of 40 minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20°C (-4°F) or elevations above 1500 m (5,000 ft).

Cold Filter Plugging Point (CFPP) below the expected low temperature OR **Cloud Point** at least 5°C (9°F) below the expected low temperature.

Fuel lubricity should pass a minimum of 3100 gram load level as measured by the BOCLE scuffing test.

Sulfur content:

- Sulfur content should not exceed 0.5%. Sulfur content less than 0.05% is preferred.
- If diesel fuel with sulfur content greater than 0.5% sulfur content is used, reduce the service interval for engine oil and filter by 50%.
- DO NOT use diesel fuel with sulfur content greater than 1.0%.

Bio-diesel fuels may be used ONLY if the fuel properties meet DIN 51606 or equivalent specification.

DO NOT mix used engine oil or any other type of lubricant with diesel fuel.

DX,FUEL1 -19-17FEB99-1/1

HANDLING AND STORING DIESEL FUEL

CAUTION: Handle fuel carefully. Do not fill the fuel tank when engine is running.

DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent condensation and freezing during cold weather.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and prevent water condensation. Contact your fuel supplier for recommendations.

DX,FUEL4 -19-18MAR96-1/1

ENGINE BREAK-IN OIL

New engines are filled at the factory with John Deere ENGINE BREAK-IN OIL. During the break-in period, add John Deere ENGINE BREAK-IN OIL as needed to maintain the specified oil level.

Change the oil and filter after the first 100 hours of operation of a new or rebuilt engine.

After engine overhaul, fill the engine with John Deere ENGINE BREAK-IN OIL.

If John Deere ENGINE BREAK-IN OIL is not available, use a diesel engine oil meeting one of the following during the first 100 hours of operation:

- API Service Classification CE
- ACEA Specification E1

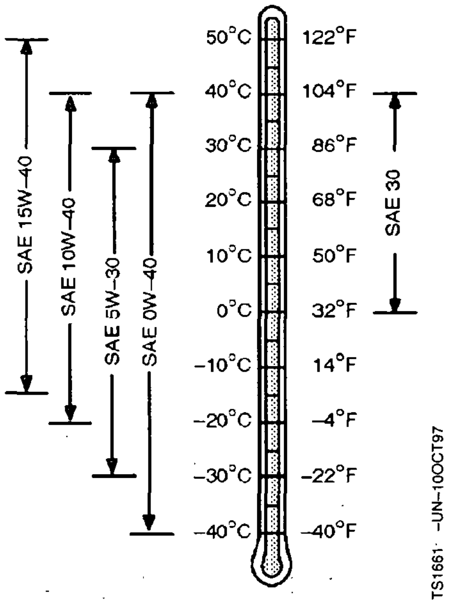
After the break-in period, use John Deere PLUS-50® or other diesel engine oil as recommended in this manual.

IMPORTANT: Do not use PLUS-50 oil or engine oils meeting API CG4, API CF4, ACEA E3, or ACEA E2 performance levels during the first 100 hours of operation of a new or rebuilt engine. These oils will not allow the engine to break-in properly.

PLUS-50 is a registered trademark of Deere & Company.

DX,ENOIL4 –19–10OCT97–1/1

DIESEL ENGINE OIL



Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following oil is preferred:

- John Deere PLUS-50®

The following oil is also recommended:

- John Deere TORQ-GARD SUPREME TORQ-GARD SUPREME®

Other oils may be used if they meet one or more of the following:

PI Service Classification CG-4
- API Service Classification CF-4
- ACEA Specification E3
- ACEA Specification E2

Multi-viscosity diesel engine oils are preferred.

If diesel fuel with sulfur content greater than 0.5% is used, reduce the service interval by 50%.

PLUS-50 is a registered trademark of Deere & Company.
TORQ-GARD SUPREME is a trademark of Deere & Company

CD,ENOIL -19-10OCT97-1/1

LUBRICANT STORAGE

. ur equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Whenever possible, store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

DX,LUBST -19-18MAR96-1/1

MIXING OF LUBRICANTS

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere dealer to obtain specific information and recommendations.

DX,LUBMIX -19-18MAR96-1/1

DIESEL ENGINE COOLANT

The engine cooling system is filled to provide year-round protection against corrosion and cylinder liner pitting, and winter freeze protection to -37°C (-34°F).

John Deere COOL-GARD is preferred for service.

If John Deere COOL-GARD is not available, use a low silicate ethylene glycol base coolant concentrate in a 50% mixture of concentrate with quality water.

The coolant concentrate shall be of a quality that provides cavitation protection to cast iron and aluminum parts in the cooling system. John Deere COOL-GARD meets this requirement.

A 50% mixture of ethylene glycol engine coolant in water provides freeze protection to -37°C (-34°F). If protection at lower temperatures is required, consult your John Deere dealer for recommendations.

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol base engine coolant concentrate.

IMPORTANT: Do not use cooling system sealing additives or antifreeze that contains sealing additives.

COOLANT DRAIN INTERVALS

Drain the factory fill engine coolant, flush the cooling system, and refill with new coolant after the first 3 years or 3000 hours of operation. Subsequent drain intervals are determined by the coolant used for service. At each interval, drain the coolant, flush the cooling system, and refill with new coolant.

When John Deere COOL-GARD is used, the coolant drain interval is 3 years or 3000 hours of operation.

If COOL-GARD is not used, the drain interval is reduced to 2 years or 2000 hours of operation.

DX,COOL8 -19-12FEB99-1/1

OPERATING IN WARM TEMPERATURE CLIMATES

John Deere engines are designed to operate using glycol base engine coolants.

Always use a recommended glycol base engine coolant, even when operating in geographical areas where freeze protection is not required.

IMPORTANT: Water may be used as coolant *in emergency situations only.*

Foaming, hot surface aluminum and iron corrosion, scaling, and cavitation will occur when water is used as the coolant, even when coolant conditioners are added.

Drain cooling system and refill with recommended glycol base engine coolant as soon as possible.

DX,COOL6 -19-18MAR96-1/1

Operating the Engine

BREAK-IN PERIOD

Within first 100 hours of operation
During the first 100 hours of operation, avoid overloading, excessive idling and no-load operation.

See ENGINE BREAK-IN OIL for eventual addition of oil.

NOTE: *During the break-in period a higher-than-usual oil consumption should be considered as normal.*

After first 100 hours of operation
After the first 100 hours, drain the crankcase and change the oil filter (see CHANGING ENGINE OIL AND FILTER). Fill crankcase with seasonal viscosity grade oil (see DIESEL ENGINE OIL).

Check tension of alternator belt.

Check connections of air intake hoses.

Check for proper tightening of cap screws all around the engine.

DPSG,CD03523,17 –19–09JUL99–1/1

STARTING THE ENGINE

CAUTION: Before starting engine in a confined building, install proper outlet exhaust ventilation equipment. Always use safety approved fuel storage and piping.

NOTE: *If temperature is below 0°C (32°F), it may be necessary to use cold weather starting aids (See COLD WEATHER OPERATION).*

1. Perform all prestarting checks outlined in Maintenance/Daily Section.
2. Open the fuel supply shut-off valve, if equipped.
3. Activate the starter motor switch to crank the engine and release it as soon as engine starts.

NOTE: *Do not operate the starter motor more than 20 seconds at a time.*

DPSG,CD03523,18 –19–09JUL99–1/1

COLD WEATHER OPERATION

Depending on equipment, various cold weather starting aids are available to assist in starting the engine at temperatures below 0°C (32°F).

Continued on next page

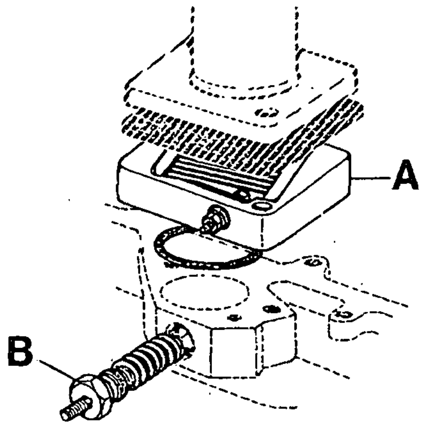
DPSG,CD03523,19 –19–09JUL99–1/4

Air intake heater

Air intake heater is either a grid-type (A) for POWERTech engines or a glow plug-type (B) for 300-Series engines installed in the air intake channel.

CAUTION: NEVER use Ether Starting Fluid when air intake heater is used to start the engine.

Activate the heating element (preheater position) for 30 seconds maximum then start the engine.



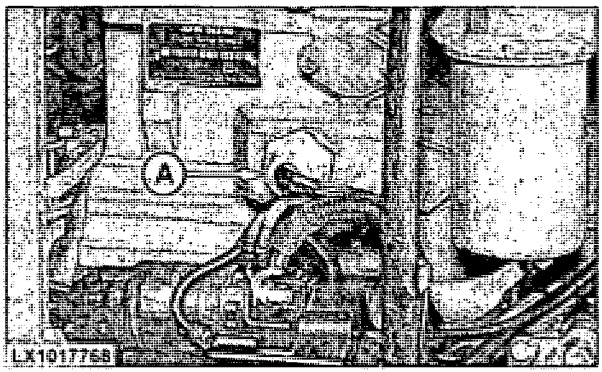
CD30750 -UN-03SEP99

DPSG,CD03523,19 -19-09JUL99-2/4

Coolant heater

Connect plug of coolant heater (A) to a power source (110 or 220 V).

At an ambient temperature of -15°C (5°F), the heating process takes approximatively 2 hours. Extend heating period if ambient temperature is lower.

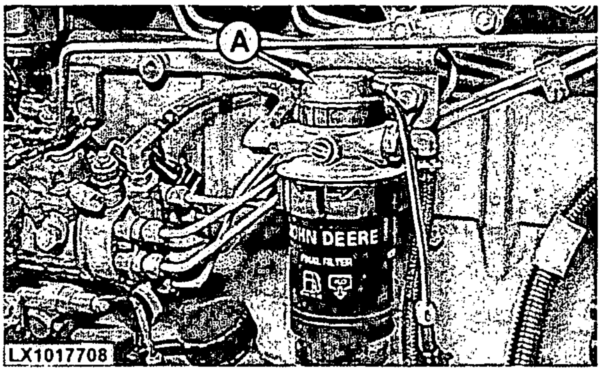


LX1017768 -UN-24OCT97

DPSG,CD03523,19 -19-09JUL99-3/4

Fuel preheater

el preheater (A) switches ON and OFF automatically in relation to the ambient temperature.



LX1017708 -UN-09OCT97

DPSG,CD03523,19 -19-09JUL99-4/4

USING A BOOSTER BATTERY OR CHARGER

A 12-volt booster battery can be connected in parallel with battery(ies) on the unit to aid in cold weather starting. ALWAYS use heavy duty jumper cables.

CAUTION: Gas given off by batteries is explosive. Keep sparks and flames away from batteries. Before connecting or disconnecting a battery charger, turn charger off. Make last connection and first disconnection at a point away from battery. Always connect NEGATIVE (–) cable last and disconnect this cable first.

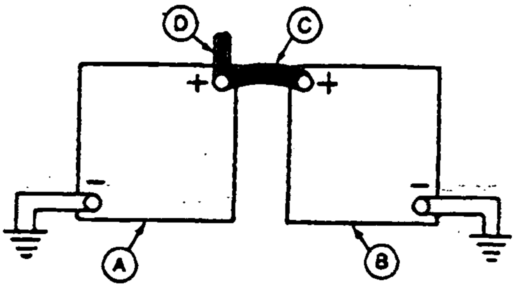
IMPORTANT: Be sure polarity is correct before making connections. Reversed polarity will damage electrical system. Always connect positive to positive and negative to ground. Always use 12-volt booster battery for 12-volt electrical systems and 24-volt booster battery/ batteries for 24-volt electrical systems.

1. Connect booster battery or batteries to produce the required system voltage for your engine application.

NOTE: To avoid sparks, DO NOT allow the free ends of jumper cables to touch the engine.

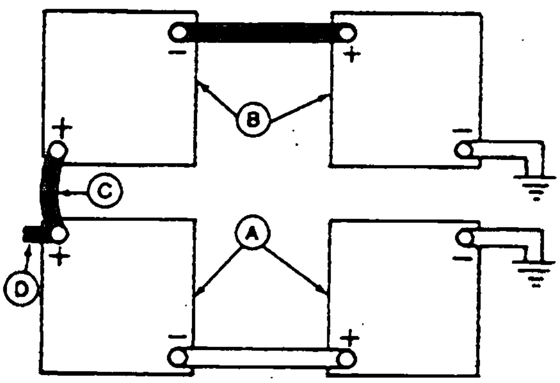
2. Connect one end of jumper cable to the POSITIVE (+) post of the booster battery.
3. Connect the other end of the jumper cable to the POSITIVE (+) post of battery connected to starter.
4. Connect one end of the other jumper cable to the NEGATIVE (–) post of the booster battery.
5. ALWAYS complete the hookup by making the last connection of the NEGATIVE (–) cable to a good ground on the engine frame and away from the battery(ies).
6. Start the engine. Disconnect jumper cables immediately after engine starts. Disconnect NEGATIVE (–) cable first.

TS204 –UN–23AUG88



RG4678 –UN–14DEC88

12-Volt System



RG4698 –UN–14DEC88

24-Volts System

A—12-Volt Machine battery/batteries
B—12-Volt Booster battery/batteries
C—Booster cable
D—Cable to starter motor

DPSG,CD03523,20 –19–09JUL99–1/1

ENGINE OPERATION

Warming engine
Operate engine at high idle for 1 to 2 minutes before applying the load.

NOTE: *This procedure does not apply to standby generator sets where the engine is loaded immediately upon reaching rated speed.*

Normal engine operation
Compare engine coolant temperature and engine oil pressure with specifications below:

Minimum oil pressure at full load rated speed[1]—Specification

Pressure .... 275 kPa (2.75 bar; 40 psi)

Coolant temperature range—Specification

Temperature .... 82°—94°C (180°—202°F)

Stop engine immediately if coolant temperature is above or oil pressure below specifications or if there are any signs of part failure. Symptoms that may be early signs of engine problems could be:

- Sudden loss of power
- Unusual noise or vibration
- Excessive black exhaust fumes
- Excessive fuel consumption
- Excessive oil consumption
- Fluid leaks

Recommendation for turbocharger engines
Should the engine stall when operating under load, IMMEDIATELY restart it to prevent overheating of turbocharger components.

Idling engine
Avoid excessive engine idling. Prolonged idling may cause the engine coolant temperature to fall below its normal range. This, in turn, causes crankcase oil dilution, due to incomplete fuel combustion, and permits formation of gummy deposits on valves, pistons and piston rings. It also promotes rapid accumulation of engine sludge and unburned fuel in the exhaust system. If an engine will be idling for more than 5 minutes, stop and restart later.

NOTE: *Generator set applications have the governor locked at a specified speed and do not have a slow idle function. These engines idle at no load governed speed (fast idle).*

[1]*Oil at normal operating temperature of 115°C (240°F).*

DPSG,CD03523,21 –19–09JUL99–1/1

STANDBY POWER UNITS

To assure that your engine will deliver efficient standby operation when needed, start engine and run at rated speed (with 50%—70% load) for 30 minutes every 2 weeks. DO NOT allow engine to run an extended period of time with no load.

DPSG,CD03523,22 –19–09JUL99–1/1

STOPPING THE ENGINE

1. Before stopping, run engine for at least 2 minutes at fast idle and no load.

2. Stop the engine.

OPSG,CD03523,23 –19–09JUL99–1/1

Maintenance

OBSERVE SERVICE INTERVALS

Using hour meter as a guide, perform all services at the hourly intervals indicated on following pages. At each scheduled maintenance interval, perform all previous maintenance operations in addition to the ones specified. Keep a record of hourly intervals and services performed using charts provided in Maintenance Records Section.

IMPORTANT: Recommended service intervals are for normal operating conditions. Service MORE OFTEN if engine is operated under adverse conditions. Neglecting maintenance can result in failures or permanent damage to the engine.

DPSG,CD03523.24 –19–09JUL99–1/1

USE CORRECT FUELS, LUBRICANTS AND COOLANT

ᐳORTANT: Use only fuels, lubricants, and coolants meeting specifications outlined in Fuels, Lubricants, and Coolant Section when servicing your John Deere Engine.

Consult your John Deere engine distributor, servicing dealer or your nearest John Deere Parts Network for recommended fuels, lubricants, and coolant. Also available are necessary additives for use when operating engines in tropical, arctic, or any other adverse conditions.

TS100 –UN–23AUG88

DPSG,CD03523,25 –19–09JUL99–1/1

MAINTENANCE INTERVAL CHART

Item	10 H / daily	500 H	1000 H / 1 year	2000 H / 2 years	2500 H / 3 years	As required
Check engine oil and coolant level	•					
Check air filter restriction indicator[a]	•					
Change engine oil and filter[b]		•				
Replace fuel filter element		•				
Check belt tension and automatic tensioner[c]		•	•			
Check and adjust valve clearance[d]			•	•		
Clean crankcase vent tube			•			
Check air intake hoses, connections and system			•			
Check vibration damper (6 cyl.)[e]				•		
Check engine speed and speed droop governor				•		
Drain and flush cooling system[f]				•	•	
Drain water and sediment from fuel filter						•
Clean filter element (see note a)						•
Test thermostat and injection nozzles (see your dealer)[g]						•

[a]Clean air filter element when restriction indicator is red. Replace filter element after 6 cleanings or once a year.

[b]Change oil and filter after the first 100 hours of operation, then every 500 hours thereafter. Change oil and filter at least once a year.

[c]Check belt tension every 500 hours on 300-Series engines and on POWERTech engines with manual tensioner. Check automatic belt tensioner every 1000 hours/1 year on POWERTech engines when equipped.

[d]Have your authorized servicing dealer or engine distributor adjust valve clearance as follows. After the first 500 hours of operation then every 1000 hours thereafter on 300-Series engines. Every 2000 hours on POWERTech engines.

[e]Have your authorized dealer or engine distributor replace the vibration damper every 4500 hours/5 years.

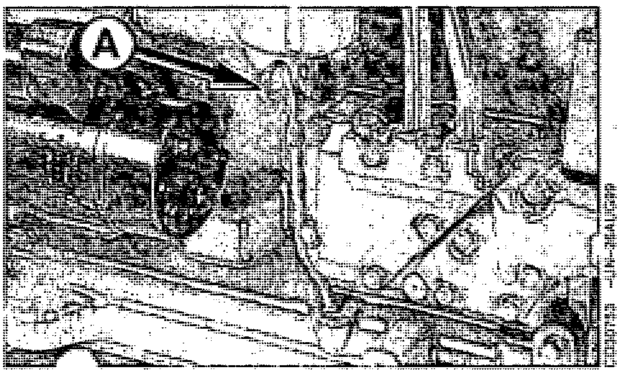
[f]Drain and flush cooling system every 2500 hours/3 years when John Deere COOL-GARD coolant is used. Otherwise every 2000 hours/2 years.

[g]Contact your dealer when thermostat or injection nozzles are suspected to be defective. Replace injection nozzles every 5000 hours and thermostat every 10000 hours.

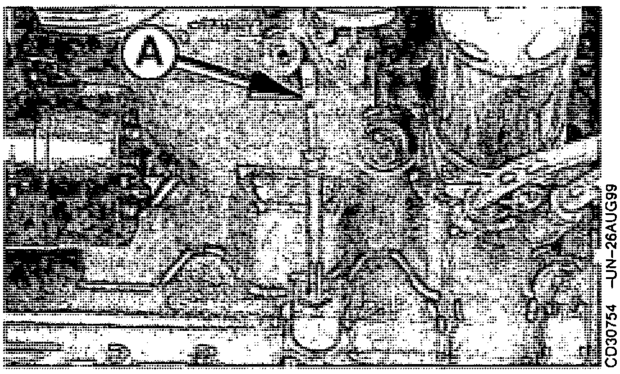
DPSG,CD03523,26 –19–09JUL99–1/1

Maintenance/Daily or every 10 hours

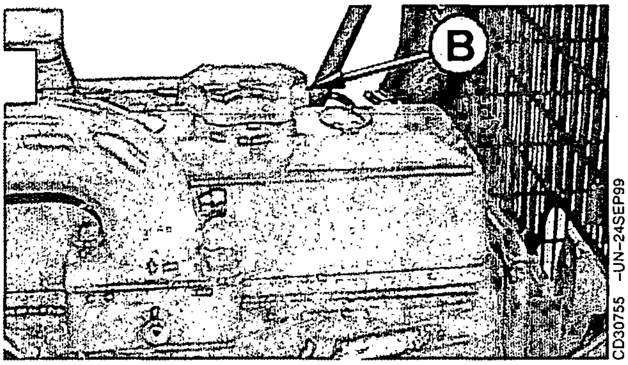
DAILY PRESTARTING CHECKS

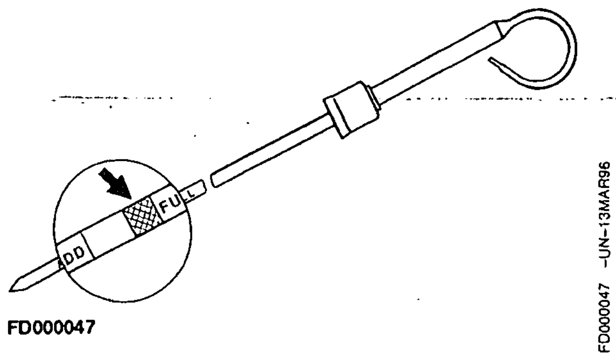


POWERTech engine



300-Series engine





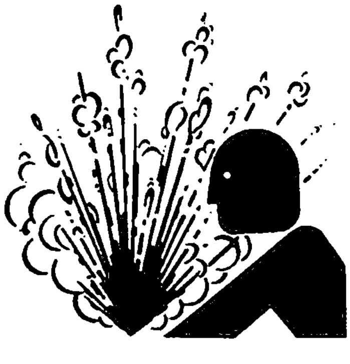
Do the following BEFORE STARTING THE ENGINE for the first time each day:

IMPORTANT: DO NOT top up with fresh oil until the oil level is BELOW the add mark.

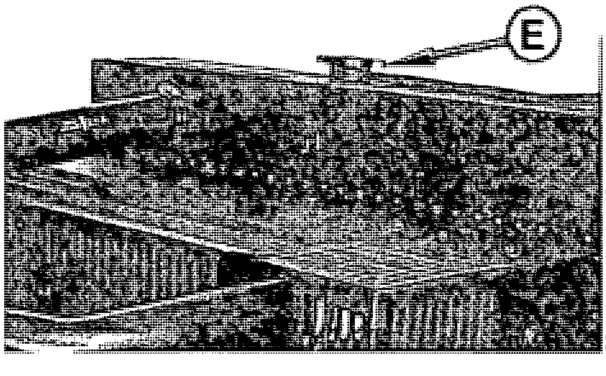
1. Check engine oil level on dipstick (A). Add as required, using seasonal viscosity grade oil. (See DIESEL ENGINE OIL). Add oil at rocker arm cover filler cap (B).

IMPORTANT: DO NOT fill above the crosshatch area. Oil levels anywhere within crosshatch are considered in the acceptable operating range.

Continued on next page DPSG,CD03523,27 -19-12JUL99-1/3



TS281 -UN-23AUG88



CD30756 -UN-26AUG99

2. **CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.**

   Only remove filler cap when engine is cold or when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

Remove radiator cap (E) and check coolant level which should be at bottom of filler neck. Fill radiator with proper coolant solution if level is low. (See DIESEL ENGINE COOLANT). Check overall cooling system for leaks.

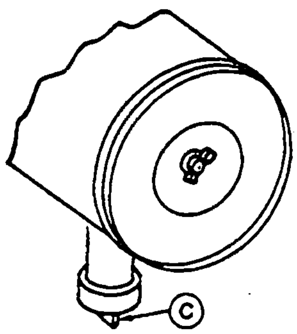
DPSG,CD03523,27 -19-12JUL99-2/3

3. If air filter has a dust unloading valve (C), squeeze valve tip to release any trapped dirt particles.
4. Check air intake restriction indicator (D). When indicator is red, air filter needs to be cleaned.

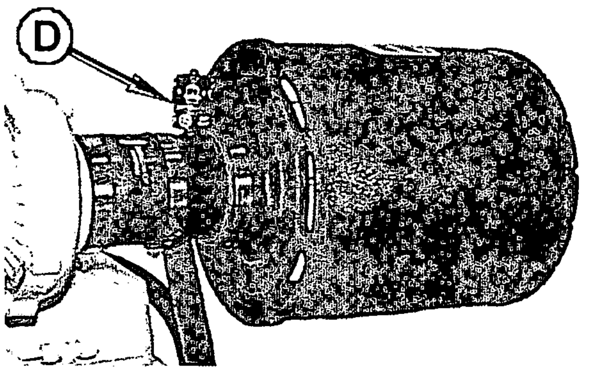
IMPORTANT: Maximum air intake restriction is 6.25 kPa (0.06 bar; 1.0 psi) (25 in. H_2O). A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine.

5. Make a thorough inspection of the engine compartment.

NOTE: Wipe all fittings, caps and plugs before performing any maintenance to reduce the chance of system contamination.



RG4687 -UN-20DEC88



CD30757 -UN-26AUG99

DPSG,CD03523,27 -19-12JUL99-3/3

Maintenance/500 hours

CHANGING ENGINE OIL AND FILTER

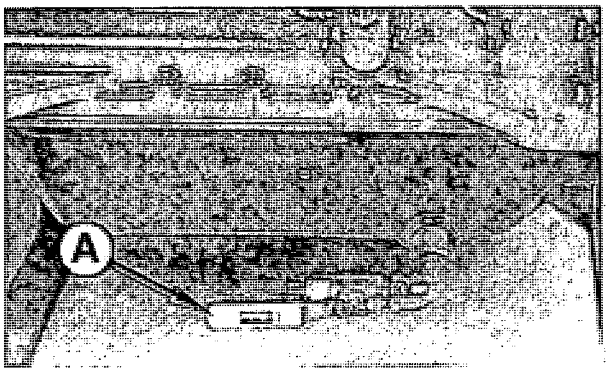
NOTE: Change engine oil and filter for the first time after 100 hours maximum of operation, then every 500 hours thereafter. Change oil and filter at least once a year.

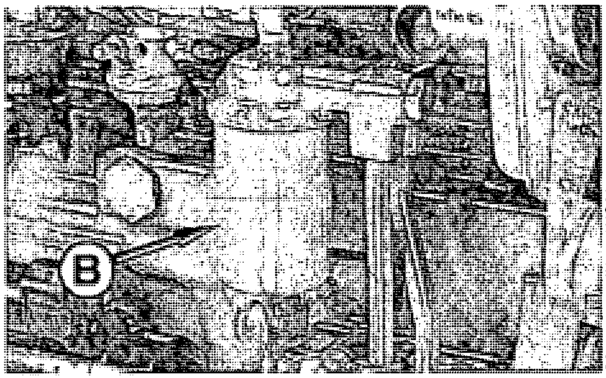
1. Run engine approximately 5 minutes to warm up oil. Shut engine off.
2. Open oil pan drain valve (A).
3. Drain crankcase oil from engine while warm.
4. Remove and discard oil filter element (B) using a suitable filter wrench.

Remove oil filter packing and clean filter mounting pad.

IMPORTANT: Filtration of oils is critical to proper lubrication. Always change filter regularly. Use filters meeting John Deere performance specifications.

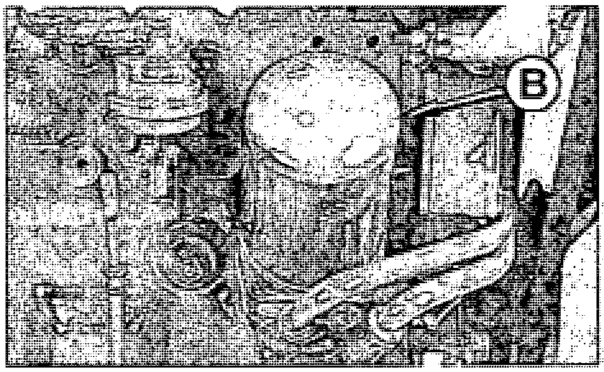
6. Oil the new packing and install a new filter element. Hand tighten element according to values printed on filter element. If values are not provided, tighten element approximately 3/4 — 1-1/4 turn after packing contacts filter housing. DO NOT overtighten filter element.
7. Close oil pan drain valve.





CD30759 -UN-26AUG99

POWERTEch engine

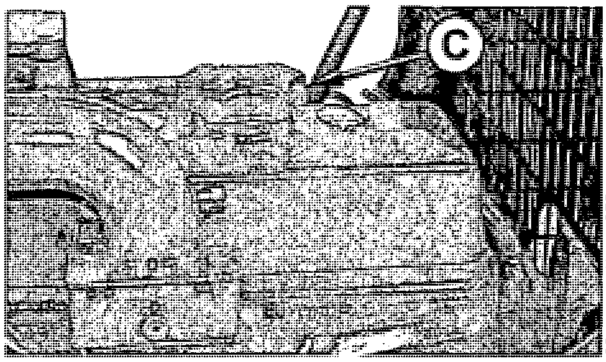


300-Series engine

Continued on next page DPSG,CD03523,29 -19-12JUL99-1/2

8. Fill engine crankcase with correct John Deere engine oil through rocker arm cover opening (C); see DIESEL ENGINE OIL.

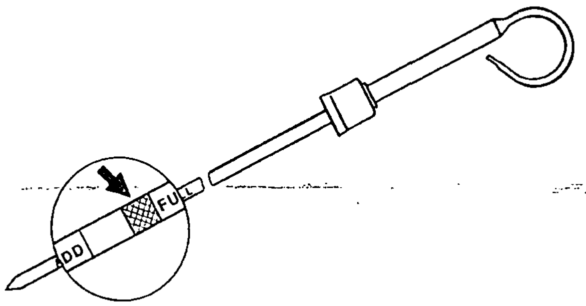
   To determine the correct oil fill quantity for your engine, see "Engine Oil Quantities" in Specifications Section.



CD30761 –UN–24SEP99

NOTE: Crankcase oil capacity may vary slightly. ALWAYS fill crankcase to full mark or within crosshatch on dipstick, whichever is present. DO NOT overfill.

IMPORTANT: Immediately after completing any oil change, crank engine for 30 seconds without permitting engine to start. This will help insure adequate lubrication to engine components before engine starts.



FD000047

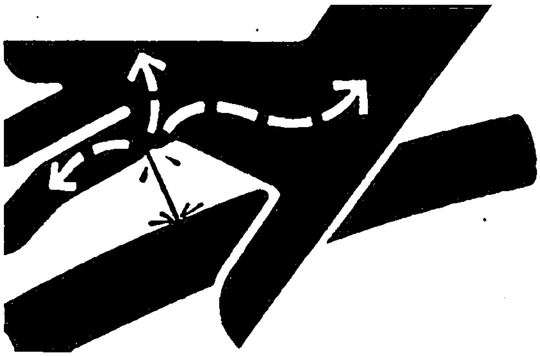
FD000047 –UN–13MAR96

9. Start engine and run to check for possible leaks.

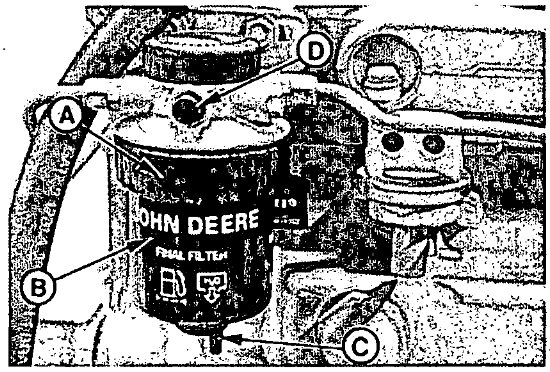
10. Stop engine and check oil level after 10 minutes. If necessary, top up.

DPSG,CD03523,29 –19–12JUL99–2/2

REPLACING FUEL FILTER ELEMENT



X9811 -UN-23AUG88



RG7721 -UN-15JAN99

A—Retaining ring B—Filter element C—Drain plug D—Bleed plug

CAUTION: CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

Thoroughly clean fuel filter assembly and surrounding area.

2. Loosen drain plug (C) and drain fuel into a suitable container.

NOTE: *Lifting up on retaining ring as it is rotated helps to get it past raised locators.*

3. Firmly grasp the retaining ring (A) and rotate it clockwise 1/4 turn. Remove ring with filter element (B).

IMPORTANT: Do not dump the old fuel into the new filter element. This could cause fuel injection problem.

A plug is provided with the new element for plugging the used element.

4. Inspect filter mounting base for cleanliness. Clean as required.

NOTE: *Raised locators on fuel filter canister must be indexed properly with slots in mounting base for correct installation.*

5. Install new filter element dry onto mounting base. Be sure element is properly indexed and firmly seated on base. It may be necessary to rotate filter for correct alignment.

6. Install retaining ring onto mounting base making certain dust seal is in place on filter base. Hand tighten ring (about 1/3 turn) until it "snaps" into the detent. DO NOT overtighten retaining ring.

NOTE: *The proper installation is indicated when a "click" is heard and a release of the retaining ring is felt.*

7. Bleed the fuel system.

DPSG,CD03523,30 -19-12JUL99-1/1

CHECKING BELT (300-SERIES ENGINES)

1. Inspect belt for cracks, fraying, or stretched out areas. Replace as necessary.

2. Check belt tension using one of following methods:

   a) Use of JDG529 Tension Gauge (A)

Belt tension—Specification

New belt	578—622 N (130—140 lb-force)
Used belt	378—423 N (85—94 lb-force)

NOTE: Belt is considered used after 10 minutes of operation.

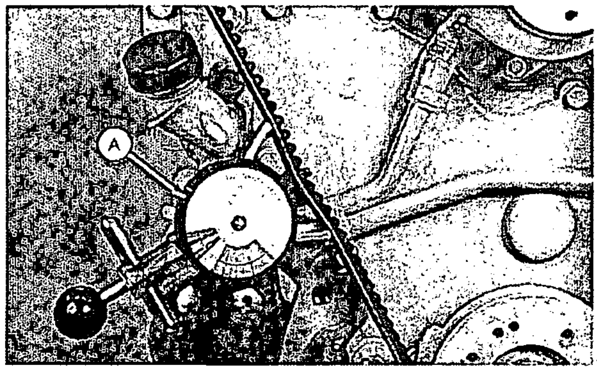
b) Use of tension tester (B) and straight edge (C)
A 89 N (20 lb) force applied halfway between pulleys should deflect belt by 19 mm (0.75 in.).

3. If adjustment is necessary, loosen alternator nuts (D) and (E). Pull alternator frame outward until belt is correctly tensioned.

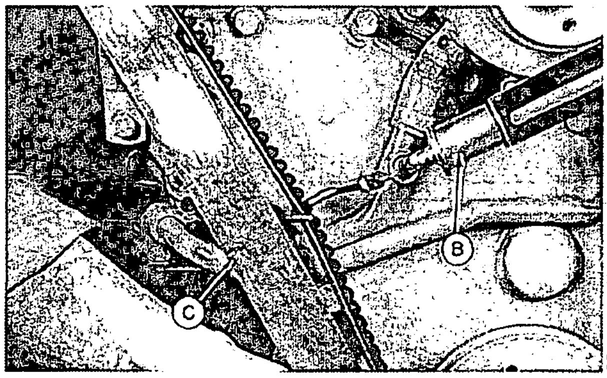
IMPORTANT: Do not pry against the alternator rear frame. Do not tighten or loosen belts while they are hot.

4. Tighten alternator bracket nuts firmly.

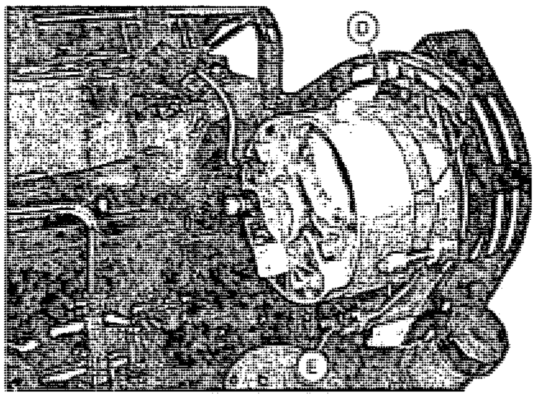
5. Run engine for 10 minutes then recheck belt tension.



CD30644 –UN–04MAY98



CD30645 –UN–04MAY98



CD30646 –UN–04MAY98

DPSG,CD03523,31 –19–12JUL99–1/1

CHECKING BELT (POWERTECH ENGINES WITH MANUAL TENSIONER)

Inspect belt for cracks, fraying, or stretched out areas. Replace if necessary.

NOTE: Belt adjustment is measured using a gauge stamped on the top edge of the alternator bracket.

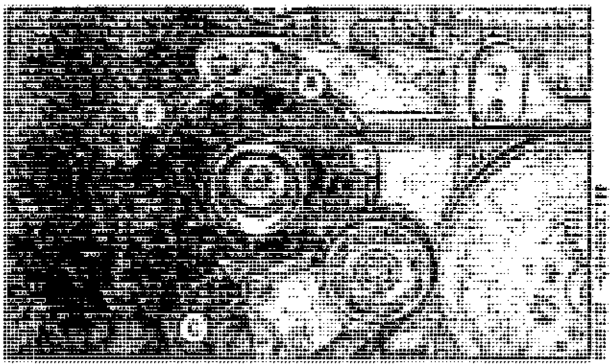
1. Loosen cap screws (B) and (C).

2. Slide alternator in slot by hand to remove all excess slack in belt.

IMPORTANT: Do not pry against alternator rear frame.

3. Using the gauge (A) on the alternator bracket, stretch belt by prying outward on alternator front frame. Stretch the belt 1 gauge unit for a used belt and 1.5 gauge units for a new belt.

4. Tighten cap screws (B) and (C).



A—Belt gauge
B—Cap screw
C—Cap screw

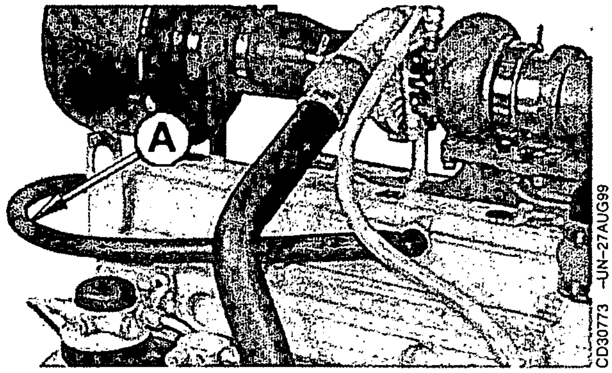
OPSG,CD03523,57 –19–16AUG99–1/1

Maintenance/1000 hours/1 year

CLEANING CRANKCASE VENT TUBE

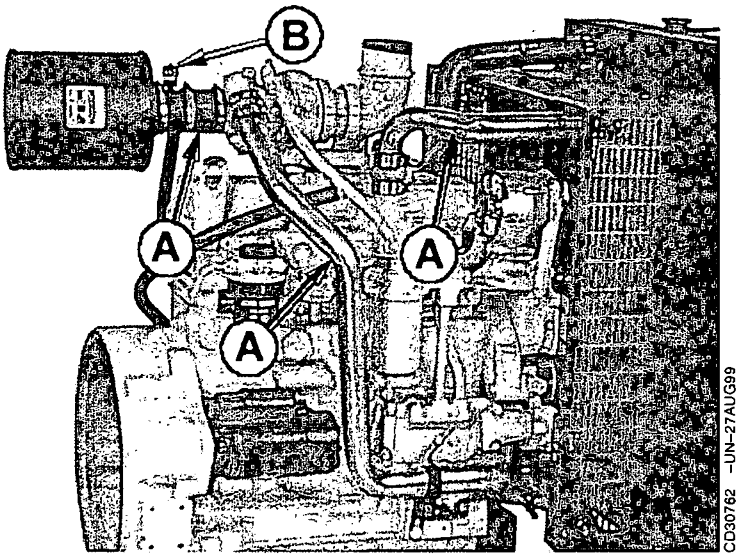
If you operate the engine in dusty conditions, clean the tube at shorter intervals.

1. Remove and clean crankcase vent tube (A).
2. Install the vent tube. Be sure the O-ring fits correctly in the rocker arm cover bore for elbow adapter. Tighten hose clamp securely.



DPSG,CD03523,32 –19–12JUL99–1/1

CHECKING AIR INTAKE SYSTEM



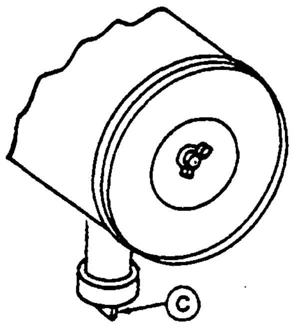
IMPORTANT: The air intake system must not leak. Any leak, no matter how small, may result in engine failure due to abrasive dirt and dust entering the intake system.

1. Inspect all intake hoses (piping) for cracks. Replace as necessary.
2. Check clamps on piping (A) which connect the air filter, engine and, if present, turbocharger and air-to-air radiator. Tighten clamps as necessary.
3. Test air restriction indicator (B) for proper operation. Replace indicator as necessary.

Continued on next page DPSG,CD03523,33 –19–12JUL99–1/2

4. If engine has a rubber dust unloading valve (C), inspect the valve on bottom of air filter for cracks or plugging. Replace as necessary.

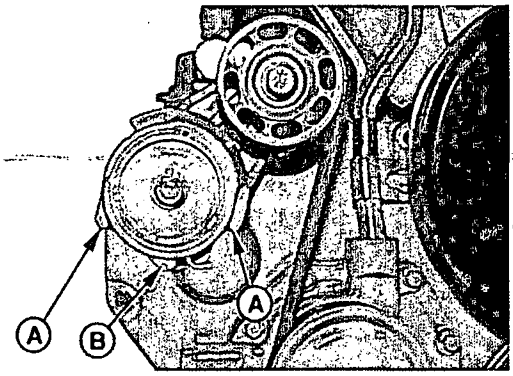
5. Service air filter as necessary.



DPSG,CD03523,33 -19-12JUL99-2/2

CHECKING AUTOMATIC BELT TENSIONER (POWERTECH ENGINES)

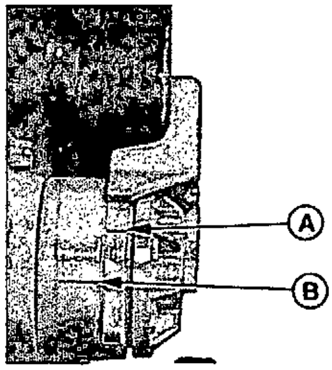
Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.



- **Checking belt wear**
  The belt tensioner is designed to operate within the limit of arm movement provided by the cast stops (A) and (B) when correct belt length and geometry is used. If the tensioner stop on swing arm (A) is hitting the fixed stop (B), check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length. Replace belt as needed (see REPLACING FAN AND ALTERNATOR BELTS).

Continued on next page DPSG,CD03523,34 -19-13JUL99-1/2

- **Checking tensioner spring tension**
  A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:
  a. Release tension on belt using a breaker bar and socket on tension arm. Remove belt from pulleys.
  b. Release tension on tension arm and remove breaker bar.
  c. Put a mark (A) on swing arm of tensioner as shown.
  d. Measure 21 mm (0.83 in.) from (A) and put a mark (B) on tensioner mounting base.
  e. Rotate the swing arm using a torque wrench until marks (A) and (B) are aligned.
  f. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.



RG7977 -UN-14NOV97

Spring—Specification

Force.. 18—22 N•m (13—16 lb-ft)

DPSG,CD03523,34 -19-13JUL99-2/2

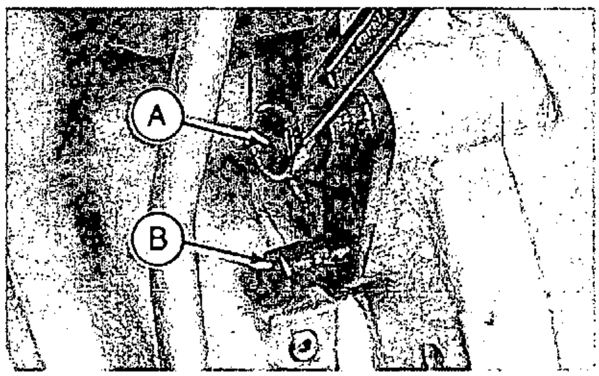
CHECK AND ADJUST ENGINE VALVE CLEARANCE (300-SERIES ENGINES)

NOTE: Valve clearance must be adjusted after the first 500 hours of operation, then every 1000 hours thereafter.

Adjust engine valve clearance as follows or have your authorized servicing dealer or engine distributor adjust the engine valve clearance.

1. Remove rocker arm cover and crankcase vent tube.

2. Using JDE83 or JDG820 Flywheel Turning Tool (A), rotate engine flywheel in running direction (clockwise viewed from water pump) until No.1 piston (front) has reached top dead center (TDC) on compression stroke. Insert timing pin JDE81-4 (B) into flywheel bore.



CD30544 -UN-19MAY98

Continued on next page DPSG,CD03523,35 -19-13JUL99-1/4

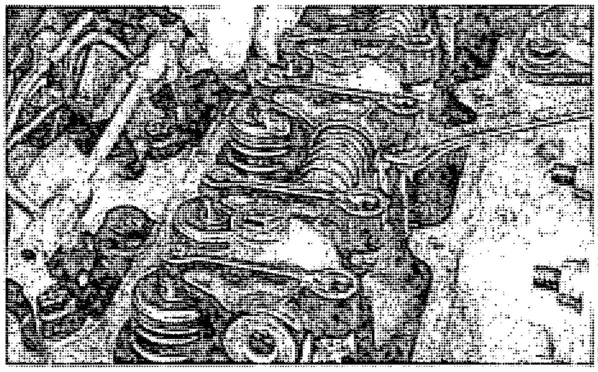
3. Check and adjust valve clearance to specifications according to following procedures.

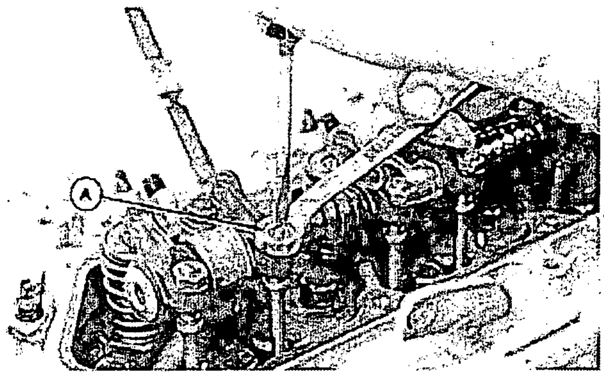
Valve clearance (engine cold)—Specification

Intake .... 0.35 mm (0.014 in.)
Exhaust .... 0.45 mm (0.018 in.)

NOTE: If rocker arm is equipped with adjusting screw and lock nut (A), tighten lock nut to 27 N•m (20 lb-ft) after adjusting valve clearance.

4. Reinstall rocker arm cover and crankcase vent tube.


CD30545 -UN-19MAY98



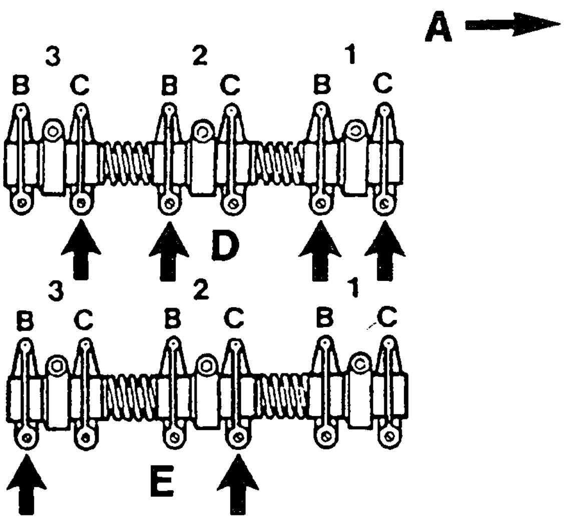
RG6307 -UN-03AUG92

DPSG,CD03523,35 -19-13JUL99-2/4

- **3-Cylinder Engine:**

NOTE: Firing order is 1-2-3.

a. Lock No. 1 piston at TDC compression stroke (D).
b. Adjust valve clearance on No. 1 and 2 exhaust valves and No.1 and 3 intake valves.
c. Rotate flywheel 360°. Lock No. 1 piston at TDC exhaust stroke (E).
d. Adjust valve clearance on No. 3 exhaust valve and No. 2 intake valve.



CD30549 -UN-16JUN98

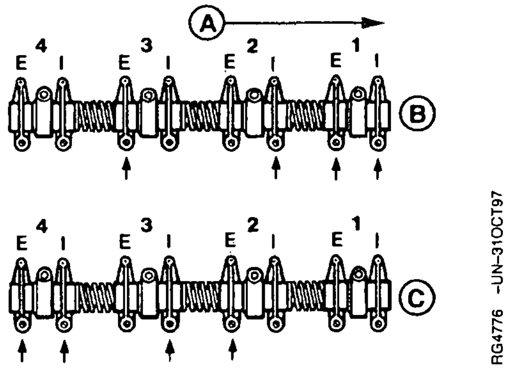
A—Front of engine
B—Exhaust valve
C—Intake valve
D—No.1 Piston at TDC compression stroke
E—No.1 Piston at TDC exhaust stroke

Continued on next page DPSG,CD03523,35 -19-13JUL99-3/4

- **4-Cylinder Engine:**

NOTE: Firing order is 1-3-4-2.

a. Lock No. 1 piston at TDC compression stroke (B).
b. Adjust valve clearance on No. 1 and 3 exhaust valves and No.1 and 2 intake valves.
c. Rotate flywheel 360°. Lock No. 4 piston at TDC compression stroke (C).
d. Adjust valve clearance on No. 2 and 4 exhaust valves and No. 3 and 4 intake valves.

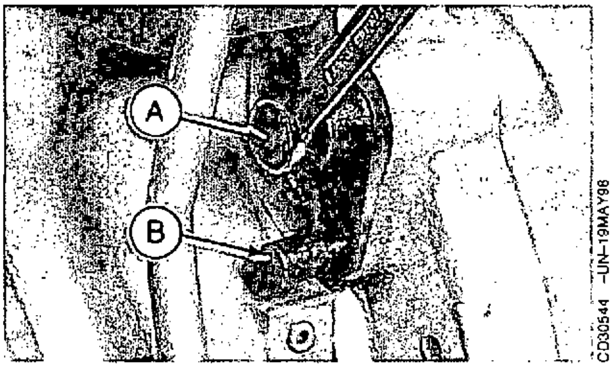


A—Front of engine
B—No.1 Piston at TDC compression stroke
C—No.4 Piston at TDC compression stroke
E—Exhaust valve
I—Intake valve

DPSG,CD03523,35 -19-13JUL99-4/4

Maintenance/2000 hours/2 years

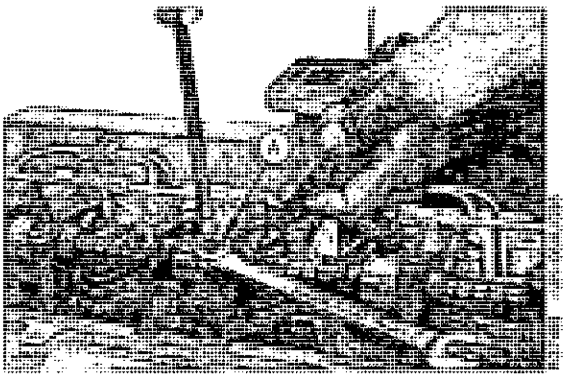
CHECK AND ADJUST ENGINE VALVE CLEARANCE (POWERTECH ENGINE)



Adjust engine valve clearance as follows or have your authorized servicing dealer or engine distributor adjust the engine valve clearance.

1. Remove rocker arm cover and crankcase vent tube.
2. Using JDE83 or JDG820 Flywheel Turning Tool (A), rotate engine flywheel in running direction (clockwise viewed from water pump) until No.1 piston (front) has reached top dead center (TDC) on compression stroke. Insert timing pin JDE81-4 (B) into flywheel bore.

DPSG,CD03523,36 -19-13JUL99-1/4



3. Check and adjust valve clearance to specifications according to following procedures.

Valve clearance (engine cold)—Specification

Intake	0.35 mm (0.014 in.)
Exhaust	0.45 mm (0.018 in.)

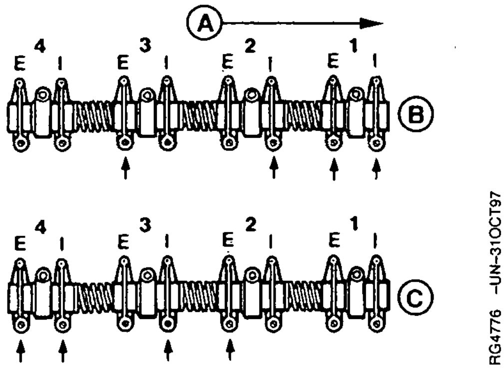
4. If valves need adjusting, loosen the lock nut on rocker arm adjusting screw. Turn adjusting screw until feeler gauge slips with a slight drag. Hold the adjusting screw from turning with screwdriver and tighten lock nut to 27 N•m (20 lb-ft). Recheck clearance again after tightening lock nut. Readjust clearance as necessary
5. Reinstall rocker arm cover and crankcase vent tube.

Continued on next page DPSG,CD03523,36 -19-13JUL99-2/4

- **4-Cylinder Engine:**

NOTE: Firing order is 1-3-4-2.

a. Lock No. 1 piston at TDC compression stroke (B).
b. Adjust valve clearance on No. 1 and 3 exhaust valves and No.1 and 2 intake valves.
c. Rotate flywheel 360°. Lock No. 4 piston at TDC compression stroke (C).
d. Adjust valve clearance on No. 2 and 4 exhaust valves and No. 3 and 4 intake valves.



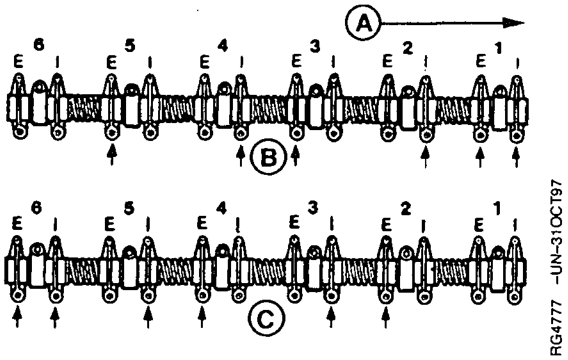
A—Front of engine
B—No.1 Piston at TDC compression stroke
C—No.4 Piston at TDC compression stroke
E—Exhaust valve
I—Intake valve

DPSG,CD03523,36 –19–13JUL99–3/4

- **6-Cylinder Engine:**

NOTE: Firing order is 1-5-3-6-2-4.

a. Lock No. 1 piston at TDC compression stroke (B).
b. Adjust valve clearance on No. 1, 3, and 5 exhaust valves and No. 1, 2, and 4 intake valves.
c. Rotate flywheel 360°. Lock No. 6 piston at TDC compression stroke (C).
d. Adjust valve clearance on No. 2, 4, and 6 exhaust valves and No. 3, 5, and 6 intake valves.



A—Front of engine
B—No.1 Piston at TDC compression stroke
C—No.6 Piston at TDC compression stroke
E—Exhaust valve
I—Intake valve

DPSG,CD03523,36 –19–13JUL99–4/4

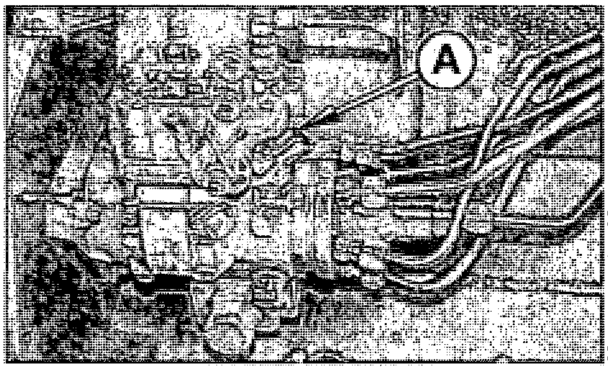
CHECKING ENGINE SPEED

NOTE: Most engines for generator set application (1500 rpm for 50 Hz or 1800 rpm for 60 Hz) run only at fast idle and therefore they do not have slow idle.

Fast idle—Specification

50 Hz Generator set	1550—1580 rpm
60 Hz Generator set	1865—1890 rpm

NOTE: Fast idle is settled by the factory then the idle adjusting screw (A) is sealed to prevent from tampering. Fast idle adjustment can only be done by an authorized fuel system agent.



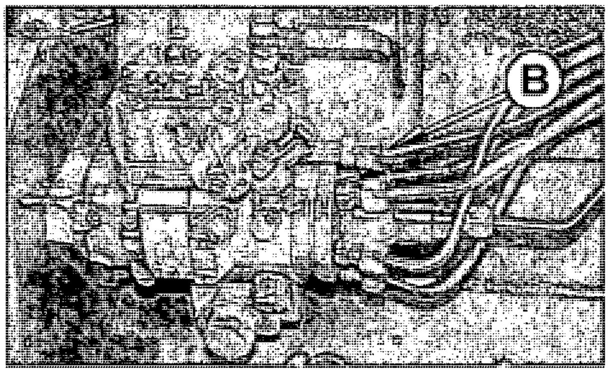
CD30763 -UN-24SEP99

DPSG,CD03523,38 -19-13JUL99-1/1

ADJUST SPEED DROOP GOVERNOR

1. Warm engine to normal operating temperature.
2. Run engine at fast idle.
3. Apply full load.
4. If specified power cannot be obtained, turn screw (B) to adjust droop until the requested power is reached.

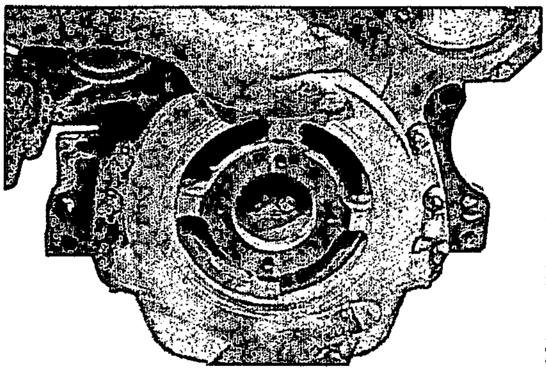
NOTE: If surging exists upon removing the load, turn screw (B) clockwise to eliminate.



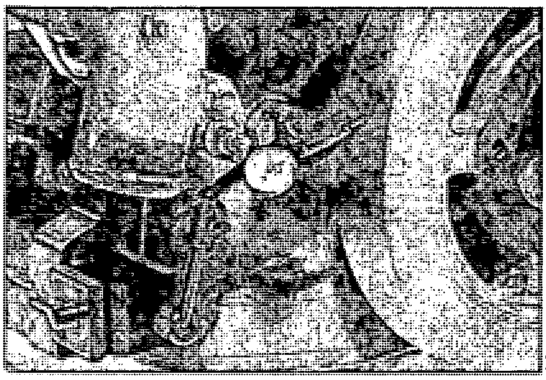
CD30764 -UN-24SEP99

DPSG,CD03523,39 -19-13JUL99-1/1

CHECKING CRANKSHAFT VIBRATION DAMPER (6-CYLINDER ENGINE ONLY)



RG8018 -UN-15JAN99



RG7508 -UN-23NOV97

1. Remove belts (shown removed).
2. Grasp vibration damper with both hands and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced.

IMPORTANT: The vibration damper assembly is not repairable and should be replaced every 4500 hours or 5 years, whichever occurs first.

3. Check vibration damper radial runout by positioning a dial indicator so probe contacts damper outer circumference.
4. With engine at operating temperature, rotate crankshaft using JDG820 or JDE83 Flywheel Turning Tool.
5. Note dial indicator reading. If runout exceeds specifications given below, replace vibration damper.

Damper—Specification

Maximum radial runout .... 1.50 mm (0.060 in.)

DPSG,CD03523,40 -19-13JUL99-1/1

Maintenance/2500 hours/3 years

DRAIN AND FLUSH COOLING SYSTEM

NOTE: Drain and flush cooling system every 2500 hours/3 years when John Deere COOL-GARD coolant is used. Otherwise every 2000 hours/2 years.

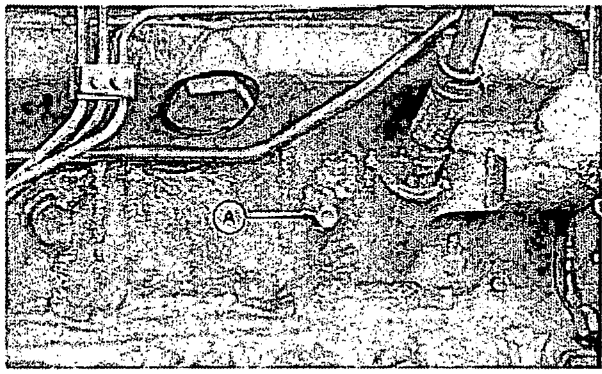
⚠ **CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.**

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

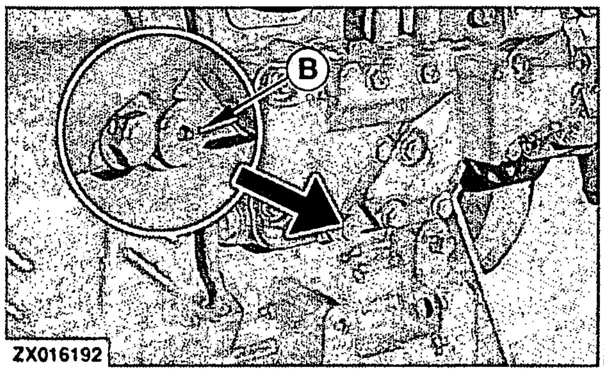
TS281 -UN-23AUG88

Slowly open the radiator cap.

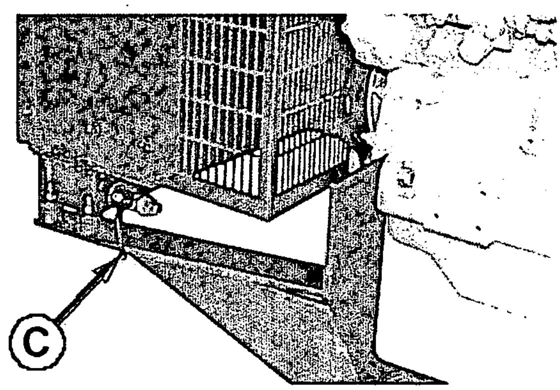
2. Remove engine block drain plug (A).
3. On POWERTech engines, remove oil cooler housing drain plug (B).
4. Open radiator drain valve (C). Drain all coolant from radiator.
5. Close all drain orifices after coolant has drained.
6. Fill the cooling system with clean water. Run engine until water passes through the thermostat to stir up possible rust or sediment.
7. Stop engine and immediately drain the water from system before rust and sediment settle.
8. After draining water, close all drain orifices and fill the cooling system with clean water and TY15979 John Deere Heavy Duty Cooling System Cleaner or equivalent cleaner. Follow manufacturer's directions on label.
9. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run engine until water passes through the thermostat, then drain out flushing water.



RG4894 -UN-14DEC88



ZX016192 -UN-11JAN99



CD30765 -UN-27AUG99

Continued on next page

DPSG,CD03523,41 -19-13JUL99-1/3

10. Check cooling system hoses for proper condition. Replace as necessary.

11. Close all drain orifices and fill the cooling system with specified coolant (see DIESEL ENGINE COOLANT).

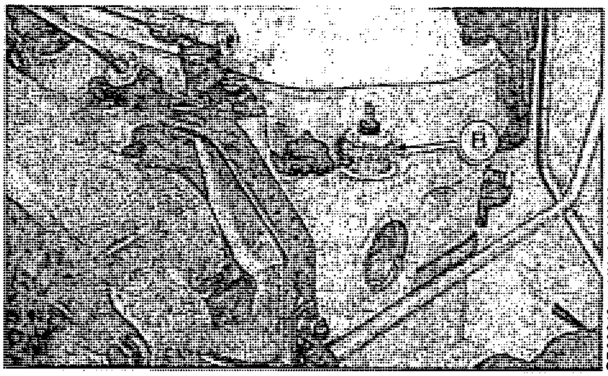
Cooling system capacity—Specification

CD3029DF128	14.5 L (15.5 qt)
CD4039DF008	16.5 L (17.5 qt)
CD4039TF008	16.5 L (17.5 qt)
CD4045DF158	20 L (21 qt)
CD4045HF158	25 L (26.5 qt)
CD4045TF158	25 L (26.5 qt)
CD4045TF258	25 L (26.5 qt)
CD6068HF158	29 L (30.5 qt)
CD6068TF158	26 L (27.5 qt)
CD6068TF258	26 L (27.5 qt)

DPSG,CD03523,41 -19-13JUL99-2/3

12. When refilling cooling system, loosen temperature sensor (B) or plug at the rear of cylinder head to allow air to escape.

13. Run engine until it reaches operating temperature then check coolant level and entire cooling system for leaks.



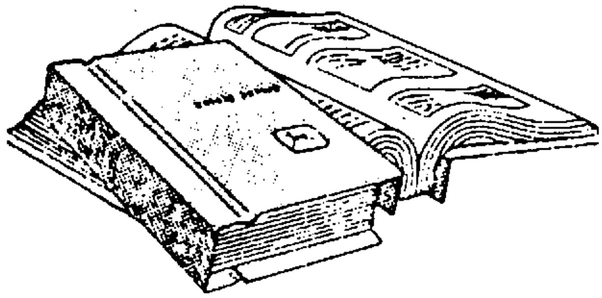
DPSG,CD03523,41 -19-13JUL99-3/3

Maintenance/As required

ADDITIONAL SERVICE INFORMATION

This manual does not allow a complete repair of your engine. If you want want more detailled service information the following publications are available from your regular parts channel.

- PC2451 — Parts Catalog
- CTM3274 — Component Technical Manual for 300-Series engines (English)
- CTM104 — Component Technical Manual for POWERTech engines (English)
- CTM67 — Component Technical Manual for OEM Engine accessories (English only)
- CTM77 — Component Technical Manual for Alternators and Starter Motors (English only)



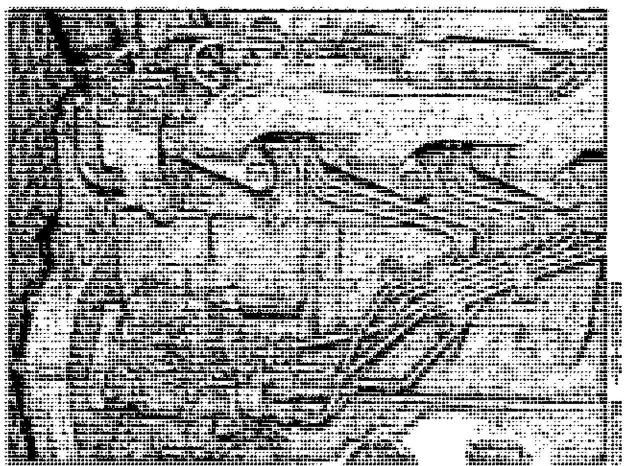
RG4624 -UN-15DEC88

DPSG,CD03523,42 -19-15JUL99-1/1

DO NOT MODIFY FUEL SYSTEM

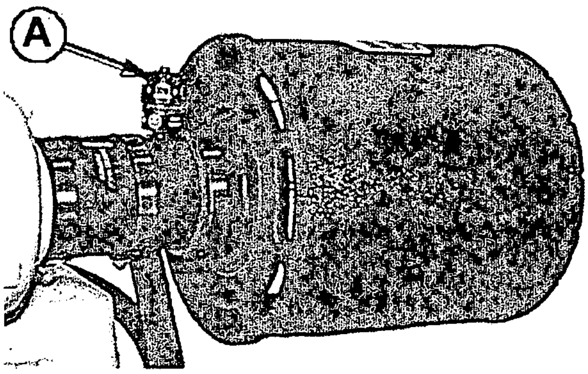
IMPORTANT: Modification or alteration of the injection pump, the injection pump timing, or the fuel injectors in ways not recommended by the manufacturer will terminate the warranty obligation to the purchaser.

Do not attempt to service injection pump or fuel injectors yourself. Special training and special tools are required (see your authorized servicing dealer or engine distributor).



DPSG,CD03523,43 -19-15JUL99-1/1

CLEAN OR REPLACE AIR FILTER (ONE-PIECE)

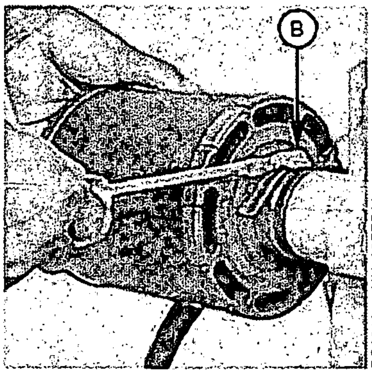


CD30766 -UN-06SEP99

Clean air filter when restriction indicator (A) is red. Air filter can be cleaned up to six times. Thereafter, or at least once a year, it must be replaced.

Proceed as follows:

1. Thoroughly clean all dirt around air filter area.
2. Loosen clamp (B) then remove air filter.



RG9912 -UN-25FEB99

IMPORTANT: Never reinstall an air filter which shows evidence of bad condition (punched, dented...) allowing no filtered air to enter the engine.

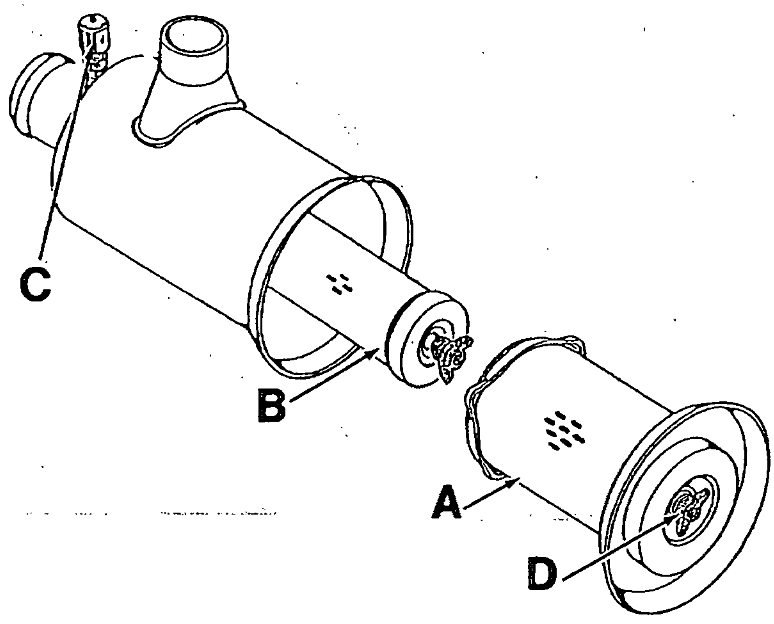
3. Clean air filter with compressed air working from "clean" to "dirty" side.

NOTE: Compressed air must not exceed 600 kPa (6 bar; 88 psi).

4. Mark air filter to keep track of each cleaning operation.
5. Fully depress air restriction indicator reset button and release to reset indicator.
6. Check air system entirely for proper condition (see CHECKING AIR INTAKE SYSTEM).

DPSG,CD03523,44 -19-15JUL99-1/1

CLEAN OR REPLACE AIR FILTER ELEMENT



A—Primary element
B—Secondary (safety) element
C—Air restriction indicator
D—Wing nut

Clean air filter when restriction indicator (C) is red. Replace both primary (A) and secondary (B) filter elements every 6 primary element cleaning or at least once a year.

Proceed as follows:

1. Thoroughly clean all dirt around air filter area.

2. Remove wing nut (D) and remove primary element (A) from canister.

IMPORTANT: Do not attempt to clean the secondary (safety) element (B). It must be only replaced as recommended.

3. Thoroughly clean all dirt from inside canister.

IMPORTANT: If primary element shows evidence of bad condition (punched, dented...), replace both the primary and the secondary elements.

4. Clean primary element with compressed air working from "clean" to "dirty" side.

NOTE: Compressed air must not exceed 600 kPa (6 bar; 88 psi).

5. Mark air filter to keep track of each cleaning operation.

6. Fully depress air restriction indicator reset button and release to reset indicator.

7. Check air system entirely for proper condition (see CHECKING AIR INTAKE SYSTEM).

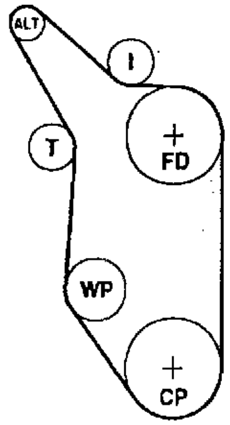
DPSG,CD03523,58 -19-16AUG99-1/1

REPLACING FAN AND ALTERNATOR BELT (POWERTECH ENGINES)

NOTE: Refer to CHECKING BELT TENSIONER SPRING TENSION AND BELT WEAR for additional information on the belt tensioner.

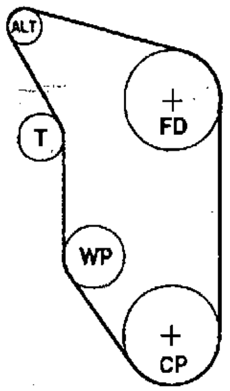
1. Inspect belts for cracks, fraying, or stretched out areas. Replace if necessary.
2. On engines with automatic belt tensioner, release tension on belt using a breaker bar and socket on tension arm.

   On engines with manual tensioner, loosen cap screws holding the alternator.
3. Remove poly-vee belt from pulleys and discard belt.
4. Install new belt, making sure belt is correctly seated in all pulley grooves. Refer to belt routing at right for your application.
5. Apply tension to belt (see CHECKING BELT).
6. Start engine and check belt alignment.



CD30769 -UN-01SEP99

Installation on 4 cyl. engines



CD30770 -UN-01SEP99

Installation on 6 cyl. engines

ALT—Alternator
CP—Crankshaft Pulley
FD—Fan Drive
I—Idler Pulley
T—Tensioner
WP—Water Pump

DPSG,CD03523,45 -19-15JUL99-1/1

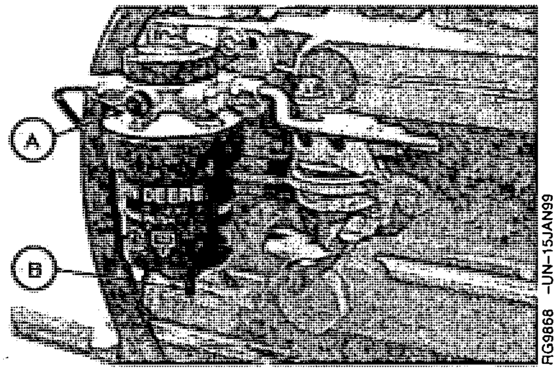
CHECKING FUEL FILTER

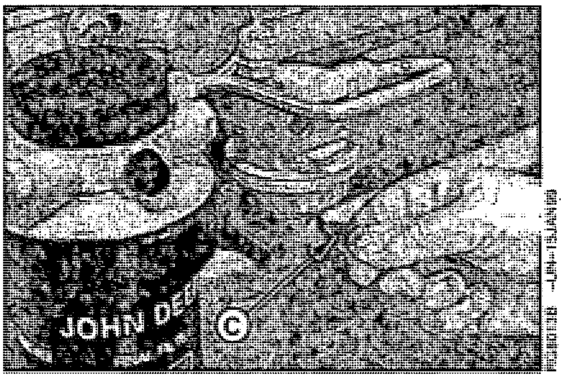
Periodically the fuel filter should be checked for water or debris.

IMPORTANT: Drain water into a suitable container and dispose of properly.

1. Loosen drain plug (B) at bottom of fuel filter two or three turns.
2. Loosen air bleed plug two full turns (A) on fuel filter base and drain water from bottom until fuel starts to drain out.
3. When fuel starts to drain out, tighten drain plug securely.
4. After draining water from the fuel filter, the filter must be primed by bleeding all air from the fuel system. Operate primer lever of the fuel supply pump (C) until fuel flow is free from air bubbles.
5. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.

If the fuel system needs further bleeding of air, see BLEEDING THE FUEL SYSTEM.



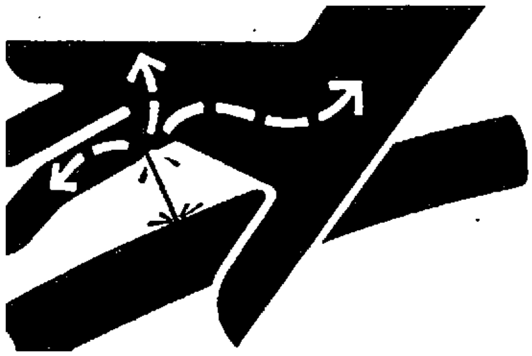


DPSG,CD03523,28 -19-12JUL99-1/1

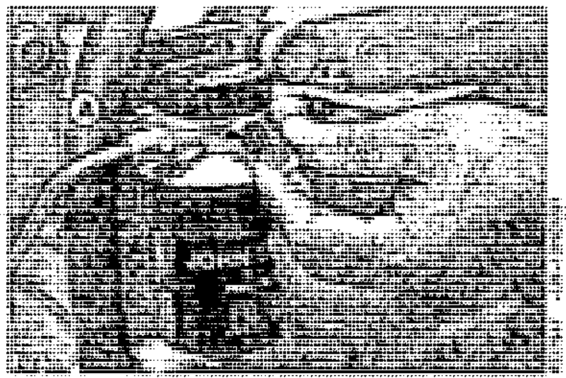
BLEEDING THE FUEL SYSTEM

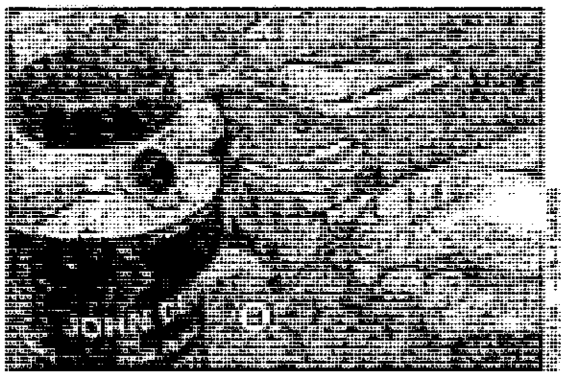
CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.



X9811 -UN-23AUG88





Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

1. Loosen the air bleed screw (A) two full turns by hand on fuel filter base.
2. Operate supply pump primer lever (B) until fuel flow is free from air bubbles.
3. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.
4. Start engine and check for leaks.

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles as explained next.

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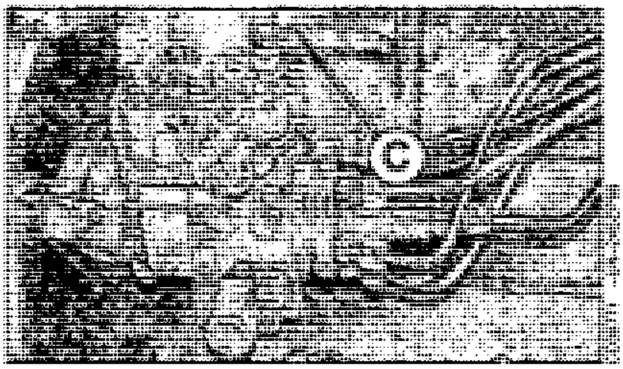
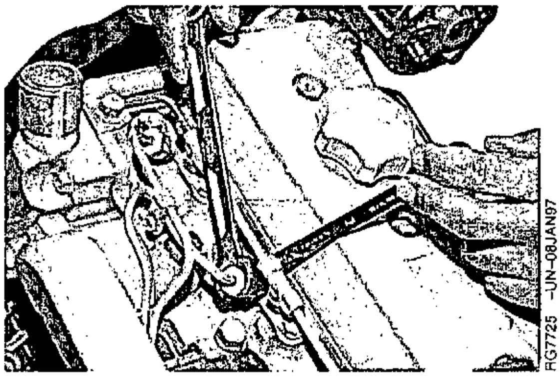
OPSG,CD03523,46 -19-10AUG99-1/2



- **At Fuel Injection Pump:**
  a. Slightly loosen fuel return line connector (C) at fuel injection pump.
  b. Operate fuel supply pump primer lever until fuel, without air bubbles, flows from fuel return line connection.
  c. Tighten return line connector to 16 N•m (12 lb-ft).
  d. Leave hand primer in the inward position toward cylinder block.

- **At Fuel Injection Nozzles:**
  a. Using two open-end wrenches, loosen fuel line connection at injection nozzle.
  b. Crank engine over with starting motor (but do not start engine), until fuel free from bubbles flows out of loosened connection. Retighten connection to 27 N•m (20 lb-ft).
  c. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.

If engine still will not start, see your authorized servicing dealer or engine distributor.



DPSG,CD03523,46 -19-10AUG99-2/2

Troubleshooting

ENGINE TROUBLESHOOTING

Symptom	Problem	Solution
Engine cranks but will not start	Incorrect starting procedure.	Verify correct starting procedure.
	No fuel.	Check fuel in tank and manual shut-off valve.
	Exhaust restricted.	Check and correct exhaust restriction.
	Fuel filter plugged or full of water.	Replace fuel filter or drain water from filter.
	Injection pump not getting fuel or air in fuel system.	Check fuel flow at supply pump or bleed fuel system.
	Faulty injection pump or nozzles.	Consult authorized diesel repair station for repair or replacement.
Engine hard to start or will not start	Engine starting under load.	Remove load.
	Improper starting procedure.	Review starting procedure.
	No fuel.	Check fuel tank.
	Air in fuel line.	Bleed fuel line.
	Cold weather.	Use cold weather starting aids.
	Slow starter speed.	See "Starter Cranks Slowly".
	Crankcase oil too heavy.	Use oil of correct viscosity.
	Improper type of fuel.	Consult fuel supplier; use proper type fuel for operating conditions.
	Water, dirt or air in fuel system.	Drain, flush, fill and bleed system.
	Clogged fuel filter.	Replace filter element.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.

Continued on next page

DPSG,CD03523,49 -19-10AUG99-1/5

Troubleshooting

Symptom	Problem	Solution
	Injection pump shut-off not reset.	Turn key switch to “OFF” then to “ON”.
Engine knocks	Low engine oil level.	Add oil to engine crankcase.
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Low coolant temperature.	Remove and check thermostat.
	Engine overheating.	See “Engine Overheats”.
Engine runs irregularly or stalls frequently	Low coolant temperature.	Remove and check thermostat.
	Clogged fuel filter.	Replace fuel filter element.
	Water, dirt or air in fuel system.	Drain, flush, fill and bleed system.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
Below normal engine temperature	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check gauge, sender and connections.
Lack of power	Engine overloaded.	Reduce load.
	Intake air restriction.	Service air cleaner.
	Clogged fuel filter.	Replace filter element.
	Improper type of fuel.	Use proper fuel.
	Overheated engine.	See “Engine Overheats”.
	Below normal engine temperature.	Remove and check thermostat.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.

Continued on next page DPSG,CD03523,49 –19–10AUG99–2/5

Symptom	Problem	Solution
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning.	See your authorized servicing dealer or engine distributor.
	Leaking exhaust manifold gasket.	See your authorized servicing dealer or engine distributor.
	Defective aneroid control line.	See your authorized servicing dealer or engine distributor.
	Restricted fuel hose.	Clean or replace fuel hose.
	Low fast idle speed.	See your authorized servicing dealer or engine distributor.
Low oil pressure	Low oil level.	Add oil.
	Improper type of oil.	Drain and fill crankcase with oil of proper viscosity and quality.
High oil consumption	Crankcase oil too light.	Use oil of correct viscosity.
	Oil leaks.	Check for leaks in lines, gaskets, and drain plug.
	Restricted crankcase vent tube.	Clean vent tube.
	Defective turbocharger.	See your authorized servicing dealer or engine distributor.
Engine emits white smoke	Improper type of fuel.	Use proper fuel.
	Low engine temperature.	Warm up engine to normal operating temperature.
	Defective thermostat.	Remove and check thermostat.
	Defective injection nozzles.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.

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DPSG,CD03523,49 -19-10AUG99-3/5

Troubleshooting

Symptom	Problem	Solution
Engine emits black or grey exhaust smoke	Improper type of fuel.	Use proper fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load.
	Injection nozzles dirty.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning.	See your authorized servicing dealer or engine distributor.
Engine overheats	Engine overloaded.	Reduce load.
	Low coolant level.	Fill radiator to proper level, check radiator and hoses for loose connections or leaks.
	Faulty radiator cap.	Have serviceman check.
	Stretched poly-vee belt or defective belt tensioner.	Check automatic belt tensioner and check belts for stretching. Replace as required.
	Low engine oil level.	Check oil level. Add oil as required.
	Cooling system needs flushing.	Flush cooling system.
	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check coolant temperature with thermometer and replace, if necessary.
	Incorrect grade of fuel.	Use correct grade of fuel.
High fuel consumption	Improper type of fuel.	Use proper type of fuel.
	Clogged or dirty air cleaner.	Service air cleaner.

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DPSG,CD03523,49 –19–10AUG99–4/5

Troubleshooting

Symptom	Problem	Solution
	Engine overloaded.	Reduce load.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Injection nozzles dirty.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Defective turbocharger.	See your authorized servicing dealer or engine distributor.
	Low engine temperature.	Check thermostat.

DPSG,CD03523,49 -19-10AUG99-5/5

ELECTRICAL TROUBLESHOOTING

Symptom	Problem	Solution
Undercharged system	Excessive electrical load from added accessories.	Remove accessories or install higher output alternator.
	Excessive engine idling.	Increase engine rpm when heavy electrical load is used.
	Poor electrical connections on battery, ground strap, starter or alternator.	Inspect and clean as necessary.
	Defective battery.	Test battery.
	Defective alternator.	Test charging system.
Battery uses too much water	Cracked battery case.	Check for moisture and replace as necessary.
	Defective battery.	Test battery.
	Battery charging rate too high.	Test charging system.
Battery will not charge	Loose or corroded connections.	Clean and tighten connections.
	Sulfated or worn-out battery.	See your authorized servicing dealer or engine distributor.
	Stretched poly-vee belt or defective belt tensioner.	Adjust belt tension or replace belts.
Starter will not crank	Engine under load	Remove load
	Loose or corroded connections.	Clean and tighten loose connections.
	Low battery output voltage.	See your authorized servicing dealer or engine distributor.
	Faulty start circuit relay.	See your authorized servicing dealer or engine distributor.
	Blown fuse.	Replace fuse.

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OPSG,CD03523,50 –19–10AUG99–1/2

Troubleshooting

Symptom	Problem	Solution
Starter cranks slowly	Low battery output.	See your authorized servicing dealer or engine distributor.
	Crankcase oil too heavy.	Use proper viscosity oil.
	Loose or corroded connections.	Clean and tighten loose connections.
Entire electrical system	Faulty battery connection.	Clean and tighten connections.
	Sulfated or worn-out battery.	See your authorized servicing dealer or engine distributor.
	Blown fuse.	Replace fuse.

DPSG,CD03523,50 –19–10AUG99–2/2

Storage

ENGINE STORAGE GUIDELINES

1. John Deere engines can be stored outside for up to three (3) months with no long term preparation IF COVERED BY WATERPROOF COVERING.

2. John Deere engines can be stored in a standard overseas shipping container for up to three (3) months with no long term preparation.

3. John Deere engines can be stored inside, warehoused, for up to six (6) months with no long term preparation.

4. John Deere engines expected to be stored more than six (6) months, long term storage preparation MUST BE taken. (See PREPARING ENGINE FOR LONG TERM STORAGE).

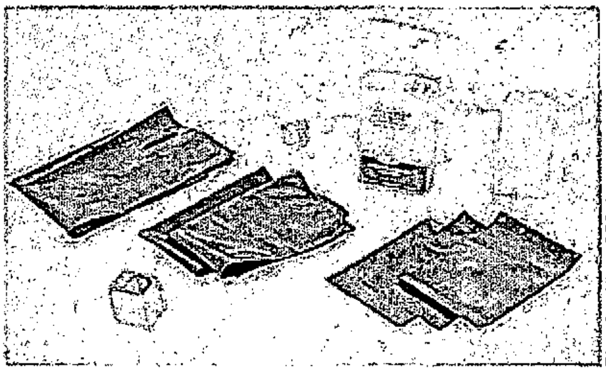
5. For John Deere engines not yet installed in machines, run a line from a container of AR41937 Nucle Oil (from AR41785 Engine Storage Kit) to the fuel transfer pump intake, and another line from the fuel return manifold to the tank, so that Nucle Oil is circulated through the injection system during cranking.

DPSG,CD03523,51 –19–10AUG99–1/1

USE AR41785 ENGINE STORAGE KIT

See your John Deere servicing dealer or engine distributor for an AR41785 Engine Storage Kit. Closely follow instructions provided with this kit.

IMPORTANT: Inhibitors can easily change to gas. Seal or tape each opening immediately after adding inhibitor.



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DPSG,CD03523,52 –19–10AUG99–1/1

PREPARING ENGINE FOR LONG TERM STORAGE

The following storage preparations are good for long term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

IMPORTANT: Any time your engine will not be used for over six (6) months, the following recommendations for storing it and removing it from storage will help to minimize corrosion and deterioration. Use the AR41785 Engine Storage Kit. Follow recommended service procedure included with storage kit.

1. Change engine oil and replace filter. Used oil will not give adequate protection. (See CHANGING ENGINE OIL AND FILTER).
2. Service air cleaner. (See CLEAN OR REPLACE AIR FILTER).
3. Draining and flushing of cooling system is not necessary if engine is to be stored only for several months. However, for extended storage periods of a year or longer, it is recommended that the cooling system be drained, flushed, and refilled. Refill with appropriate coolant. (See DIESEL ENGINE COOLANT).
4. Drain fuel tank and add 30 ml (1 oz) of inhibitor to the fuel tank for each 15 L (4 U.S. gal) of tank capacity. Completely drain fuel filter and close fuel valve, if equipped.
5. Add 30 ml (1 oz) of inhibitor to the engine crankcase for each 0.95 L (1 qt) of crankcase oil.
6. Disconnect air intake piping from the manifold. Pour 90 ml (3 oz) of inhibitor into intake system and reconnect the piping.
7. Crank the engine several revolutions with starter (do not allow the engine to start).
8. Remove fan/alternator belt, if desired.
9. Remove and clean battery. Store them in a cool, dry place and keep them fully charged.
10. Clean the exterior of the engine with salt-free water and touchup any scratched or chipped painted surfaces with a good quality paint.
11. Coat all exposed (machined) metal surfaces with grease or corrosion inhibitor if not feasible to paint.
12. Seal all openings on engine with plastic bags and tape supplied in storage kit. Follow instructions supplied in kit.
13. Store the engine in a dry protected place. If engine must be stored outside, cover it with a waterproof canvas or other suitable protective material and use a strong waterproof tape.

DPSG,CD03523,53 –19–10AUG99–1/1

REMOVING ENGINE FROM LONG TERM STORAGE

Refer to the appropriate section for detailed services listed below or have your authorized servicing dealer or engine distributor perform services that you may not be familiar with.

1. Remove all protective coverings from engine. Unseal all openings in engine and remove covering from electrical systems.
2. Remove the battery from storage. Install battery (fully charged) and connect the terminals.
3. Install fan/alternator belt if removed.
4. Fill fuel tank.
5. Perform all appropriate prestarting checks. (See DAILY PRESTARTING CHECKS).

IMPORTANT: DO NOT operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

6. Crank engine for 20 seconds with starter (do not allow the engine to start). Wait 2 minutes and crank engine an additional 20 seconds to assure bearing surfaces are adequately lubricated.
7. Start engine and run at no load for several minutes. Warm up carefully and check all gauges before placing engine under load.
8. On the first day of operation after storage, check overall engine for leaks and check all gauges for correct operation.

DPSG,CD03523,54 –19–10AUG99–1/1

Specifications

GENERAL ENGINE SPECIFICATIONS

ITEM	UNIT OF MEASURE	3029DF128	4039DF008	4039TF008
Number of Cylinders		3	4	4
Fuel		Diesel	Diesel	Diesel
Bore	mm	106.5	106.5	106.5
Stroke	mm	110	110	110
Displacement	L	2.9	3.9	3.9
Compression Ratio		17.8:1	17.8:1	17.8:1
POWER[a] @ 1500 rpm (Prime)	kW (hp)	26 (35)	35 (48)	55 (75)
POWER[a] @ 1500 rpm (Standby)	kW (hp)	30 (41)	38 (52)	61 (83)
POWER[a] @ 1800 rpm (Prime)	kW (hp)	30 (41)	41 (56)	67 (91)
POWER[a] @ 1800 rpm (Standby)	kW (hp)	34 (46)	47 (64)	73 (99)
Width (overall)	mm	582	588	588
Length (overall)	mm	888	1016	1016
Height (overall)	mm	931	960	979
Weight (dry)[b]	kg	345	410	455
Engine oil quantity	L	6	12	12
Engine coolant quantity	L	14.5	16.5	16.5

[a]With Fan
[b]Approximate

Continued on next page DPSG,CD03523,55 -19-10AUG99-1/3

Specifications

ITEM	UNIT OF MEASURE	4045HF158	4045TF158	4045TF258	4045DF158
Number of Cylinders		4	4	4	4
Fuel		Diesel	Diesel	Diesel	Diesel
Bore	mm	106.5	106.5	106.5	106.5
Stroke	mm	127	127	127	127
Displacement	L	4.5	4.5	4.5	4.5
Compression Ratio		17.0:1	17.0:1	17.0:1	17.6:1
POWER[a] @ 1500 rpm (Prime)	kW (hp)	88 (120)	61 (83)	72 (98)	41 (56)
POWER[a] @ 1500 rpm (Standby)	kW (hp)	96 (131)	68 (92)	80 (109)	42 (57)
POWER[a] @ 1800 rpm (Prime)	kW (hp)	108 (147)	72 (98)	80 (109)	48 (65)
POWER[a] @ 1800 rpm (Standby)	kW (hp)	120 (163)	79 (107)	88 (120)	51 (69)
Width (overall)	mm	798	668	668	668
Length (overall)	mm	1356	1219	1219	1219
Height (overall)	mm	1136	1010	1010	1010
Weight (dry)[b]	kg	446	436	436	391
Engine oil quantity	L	12	12	12	8
Engine coolant quantity	L	25	25	25	20

[a]With Fan
[b]Approximate

Continued on next page DPSG,CD03523,55 –19–10AUG99–2/3

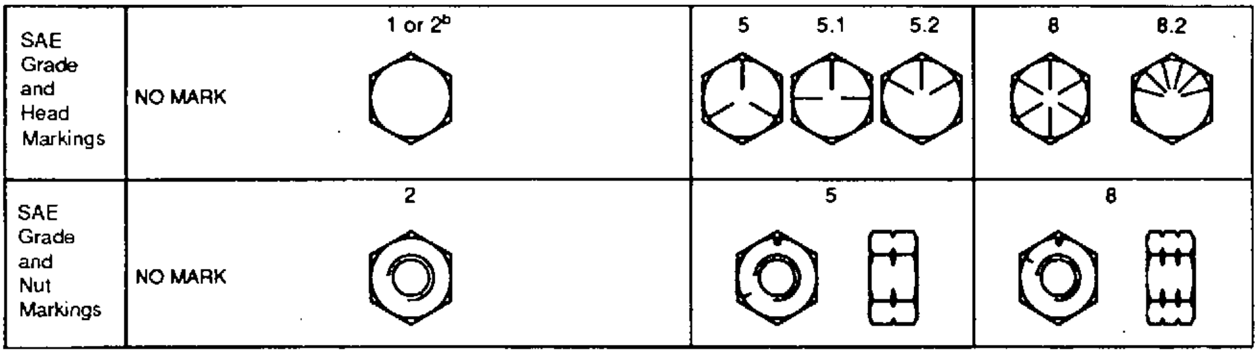
Specifications

ITEM	UNIT OF MEASURE	6068HF158	6068TF158	6068TF258
Number of Cylinders		6	6	6
Fuel		Diesel	Diesel	Diesel
Bore	mm	106.5	106.5	106.5
Stroke	mm	127	127	127
Displacement	L	6.8	6.8	6.8
Compression Ratio		17.0:1	17.0:1	17.0:1
POWER[a] @ 1500 rpm (Prime)	kW (hp)	134 (182)	92 (125)	105 (143)
POWER[a] @ 1500 rpm (Standby)	kW (hp)	148 (201)	101 (137)	116 (158)
POWER[a] @ 1800 rpm (Prime)	kW (hp)	164 (223)	108 (147)	124 (169)
POWER[a] @1800 rpm (Standby)	kW (hp)	187 (254)	119 (162)	137 (186)
Width (overall)	mm	798	668	668
Length (overall)	mm	1476	1383	1383
Height (overall)	mm	1136	1032	1032
Weight (dry)[b]	kg	613	593	593
Engine oil quantity	L	19.5	19.5	19.5
Engine coolant quantity	L	29	26	26

[a]With Fan
[b]Approximate

OPSG,CD03523,55 –19–10AUG99–3/3

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES



Size	Grade 1				Grade 2[b]				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	240	175	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	400	300	510	375	400	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

[b] *Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.*

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

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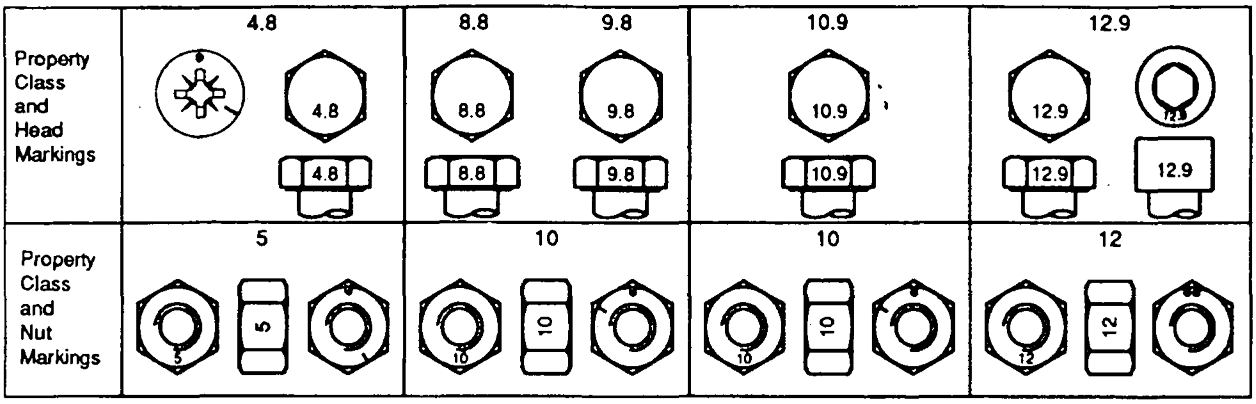
METRIC BOLT AND CAP SCREW TORQUE VALUES



Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	255	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

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DX,TORQ2 –19–20JUL94–1/1

Index

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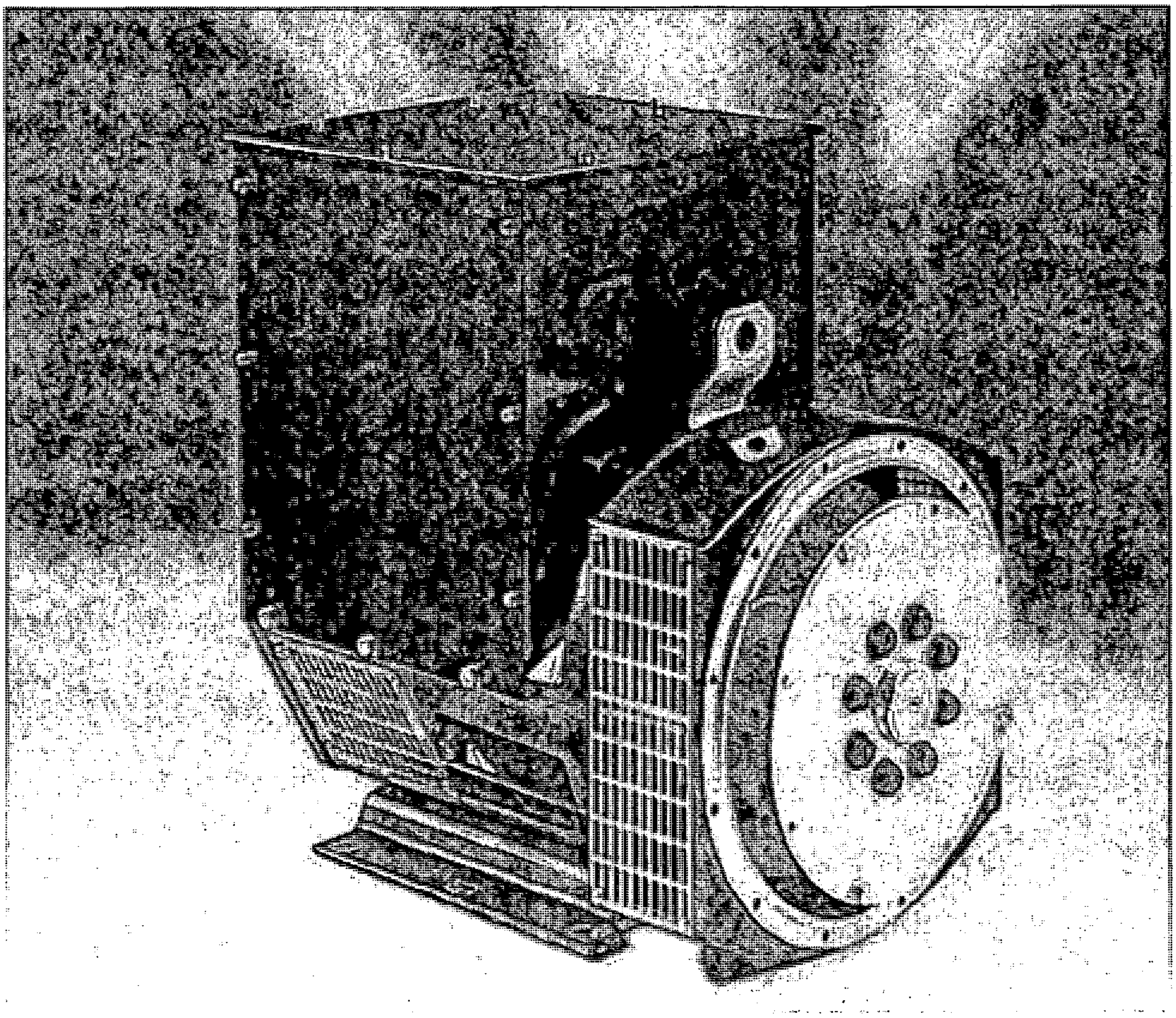
SPARE PARTS

The spare parts catalogue is too extensive for hard copy presentation.

Please refer to copy on enclosed CD.

Publication No: UCH-027
27th Edition
2/001

STAMFORD
AC GENERATORS FROM
NEWAGE INTERNATIONAL



Installation, Service & Maintenance Manual

for AC generators with the following prefixes:

UCI; UCM; UCD 224 & 274 .

SAFETY PRECAUTIONS

Before operating the generating set, read the generating set operation manual and this generator manual and become familiar with it and the equipment.

SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE EQUIPMENT IS CORRECTLY OPERATED AND MAINTAINED.

Many accidents occur because of failure to follow fundamental rules and precautions.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

- Ensure installation meets all applicable safety and local electrical codes. Have all installations performed by a qualified electrician.
- Do not operate the generator with protective covers, access covers or terminal box covers removed.
- Disable engine starting circuits before carrying out maintenance.
- Disable closing circuits and/or place warning notices on any circuit breakers normally used for connection to the mains or other generators, to avoid accidental closure.

Observe all **IMPORTANT, CAUTION, WARNING,** and **DANGER** notices, defined as:

Important ! **Important refers to hazard or unsafe method or practice which can result in product damage or related equipment damage.**

Caution ! **Caution refers to hazard or unsafe method or practice which can result in product damage or personal injury.**

Warning ! **Warning refers to a hazard or unsafe method or practice which CAN result in severe personal injury or possible death.**

Danger ! **Danger refers to immediate hazards which WILL result in severe personal injury or death.**

Due to our policy of continuous improvement, details in this manual which were correct at time of printing, may now be due for amendment. Information included must therefore not be regarded as binding.

FOREWORD

The function of this book is to provide the user of the Stamford generator with an understanding of the principles of operation, the criteria for which the generator has been designed, and the installation and maintenance procedures. Specific areas where the lack of care or use of incorrect procedures could lead to equipment damage and/or personal injury are highlighted, with **WARNING** and/or **CAUTION** notes, and it is **IMPORTANT** that the contents of this book are read and understood before proceeding to fit or use the generator.

The Service, Sales and technical staff of Newage International are always ready to assist and reference to the company for advice is welcomed.

Warning ! **Incorrect installation, operation, servicing or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be qualified to perform electrical and mechanical service.**

EC DECLARATION OF INCORPORATION

All Stamford generators are supplied with a declaration of incorporation for the relevant EC legislation, typically in the form of a label as below.

EC DECLARATION OF INCORPORATION

IN ACCORDANCE WITH THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1992 AND THE SUPPLY OF MACHINERY (SAFETY) (AMENDMENT) REGULATIONS 1994 IMPLEMENTING THE EC MACHINERY DIRECTIVE 89/392/EEC AS AMENDED BY 91/368/EEC.

THIS STAMFORD A.C. GENERATOR WAS MANUFACTURED BY OR ON BEHALF OF NEWAGE INTERNATIONAL LTD BARNACK ROAD STAMFORD LINCOLNSHIRE ENGLAND.

THIS COMPONENT MACHINERY MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE INCORPORATED HAS BEEN DECLARED IN CONFORMITY WITH THE PROVISIONS OF THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1995/MACHINERY DIRECTIVE.

FOR AND ON BEHALF OF NEWAGE INTERNATIONAL LIMITED

NAME: LAWRENCE HAYDOCK
POSITION: TECHNICAL DIRECTOR
SIGNATURE:

THIS COMPONENT MACHINERY CARRIES THE CE MARK FOR COMPLIANCE WITH THE STATUTORY REQUIREMENTS FOR THE IMPLEMENTATION OF THE FOLLOWING DIRECTIVES

The EMC Directive 89/336/EEC
WARNING! This Component Machinery shall not be used in the Residential, Commercial and Light Industrial environment unless it also conforms to the relevant standard (EN 50081 - 1) REFER TO FACTORY FOR DETAILS

ii) The Low Voltage Directive 73/23/EEC as amended by 93/68/EEC

Under the EC Machinery Directive section 1.7.4. It is the responsibility of the generator set builder to ensure the generator identity is clearly displayed on the front cover of this book.

ELECTROMAGNETIC COMPATIBILITY

Additional Information

European Union
Council Directive 89/336/EEC

For installations within the European Union, electrical products must meet the requirements of the above directive, and Newage ac generators are supplied on the basis that:

- They are to be used for power-generation or related function.
- They are to be applied in one of the following environments:

  Portable (open construction - temporary site supply)
  Portable (enclosed - temporary site supply)
  Containerised (temporary or permanent site supply)
  Ship-borne below decks (marine auxiliary power)
  Commercial vehicle (road transport / refrigeration etc)
  Rail transport (auxiliary power)
  Industrial vehicle (earthmoving, cranes etc)
  Fixed installation (industrial - factory / process plant)
  Fixed installation (residential, commercial and light industrial - home / office / health)
  Energy management (Combined heat and power and/or peak lopping)
  Alternative energy schemes

- The standard generators are designed to meet the 'industrial' emissions and immunity standards. Where the generator is required to meet the residential, commercial and light industrial emissions and immunity standards reference should be made to Newage document reference N4/X/011, as additional equipment may be required.
- The installation earthing scheme involves connection of the generator frame to the site protective earth conductor using a minimum practical lead length.
- Maintenance and servicing with anything other than factory supplied or authorised parts will invalidate any Newage liability for EMC compliance.
- Installation, maintenance and servicing is carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives.

CONTENTS

CONTENTS

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

The UC22/27 range of generators is of brushless rotating field design, available up to 660V/50Hz (1500 rpm) or 60Hz (1800 rpm), and built to meet BS5000 Part 3 and international standards.

All the UC22/27 range are self-excited with excitation power derived from the main output windings, using either the SX460/ SX440/SX421 AVR. The UC22 is also available with specific windings and a transformer controlled excitation system.

A permanent magnet generator (PMG) powered excitation system is available as an option using either the MX341 or MX321 AVR.

Detailed specification sheets are available on request.

1.2 DESIGNATION

U	C	·	I	2	2	4	C	2
U	C	·	M	2	7	4	C	2

GENERATOR TYPE UC

SPECIFIC TYPE

INDUSTRIAL = (I) OR MARINE = (M)

SHAFT HEIGHT IN CM ON BC/UC

NUMBER OF POLES 2, 4, OR 6

CORE LENGTH

NUMBER OF BEARINGS 1 OR 2

1.3 SERIAL NUMBER LOCATION AND IDENTITY NUMBER LOCATION

Each generator is metal stamped with it's own unique serial number, the location of this number is described below.

UCI and UCM generators have their serial number stamped into the upper section of the drive end frame to end bracket adaptor ring, shown as item 31 in the parts lists at the back of this book.

UCD generators have their serial number stamped into the top of the drive end adaptor /fan shroud casting. If for any reason this casting is removed, it is imperative that care is taken to refit it to the correct generator to ensure correct identification is retained.

Inside the terminal box two adhesive rectangular labels have been fixed, each carrying the generators unique identity number. One label has been fixed to the inside of the terminal box sheet metal work, and the second label fixed to the main frame of the generator.

1.4 RATING PLATE

The generator has been supplied with a self adhesive rating plate label to enable fitting after final assembly and painting.

It is intended that this label will be stuck to the outside of the terminal box on the left hand side when viewed from the N.D.E. To assist with squarely positioning the label, location protrusions have been made in the sheet metalwork.

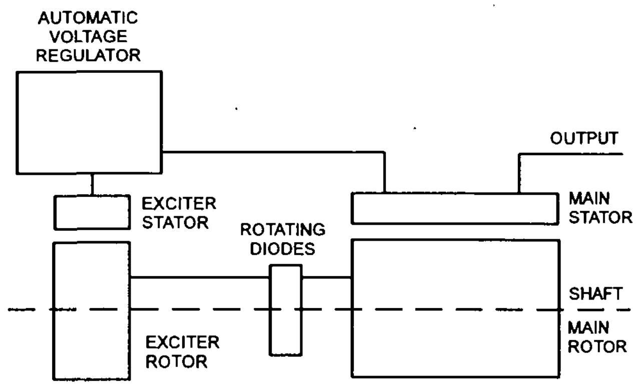
A CE Mark label is also supplied loose for fitment after final assembly and painting. This should be attached to an external surface of the Generator at a suitable location where it will not be obscured by the customer's wiring or other fittings.

The surface in the area where a label is to be stuck must be flat, clean, and any paint finish be fully dry before attempting to attach label. Recommended method for attaching label is peel and fold back sufficient of the backing paper to expose some 20 mm of label adhesive along the edge which is to be located against the sheet metal protrusions. Once this first section of label has been carefully located and stuck into position the backing paper can be progressively removed, as the label is pressed down into position. The adhesive will achieve a permanent bond in 24 hours.

SECTION 2

PRINCIPLE OF OPERATION

2.1 SELF-EXCITED AVR CONTROLLED GENERATORS

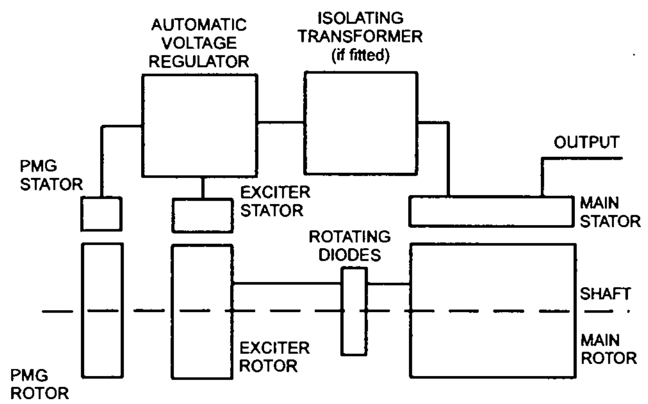


The main stator provides power for excitation of the exciter field via the SX460 (SX440 or SX421) AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature.

The SX460 or SX440 AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine.

The SX421 AVR in addition to the SX440 features has three phase rms sensing and also provides for over voltage protection when used in conjunction with an external circuit breaker (switchboard mounted).

2.2 PERMANENT MAGNET GENERATOR (PMG) EXCITED - AVR CONTROLLED GENERATORS



The permanent magnet generator (PMG) provides power for excitation of the exciter field via the AVR (MX341 or MX321) which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived, via an isolating transformer in the case of MX321 AVR, from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature.

The PMG system provides a constant source of excitation power irrespective of main stator loading and provides high motor starting capability as well as immunity to waveform distortion on the main stator output created by non linear loads, e.g. thyristor controlled dc motor.

The MX341 AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides an adjustable voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burdén on the engine. It also provides over-excitation protection which acts following a time delay, to de-excite the generator in the event of excessive exciter field voltage.

The MX321 provides the protection and engine relief features of the MX341 and additionally incorporates 3 phase rms sensing and over-voltage protection.

The detailed function of all the AVR circuits is covered in the load testing (subsection 4.7).

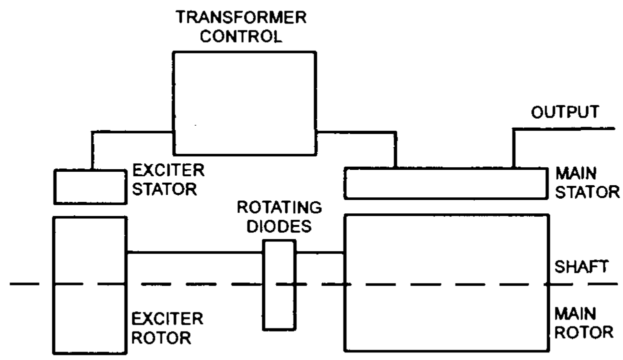
2.3 AVR ACCESSORIES

The SX440, SX421, MX341 and MX321 AVRs incorporate circuits which, when used in conjunction with accessories, can provide for parallel operation either with 'droop' or 'astatic' control, VAR/PF control and in the case of the MX321 AVR, short circuit current limiting.

Function and adjustment of the accessories which can be fitted inside the generator terminal box are covered in the accessories section of this book.

Separate instructions are provided with other accessories available for control panel mounting.

2.4 TRANSFORMER CONTROLLED GENERATORS



The main stator provides power for excitation of the exciter field via a transformer rectifier unit. The transformer combines voltage and current elements derived from the main stator output to form the basis of an open-loop control system, which is self regulating in nature. The system inherently compensates for load current magnitude and power factor and provides short circuit maintenance in addition to a good motor starting performance.

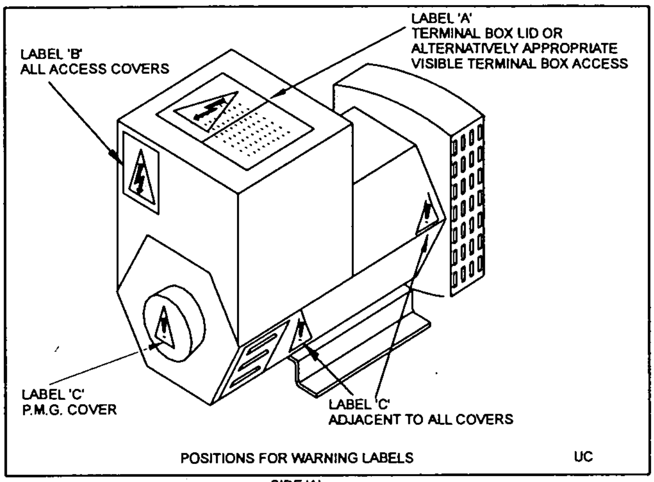
Three phase generators normally have a three phase transformer control for improved performance with unbalanced loads but a single phase transformer option is available.

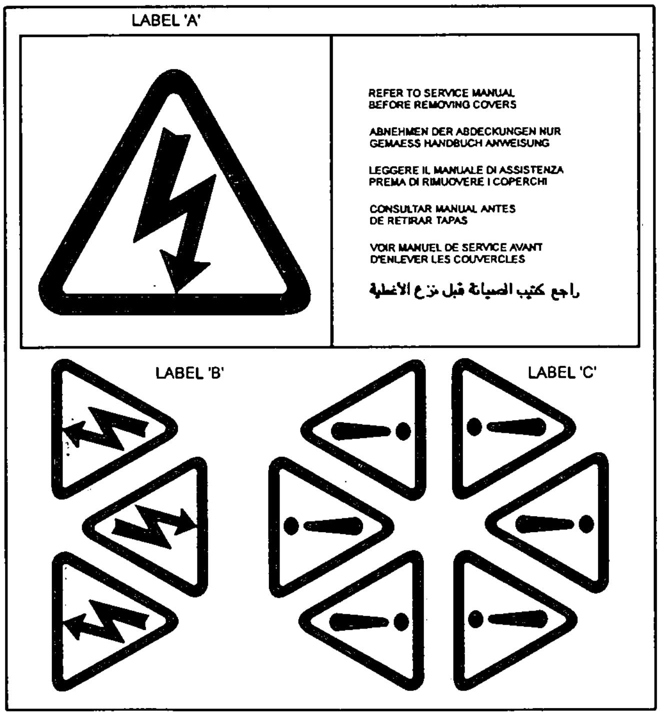
No accessories can be provided with this control system.

SECTION 3

APPLICATION OF THE GENERATOR

The generator is supplied as a component part for installation in a generating set. It is not, therefore, practicable to fit all the necessary warning/hazard labels during generator manufacture. The additional labels required are packaged with this Manual, together with a drawing identifying their locations. (See below).





It is the responsibility of the generating set manufacturer to ensure that the correct labels are fitted, and are clearly visible.

The generators have been designed for use in a maximum ambient temperature of 40°C and altitude less than 1000m above sea level in accordance with BS5000.

Ambients in excess of 40°C and altitudes above 1000m can be tolerated with reduced ratings - refer to the generator nameplate for rating and ambient. In the event that the generator is required to operate in an ambient in excess of the nameplate value or at altitudes in excess of 1000 metres above sea level, refer to the factory.

The generators are of air-ventilated screen protected drip-proof design and are not suitable for mounting outdoors unless adequately protected by the use of canopies. Anti-condensation heaters are recommended during storage and for standby duty to ensure winding insulation is maintained in good condition.

When installed in a closed canopy it must be ensured that the ambient temperature of the cooling air to the generator does not exceed that for which the generator has been rated.

The canopy should be designed such that the engine air intake to the canopy is separated from the generator intake, particularly where the radiator cooling fan is required to draw air into the canopy. In addition the generator air intake to the canopy should be designed such that the ingress of moisture is prohibited, preferably by use of a 2 stage filter.

The air intake/outlet must be suitable for the air flow given in the following table with additional pressure drops less than or equal to those given below:

Frame	Air Flow		Additional (intake/outlet) Pressure Drop
	50Hz	60Hz	
UC22	$0.216m^3/sec$	$0.281m^3/sec$	6mm water gauge
	458cfm	595cfm	0.25"
UCD22	$0.25m^3/sec$	$0.31m^3/sec$	6mm water gauge
	530cfm	657cfm	0.25"
UC27	$0.514m^3/sec$	$0.617m^3/sec$	6mm water gauge
	1090cfm	1308cfm	0.25"
UCD27	$0.58m^3/sec$	$0.69m^3/sec$	6mm water gauge
	1230cfm	1463cfm	0.25"

Important ! Reduction in cooling air flow or inadequate protection to the generator can result in damage and/or failure of windings.

Dynamic balancing of the generator rotor assembly has been carried out during manufacture in accordance with BS 6861 Part 1 Grade 2.5 to ensure vibration limits of the generator are in accordance with BS 4999 Part 142.

The main vibration frequencies produced by the generator are as follows:-

4 pole	1500 rpm	25 Hz
4 pole	1800 rpm	30 Hz

However, vibrations induced by the engine are complex and contain frequencies of 1.5, 3, 5 or more times the fundamental frequency of vibration. These induced vibrations can result in generator vibration levels higher than those derived from the generator itself. It is the responsibility of the generating set designer to ensure that the alignment and stiffness of the bedplate and mountings are such that the vibration limits of BS5000 Part 3 are not exceeded.

In standby applications where the running time is limited and educed life expectancy is accepted, higher levels than specified n BS5000 can be tolerated, up to a maximum of 18mm/sec.

Two bearing generators open coupled require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment. Close coupling of engine to generator can increase the overall rigidity of the set. For the purposes of establishing set design the bending moment at the engine flywheel housing to generator adaptor interface should not exceed 1000ft.lb. (140 kgm). A flexible coupling, designed to suit the specific engine/generator combination, is recommended to minimise torsional effects.

Belt driven applications of two bearing generators require the pulley diameter and design to be such that the side load or force applied to the shaft is central to the extension and does not exceed the values given in the table below:-

Frame	Side Load		Shaft extension mm
	kgf	N	
UC22	408	4000	110
UC27	510	5000	140

In instances where shaft extensions greater than specified in the table have been supplied reference must be made to the factory for appropriate loadings.

Alignment of single bearing generators is critical and vibration can occur due to the flexing of the flanges between the engine and generator. As far as the generator is concerned the maximum bending moment at this point must not exceed 1000ft.lb. (140 kgm). A substanial bedplate with engine/generator mounting pads is required.

It is expected that the generator will be incorporated into a generating set operating in an environment, where the maximum shock load experienced by the generator will not exceed 3g. in any plane. If shock loads in excess of 3g are to be encountered, anti-vibration mountings must be incorporated into the generating set to ensure they absorb the excess.

The maximum bending moment of the engine flange must be checked with the engine manufacturer.

Generators can be supplied without a foot, providing the option for customers own arrangement. See SECTION 4.2.1 for assembly procedure.

Torsional vibrations occur in all engine-driven shaft systems and may be of a magnitude to cause damage at certain critical speeds. It is therefore necessary to consider the torsional vibration effect on the generator shaft and couplings.

It is the responsibility of the generator set manufacturer to ensure compatibility, and for this purpose drawings showing the shaft dimensions and rotor inertias are available for customers to forward to the engine supplier. In the case of single bearing generators coupling details are included.

Important ! **Torsional incompatibility and/or excessive vibration levels can cause damage or failure of generator and/or engine components.**

The terminal box is constructed with removable panels for easy adaptation to suit specific glanding requirements. Within the terminal box there are insulated terminals for line and neutral connections and provision for earthing. Additional earthing points are provided on the generator feet.

The neutral is NOT connected to the frame.

The main stator winding has leads brought out to the terminals in the terminal box.

Warning ! **No earth connections are made on the generator and reference to site regulations for earthing must be made. Incorrect earthing or protection arrangements can result in personal injury or death.**

Fault current curves (decrement curves), together with generator reactance data, are available on request to assist the system designer to select circuit breakers, calculate fault currents and ensure discrimination within the load network.

Warning ! **Incorrect installation, service or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be qualified to perform electrical and mechanical service.**

SECTION 4

INSTALLATION - PART 1

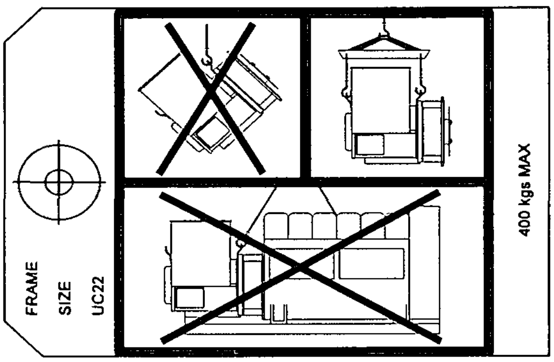
4.1 LIFTING

> **Warning !** **Incorrect lifting or inadequate lifting capacity can result in severe personal injury or equipment damage. MINIMUM LIFTING CAPACITY REQUIRED IS 750Kg. Generator lifting lugs should NOT be used for lifting the complete generator set.**

Two lifting lugs are provided for use with a shackle and pin type lifting aid. Chains of suitable length and lifting capacity must be used. Lifting points are designed to be as close to the centre of gravity of the generator as possible, but due to design restrictions it is not possible to guarantee that the generator frame will remain horizontal while lifting. Care is therefore needed to avoid personal injury or equipment damage. The correct lifting arrangement is shown on the label attached to the lifting lug. (See sample below).

IMPORTANT

REFER TO SERVICE MANUAL BEFORE REMOVING COVERS. IT IS THE GENERATOR SET MANUFACTURER'S RESPONSIBILITY TO FIT THE SELF ADHESIVE WARNING LABELS SUPPLIED WITH THE GENERATOR. THE LABEL SHEET CAN BE FOUND WITH THE INSTRUCTION BOOK.



Single bearing generators are supplied fitted with a rotor retaining bar at the non-drive end of the shaft.

To remove retaining bar:

1. Remove the four screws holding the sheet metal cover at the non drive end and remove cover
2. Remove central bolt holding the retaining bar to the shaft
3. Refit sheet metal cover.

Once the bar is removed, to couple the rotor to engine, the rotor is free to move in the frame, and care is needed during coupling and alignment to ensure the frame is kept in the horizontal plane.

Generators fitted with a PMG excitation system are not fitted with retaining bar. Refer to frame designation to verify generator type (subsection 1.2)

4.2 ASSEMBLY

During the assembly of the generator to the engine it will be necessary firstly to carefully align, then rotate, the combined generator rotor - engine crankshaft assembly, as part of the construction process, to allow location, insertion and tightening of the coupling bolts. This requirement to rotate the combined assemblies exists for both single and two bearing units.

During the assembly of single bearing units it is necessary to align the generator's coupling holes with the engine flywheel holes; it is suggested that two diametrically opposite location dowel pins are fitted to the engine flywheel, over which the generator coupling can slide into final location into the engine flywheel spigot recess. The dowels must be removed and replaced by coupling bolts before the final bolt tightening sequence.

While fitting and tightening the coupling bolts it will be necessary to rotate the engine crankshaft - generator rotor assembly. Care should be taken to ensure that rotation is carried out in an approved manner that ensures safe working practice when reaching inside the machine to insert or tighten coupling bolts, and that no component of the assembly is damaged by non-approved methods of assembly rotation.

Engine manufacturers have available a proprietary tool or facility designed to enable manual rotation of the crankshaft assembly. This must always be used, having been engineered as an approved method of assembly rotation, engaging the manually driven pinion with the engine flywheel starter ring-gear.

> **Caution !** **Before working inside the generator, during the aligning and fitting of coupling bolts, care should be taken to lock the assembly to ensure there is no possibility of rotational movement.**

4.2.1 NO FOOT OPTION

Generators can be supplied without a foot providing the option for customers own arrangement.

For details of mounting this arrangement, see the general arrangement drawing supplied with the generator. Alternatively refer to Newage International for a copy of the latest general arrangement drawing showing the 'NO FOOT OPTION' appropriate to your generator.

4.2.2 TWO BEARING GENERATORS

A flexible coupling should be fitted and aligned in accordance with the coupling manufacturer's instruction.

If a close coupling adaptor is used the alignment of machined faces must be checked by offering the generator up to the engine. Shim the generator feet if necessary. Ensure adaptor guards are fitted after generator/engine assembly is complete. Open coupled sets require a suitable guard, to be provided by the set builder.

In the case of belt driven generators, ensure alignment of drive and driven pulleys to avoid axial load on the bearings. Screw type tensioning devices are recommended to allow accurate adjustment of belt tension whilst maintaining pully alignment. Side loads should not exceed values given in SECTION 3.

Belt and pulley guards must be provided by the set builder.

Important ! **Incorrect belt tensioning will result in excessive bearing wear.**

Caution !	**Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.**

4.2.3 SINGLE BEARING GENERATORS

Alignment of single bearing generators is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

For transit and storage purposes the generator frame spigot and rotor coupling plates have been coated with a rust preventative. This MUST BE removed before assembly to engine.

A practical method for removal of this coating is to clean the mating surface areas with a de-greasing agent based on a petroleum solvent.

Care should be taken not to allow any cleaning agent to come into prolonged contact with skin.

The sequence of assembly to the engine should generally be as follows:

1. On the engine check the distance from the coupling mating face on the flywheel to the flywheel housing mating face. This should be within +/-0.5mm of nominal dimension. This is necessary to ensure that a thrust is not applied to the a.c. generator bearing or engine bearing.

2. Check that the bolts securing the flexible plates to the coupling hub are tight and locked into position. Torque tightening is 24.9kgfm (244Nm; 180 lb ft).

2a. **UCD224 Only**
Torque tightening is 15.29 kgfm (150Nm; 110 lb ft).

3. Remove covers from the drive end of the generator to gain access to coupling and adaptor bolts.

4. Check that coupling discs are concentric with adaptor spigot. This can be adjusted by the use of tapered wooden wedges between the fan and adaptor. Alternatively the rotor can be suspended by means of a rope sling through the adaptor opening.

5. Offer the a.c. generator to engine and engage both coupling discs and housing spigots at the same time, finally pulling home by using the housing and coupling bolts. Use heavy gauge washers between bolt head and discs on disc to flywheel bolts.

6. Tighten coupling disc to flywheel. Refer to engine manual for torque setting of disc to flywheel bolts.

7. Remove wooden wedges.

Caution !	**Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.**

4.3 EARTHING

The generator frame should be solidly bonded to the generating set bedplate. If antivibration mounts are fitted between the generator frame and its bedplate a suitably rated earth conductor (normally one half of the cross sectional area of the main line cables) should bridge across the antivibration mount.

Warning !	**Refer to local regulations to ensure that the correct earthing procedure has been followed.**

4.4 PRE-RUNNING CHECKS
4.4.1 INSULATION CHECK

Before starting the generating set, both after completing assembly and after installation of the set, test the insulation resistance of windings.

The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Disconnect any earthing conductor connected between neutral and earth and megger an output lead terminal U, V or W to earth. The insulation resistance reading should be in excess of 5MΩ to earth. Should the insulation resistance be less than 5MΩ the winding must be dried out as detailed in the Service and Maintenance section of this Manual.

Important ! **The windings have been H.V. tested during manufacture and further H.V. testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V. testing, for customer acceptance, the tests must be carried out at reduced voltage levels i.e. Test Voltage= 0.8 (2 X Rated Voltage + 1000)**

4.4.2 DIRECTION OF ROTATION

The generator is supplied to give a phase sequence of U V W with the generator running clockwise looking at the drive end (unless otherwise specified at the time of ordering). If the generator phase rotation has to be reversed after the generator has been despatched apply to factory for appropriate wiring diagrams.

UCI224, UCI274, UCM224, UCM274

Machines are fitted with bi-directional fans and are suitable for running in either direction of rotation.

UCD224, UCD274

Machines are fitted with uni-directional fans and are suitable for running in one direction only.

4.4.3 VOLTAGE AND FREQUENCY

Check that the voltage and frequency levels required for the generating set application are as indicated on the generator nameplate.

Three phase generators normally have a 12 ends out reconnectable winding. If it is necessary to reconnect the stator for the voltage required, refer to diagrams in the back of this manual.

4.4.4 AVR SETTINGS

To make AVR selections and adjustments remove the AVR cover and refer to 4.4.4.1, 4.4.4.2, 4.4.4.3, 4.4.4.4 or 4.4.4.5 depending upon type of AVR fitted. Reference to the generator nameplate will indicate AVR type (SX460, SX440, SX421, MX341 or MX321).

Most of the AVR adjustments are factory set in positions which will give satisfactory performance during initial running tests. Subsequent adjustment may be required to achieve optimum performance of the set under operating conditions. Refer to 'Load Testing' section for details.

4.4.4.1 TYPE SX460 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 1 for location of selection links.

1. Frequency selection

50Hz operation LINK C-50
60Hz operation LINK C-60

2. External hand trimmer selection

No external hand trimmer LINK 1-2
External hand trimmer required - REMOVE LINK 1-2 and connect trimmer across terminals 1 and 2.

3. AVR Input Selection

High voltage	(220/240V) Input	NO LINK
Low voltage	(110/120V) Input	LINK 3-4

Refer to diagram in the back of this manual to determine wiring.

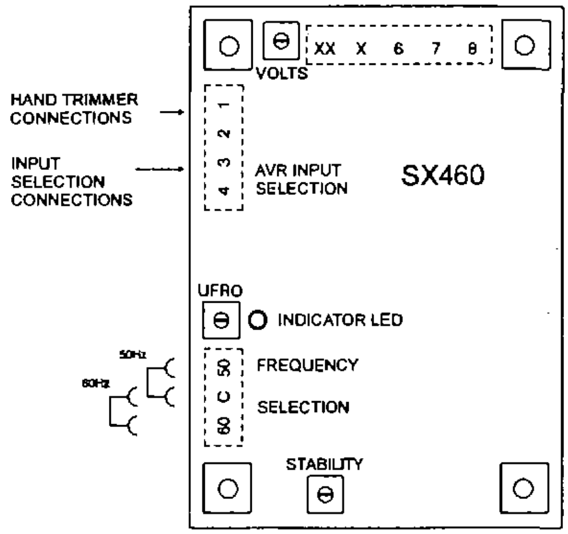


Fig. 1

4.4.4.2 TYPE SX440 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 2 for location of selection links.

1. Frequency selection terminals

50Hz operation LINK C-50
60Hz operation LINK C-60

2. Stability selection terminals

Frame UC22 LINK A-C
Frame UC27 LINK B-C

3. Sensing selection terminals

LINK 2-3
LINK 4-5
LINK 6-7

4. Excitation Interruption Link

LINK K1-K2

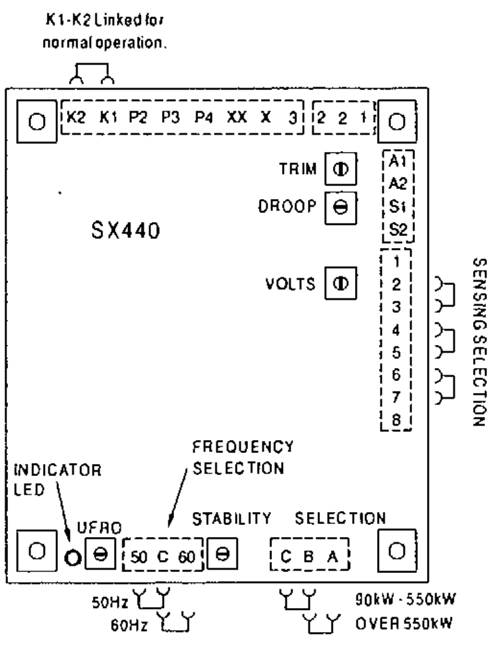


Fig. 2

4.4.4.3 TYPE SX421 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 3 for location of selection links.

1. **Frequency selection terminals**
   50Hz operation LINK C-50
   60Hz operation LINK C-60

2. **Stability selection terminals**
   Depending upon kW output LINK B-D
   or LINK A-C
   or LINK B-C

3. **Terminals K1 - K2**
   Excitation circuit breaker closed

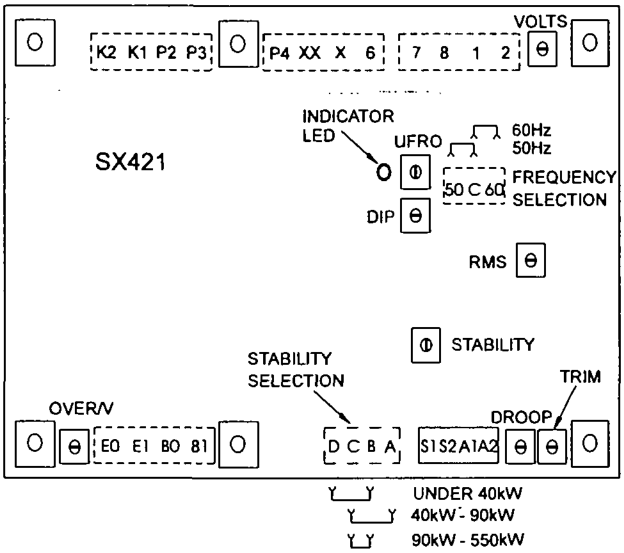


Fig. 3

4.4.4.4 TYPE MX341 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 4 for location of setting links.

1. **Frequency selection terminals**
   50Hz operation LINK 2-3
   60Hz operation LINK 1-3

2. **Stability selection terminals**
   Frame UC22 LINK A-C
   Frame UC27 LINK B-C

3. **Sensing selection terminals ***
   LINK 2-3
   LINK 4-5
   LINK 6-7

4. **Excitation Interruption Link**
   LINK K1-K2

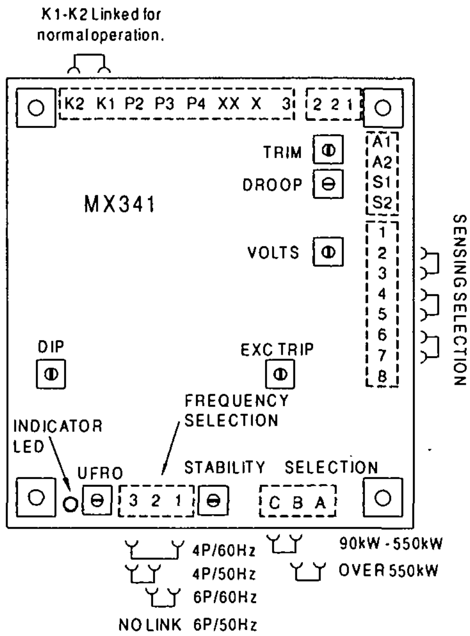


Fig. 4

4.4.4.5 TYPE MX321 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 5 for location of setting links.

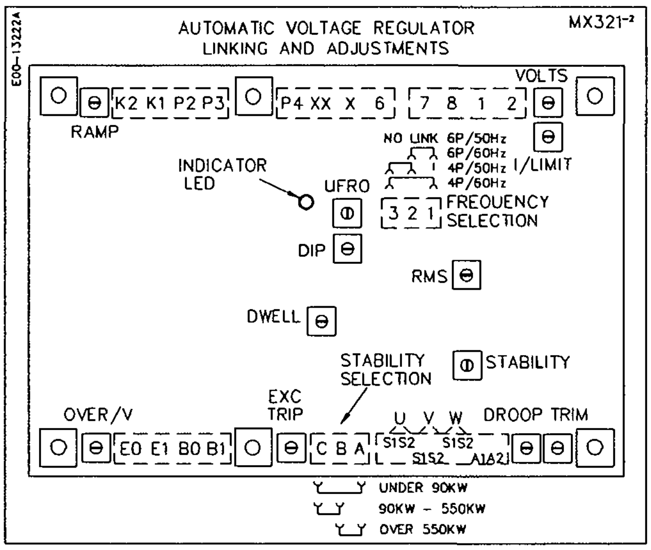


Fig. 5

1. **Frequency selection terminals**
   50Hz operation LINK 2-3
   60Hz operation LINK 1-3

2. **Stability selection terminals**
   Frame UC22 LINK A-C
   Frame UC27 LINK B-C

3. **Terminals K1 - K2**
   Excitation circuit breaker closed.
   If this option not fitted, K1 - K2 linked at auxiliary terminal block.

4.4.5 TRANSFORMER CONTROLLED EXCITATION SYSTEM (Series 5)

This control system is identified with the digit 5 as the last digit of the frame size quoted on the nameplate.

The excitation control is factory set for the specific voltage shown on the nameplate and requires no adjustment.

4.5 GENERATOR SET TESTING

Warning !	**During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments.**

4.5.1 TEST METERING/CABLING

Connect any instrument wiring and cabling required for initial test purposes with permanent or spring-clip type connectors.

Minimum instrumentation for testing should be line - line or line to neutral voltmeter, Hz meter, load current metering and kW meter. If reactive load is used a power factor meter is desirable.

Important ! **When fitting power cables for load testing purposes, ensure cable voltage rating is at least equal to the genrator rated voltage. The load cable termination should be placed on top of the winding lead termination and clamped with the nut provided.**

Caution !	**Check that all wiring terminations for internal or external wiring are secure, and fit all terminal box covers and guards. Failure to secure wiring and/or covers may result in personal injury and/or equipment failure.**

4.6 INITIAL START-UP

Warning !	**During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.**

On completion of generating set assembly and before starting the generating set ensure that all engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Important ! **Overspeeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.**

In addition remove the AVR access cover (on AVR controlled generators) and turn VOLTS control fully anti-clockwise. Start the generating set and run on no-load at nominal frequency. Slowly turn VOLTS control potentiometer clockwise until rated voltage is reached. Refer to Fig. 6a, 6b, 6c, 6d or 6e for control potentiometer location.

Important ! **Do not increase the voltage above the rated generator voltage shown on the generator nameplate.**

The STABILITY control potentiometer will have been pre-set and should normally not require adjustment, but should this be required, usually identified by oscillation of the voltmeter, refer to Fig. 6a, 6b, 6c, 6d or 6e for control potentiometer location and proceed as follows:-

1. Run the generating set on no-load and check that speed is correct and stable
2. Turn the STABILITY control potentiometer clockwise, then turn slowly anti-clockwise until the generator voltage starts to become unstable.

The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

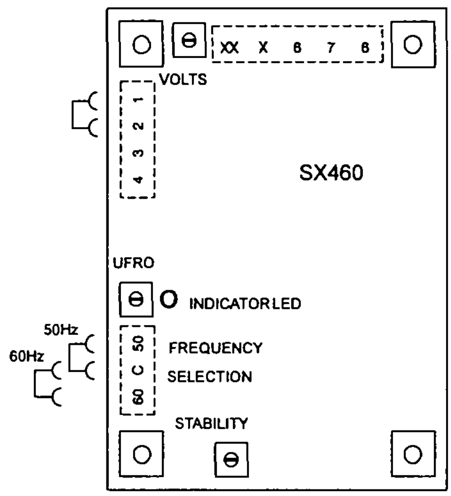


Fig. 6a

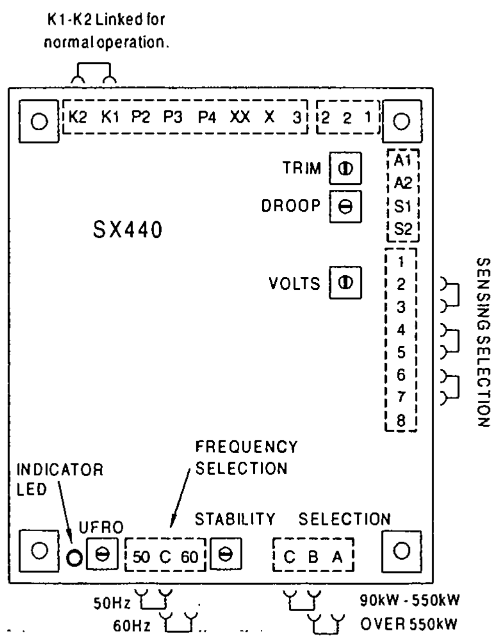


Fig. 6b

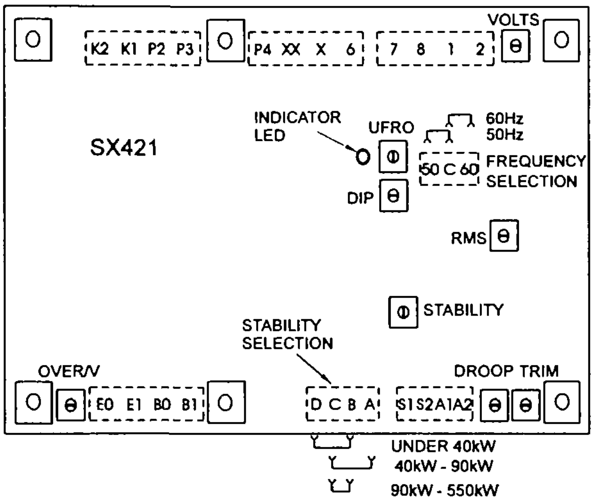


Fig. 6c

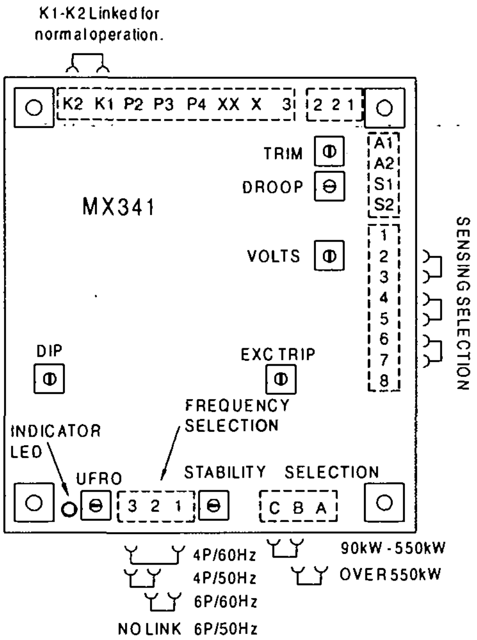


Fig. 6d

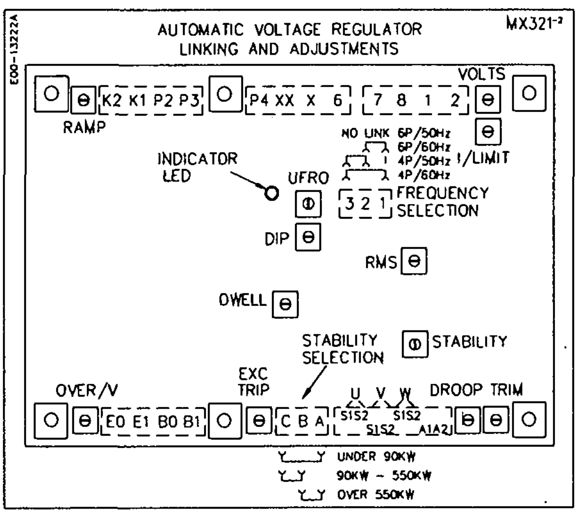


Fig. 6e

4.7 LOAD TESTING

Warning !

During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.

4.7.1 AVR CONTROLLED GENERATORS - AVR ADJUSTMENTS

Refer to Fig. 6a, 6b, 6c, 6d or 6e for control potentiometer locations.

Having adjusted VOLTS and STABILITY during the initial start-up procedure, other AVR control functions should not normally need adjustment.

If however, poor voltage regulation on-load or voltage collapse is experienced, refer to the following paragraphs on each function to a) check that the symptoms observed do indicate adjustment is necessary, and b) to make the adjustment correctly.

4.7.1.1 UFRO (Under Frequency Roll Off) (AVR Types SX460, SX440, SX421, MX341 and MX321)

The AVR incorporates an underspeed protection circuit which gives a voltage/speed (Hz) characteristic as shown:

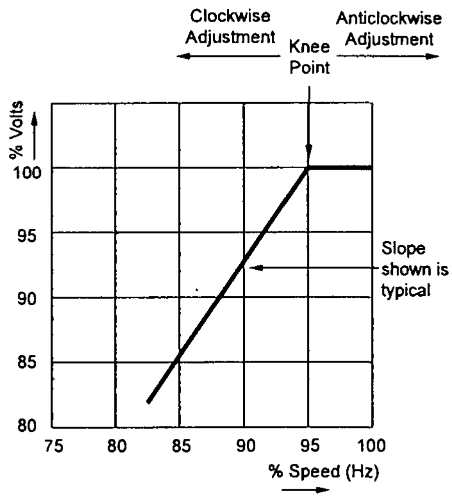


Fig. 7

The UFRO control potentiometer sets the "knee point".

Symptoms of incorrect setting are a) the light emitting diode (LED) indicator, just above the UFRO Control potentiometer, being permanently lit when the generator is on load, and b) poor voltage regulation on load, i.e. operation on the sloping part of the characteristic.

Clockwise adjustment lowers the frequency (speed) setting of the "knee point" and extinguishes the LED. For Optimum setting the LED should illuminate as the frequency falls just below nominal frequency, i.e. 47Hz on a 50Hz generator or 57Hz on a 60Hz generator.

Important ! **With AVR Types MX341 and MX321. If the LED is illuminated and no output voltage is present, refer to EXC TRIP and/or OVER/V sections below.**

4.7.1.2 EXC TRIP (Excitation Trip)
AVR Types MX341 and MX321

An AVR supplied from a permanent magnet generator inherently delivers maximum excitation power on a line to line or line to neutral short circuit or large overload. In order to protect the generator windings the AVR incorporates an over excitation circuit which detects high excitation and removes it after a pre-determined time, i.e. 8-10 seconds.

Symptoms of incorrect setting are the generator output collapses on load or small overload, and the LED is permanently illuminated.

The correct setting is 70 volts +/-5% between terminals X and XX.

4.7.1.3 OVER/V (Over Voltage)
AVR Type SX421, MX321

Over voltage protection circuitry is included in the AVR to remove generator excitation in the event of loss of AVR sensing input.

The MX321 has both internal electronic de-excitation and provision of a signal to operate an external circuit breaker.

The SX421 only provides a signal to operate an external breaker, which MUST be fitted if over voltage protection is required.

Incorrect setting would cause the generator output voltage to collapse at no-load or on removal of load, and the LED to be illuminated.

The correct setting is 300 volts +/-5% across terminals E1, E0. Clockwise adjustment of the OVER/V control potentiometer will increase the voltage at which the circuit operates.

4.7.1.4 TRANSIENT LOAD SWITCHING ADJUSTMENTS
AVR Types SX421, MX341 and MX321

The additional function controls of DIP and DWELL are provided to enable the load acceptance capability of the generating set to be optimised. The overall generating set performance depends upon the engine capability and governor response, in conjunction with the generator characteristics.

It is not possible to adjust the level of voltage dip or recovery independently from the engine performance, and there will always be a 'trade off' between frequency dip and voltage dip.

DIP
AVR Types SX421, MX341 and MX321

AVR Types SX421, MX341 and MX321
The dip function control potentiometer adjusts the slope of the voltage/speed (Hz) characteristic below the knee point as shown below:

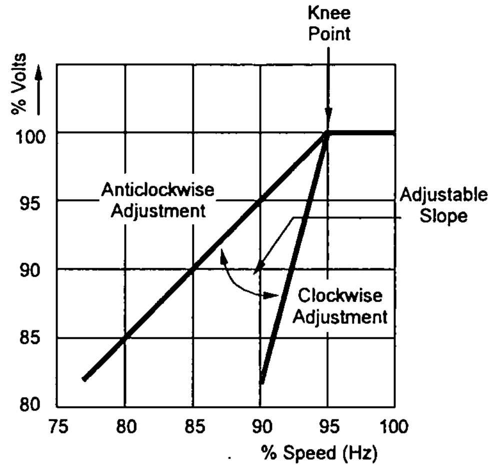


Fig. 8

DWELL
AVR Type MX321

The dwell function introduces a time delay between the recovery of voltage and recovery of speed.

The purpose of the time delay is to reduce the generator kW below the available engine kW during the recovery period, thus allowing an improved speed recovery.

Again this control is only functional below the "knee point", i.e. if the speed stays above the knee point during load switching there is no effect from the DWELL function setting.

Clockwise adjustment gives increased recovery time.

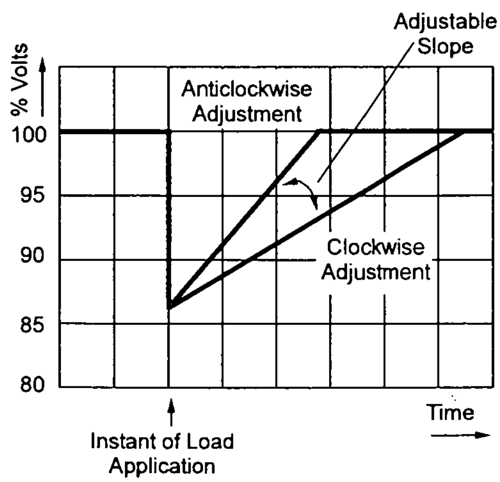


Fig. 9

The graphs shown above are representations only, since it is impossible to show the combined effects of voltage regulator and engine governor performance.

4.7.1.5 RAMP
AVR Type MX321

The RAMP potentiometer enables adjustment of the time taken for the generator's initial build up to normal rated voltage during each start and run up to speed. The potentiometer is factory set to give a ramp time of three seconds, which is considered to be suitable for most applications. This time can be reduced to one second by turning the pot. fully counter clockwise, and increased to eight seconds by turning the pot. fully clockwise.

4.7.2 TRANSFORMER CONTROLLED GENERATORS - TRANSFORMER ADJUSTMENT

Normally no adjustment is required but should the no-load voltage and/or on-load voltage be unacceptable, adjustment of the transformer air gap can be made as follows.

Stop the generator. Remove transformer cover box. (Normally left hand side of the terminal box when viewed from the non drive end).

Slacken the three transformer mounting bolts along the top of the transformer.

Start the set with a voltmeter connected across the main output terminals.

Adjust the air gap between the transformer top lamination section and the transformer limbs to obtain required voltage on no-load. Slightly tighten the three mounting bolts. Switch load 'on' and 'off' two or three times. Application of load will normally raise the voltage setting slightly. With the load 'off' recheck the no-load voltage.
Readjust air gap and finally tighten mounting bolts.

Refit the access cover.

Warning !

Failure to refit covers can result in operator personal injury or death.

4.8 ACCESSORIES

Refer to the "ACCESSORIES" - Section 6 of this Manual for setting up procedures related to generator mounted accessories.

If there are accessories for control panel mounting supplied with the generator refer to the specific accessory fitting procedures inserted inside the back cover of this book.

SECTION 5

INSTALLATION - PART 2

5.1 GENERAL

The extent of site installation will depend upon the generating set build, e.g. if the generator is installed in a canopied set with integral switchboards and circuit breaker, on site installation will be limited to connecting up the site load to the generating set output terminals . In this case reference should be made to the generating set manufacturer's instruction book and any pertinent local regulations.

If the generator has been installed on a set without switchboard or circuit breaker the following points relating to connecting up the generator should be noted.

5.2 GLANDING

The terminal box is most conveniently glanded on either the right or left hand side. Both panels are removable for drilling/punching to suit glands/or glanding boxes. If single core cables are taken through the terminal box side panel an insulated or non-magnetic gland plate should be fitted.

Incoming cables should be supported from either below or above the box level and at a sufficient distance from the centre line of the generating set so as to avoid a tight radius at the point of entry into the terminal box panel, and allow movement of the generator set on its anti-vibration mountings without excessive stress on the cable.

Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Should the insulation resistance be less than 5MΩ the windings must be dried out as detailed in the Service and Maintenance section of this manual.

When making connections to the terminals the incoming cable termination should be placed on top of the winding lead termination(s) and clamped with the nut provided.

Important ! **To avoid the possibility of swarf entering any electrical components in the terminal box, panels must be removed for drilling.**

5.3 EARTHING

The neutral of the generator is not bonded to the generator frame as supplied from the factory. An earth terminal is provided inside the terminal box adjacent to the main terminals. Should it be required to operate with the neutral earthed a substantial earth conductor (normally equivalent to one half of the section of the line conductors) must be connected between the neutral and the earth terminal inside the terminal box. Additional earth terminals are provided on the generator feet. These should be already bonded to the generating set bedplate by the generating set builder, but will normally be required to be connected to the site earth system.

Caution !	**Reference to local electricity regulations or safety rules should be made to ensure correct earthing procedures have been followed.**

5.4 PROTECTION

It is the responsibility of the end user and his contractors/sub-contractors to ensure that the overall system protection meets the needs of any inspectorate, local electricity authority or safety rules, pertaining to the site location.

To enable the system designer to achieve the necessary protection and/or discrimination, fault current curves are available on request from the factory, together with generator reactance values to enable fault current calculations to be made.

Warning !	**Incorrect installation and/or protective systems can result in personal injury and/or equipment damage. Installers must be qualified to perform electrical installation work.**

5.5 COMMISSIONING

Ensure that all external cabling is correct and that all the generating set manufacturer's pre-running checks have been carried out before starting the set.

The generator AVR controls will have been adjusted during the generating set manufacturer's tests and should normally not require further adjustment.

Should malfunction occur during commissioning refer to Service and Maintenance section 'Fault Finding' procedure (subsection 7.4).

SECTION 6

ACCESSORIES

Generator control accessories may be fitted, as an option, in the generator terminal box. If fitted at the time of supply, the wiring diagram(s) in the back of this book shows the connections. When the options are supplied separately, fitting instructions are provided with the accessory.

The following matrix indicates availability of accessories with the differing AVRs.

Note the SX460 is not suitable for operation with accessories.

AVR Model	Parallel -ing Droop or Astatic	Manual Voltage Regulator	VAr/PF Control	Current Limit
SX440	✔	✘	✔	✘
SX421	✔	✘	✔	✘
MX341	✔	✔	✔	✘
MX321	✔	✔	✔	✔

6.1 REMOTE VOLTAGE ADJUST (ALL AVR TYPES)

A remote voltage adjust (hand trimmer) can be fitted.

SX460	Remove link 1-2 on the AVR and connect adjuster to terminals 1 and 2.
SX440, SX421 MX341 and MX321	Remove link 1-2 at the auxiliary terminals and connect adjuster to terminals 1 and 2.

6.2 PARALLEL OPERATION

Understanding of the following notes on parallel operation is useful before attempting the fitting or setting of the droop kit accessory. When operating in parallel with other generators or the mains, it is essential that the phase sequence of the incoming generator matches that of the busbar and also that all of the following conditions are met before the circuit breaker of the incoming generator is closed on to the busbar (or operational generator).

1. Frequency must match within close limits.

2. Voltages must match within close limits.

3. Phase angle of voltages must match within close limits.
   A variety of techniques, varying from simple synchronising lamps to fully automatic synchronisers, can be used to ensure these conditions are met.

Important ! **Failure to meet conditions 1, 2, and 3 when closing the cricuit breaker, will generate excessive mechanical and electrical stresses, resulting in equipment damage.**

Once connected in parallel a minimum instrumentation level per generator of voltmeter, ammeter, wattmeter (measuring total power per generator), and frequency meter is required in order to adjust the engine and generator controls to share kW in relation to engine ratings and kVAr in relation to generator ratings.

It is important to recognise that:

1. True kW are derived from the engine, and speed governor characteristics determine the kW sharing between sets

and

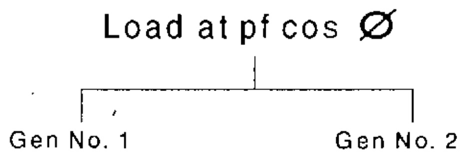
2. kVAr are derived from the generator, and excitation control characteristics determine the kVAr sharing.
   Reference should be made to the generating set manufacturer's instructions for setting the governor controls.

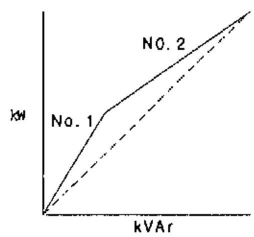
6.2.1 DROOP

The most commonly used method of kVAr sharing is to create a generator voltage characteristic which falls with decreasing power factor (increasing kVAr). This is achieved with a current transformer (C.T.) which provides a signal dependent on current phase angle (i.e. power factor) to the AVR.

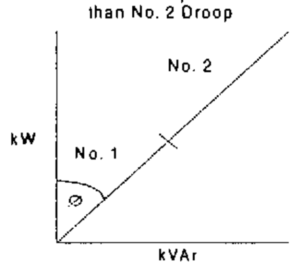
The current transformer has a burden resistor on the AVR board, and a percentage of the burden resistor voltage is summed into the AVR circuit. Increasing droop is obtained by turning the DROOP control potentiometer clockwise.

The diagrams below indicate the effect of droop in a simple two generator system:-

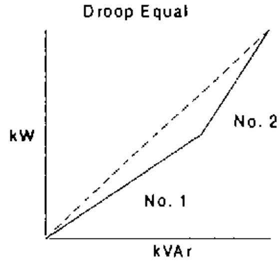




No. 1 Droop Greater than No. 2 Droop



No. 1 and No. 2 Droop Equal



No. 1 Droop less than No. 2 Droop

Generally 5% droop at full load current zero p.f. is sufficient to ensure kVAr sharing.

If the droop accessory has been supplied with the generator it will have been tested to ensure correct polarity and set to a nominal level of droop. The final level of droop will be set during generating set commissioning.

The following setting procedure will be found to be helpful.

6.2.1.1 SETTING PROCEDURE

Depending upon available load the following settings should be used - all are based on rated current level.

0.8 P.F. LOAD	(at full load current)	SET DROOP TO 3%
Zero P.F. LOAD	(at full load current)	SET DROOP TO 5%

Setting the droop with low power factor load is the most accurate. Run each generator as a single unit at rated frequency or rated frequency + 4% depending upon type of governor and nominal voltage. Apply available load to rated current of the generator. Adjust 'DROOP' control potentiometer to give droop in line with above table. Clockwise rotation increases amount of droop. Refer to Fig 9a, 9b, 9c or 9d for potentiometer locations.

Note 1)
Reverse polarity of the C.T. will raise the generator voltage with load. The polarities S1-S2 shown on the wiring diagrams are correct for clockwise rotation of the generator looking at the drive end. Reversed rotation requires S1-S2 to be reversed.

Note 2)
The most important aspect is to set all generators equal. The precise level of droop is less critical.

Note 3)
A generator operated as a single unit with a droop circuit set at rated load 0.8 power factor is unable to maintain the usual +/- 0.5% regulation. A shorting switch can be connected across S1-S2 to restore regulation for single running.

Important ! **LOSS OF FUEL to an engine can cause its generator to motor with consequent damage to the generator windings. Reverse power relays should be fitted to trip main circuit breaker. LOSS OF EXCITATION to the generator can result in large current oscillations with consequent damage to generator windings. Excitation loss detection equipment should be fitted on trip main circuit breaker.**

6.2.2 ASTATIC CONTROL

The 'droop' current transformer can be used in a connection arrangement which enables the normal regulation of the generator to be maintained when operating in parallel.

This feature is only supplied from the factory as a fitted droop kit, however, if requested at the time of order, the diagrams inside the back cover of this book will give the necessary site connections. The end user is required to provide a shorting switch for the droop current transformer secondary.

Should the generator be required to be converted from standard droop to 'astatic' control, diagrams are available on request.

The setting procedure is exactly the same as for DROOP. (Subsection 6.2.1.1)

Important ! **When using this connection arrangement a shorting switch is required across each C.T. burden (terminals S1 and S2.)The switch must be closed a) when a generating set is not running and b) when a generating set is selected for single running.**

6.3 MANUAL VOLTAGE REGULATOR (MVR) - MX341 and MX321 AVR

This accessory is provided as an 'emergency' excitation system, in the event of an AVR failure.

Powered from the PMG output the unit is manually set, but automatically controls the excitation current, independent of generator voltage or frequency.

The unit is provided with 'MANUAL', 'OFF', 'AUTO' switching facility.

'MANUAL'
- position connects the exciter field to the MVR output. Generator output is then controlled by the operator adjusting the excitation current.

'OFF'
- disconnects the exciter field from both MVR and the normal AVR.

'AUTO'
- connects the exciter field to the normal AVR and the generator output is controlled at the pre-set voltage under AVR control.

Switching mode of operation should be carried out with the generator set stationary to avoid voltage surges on the connected load, although neither the MVR nor AVR will be damaged should the switching be carried out with the set running.

6.4 OVERVOLTAGE DE-EXCITATION BREAKER SX421 and MX321 AVR

This accessory provides positive interuption of the excitation power in the event of overvoltage due to loss of sensing or internal AVR faults including the output power device.

With the MX321 AVR this accessory is supplied loose for fitting in the control panel.

In the case of the SX421 the cricuit breaker is always supplied and will normally be fitted in the generator.

Important ! **When the circuit breaker is supplied loose, the AVR is fitted with a link on terminals K1-K2 to enable operation of the AVR. When connecting the circuit breaker this link must be removed.**

6.4.1 RESETTING THE BREAKER

..ı the event of operation of the circuit breaker, indicated by loss of generator output voltage, manual resetting is required. When in the "tripped" state the circuit breaker switch lever shows "OFF". To reset move the switch lever to the position showing "ON".

When fitted in the generator, access to the breaker is gained by removal of the AVR access cover.

Danger !

Terminals which are LIVE with the generating set running are exposed when the AVR access cover is removed. Resetting of the circuit breaker MUST be carried out with the generating set stationary, and engine starting circuits disabled.

The circuit breaker is mounted on the AVR mounting bracket either to the left or to the right of the AVR depending upon AVR poistion. After resetting the circuit breaker replace the AVR access cover before restarting the generating set. Should resetting of he circuit breaker not restore the generator to normal operation, ıefer to subsection 7.5.

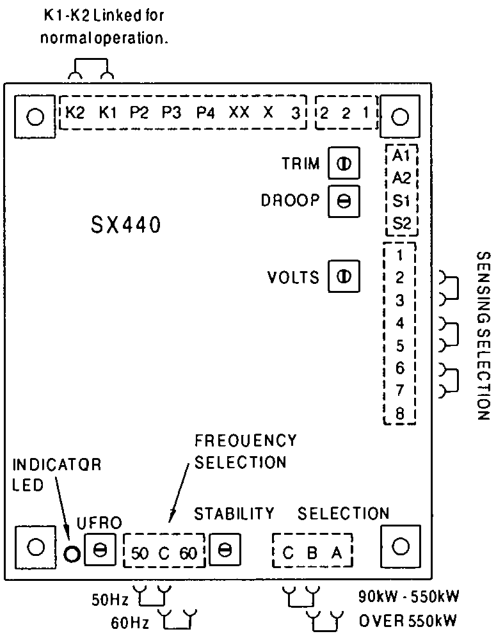


Fig. 9a

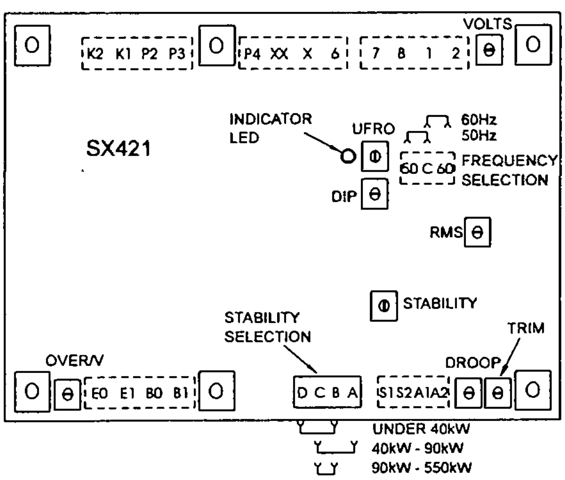


Fig. 9b

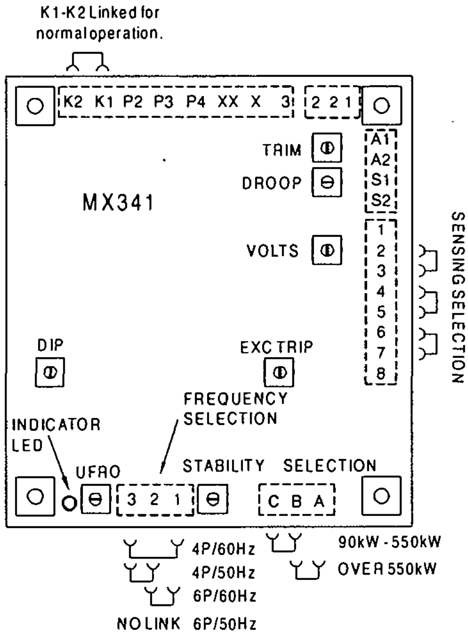


Fig. 9c

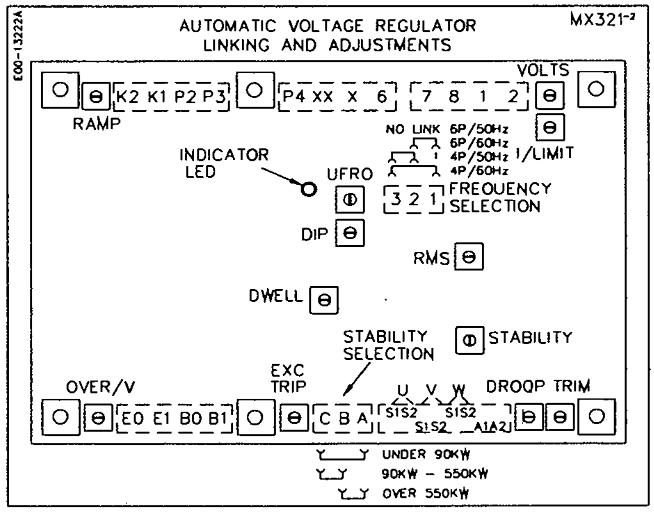


Fig. 9d

6.5 CURRENT LIMIT - MX321 AVR

These accessories work in conjunction with the AVR circuits to provide an adjustment to the level of current delivered into a fault. One current transformer (CT) per phase is fitted to provide current limiting on any line to line or line to neutral fault.

Note: The W phase CT can also provide "DROOP". Refer to 6.2.1.1 for setting droop independent of current limit.

Adjustment means is provided with the "I/LIMIT" control potentiometer on the AVR. Refer to Fig. 9d for location. If current limit transformers are supplied with the generator the limit will be set in accordance with the level specified at the time of order, and no further adjustment will be necessary. However, should the level need to be adjusted, refer to the setting procedure given in 6.5.1.

6.5.1 SETTING PROCEDURE

Run the generating set on no-load and check that engine governor is set to control nominal speed.

Stop the generating set. Remove the link between terminals K1-K2 at the auxiliary terminal block and connect a 5A switch across the terminals K1-K2.

Turn the "I/LIMIT" control potentiometer fully anticlockwise. Short circuit the stator winding with a bolted 3 phase short at the main terminals. An AC current clip-on ammeter is required to measure the winding lead current.

With the switch across K1-K2 open start the generating set.

Close the switch across K1-K2 and turn the "I/LIMIT" control potentiometer clockwise until required current level is observed on the clip-on ammeter. As soon as correct setting is achieved open the K1-K2 switch.

Should the current collapse during the setting procedure, the internal protective circuits of the AVR will have operated. In this event shut down the set and open the K1-K2 switch. Restart the set and run for 10 minutes with K1-K2 switch open, to cool the generator windings, before attempting to resume the setting procedure.

Important ! **Failure to carry out the correct COOLING procedure, may cause overheating and consequent damage to the generator windings.**

6.6 POWER FACTOR CONTROLLER (PFC3)

This accessory is primarily designed for those generator applications where operation in parallel with the mains supply is required.

Protection against loss of mains voltage or generator excitation is not included in the unit and the system designer must incorporate suitable protection.

The electronic control unit requires both droop and kVAr current transformers. When supplied with the generator, wiring diagrams inside the back cover of this manual show the conections and the additional instruction leaflet provided gives details of setting procedures for the power factor controller (PFC3).

The unit monitors the power factor of the generator current and adjusts excitation to maintain the power factor constant.

This mode can also be used to control the power factor of the mains if the point of current monitoring is moved to the mains cables. Refer to the factory for appropriate details.

It is also possible to operate the unit to control kVAr of the generator if required. Refer to the factory for appropriate details.

SECTION 7

SERVICE AND MAINTENANCE

As part of routine maintenance procedures, periodic attention to winding condition (particularly when generators have been idle for a long period) and bearings is recommended. (Refer to subsections 7.1 and 7.2 respectively).

When generators are fitted with air filters regular inspection and filter maintenance is required. (Refer to subsection 7.3).

7.1 WINDING CONDITION

Warning !	**Service and fault finding procedures present hazards which can result in severe personal injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures. Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.**

Guidance of Typical Insulation Resistance [IR] Values

The following is offered as general information about IR values and is aimed at providing guidance about the typical IR values for generators from new through to the point of refurbishment.

New Machines

The generators Insulation Resistance, along with many other critical factors, will have been measured during the alternator manufacturing process. The generator will have been transported with an appropriate packaging suitable for the method of delivery to the Generating Set assemblers works. Where we expect it to be stored in a suitable location protected from adverse environmental conditions.

However, absolute assurance that the generator will arrive at the Gen-set production line with IR values still at the factory test levels of above 100 MΩ cannot be guaranteed.

At Generating Set Manufacturers Works

The generator should have been transported and stored such that it will be delivered to the assembly area in a clean dry condition. If held in appropriate storage conditions the generator IR value should typically be 25 MΩ.

If the unused/new generators IR values fall below 10 MΩ then a drying out procedure should be implemented by one of the processes outlined below before being despatched to the end customer's site. Some investigation should be undertaken into the storage conditions of the generator while on site.

Generators in Service

Whilst It is known that a generator will give reliable service with an IR value of just 1.0 MΩ. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions.

Any temporarily reduction in IR values can be restored to expected values by following one of the drying out procedures.

7.1.1 WINDING CONDITION ASSESSMENT

Caution !	**The AVR should be disconnected and the Resistance Temperature Detector (R.T.D.) leads grounded during this test.**

The condition of the windings can be assessed by measurement of insulation resistance [IR] between phase to phase, and phase to earth.

Measurement of winding insulation should be carried out: -

1. As part of a periodic maintenance plan.
2. After prolonged periods of shutdown.
3. When low insulation is suspected, e.g. damp or wet windings.

Care should be taken when dealing with windings that are suspected of being excessively damp or dirty. The initial measurement of the [IR] Insulation Resistance should be established using a low voltage (500V) megger type instrument. If manually powered the handle should initially be turned slowly so that the full test voltage will not be applied, and only applied for long enough to very quickly assess the situation if low values are suspected or immediately indicated.

Full megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

Procedure for Insulation Testing

Disconnect all electronic components, AVR, electronic protection equipment etc. Ground the [RTD's] Resistance Temperature Detection devices if fitted. Short out the diodes on the rotating diode assembly. Be aware of all components connected to the system under test that could cause false readings or be damaged by the test voltage.

Carry out the insulation test in accordance with the 'operating instructions for the test equipment.

The measured value of insulation resistance for all windings to earth and phase to phase should be compared with the guidance given above for the various 'life stages' of a generator. The minimum acceptable value must be greater than 1.0 MΩ.

If low winding insulation is confirmed use one or more of the methods, given below, for drying the winding should be carried out.

7.1.2 METHODS OF DRYING OUT GENERATORS

Cold Run

Consider a good condition generator that has not been run for some time, and has been standing in damp, humid conditions. It is possible that simply running the gen set unexcited - AVR terminals K1 K2 open circuit - for a period of say 10 minutes will sufficiently dry the surface of the windings and raise the IR sufficiently, to greater than 1.0 MΩ , and so allow the unit to be put into service.

Blown Air Drying

Remove the covers from all apertures to allow the escape of the water-laden air. During drying, air must be able to flow freely through the generator in order to carry off the moisture.

Direct hot air from two electrical fan heaters of around 1 – 3 kW into the generator air inlet apertures. Ensure the heat source is at least 300mm away from the windings to avoid over heating and damage to the insulation.

Apply the heat and plot the insulation value at half hourly intervals. The process is complete when the parameters covered in the section entitled, 'Typical Drying Out Curve', are met.

Remove the heaters, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest prior to running.

Short Circuit Method

NOTE: This process should only be performed by a competent engineer familiar with safe operating practices within and around generator sets of the type in question.

Ensure the generator is safe to work on, initiate all mechanical and electrical safety procedures pertaining to the genset and the site.

Bolt a short circuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current.

Disconnect the cables from terminals "X" and "XX" of the AVR.

Connect a variable dc supply to the "X" (positive) and "XX" (negative) field cables. The dc supply must be able to provide a current up to 2.0 Amp at 0 - 24 Volts.

Position a suitable ac ammeter to measure the shorting link current.

Set the dc supply voltage to zero and start the generating set. Slowly increase the dc voltage to pass current through the exciter field winding. As the excitation current increases, so the stator current in the shorting link will increase. This stator output current level must be monitored, and not allowed to exceed 80% of the generators rated output current.

After every 30 minutes of this exercise:

Stop the generator and switch off the separate excitation supply, and measure and record the stator winding IR values, and plot the results. The resulting graph should be compared with the classic shaped graph. This drying out procedure is complete when the parameters covered in the section entitled 'Typical Drying Out Curve' are met.

Once the Insulation Resistance is raised to an acceptable level - minimum value 1.0 MΩ – the dc supply may be removed and the exciter field leads "X" and "XX" re-connected to their terminals on the AVR.

Rebuild the genset, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest the generator prior to running.

TYPICAL DRYING OUT CURVE

Whichever method is used to dry out the generator the resistance should be measured every half-hour and a curve plotted as shown. (fig 6.)

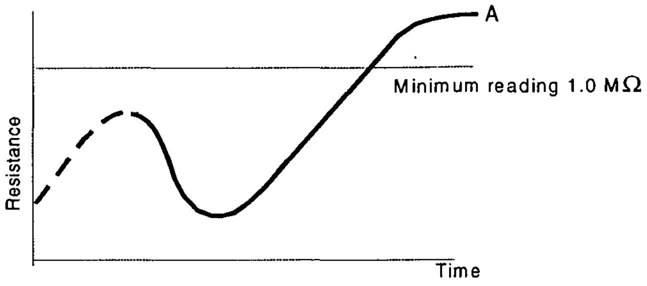


Fig. 9

The illustration shows a typical curve for a machine that has absorbed a considerable amount of moisture. The curve indicates a temporary increase in resistance, a fall and then a gradual rise to a steady state. Point 'A', the steady state, must be greater than 1.0 MΩ. (If the windings are only slightly damp the dotted portion of the curve may not appear).

For general guidance expect that the typical time to reach point 'A' will be:

1 hour for a BC16/18,
2 hours for a UC22/27
3 hours for an HC4,5,6&7
Drying should be continued after point "A" has been reached for at least one hour.

It should be noted that as winding temperature increases, values of insulation resistance may significantly reduce. Therefore, the reference values for insulation resistance can only be established with windings at a temperature of approximately 20°C.

If the IR value remains below 1.0 MΩ, even after the above drying methods have been properly conducted, then a Polarisation Index test [PI] should be carried out.

If the minimum value of 1.0 MΩ for all components cannot be achieved rewinding or refurbishment of the generator will be necessary.

The generator must not be put into service until the minimum values can be achieved.

Important ! **The short circuit must not be applied with the AVR connected in circuit. Current in excess of the rated generator current will cause damage to the windings.**

After drying out, the insulation resistances should be rechecked to verify minimum resistances quoted above are achieved.
On re-testing it is recommended that the main stator insulation resistance is checked as follows:-
Separate the neutral leads

Ground	V and W	phase and megger	U phase to ground
Ground	U and W	phase and megger	V phase to ground
Ground	U and V	phase and megger	W phase to ground

If the minimum value of 1.0MΩ is not obtained, drying out must be continued and the test repeated.

7.2 BEARINGS

All bearings are supplied sealed for life and are, therefore, not regreasable.

Important ! **The life of a bearing in service is subject to the working conditions and the environment.**

Important ! **Long stationary periods in an environment where there is vibration can cause false brinnelling which puts flats on the ball and grooves on the races.**
Very humid atmospheres or wet conditions can emulsify the grease and cause corrosion.

Important ! **High axial vibration from the engine or misalignment of the set will stress the bearing.**

The bearing, in service, is affected by a variety of factors that together will determine the bearing life. We recommend that the health of the bearings be monitored, using 'spike energy' vibration monitoring equipment. This will allow the timely replacement of bearings, that exhibit a deteriorating trend, during a major engine overhaul.

If excessive heat, noise or vibration is detected, change the bearing as soon as practicable. Failure to do so could result in bearing failure.

In the event that 'spike energy' vibration monitoring equipment is not available, it is strongly recommend that consideration be given to changing the bearing during each 'major engine overhaul'.

Belt driven application will impose an additional load on bearings. The bearing life will therefore be significantly affected. It is important that the side load limits given in SECTION 3 are not exceeded and the health of the bearing is monitored more closely.

7.3 AIR FILTERS

The frequency of filter maintenance will depend upon the severity of the site conditions. Regular inspection of the elements will be required to establish when cleaning is necessary.

7.3.1 CLEANING PROCEDURE

Danger ! **Removal of filter elements enables access to LIVE parts.**
Only remove elements with the generator out of service.

Remove the filter elements from the filter frames. Immerse or flush the element with a suitable detergent until the element is clean. Dry elements thoroughly before refitting.

7.4 FAULT FINDING

Important ! **Before commencing any fault finding procedure examine all wiring for broken or loose conections.**

Four types of excitation control system, involving four types of AVR, can be fitted to the range of generators covered by this manual. The systems can be identified by a combination of AVR type, where applicable, and the last digit of the generator frame size designation. Refer to the generator nameplate then proceed to the appropriate subsection as indicated below:-

DIGIT	EXCITATION CONTROL	SUBSECTION
6	SX460 AVR	7.4.1
4	SX440 AVR	7.4.2
4	SX421 AVR	7.4.3
5	Transformer control	7.4.4
3	MX341 AVR	7.4.5
3	MX321 AVR	7.4.6

7.4.1 SX460 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check speed 2. Check residual voltage. Refer to subsection 7.4.7. 3. Follow Separate Excitation Test Procedure to check generator and AVR.
Unstable voltage either on no-load or with load	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow Separate Excitation Procedure to check generator and AVR. Refer to subsection 7.5.

7.4.2 SX440 AVR - FAULT FINDING

No voltage build-up when starting set.	1. Check link K1-K2 on auxiliary terminals. 2. Check speed. 3. Check residual voltage. Refer to subsection 7.4.7. 4. Follow Separate Excitation Test Procedure to check generator and AVR. Refer to subsection 7.5.
Unstable voltage either on no-load or with load.	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow Separate Excitation Procedure to check generator and AVR. Refer tosubsection 7.5.

7.4.3 SX421 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check circuit breaker 'ON'. Refer to subsection 6.4.1. 2. Check speed. 3. Check residual voltage. Refer to subsection 7.4.7. 4. Follow Separate Excitation Procedure to check generator and AVR. Refer to subsection 7.5.
Unstable voltage either on no-load or with load	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity. Check continuity of leads 7-8 and P3-P2 for continuity. 3. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow Separate Excitation to check generator and AVR. Refer to subsection 7.5.
Excessive voltage/speed dip on-load switching	1. Check governor response. 2. Refer to generating set manual. Check 'DIP' setting. Refer to subsection 4.7.1.4.

7.4.4 TRANSFORMER CONTROL - FAULT FINDING

No voltage build-up when starting set	1. Check transformers rectifiers. 2. Check transformer secondary winding for open circuit.
Low volatge	1. Check speed. 2. Check transformer air gap setting. Refer to subsection 4.7.2.
High voltage	1. Check speed. 2. Check transformer air gap setting. Refer to subsection 4.7.2. 3. Check transformer secondary winding for short circuited turns.
Excessive voltage drop on-load	1. Check speed drop on-load. 2. Check transformer rectifiers. Check transformer air gap setting. Refer to subsection 4.7.2.

7.4.5 MX341 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check link K1-K2 on auxiliary terminals. 2. Follow Separate Excitation Test Procedure to check machine and AVR. Refer to subsection 7.5.
Loss of voltage when set running	1. First stop and re-start set. If no voltage or voltage collapses after short time, follow Separate Excitation Test Procedure. Refer to subsection 7.5.
Generator voltage high followed by collapse	1. Check sensing leads to AVR. 2. Refer to Separate Excitation Test Procedure. Refer to subsection 7.5.
Voltage unstable either on no-load or with load	1. Check speed stability. 2. Check "STAB" setting. Refer to Load Testing section for procedure. Refer to subsection 4.6.
Low voltage on-load	1. Check speed. 2. If correct check "UFRO" setting. Refer to subsection 4.7.1.1.
Excessive voltage/speed dip on load switching	1. Check governor response. Refer to generating set manual. Check "DIP" setting. Refer to subsection 4.7.1.4.
Sluggish recovery on load switching	1. Check governor response. Refer to generating set manual.

7.4.6 MX321 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check link K1-K2 on auxiliary terminals. Follow Separate Excitation Test Procedure to check machine and AVR. Refer to subsection 7.5.
Voltage very slow to build up	1. Check setting of ramp potentiometer. Refer to 4.7.1.5.
Loss of voltage when set running	1. First stop and re-start set. If no voltage or voltage collapses after short time, follow Separate Excitation Test Procedure. Refer to subsection 7.5.
Generator voltage high followed by collapse	1. Check sensing leads to AVR. 2. Refer to Separate Excitation Test Procedure. Refer to subsection 7.5.
Voltage unstable either on no-load or with load	1. Check speed stability. 2. Check "STAB" setting. Refer to Load Testing section for procedure. Refer to subsection 4.6.
Low voltage on-load	1. Check speed. 2. If correct check "UFRO" setting. Refer to subsection 4.7.1.1.
Excessive voltage/speed dip on load switching	1. Check governor responses. Refer to generating set manual. Check "DIP" setting. Refer to subsection 4.7.1.4.
Sluggish recovery on load switching	1. Check governor response. Refer to generating set manual. Check "DWELL" setting. Refer to Load Testing section 4.7.1.4.

7.4.7 RESIDUAL VOLTAGE CHECK

This procedure is applicable to generators with either SX460 or SX440 or SX421 AVR.

With the generator set stationary remove AVR access cover and leads X and XX from the AVR.

Start the set and measure voltage across AVR terminals 7-8 on SX460 AVR or P2-P3 on SX440 or SX421 AVR.

Stop the set, and replace leads X and XX on the AVR terminals.If the measured voltage was above 5V the generator should operate normally.

If the measured voltage was under 5V follow the proceedure below.

Using a 12 volt d. c. battery as a supply clip leads from battery negative to AVR terminal XX, and from battery positive through a diode to AVR terminal X. See Fig. 10.

Important ! **A diode must be used as shown below to ensure the AVR is not damaged.**

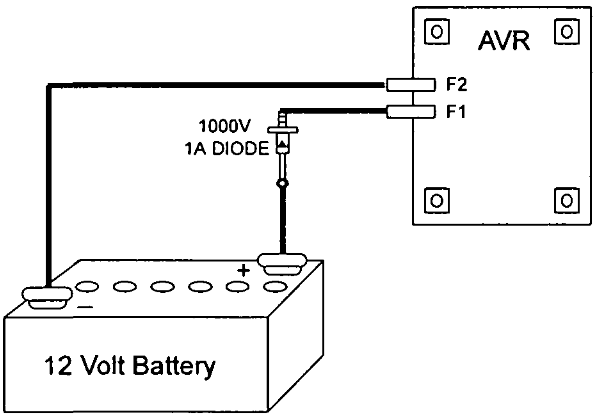


Fig. 11

Important ! **If the generating set battery is used for field flashing the generator main stator neutral must be disconnected from earth.**

Restart the set and note output voltage from main stator, which should be approximately nominal voltage, or voltage at AVR terminals 7 and 8 on SX460, P2-P3 on SX440 or SX421 which should be between 170 and 250 volts.

Stop the set and unclip battery supply from terminals X and XX. Restart the set. The generator should now operate normally. If no voltage build-up is obtained it can be assumed a fault exists in either the generator or the AVR circuits. Follow the SEPARATE EXCITATION TEST PROCEDURE to check generator windings, rotating diodes and AVR. Refer to subsection 7.5.

7.5 SEPARATE EXCITATION TEST PROCEDURE

The generator windings, diode assembly and AVR can be checked using the appropriate following section.

7.5.1 GENERATOR WINDINGS, ROTATING DIODES and PERMANENT MAGNET GENERATOR (PMG)

7.5.2 EXCITATION CONTROL TEST.

7.5.1 GENERATOR WINDINGS, ROTATING DIODES and PERMANENT MAGNET GENERATOR (PMG)

Important ! **The resistances quoted apply to a standard winding. For generators having windings or voltages other than those specified refer to factory for details. Ensure all disconnected leads are isolated and free from earth.**

Important ! **Incorrect speed setting will give proportional error in voltage output.**

CHECKING PMG

Start the set and run at rated speed.

Measure the voltages at the AVR terminals P2, P3 and P4. These should be balanced and within the following ranges:-

50Hz generators - 170-180 volts
60Hz generators - 200-216 volts

Should the voltages be unbalanced stop the set, remove the PMG sheet metal cover from the non drive endbracket and disconnect the multipin plug in the PMG output leads. Check leads P2, P3, P4 for continuity. Check the PMG stator resistances between output leads. These should be balanced and within +/-10% of 2.3 ohms. If resistances are unbalanced and/or incorrect the PMG stator must be replaced. If the voltages are balanced but low and the PMG stator winding resistances are correct - the PMG rotor must be replaced.

CHECKING GENERATOR WINDINGS AND ROTATING DIODES

This procedure is carried out with leads X and XX disconnected at the AVR or transformer control rectifier bridge and using a 12 volt d.c. supply to leads X and XX.

Start the set and run at rated speed.

Measure the voltages at the main output terminals U, V and W. If voltages are balanced and within +/-10% of the generator nominal voltage, refer to 7.5.1.1.

Check voltages at AVR terminals 6, 7 and 8. These should be balanced and between 170-250 volts.

If voltages at main terminals are balanced but voltage at 6, 7 and 8 are unbalanced, check continuity of leads 6, 7 and 8. Where an isolating transformer is fitted (MX321 AVR) check transformer windings. If faulty the transformer unit must be replaced.

If voltages are unbalanced, refer to 7.5.1.2.

7.5.1.1 BALANCED MAIN TERMINAL VOLTAGES

If all voltages are balanced within 1% at the main terminals, it can be assumed that all exciter windings, main windings and main rotating diodes are in good order, and the fault is in the AVR or transformer control. Refer to subsection 7.5.2 for test procedure.

If voltages are balanced but low, there is a fault in the main excitation windings or rotating diode assembly. Proceed as follows to identify:-

Rectifier Diodes

The diodes on the main rectifier assembly can be checked with a multimeter. The flexible leads connected to each diode should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 ohms scale, or an infinity reading in both directions.

On an electronic digital meter a healthy diode will give a low reading in one direction, and a high reading in the other.

Replacement of Faulty Diodes

The rectifier assembly is split into two plates, the positive and negative, and the main rotor is connected across these plates. Each plate carries 3 diodes, the negative plate carrying negative biased diodes and the positive plate carrying positive biased diodes. Care must be taken to ensure that the correct polarity diodes are fitted to each respective plate. When fitting the diodes to the plates they must be tight enough to ensure a good mechanical and electrical contact, but should not be overtightened. The recommended torque tightening is 4.06 - 4.74Nm (36-42lb in).

Surge Suppressor

The surge suppressor is a metal-oxide varistor connected across the two rectifier plates to prevent high transient reverse voltages in the field winding from damaging the diodes. This device is not polarised and will show a virtually infinite reading in both directions with an ordinary resistance meter. If defective this will be visible by inspection, since it will normally fail to short circuit and show signs of disintegration. Replace if faulty.

Main Excitation Windings

If after establishing and correcting any fault on the rectifier assembly the output is still low when separately excited, then the main rotor, exciter stator and exciter rotor winding resistances should be checked (see Resistance Charts), as the fault must be in one of these windings. The exciter stator resistance is measured across leads X and XX. The exciter rotor is connected to six studs which also carry the diode lead terminals. The main rotor winding is connected across the two rectifier plates. The respective leads must be disconnected before taking the readings.

Resistance values should be within +/-10% of the values given in the table below:-

Frame Size	Main Rotor	Exciter Stator			Exciter Rotor
		Type 1	Type 2*	Type 3**	
UC22C	0.59	21	28	138	0.142
UC22D	0.64	21	28	138	0.142
UC22E	0.69	20	30	155	0.156
UC22F	0.83	20	30	155	0.156
UC22G	0.94	20	30	155	0.156
UC27C	1.12	20	-	-	0.156
UC27D	1.26	20	-	-	0.156
UC27E	1.34	20	-	-	0.182
UC27F	1.52	20	-	-	0.182
UC27G	1.69	20	-	-	0.182
UC27H	1.82	20	-	-	0.182
UCD27J	2.08	20	-	-	0.182
UCD27K	2.08	20	-	-	0.182

* Used with 1 phase transformer controlled 3 phase or 1 phase generators.

** Used with 3 phase transformer controlled 3 phase generators.

7.5.1.2 UNBALANCED MAIN TERMINAL VOLTAGES

If voltages are unbalanced, this indicates a fault on the main stator winding or main cables to the circuit breaker. NOTE: Faults on the stator winding or cables may also cause noticeable load increase on the engine when excitation is applied. Disconnect the main cables and separate the winding leads U1-U2, U5-U6, V1-V2, V5-V6, W1-W2, W5-W6 to isolate each winding section. (U1-L1, U2-L4 on single phase generators).

Measure each section resistance - values should be balanced and within +/-10% of the value given below:-

AVR CONTROLLED GENERATORS				
Frame Size	SECTION RESISTANCES			
	Winding 311	Winding 17	Winding 05	Winding 06
UC22C	0.09	0.14	0.045	0.03
UC22D	0.065	0.1	0.033	0.025
UC22E	0.05	0.075	0.028	0.02
UC22F	0.033	0.051	0.018	0.012
UC22G	0.028	0.043	0.014	0.01
UC27C	0.03	0.044	0.016	0.011
UC27D	0.019	0.026	0.01	0.007
UC27E	0.016	0.025	0.009	0.008
UC27F	0.012	0.019	0.007	0.005
UC27G	0.01	0.013	0.006	0.004
UC27H	0.008	0.014	0.004	0.004
UCD27J	0.006	0.009	-	-
UCD27K	0.006	0.009	-	-

TRANSFORMER CONTROLLED GENERATORS					
Frame Size	SECTION RESISTANCES, 3 PHASE WINDINGS				
	380V	400V	415V	416V	460V
	50Hz	50Hz	50Hz	60Hz	60Hz
UC22C	0.059	0.078	0.082	0.055	0.059
UC22D	0.054	0.056	0.057	0.049	0.054
UC22E	0.041	0.05	0.053	0.038	0.041
UC22F	0.031	0.032	0.033	0.025	0.031
UC22G	0.022	0.026	0.028	0.021	0.022

Measure insulation resistance between sections and each section to earth.

Unbalanced or incorrect winding resistances and/or low insulation resistances to earth indicate rewinding of the stator will be necessary. Refer to removal and replacement of component assemblies subsection 7.5.3.

7.5.2 EXCITATION CONTROL TEST
7.5.2.1 AVR FUNCTION TEST

All types of AVR's can be tested with this procedure:

1. Remove exciter field leads X & XX (F1 & F2) from the AVR terminals X & XX (F1 & F2).
2. Connect a 60W 240V household lamp to AVR terminals X & XX (F1 & F2).
3. Set the AVR VOLTS control potentiometer fully clockwise.
4. Connect a 12V, 1.0A DC supply to the exciter field leads X & XX (F1 & F2) with X (F1) to the positive.

5. Start the generating set and run at rated speed.

6. Check that the generator output voltage is within +/-10% of rated voltage.

Voltages at AVR terminals 7-8 on SX460 AVR or P2-P3 on SX440 or SX421 AVR should be between 170 and 250 volts. If the generator output voltage is correct but the voltage on 7-8 (or P2-P3) is low, check auxiliary leads and connections to main terminals.

Voltages at P2, P3, P4 terminals on MX341 and MX321 should be as given in 7.5.1.

The lamp connected across X-XX should glow. In the case of the SX460, SX440 and SX421 AVRs the lamp should glow continuously. In the case of the MX341 and MX321 AVRs the lamp should glow for approximately 8 secs. and then turn off. Failure to turn off indicates faulty protection circuit and the AVR should be replaced. Turning the "VOLTS" control potentiometer fully anti-clockwise should turn off the lamp with all AVR types.

Should the lamp fail to light the AVR is faulty and should be replaced.

Important ! **After this test turn VOLTS control potentiometer fully anti-clockwise.**

7.5.2.2 TRANSFORMER CONTROL

The transformer rectifier unit can only be checked by continuity, resistance checks and insulation resistance measurement.

Two phase transformer

Separate primary leads T1-T2-T3-T4 and secondary leads 10-11. Examine windings for damage. Measure resistances across T1-T3 and T2-T4. These will be a low value but should be balanced. Check that there is resistance in the order of 8 ohms between leads 10 and 11. Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary resistance, open or short circuited winding sections, indicates the transformer unit should be replaced.

Three phase transformer

Separate primary leads T1-T2-T3 and secondary leads 6-7-8 and 10-11-12.

Examine windings for damage. Measure resistances across T1-T2, T2-T3, T3-T1. These will be low but should be balanced. Check that resistances are balanced across 6-10, 7-11 and 8-12 and in the order of 18 ohms.

Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary or secondary winding resistances, open or short circuited winding sections indicates the transformer unit should be replaced.

Rectifier units - Three phase and single phase

With the leads 10-11-12-X and XX removed from the rectifier unit (lead 12 is not fitted on single phase transformer rectifier units), check forward and reverse resistances between terminals 10-X, 11-X, 12-X, 10-XX, 11-XX and 12-XX with a multimeter.

A low forward resistance and high reverse resistance should be read between each pair of terminals. If this is not the case the unit is faulty and should be replaced.

7.5.3 REMOVAL AND REPLACEMENT OF COMPONENT ASSEMBLIES

METRIC THREADS ARE USED THROUGHOUT

Caution !	**When lifting single bearing generators, care is needed to ensure the generator frame is kept in the horizontal plane. The rotor is free to move in the frame and can slide out if not correctly lifted. Incorrect lifting can cause serious personal injury.**

7.5.3.1 REMOVAL OF PERMANENT MAGNET GENERATOR (PMG)

1. Remove 4 screws holding the sheet metal cylindrical cover at the non-drive end and remove the cover.

2. Disconnect the in line connector from the PMG stator (3 wires go to this connector). It may be necessary to cut off the nylon cable tie first.

3. Remove the 4 threaded pillars and clamps holding the PMG stator onto the end bracket.

4. Tap the stator out of the 4 spigots and withdraw. The highly magnetic rotor will attract the stator. Take care to avoid contact which may damage the windings.

5. Remove the bolt in the centre from the rotor shaft and pull off the rotor. It may be necessary to gently tap the rotor away. Take care to tap gently and evenly - the rotor has ceramic magnets which are easily broken by shock.

Important ! **The rotor assembly must not be dismantled.**

Replacement is a reversal of the above procedure.

7.5.3.2 REMOVAL OF BEARINGS

Important ! **Position the main rotor so that a full pole face of the main rotor core is at the bottom of the stator bore.**

NOTE: Removal of the bearings may be effected either after the rotor assembly has been removed OR more simply by removal of endbracket(s). Refer to 7.5.3.3. and 7.5.3.4.

The bearings are pre-packed with grease and sealed for life.

The bearing(s) are a press fit and can be removed from the shaft with 3 leg or 2 leg manual or hydraulic bearing pullers.

SINGLE BEARING ONLY: Before trying to pull off the bearing remove the small circlip retaining it.

When fitting new bearings use a bearing heater to expand the bearing before fitting to the shaft. Tap the bearing into place ensuring that it contacts the shoulder on the shaft.

Refit the retaining circlip on single bearing generators.

7.5.3.3 REMOVAL OF ENDBRACKET AND EXCITER STATOR

1. Remove exciter leads X+, XX- at the AVR.

2. Slacken 4 bolts (2 each side) situated on horizontal centre line holding the terminal box.

3. Remove 2 bolts holding lifting lug, at the non-drive end, and remove lug.

4. Remove sheet metal cylindrical cover (4 screws) over PMG (if fitted)
   or
   Remove shallow sheet metal cover (4 screws) at the non-drive end.

5. Ease up the terminal box and support clear of the non-drive endbracket.

6. Remove 6 bolts holding the non-drive endbracket to the stator bar assembly. The endbracket is now ready for removal.

7. Replace the lifting lug onto the endbracket and sling the endbracket on a hoist to facilitate lifting.

8. Tap the endbracket around its perimeter to release from the generator. The endbracket and exciter stator will come away as a single assembly.

9. Remove the 4 screws holding the exciter stator to the endbracket and gently tap the exciter stator to release it. Replacement is a reversal of the above procedure.

7.5.3.4 REMOVAL OF THE ROTOR ASSEMBLY

Remove the permanent magnet generator. Refer to 7.5.3.1
or
Remove the four screws holding the sheet metal cover at the non drive end and remove cover.

Caution !	**With the PMG rotor removed single bearing generator rotors are free to move in the frame. Ensure frame is kept in the horizontal plane when lifting.**

TWO BEARING GENERATORS

1. Remove 2 screws holding the sheet metal cover around the adaptor at the drive end and remove the cover.

2. Remove the bolts holding the adaptor to the endbracket at the drive end.

3. Tap off the adaptor. It may be preferred to sling the adaptor first depending on its size and weight.

4. Remove the screens and louvres (if fitted) at each side on the drive end.

Now ensure that the rotor is positioned with a full pole face at the bottom centre line. This is to avoid damage to the bearing exciter, or rotor winding, by limiting the possible rotor downward movement to the air gap length.

5. Remove 6 bolts holding drive endbracket onto adaptor ring DE. The boltheads face towards the non-drive end. The top bolt passes through the centre of the lifting lug.

6. Tap the drive endbracket away from the adaptor ring DE and withdraw the endbracket.

7. Ensure the rotor is supported at the drive end on a sling.

8. Tap the rotor from the non-drive end to push the bearing clear of the endbracket and its position within an 'O' ring.

9. Continue to push the rotor out of the stator bore, gradually working the sling along the rotor as it is withdrawn, to ensure that it is fully supported all the time.

SINGLE BEARING GENERATORS

1. Remove the screws, screens and louvres (if fitted) at each side on drive end adaptor.

2. **UCI224, UCI274, UCM224, UCM274, UCD274 Only**

   Remove 6 bolts holding the adaptor at the drive end. It may be preferred to sling the adaptor on a hoist. The bolt heads face towards the non-drive end. The top bolt passes through the centre of the lifting lug.

2a. **UCD224 Only**

   Remove 6 bolts holding the adaptor at the drive end. It may be preferred to sling the adaptor on a hoist.

3. **UCI224, UCI274, UCM224, UCM274, UCD274 Only**

   Tap the adaptor away from stator bar adaptor ring.

3a. **UCD224 Only**

   Tap the adaptor away from stator bar assembly.

ALL SINGLE BEARING GENERATORS

4. Ensure the rotor is supported at drive end on a sling.

5. Tap the rotor from the non-drive end to push the bearing clear of the endbracket and its position within an 'O' ring.

6. Continue to push the rotor out of the stator bore, gradually working the sling along the rotor as it is withdrawn, to ensure that it is fully supported at all times.

Replacement of rotor assemblies is a reversal of the procedures above.

Before commencing re-assembly, components should be checked for damage and bearing(s) examined for loss of grease.

Fitting of new bearing(s) is recommended during major overhaul.

Before replacement of a single bearing rotor assembly, check that the drive discs are not damaged, cracked or showing other signs of fatigue. Also check that the holes in the discs for drive fixing screws are not elongated.

Damaged or worn components must be replaced.

Caution !	**When major components have been replaced, ensure that all covers and guards are securely fitted, before the generator is put into service.**

7.6 RETURNING TO SERVICE

After rectification of any faults found, remove all test connections and reconnect all control system leads.
Restart the set and adjust VOLTS control potentiometer on AVR controlled generators by slowly turning clockwise until rated voltage is obtained.

Refit all terminal box covers/access covers and reconnect heater supply.

Caution !	**Failure to refit all guards, access covers and terminal box covers can result in personal injury of death.**

SECTION 8

SPARES AND AFTER SALES SERVICE

8.1 RECOMMENDED SPARES

Service parts are conveniently packaged for easy identification. Genuine parts may be recognised by the Nupart name.

We recommend the following for Service and Maintenance. In critical applications a set of these service spares should be held with the generator.

AVR Controlled Generators

1.	Diode Set (6 diodes with surge suppressor)		**RSK**	**2001**
2.	AVR SX440		**E000**	**24030**
	AVR SX460		**E000**	**24602**
	AVR SX421		**E000**	**24210**
	AVR MX321		**E000**	**23212**
	AVR MX341		**E000**	**23410**
3.	Non drive end Bearing	**UC22**	**051**	**01032**
		UC27	**051**	**01049**
4.	Drive end Bearing	**UC22**	**051**	**01044**
		UC27	**051**	**01050**

Transformer Controlled Generators (UC22 Only)

1.	Diode Set (6 diodes with surge suppressor)		**RSK**	**2001**
2.	Diode Assembly		**E000**	**22006**
3.	Non drive end Bearing	**UC22**	**051**	**01032**
4.	Drive end Bearing	**UC22**	**051**	**01044**

When ordering parts the machine serial number or machine identity number and type should be quoted, together with the part description. For location of these numbers see paragraph 1.3.

Orders and enquiries for parts should be addressed to:

Newage International Limited
Nupart Department
PO Box 17, Barnack Road
STAMFORD
Lincolnshire
PE9 2NB
ENGLAND

Telephone: 44 (0) 1780 484000
Fax: 44 (0) 1780 766074

Or any of our subsidiary companies listed on the back cover.

8.2 AFTER SALES SERVICE

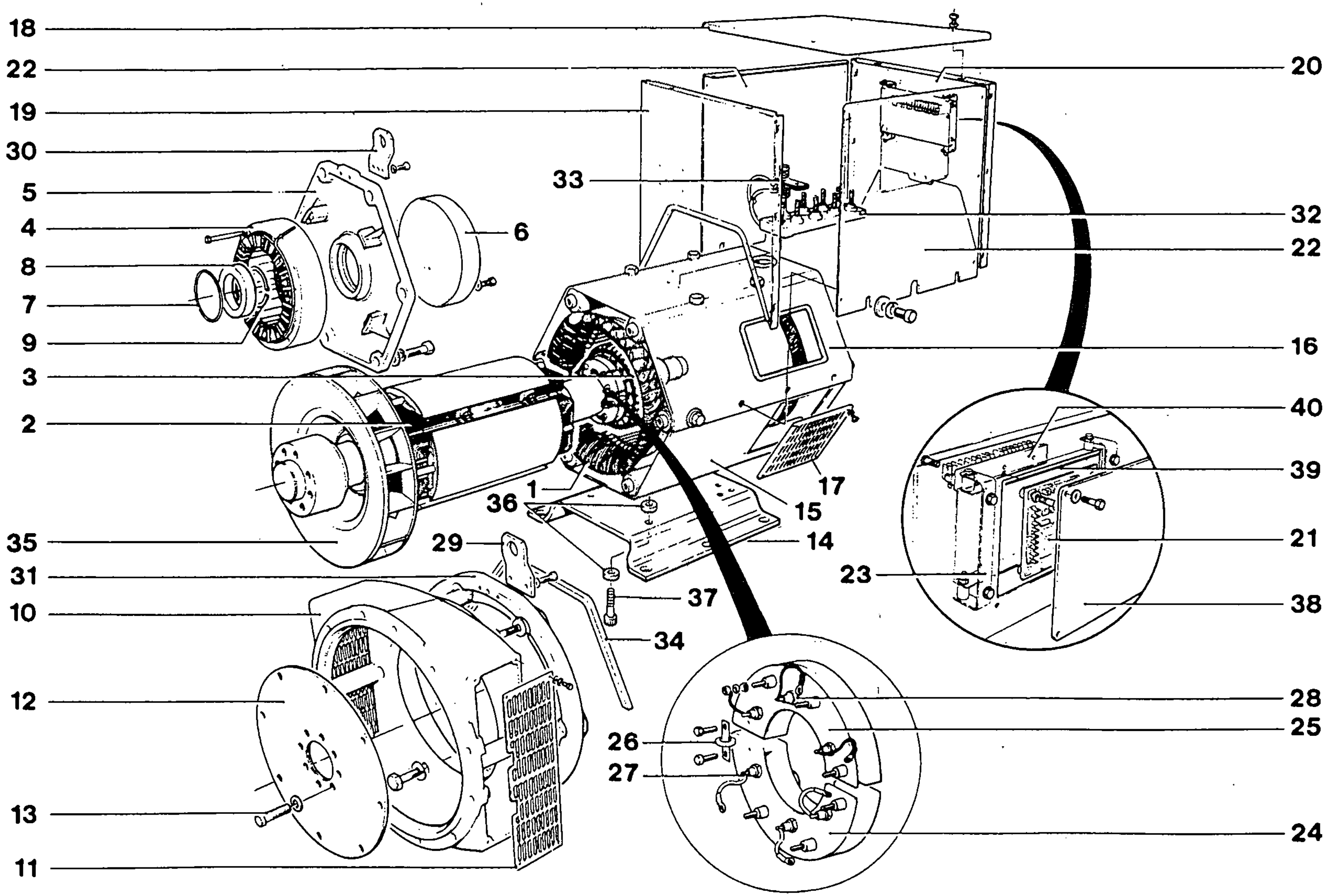
A full technical advice and on-site service facility is available from our Service Department at Stamford or through our Subsidiary Companies. A repair facility is also available at our Stamford Works.

PARTS LIST
TYPICAL SINGLE BEARING GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode - Forward Polarity
4	Exciter Stator	28	Diode - Reverse Polarity
5	N.D.E. Bracket	29	Lifting Lug - D.E.
6	Cover N.D.E.	30	Lifting Lug - N.D.E.
7	Bearing 'O' Ring N.D.E.	31	Frame to Endbracket Adaptor Ring
8	Bearing N.D.E.	32	Main Terminal Panel
9	Bearing Circlip N.D.E.	33	Terminal Link
10	D.E. Bracket/Engine Adaptor	34	Edging Strip
11	D.E. Screen	35	Fan
12	Coupling Disc	36	Foot Mounting Spacer
13	Coupling Bolt	37	Cap Screw
14	Foot	38	AVR Access Cover
15	Frame Cover Bottom	39	AVR Anti-Vibration Mounting Assembly
16	Frame Cover Top	40	Auxiliary Terminal Assembly
17	Air Inlet Cover		
18	Terminal Box Lid		
19	Endpanel D.E.		
20	Endpanel N.D.E.		
21	AVR		
22	Side Panel		
23	AVR Mounting Bracket		
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End
PMG	Permanent Magnet Generator
AVR	Automatic Voltage Regulator

Fig. 11.
TYPICAL SINGLE BEARING GENERATOR



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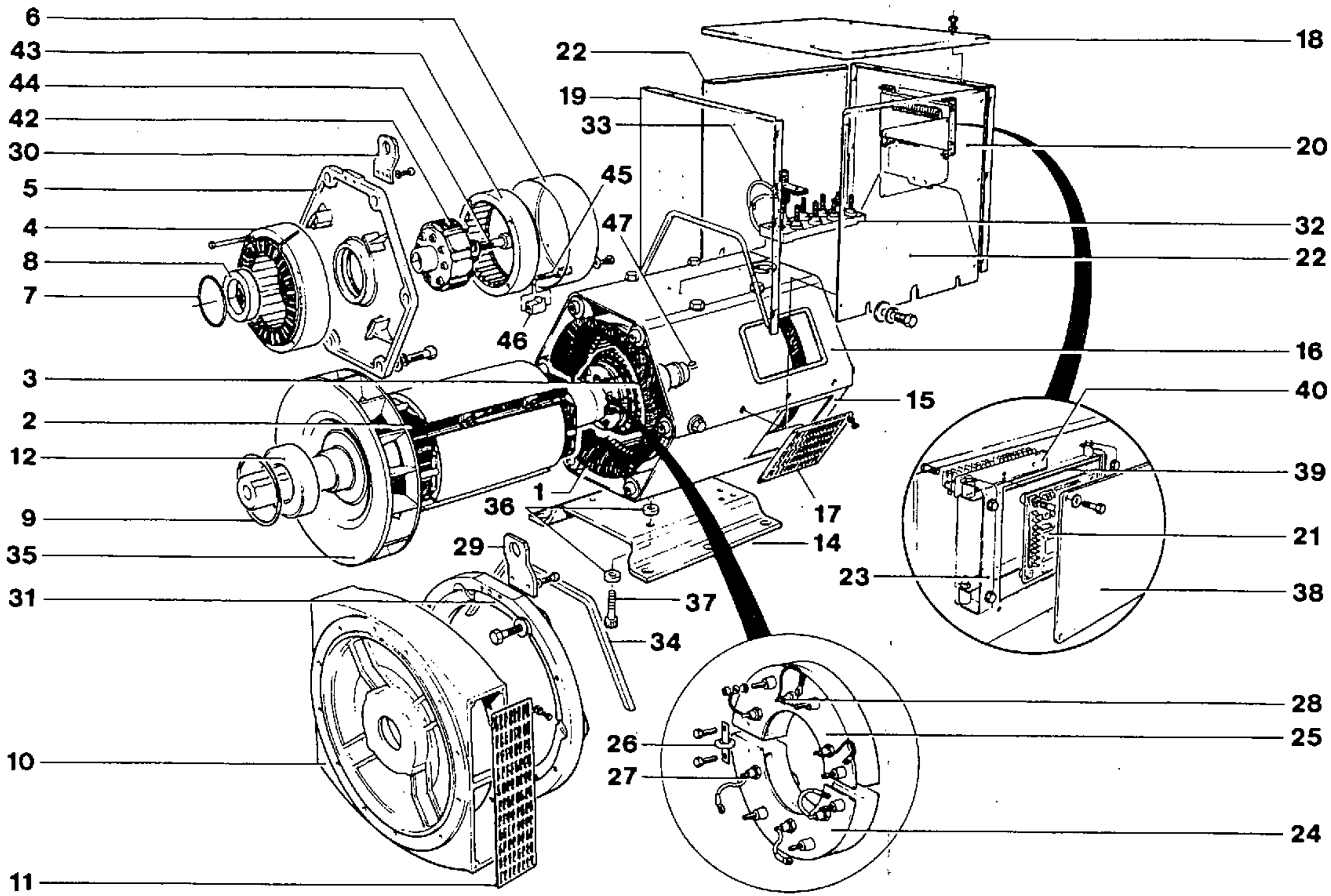
PARTS LIST
TYPICAL TWO BEARING GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode - Forward Polarity
4	Exciter Stator	28	Diode - Reverse Polarity
5	N.D.E. Bracket	29	Lifting Lug - D.E.
6	Cover N.D.E.	30	Lifting Lug - N.D.E.
7	Bearing 'O' Ring N.D.E.	31	Frame to Endbracket Adaptor Ring
8	Bearing N.D.E.	32	Main Terminal Panel
9	Bearing Wave Washer D.E.	33	Terminal Link
10	D.E. Bracket	34	Edging Strip
11	D.E. Screen	35	Fan
12	Bearing D.E.	36	Foot Mounting Spacer
14	Foot	37	Cap Screw
15	Frame Cover Bottom	38	AVR Access Cover
16	Frame Cover Top	39	AVR Anti-Vibration Mount
17	Air Inlet Cover	40	Auxiliary Terminal Assembly
18	Terminal Box Lid	42	PMG Exciter Rotor
19	Endpanel D.E.	43	PMG Exciter Stator
20	Endpanel N.D.E.	44	PMG Bolt
21	AVR	45	PMG Pillar
22	Side Panel	46	PMG Clamp
23	AVR Mounting Bracket	47	PMG Dowel
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End
PMG	Permanent Magnet Generator
AVR	Automatic Voltage Regulator

Fig. 12.
TYPICAL TWO BEARING GENERATOR



PARTS LIST
TYPICAL TWO BEARING (SERIES 5) GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode - Forward Polarity
4	Exciter Stator	28	Diode - Reverse Polarity
5	N.D.E. Bracket	29	Lifting Lug - D.E.
6	Cover N.D.E.	30	Lifting Lug - N.D.E.
7	Bearing 'O' Ring N.D.E.	31	Frame to Endbracket Adaptor Ring
8	Bearing N.D.E.	32	Main Terminal Panel
9	Bearing Wave Washer D.E.	33	Terminal Link
10	D.E. Bracket	34	Edging Strip
11	D.E. Screen	35	Fan
12	Bearing D.E.	36	Foot Mounting Spacer
13		37	Cap Screw
14	Foot		
15	Frame Cover Bottom		
16	Frame Cover Top		
17	Air Inlet Cover		
18	Terminal Box Lid		
19	Endpanel D.E.		
20	Endpanel N.D.E.		
21	Series 5 Control Gear		
22	Side Panel		
23			
24	Main Rectifier Assembly - Forward		

N.D.E. Non Drive End
D.E. Drive End

Fig. 13.
TYPICAL TWO BEARING (SERIES 5) GENERATOR

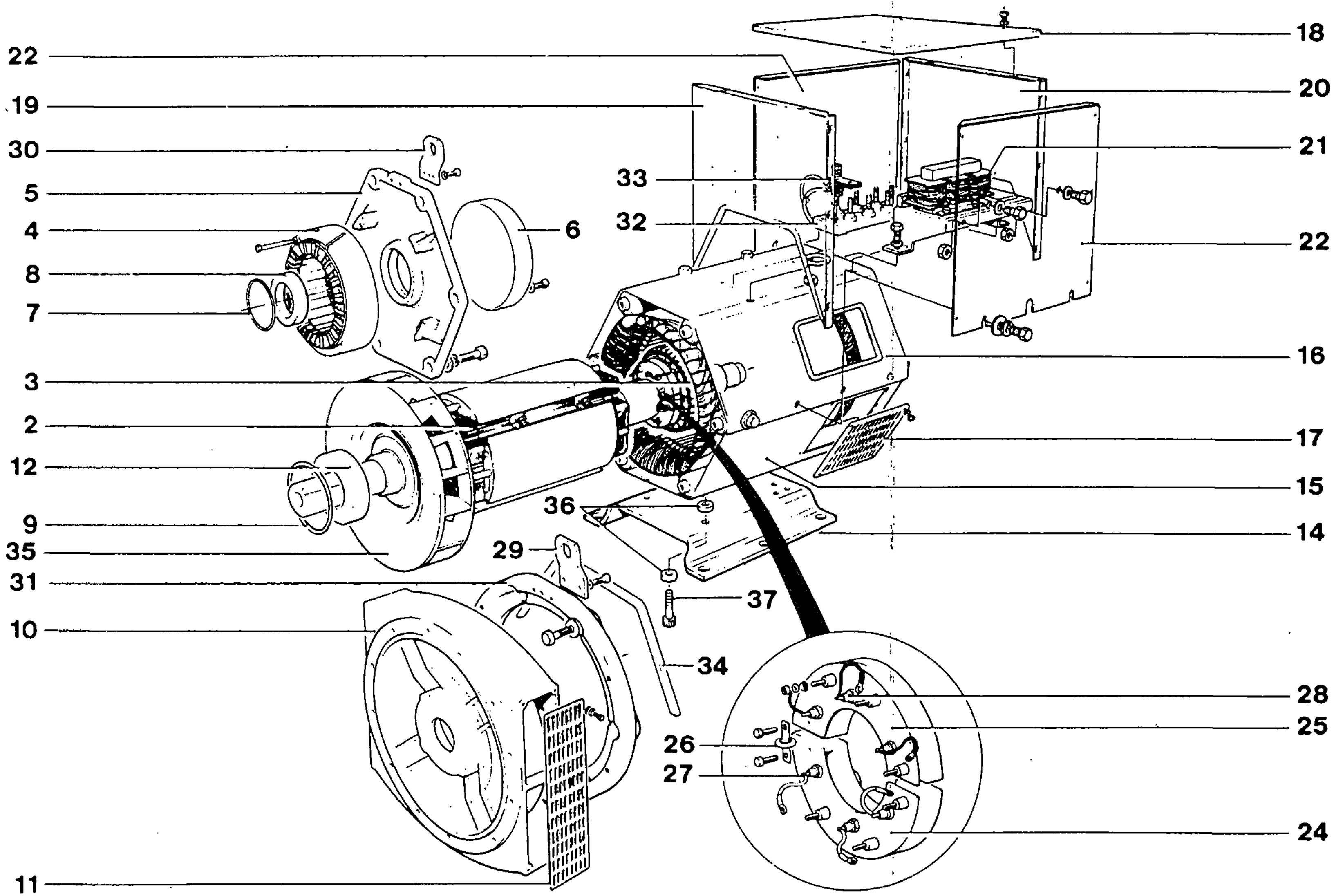


Fig. 14.
ROTATING RECTIFIER ASSEMBLY

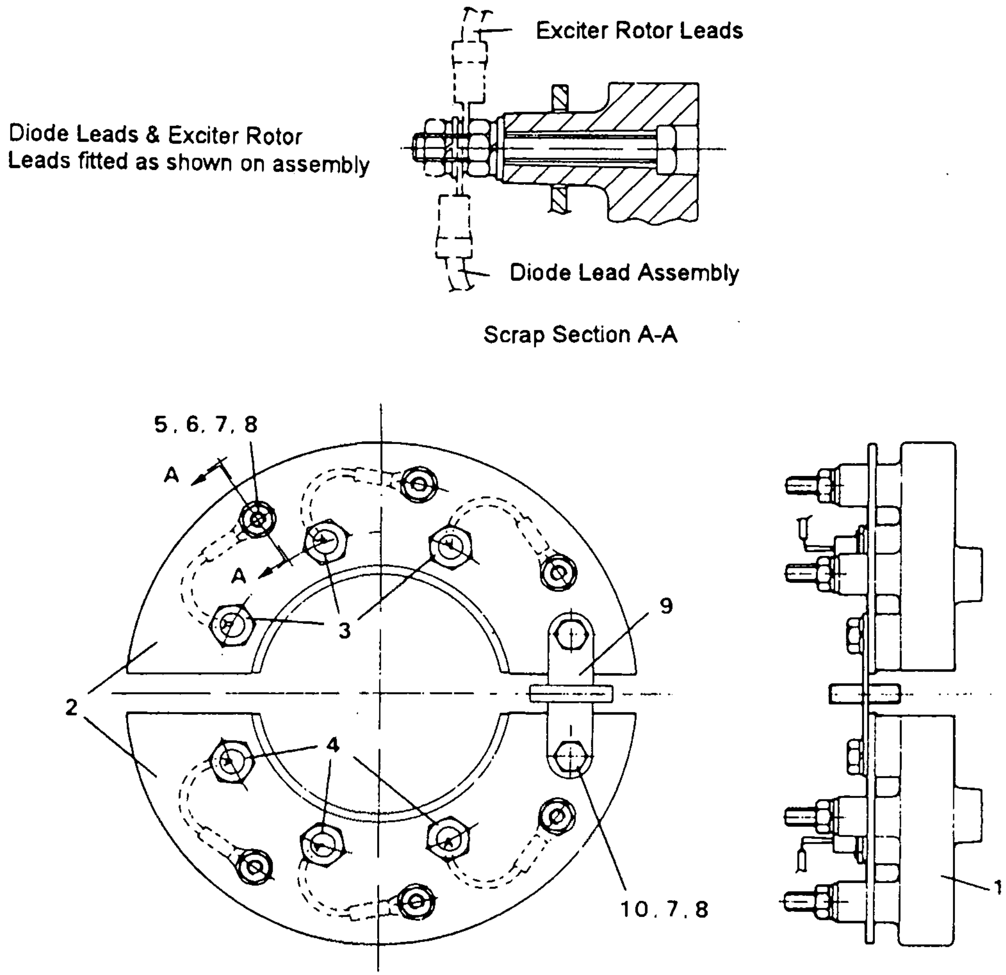


Plate Ref.	Description	Qty
1	Hub	1
2	Fin	2
3	Diode (fwd)	3
4	Diode (rev)	3
5	Hx. Screw	6
6	Hx. Nut	6
7	Pl. Washer	8
8	SC. L/Washer	8
9	Varistor	1
10	Hx. Screw	2

NOTES:
Fitting of Diodes.

1. Underside of diodes to be smeared with Midland Silicone 'Heat Sink' compound type MS2623. This compound **must not** be applied to the diode threads.
2. Diodes to be tightened to a torque of 2.03 - 2.37 Nm.
3. For Nupart rectifier service kit see page 28.

This manual is available in the following languages on request:
English, French, German, Italian and Spanish.

Denne manual er til rådighed på følgende sprog: engelsk, fransk, tysk, italiensk og spansk.

Denne håndboken er tilgjengelig på de følgende språkene: engelsk, fransk, tysk, italiensk og spansk.

Sur simple demande, ce manuel vous sera fourni dans l'une des langues suivantes: anglais, français, allemand, italien, espagnol.

Dieses Handbuch ist auf Anfrage in den folgenden Sprachen erhältlich: Englisch, Französisch, Deutsch, Italienisch, Spanisch.

Deze handleiding is op verzoek leverbaar in de volgende talen: Engels, Frans, Duits, Italiaans, Spaans.

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A.C. GENERATOR WARRANTY

WARRANTY PERIOD

A.C. Generators

In respect of a.c. generators the Warranty Period is eighteen months from the date when the goods have been notified as ready for despatch by N.I. or twelve months from the date of first commissioning (whichever is the shorter period).

DEFECTS AFTER DELIVERY

We will make good by repair or, at our option, by the supply of a replacement, any fault which under proper use appears in the goods within the period specified on Clause 12, and is found on examination by us to be solely due to defective material and workmanship; provided that the defective part is promptly returned, carriage paid, with all identification numbers and marks intact, or our works or, if appropriate to the Dealer who supplied the goods.

Any part repaired or replaced, under warranty, will be returned by N.I. free of charge (via sea freight if outside the UK).

We shall not be liable for any expenses which may be incurred in removing or replacing any part sent to us for inspection or in fitting any replacement supplied by us. We shall be under no liability for defects in any goods which have not been properly installed in accordance with N.I. recommended installation practices as detailed in the publications 'N.I. Installation, Service and Maintenance Manual' and 'N.I. Application Guidelines', or which have been improperly stored or which have been repaired, adjusted or altered by any person except ourselves or our authorised agents, or in any second-hand goods, proprietary articles or goods not of our own manufacture although supplied by us, such articles and goods being covered by the warranty (if any) given by the separate manufacturers.

Any claim under this clause must contain fully particulars of the alleged defect, the description of the goods, the date of purchase, and the name and address of the Vendor, the Serial Number (as shown on the manufacturers identification plate) or for Spares the order reference under which the goods were supplied.

Our judgement in all cases of claims shall be final and conclusive and the claimant shall accept our decision on all questions as to defects and the exchange of a part or parts.

Our liability shall be fully discharged by either repair or replacement as above, and in any event shall not exceed the current list price of the defective goods.

Our liability under this clause shall be in lieu of any warranty or condition implied by law as to the quality or fitness for any particular purpose of the goods, and save as expressly provided in this clause we shall not be under any liability, whether in contract, tort or otherwise, in respect of defects in goods delivered or for any injury, damages or loss resulting from such defects or from any work undone in connection therewith.

MACHINE SERIAL NUMBER

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LINCOLNSHIRE
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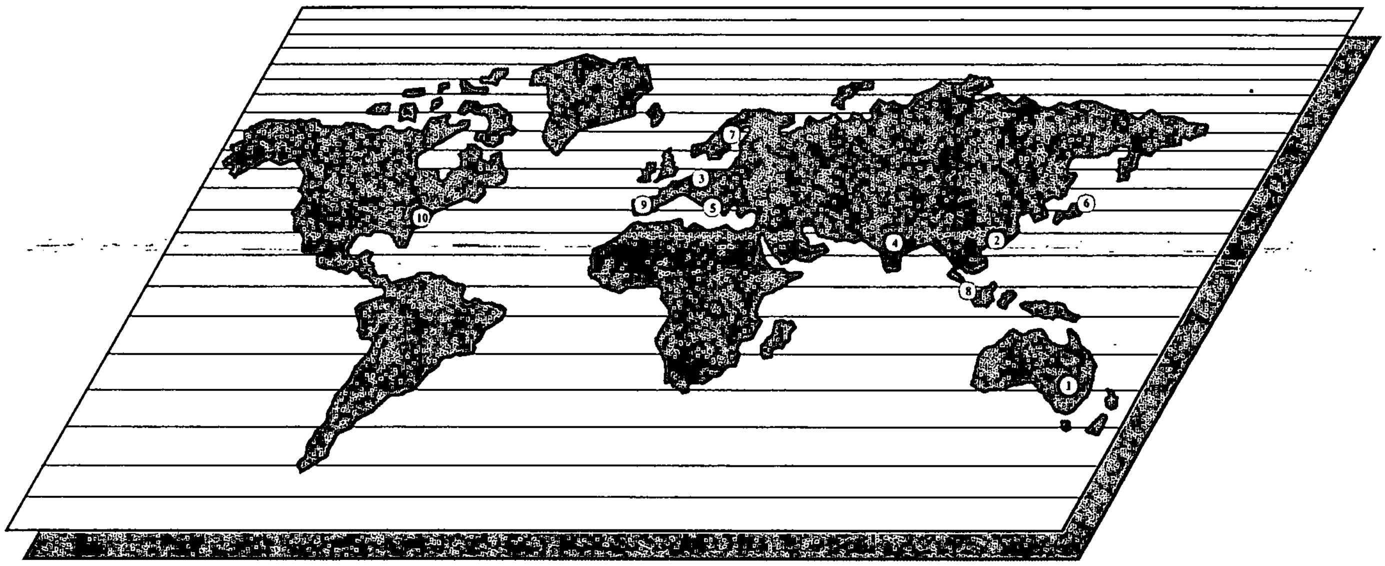
Fax: 44 (0) 1780 484100
Web site: www.newagestamford.com

SUBSIDIARY COMPANIES



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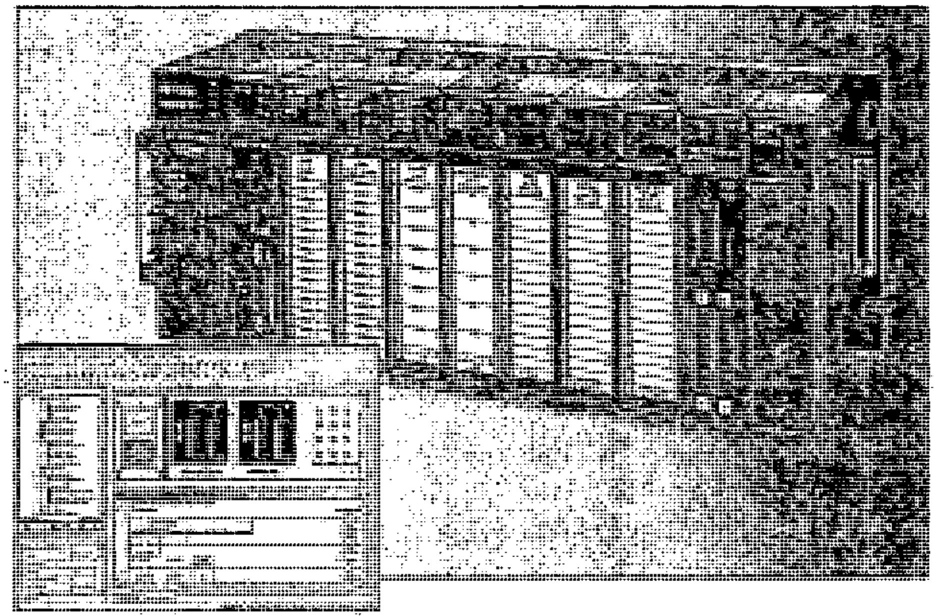
FANUC

GE Fanuc Automation

Series 90™-30 PLCs

The Series 90™-30 PLCs are a family of controllers, I/O systems and specialty modules designed to meet the demand for versatile industrial solutions. With its single overall control architecture, the Series 90-30 has been the PLC of record in over 200,000 applications, such as high-speed packaging, material handling, complex motion control, ~~water~~ treatment, continuous emissions monitoring, mining, food processing, elevator control, injection molding and many more.



Thanks to its modular design, the Series 90-30 offers unmatched versatility. Configure just the system you need, saving critical space and reducing cost.

With over 100 I/O modules, the Series 90-30 PLC can be adapted to a wide range of applications.

- Digital interfaces for push buttons, switches, proximity sensors, relays, contactors and many other devices
- Analog modules with varying degrees of resolution for flow, temperature or pressure applications
- Direct connect wiring or remote termination
- Local or remote I/O systems

Series 90-30 Ethernet communications provide a real-time link between the plant floor and the boardroom. You can begin with an Ethernet-enabled CPU, or at a later date, choose from our selection of rack-mounted Ethernet modules. The Series 90-30 Ethernet module supports both SRTP and Modbus TCP/IP application protocols.

The scaleable processing power in the Series 90-30 CPU creates a clear upgrade path. Create the system that's ideal today, while leaving open the option of creating a more powerful system tomorrow — without having to change your application software.

Motion control integrated into the Series 90-30 fosters high performance point-to-point applications.

A variety of Series 90-30 field bus interfaces enables distributed control and/or I/O. Choose from Ethernet EGD, Profibus-DP™, Genius®, DeviceNet™ and Interbus-S™ modules. Field Bus interface modules are easy to install and quick to configure. Plug them into an existing system or design a new system around them.

Ease of programming is a strong suit of the Series 90-30. Choose the programming options that meet your needs: Windows®-based IEC programming, advanced C or State Logic®. Floating point math, PID, indirect addressing, array moves and sequencing are just a few of the over 200 instructions available.

The Series 90-30 stands out among small controls for offering redundancy options. The Series 90-30 is the low-cost solution for high availability applications, with redundant CPUs and power supplies.

Easy trouble shooting and machine setup using a handheld PDA. CIMPLICITY® Machine Edition Logic Developer PDA software allows you to interface a Palm® handheld device to your Series 90-30 controller. With Logic Developer PDA, you can monitor/change data, view diagnostics, force ON/OFF, and configure machine setup — saving you time and increasing productivity.

Ordering Information

Description	Catalog Number		Catalog Number	
Discrete Input Modules	IC693MDL230	120 VAC Isolated Input (8 Points)	IC693MDL646	24 VDC Input, Neg/Pos Logic, 1 msec Filter (16 Points)
	IC693MDL231	240 VAC Isolated Input (8 Points)	IC693MDL648	48 VDC Input, Neg/Pos Logic, 1 msec filter, Neg/Pos Logic (16 Points)
	IC693MDL240	120 VAC Input (16 Points)	IC693MDL653	24 VDC Input, Neg/Pos Logic, 2msec Filter (32 Points)
	IC693MDL241	24 VAC/VDC Input (16 Points)	IC693MDL654	5/12 VDC (TTL) Input, Neg/Pos Logic, (32 Points)
	IC693MDL632	125 VDC Input (8 Points)	IC693MDL655	24 VDC Input, Neg/Pos Logic, 1 ms, (32 Points)
	IC693MDL634	24 VDC Input, Neg/Pos Logic (8 Points)	IC693ACC300	Input Simulator Module (8 Points)
	IC693MDL645	24 VDC Input, Neg/Pos Logic (16 Points)		
Discrete Output Modules	IC693MDL310	120 VAC Output, 0.5 Amp (12 Points)	IC693MDL740	12/24 VDC Output, 0.5 Amp, Positive Logic (16 Points)
	IC693MDL330	120/240 VAC Output, 2 Amp (8 Points)	IC693MDL741	12/24 VDC Output, 0.5 Amp, Negative Logic (16 Points)
	IC693MDL340	120 VAC Output, 0.5 Amp (16 Points)	IC693MDL742	12/24 VDC Output, 1 Amp, Positive Logic (16 Points), Fused
	IC693MDL390	120/240 VAC Isolated Output, 2 Amp (5 Points)	IC693MDL748	48 VDC Output, 0.5 Amps, Positive Logic (8 Points)
	IC693MDL730	12/24 VDC Output, 2 Amp, Positive Logic (8 Points)	IC693MDL750	12/24 VDC Output, Negative Logic (32 Points)
	IC693MDL731	12/24 VDC Output, 2 Amp, Negative Logic (8 Points)	IC693MDL751	12/24 VDC Output, Positive Logic (32 Points)
	IC693MDL732	12/24 VDC Output, 0.5 Amp, Positive Logic (8 Points)	IC693MDL752	5/12/24 VDC (TTL) Output, Negative Logic, (32 Points)
	IC693MDL733	12/24 VDC Output, 0.5 Amp, Negative Logic (8 Points)	IC693MDL753	12/24 VDC Output, Positive Logic (32 Points)
	IC693MDL734	125 VDC Output, (6 Points)		
Relay Output Module	IC693MDL930	Relay Output, Isolated, 4 Amp (8 Points)	IC693MDL940	Relay Output, 2 Amp (16 Points)
	IC693MDL931	Relay Output, 8 Amp Form B/C contacts, Isolated in 2 Groups of 4 (8 Points)		
Mixed Discrete Module	IC693MDR390	Mixed I/O, 24 VDC Input (8 points), Relay Output (8 points)	IC693MAR590	Mixed I/O, 120 VAC Input (8 Points), Relay Output (8 Points)
Analog Input Modules	IC693ALG220	Analog Input, Voltage/Current, 4 Channels	IC693ALG222	Analog Input, Voltage 16 Single/8 Differential Channels
	IC693ALG221	Analog Input, Current, 4 Channels	IC693ALG223	Analog Input, Current, 16 Single Channels
Analog Output Modules	IC693ALG390	Analog Output, Voltage, 2 Channels	IC693ALG392	High Density Analog Output (8 Channels)
	IC693ALG391	Analog Output, Current, 2 Channels		
Mixed Analog Modules	IC693ALG442	Analog Combo Module 4IN/2OUT		
Motion Modules	IC693APU300	High Speed Counter (HSC)	IC693APU305	High Speed Counter with Gray Code Encoder or an A QUAD B Encoder Input
	IC693APU301	Axis Positioning Module (APM), 1 Axis	IC693DSM302	Digital Servo Motion Controller, 2 Axis
	IC693APU302	Axis Positioning Module (APM), 2 Axis	IC693DSM314	Digital Servo Motion Controller, 1-2 Axis of Digital Servo or 1-4 Axis Analog Servo
Specialty Modules	IC693MDL760	Solenoid Valve Output (11 Points)/24 VDC Output, 0.5 Amp, Positive Logic (5 Points)	IC693PTM101	Power Transducer Module, CT and PT Interface 120/240 VAC (1m cable)
	IC693PCM301	Programmable Coprocessor Module, 192 KB (47 KB Basic or C Program), 2 Serial Ports	IC693TCM302	Temperature Control Module, (8) TC In and (8) 24 VDC Solid State Outputs
	IC693PCM311	Programmable Coprocessor Module, 640 KB (640 KB Basic or C Program), 2 Serial Ports	IC693TCM303	Temperature Control Module Extended Temperature Range, (8) TC In and (8) 24 VDC Solid State Outputs
	IC693PTM100	Power Transducer Module, CT and PT Interface 120/240 VAC (0.5m Cable)		
Communications Modules	IC693BEM331	Genius Bus Controller (Supports I/O and Datagrams)	IC693PBM200	Profibus DP Master Module
	IC693CMM302	Communication Module, Genius (1 Kbyte) GCM+ (No Datagram Support)	IC693PBM201	Profibus DP Slave Module
	IC693CMM311	Communications Module, CCM, RTU, SNP, and SNPx Protocols	IC693DNM200	DeviceNet Master Module
	IC693CMM321	Ethernet Interface TCP/IP Module, 10Mbs (Supports SRTP and Modbus TCP/IP, No EGD)	IC693DNS201	DeviceNet Slave Module
Controllers	IC693CPU311	5-Slot Base with CPU in Base (6KBytes User Program), Not Expandable	IC693CPU360	CPU 360 Module (240KBytes Configurable User Memory, 4K I/O, 8 Racks), No Built-In Serial Ports, Logic Execution is .22msec/K
	IC693CPU313	5-Slot Base with Turbo CPU in Base (Logic Execution is .6 msec), 1K Registers, (12KBytes User Program), Not Expandable	IC693CPU363	CPU 363 Module (240KBytes Configurable User Memory 4K I/O, 8 Racks), 2 Built-In Serial Ports, Logic Execution is .22msec/K
	IC693CPU323	10-Slot Base with Turbo CPU in Base (Logic Execution is .6 msec) 12Kbytes User Program, Not Expandable	IC693CPU364	CPU 364 Module (240KBytes Configurable User Memory 4K I/O, 8 Racks), No Built-In Serial Ports, Built-In 10Mbs Ethernet, Supports SRTP, Channels and EGD, Logic Execution is .22msec/K
	IC693CPU350	CPU 350 Module (32KBytes User Memory, 4K I/O, 8 Racks), No Built-In Serial Ports, Logic Execution is .22msec/K	IC693CPU374	CPU 374 Module (240KBytes Configurable User Memory), No Built-In Serial Ports, Built-In 10/100Mbs with Built-In Switch, Ethernet Supports SRTP, EGD and No Channel Support; Logic Execution is .22msec/K.
Backplanes	IC693CHS391	Base, CPU, 10 Slots, Use with CPU331/CSE331 and above	IC693CHS397	Base, CPU, 5 Slots (use with CPU331/CSE331 and above)
	IC693CHS392	Base, Expansion, 10 Slots	IC693CHS398	Base, Expansion, 5 Slots
	IC693CHS393	Base, Remote Expansion, 10 Slots (700 ft.)	IC693CHS399	Base, Remote Expansion, 5 Slots (700 ft.)
Power Supplies	IC693PWR321	Power Supply, 120/240 VAC, 125 VDC, Standard, 30 Watts	IC693PWR332	Power Supply, 12 VDC, High Capacity, 30 Watts
	IC693PWR322	Power Supply, 24/48 VDC, Standard, 30 Watts	IC693ACC340	Redundant Power Supply Base (RPSB) with 0.1 meter cable to connect to Power Supply Adapter Module
	IC693PWR328	Power Supply, 48 VDC, Standard, 30 Watts	IC693ACC341	Redundant Power Supply Base with 0.5 meter cable to connect to Power Supply Adapter Module
	IC693PWR330	Power Supply, 120/240 VAC, 125 VDC, High Capacity, 30 Watts	IC693ACC350	Redundant Power Supply Adapter (RPSA) Module: The RPSA replaces the power supply on a CPU base or expansion base and connects to a Redundant Power Supply Base.
	IC693PWR331	Power Supply, 24 VDC, High Capacity, 30 Watts		
Accessories	IC693ACC301	Replacement Battery, CPU & PCM (Qty. 2)	IC693CBL301	Rack to Rack Expansion Cable, 2 Meters
	IC693ACC302	High Capacity Battery Pack	IC693CBL302	Rack to Rack Expansion Cable, 15 Meters
	IC200ACC003	EZ Program Store Flash Device (for CPU374 only)	IC693CBL312	Rack to Rack Expansion Cable, 0.15 Meters, Shielded
	IC693ACC310	Filler Module, Blank Slot	IC693CBL313	Rack to Rack Expansion Cable, 8 Meters
	IC693CBL300	Rack to Rack Expansion Cable, 1 Meter	IC693CBL314	Rack to Rack Expansion Cable, 15 Meters, Shielded
Programming and Trouble Shooting Tools	IC646MPP001	Logic Developer - PLC Professional	IC646MPH101	Logic Developer PDA Software Tool with Cable Adapter
	IC646MPS001	Logic Developer - PLC Standard		

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GE Fanuc Automation Information Centers

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Additional Resources

For detailed technical specifications and product ordering information, please visit the GE Fanuc e-catalog at:

www.gefanuc.com

GFA-148J
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GE FANUC

GE Fanuc Automation

Programmable Control Products

Series 90™-30 PLC
Installation and Hardware Manual

GFK-0356Q

August 2002

GFL-002

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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Alarm Master	Field Control	Modelmaster	Series 90
CIMPLICITY	GEnet	Motion Mate	Series One
CIMPLICITY Control	Genius	PowerMotion	Series Six
CIMPLICITY PowerTRAC	Genius PowerTRAC	ProLoop	Series Three
CIMPLICITY 90-ADS	Helpmate	PROMACRO	VuMaster
CIMSTAR	Logicmaster	Series Five	Workmaster

RFI Standards

The Series 90-30 PLC and its associated modules have been tested and found to meet or exceed the requirements of FCC Rule, Part 15, Subpart J. The Federal Communications Commission (FCC) requires the following note to be published according to FCC guidelines.

NOTE

This equipment generates, uses, and can radiate radio frequency energy and if not installed in accordance with this instruction manual, may cause harmful interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules, which are designed to provide reasonable protection against harmful interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

The following note is required to be published by the Canadian Department of Communications.

NOTE

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

The following statements are required to appear in the *Series 90_-30 Installation Manual* and the *Series 90_-30 I/O Specifications Manual* for Class I Div 2 Hazardous Locations.

1. EQUIPMENT LABELED WITH REFERENCE TO CLASS I, GROUPS A, B, C, and D, DIV. 2 HAZARDOUS LOCATIONS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.
2. WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2:
3. WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
4. ALL UNUSED SLOTS IN ALL BASEPLATES MUST BE POPULATED WITH FILLER MODULES, IC693ACC310, OR EQUIVALENT.

Preface

This manual describes the GE Fanuc Series 90-30 Programmable Logic Controller (PLC). It contains a description of hardware components and provides basic hardware installation procedures. The Series 90-30 PLC is a member of the Series 90_ family of Programmable Logic Controllers from GE Fanuc.

For a list of product standards, refer to data sheet GFK-0867B or later, *GE Fanuc Approvals, Standards, General Specifications* which lists all of the standards for GE Fanuc products. Installation instructions in this manual are provided for installations that do not require special procedures for noisy or hazardous environments. For installations that must conform to more stringent requirements (such as CE Mark), see GFK-1179, *Installation Requirements for Conformance to Standards*.

What's New in This Manual

- Added the model 374 CPU, which supports connection to an Ethernet network through two built-in 10BaseT/100BaseTx auto-negotiating full-duplex Ethernet ports. Models 364 (release 9.10 and later) and 374 are the only Series 90-30 CPUs that support Ethernet Global Data. Note that the CPU374 is supported only by the Windows®-based programmers.
- Other corrections and clarifications as necessary.

Related Publications

For more information on Series 90-30 products, refer to these publications. (For a publication to product catalog number cross-reference refer to Appendix G):

GFK-0255 - Series 90™ PCM and Support Software User's Manual

GFK-0256 - MegaBasic™ Programming Reference Manual

GFK-0293 - Series 90™ -30 High Speed Counter User's Manual

GFK-0401 - Workmaster® II PLC Programming Unit Guide to Operation

GFK-0402 - Series 90™ -30 and 90-20 PLC Hand-Held Programmer User's Manual

GFK-0412 - Genius® Communications Module User's Manual

GFK-0466 - Logicmaster 90™ Series 90™ -30/20/Micro Programming Software User's Manual

GFK-0467 - Series 90™ -30/20/Micro Programmable Controllers Reference Manual

GFK-0487 - Series 90™ PCM Development Software (PCOP) User's Manual

GFK-0499 - CIMPLICITY® 90-ADS Alphanumeric Display System User's Manual

Preface

GFK-0582 - Series 90™ PLC Serial Communications User's Manual

GFK-0631 - Series 90™ -30 I/O LINK Interface User's Manual

GFK-0641 - CIMPLICITY® 90-ADS Alphanumeric Display System Reference Manual

GFK-0664 - Series 90™-30 PLC Axis Positioning Module Programmer's Manual

GFK-0685 - Series 90™ Programmable Controllers Flow Computer User's Manual

GFK-0695 - Series 90™-30 Enhanced Genius) Communications Module User's Manual

GFK-0726 - Series 90™-30 PLC State Logic Processor User's Guide

GFK-0732 - Series 90™-30 PLC ECLiPS User's Manual

GFK-0747 - Series 90™-30 PLC OnTOP User's Guide

GFK-0750 - OnTop for Series 90™-30 (State Logic) Program User's Manual

GFK-0781 - Motion Mate™ APM300 for Series 90™-30 PLC Follower Mode User's Manual

GFK-0823 - Series 90™ -30 I/O LINK Master Module User's Manual

GFK-0828 - Series 90™ -30 Diagnostic System User's Manual

GFK-0840 - Motion Mate™ APM300 for Series 90™ -30 PLC Standard Mode User's Manual

GFK-0867 - GE Fanuc Product Agency Approvals, Standards, General Specifications

GFK-0898 - Series 90™ -30 PLC I/O Module Specifications

GFK-1028 - Series 90™ -30 I/O Processor Module User's Manual

GFK-1034 - Series 90™ -30 Genius® Bus Controller User's Manual

GFK-1037 - Series 90™ -30 FIP Remote I/O Scanner User's Manual

GFK-1056 - Series 90™ -30 State Logic Control System User's Manual

GFK-1186 - TCP/IP Ethernet Communications for the Series 90_-30 PLC Station Manager Manual

GFK-1179 - Series 90™ PLC Installation Requirements for Conformance to Standards

GFK-1464 - Motion Mate DSM302 for Series 90™-30 PLCs User's Manual

GFK-1466 - Temperature Control Module for the Series 90™-30 PLC User's Manual

GFK-1541 - TCP/IP Ethernet Communications for the Series 90™ PLC User's Manual

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Chapter 1 Overview of the Series 90-30 PLC

The Series 90™-30 Programmable Logic Controller (PLC) is a member of the GE Fanuc Series 90 PLC family.

The Basic Parts of a Series 90-30 PLC

The Series 90-30 PLC is very versatile because (1) it is programmable, and (2) it is assembled from a wide variety of modular, plug-together components. Therefore, by choosing the correct components and developing an appropriate program, the PLC can be used for an almost unlimited variety of applications. Although there are many choices of individual hardware components to use in a system, there are just a few basic categories. Each of these component categories is covered in detail in a separate chapter in this manual. They are introduced in this chapter so you can see how they fit together:

- Baseplates
- Power Supplies
- CPUs
- I/O Modules
- Option Modules
- Cables

Baseplates

The baseplates are the foundation of the PLC system because most other components mount on them. As a basic minimum, every system has at least one baseplate, which usually contains the CPU (in which case, it is referred to as "the CPU Baseplate"). Many systems require more modules than can be mounted on one baseplate, so there are also Expansion and Remote baseplates that connect together. The three categories of baseplates, CPU, Expansion, and Remote, are available in two sizes, 5-slot and 10-slot, named according to the number of modules they can hold.

Power Supply Modules

Every baseplate must have its own power supply. The power supply always mounts in a baseplate's left-most slot. There are several power supply models available to meet a variety of requirements.

CPUs

The CPU is the manager of the PLC. Every PLC system must have one. A CPU uses the instructions in its firmware and application program to direct the PLC's operation and to monitor the system to make sure there are no basic faults. Some Series 90-30 CPUs are built into baseplates, but most are contained in plug-in modules. In some cases, the CPU resides in a Personal Computer using a Personal Computer Interface Card that interfaces to Series 90-30 Input, Output, and Option modules.

Input and Output (I/O) Modules

These modules enable the PLC to interface with input and output field devices such as switches, sensors, relays, and solenoids. They are available in both discrete and analog types.

Option Modules

These modules extend the capability of the PLC beyond the basic functions. These provide such things as communications and networking options, motion control, high speed counting, temperature control, interfacing to operator interface stations, etc.

Cables

These connect the PLC components together or to other systems. Many standard prefabricated cables are available from GE Fanuc. They are primarily used to:

- Interconnect baseplates
- Connect a programmer to the CPU or to an option module
- Connect option modules to field devices or other systems.

Assembling a Basic Series 90-30 PLC System

Let's assemble, on paper, a basic system using the following components:

- Baseplate
- Power Supply module
- CPU module
- Some I/O modules

We'll start with the **baseplate**. To keep it simple, we'll use a 5-slot size. Note that a 5-slot baseplate actually has six slots, but the power supply slot is not numbered. Note also, that this baseplate has a CPU slot, which is slot number 1, and it has an expansion connector on the right end, which is used for connecting to another baseplate if the system has more than one baseplate.

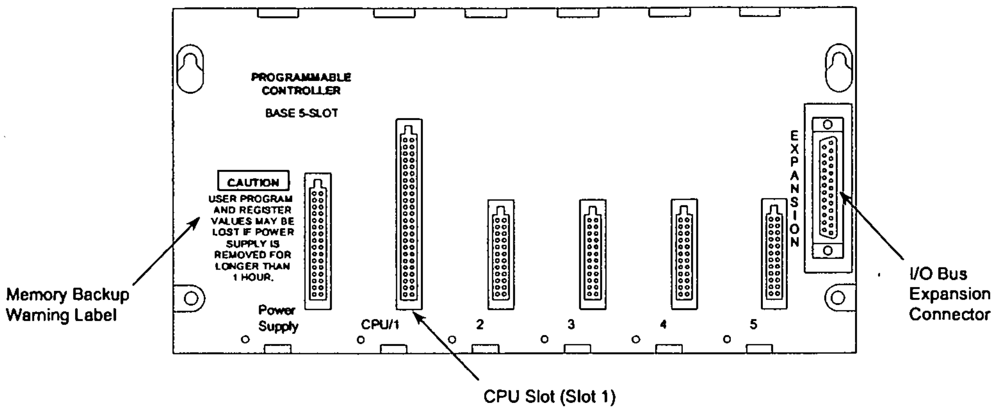


Figure 1-1. Five-Slot CPU Baseplate

Next, we'll add a **power supply** module. It mounts in the unnumbered slot on the left end of the baseplate. This slot has a unique connector that will only fit a power supply module.

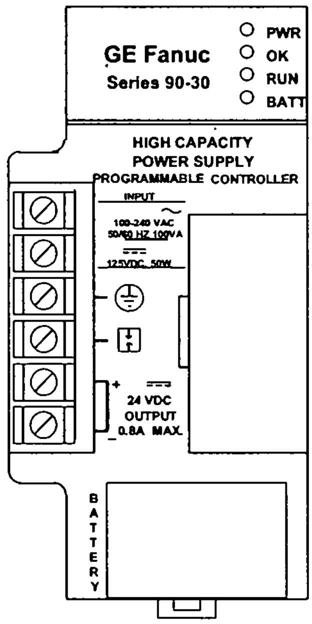


Figure 1-2. Power Supply Module

Then add a **CPU module**. A CPU module can only mount in baseplate slot 1, next to the power supply. Slot 1 has a unique connector that will only fit CPU or special Option modules.

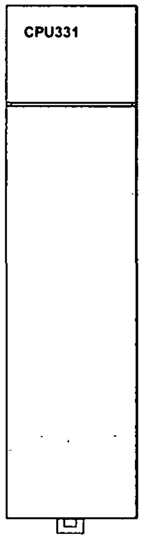


Figure 1-3. CPU Module

To finish, we will add some **I/O modules** to baseplate slots 2 through 5.

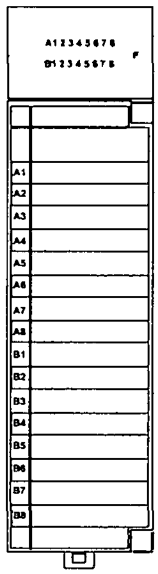


Figure 1-4. I/O Module

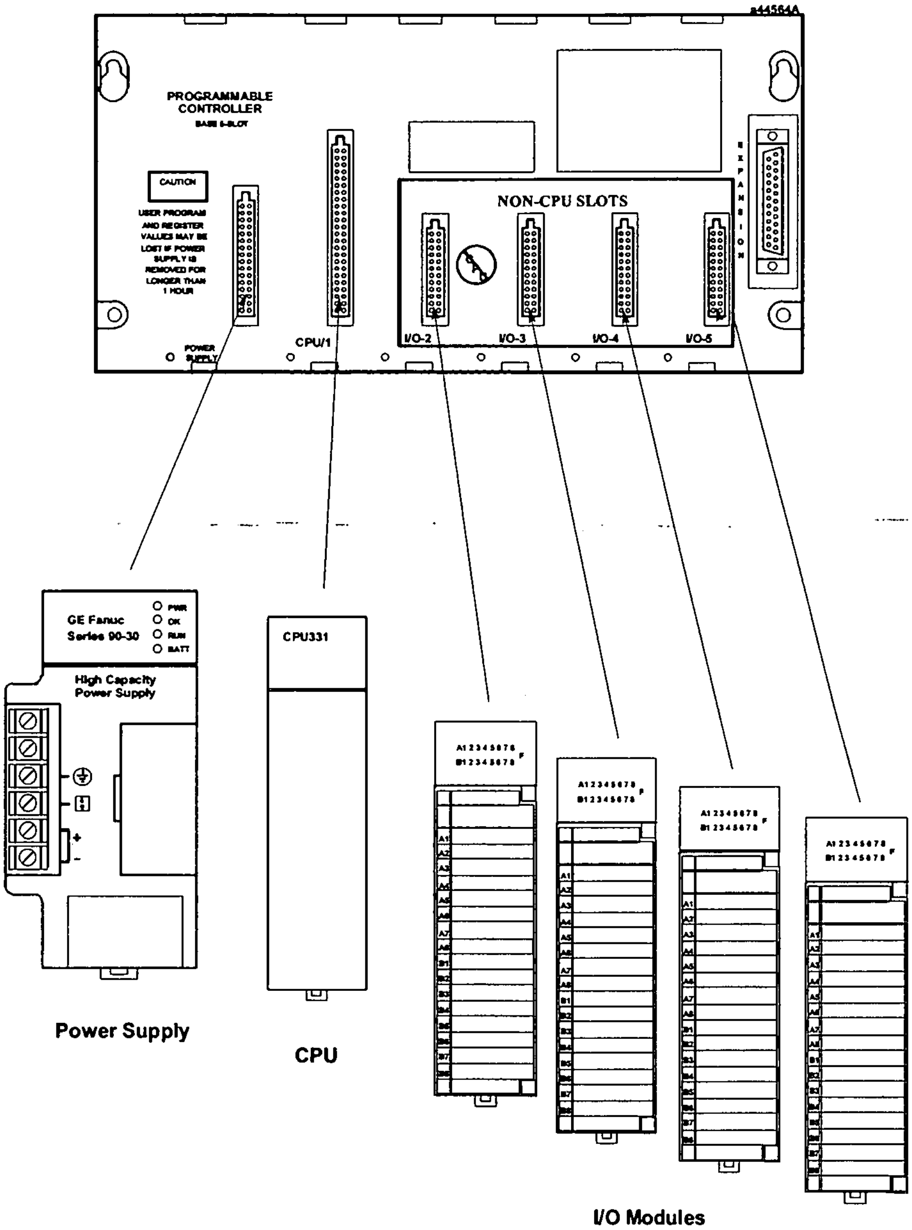


Figure 1-5. Assembling the System

When assembled, the system will look like this:

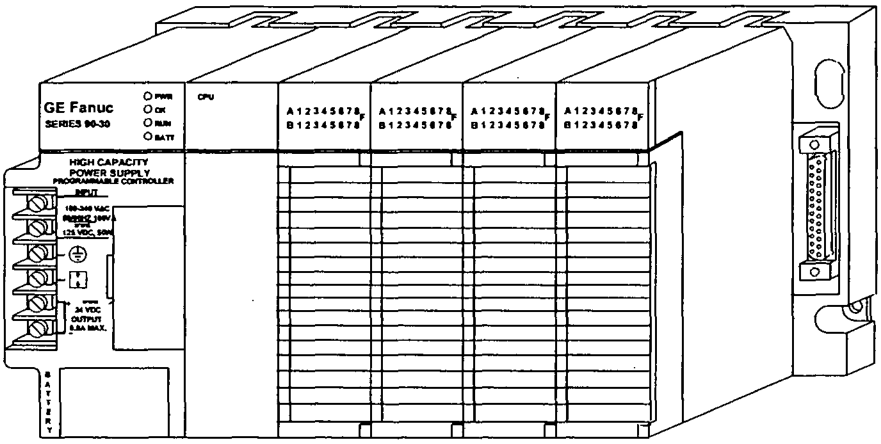


Figure 1-6. A Basic System

An assembly of baseplate and modules such as this one is called a "Rack."

What else would be needed to make this basic system functional?

To make this basic system functional, you would need:

- **Mounting.** Safe, secure mounting for the PLC in a protective enclosure.
- **Wiring.** This includes properly installed incoming power to the power supply, as well as wiring from the I/O modules to field devices such as switches, sensors, solenoids, relays, etc.
- **Program**. An application program for the PLC to run. This is developed with GE Fanuc PLC programming software.

What if the application requires more than five modules?

You could use a 10-slot baseplate, shown in the next picture:

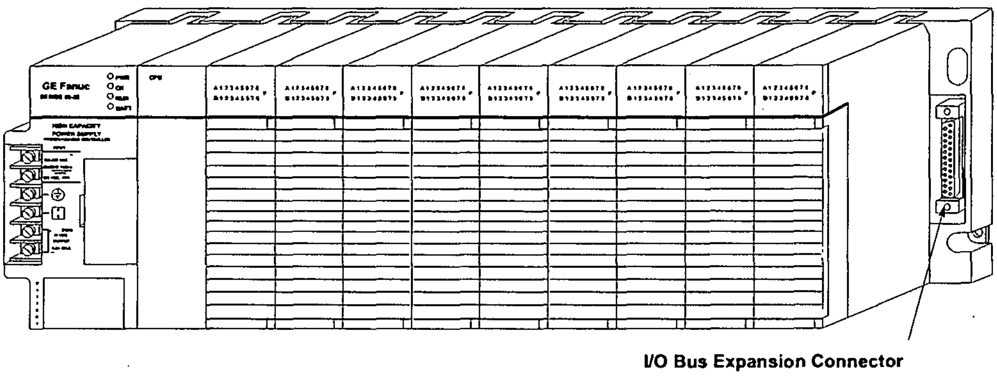


Figure 1-7. Ten-Slot Rack

What if the application requires more than ten modules?

You can add one or more Expansion or Remote racks to this system. Some CPUs can support up to seven additional racks. If you added seven additional 10-slot racks, you could have 70 more modules.

Racks are interconnected in a "daisy-chain" cabling arrangement. This interconnection system is called the "I/O Expansion Bus." The connections are made from one baseplate's I/O Bus Expansion Connector (shown in the figure above) to the next one's. The I/O Bus Expansion Cables, shown below, have a double connector on one end to facilitate these connections.

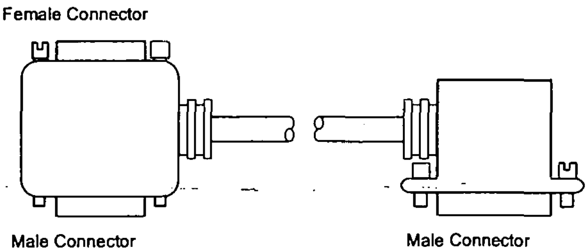


Figure 1-8. I/O Bus Expansion Cable

The next figure shows a system that has a CPU baseplate, one Expansion rack and three Remote racks. Notice that the last rack, the one at the end of the I/O Expansion Bus, must be terminated. A convenient way of terminating the bus is with an IC693ACC307 I/O Bus Terminator Plug, as shown.

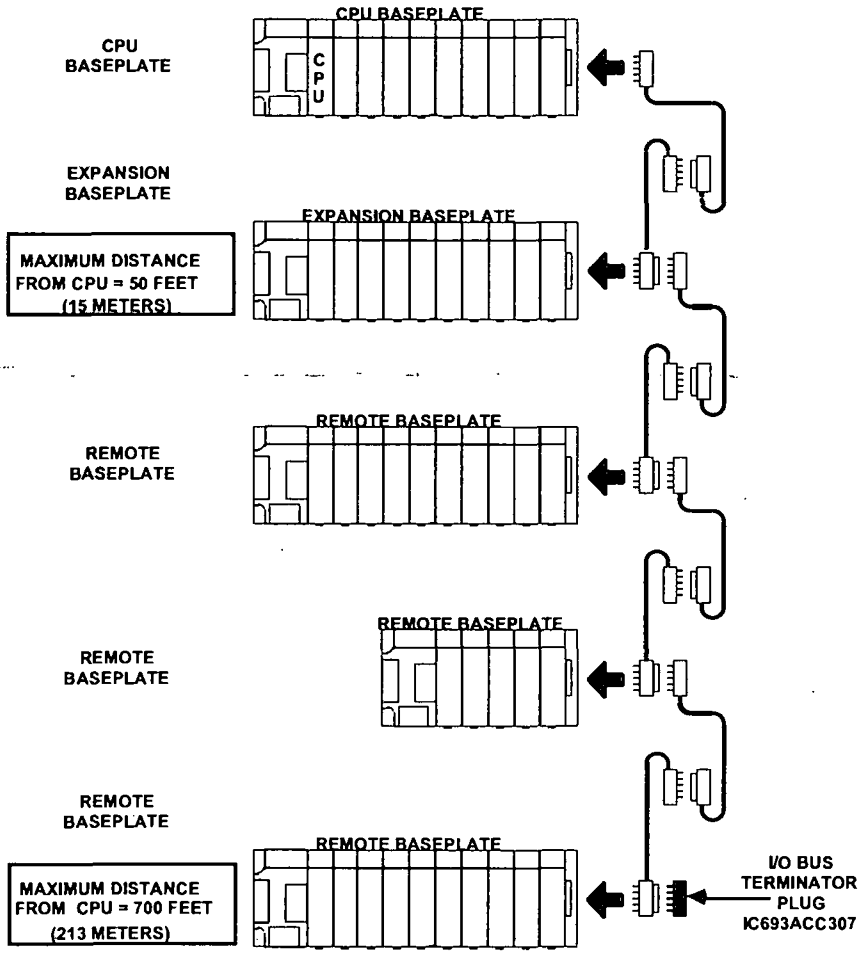


Figure 1-9. Connecting Expansion and Remote Baseplates

What is the Difference Between Expansion and Remote baseplates?

The main factor to consider is distance. How far will the baseplate be from the CPU baseplate? If the cabling distance from the CPU baseplate is 50 feet (15 meters) or less, use an Expansion baseplate. The Expansion baseplate is preferable because of its higher communication speed with the CPU baseplate. However, if a baseplate must be located where it requires a cabling distance from the CPU rack in excess of 50 feet, an Expansion baseplate will not work - a Remote baseplate must be used. The limit for a Remote baseplate is a cabling distance of 700 feet (213 meters) from the CPU baseplate to the farthest Remote baseplate.

What if I need to cover more than 700 feet (213 meters)?

You can cover much greater distances by using Series 90-30 communications option modules. For example, Genius Bus Controller Modules (GBC) can communicate at distances up to 7,500 feet (2,286 meters) over a shielded twisted-pair cable, as shown in Example 1 below. Or, serial communications with Communications Coprocessor Modules (CMM) using the RS-485 standard can cover up to 4,000 feet (1,219 meters), as shown in Example 2 below. And virtually unlimited communication distances can be attained with modems and telephone lines or radio transmitters. Also, there are numerous networking options available such as Ethernet or WorldFIP.

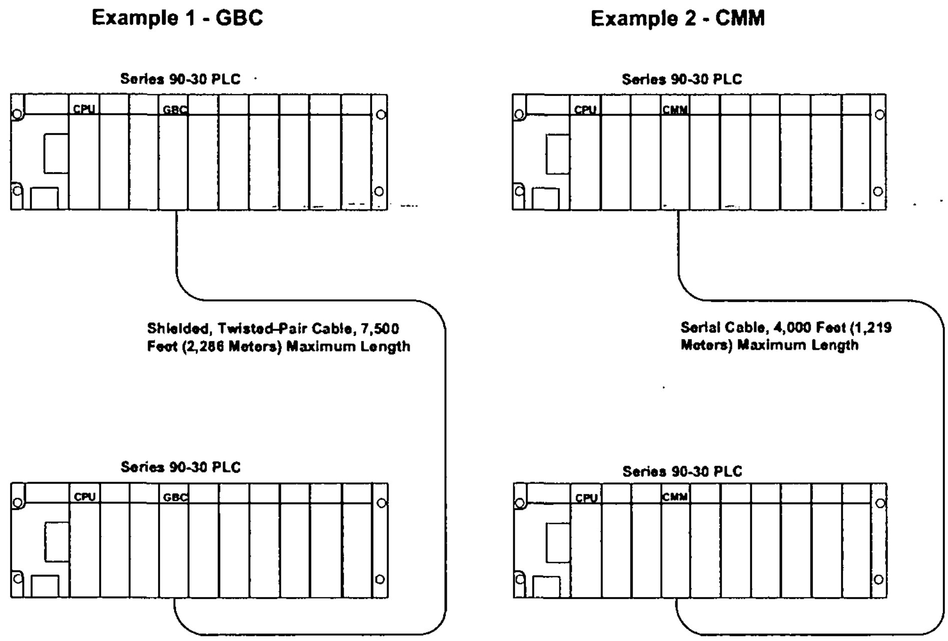


Figure 1-10. Connecting PLCs Using GBC or CMM Modules

Chapter 2 Installation

This chapter discusses installation details only. Other information about the products such as hardware descriptions and specifications, is covered in the applicable chapters.

Important Note

Series 90-30 PLCs must be mounted in a protective enclosure.

The installation instructions described in this chapter apply to PLC installations that do not require special procedures for noisy or hazardous environments. For installations that must conform to more stringent requirements (such as CE Mark), see ***GFK-1179, Installation Requirements for Conformance to Standards.*** *Also see* ***GFK-0867, GE Fanuc Product Agency Approvals, Standards, General Specifications.***

Receiving your Products - Visual Inspection

When you receive your Series 90-30 PLC system, carefully inspect all shipping containers for damage that may have occurred during shipping. If any part of the system is damaged, notify the carrier immediately. The damaged shipping container should be saved as evidence for inspection by the carrier.

As the consignee, it is your responsibility to register a claim with the carrier for damage incurred during shipment. However, GE Fanuc will fully cooperate with you if such action is necessary.

Pre-installation Check

After unpacking Series 90-30 PLC racks, cables, modules, etc., **record all serial numbers**. Serial numbers are printed on the module packaging. Serial numbers are required to make a claim during the warranty period of the equipment. All software product registration cards should be completed and returned to GE Fanuc. See "Module Features" in this chapter for location of module serial numbers. See "Common Baseplate Features" in chapter 3 for location of baseplate serial numbers.

You should verify that all components of the system have been received and that they agree with your order. If the parts received do not agree with your order, call Programmable Control Customer Service at 1-800-432-7521. A Customer Service representative will provide further instructions.

If you require assistance with your installation, GE Fanuc's Technical Support department offers expert help. Call the support number for your area from the list in Chapter 13, "Maintenance and Troubleshooting." The GE Fanuc web site support address is *www.gefanuc.com/support/plc.*

Warranty Claims

Record the serial number of the defective item and contact your distributor for instructions.

Working with Series 90-30 Modules

Module Features

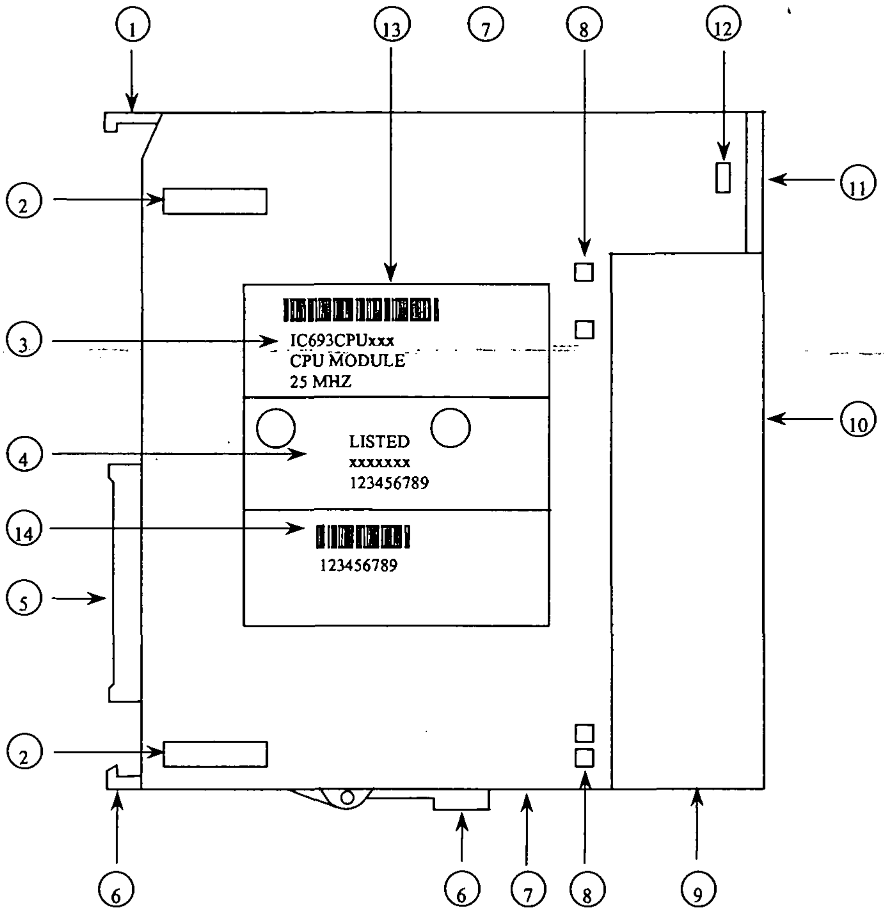


Figure 2-1. Features of Series 90-30 Module

1. Pivot hook
2. Circuit board holding tabs (two on each side of module)
3. Catalog number and description section of label (Includes MAC address for CPU374.)
4. Certification (UL, CE, etc.) section of label
5. Module connector - plugs into baseplate backplane connector
6. Release lever - spring loaded
7. Ventilation openings in module case (top and bottom)
8. Front cover holding tabs (two on each side of module)
9. Front cover (shown) or terminal board (for I/O modules).
10. Front cover faceplate or hinged cover for terminal board.
11. Lens cap (some modules do not have).
12. Lens cap holding tabs (one on each side of module)
13. Module label
14. Serial Number - used to determine module warranty status. (On some modules, the Serial Number may be on a small tag on the back of the module.)

Installing a Module

Warning

Do not insert or remove modules with power applied. This could cause the PLC to stop or malfunction. Injury to personnel and damage to the module or baseplate may result. Also, attempts to force a module into an improper slot type will result in damage to the module and/or the baseplate. Modules will mount in the correct slot type easily, with a minimum of force.

Use the following instructions as a guide when inserting a module into a baseplate slot.

- Check that module catalog number matches slot configuration. Each slot is, or will be, assigned a particular module type during configuration. A Power Supply module must be installed in the left end unnumbered slot only, and a CPU module and some special Option modules can only be installed in Slot 1 of a CPU baseplate. I/O Modules and most Option modules install in slots numbered 2 and higher.
- Grasp the module firmly with terminal board toward you and with rear pivot hook facing away from you.
- Align the module with the desired baseplate slot and connector. Tilt the module upwards so that top rear pivot hook of the module engages the baseplate's top module retainer.
- Swing the module downward until the module's connector engages the baseplate's backplane connector, and the release lever on the bottom of the module snaps into place in the baseplate's bottom module retainer.
- Visually inspect the module to be sure that it properly seated.

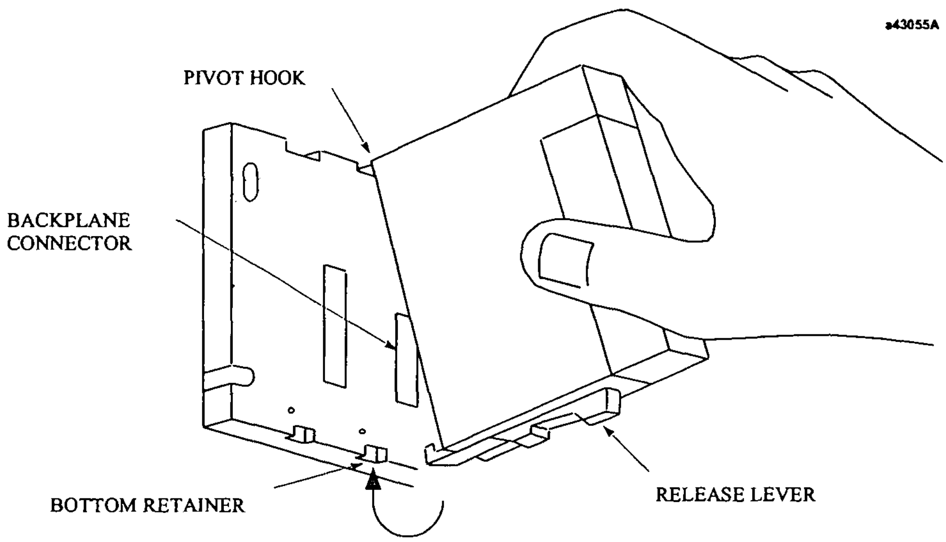


Figure 2-2. Installing a Module

Removing a Module

Warning

Do not insert or remove modules with power applied. This could cause the PLC to stop or malfunction. Injury to personnel and damage to the module or baseplate may result. Also potentially dangerous voltages from user devices may be present on a module's screw terminals even though power to the rack is turned off. Care must be taken any time that you are handling the module's removable terminal board or any wires connected to it.

- If the module has wiring, remove the module's terminal board (NOTE: You do not have to unwire the terminal board) or cables. The procedure for removing a terminal board is described later in this section.
- Locate the release lever at the bottom of the module and firmly press it up, towards the module.
- While holding the module firmly at its top and fully depressing release lever, swing (pivot) the module upward (release lever must be free of its retaining slot).
- Disengage pivot hook at the top rear of the module by moving the module up and away from the baseplate.

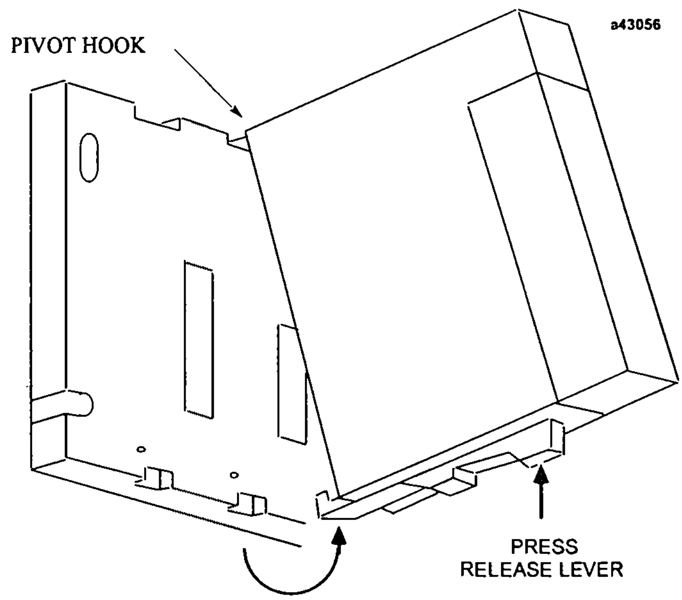


Figure 2-3. Removing a Module

Note

Modules in expansion or remote baseplates can be added, removed, or replaced while the PLC is in RUN mode if power is first removed from the expansion or remote baseplate. I/O data to/from this baseplate will not be updated while power is removed.

Installing a Module's Terminal Board

Note: Modules IC693MDL730F (and later) and IC693MDL731F (and later) have special terminal boards that are equipped with holding screws. For Installation and Removal instructions, please see the section "Installing and Removing Terminal Boards with Holding Screws" later in this chapter.

To install a terminal board (circled numbers refer to drawing below):

- Hook the pivot hook ①, located on the bottom of the terminal board, to the lower slot on the module.
- Push the terminal board toward the module ② until it snaps into place.
- Open the terminal board cover ③ and ensure that the latch on the module is securely holding the terminal board in place.

Caution

Compare the module catalog number on the label on the back of the hinged door (see Figure 2-6) and the label on the side of the module (see below) to ensure that they match. If a wired terminal board is installed on the wrong module type, damage to the module may occur when the system is powered up.

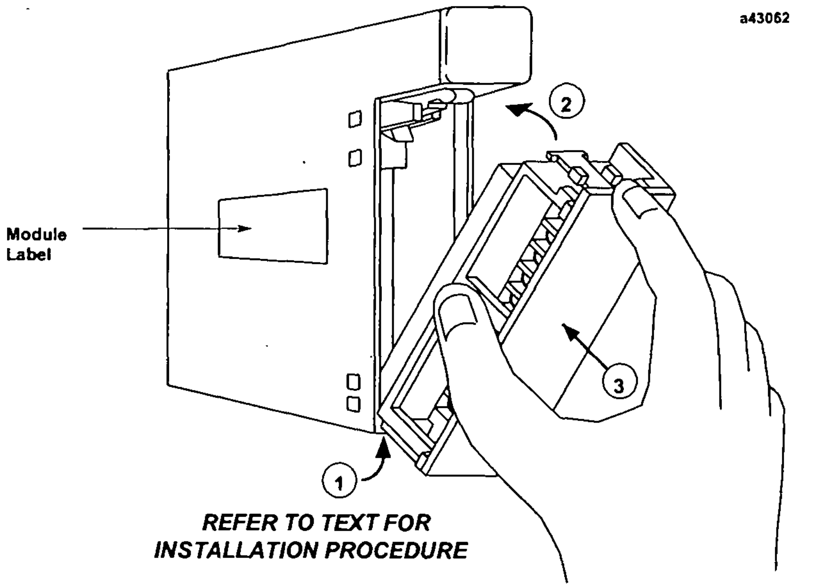
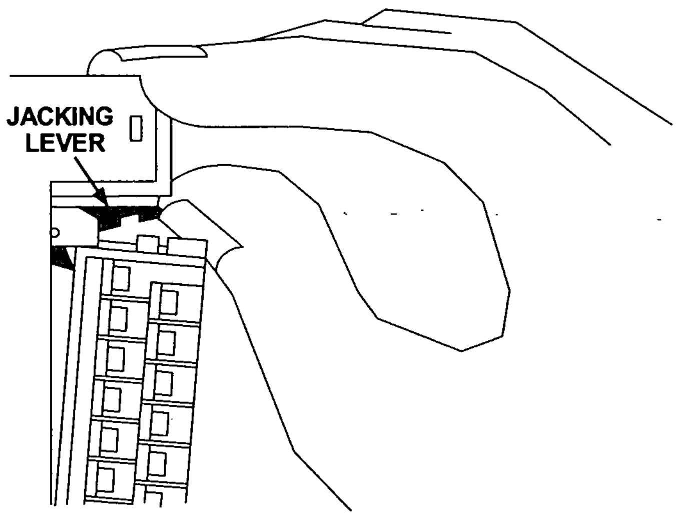


Figure 2-4. Installing an I/O Module's Terminal Board

Removing a Module's Terminal Board

To remove a terminal board:

- Open the plastic terminal board cover.
- Push up on the jacking lever to release the terminal block.



- Grasp pull-tab and pull it towards you until contacts have separated from module housing and bottom pivot hook has disengaged.

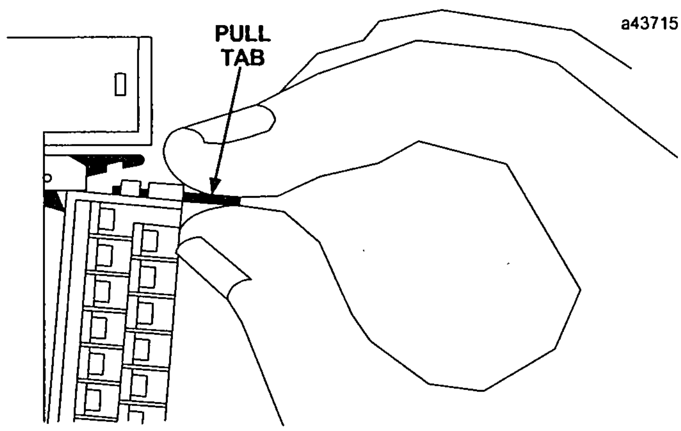


Figure 2-5. Removing a Module's Terminal Board

I/O Module Terminal Board Posts

The terminal board has three posts on the left side. The top and bottom posts hold the terminal board cover in place. The middle post keeps the terminal board wiring in place. If you do not require it to hold the wiring in place, the middle post can be easily snapped off. (Be careful that you do not inadvertently snap it off if you need it to keep your wiring in place.)

Installing and Removing Terminal Boards with Holding Screws

Discrete output modules IC693MDL730F (and later) and IC693MDL731F (and later) have a special terminal board that is equipped with holding screws, shown in the figure below. These screws prevent the terminal board-to-module connections from deteriorating in applications where the PLC is subjected to severe vibration .

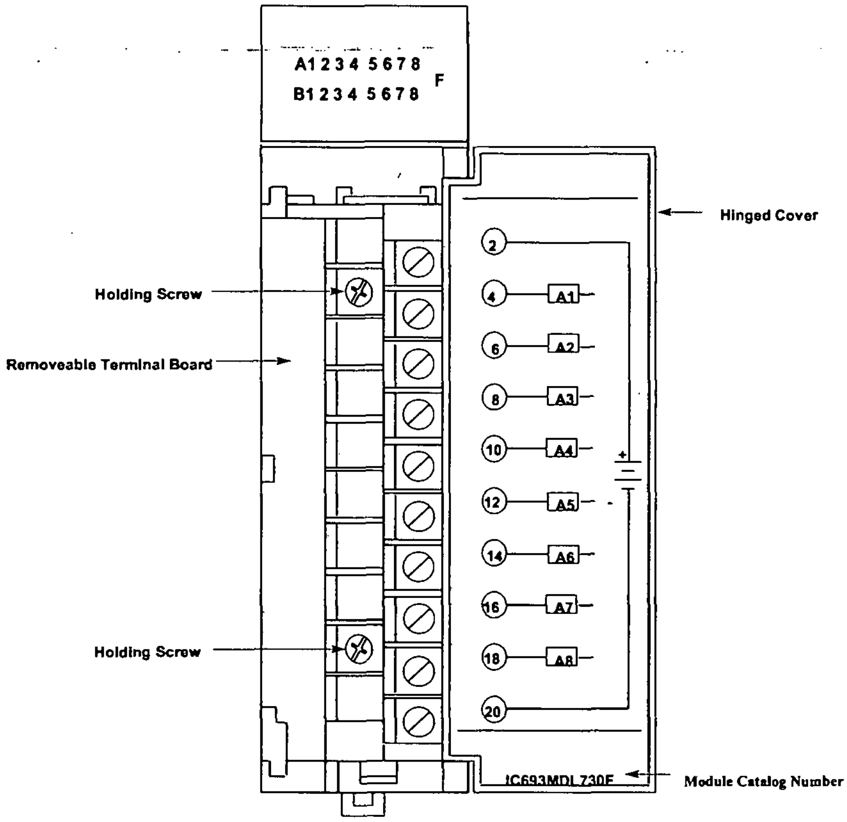


Figure 2-6. Terminal Board with Holding Screws

- **Removing:** To Remove these terminal boards, first loosen the two holding screws on the front of the terminal board, then follow the standard removal instructions in the section "Removing an I/O Module's Terminal Board." The holding screws are held captive in the terminal board and do not have to be completely removed.
- **Installing:** To install these terminal boards, follow the standard installation instructions in the section "Installing an I/O Module's Terminal Board," then tighten the two holding screws to 8 to 10 inch-pounds (1 Newton-meter) of torque.

Baseplate Mounting

Warning

Be sure to follow baseplate grounding instructions in this chapter. Failure to properly ground the PLC can result in improper operation, damage to equipment, and injury to personnel.

Mounting a Baseplate to a Panel

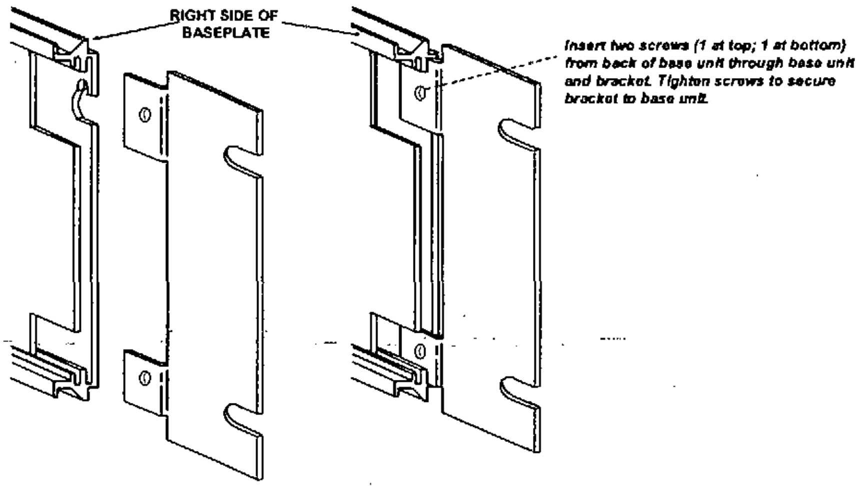
- Use four good-quality 8-32 x 1/2 (4 x 12mm) machine screws, lock washers and flat washers. Install the screws in four tapped holes. The "Baseplates" chapter has the applicable dimensions and mounting clearances. Alternately, 10-slot baseplates can be mounted in standard 19-inch racks by using the appropriate adapter. This is also discussed in the "Baseplates" chapter.
- A vertical mounting orientation is preferred for maximum heat dissipation. Other mounting orientations will require derating the Power Supply current capabilities. See Chapter 12, "System Design," for details.
- All baseplates must be grounded. The "Baseplate Safety Grounding" section of this chapter has details.
- The Rack Number Selection switch must be set on each Expansion or Remote baseplate. A CPU baseplate does not require this switch. Rack numbers should be assigned by the system designer. Failure to set the Rack Number Selection switches properly will result in system malfunction. See the "Baseplates" chapter for details on setting these switches.

Mounting a Baseplate to a 19" Rack

Two optional Baseplate Adapter Brackets allow a 10-slot baseplate to be mounted in a 19 inch rack. Each baseplate installation requires only one of the adapter brackets.

- **IC693ACC308 Front Mount Adapter Bracket.** Used to mount a baseplate to the front face of a 19" rack. Install the adapter bracket by inserting the tabs at the top and bottom of the adapter bracket into the corresponding slots at the top and bottom of the plastic baseplate cover. NOTE: Although Figure 2-7 shows the plastic baseplate cover removed, this is for illustration purposes only. It is not necessary to remove the cover to install the bracket. With the bracket in place, insert and tighten the two screws (included with the bracket) through the back of the baseplate holes into the threaded holes in the bracket.

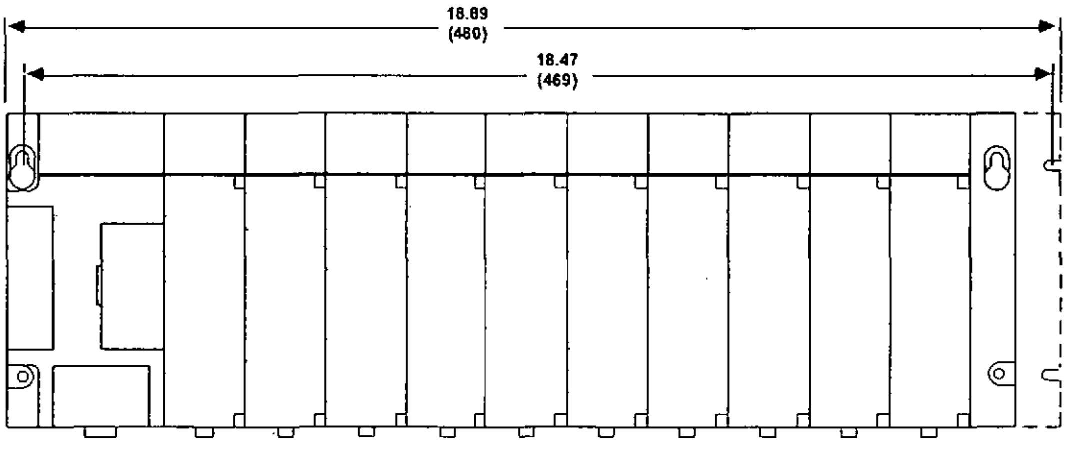
- **IC693ACC313 Recessed Mount Adapter Bracket.** Used to recess mount a baseplate inside a 19" rack. A baseplate mounts on the rear panel of this adapter bracket using four 8-32 (4mm) screws, nuts, lock washers, and flat washers. The Adapter Bracket bolts through its four slotted holes to the face of the 19" rack using applicable hardware (lock washers recommended).



Note: Baseplate is shown with cover removed for illustration purposes. It is not necessary to remove the baseplate cover to install the bracket.

Figure 2-7. IC693ACC308 Front Mount Adapter Bracket Installation

Dimensions for rack mounting a 10-slot baseplate with the IC693ACC308 Front Mount Adapter Bracket are shown in the following figure.



DIMENSIONS IN INCHES (MILLIMETERS IN PARENTHESES)

Figure 2-8. Dimensions for 19-inch Rack Mounting Using IC693ACC308 Adapter Bracket

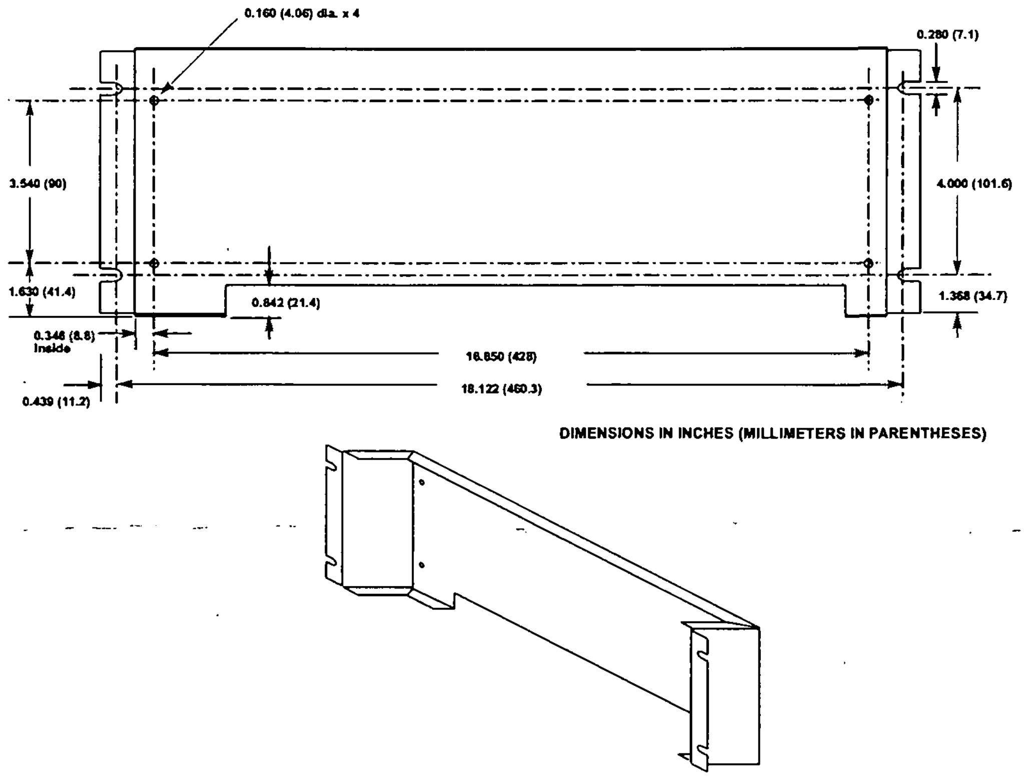


Figure 2-9. IC693ACC313 Recessed Mount Adapter Bracket

Grounding Procedures

System Grounding Procedures

Warning

In addition to the following grounding information, we strongly urge that you follow all applicable codes that apply to your area. For example, in the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes will apply. For maximum safety to personnel and property you must follow these codes. Failure to do so can mean injury or death to personnel, damage to property, or both.

All components of a programmable logic control system and the devices it is controlling must be properly grounded. This is particularly important for the following reasons.

- A low resistance path from all parts of a system to earth minimizes exposure to shock in the event of short circuits or equipment malfunction.
- The Series 90-30 PLC system requires proper grounding for correct operation.

Ground Conductors

- Ground conductors should be connected in a tree fashion with branches routed to a central earth ground point, shown in the figure below. This ensures that no ground conductor carries current from any other branch. This method is shown in the following figure.
- Ground conductors should be as short and as large in size as possible. Braided straps or ground cables (typically green insulation with a yellow tracer - AWG #12 (3.3 mm^2) or larger) can be used to minimize resistance. Conductors must always be large enough to carry the maximum short circuit current of the path being considered.

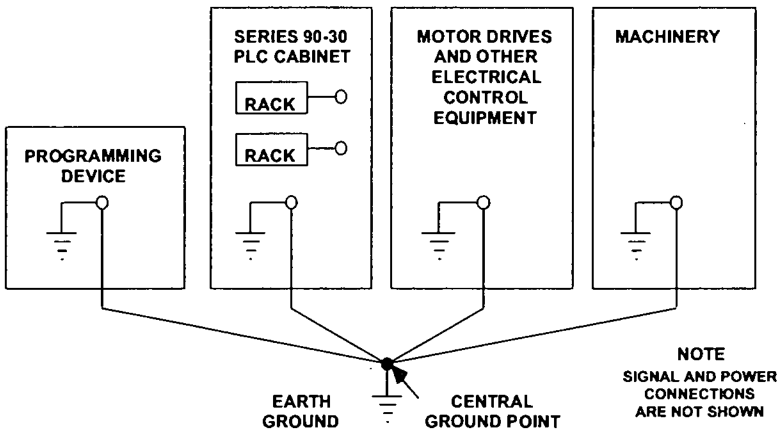


Figure 2-10. Recommended System Grounding

2

Series 90-30 PLC Equipment Grounding

Equipment grounding recommendations and procedures are listed below. These grounding procedures must be properly followed for safe, proper operation of your Series 90-30 PLC system.

Baseplate Safety Grounding

The following recommendations are offered, but applicable safety codes for your area or equipment type should also be consulted. The baseplate's metal back must be grounded using a separate conductor; the baseplate mounting screws are not considered to an acceptable ground connection by themselves. Use a minimum AWG #12 (3.3 mm^2) wire with a ring terminal and star lock washer under the head of one of the baseplate's two lower mounting holes. These two holes have openings to the side to allow connecting a wire and ring terminal under the head of a mounting screw. Connect the other end of this ground wire to a tapped hole in the panel that the baseplate is mounted to, using a machine screw, star lock washer, and flat washer. Alternately, if your panel has a ground stud, it is recommended you use a nut and star lock washer for each wire on the ground stud to ensure adequate grounding. Where connections are made to a painted panel, the paint should be removed so clean, bare metal is exposed at the connection point. Terminals and hardware used should be rated to work with the aluminum baseplate material.

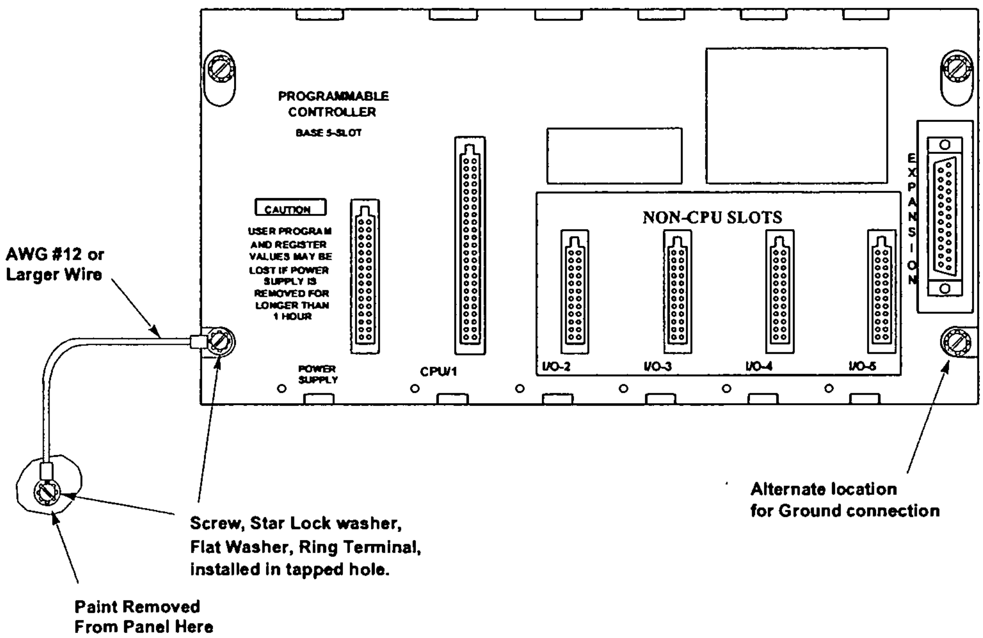


Figure 2-11. Baseplate Grounding

Warning

All baseplates must be grounded to minimize electrical shock hazard. Failure to do so can result in severe personal injury.

All baseplates grouped together in a Series 90-30 PLC system must have a common ground connection. This is especially important for baseplates that are not mounted in the same control cabinet.

Grounding 19" Rack-Mounted Baseplates

There are two Adapter Brackets used for mounting a 10-slot Series 90-30 baseplate to a 19" Rack. Regardless of which of the two Adapter Brackets is used, the 19" Rack should be grounded as per the instructions in "System Grounding Procedures," including Figure 2-10. (For details on the Adapter Brackets, see the "Mounting a Baseplate to a 19" Rack" section earlier in this chapter.)

Nineteen-Inch Rack-mounted PLC baseplates should be grounded according to the guidelines in the "Baseplate Safety Grounding" section, using a separate ground wire from the PLC baseplate as shown in the previous figure (Fig. 2-11).

- If using the **Recessed Mount Adapter Bracket (IC693ACC313)**, the ground wire can be installed as shown in Figure 2-11 with the ground attached to the Recessed Mount Adapter Bracket. An additional ground wire connecting the Adapter Bracket to a solid chassis ground on the 19" Rack should be installed. Use the same or equivalent hardware and paint removal scheme as shown in Figure 2-11.
- If using the **Surface Mount Adapter Bracket (IC693ACC308)**, the ground wire should be run from the baseplate as shown in Figure 2-11, to a solid chassis ground on the 19" Rack. Use the same or equivalent hardware and paint removal scheme as shown in Figure 2-11.

Programmer Grounding

For proper operation, the computer (programmer) running the PLC software must have a ground connection in common with the CPU baseplate. Normally, this common ground connection is provided by ensuring that the programmer's power cord is connected to the same power source (with the same ground reference point) as the baseplate. If it is not possible to ensure this common ground scheme, use a port isolator (IC690ACC903) between the programmer and PLC serial connection. If the programmer ground is at a different potential than the PLC ground, a shock hazard could exist. Also, damage to the ports or converter (if used) could occur when the programmer serial cable is connected between the two.

Warning

Failure to follow programmer grounding recommendations could result in personal injury, equipment damage, or both.

Module Shield Grounding

In general, the aluminum PLC baseplate is used for module shield grounding. On some Series 90-30 modules, shield connections to the user terminal connector on the module are routed to the baseplate through the module's backplane connector. Other modules, such as CPUs 351, 352, 363, 364, and 374 require a separate shield ground. These are discussed in the next several sections.

Shield Grounding Information for CPUs with External Port Connections

CPUs with external port connections, the 351, 352, 363, 364, and 374 must have a separate shield ground connection to provide shielding for these ports. Because the design of the ground connection for the CPU351 and 352 is different from that of the CPU363, 364, and 374, each grounding method is discussed in a separate section.

CPU351 and 352 Shield Grounding

The CPU 351 or 352 module must be connected to frame ground at the slot where it is installed. Two methods are provided for making this ground connection. Each CPU comes with an EMC Grounding Kit (44A737591-G01) that contains a ground wire, grounding bracket, and screws.

1. The connection from the CPU to frame ground can be made using the ground wire (part number 44A735970-001R01) that comes with the module in the EMC Grounding Kit. This wire has a stab-on connector on one end for connection to a mating terminal on the bottom of the CPU, and a ring terminal on the other end for connection to a grounded enclosure. Where the ring terminal contacts a painted enclosure panel, either a star lock washer can be installed between the terminal and the panel to cut through the paint, or the paint can be scraped away down to clean, bare metal to ensure a good contact. **Note: The star lock washer method is suitable for a shield ground, but <u>not suitable for a safety ground</u>.**

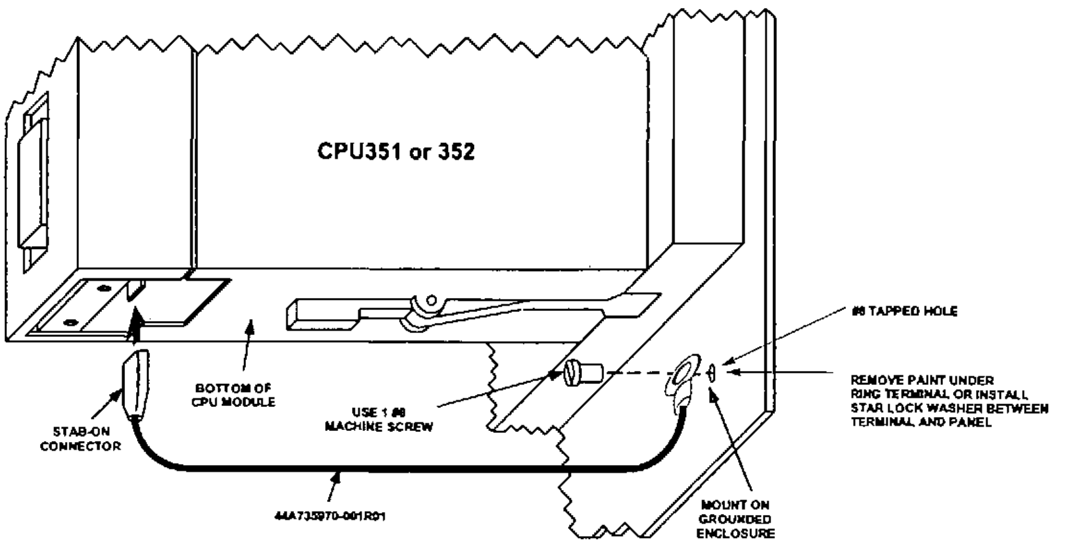


Figure 2-12. CPU 351 or 352 - Attaching Shield Ground Wire

2. The second method, which can be used for systems in noisy environments consists of installing the green ground wire ***and*** the optional grounding bracket (part number 44C715646-001R01). This bracket attaches to the CPU using two #4 thread-rolling screws (part number N666P9004B6) and to the grounded enclosure using two #6 thread-rolling screws (part number N666P13006B6). Two holes must be drilled in the enclosure for mounting this bracket. Also, if the bracket will be attached to a painted surface, the paint should be removed down to bare metal under the bracket to ensure good contact between the bracket and the surface. See the next figure.

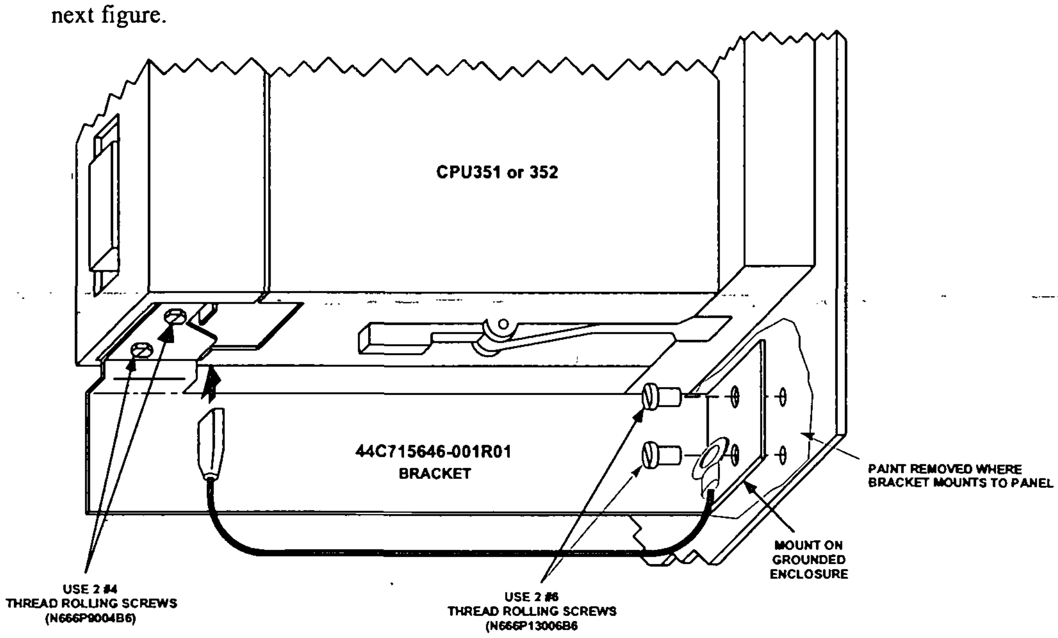


Figure 2-13. CPU 351 or 352 - Mounting the Shield Grounding Bracket and Wire

Note: When the grounding bracket is used, pin 1 of the cable connector that plugs into the Port 2 connector should not be connected. A metal connector shell must be used on the cable for this port, and the cable shield must be terminated at the metal shell instead of pin 1 of the connector.

CPU363, CPU364, and CPU374 Shield Grounding

The CPU363, CPU364, and CPU374 modules must be connected to frame ground at the slot where they are installed. Each module comes with a grounding wire for this purpose. These modules do not support or require the use of a grounding bracket. If the ring terminal on the grounding wire is to be mounted to a painted surface, remove the paint under the ring terminal to ensure good contact, or place a star lock washer between the ring terminal and the painted surface. See the next figure. **Note: The star lock washer method is suitable for a shield ground, but <u>not suitable for a safety ground</u>.**

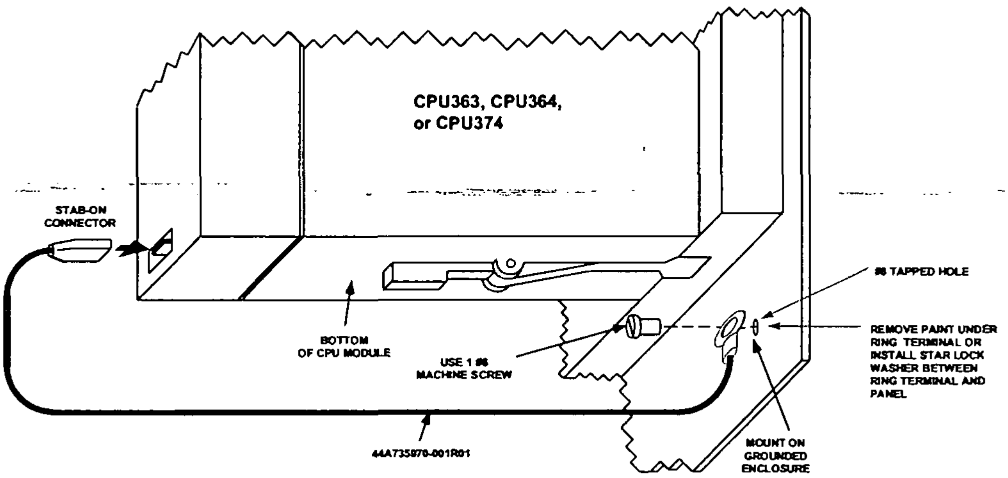


Figure 2-14. CPU 363, CPU364, or CPU374 - Attaching Ground Wire

Additional Modules with Shield Grounding Requirements

Some of the Series 90-30 Option modules, such as the FIP Remote I/O Scanner (IC693BEM330), and DSM modules (IC693DSM302 and IC693DSM314) also have shield grounding requirements. These modules come equipped with suitable grounding hardware. Please refer to each module's user's manual for grounding instructions. Appendix G contains a product to publication cross-reference to help you identify the correct manual.

General Wiring Guidelines

Warning

In addition to the following wiring suggestions, we strongly urge that you follow all wiring and safety codes that apply to your area or your type of equipment. For example, in the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes will apply. For maximum safety to personnel and property you must follow these codes. Failure to do so can lead to personal injury or death, property damage or destruction, or both.

Color Coding Wires

These color codes are commonly used in industrial equipment manufactured in the United States. They are cited here as a reference. Where they are in conflict with codes that apply to your area or your type of equipment, you should follow your applicable codes instead. Besides satisfying code requirements, wire color coding makes testing and troubleshooting safer, faster, and easier.

- Green or green with stripe- Ground
- Black - Primary AC
- Red - Secondary AC
- Blue - DC
- White - Common or neutral
- Yellow - Secondary power source not controlled by the main disconnect. Alerts maintenance personnel that there may be power present (from an external source) even if the equipment is disconnected from its main power source.

Wire Routing

To reduce noise coupling among PLC wires, it is recommended you keep electrically noisy wiring, such as AC power wiring and Discrete Output Module wiring, physically separated from low-level signal wiring such as DC and Analog Input module wiring or communications cables. This can be accomplished by grouping separately, where practical, the following categories of wiring:

- **AC power wiring.** This includes the AC input to the PLC power supply, as well as other AC devices in the control cabinet.
- **Analog Input or Output Module wiring.** This should be shielded to further reduce noise coupling. See the *Series 90-30 I/O Module Specifications Manual*, GFK-0898 for details.
- **Discrete Output Module wiring.** These often switch inductive loads that produce noise spikes when switched off.
- **DC Input Module wiring.** Although suppressed internally, these low-level inputs should be further protected against noise coupling by observing these wiring practices.
- **Communications Cables.** Wiring such as Genius Bus or serial cables should be kept away from noise-producing wiring.

Where AC or Output wiring bundles must pass near noise-sensitive signal wiring bundles, avoid running them beside each other. Route them so that, if they have to cross, they do so at a right angle. This will minimize coupling between them.

Grouping Modules to Keep Wires Segregated

If practical, grouping similar modules together in the PLC racks can help keep wiring segregated. For example, one rack could contain only AC modules, and a different rack only DC modules, with further grouping in each rack by input and output types. For smaller systems, as an example, the left end of a rack could contain Analog modules, the middle could contain DC modules, and the right end could contain AC modules.

Discrete I/O Module Connection Methods

- For modules with 16 points or less, the standard method is to use the removable terminal board which comes with these modules. The removable terminal board makes it easy to prewire field wiring to the user supplied input and output devices, and to replace modules in the field without disturbing existing field wiring.
- Some discrete 16-point I/O modules can be used with an optional Terminal Block Quick Connect (TBQC) assembly. This assembly contains a module faceplate, with built-in connector, that replaces the removable terminal board. The assembly also contains a DIN-rail mounted terminal block and a cable to connect the module to the terminal block. The advantage of this method is that it saves about two hours of wiring time per module compared with hand wiring from a module's removable terminal board to a user-supplied, panel-mounted terminal block or strip.
- Older 32-point I/O modules have one 50-pin connector on the front of the module that is either connected by a cable with a connector on each end to a Weidmuller panel-mounted terminal block (Weidmuller catalog no. 912263), or is connected by a cable with stripped, tinned leads to a user-supplied terminal block or strip.
- Newer 32-point I/O modules have two 24-pin connectors on the front of the module. These module may be wired in one of three ways. (1) Use a pair of cables (IC693CBL327/328 - see data sheet in "Cables" chapter) to connect the module to a user-supplied, panel-mounted terminal block or strip. These cables have a 24-pin connector on one end, and stripped, tinned leads with wire markers on the other end. (2) Use a pair of dual-connector cables to connect the module to a Terminal Block Quick Connect (TBQC) terminal block (IC693ACC377). See Appendix H for details. (3) Make your own custom cables. Instructions are found in the IC693CBL327/328 data sheet in Chapter 10.

Connections to I/O Module Terminal Boards

Series 90-30 PLC I/O terminal boards have either 10 or 20 screw terminals that will accept from two AWG #22 (0.36 mm^2) to two AWG #16 (1.3 mm^2), or one AWG #14 (2.1 mm^2) copper 90°C (194°F) wire(s). Each terminal can accept solid or stranded wires, but the wires into any given terminal should be the same type (both solid or both stranded) to ensure a good connection. Wires are routed to and from the terminals out of the bottom of the terminal board cavity. The suggested torque for the I/O terminal board connection screws is from 9.6 in-lbs to 11.5 in-lbs (1.1–1.3 Newton-meters).

For 24 volt DC input modules, an internal 24 volt power connection is provided on the terminal board to supply a limited number of input devices. Also, a 24 volt DC output is available on the power supply module's terminal board to supply a limited number of output devices.

Terminal Block Quick Connect Installation for 16-Point Discrete Modules

The Terminal Block Quick Connect (TBQC) Assembly is an option for certain Series 90-30 discrete I/O modules. See Appendix H for more information.

- Remove standard terminal board from module.
- Install TBQC faceplate (it has a 24-pin connector).
- Mount the TBQC terminal block. It has a 24-pin connector and a terminal strip, and mounts on a standard 35 mm DIN-rail.
- Connect a TBQC cable between the TBQC faceplate connector on the module and the connector on the TBQC terminal block.
- Wire I/O devices to the terminal block.

Installation of 32-Point Discrete, 50-Pin Connector Modules

These 50-Pin modules are an older design and are not generally used on new systems, unless to fulfill standardization requirements. They are mainly used as replacements for existing installations. For new installations, we recommend the dual 24-pin connector style because they have additional features not found on the older modules (LED indicators, TBQC), and it is much easier to fabricate custom-length cables for them. Installation information is provided here for the convenience of those still using these modules.

Using Weidmuller #912263 Terminal Block

Note: The TBQC is not available for these modules, but you may purchase a Weidmuller #912263 from your electronics distributor for this application.

- Mount the Weidmuller#912263 terminal block. It has a 50-pin connector and a terminal strip, and mounts on a standard 35 mm DIN-rail.
- Connect an IC693CBL306/307 cable between the module's faceplate connector and the connector on the Weidmuller terminal block. See Chapter 10 for cable data.
- Wire I/O devices to the terminal block. See the *Series 90-30 PLC I/O Module Specifications Manual*, GFK-0898, for pin-out information.

Using a Generic Terminal Block or Strip

- Mount terminal block/strip to the enclosure panel.
- Connect an IC693CBL308 or 309 cable, or a custom made cable, to the module's faceplate connector and wire the stripped ends of the cable to the terminal block/strip. See Chapter 10 for cable data.
- Wire I/O devices to the terminal block/strip.

Direct Method

- Connect an IC693CBL308 or 309 cable, or a custom made cable, to the module's faceplate connector and wire the stripped ends of the cable directly to the field devices. See Chapter 10 for cable data. See the Series 90-30 PLC I/O Module Specifications Manual, GFK-0898, for pin-out information.

Installation of Discrete 32-Point, Dual 24-Pin Connector Modules

Using a TBQC

- Mount two TBQC terminal blocks. Each has a 24-pin connector and a terminal strip, and mounts on a standard 35 mm DIN-rail.
- Connect a pair of TBQC cables (IC693CBL329 - 334) between the module's faceplate connector and the connectors on the two TBQC terminal blocks. Note that both a right side and left side cable is required. See Appendix H for a list of cables.
- Wire I/O devices to the terminal blocks. See the Series 90-30 PLC I/O Module Specifications Manual, GFK-0898, for pin-out information.

The Terminal Block Quick Connect (TBQC) Assembly is an option for certain Series 90-30 discrete I/O modules. See Appendix H for more information.

With a Generic Terminal Block/Strip

- Mount terminal block/strip to the enclosure panel.
- Connect an IC693CBL327/328 cables, or a custom made cables, to the module's faceplate connectors, and wire the stripped ends of the cables to the terminal block/strip. Note that both a right side and left side cable is required. See Appendix H for a list of cables. See Chapter 10 for cable data sheets.
- Wire I/O devices to the terminal block/strip. See the Series 90-30 PLC I/O Module Specifications Manual, GFK-0898, for pin-out information.

Direct Method

- Connect an IC693CBL327/328 cable, or a custom made cable, to the module's faceplate connectors, and wire the stripped ends of the cable directly to the field devices. See Chapter 10 for cable data. See the *Series 90-30 PLC I/O Module Specifications Manual*, GFK-0898, for pin-out information.

General Wiring Methods for Analog Modules

Twisted, shielded instrumentation cable is strongly recommended for analog module input or output signal connections. Proper grounding of the shield is also important. For maximum electrical noise suppression, the cable shield should only be grounded at one end of the cable. For Input modules, ground the end that is in the noisiest environment (which often is at the field device end). For Output modules, ground at the module end. See GFK-0898, *Series 90-30 PLC I/O Module Specifications,* for more shield grounding information.

Analog Input Module Wiring Methods

Correcting electrical noise problems can sometimes be a trial-and-error routine. However, in general, it is generally best to ground the cable shield as close to the source of the noise as possible, which is usually at the device end. In troubleshooting noise problems, sometimes it is beneficial to experiment with the shield grounding point location. Remember, the cable shield should be grounded at one end only. Also, it is best to keep the length of stripped cable leads as short as possible to minimize the length of unshielded conductors that will be exposed to the noisy environment. See the *Series 90-30 PLC I/O Module Specifications Manual,* GFK-0898 for additional details.

Using a Generic Terminal Block or Strip

- Mount a terminal strip inside the control enclosure and run a shielded cable from the terminal strip to each input circuit on the module's terminal board terminals.
- Connect each cable's shield to the metal panel next to the terminal strip. Do not connect the shields at the module end (cut shield off at module end of cable and insulate with shrink tubing).
- Wire the field device to the terminal strip with a shielded cable, grounding the shield at the device end only (cut shield off at terminal strip end of cable and insulate with shrink tubing). Also, keep the length of exposed (outside of shield) leads at the terminal strip and device ends as short as possible.

Direct Method

- Run a shielded cable from the field device (transducer, potentiometer, etc.) directly to the module.
- Connect the conductors to the applicable screws on the module's terminal board.

- Ground the shield at the field device end, exposing a minimum amount of conductor to the noisy environment. Do not connect the shield at the module end (cut shield off at module end of cable and insulate with shrink tubing).

TBQC not Recommended for Analog Modules

The Terminal Block Quick Connect (TBQC) Assembly is not recommended for use with analog modules due to cable shielding requirements.

Analog Output Module Wiring

General

Each output should be connected using a good quality shielded wire with the cable shield grounded at the module end. See GFK-0898, *Series 90-30 PLC I/O Module Specifications,* for more information.

Using a Generic Terminal Block or Strip

- Mount a terminal strip inside the control enclosure and run a shielded cable from the terminal strip to each output circuit on the module's terminal board terminals.
- Ground each cable's shield at the module end only. Do not connect the shields at the terminal strip end (cut shields off at terminal strip end of cables and insulate with shrink tubing).
- Wire the field device to the terminal strip with shielded cables, grounding the shields at the terminal strip end only (cut shields off at field device end of cables and insulate with shrink tubing). Also, keep the length of exposed (outside of shield) leads at the terminal strip and device ends as short as possible.

Direct Method

- Run a shielded cable from each field device (transducer, potentiometer, etc.) directly to the module.
- Connect the conductors to the applicable screws on the module's terminal board.
- Ground the shield at the module end only, exposing a minimum amount of conductor to the noisy environment. Do not connect the shield at the device end (cut shield off at device end of cable and insulate with shrink tubing).

TBQC not Recommended for Analog Modules

The Terminal Block Quick Connect (TBQC) Assembly is not recommended for use with analog modules due to cable shielding requirements.

AC Power Source Connections

AC Input Wiring to AC/DC Power Supplies

Warning

If the same AC power source is used to provide AC power to other baseplates in a Series 90-30 PLC System, ensure that all AC input connections are identical at each rack. Do not cross Line 1 (L1) and Line 2 (L2). A resulting difference in potential can injure personnel or cause damage to equipment. Each baseplate must be connected to a common ground.

Ensure that the protective cover is installed over all terminal hoards. During normal operation with an AC power source either 120 VAC or 240 VAC is present on the AC Power Supply. The cover protects against accidental shock hazard which could cause severe or fatal injury to the operator or maintenance personnel.

Both the Standard (IC693PWR321) and High Capacity (IC693PWR330) AC/DC power supplies currently have six terminals for user connections. Early versions of some Series 90-30 power supplies had five terminals (see next figure). The wiring methods for both five-terminal and six-terminal types is similar, except that step 3 below does not apply to the five-terminal type.

The power supply terminal boards will accept one AWG #14 (2.1 mm^2) or two AWG #16 (1.3 mm^2) copper 75_ C (167_ F) wires. Each terminal can accept solid or stranded wires, but the wires in any given terminal should be the same type. The suggested torque for the power supply terminal board is 12 in-lbs (1.36 Newton-meters). Open the door protecting the terminal board and make the following connections from the AC power source, and ground connections (system grounding requirements are described in detail later in this chapter).

1. These are wide range supplies that can operate from an AC power source within the nominal range of 100 VAC to 240 VAC at 50/60 Hz. This may vary -15% to +10% for a total maximum range of 85 VAC to 264 VAC. These are auto-ranging supplies that do not require jumper or switch settings for selection of power source voltage.
2. Connect the hot and neutral wires or lines L1 and L2 to the upper two terminals on the terminal board. Connect the safety ground wire to the ground terminal, which is the third terminal from the top, and is marked with a ground symbol.
3. For power supplies with six terminals, the factory jumper between the 3rd and 4th terminals (see figure below), should be left in place for normal installations. However, this jumper must be removed and external surge suppressors installed in installations with a "Floating Neutral" input. Please see the section "Special Instructions for Floating Neutral (IT) Systems" later in this chapter for details.
4. After all connections to Power Supply terminal board have been completed, the protective cover plate should be carefully reinstalled.

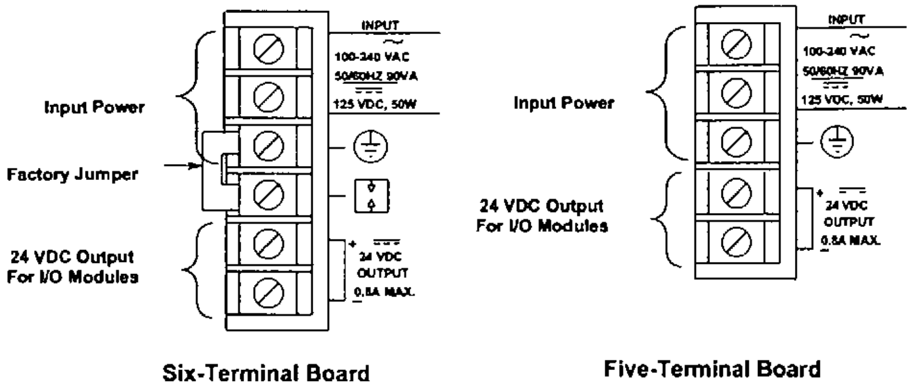


Figure 2-15. Power Supply Terminal Boards

Power Supply Overvoltage Protection Devices

The overvoltage protection devices for this power supply are connected internally to pin 4 on the user terminal board. This pin is normally connected to frame ground (pin 3) with the supplied jumper strap which is installed at the factory. If overvoltage protection is not required *or* is supplied upstream, this feature can be disabled by leaving pin 4 unconnected by removing the jumper strap. Also, this jumper must be removed and external surge suppressors installed in installations with a "Floating Neutral" input, please see the following section "Special Instructions for Floating Neutral (IT) Systems" later in this chapter.

If you want to Hi-pot test this supply, overvoltage protection *must be disabled* during the test by removing the terminal board strap. Re-enable overvoltage protection after testing by reinstalling the strap.

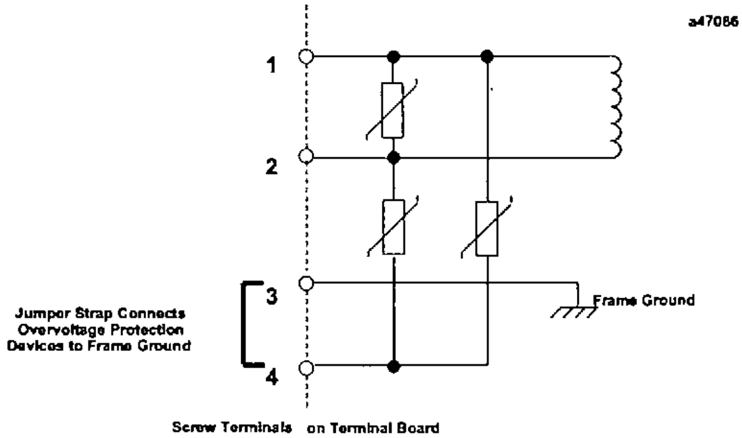


Figure 2-16. Overvoltage Protection Devices and Jumper Strap

Special Installation Instructions for Floating Neutral (IT) Systems

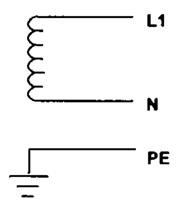
When the AC input power supplies listed below are installed in a system where the Neutral line is **not** referenced to Protective Earth Ground, these special installation instructions must be followed to prevent damage to the power supply.

IC693PWR321S (or later version)
IC693PWR330A (or later version)

Definition of Floating Neutral Systems

A *Floating Neutral System* is a system of power distribution wiring where Neutral and Protective Earth Ground are **not** tied together by a negligible impedance. In Europe this is referred to as an IT system (see IEC950). In a *Floating Neutral System*, voltages measured from input terminals to protective earth ground may exceed the 264 Volts AC maximum input voltage specified in the power supply specifications in Chapter 24in this manual.

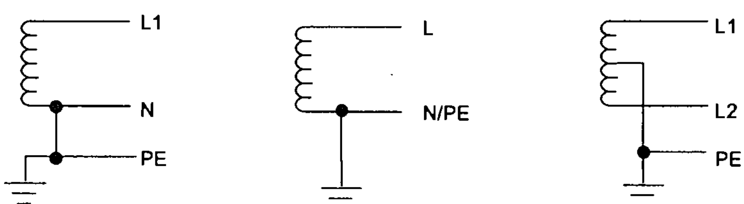
Example of Floating Neutral System



This system **must** be installed using the special installation instructions on the following page.

Systems in which one leg of the power distribution wiring is tied to Protective Earth or a tap between two legs of the power distribution wiring is tied to Protective Earth are **not** *Floating Neutral Systems*.

Examples of Non-Floating Neutral System



These non-floating neutral systems **do not** require these special installation instructions.

Use These Special Installation Instructions for Floating Neutral Systems

1. The input power terminals should be wired according to the instructions in the "AC Power Source Connections" section of this chapter.
2. The factory installed jumper between terminals 3 and 4 of the Power Supply module **must** be removed if using one of the Power Supplies that have this feature. See the "Overvoltage Protection Devices" section of the "Power Supplies" chapter for details.
3. Voltage surge protection devices, such as MOVs, **MUST** be installed between the following terminals:

   - From L1 to earth ground
   - From L2 (Neutral) to earth ground

The voltage surge devices must be rated such that the system is protected from power line transients that exceed *Line voltage + 100V + (N-PE)*$_{MAX}$.

The expression *N-PE* refers to the voltage potential between neutral and Protective Earth (PE) ground.

For example, in a 240 Volt AC system with neutral floating 50V above earth ground, the transient protection should be rated at:

240V + 100V +50V = 390V

DC Power Source Connections

DC Input Wiring to AC/DC and DC-Only Power Supplies

DC Input power can range from 12 to 30 VDC for the 24 VDC supply, 18 to 56 VDC for the 24/48 VDC supply or 100 to 150 VDC for the 125 VDC supply. All Series 90-30 power supplies have DC input capabilities. The following connection information applies to all of them:

Connect the + and - wires from the power source to the top terminals on the terminal board (+ to the top terminal, - to the second terminal). Connect the third terminal from the top to system ground.

+24 VDC Output (All Supplies)

The bottom two terminals are connected to the isolated 24 volt DC output that can be used to supply power to input circuits (within power limitations of the supply).

Warning

If the same DC input power source is used to provide power to two or more power supplies in a Series 90-30 PLC System, ensure that connection polarity is identical at each rack (top terminal + and second terminal -). Do not cross the Positive (+) and Negative (-) lines. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each baseplate must be connected to a common system ground, described earlier in this chapter.

Basic Installation Procedure

Note: Series 90-30 PLCs must be mounted in a protective enclosure. The enclosure should be capable of properly dissipating the heat produced by all of the devices mounted inside it. For details on calculating heat dissipation, refer to Appendix F.

The system design, which includes producing the layout and wiring drawings, should be completed before beginning the installation procedure. This section offers a basic step-by-step approach to installing a Series 90-30 PLC system. Some steps refer to earlier sections of this chapter for additional details. An attempt was made to place the steps in an order that will make the process as efficient as possible. However, due to the wide variance in system designs, this order may not be the most efficient for your system, so you may wish modify this procedure to fit your needs.

1. Gather the schematics, layouts, prints, and other information for the job.

Warning

To avoid the possibility of electrical shock to personnel or damage to your PLC, we recommend that you shut off all power to the system before mounting and wiring the PLC. Also, keep all electronic components away from the area while drilling and tapping to keep metal chips and filings out of these sensitive components.

2. From the layout drawing, determine where the baseplate(s) will be mounted. Lay out the hole locations, either using the dimensions given on your layout drawing or from the “Baseplates” chapter of this manual.
3. Mark the hole locations for the baseplate safety ground wire (see “Baseplate Safety Ground” in this chapter).
4. Mark the hole locations for module shield ground connections (if any). See “Module Shield Ground” (and accompanying sections) in this chapter for instructions.
5. Finish laying (marking hole locations) out the rest of the system. This includes any terminal blocks you will be using. DIN-rail mounted terminal blocks for some of the 32-point I/O modules are manufactured by Weidmuller. DIN-rail mounted GE Fanuc Terminal Block Quick Connect (TBQC) assemblies are optional for some of the 16-point and 32-point discrete I/O modules. If using these TBQCs, refer to Appendix H for data. Also, APM and DSM modules use DIN-rail mounted terminal blocks.

Note

We recommend drilling and tapping all holes before mounting any components. This will avoid getting chips and filings in the components.

6. Drill and tap the marked holes. For baseplate mounting, use 8-32 or 4mm size.
7. Mount the baseplates. Use good quality 8-32 x 1/2 inch or 4 x 12mm size screws. We recommend using star lock washers and flat washers under the screw heads (star lock washer should be located between screw head and flat washer) to ensure a tight baseplate ground connection, and to keep the screws from loosening. Connect each baseplate ground wire as shown in the “Baseplate Safety Ground” section of this chapter.
8. If you have Expansion or Remote racks, determine the correct rack number for each one, then set the rack numbers using the Rack Number Selection dual in-line package (DIP) switch on

the baseplate. Please refer to the "Baseplates" chapter for details on setting these DIP switches. Rack numbers should be assigned by the system programmer because they correspond to system configuration settings and program memory addressing.

9. If you have more than one baseplate (rack), connect the I/O Bus Expansion Cables between the I/O Bus Expansion Connectors, which are located on the right end of the baseplates. The cables are connected in a "daisy-chain" arrangement from one baseplate to the other. This is made possible by the fact that the cables have a dual connector on one end. Therefore, when the cable is plugged into a baseplate connector, the second connector on that end of the cable provides a socket for connecting to the next cable. The data sheet for the I/O Bus Expansion cables (IC693CBL300 etc.) in the "Cables" chapter has sample wiring figures.

10. On the last I/O Bus Expansion Connector, plug in an I/O Bus Expansion Terminator, Catalog Number IC693ACC307 (unless using a cable with built-in terminator resistors, which would either be GE Fanuc cable IC693CBL302, or your own custom-built cable).

11. Install the modules in their correct slots using your system layout drawings. (The label on the side of each module identifies the module type and catalog number.) Refer to the section "Installing Modules" if you are not familiar with how to do this.

12. Connect cables to Option modules. Route cables away from noise-producing wires. See the "Wire Routing" section of this chapter.

13. Be sure to follow the information in the "Wiring Guidelines" section of this chapter to protect the system from electrical noise. Install the power wires to the Power Supply and I/O modules:

    - **I/O modules with removable terminal boards.** You can wire the terminal boards in-place on the modules or remove them from the modules before wiring. Although removing them may help make wiring easier (a previous section "Working with Removable Terminal Boards" shows how to remove a terminal board), care should be taken to avoid mixing them (each terminal board has the catalog number of the module printed on it, and the hinged cover has a wiring diagram for that module type). If you are using wire duct, routing each module's wires through the opening in the duct directly under the module will help to keep each terminal board in its correct position.

    - **I/O Modules with terminal blocks.** Some modules use terminal blocks that mount to the enclosure panel. This includes all 32-point modules and, can include other I/O modules if they are fitted with the optional Terminal Block Quick Connect Assembly. Connect the terminal blocks to the connectors on the modules with the provided cables.

14. Connect the signal (switches, sensors, solenoids, etc.) wires to the terminal boards, or terminal blocks/strips. If wiring to terminal boards, these can be removed for ease of wiring, if desired. See the section "Removing a Module's Terminal Board."

15. When finished wiring the I/O terminal boards (if used and if you removed them for ease of wiring), re-install them on the modules, being careful to match each one with the correct module.

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GFZ–0085

GE Fanuc Automation

Programmable Control Products

Series 90™–30 Programmable Controller

Troubleshooting Guide

GE Fanuc Automation

Programmable Control Products

Series 90^{TM}–30 Programmable Controller

Troubleshooting Guide

GFZ–0085 August 1993

Notice

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ProLoop	CIMPLICITY PowerTRAC	Series Five
Workmaster	Genius Power TRAC	

Safety Con ˙ ˙erations

General Warnings When Troubleshooting

Stand clear of controlled equipment when power is applied. If the problem is intermittent, sudden unexpected machine motion could occur, causing injury. Also reference NFPA 70E Part II for additional guidelines for safety practices.

Never reach into a machine to operate a switch since unexpected motion could occur, causing injury.

Remove all electrical power at the Main Power Disconnect to ensure total power removal.

Always remove power before inserting or removing modules, or before connecting I/O cabling.

Preface

This guide describes a logical sequence for troubleshooting your Series 90–30 programmable controller. It includes the procedure for changing or adding a EPROM or EEPROM to your CPU. The Series 90–30 PLC is a member of the Series 90™ family of programmable logic controllers from GE Fanuc Automation.

Revisions to this Troubleshooting Guide

This is the first release of this Troubleshooting Guide. Included are models CPU 311, 313, 321, 323, 331 and 341.

Related Publications

Series 90™–30 Programmable Controller Installation Manual (GFK–0356).

Series 90™–30 and 90–20 PLC Hand–Held Programmer User's Manual (GFK–0402)

Logicmaster™ 90 Series 90–30 and 90–20 Programming Software User's Manual (GFK–0466)

Series 90™–30/90–20 Programmable Controllers Reference Manual (GFK–0467)

We Welcome Your Comments and Suggestions

At GE Fanuc Automation, we strive to produce quality technical documentation. After you have used this troubleshooting guide, please take a few moments to write us with your comments and suggestions. Our address is: Manager Technical Publications, GE Fanuc Automation. PO Box 8106, Charlottesville, VA 22906

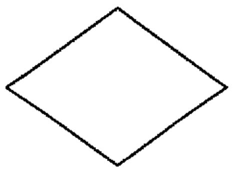
Drake C. Fink
Sr. Staff Systems Engineer

SYMBOLS USED IN THIS GUIDE

BEGIN AT THIS SYMBOL ON THE FIRST CHART.

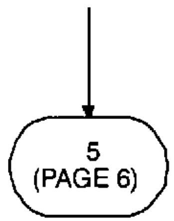
FOLLOW THE PATH WITH THE CORRECT ANSWER IN THE DIRECTION OF THE ARROW

SYMBOLS USED THROUGHOUT THE GUIDE ARE GEOMETRICALLY CODED

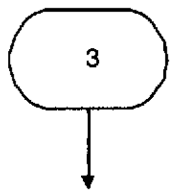


A DIAMOND ASKS A QUESTION

A RECTANGLE TELLS YOU TO DO SOMETHING



A NUMBERED BUBBLE WITH AN ARROW INTO THE BUBBLE INDICATES THAT THE PROCEDURE IS CONTINUED AT A CORRESPONDINGLY NUMBERED BUBBLE ON THE INDICATED PAGE NUMBER.



A NUMBERED BUBBLE WITH AN ARROW OUT OF THE BUBBLE INDICATES THE START OF A PROCEDURE ON THAT PAGE.I

Adding or Changing the EEPROM in the 90™–30

Application programs are normally developed in the CPU's RAM memory and executed from RAM memory. If additional program integrity is desired, or operation of the PLC without a battery is desired, an optional EEPROM or EPROM can be installed in a spare socket (labeled PROGRAM PROM) on the Model 311/313 backplane or in a socket on the model 331/341 CPU module. EEPROMs can be written to and read from. EPROMs can be read when installed in the PLC; however, they must be written to using an external PROM programming device.

Following is the procedure for adding or changing the EEPROM or EPROM. For clarity, the term PROM is used to refer to either an EEPROM or an EPROM.

1. Remove power from the system.
2. If 311/313
   - Remove all modules, including the power supply.
   - Remove the plastic cover.
3. If 331/341:
   - Remove CPU from backplane.
   - Remove front plate and bezel. Unsnap circuit board and remove from case.
4. If the socket is the type which has a screw near the top edge (some versions of 311/331), loosen screw at top of PROM socket (CCW twist;).
5. If present, remove old PROM from socket. Replace with or install new PROM. Orient the PROM so the end with a notch (the top of the prom) is toward the top edge of the backplane. Pin 1 of the prom is the first pin on the left as you move counter–clockwise from the notch. On the 311/331, correct installation orients the notch toward the screw.
6. When present, tighten screw at top of PROM socket (CW twist).
7. If 311/313:
   - Replace the plastic cover.
   - Replace all modules, including the power supply.
8. If 331 CPU:
   - Assure jumper JP1, located at the bottom of the PROM socket, is in the 1–2 position for EPROM and the 3–2 position for EEPROM. This informs the CPU firmware which type of device is present.
9. If 331/341 CPU:
   - Replace circuit board in case.
   - Reinstall front plate and bezel.
   - Replace CPU in backplane.

Changing the EEPROM (continued)

10. Apply power. The PLC follows the flowchart found in the "Power–Up Sequence" figure in the Power–Up and Power–Down Section of the *Series 90–30/90–20 Programmable Controllers Reference Manual* (GFK–0467) to determine if a program will be loaded from PROM to RAM.

11. For the EEPROM to be used by the CPU, the CPU configuration must be set to use EEPROM as the "Program Source". You may use the LM90 Configuration software or the HHP to accomplish this.

12. To store the program in RAM, you may use either the Hand–Held Programmer or Logicmaster 90–30, Rev 3.5 or higher. Refer to the instructions in the *HHP User's Manual* (GFK–0402) for HHP. To use Logicmaster 90–30, follow these instructions:

- Start the LM90–30 Programmer Package
- Activate the Utilities Menu (F9)
- Select the EEPROM function (F10)
- Select the WRITE operation
- Verify the items you want to write to EEPROM are selected.
- Press ENTER to start the operation. Refer to the *Logicmaster 90 Series 90–30 and 90–20 Programming Software User's Manual* (GFK–0466) for more information.

Notes and Precautions

1. **WARNING**: Do not discard the lithium–manganese dioxide battery in fire. Do not attempt to discharge the battery. The battery may burst or burn or release hazardous materials. Dispose of the battery as you would any hazardous material.

2. **CAUTION**: After a power fault, the system will come back on in the mode (*STOP, RUN/ENABLED, RUN/DISABLED)* in which it was operating before power loss, unless the power up configuration specifies a particular mode.

3. Not having a battery installed will not prevent the PLC from running. It will generate a PLC fault on power cycle that prevents the PLC from entering *RUN* mode automatically. Clearing this fault will enable the PLC to be placed in *RUN* mode.

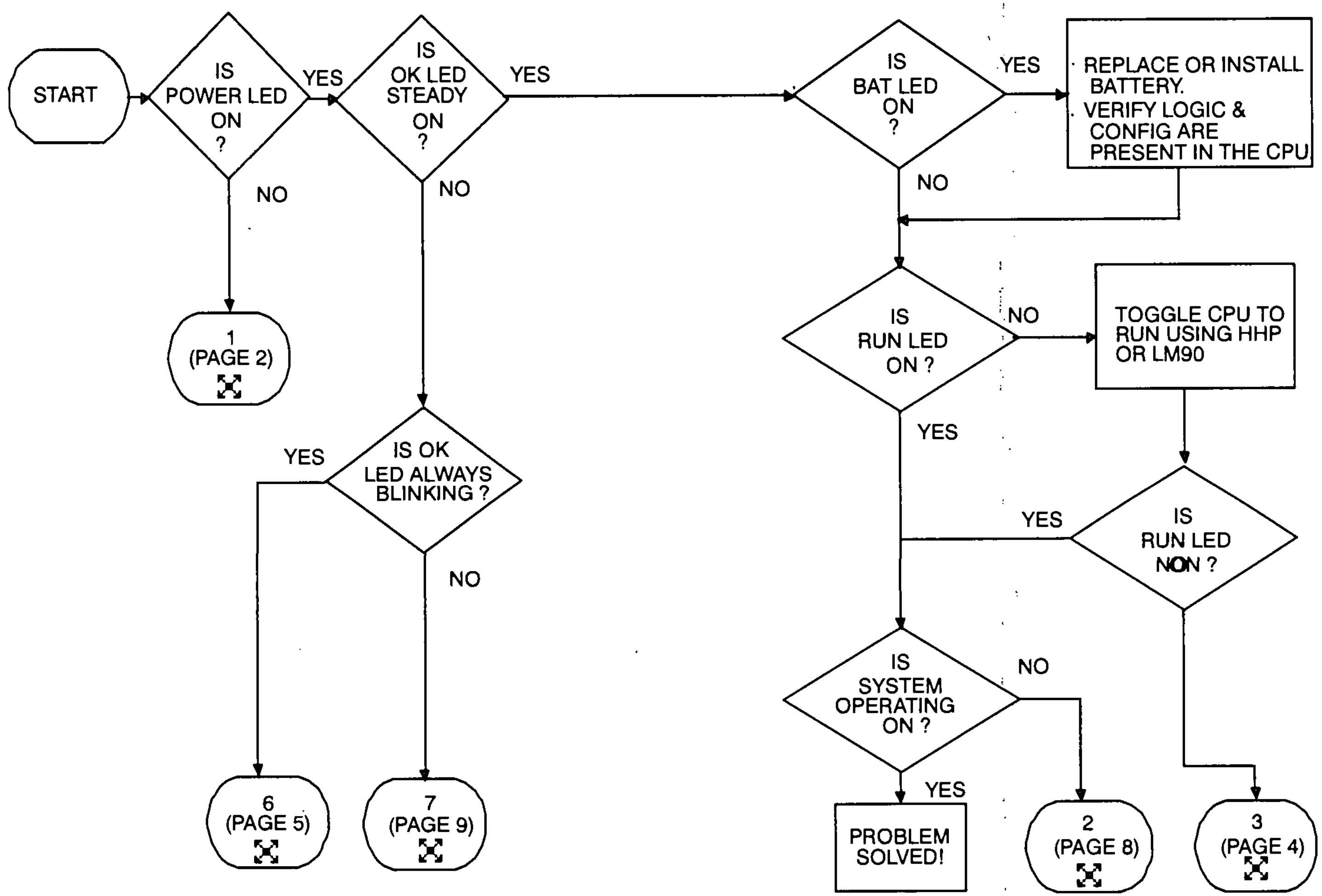
4. To short the 'super cap' on a 311/321 PLC:

- Remove power from the system.
- Remove all modules, including the power supply.
- Remove the plastic face plate.
- Find component C20 along the left edge of the module. This is the 'super cap'. Short the positive (+) and negative (–) leads of this device.
- Replace the plastic face plate.
- Replace all modules.
- Restore power to the system.

5. Supply (input) voltage tolerances for Series 90–30 power supplies:

IC693PWR321:	100 to 240 VAC 100 to 250 VDC (125 VDC nominal)
IC693PWR322:	18 to 56 VDC, 21 VDC minimum to start 24 VDC OR 48 VDC nominal

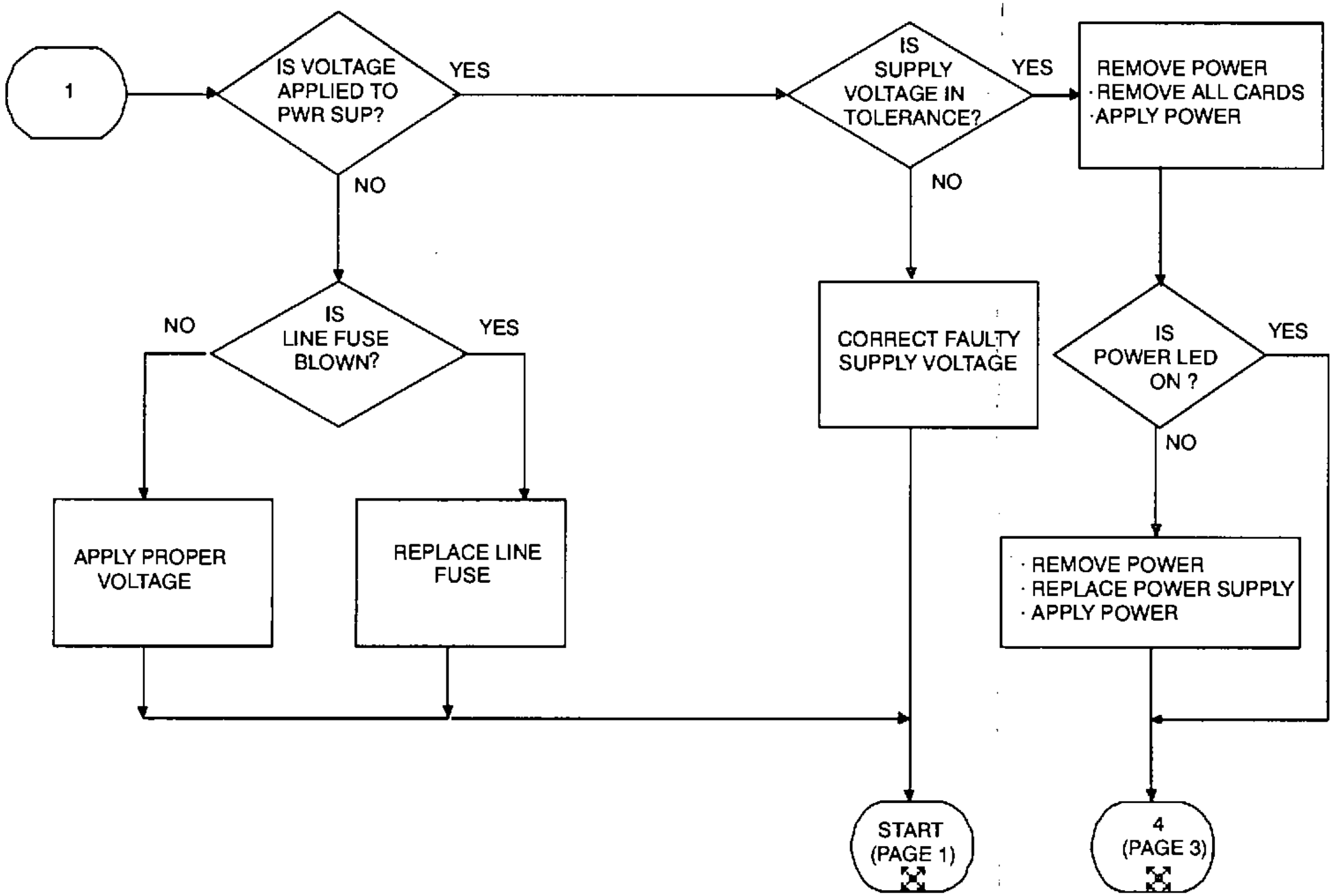
6. Total cable length must not exceed 50 feet between a CPU rack and an expansion rack. Length must not exceed 700 feet between a CPU rack and a remote rack. No termination plug is needed on a one–rack system.



PAGE 1

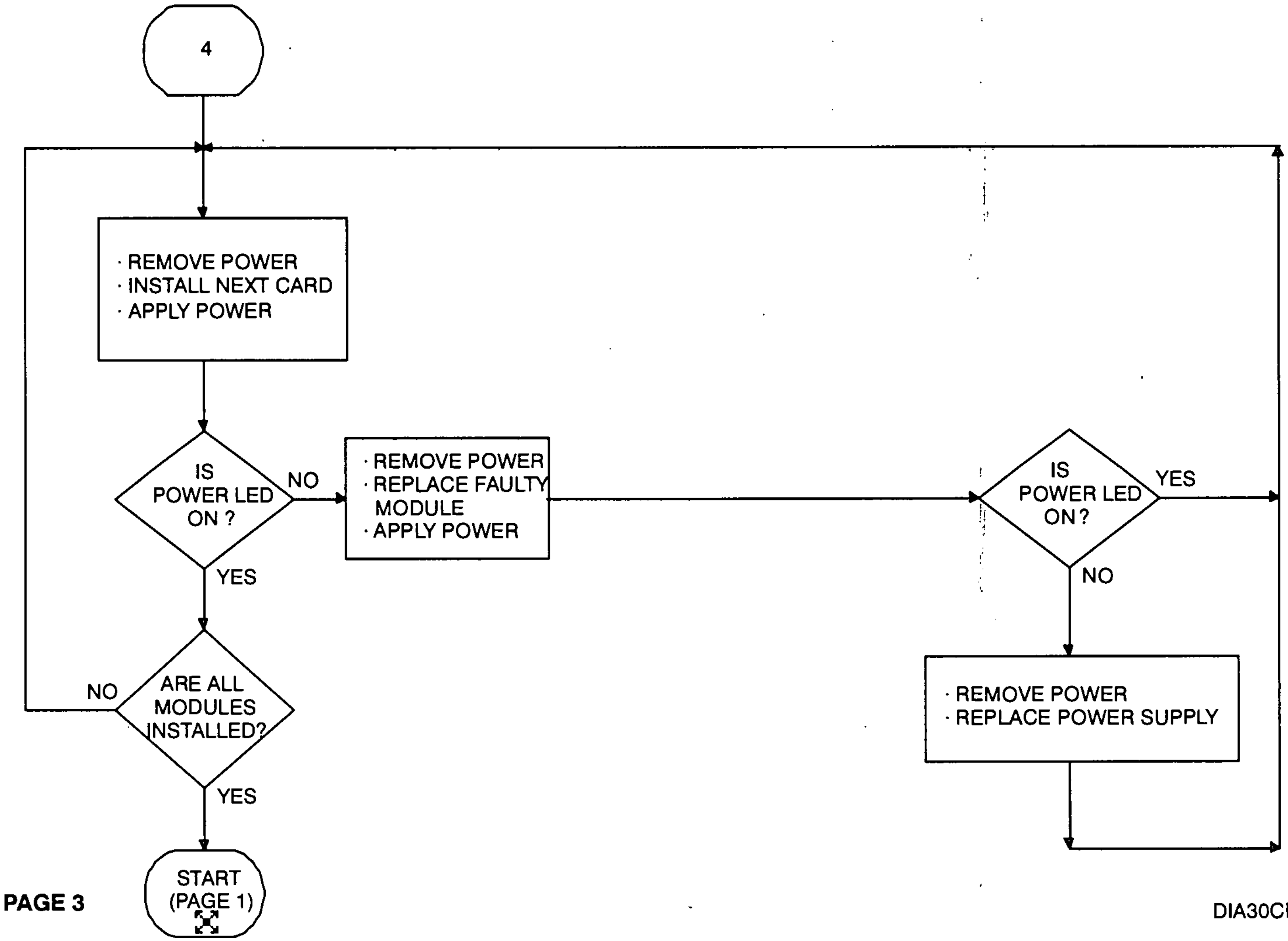
(Refer to the Preface for information on safety considerations, related publications and the symbols used in this guide.)

DIA30AL
GFZ-0085



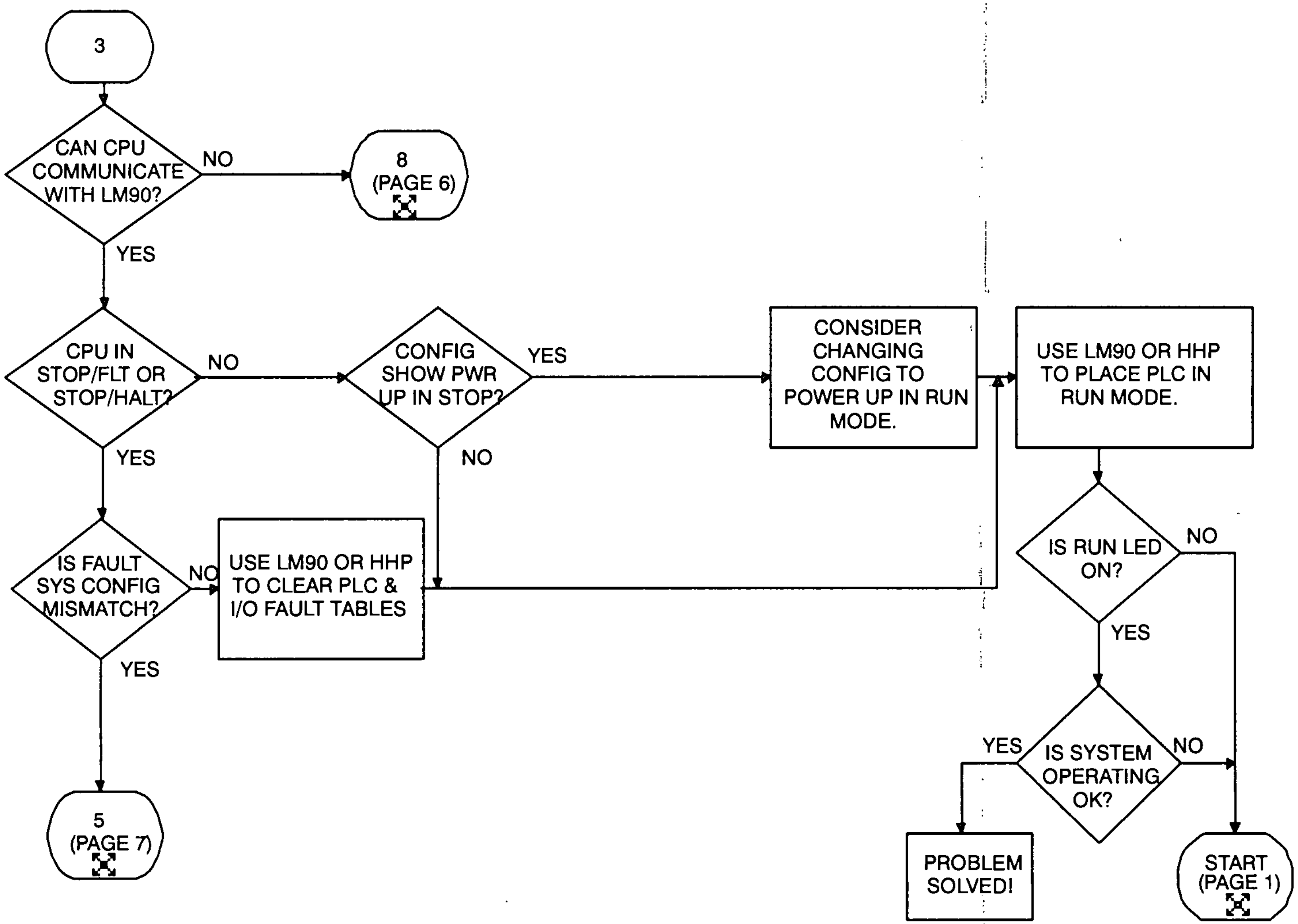
PAGE 2

DIA30BL



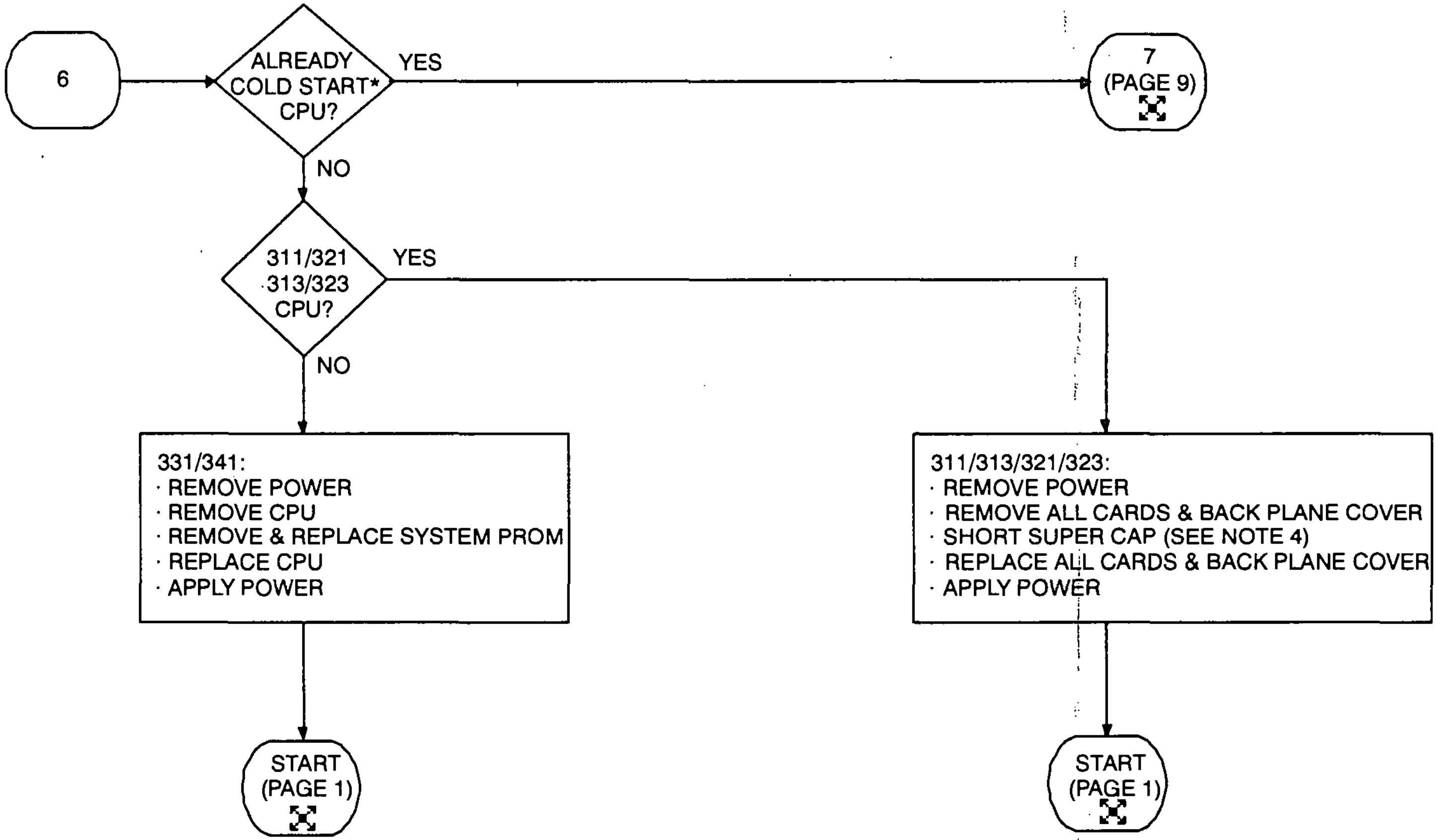
PAGE 3

DIA30CL



PAGE 4

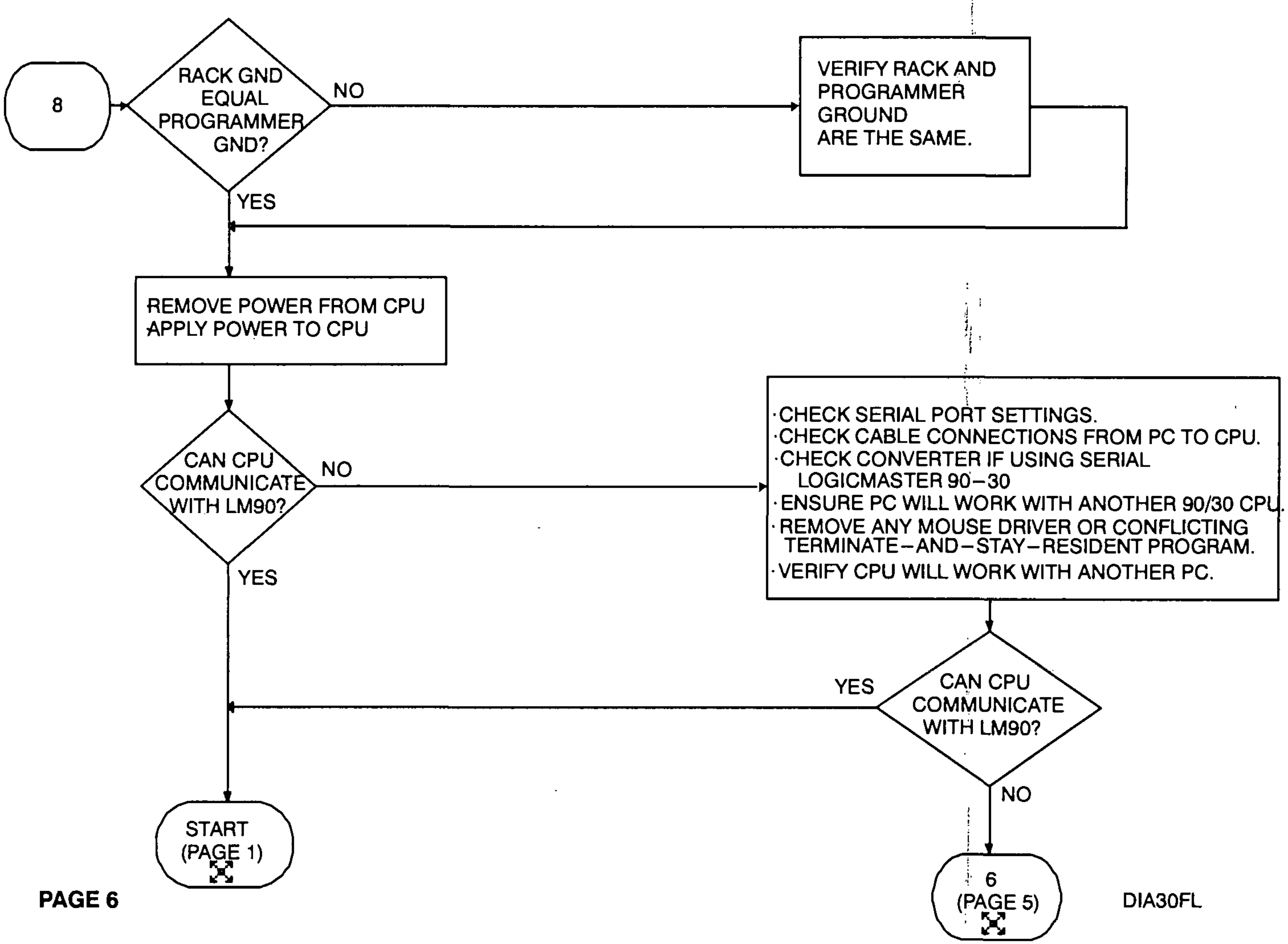
DIA30DL



*COLD START DELETES THE CONTENTS OF THE CPU'S MEMORY AND RESTORES COMMUNICATION PARAMETERS (BAUD RATE, PARITY, ETC.) TO THEIR DEFAULT VALUES.

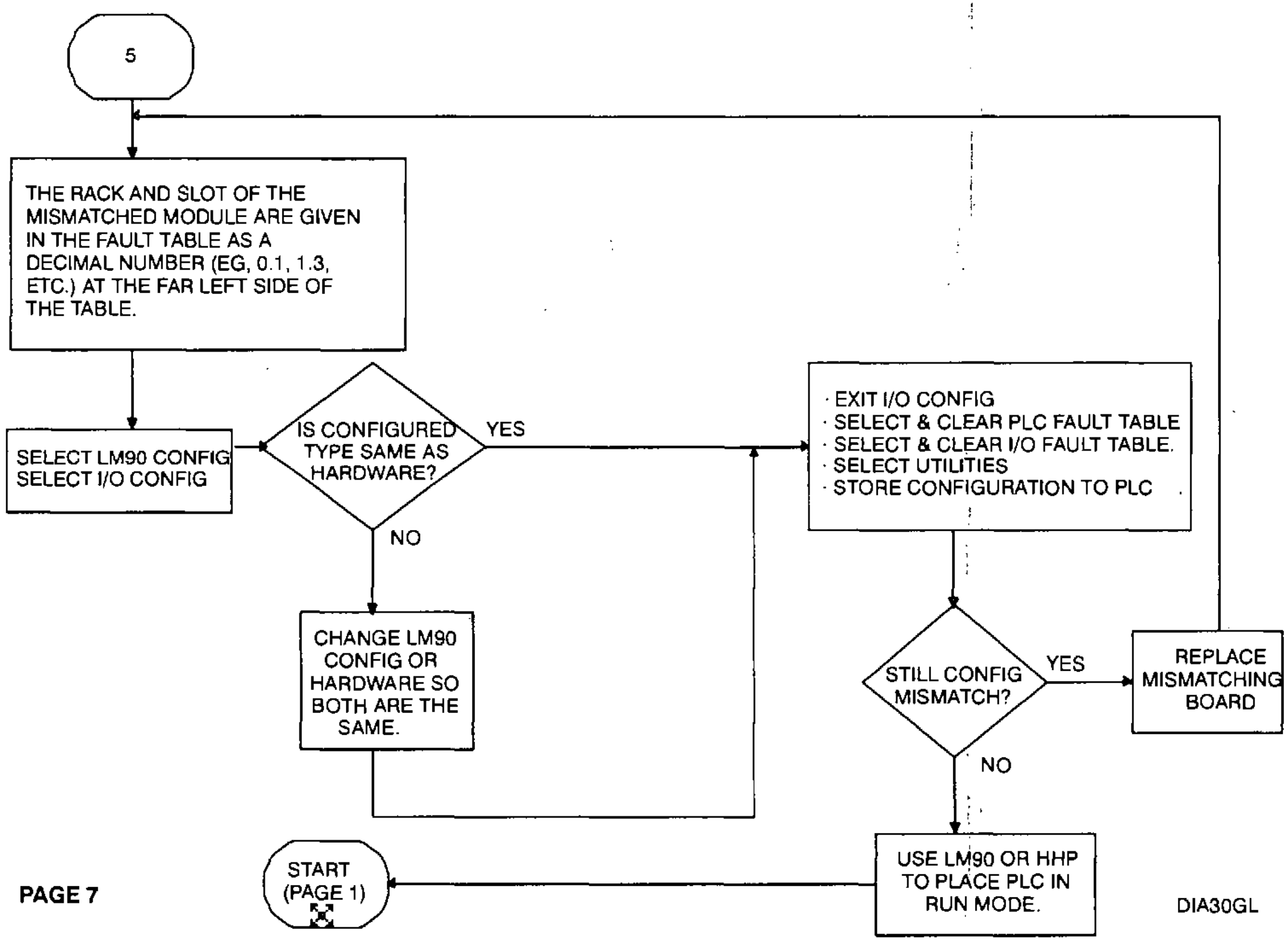
PAGE 5

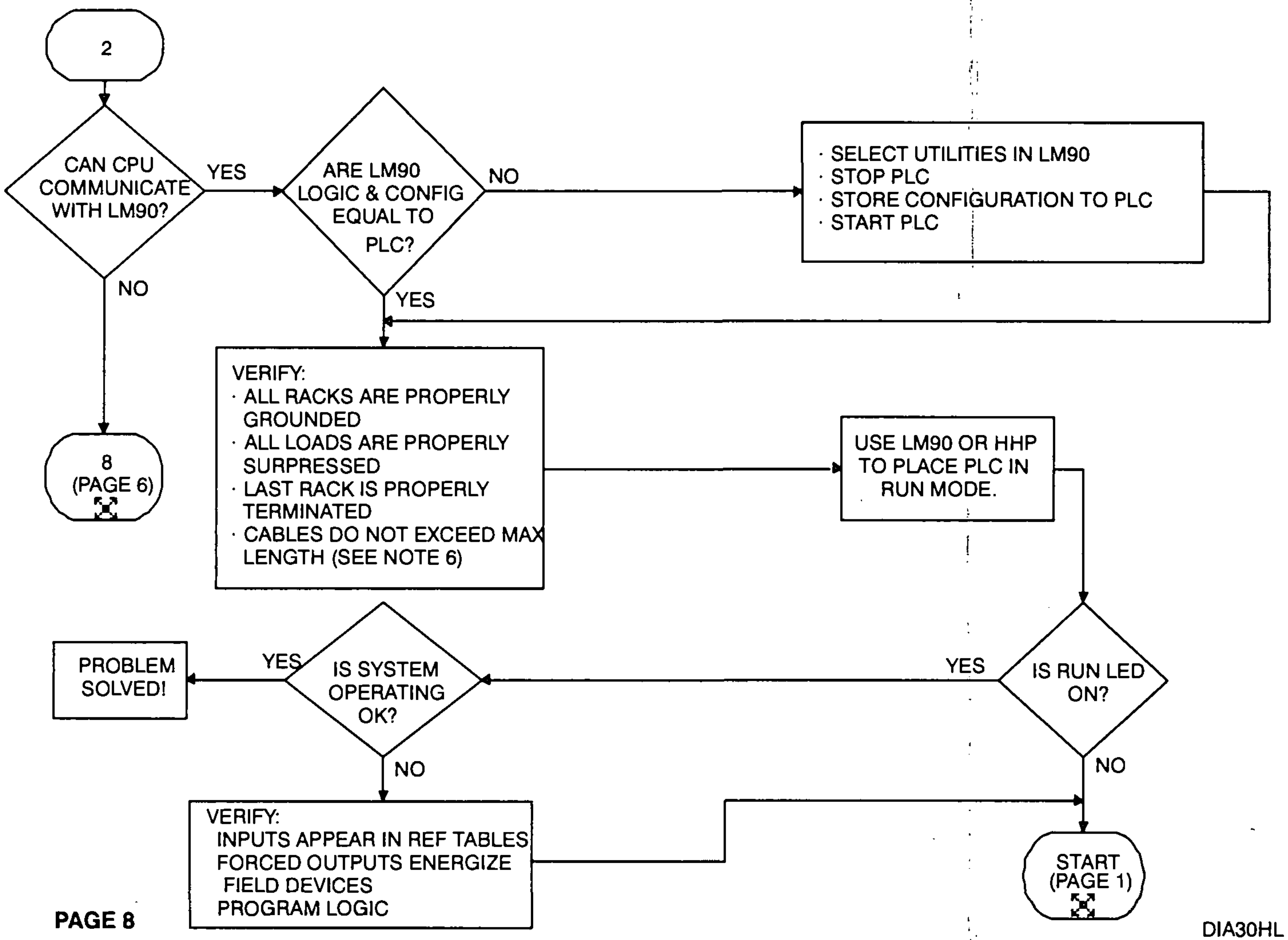
DIA30EL

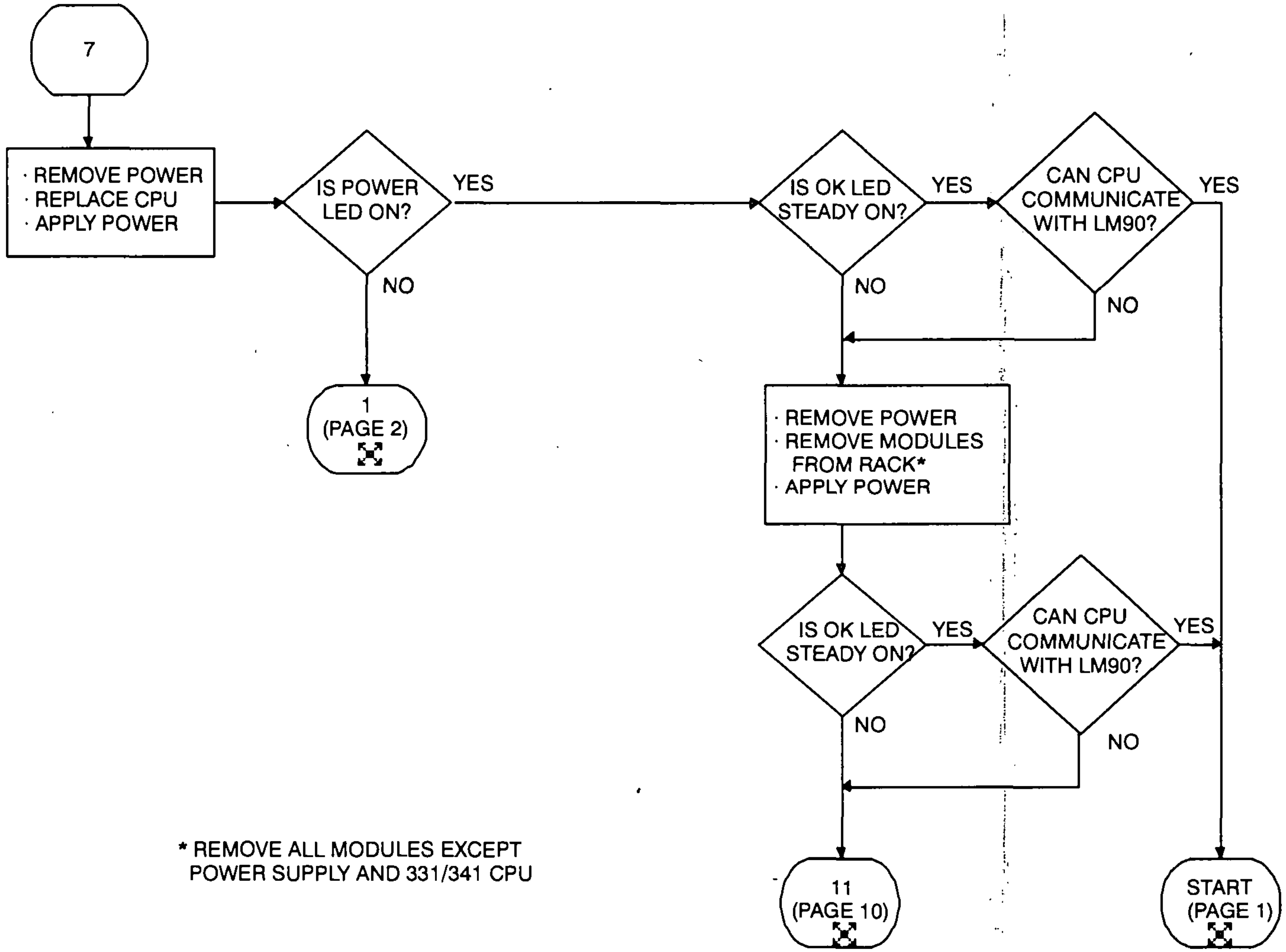


PAGE 6

DIA30FL

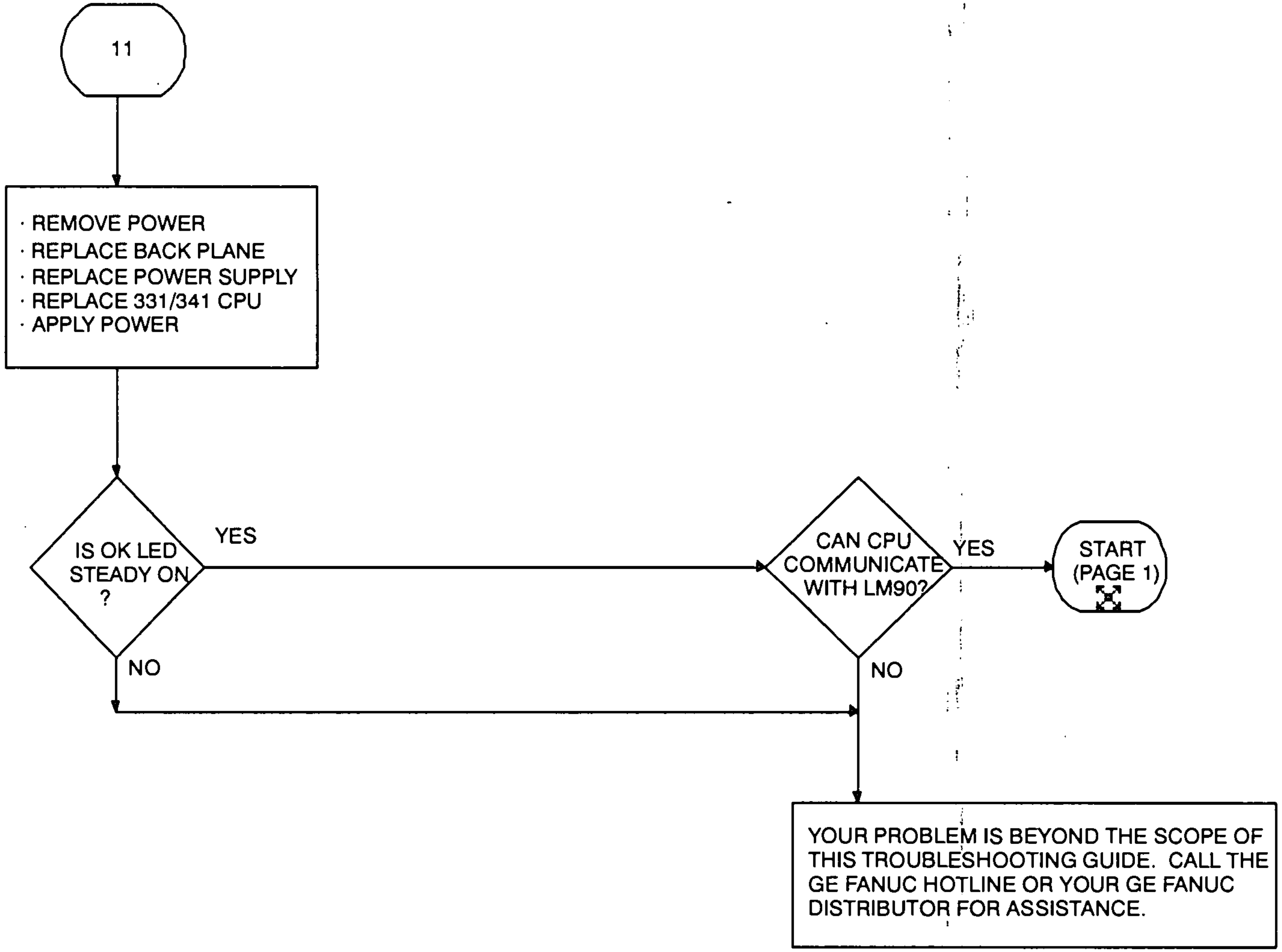

5
THE RACK AND SLOT OF THE MISMATCHED MODULE ARE GIVEN IN THE FAULT TABLE AS A DECIMAL NUMBER (EG, 0.1, 1.3, ETC.) AT THE FAR LEFT SIDE OF THE TABLE.
SELECT LM90 CONFIG
SELECT I/O CONFIG
IS CONFIGURED TYPE SAME AS HARDWARE?
YES
NO
CHANGE LM90 CONFIG OR HARDWARE SO BOTH ARE THE SAME.
· EXIT I/O CONFIG
· SELECT & CLEAR PLC FAULT TABLE
· SELECT & CLEAR I/O FAULT TABLE.
· SELECT UTILITIES
· STORE CONFIGURATION TO PLC
STILL CONFIG MISMATCH?
YES
REPLACE MISMATCHING BOARD
NO
USE LM90 OR HHP TO PLACE PLC IN RUN MODE.
START (PAGE 1)
PAGE 7
DIA30GL


2
CAN CPU COMMUNICATE WITH LM90?
YES
NO
ARE LM90 LOGIC & CONFIG EQUAL TO PLC?
NO
YES
· SELECT UTILITIES IN LM90
· STOP PLC
· STORE CONFIGURATION TO PLC
· START PLC
8 (PAGE 6)
VERIFY:
· ALL RACKS ARE PROPERLY GROUNDED
· ALL LOADS ARE PROPERLY SURPRESSED
· LAST RACK IS PROPERLY TERMINATED
· CABLES DO NOT EXCEED MAX LENGTH (SEE NOTE 6)
USE LM90 OR HHP TO PLACE PLC IN RUN MODE.
PROBLEM SOLVED!
YES
IS SYSTEM OPERATING OK?
YES
IS RUN LED ON?
NO
NO
VERIFY:
INPUTS APPEAR IN REF TABLES
FORCED OUTPUTS ENERGIZE FIELD DEVICES
PROGRAM LOGIC
START (PAGE 1)
PAGE 8
DIA30HL



PAGE 9

DIA30JL



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DIA30KL

SE POWER EQUIPMENT

ESTABLISHED 1981

DIESEL STANDBY GENERATOR

LOCAL CONTROL PANEL

FUNCTIONAL DESCRIPTION

FOR

Brisbane City Council

19th May 2003

ABBREVIATIONS

G1 Generator 1 Diesel

1. GENERAL

1.1. The PLC for the above operation is a GE Fanuc IC693CPU350. This program has been designed for the use on G1. The operation below controls G1.

1.2. A mode selector switch selects how G1 shall operate :

1.2.1. Off

1.2.2. Manual Mode

1.2.3. Test Mode.

1.2.4. Automatic Mode.

2. MANUAL MODE

2.1. To operate G1 in MANUAL Mode.

2.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.

2.3. Press the MANUAL START push button to start the generator.

2.4. The generator will begin to crank.

2.4.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

2.4.2. The generator set is allowed 3 attempts to start.

2.4.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.

2.4.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

2.4.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

2.4.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

2.4.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

2.5. To Manual Transfer to Generator in the MANUAL Mode.

2.5.1. Start the generator and wait for the generator to run up to speed and voltage and ready to accept load.

2.5.2. Press the MANUAL TRANSFER TO GEN push button.

2.5.3. The MAINS ATS shall Open.

2.5.4. After a 30 second delay the GEN ATS shall Close.

2.5.5. If the MAINS ATS fails to Open.

2.5.5.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

2.5.5.2. The system shall return back to MAINS ATS operation.

2.5.6. If the GEN ATS fails to Close.

2.5.6.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

2.5.6.2. The system shall return back to MAINS ATS operation.

2.6. To Manual Transfer to Mains in the MANUAL Mode.

2.6.1. The GENERATOR ATS is Closed.

2.6.2. Press the MAN TRANSFER TO MAINS push button.

2.6.3. The GEN ATS shall Open.

2.6.4. After a 30 second delay the MAINS ATS shall Close.

2.6.5. If the GEN ATS fails to Open.

2.6.5.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

2.6.5.2. The system shall return back to GEN ATS operation.

2.6.6. If the MAINS ATS fails to Close.

2.6.6.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

2.6.6.2. The system shall return back to GEN ATS operation.

2.7. To stop the generator in the MANUAL Mode.

2.7.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.

2.7.2. If the generator is still GEN ATS operation. The MANUAL TRANSFER TO MAINS is initiated.

2.7.3. When the GEN ATS is Open, the generator will enter the cool down time of 1 second.

2.7.4. After the cool down time, the generator will shut down.

2.7.5. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

3. NON-PERMANENT SITE, MANUAL MODE

3.1. To operate G1 in a Non-Permanent Site Location in MANUAL Mode.

3.2. Connect the generator cables to the site generator CB ensuring the site generator CB is OFF. See BCC procedures.

3.3. A plug with shorting links is required to be installed. It is required to be plugged into the 27 Pin Station Plug.

3.3.1. Pins 11 and 12 are required to be connected. This is to indicate that the Mains ATS is Closed. If they are not connected a MAINS ATS Alarm shall be indicated.

3.4. Select from the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.

3.5. Press the MANUAL START push button to start the generator.

3.6. The generator will begin to crank.

3.6.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

3.6.2. The generator set is allowed 3 attempts to start.

3.6.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.

3.6.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

3.6.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

3.6.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

3.6.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

3.7. To connect the generator to the site load.

3.7.1. Manually switch over to the generator supply via the site CB's. See BCC procedures.

3.7.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.

3.8. To disconnect the generator from the site load.

3.8.1. Manually switch over to the mains supply via the site CB's. See BCC procedures.

3.8.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.

3.9. To stop the generator in the MANUAL Mode.

3.9.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.

3.9.2. The generator will enter the cool down time of 1 second.

3.9.3. After the cool down time, the generator will shut down.

3.9.4. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

4. TEST OPERATION

4.1. To operate the generator in the TEST Mode.

4.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the TEST position.

4.3. If the selector is changed to MAN while the generator is operating on TEST, the system shall change to MANUAL TRANSFER TO GEN.

4.4. The generator shall begin to crank.

4.4.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

4.4.2. The generator is allowed 3 attempts to start.

4.4.3. If it fails to start on the third attempt, the generator is faulted on FAIL TO START Alarm.

4.5. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

4.6. The MAINS ATS shall Open.

4.7. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

4.8. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

4.9. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

4.10. After the warm up time has expired and the MAINS ATS has been open for 30 seconds the GEN ATS shall Close.

4.11. If the MAINS ATS fails to Open.

4.11.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

4.11.2. The system shall shut down and return back to MAINS ATS operation.

4.12. If the GEN ATS fails to Close.

4.12.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

4.12.2. The system shall shut down and return back to MAINS ATS operation.

4.13. To stop the generator in the TEST Mode.

4.13.1. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO or OFF position.

4.13.2. The GEN ATS shall Open.

4.13.3. After a 30 second delay the MAINS ATS shall Close.

4.13.4. If the GEN ATS fails to Open.

4.13.4.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

4.13.4.2. The system shall return back to GEN ATS operation.

4.13.5. If the MAINS ATS fails to Close.

4.13.5.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

4.13.5.2. The system shall return back to GEN ATS operation.

4.13.6. When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

4.13.7. After the cool down time, the generator will shut down.

4.13.8. If a Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

4.13.9. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

5. AUTOMATIC OPERATION

5.1. To operate the generator in the AUTO Mode.

5.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.

5.3. The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.

5.4. The Remote Start Command.

5.4.1. The generator shall begin to crank.

5.4.1.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

5.4.1.2. The generator is allowed 3 attempts to start.

5.4.1.3. If it fails to start on the third attempt, the generator is faulted on FAIL TO START Alarm.

5.4.2. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

5.4.3. The MAINS ATS shall Open.

5.4.4. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

5.4.5. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

5.4.6. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

5.4.7. After the warm up time has expired and the MAINS ATS has been open for 30 seconds the GEN ATS shall Close.

5.4.8. If the MAINS ATS fails to Open.

5.4.8.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

5.4.8.2. The system shall shut down and return back to MAINS ATS operation.

5.4.9. If the GEN ATS fails to Close.

5.4.9.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

5.4.9.2. The system shall shut down and return back to MAINS ATS operation.

5.5. To stop the generator in the AUTO Mode.

5.5.1. The Phase Failure Relay from the clients switch board shall give a Stop Signal for the generators to run.

5.5.2. The Remote Stop Command.

5.5.3. There is a 2 minute proving time for the Phase Failure Relay.

5.5.4. After the 2 minute proving time the GEN ATS shall Open.

5.5.5. After a 30 second delay the MAINS ATS shall Close.

5.5.6. If the GEN ATS fails to Open.

5.5.6.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

5.5.6.2. The system shall return back to GEN ATS operation.

5.5.7. If the MAINS ATS fails to Close.

5.5.7.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

5.5.7.2. The system shall return back to GEN ATS operation.

5.5.8. When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

5.5.9. After the cool down time, the generator will shut down.

5.5.10. If a Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

5.5.11. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

6. FAULT OPERATION

6.1. Emergency Stop Operation.

6.1.1. Operation of the Emergency Stop push button immediately shuts down the generator and Opens the Generator CB. The Emergency Stop is latched, and requires manual resetting to release the Emergency Stop push button.

6.1.2. After the Emergency Stop push button is released, a fault reset will need to be initiated to reset the PLC.

6.2. HIGH HIGH Alarm Operation.

6.2.1. The Generator CB is Opened immediately.

6.2.2. The generator is shut down immediately.

6.2.3. The following alarms will initiate a HIGH HIGH Alarm condition :-

6.2.3.1. Emergency Stop Fault

6.2.3.2. MEN Fault

6.2.3.3. Low Oil Pressure Shutdown Fault, 10 Seconds Startup Delay

6.2.3.4. High Engine Temperature Shutdown Fault, 30 Second Startup Delay

6.2.3.5. Low Radiator Level Fault, 5 Second Delay

6.2.3.6. Over Speed Fault

6.3. HIGH Alarm Operation

6.3.1. The Generator CB is Opened immediately.

6.3.2. Once the generator circuit breaker is opened, the generator will run through its normal cool down time and shut down.

6.3.3. The following alarms will initiate a HIGH Alarm condition:-

6.3.3.1. Generator Under Speed Fault, 5 Second Delay

6.3.3.2. Alternator Under Voltage Fault, 5 Second Delay

6.3.3.3. Alternator Over Voltage Fault, 5 Second Delay

6.3.3.4. Generator CB Tripped Fault

6.3.3.5. Alternator High Temperature Fault, 30 Second Startup Delay

6.4. MEDIUM Alarm Operation.

6.4.1. A Normal Shutdown shall be Initiated.

6.4.2. If the GEN ATS does not Open then the Generator CB is Opened.

6.4.3. The following alarms will initiate a MEDIUM Alarm condition :-

6.4.3.1. Fuel Empty Level Fault, 5 Second Delay

6.4.3.2. Fail To Start Fault, 3 Attempts

6.5. LOW Alarm Operation.

6.5.1. A Warning has occurred on the generator. The generator will not shut down.

6.5.2. The following alarms will initiate a LOW Alarm condition :-

6.5.2.1. Low Oil Pressure Warning Alarm, 10 Seconds Startup Delay

6.5.2.2. High Engine Temperature Warning Alarm, 30 Second Startup Delay

6.5.2.3. Fuel Low Level Alarm, 5 Second Delay

6.5.2.4. Battery Charger AC Supply Failed Alarm, 60 Second Delay

6.5.2.5. Control Battery Low Volts Alarm, 30 Second Delay

6.5.2.6. Start Battery Low Volts Alarm, 60 Second Delay

Table of Contents

Main Rack: Base 10 Slot (IC693CHS391)

Main Rack: Slot 0

IC693PWR331 Power Supply 24 VDC 30W

Power Consumption

Voltages / Supplied

+5VDC (Watts) 30
+24VDC Relay Power (Watts) 15
+24VDC Isolated (Watts) 20
Total System: 30

Settings

Parameters / Values

Hand Held Programmer: No
Converter: 0

Main Rack: Slot 1

IC693CPU350 Series 90-30 CPU Model 350

Settings

Parameters / Values

I/O Scan-Stop: No
Power Up Mode: Run
Logic / Configuration From: RAM
Registers: RAM
Passwords: Disabled
Checksum Words: 8
Data Rate (bps): 19200
Parity: Odd
Stop Bits: 1
Modem Turnaround Time (.01 Sec / Count): 0
Idle Time (Sec): 10
Timer Faults: Disabled
SNP ID:
Key Switch Run/Stop: Enabled
Memory Protect: Disabled
Ignore Fatal Faults: Disabled

Scan

Parameters / Values

Sweep Mode: Normal
Sweep Timer (mSec): N/A

Memory

Parameters / Values

%I Discrete Input: 2048
%Q Discrete Output: 2048
%S System Use: 128
%M Internal Discrete: 4096
%T Temporary Status: 256
%G Genius® Global: 1280
%AI Analog Input: 2048
%AQ Analog Output: 512
%R Register Memory: 9999

Power Consumption

Parameters / Values

+5VDC (Watts) 3.35
+24VDC Relay Power (Watts) 0
+24VDC Isolated (Watts) 0

Main Rack: Slot 2

IC693CMM311 Communications Coprocessor

Settings

Parameters / Values

Configuration Mode: RTU Only

Port 1

Parameters / Values

RTU Enable: Yes
Data Rate (bps): 9600
Flow Control: None
Parity: None
Station Address: 1

Port 2

Parameters / Values

RTU Enable: Yes
Interface: RS485
Data Rate (bps): 9600
Flow Control: None
Parity: None
Station Address: 1

Power Consumption

Parameters / Values

+5VDC (Watts) 2.00
+24VDC Relay Power (Watts) 0
+24VDC Isolated (Watts) 0

Main Rack: Slot 3

IC693MDL645 16 Circuit Input 24 VDC Positive / Negative Logic

Settings

Parameters / Values

Reference Address: %I00001
Length: 16

Wiring

Terminal / Wiring Information

From Terminal 1 to Terminal 20 : No wiring information.

Power Consumption

Parameters / Values

+5VDC (Watts) 0.40
+24VDC Relay Power (Watts) 0

+24VDC Isolated (Watts) 0.6

Main Rack: Slot 4

IC693MDL645 16 Circuit Input 24 VDC Positive / Negative Logic

Settings

Parameters / Values

Reference Address: %I00017
Length: 16

Wiring

Terminal / Wiring Information

From Terminal 1 to Terminal 20 : No wiring information.

Power Consumption

Parameters / Values

+5VDC (Watts) 0.40
+24VDC Relay Power (Watts) 0
+24VDC Isolated (Watts) 0.6

Main Rack: Slot 5

IC693MDL645 16 Circuit Input 24 VDC Positive / Negative Logic

Settings

Parameters / Values

Reference Address: %I00033
Length: 16

Wiring

Terminal / Wiring Information

From Terminal 1 to Terminal 20 : No wiring information.

Power Consumption

Parameters / Values

+5VDC (Watts) 0.40
+24VDC Relay Power (Watts) 0
+24VDC Isolated (Watts) 0.6

Main Rack: Slot 7

IC693MDL940 16 Circuit Output Relay 2A

Settings

Parameters / Values

Reference Address: %Q00001
Length: 16

Wiring

Terminal / Wiring Information

From Terminal 1 to Terminal 20 : No wiring information.

Power Consumption

Parameters / Values
+5VDC (Watts) 0.04
+24VDC Relay Power (Watts) 3.24
+24VDC Isolated (Watts) 0

Main Rack: Slot 8

IC693MDL940 16 Circuit Output Relay 2A

Settings

Parameters / Values
Reference Address: %Q00017
Length: 16

Wiring

Terminal / Wiring Information
From Terminal 1 to Terminal 20 : No wiring information.

Power Consumption

Parameters / Values
+5VDC (Watts) 0.04
+24VDC Relay Power (Watts) 3.24
+24VDC Isolated (Watts) 0

Main Rack: Slot 9

IC693MDL940 16 Circuit Output Relay 2A

Settings

Parameters / Values
Reference Address: %Q00033
Length: 16

Wiring

Terminal / Wiring Information
From Terminal 1 to Terminal 20 : No wiring information.

Power Consumption

Parameters / Values
+5VDC (Watts) 0.04
+24VDC Relay Power (Watts) 3.24
+24VDC Isolated (Watts) 0

%I References

Overlap	Start	End	Addr	Mem Type	Cat Num
	1	16	(0.3)	Consumed	IC693MDL645
	17	32	(0.4)	Consumed	IC693MDL645
	33	48	(0.5)	Consumed	IC693MDL645

Total %I: 48 Highest Reference: 48

%Q References

Overlap	Start	End	Addr	Mem Type	Cat Num
	1	16	(0.7)	Produced	IC693MDL940
	17	32	(0.8)	Produced	IC693MDL940
	33	48	(0.9)	Produced	IC693MDL940

Total %Q: 48 Highest Reference: 48

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	E
SEL_AUTO	BIT	1	%I00001	Selector Switch Auto		Global	R		
SEL_TEST	BIT	1	%I00002	Selector Switch Test		Global	R		
SEL_MAN	BIT	1	%I00003	Selector Switch Manual		Global	R		
EM_STOP_PB	BIT	1	%I00004	Emergency Stop PB		Global	R		
LAMP_TEST_PB	BIT	1	%I00005	Lamp Test PB		Global	R		
ALM_RESET_PB	BIT	1	%I00006	Alarm Reset PB		Global	R		
ALM_MUTE_PB	BIT	1	%I00007	Alarm Mute PB		Global	R		
MAN_STR_PB	BIT	1	%I00008	Manaul Start PB		Global	R		
MAN_STP_PB	BIT	1	%I00009	Manual Stop PB		Global	R		
MAN_TRF_MAINS_PB	BIT	1	%I00010	Manual Transfer to Mains PB		Global	R		
MAN_TRF_GEN_PB	BIT	1	%I00011	Manual Transfer to Generator PB		Global	R		
SPD_STP_CRK	BIT	1	%I00017	Crank Cutout Relay		Global	R		
SPD_UNDER	BIT	1	%I00018	Under Speed Relay		Global	R		
SPD_OVER	BIT	1	%I00019	Over Speed Relay		Global	R		
VOLTS_UNDER	BIT	1	%I00020	Under Voltage Relay		Global	R		
VOLTS_OVER	BIT	1	%I00021	Over Voltage Relay		Global	R		
ALT_TEMP	BIT	1	%I00022	Alternator High Temperature Relay		Global	R		
GEN_CB_TRIP	BIT	1	%I00023	Generator CB Tripped		Global	R		
MEN_FLT	BIT	1	%I00024	MEN Fault Relay		Global	R		
BAT_CHG_AC	BIT	1	%I00025	Battery Charger AC Relay		Global	R		
BAT_CONT_LOW_V	BIT	1	%I00026	Control Battery Charger Low Voltage		Global	R		
BAT_STR_LOW_V	BIT	1	%I00027	Start Battery Charger Low Voltage		Global	R		
MAINS_FAILED	BIT	1	%I00033	BCC Mains Failed		Global	R		
MAINS_ATS_CLS	BIT	1	%I00034	BCC Mains ATS Closed		Global	R		
GEN_ATS_CLS	BIT	1	%I00035	BCC Generator ATS Closed		Global	R		
REM_STR	BIT	1	%I00036	BCC Remote Start		Global	R		
REM_STP	BIT	1	%I00037	BCC Remote Stop		Global	R		
OIL_P_LOW_SD	BIT	1	%I00041	Low Oil Pressure Shutdown		Global	R		
OIL_P_LOW_W	BIT	1	%I00042	Low Oil Pressure Warning		Global	R		
ENG_T_HI_SD	BIT	1	%I00043	High Engine Temperature Shutdown		Global	R		
ENG_T_HI_W	BIT	1	%I00044	High Engine Temperature Warning		Global	R		
RAD_WATER_LOW	BIT	1	%I00045	Low Radiator Water Level		Global	R		
FUEL_LEV_LOW	BIT	1	%I00046	Low Fuel Level		Global	R		
FUEL_LEV_EMPTY	BIT	1	%I00047	Fuel Empty		Global	R		
CAN_DOORS_OPEN	BIT	1	%I00048	Canopy Doors Open		Global	R		
STEP_1	BIT	1	%M00001	Step Sequence No.1		Global			
STEP_2_E	BIT	1	%M00002	Step Sequence No.2		Global			
STEP_3	BIT	1	%M00003	Step Sequence No.3		Global			
STEP_4	BIT	1	%M00004	Step Sequence No.4		Global			
STEP_5	BIT	1	%M00005	Step Sequence No.5		Global			
STEP_6	BIT	1	%M00006	Step Sequence No.6		Global			
STEP_7	BIT	1	%M00007	Step Sequence No.7		Global			
STEP_8	BIT	1	%M00008	Step Sequence No.8		Global			
STEP_9	BIT	1	%M00009	Step Sequence No.9		Global			
STEP_2_GE	BIT	1	%M00022	Step Sequence No.2 GE		Global			
GEN_OFF	BIT	1	%M00101	Generator OFF		Global			
AUTO_TEST_STR	BIT	1	%M00102	Auto Test Start / Stop		Global			
REMOTE_STR	BIT	1	%M00103	Remote Start		Global			
MAINS_FAIL_STP	BIT	1	%M00104	Mains Failed Stop		Global			
REMOTE_STP	BIT	1	%M00105	Remote Stop		Global			
TEST_STR	BIT	1	%M00106	Test Start		Global			
TEST_STP	BIT	1	%M00107	Test Stop		Global			
GEN_RUN_OFF	BIT	1	%M00108	Generator Run Off		Global			
ENABLE_OFFLINE	BIT	1	%M00109	Enable Generator to go Offline		Global			
HH_ALM_OS1	BIT	1	%M00110	High High Alarm One Shot		Global			
H_ALM_OS1	BIT	1	%M00111	High Alarm One Shot		Global			
H_ALM_OS2	BIT	1	%M00112	High Alarm One Shot		Global			
M_ALM_OS1	BIT	1	%M00113	Medium Alarm One Shot		Global			
M_ALM_OS2	BIT	1	%M00114	Medium Alarm One Shot		Global			
M_ATS_ALM_OS1	BIT	1	%M00115	Mains ATS Alarm One Shot		Global			
M_ATS_ALM_OS2	BIT	1	%M00116	Mains ATS Alarm One Shot		Global			
MAINS_FAIL_STR	BIT	1	%M00117	Mains Fail Start		Global			
GEN_RUNNING	BIT	1	%M00201	Generator Running		Global			
FAIL_STR_TM	BIT	1	%M00202	Failed to Start Time		Global			
FAIL_STR_DLY	BIT	1	%M00203	Failed to Start Pulse Delay		Global			

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	E
FAIL_STR_CNT	BIT	1	%M00204	Failed to Start Counter		Global			
CRK_CUTOUT	BIT	1	%M00205	Generator Crank Cutout		Global			
ENB_STR_DLY	BIT	1	%M00206	Enable Start Delay for Alarms		Global			
OIL_P_DLY	BIT	1	%M00207	Oil Pressure Alarm Delay		Global			
STR_UP_DLY	BIT	1	%M00208	Startup Alarm Delay		Global			
ATS_OPN_1	BIT	1	%M00209	Mains ATS Open Command		Global			
ATS_CLS_1	BIT	1	%M00210	Generator ATS Close Command		Global			
G_ATS_OPN_1	BIT	1	%M00211	Generator ATS Open Command		Global			
M_ATS_CLS_1	BIT	1	%M00212	Mains ATS Close Command		Global			
M_ATS_CLS_ENB	BIT	1	%M00213	Mains ATS Close Enable		Global			
G_ATS_CLS_ENB	BIT	1	%M00214	Generator ATS Close Enable		Global			
HIGH_HIGH_ALM	BIT	1	%M00300	High High Alarm		Global			
EM_STP_ALM	BIT	1	%M00301	Emergency Stop Alarm		Global			
MEN_ALM	BIT	1	%M00302	MEN Alarm		Global			
OIL_P_SD_ALM	BIT	1	%M00303	Low Oil Pressure Shutdown Alarm		Global			
ENG_T_SD_ALM	BIT	1	%M00304	High Engine Temperature Shutdown Alarm		Global			
RAD_WATER_LOW_ALM	BIT	1	%M00305	Low Radiator Water Level Alarm		Global			
SPD_OVER_ALM	BIT	1	%M00306	Over Speed Alarm		Global			
RAD_WATER_LOW_DLY	BIT	1	%M00315	Radiator Water Level Low Delay		Global			
SPD_OVER_DLY	BIT	1	%M00316	Over Speed Delay Timer		Global	R		
HIGH_ALM	BIT	1	%M00320	High Alarm		Global			
ᶜᴾᴰ_UNDER_ALM	BIT	1	%M00321	Under Speed Alarm		Global			
TS_UNDER_ALM	BIT	1	%M00322	Alternator Voltage Under Alarm		Global			
VOLTS_OVER_ALM	BIT	1	%M00323	Alternator Voltage Over Alarm		Global			
GEN_CB_TRIP_ALM	BIT	1	%M00324	Generator CB Tripped Alarm		Global			
ALT_TEMP_ALM	BIT	1	%M00325	Alternator High Temperature Alarm		Global			
SPD_UNDER_DLY	BIT	1	%M00331	Under Speed Alarm Delay		Global			
VOLTS_UNDER_DLY	BIT	1	%M00332	Under Voltage Alarm Delay		Global			
VOLTS_OVER_DLY	BIT	1	%M00333	Over Voltage Alarm Delay		Global			
MEDIUM_ALM	BIT	1	%M00340	Medium Alarm		Global			
FUEL_LEV_EMPTY_ALM	BIT	1	%M00341	Fuel Empty Alarm		Global			
FAIL_TO_STR_ALM	BIT	1	%M00342	Fail to Start Alarm		Global			
FUEL_LEV_EMPTY_DLY	BIT	1	%M00351	Fuel Level Empty Alarm Delay		Global			
LOW_ALM	BIT	1	%M00360	Low Alarm		Global			
OIL_P_W_ALM	BIT	1	%M00361	Low Oil Pressure Warning Alarm		Global			
ENG_T_W_ALM	BIT	1	%M00362	High Engine Temperature Warning Alarm		Global			
FUEL_LEV_LOW_ALM	BIT	1	%M00363	Low Fuel Level Alarm		Global			
BAT_CHG_AC_ALM	BIT	1	%M00364	Battery Charger AC Alarm		Global			
PᴬT_CONT_LOW_V_ALM	BIT	1	%M00365	Control Battery Charger Low Voltage Alarm		Global			
B_STR_LOW_V_ALM	BIT	1	%M00366	Start Battery Charger Low Voltage Alarm		Global			
FUEL_LEV_LOW_DLY	BIT	1	%M00373	Fuel Level Low Alarm Delay		Global	R		
BAT_CHG_AC_DLY	BIT	1	%M00374	Battery Charger AC Failure Delay		Global	R		
BAT_CONT_LOW_V_DLY	BIT	1	%M00375	Control Battery Low Voltage Delay		Global	R		
BAT_STR_LOW_V_DLY	BIT	1	%M00376	Start Battery Low Voltage Delay		Global	R		
MAINS_ATS_OPN_ALM	BIT	1	%M00381	Mains ATS Failed to Open Alarm		Global			
MAINS_ATS_CLS_ALM	BIT	1	%M00382	Mains ATS Failed to Close Alarm		Global			
GEN_ATS_OPN_ALM	BIT	1	%M00383	Generator ATS Failed to Open Alarm		Global			
GEN_ATS_CLS_ALM	BIT	1	%M00384	Generator ATS Failed to Close Alarm		Global			
NEW_ALM	BIT	1	%M00400	New Alarm		Global	R		
%M00401	BIT	1	%M00401	**No Description**		Global	R		

Program: BCC_4000_4 A: GLOBAL VARIABI

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	E
%M00402	BIT	1	%M00402	**No Description**		Global	R		
%M00403	BIT	1	%M00403	**No Description**		Global	R		
%M00404	BIT	1	%M00404	**No Description**		Global	R		
%M00405	BIT	1	%M00405	**No Description**		Global	R		
%M00406	BIT	1	%M00406	**No Description**		Global	R		
%M00421	BIT	1	%M00421	**No Description**		Global	R		
%M00422	BIT	1	%M00422	**No Description**		Global	R		
%M00423	BIT	1	%M00423	**No Description**		Global	R		
%M00424	BIT	1	%M00424	**No Description**		Global	R		
%M00425	BIT	1	%M00425	**No Description**		Global	R		
%M00441	BIT	1	%M00441	**No Description**		Global	R		
%M00442	BIT	1	%M00442	**No Description**		Global	R		
%M00461	BIT	1	%M00461	**No Description**		Global	R		
%M00462	BIT	1	%M00462	**No Description**		Global	R		
%M00463	BIT	1	%M00463	**No Description**		Global	R		
%M00464	BIT	1	%M00464	**No Description**		Global	R		
%M00465	BIT	1	%M00465	**No Description**		Global	R		
%M00466	BIT	1	%M00466	**No Description**		Global	R		
%M00481	BIT	1	%M00481	**No Description**		Global	R		
%M00482	BIT	1	%M00482	**No Description**		Global	R		
%M00483	BIT	1	%M00483	**No Description**		Global	R		
%M00484	BIT	1	%M00484	**No Description**		Global	R		
AUTO_IND	BIT	1	%Q00001	Controls in Auto Indicator		Global			
TEST_IND	BIT	1	%Q00002	Controls in Test Indicator		Global			
MAN_IND	BIT	1	%Q00003	Controls in Manual Indicator		Global			
REM_STR_IND	BIT	1	%Q00004	Remote Start Indicator		Global			
MAINS_AVAIL_IND	BIT	1	%Q00005	Mains Available Indicator		Global			
MAINS_CON_IND	BIT	1	%Q00006	Mains Connected Indicator		Global			
GEN_RUN_IND	BIT	1	%Q00007	Generator Running Indicator		Global			
GEN_CON_IND	BIT	1	%Q00008	Generator Connected Indicated		Global			
MAINS_FAILED_IND	BIT	1	%Q00009	Mains Failed Indicator		Global			
EM_STOP_IND	BIT	1	%Q00010	Emergency Stop Indicator		Global			
MEN_FLT_IND	BIT	1	%Q00011	MEN Fault Indicator		Global			
OIL_P_LOW_SD_IND	BIT	1	%Q00012	Low Oil Pressure Shutdown Indicator		Global			
OIL_P_LOW_W_IND	BIT	1	%Q00013	Low Oil Pressure Warning Indicator		Global			
ENG_T_HI_SD_IND	BIT	1	%Q00014	High Engine Temperature Shutdown Indicator		Global			
ENG_T_HI_W_IND	BIT	1	%Q00015	High Engine Temperature Warning Indicator		Global			
RAD_WATER_LOW_IND	BIT	1	%Q00016	Low Radiator Water Level Indicator		Global			
FUEL_LEV_EMPTY_IND	BIT	1	%Q00017	Fuel Empty Indicator		Global			
FUEL_LEV_LOW_IND	BIT	1	%Q00018	Low Fuel Level Indicator		Global			
SPD_OVER_IND	BIT	1	%Q00019	Over Speed Indicator		Global			
SPD_UNDER_IND	BIT	1	%Q00020	Under Speed Indicator		Global			
FAIL_TO_STR_IND	BIT	1	%Q00021	Fail to Start Indicator		Global			
VOLTS_UNDER_IND	BIT	1	%Q00022	Alternator Voltage Under Indicator		Global			
VOLTS_OVER_IND	BIT	1	%Q00023	Alternator Voltage Over Indicator		Global			
ALT_TEMP_IND	BIT	1	%Q00024	Alternator High Temperature Indicator		Global			
GEN_CB_TRIP_IND	BIT	1	%Q00025	Generator CB Tripped Indicator		Global			
BAT_CHG_AC_IND	BIT	1	%Q00026	Battery Charger AC Indicator		Global			
BAT_CONT_LOW_V_IND	BIT	1	%Q00027	Control Battery Charger Low Voltage Indicator		Global			
BAT_STR_LOW_V_IND	BIT	1	%Q00028	Start Battery Charger Low Voltage Indicator		Global			
CAN_DOORS_OPEN_IND	BIT	1	%Q00029	Canopy Doors Open Indicator		Global			
MAINS_ATS_OPN_CMD	BIT	1	%Q00033	BCC Mains ATS Open Command		Global			
GEN_ATS_CLS_CMD	BIT	1	%Q00034	BCC Generator ATS Close Command		Global			
GEN_SD_ALM	BIT	1	%Q00035	BCC Generator Shutdown Alarm		Global			
GEN_W_ALM	BIT	1	%Q00036	BCC Generator Warning Alarm		Global			

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr
FUEL_LOW	BIT	1	%Q00037	BCC Low Fuel		Global		
GEN_RUN	BIT	1	%Q00038	BCC Generator Running		Global		
GEN_CON	BIT	1	%Q00039	BCC Generator Connected		Global		
SMR	BIT	1	%Q00040	Starter Motor Relay		Global		
GCR	BIT	1	%Q00041	Governor Control Relay		Global		
AAR	BIT	1	%Q00042	Audible Alarm Relay		Global		
SDAR	BIT	1	%Q00043	Generator Shunt Trip Relay		Global		
OORS_OPEN	BIT	1	%Q00044	BCC Doors Open Alarm		Global		
EN_AUTO	BIT	1	%Q00045	Generator Auto Mode		Global		
SEQ_CNT	WORD	1	%R00001	Sequence Counter		Global	R	
MODBUS_INPUTS	WORD	1	%R00002	Modbus Digital Inputs		Global	R	
MODBUS_OUTPUTS	WORD	1	%R00005	Modbus Digital Outputs		Global	R	
MODBUS_STATUS_1	WORD	1	%R00008	Modbus Status 1		Global	R	
MODBUS_STATUS_2	WORD	1	%R00009	Modbus Status 2		Global	R	
MODBUS_ALARMS	WORD	1	%R00010	Modbus Alarms		Global	R	
%R00100	WORD	3	%R00100	**No Description**		Global	R	
%R00103	WORD	3	%R00103	**No Description**		Global	R	
%R00106	WORD	3	%R00106	**No Description**		Global	R	
%R00109	WORD	3	%R00109	**No Description**		Global	R	
%R00112	WORD	3	%R00112	**No Description**		Global	R	
%R00115	WORD	3	%R00115	**No Description**		Global	R	
%R00118	WORD	3	%R00118	**No Description**		Global	R	
%R00121	WORD	3	%R00121	**No Description**		Global	R	
%R00124	WORD	3	%R00124	**No Description**		Global	R	
%R00127	WORD	3	%R00127	**No Description**		Global	R	
%R00130	WORD	3	%R00130	**No Description**		Global	R	
%R00133	WORD	3	%R00133	**No Description**		Global	R	
%R00136	WORD	3	%R00136	**No Description**		Global	R	
%R00139	WORD	3	%R00139	**No Description**		Global	R	
R00200	WORD	3	%R00200	**No Description**		Global	R	
00203	WORD	3	%R00203	**No Description**		Global	R	
%R00206	WORD	3	%R00206	**No Description**		Global	R	
%R00209	WORD	3	%R00209	**No Description**		Global	R	
%R00212	WORD	3	%R00212	**No Description**		Global	R	
%R00215	WORD	3	%R00215	**No Description**		Global	R	
%R00218	WORD	3	%R00218	**No Description**		Global	R	
%R00221	WORD	3	%R00221	**No Description**		Global	R	
%R00224	WORD	3	%R00224	**No Description**		Global	R	
%R00227	WORD	3	%R00227	**No Description**		Global	R	
%R00230	WORD	3	%R00230	**No Description**		Global	R	
%R00300	WORD	3	%R00300	**No Description**		Global	R	
%R00303	WORD	3	%R00303	**No Description**		Global	R	
%R00306	WORD	3	%R00306	**No Description**		Global	R	
%R00309	WORD	3	%R00309	**No Description**		Global	R	
%R00312	WORD	3	%R00312	**No Description**		Global	R	
%R00315	WORD	3	%R00315	**No Description**		Global	R	
%R00318	WORD	3	%R00318	**No Description**		Global	R	
%R00321	WORD	3	%R00321	**No Description**		Global	R	
%R00324	WORD	3	%R00324	**No Description**		Global	R	
%R00327	WORD	3	%R00327	**No Description**		Global	R	
%R00330	WORD	3	%R00330	**No Description**		Global	R	
%R00333	WORD	3	%R00333	**No Description**		Global	R	
00336	WORD	3	%R00336	**No Description**		Global	R	
0339	WORD	3	%R00339	**No Description**		Global	R	
FST_SCN	BIT	1	%S00001	Set to 1 when the current sweep is the first sweep		Global	R	
LST_SCAN	BIT	1	%S00002	Reset from 1 to 0 when the current sweep is the last sweep		Global	R	
T_10MS	BIT	1	%S00003	0.01 Second Timer Contact		Global	R	
T_100MS	BIT	1	%S00004	0.1 Second Timer Contact		Global	R	
T_1S	BIT	1	%S00005	1 Second Timer Contact		Global	R	
T_1M	BIT	1	%S00006	1 Minute Timer Contact		Global	R	
ALW_ON	BIT	1	%S00007	Always ON		Global	R	
ALW_OFF	BIT	1	%S00008	Always OFF		Global	R	
PLC_BAT	BIT	1	%S00014	Set to indicate a bad battery in the CPU		Global	R	
%R00400	WORD	1	%R00400	**No Description**		Global	R	

Program: BCC_4000_4 A: GLOBAL VARIABL

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	E
FST_SCN	BIT	1	%S00001	Set to 1 when the current sweep is the first sweep		System	R		
LST_SCN	BIT	1	%S00002	Reset from 1 to 0 when the current sweep is the last sweep		System	R		
T_10MS	BIT	1	%S00003	0.01 second timer contact		System	R		
T_100MS	BIT	1	%S00004	0.1 second timer contact		System	R		
T_SEC	BIT	1	%S00005	1.0 second timer contact		System	R		
T_MIN	BIT	1	%S00006	1.0 minute timer contact		System	R		
ALW_ON	BIT	1	%S00007	Always ON		System	R		
ALW_OFF	BIT	1	%S00008	Always OFF		System	R		
SY_FULL	BIT	1	%S00009	Set when the PLC fault table fills up		System	R		
IO_FULL	BIT	1	%S00010	Set when the I/O fault table fills up		System	R		
OVR_PRE	BIT	1	%S00011	Set when an override exists in %I, %Q, %M or %G memory		System	R		
PRG_CHK	BIT	1	%S00013	Set when background program check is active		System	R		
PLC_BAT	BIT	1	%S00014	Set to indicate a bad battery in a Release 4 or later CPU		System	R		
SNPXACT	BIT	1	%S00017	SNP-X host is actively attached to the CPU		System	R		
SNPX_RD	BIT	1	%S00018	SNP-X host has read data from the CPU		System	R		
SNPX_WT	BIT	1	%S00019	SNP-X host has written data to the CPU		System	R		
RLTN_OK	BIT	1	%S00020	Set ON when a relational function using REAL data is success		System	R		
CONTCON	BIT	1	%S00032	Reserved for use by the programming software for cont contact		System	R		
PB_SUM	BIT	1	%SA0001	Set when PLC checksum does not match app checksum		System	R		
OV_SWP	BIT	1	%SA0002	Set when PLC sweep time is longer than user specified sweep time		System	R		
APL_FLT	BIT	1	%SA0003	Set when an application fault occurs		System	R		
CFG_MM	BIT	1	%SA0009	Set when a config mismatch is detected during system powerup		System	R		
HRD_CPU	BIT	1	%SA0010	Set when the diagnostics detects a problem with the CPU hardware		System	R		
LOW_BAT	BIT	1	%SA0011	Set when a low battery fault occurs		System	R		
LOS_RCK	BIT	1	%SA0012	Set when an expansion rack stops communicating with the CPU		System	R		
LOS_IOM	BIT	1	%SA0014	Set when an I/O module stops communicating with the PLC CPU		System	R		
LOS_SIO	BIT	1	%SA0015	Set when an option module stops communicating with the PLC CPU		System	R		
ADD_RCK	BIT	1	%SA0017	Set when an expansion rack is added to the system		System	R		
ADD_IOM	BIT	1	%SA0019	Set when an I/O module is added to a rack		System	R		
ADD_SIO	BIT	1	%SA0020	Set when an option module is added to a rack		System	R		
HRD_SIO	BIT	1	%SA0027	Set when a hardware failure is detected in an option module		System	R		
SFT_SIO	BIT	1	%SA0031	Set when an unrecoverable fault is detected in an option module		System	R		
BAD_RAM	BIT	1	%SB0010	Set when the CPU detects		System	R		

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	E
				corrupted RAM memory at powerup					
BAD_PWD	BIT	1	%SB0011	Set when a password violation occurs		System	R		
SFT_CPU	BIT	1	%SB0013	Set when the CPU detects an unrecoverable error in the software		System	R		
ɔR_ER	BIT	1	%SB0014	Set when an error occurs during a programmer store operation		System	R		
ANY_FLT	BIT	1	%SC0009	Set when any fault occurs		System	R		
SY_FLT	BIT	1	%SC0010	Set when fault occurs where an entry is put in the PLC fault tbl		System	R		
IO_FLT	BIT	1	%SC0011	Set when fault occurs where an entry is put in the I/O fault tbl		System	R		
SY_PRES	BIT	1	%SC0012	Set as long as there is at least one entry in the PLC fault tbl		System	R		
IO_PRES	BIT	1	%SC0013	Set as long as there is at least one entry in the I/O fault tbl		System	R		
HRD_FLT	BIT	1	%SC0014	Set when a hardware fault occurs		System	R		
SFT_FLT	BIT	1	%SC0015	Set when a software fault occurs		System	R		

1 Written for EPAC.
Project: Brisbane City Council, Standby Generator Program.

2 FST_SCN PRESETS

—| |— [CALL]

%S00001
Set to 1 when the current sweep is the first sweep

3 SEQ

[CALL]

4 MAIN

[CALL]

5 ALARM

[CALL]

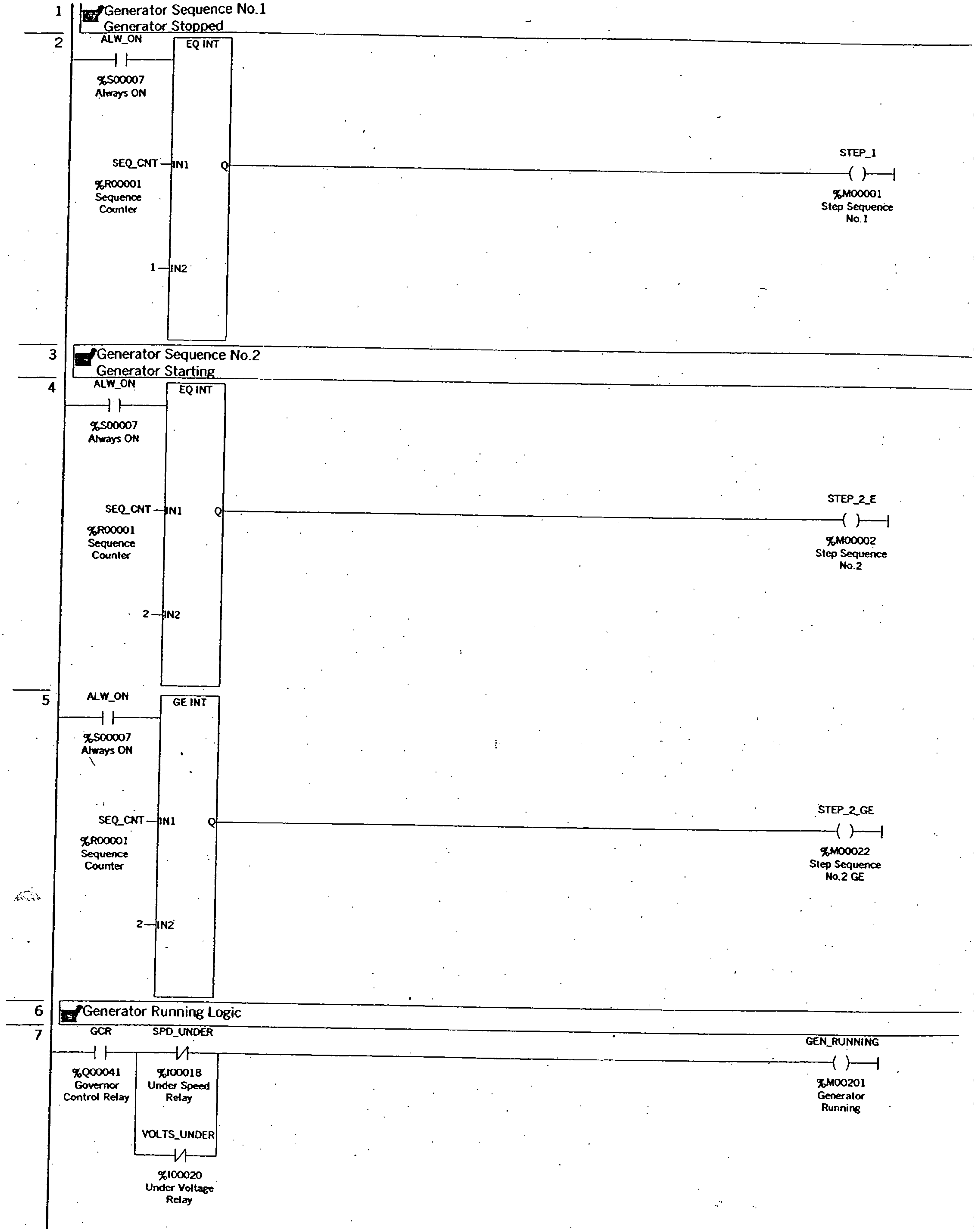
6 AUD_ALM

[CALL]

7 MODBUS

[CALL]

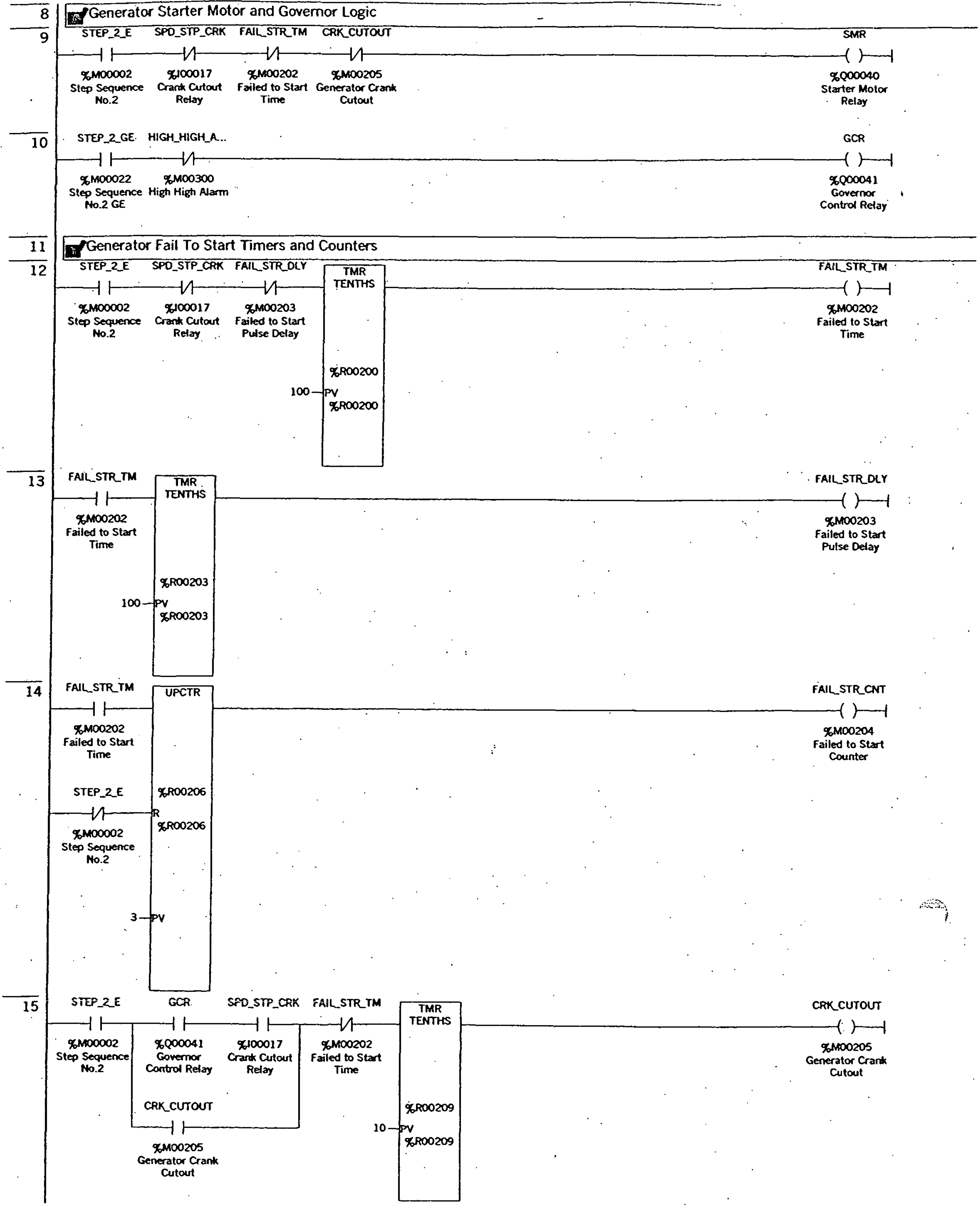
Program: BCC_4000_4 A: _M



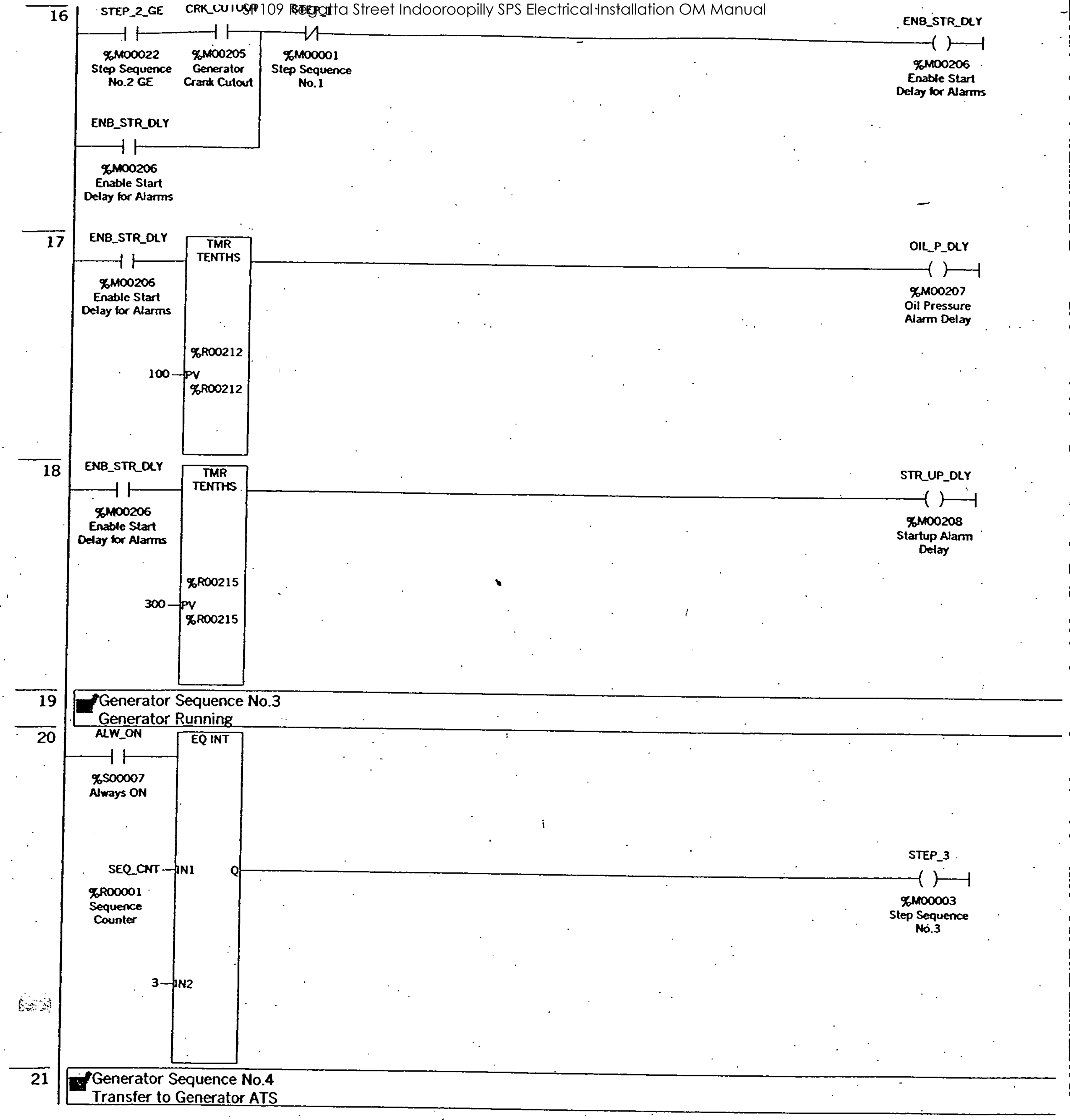
Program: BCC_4000_4

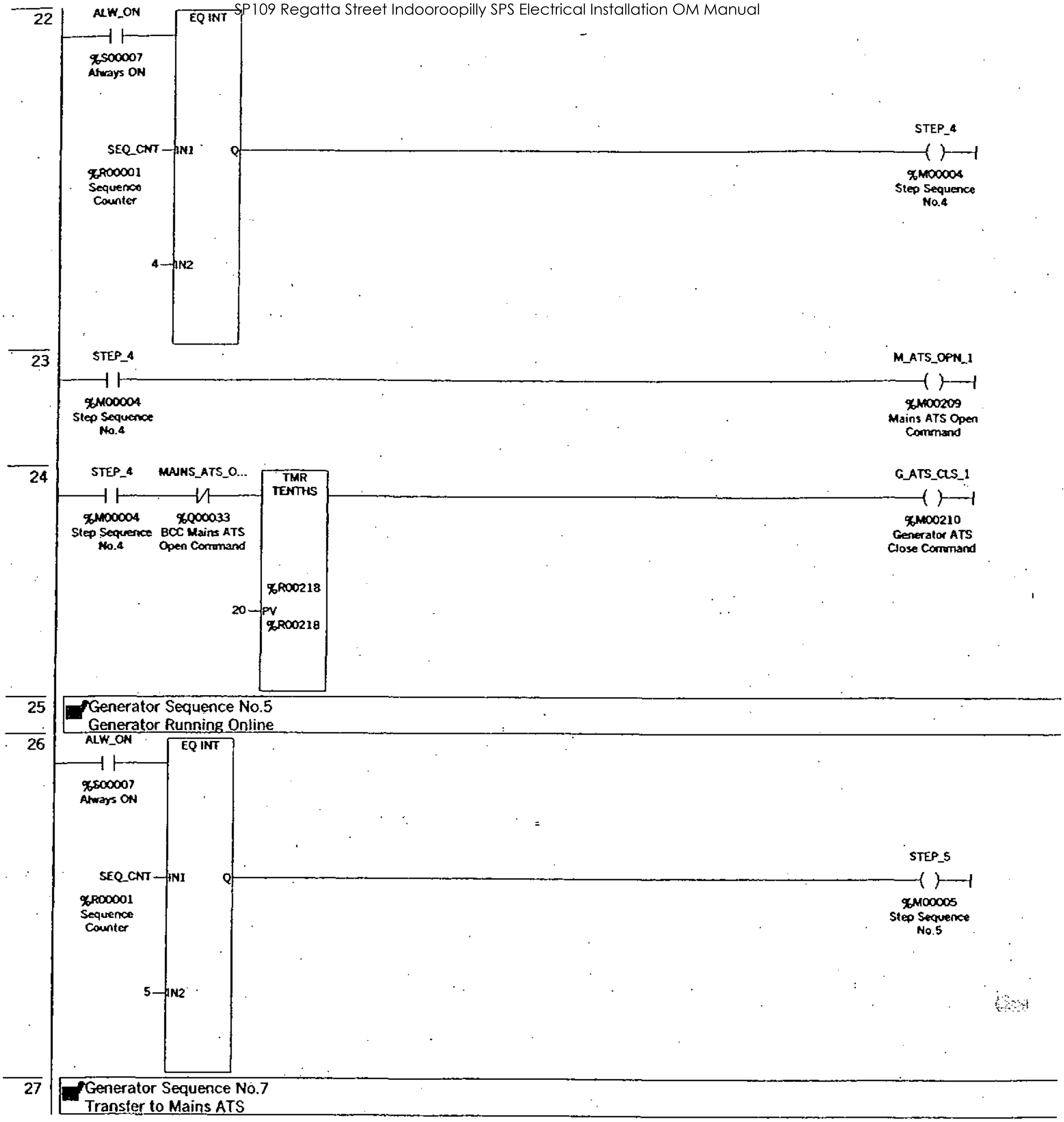
A:

M

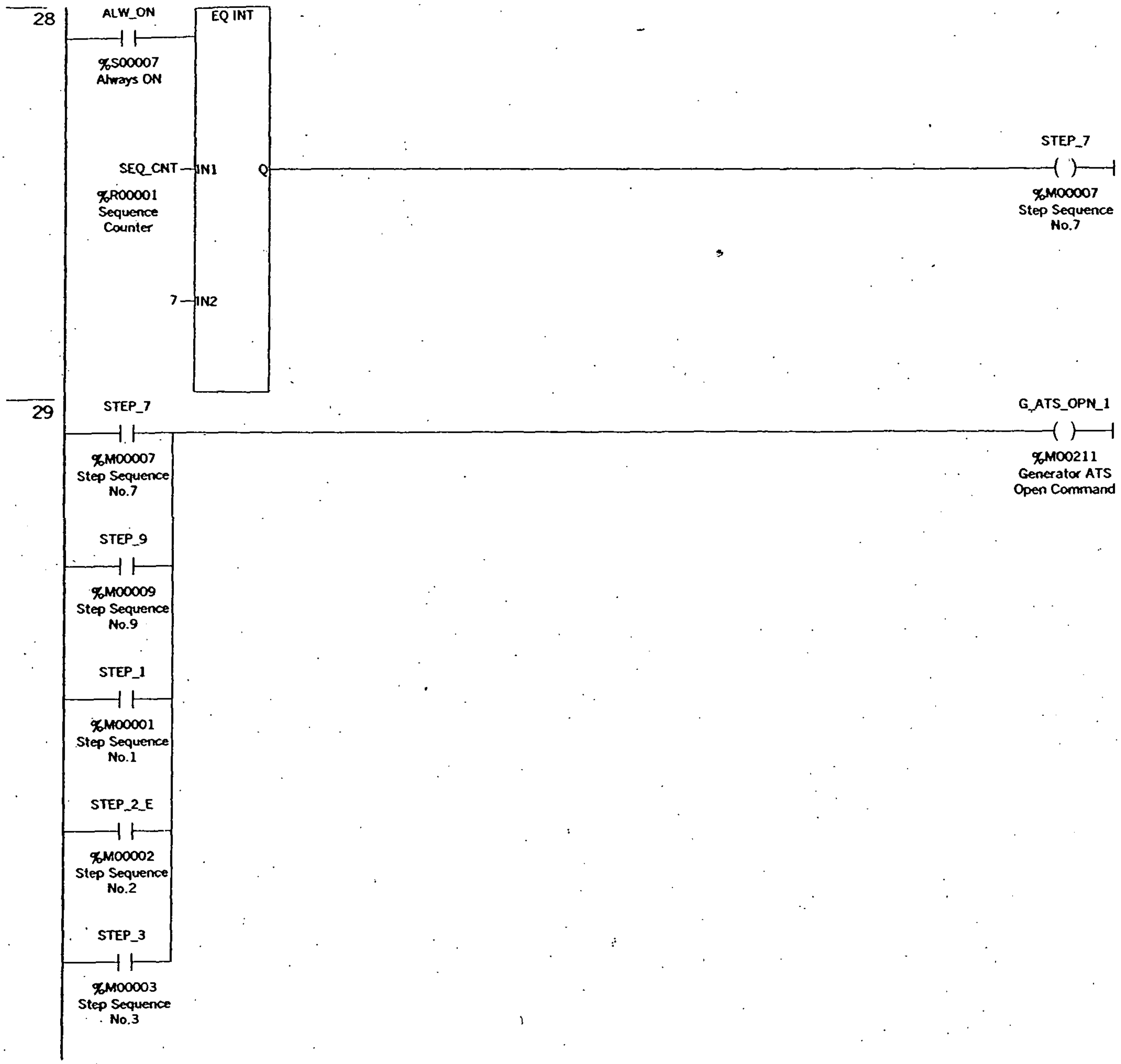


Program: BCC_4000_4 A: M/

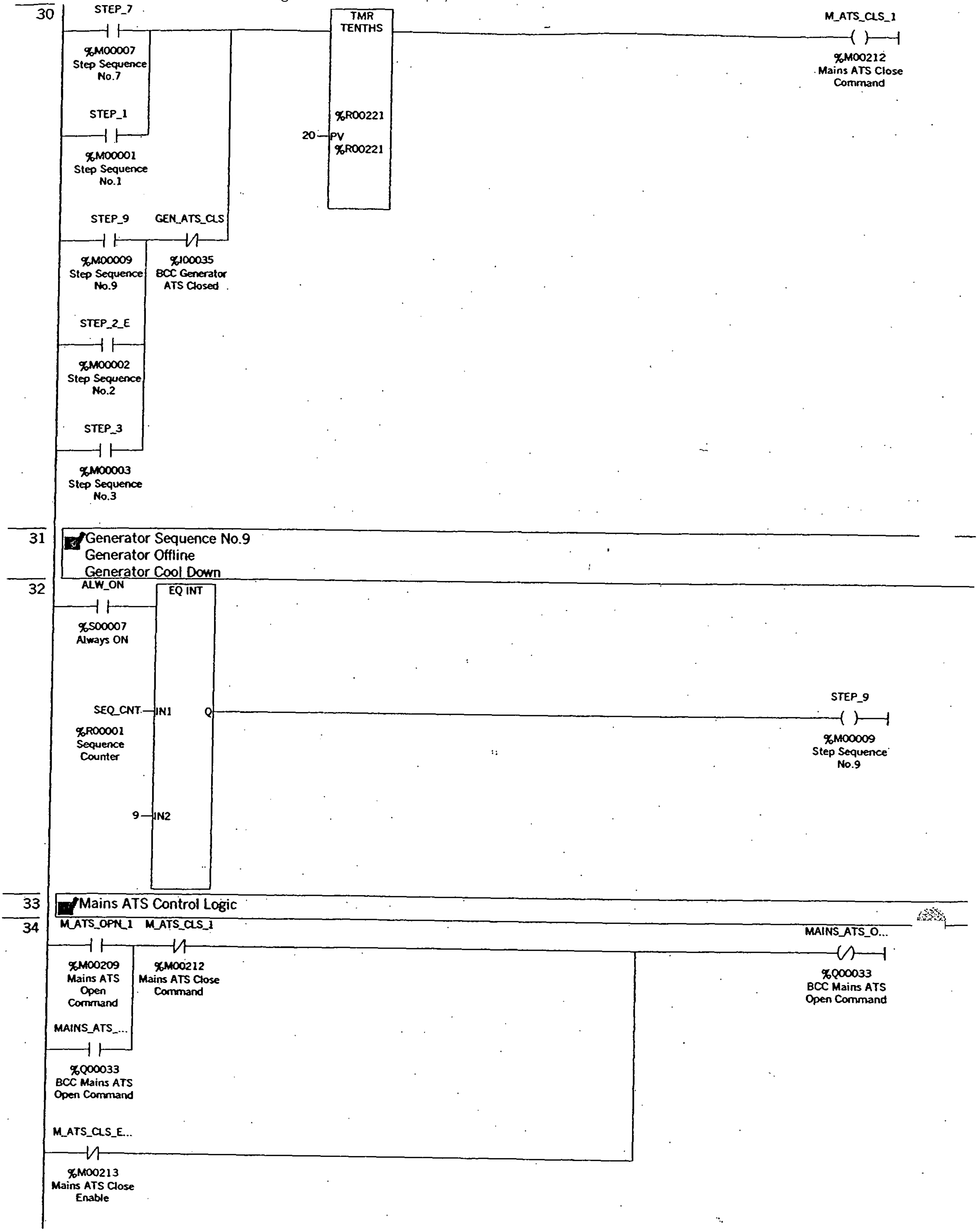

16
STEP_2_GE
%M00022 Step Sequence No.2 GE
CRK_CUTOUT
%M00205 Generator Crank Cutout
STEP_1
%M00001 Step Sequence No.1
ENB_STR_DLY
%M00206 Enable Start Delay for Alarms
ENB_STR_DLY
%M00206 Enable Start Delay for Alarms
17
ENB_STR_DLY
%M00206 Enable Start Delay for Alarms
TMR TENTHS
%R00212
100 PV
%R00212
OIL_P_DLY
%M00207 Oil Pressure Alarm Delay
18
ENB_STR_DLY
%M00206 Enable Start Delay for Alarms
TMR TENTHS
%R00215
300 PV
%R00215
STR_UP_DLY
%M00208 Startup Alarm Delay
19
Generator Sequence No.3
Generator Running
20
ALW_ON
%S00007 Always ON
EQ INT
SEQ_CNT IN1
%R00001 Sequence Counter
3 IN2
Q
STEP_3
%M00003 Step Sequence No.3
21
Generator Sequence No.4
Transfer to Generator ATS



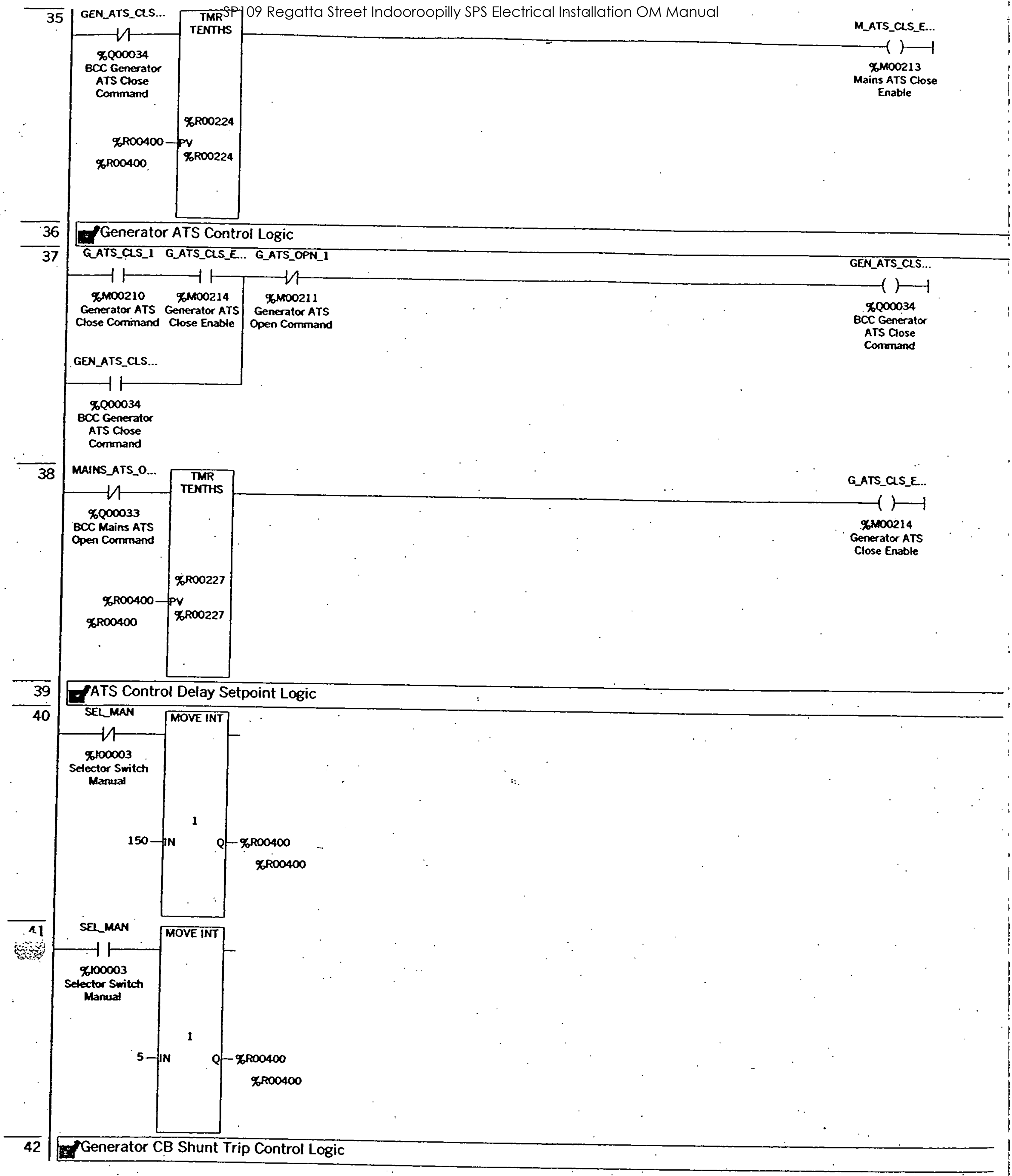
Program: BCC_4000_4 A: M/



Program: BCC_4000_4 A: M



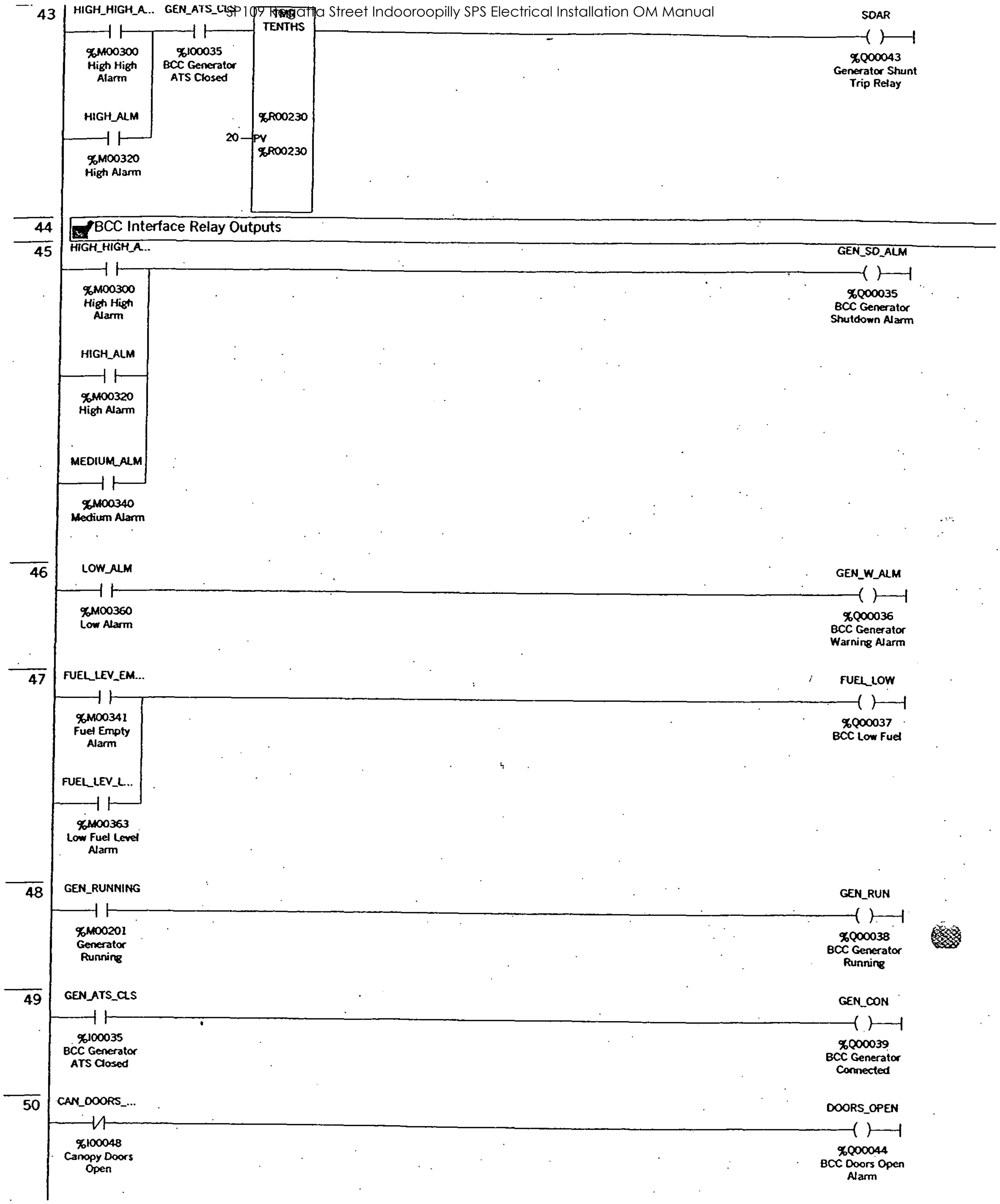
Program: BCC_4000_4 A: M:



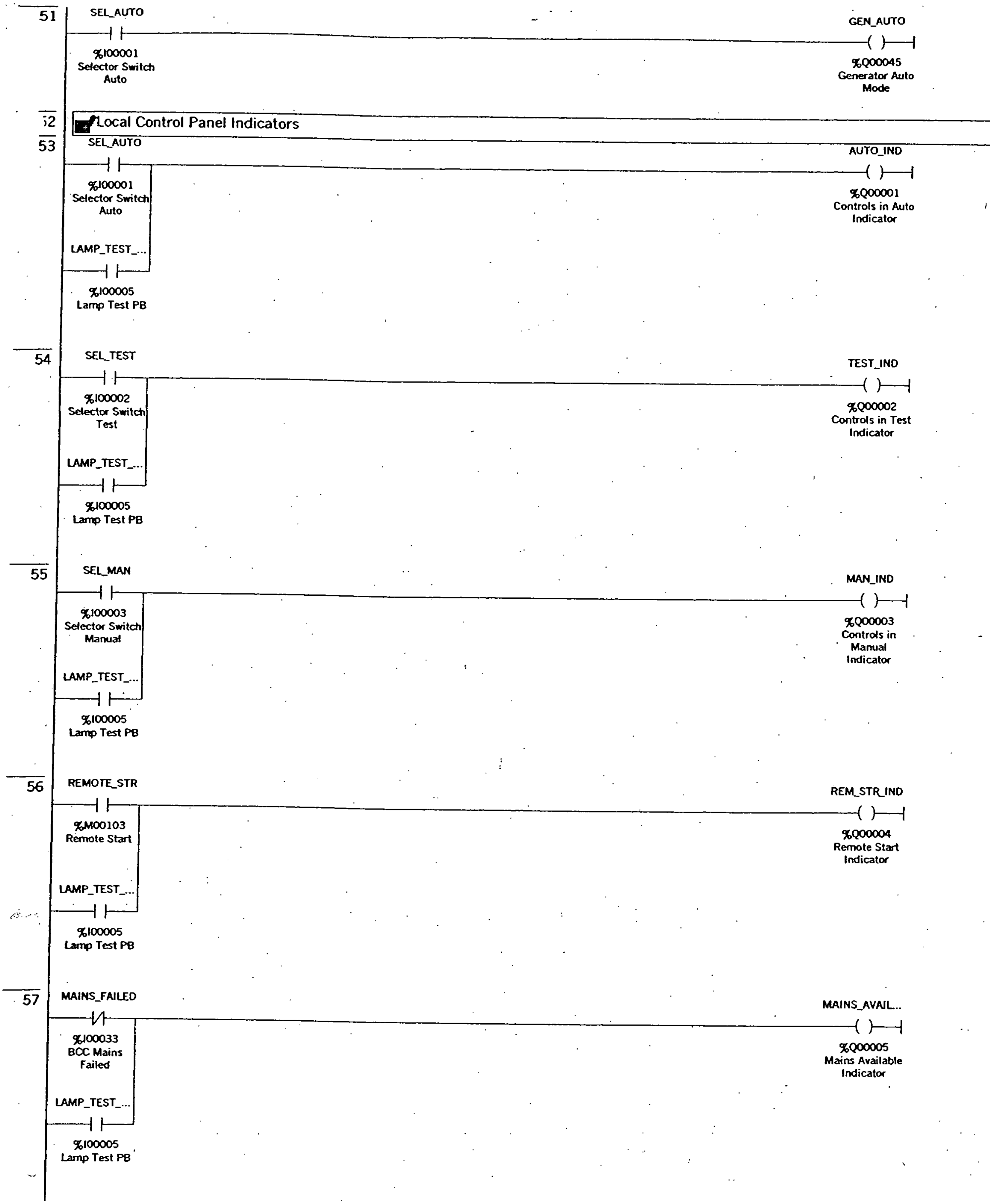
Program: BCC_4000_4

A:

M

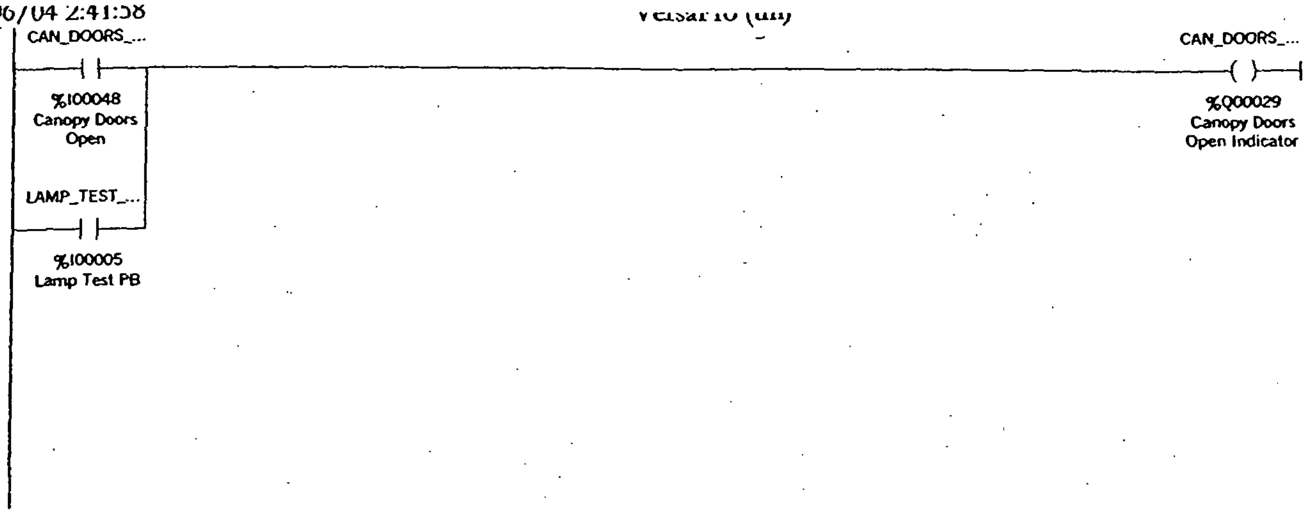


Program: BCC_4000_4 A: M

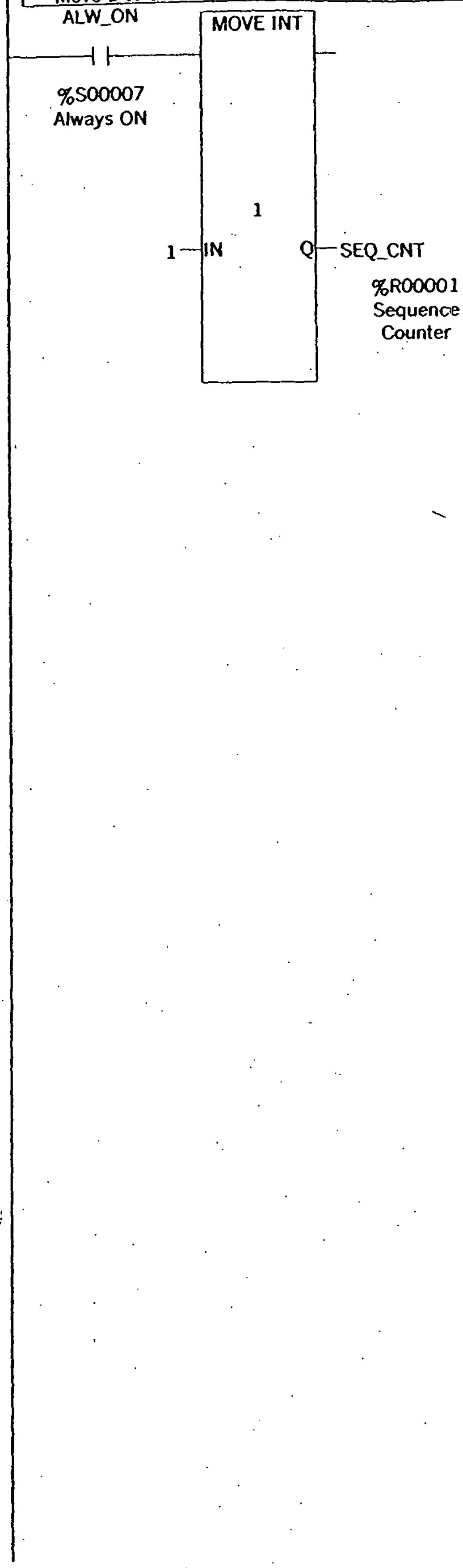


P um: BCC_4000_4 A: M·

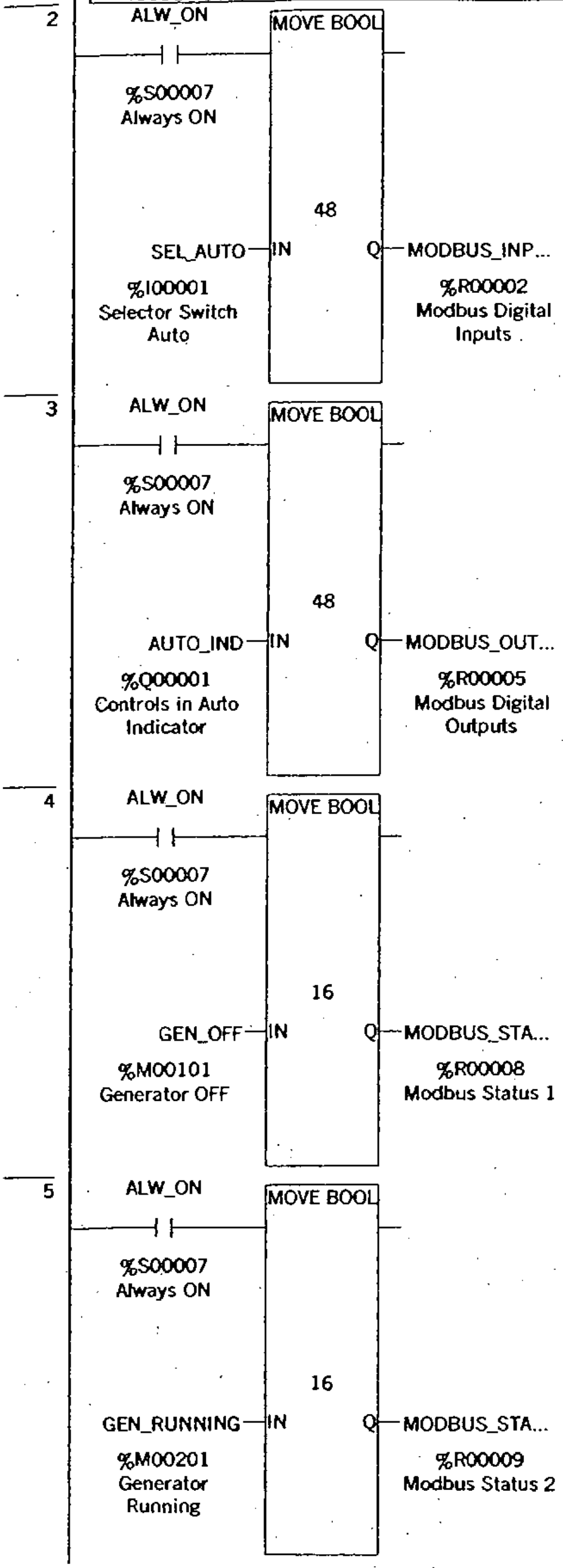
62


CAN_DOORS_...
%I00048
Canopy Doors
Open
LAMP_TEST_...
%I00005
Lamp Test PB
CAN_DOORS_...
%Q00029
Canopy Doors
Open Indicator

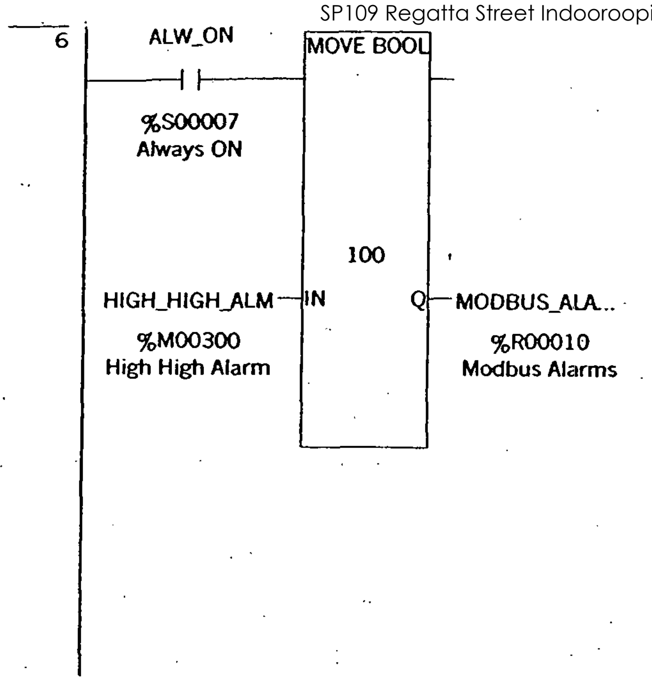
1 Presets Routine
Move 1 to the Sequence Counter

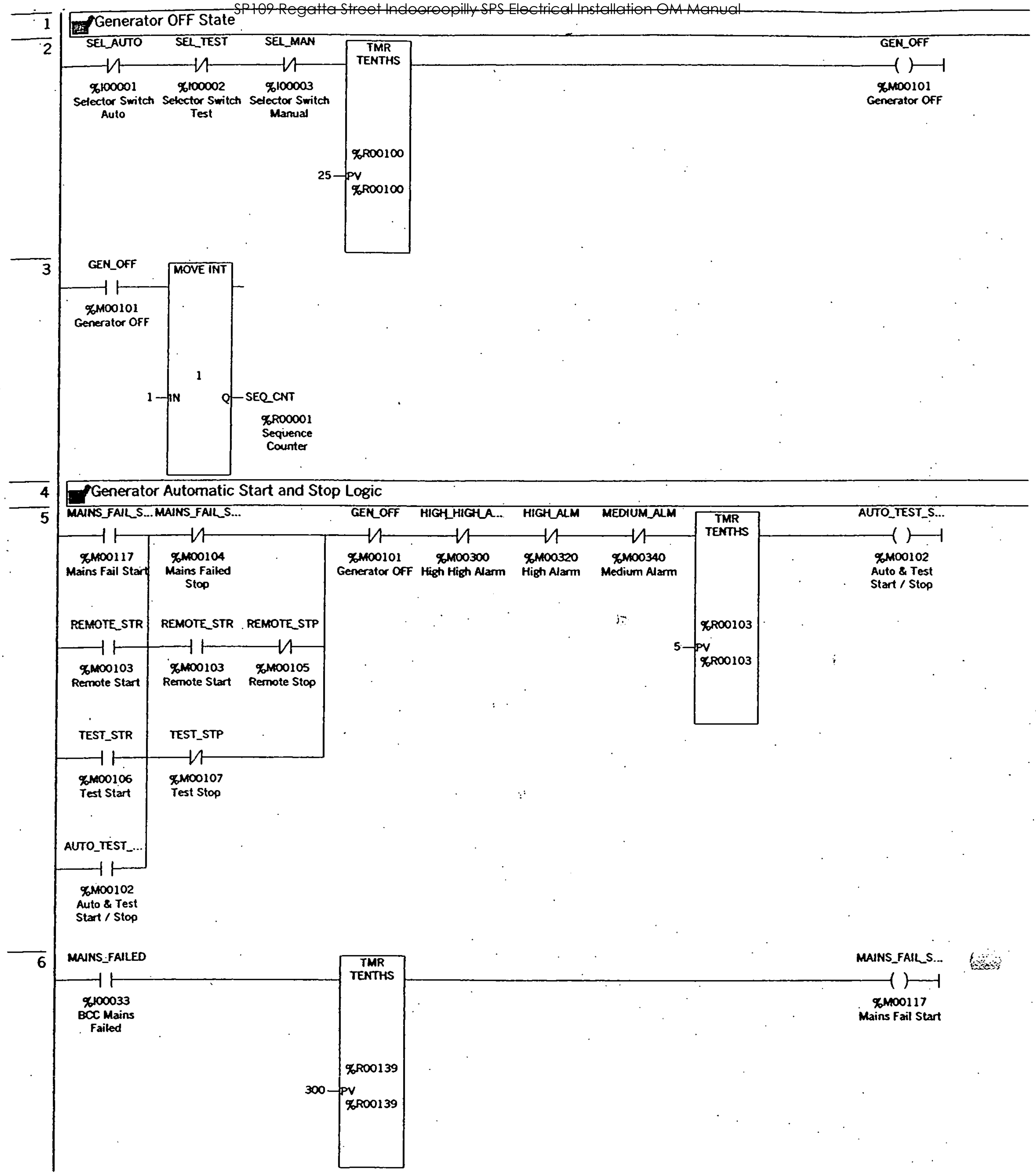
2


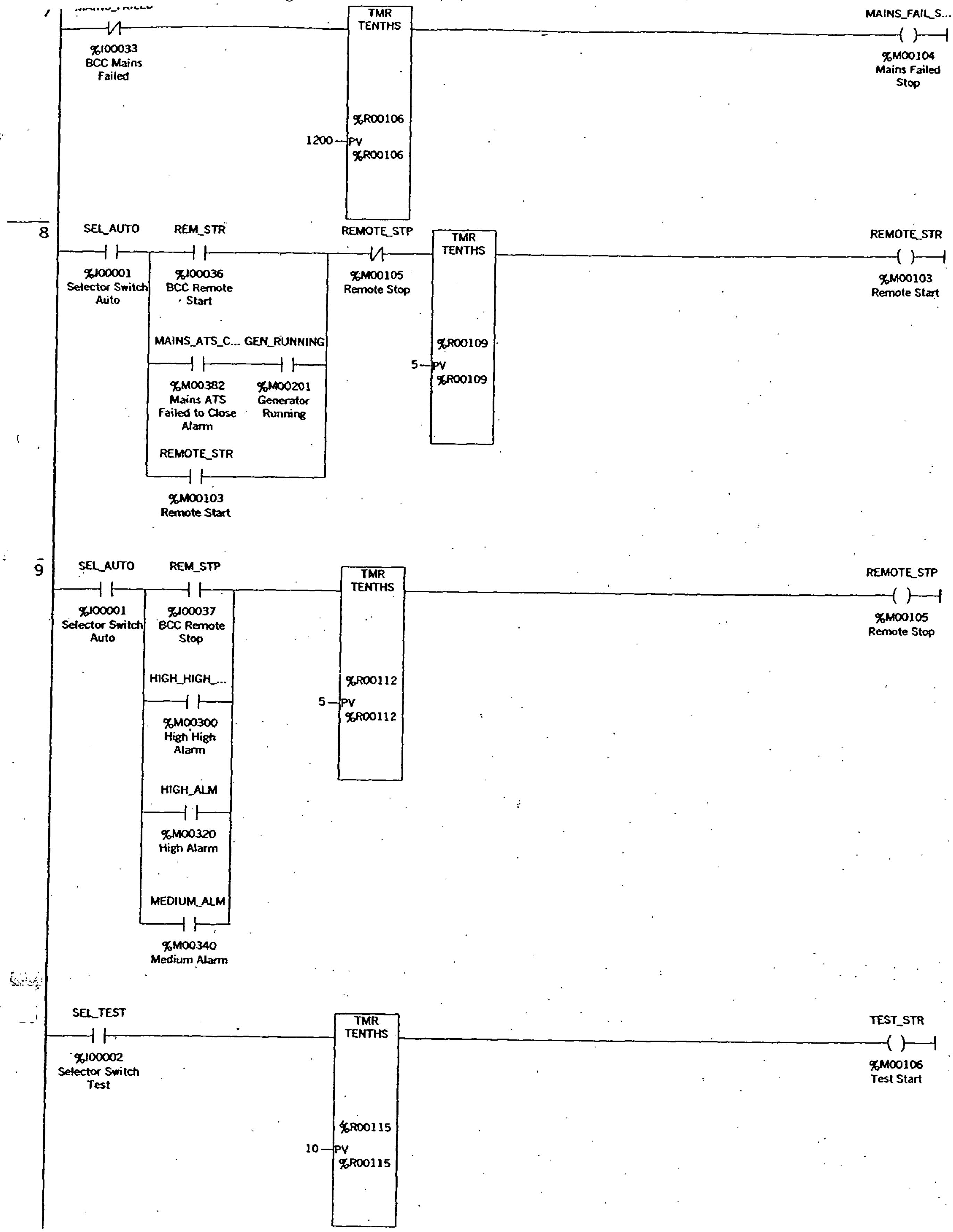
1 Generator Modbus RTU Slave Interface
40001 - Generator Sequence Number



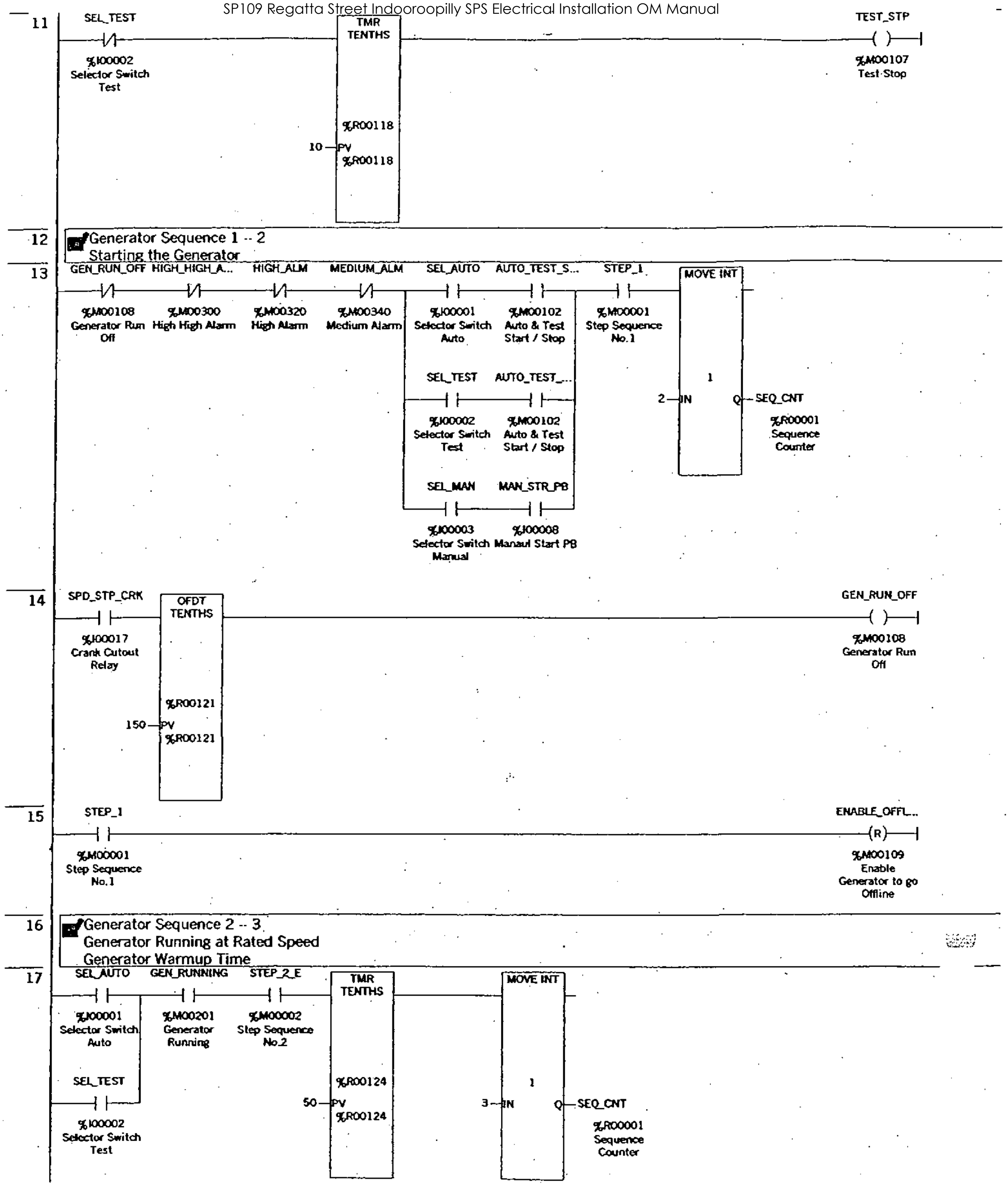
Program: BCC_4000_4 A: MODI


6
ALW_ON
%S00007
Always ON
MOVE BOOL
100
HIGH_HIGH_ALM
IN
Q
MODBUS_ALA...
%M00300
High High Alarm
%R00010
Modbus Alarms


1
Generator OFF State
2
SEL_AUTO
%I00001
Selector Switch
Auto
SEL_TEST
%I00002
Selector Switch
Test
SEL_MAN
%I00003
Selector Switch
Manual
TMR
TENTHS
%R00100
25
PV
%R00100
GEN_OFF
%M00101
Generator OFF
3
GEN_OFF
%M00101
Generator OFF
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter
4
Generator Automatic Start and Stop Logic
5
MAINS_FAIL_S...
%M00117
Mains Fail Start
MAINS_FAIL_S...
%M00104
Mains Failed
Stop
REMOTE_STR
%M00103
Remote Start
REMOTE_STR
%M00103
Remote Start
REMOTE_STP
%M00105
Remote Stop
TEST_STR
%M00106
Test Start
TEST_STP
%M00107
Test Stop
AUTO_TEST_...
%M00102
Auto & Test
Start / Stop
GEN_OFF
%M00101
Generator OFF
HIGH_HIGH_A...
%M00300
High High Alarm
HIGH_ALM
%M00320
High Alarm
MEDIUM_ALM
%M00340
Medium Alarm
TMR
TENTHS
%R00103
5
PV
%R00103
AUTO_TEST_S...
%M00102
Auto & Test
Start / Stop
6
MAINS_FAILED
%I00033
BCC Mains
Failed
TMR
TENTHS
%R00139
300
PV
%R00139
MAINS_FAIL_S...
%M00117
Mains Fail Start



Program: BCC_4000_4   A: Sl



Program: BCC_4000_4

A:

51 %M00484 ——| |—— %M00484 ——————————————— NEW_ALM —(S)—| %M00400 New Alarm

P... am: BCC_4000_4 A: AUD_/

NTB Design

Folder Name.. BCC_4000_2
Nickname.. C4000_2
Location.................... C:\Program Files\GE Fanuc Automation\VersaPro \Project\BCC_4000_2
Created...27-Jun-03, 16:36:03
Modified.. 03-Jul-03, 18:02:02
Description..BCC, Standby Generator, 4000

Block Name:.. AUD_ALM.blk
Description:... Control Logic for the Audiable Alarm Logic.
Block Type:...Ladder

1 Audible Alarm Control Logic

2 NEW_ALM — AAR ( )
%M00400 New Alarm — %Q00042 Audible Alarm Relay

3 Mutes the New Audible Alarm

4 ALM_MUTE_PB — NEW_ALM (R)
%I00007 Alarm Mute PB — %M00400 New Alarm

5 Sets the New Alarm Bit

6 EM_STP_ALM — %M00401 (↑)
%M00301 Emergency Stop Alarm — %M00401

7 %M00401 — NEW_ALM (S)
%M00401 — %M00400 New Alarm

MEN_ALM — %M00402 (↑)
%M00302 MEN Alarm — %M00402

9 %M00402 — NEW_ALM (S)
%M00402 — %M00400 New Alarm

10 OIL_P_SD_ALM — %M00403 (↑)
%M00303 Low Oil Pressure Shutdown Alarm — %M00403

11 %M00403 — NEW_ALM (S)
%M00403 — %M00400 New Alarm

ENG_T_SD_ALM — %M00404 (↑)
%M00304 High Engine Temperature Shutdown Alarm — %M00404

13 %M00404 — NEW_ALM (S)
%M00404 — %M00400 New Alarm

14 RAD_WATER_LOW_ALM — %M00405 (↑)
%M00305 Low Radiator Water Level Alarm — %M00405

15 %M00405 — NEW_ALM (S)
%M00405 — %M00400 New Alarm

SPD_OVER_ALM — %M00406 (↑)
%M00306 Over Speed Alarm — %M00406

17
%M00406 — %M00406 — (S) NEW_ALM %M00400 New Alarm

18
SPD_UNDER_ALM — %M00321 Under Speed Alarm — (↑) %M00421 %M00421

19
%M00421 — %M00421 — (S) NEW_ALM %M00400 New Alarm

20
VOLTS_UNDER_ALM — %M00322 Alternator Voltage Under Alarm — (↑) %M00422 %M00422

21
%M00422 — %M00422 — (S) NEW_ALM %M00400 New Alarm

22
VOLTS_OVER_ALM — %M00323 Alternator Voltage Over Alarm — (↑) %M00423 %M00423

23
%M00423 — %M00423 — (S) NEW_ALM %M00400 New Alarm

24
GEN_CB_TRIP_AL... — %M00324 Generator CB Tripped Alarm — (↑) %M00424 %M00424

25
%M00424 — %M00424 — (S) NEW_ALM %M00400 New Alarm

26
ALT_TEMP_ALM — %M00325 Alternator High Temperature Alarm — (↑) %M00425 %M00425

27
%M00425 — %M00425 — (S) NEW_ALM %M00400 New Alarm

28
FUEL_LEV_EMPTY_ALM — %M00341 Fuel Empty Alarm — (↑) %M00441 %M00441

29
%M00441 — %M00441 — (S) NEW_ALM %M00400 New Alarm

30
FAIL_TO_STR_ALM — %M00342 Fail to Start Alarm — (↑) %M00442 %M00442

31 %M00442 — (S) NEW_ALM
%M00442 %M00400 New Alarm

32 OIL_P_W_ALM — (↑) %M00461
%M00361 Low Oil Pressure Warning Alarm %M00461

33 %M00461 — (S) NEW_ALM
%M00461 %M00400 New Alarm

34 ENG_T_W_ALM — (↑) %M00462
%M00362 High Engine Temperature Warning Alarm %M00462

35 %M00462 — (S) NEW_ALM
%M00462 %M00400 New Alarm

36 FUEL_LEV_LOW_ALM — (↑) %M00463
%M00363 Low Fuel Level Alarm %M00463

37 %M00463 — (S) NEW_ALM
%M00463 %M00400 New Alarm

38 BAT_CHG_AC_ALM — (↑) %M00464
%M00364 Battery Charger AC Alarm %M00464

39 %M00464 — (S) NEW_ALM
%M00464 %M00400 New Alarm

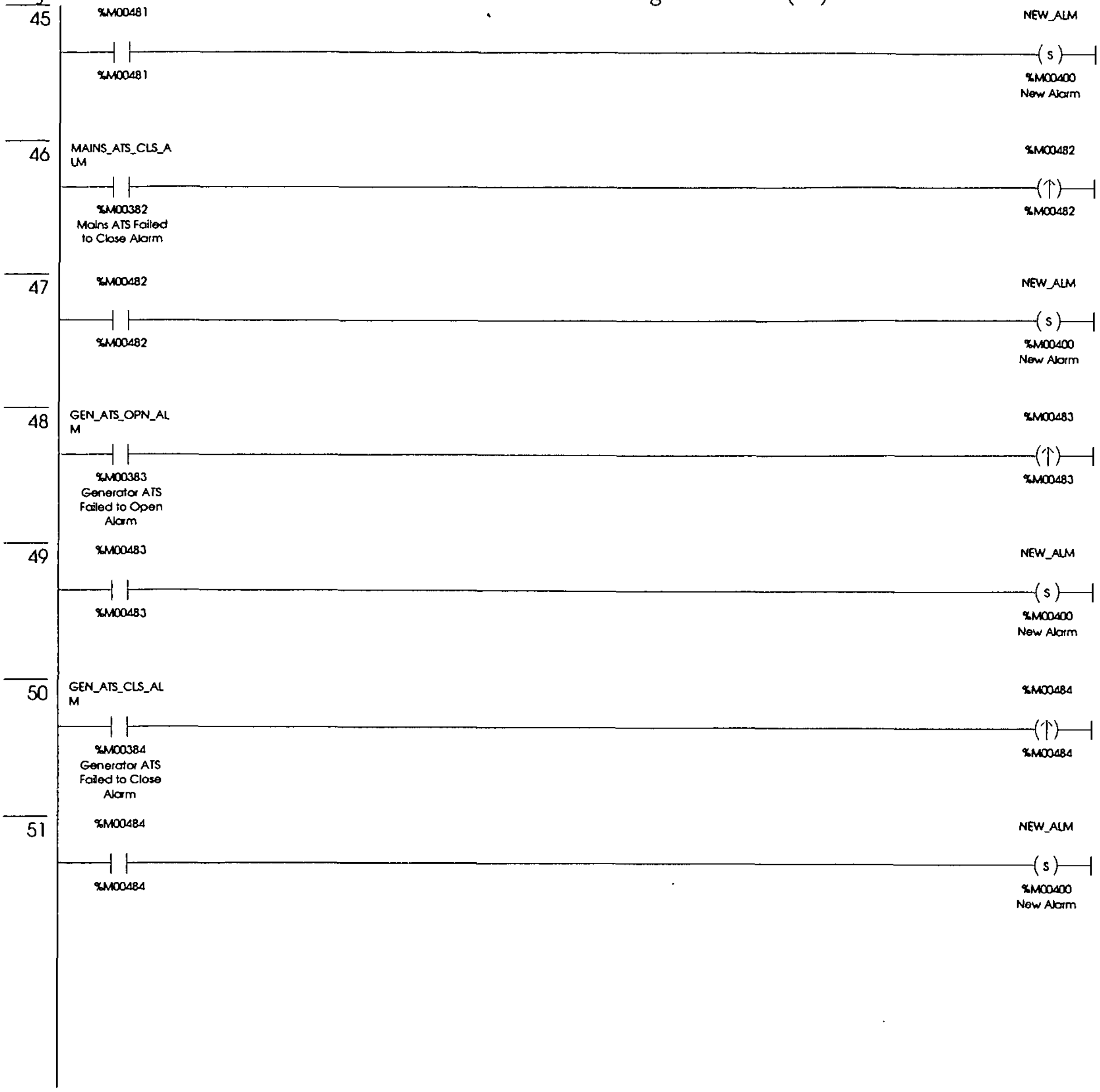
40 BAT_CONT_LOW_V_ALM — (↑) %M00465
%M00365 Control Battery Charger Low Voltage Alarm %M00465

41 %M00465 — (S) NEW_ALM
%M00465 %M00400 New Alarm

42 BAT_STR_LOW_V_ALM — (↑) %M00466
%M00366 Start Battery Charger Low Voltage Alarm %M00466

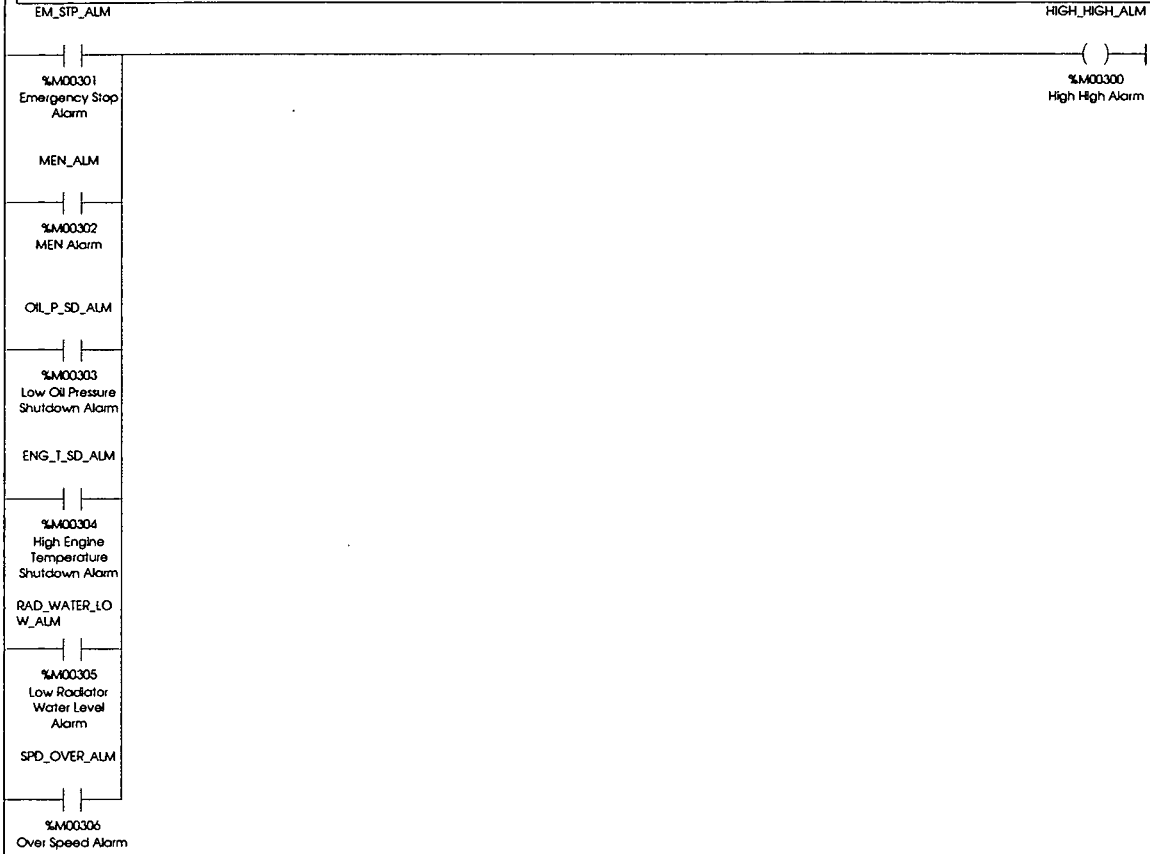
43 %M00466 — (S) NEW_ALM
%M00466 %M00400 New Alarm

44 MAINS_ATS_OPN_ALM — (↑) %M00481
%M00381 Mains ATS Failed to Open Alarm %M00481

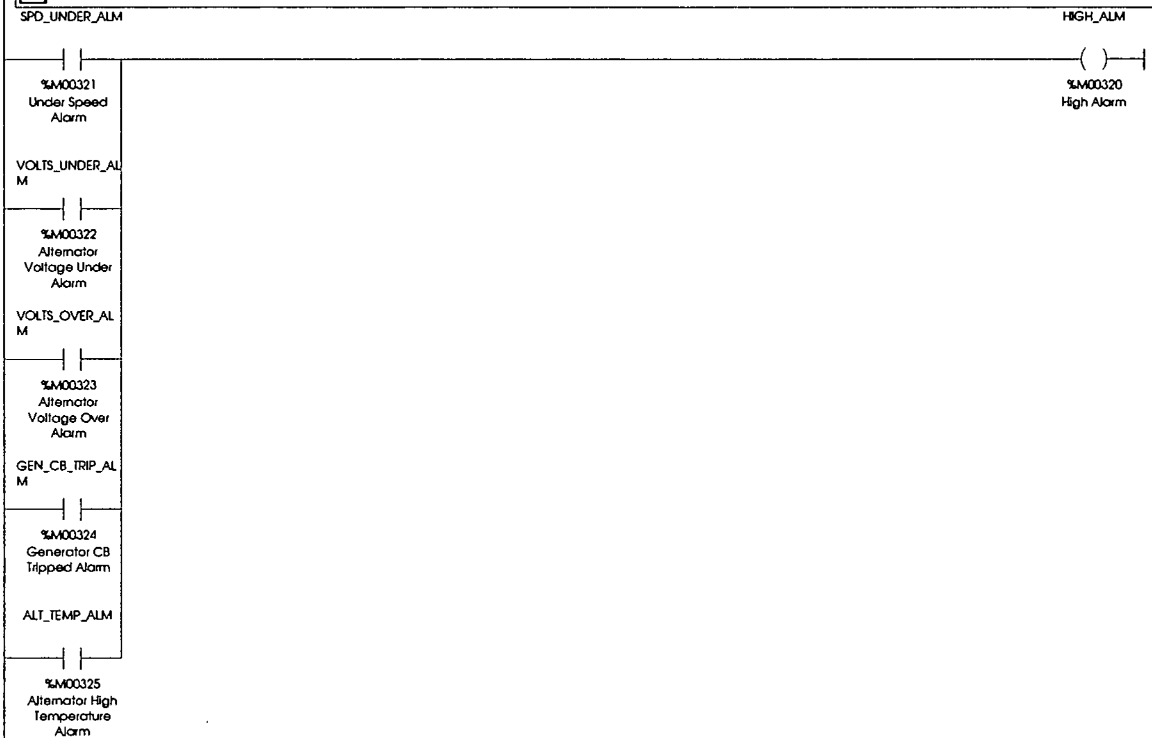

45
%M00481
NEW_ALM
s
%M00481
%M00400
New Alarm
46
MAINS_ATS_CLS_ALM
%M00482
↑
%M00382
Mains ATS Failed to Close Alarm
%M00482
47
%M00482
NEW_ALM
s
%M00482
%M00400
New Alarm
48
GEN_ATS_OPN_ALM
%M00483
↑
%M00383
Generator ATS Failed to Open Alarm
%M00483
49
%M00483
NEW_ALM
s
%M00483
%M00400
New Alarm
50
GEN_ATS_CLS_ALM
%M00484
↑
%M00384
Generator ATS Failed to Close Alarm
%M00484
51
%M00484
NEW_ALM
s
%M00484
%M00400
New Alarm

Block Name:..ALARM.blk
Description:...Control Logic for the Generator Alarms.
Block Type:...Ladder

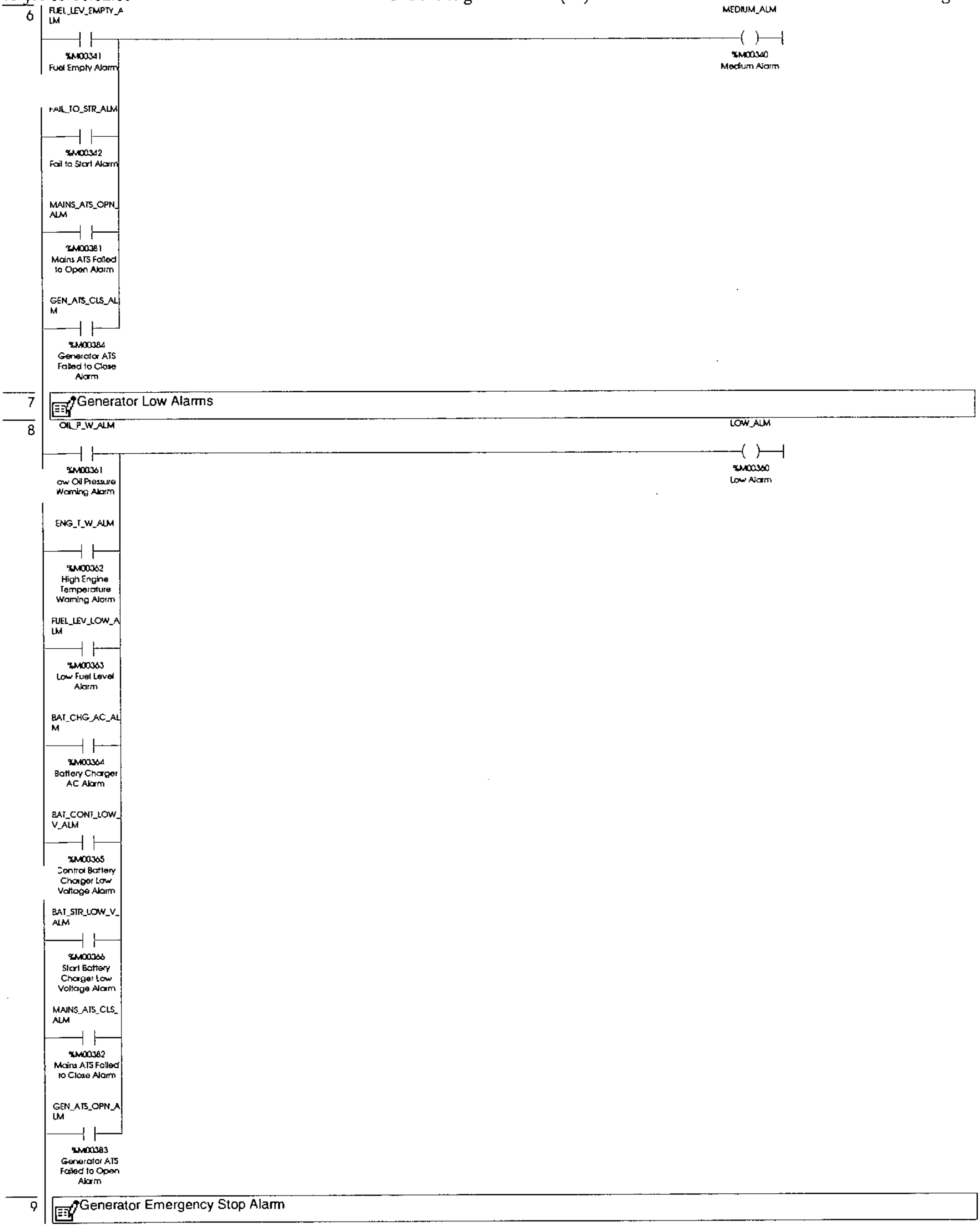
1 Generator High High Alarms

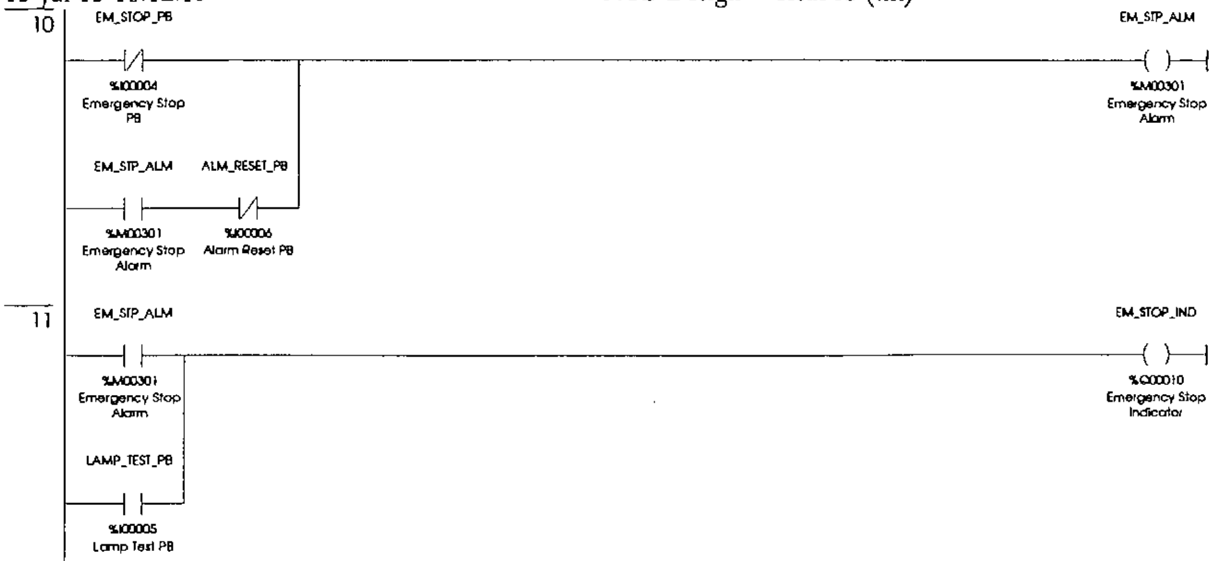
2


3 Generator High Alarms

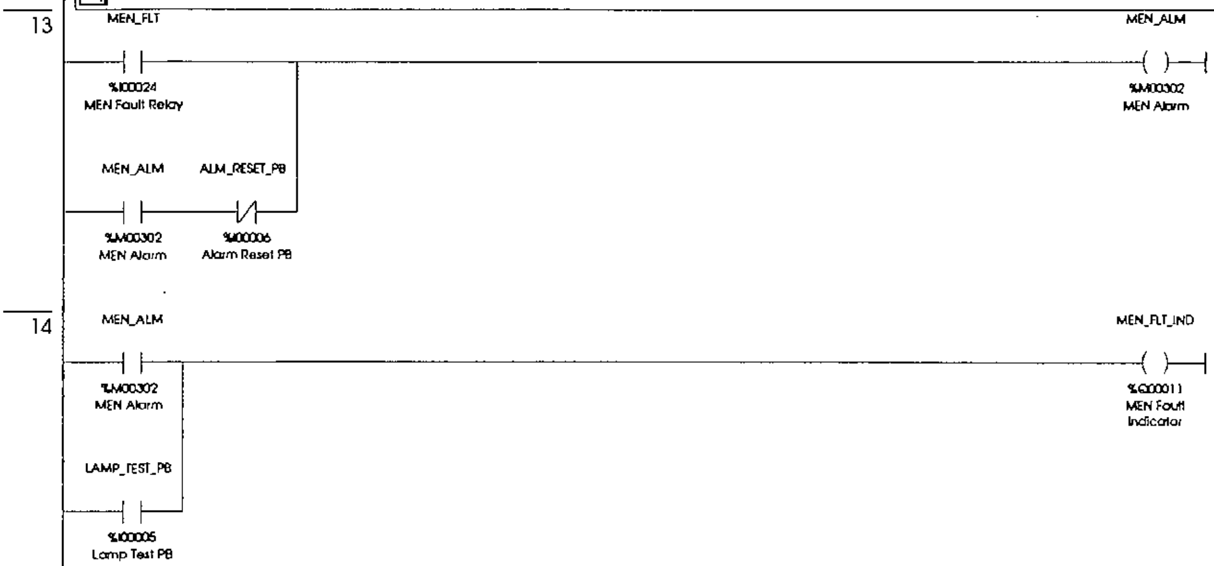
4


5 Generator Medium Alarms

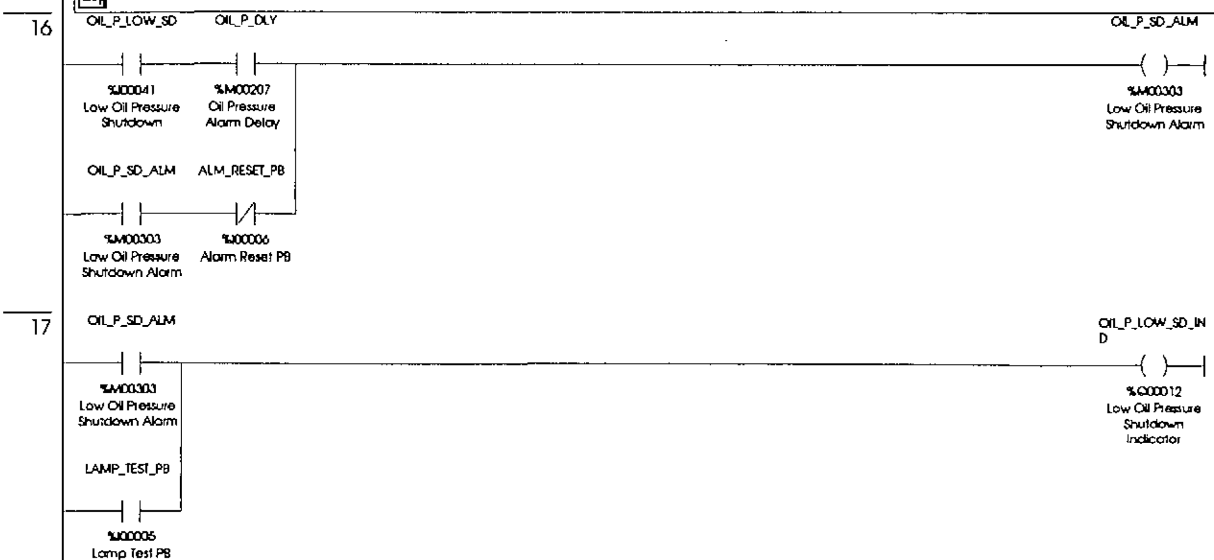

6
FUEL_LEV_EMPTY_ALM
%M00341
Fuel Empty Alarm
MEDIUM_ALM
%M00340
Medium Alarm
FAIL_TO_STR_ALM
%M00342
Fail to Start Alarm
MAINS_ATS_OPN_ALM
%M00381
Mains ATS Failed to Open Alarm
GEN_ATS_CLS_ALM
%M00384
Generator ATS Failed to Close Alarm
7
Generator Low Alarms
8
OIL_P_W_ALM
%M00361
ow Oil Pressure Warning Alarm
LOW_ALM
%M00360
Low Alarm
ENG_T_W_ALM
%M00362
High Engine Temperature Warning Alarm
FUEL_LEV_LOW_ALM
%M00363
Low Fuel Level Alarm
BAT_CHG_AC_ALM
%M00364
Battery Charger AC Alarm
BAT_CONT_LOW_V_ALM
%M00365
Control Battery Charger Low Voltage Alarm
BAT_STR_LOW_V_ALM
%M00366
Start Battery Charger Low Voltage Alarm
MAINS_ATS_CLS_ALM
%M00382
Mains ATS Failed to Close Alarm
GEN_ATS_OPN_ALM
%M00383
Generator ATS Failed to Open Alarm
9
Generator Emergency Stop Alarm



12 Generator MEN Alarm



15 Generator Low Oil Pressure Shut Down Alarm



18 Generator High Engine Temperature Shut Down Alarm

19
ENG_T_HI_SD — %I00043 High Engine Temperature Shutdown
STR_UP_DLY — %M00208 Startup Alarm Delay
ENG_T_SD_ALM — %M00304 High Engine Temperature Shutdown Alarm
ENG_T_SD_ALM — %M00304 High Engine Temperature Shutdown Alarm
ALM_RESET_PB — %I00006 Alarm Reset PB

20
ENG_T_SD_ALM — %M00304 High Engine Temperature Shutdown Alarm
LAMP_TEST_PB — %I00005 Lamp Test PB
ENG_T_HI_SD_IND — %Q00014 High Engine Temperature Shutdown Indicator

21 Generator Low Radiator Water Level Alarm

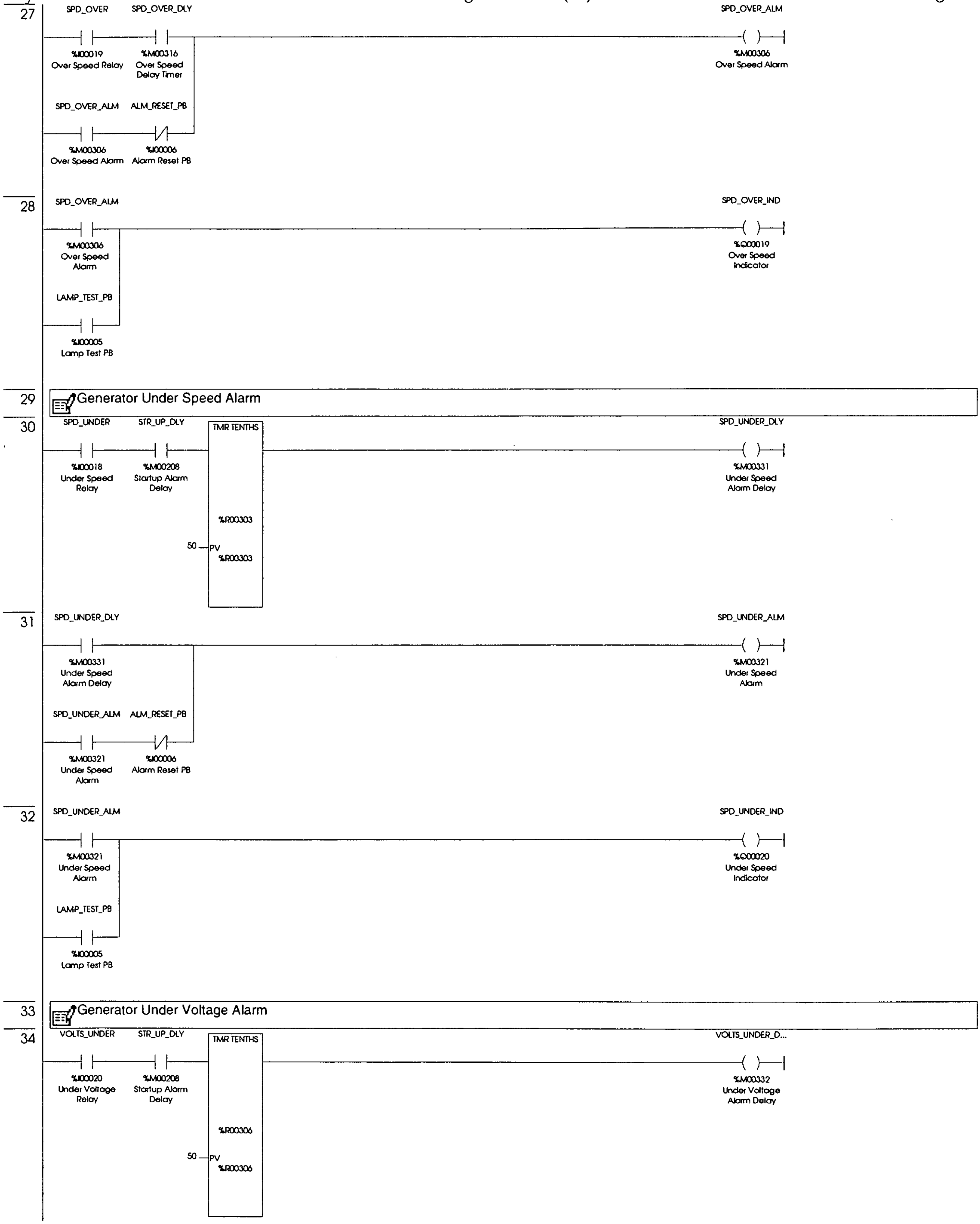
22
RAD_WATER_LOW — %I00045 Low Radiator Water Level
TMR TENTHS %R00300
50 — PV %R00300
RAD_WATER_LOW_DLY — %M00315 Radiator Water Level Low Delay

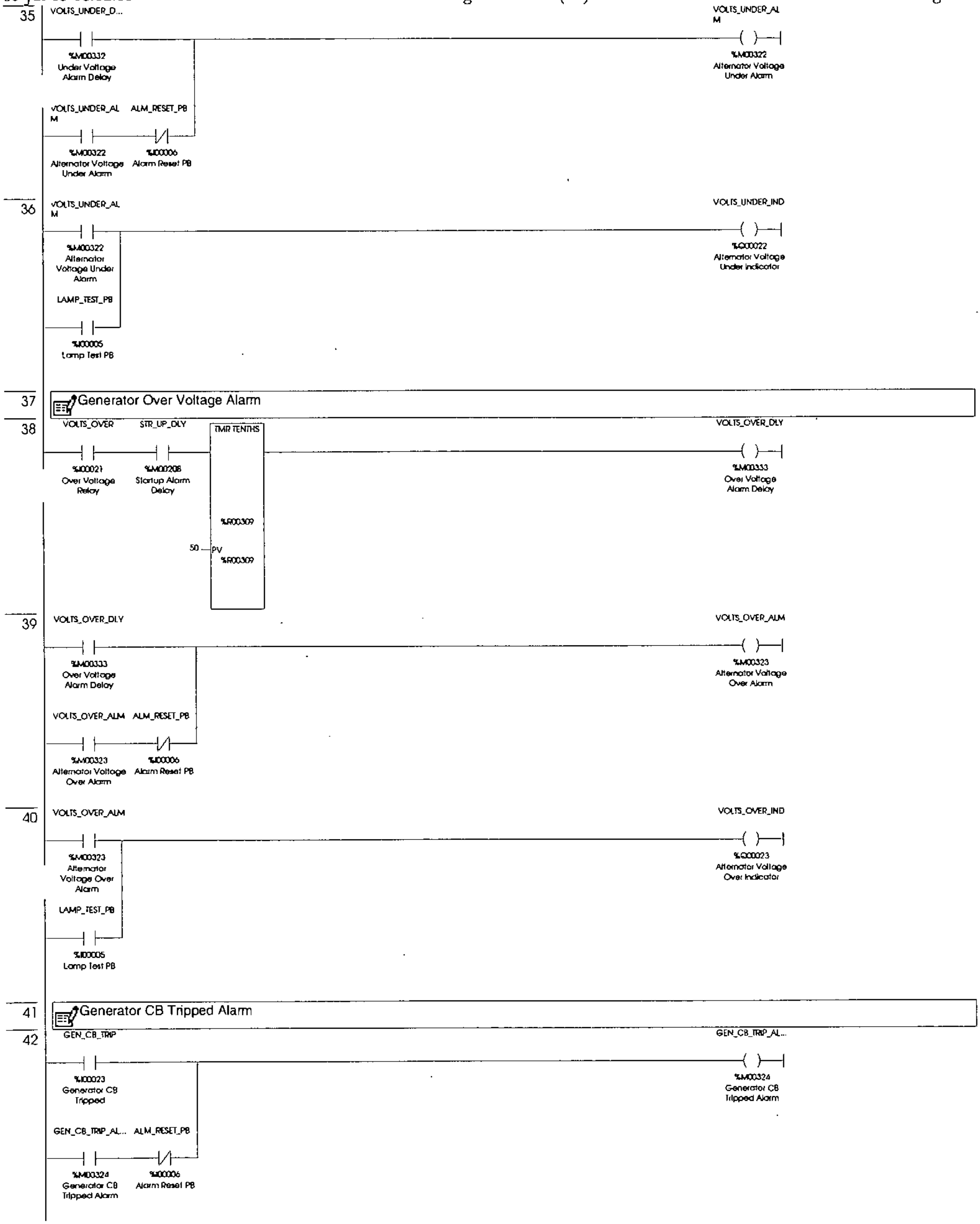
23
RAD_WATER_LOW_DLY — %M00315 Radiator Water Level Low Delay
RAD_WATER_LOW_ALM — %M00305 Low Radiator Water Level Alarm
ALM_RESET_PB — %I00006 Alarm Reset PB
RAD_WATER_LOW_ALM — %M00305 Low Radiator Water Level Alarm

24
RAD_WATER_LOW_ALM — %M00305 Low Radiator Water Level Alarm
LAMP_TEST_PB — %I00005 Lamp Test PB
RAD_WATER_LOW_IND — %Q00016 Low Radiator Water Level Indicator

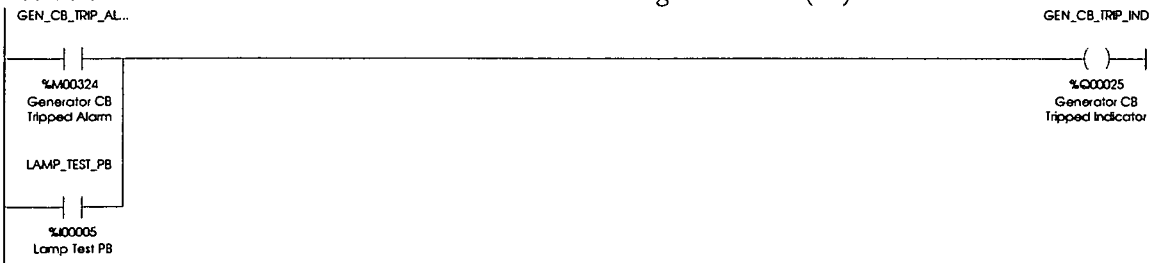
25 Generator Over Speed Alarm

26
GCR — %Q00041 Governor Control Relay
TMR TENTHS %R00339
50 — PV %R00339
SPD_OVER_DLY — %M00316 Over Speed Delay Timer


27
SPD_OVER
SPD_OVER_DLY
SPD_OVER_ALM
%I00019
Over Speed Relay
%M00316
Over Speed
Delay Timer
%M00306
Over Speed Alarm
SPD_OVER_ALM
ALM_RESET_PB
%M00306
Over Speed Alarm
%I00006
Alarm Reset PB
28
SPD_OVER_ALM
SPD_OVER_IND
%M00306
Over Speed
Alarm
%Q00019
Over Speed
Indicator
LAMP_TEST_PB
%I00005
Lamp Test PB
29
Generator Under Speed Alarm
30
SPD_UNDER
STR_UP_DLY
TMR TENTHS
SPD_UNDER_DLY
%I00018
Under Speed
Relay
%M00208
Startup Alarm
Delay
%M00331
Under Speed
Alarm Delay
%R00303
50
PV
%R00303
31
SPD_UNDER_DLY
SPD_UNDER_ALM
%M00331
Under Speed
Alarm Delay
%M00321
Under Speed
Alarm
SPD_UNDER_ALM
ALM_RESET_PB
%M00321
Under Speed
Alarm
%I00006
Alarm Reset PB
32
SPD_UNDER_ALM
SPD_UNDER_IND
%M00321
Under Speed
Alarm
%Q00020
Under Speed
Indicator
LAMP_TEST_PB
%I00005
Lamp Test PB
33
Generator Under Voltage Alarm
34
VOLTS_UNDER
STR_UP_DLY
TMR TENTHS
VOLTS_UNDER_D...
%I00020
Under Voltage
Relay
%M00208
Startup Alarm
Delay
%M00332
Under Voltage
Alarm Delay
%R00306
50
PV
%R00306

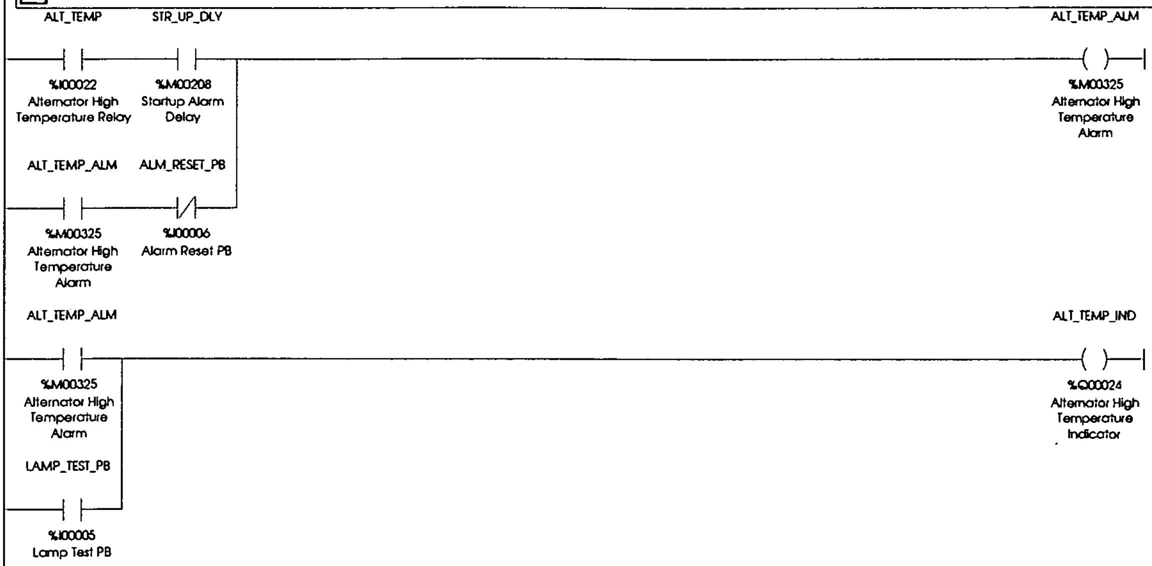

35
VOLTS_UNDER_D...
%M00332
Under Voltage Alarm Delay
VOLTS_UNDER_AL M
%M00322
Alternator Voltage Under Alarm
VOLTS_UNDER_AL M
ALM_RESET_PB
%M00322
Alternator Voltage Under Alarm
%I00006
Alarm Reset PB
36
VOLTS_UNDER_AL M
%M00322
Alternator Voltage Under Alarm
LAMP_TEST_PB
%I00005
Lamp Test PB
VOLTS_UNDER_IND
%Q00022
Alternator Voltage Under Indicator
37
Generator Over Voltage Alarm
38
VOLTS_OVER
%I00021
Over Voltage Relay
STR_UP_DLY
%M00208
Startup Alarm Delay
TMR TENTHS
%R00309
50
PV
%R00309
VOLTS_OVER_DLY
%M00333
Over Voltage Alarm Delay
39
VOLTS_OVER_DLY
%M00333
Over Voltage Alarm Delay
VOLTS_OVER_ALM
ALM_RESET_PB
%M00323
Alternator Voltage Over Alarm
%I00006
Alarm Reset PB
VOLTS_OVER_ALM
%M00323
Alternator Voltage Over Alarm
40
VOLTS_OVER_ALM
%M00323
Alternator Voltage Over Alarm
LAMP_TEST_PB
%I00005
Lamp Test PB
VOLTS_OVER_IND
%Q00023
Alternator Voltage Over Indicator
41
Generator CB Tripped Alarm
42
GEN_CB_TRIP
%I00023
Generator CB Tripped
GEN_CB_TRIP_AL...
ALM_RESET_PB
%M00324
Generator CB Tripped Alarm
%I00006
Alarm Reset PB
GEN_CB_TRIP_AL...
%M00324
Generator CB Tripped Alarm

43



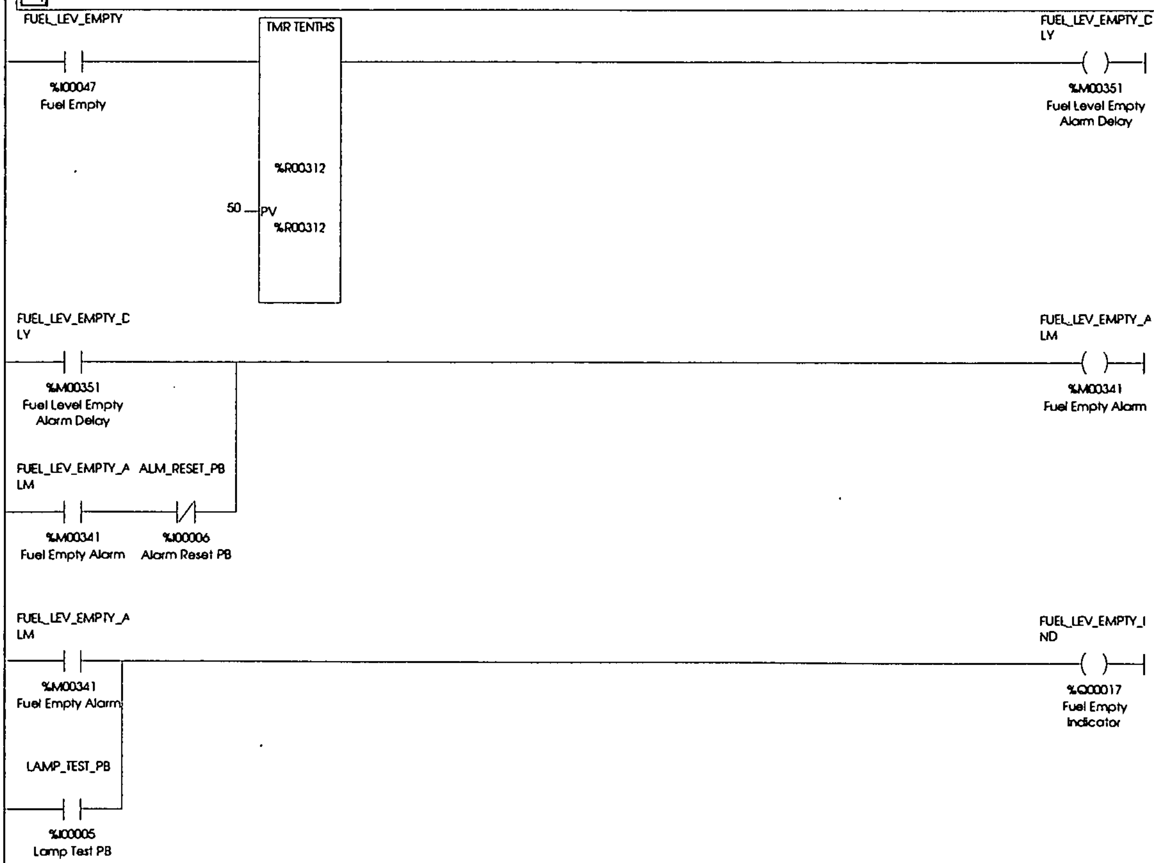
44 Generator High Alternator Temperature Alarm

45



47 Generator Fuel Level Empty Alarm

48



51 Generator Fail To Start Alarm

52
FAIL_STR_CNT — %M00204 Failed to Start Counter
FAIL_TO_STR_ALM — %M00342 Fail to Start Alarm
ALM_RESET_PB — %I00006 Alarm Reset PB
FAIL_TO_STR_ALM — %M00342 Fail to Start Alarm

53
FAIL_TO_STR_ALM — %M00342 Fail to Start Alarm
LAMP_TEST_PB — %I00005 Lamp Test PB
FAIL_TO_STR_IND — %Q00021 Fail to Start Indicator

54
Generator Low Oil Pressure Warning Alarm

55
OIL_P_LOW_W — %I00042 Low Oil Pressure Warning
OIL_P_DLY — %M00207 Oil Pressure Alarm Delay
OIL_P_W_ALM — %M00361 Low Oil Pressure Warning Alarm
ALM_RESET_PB — %I00006 Alarm Reset PB
OIL_P_W_ALM — %M00361 Low Oil Pressure Warning Alarm

56
OIL_P_W_ALM — %M00361 Low Oil Pressure Warning Alarm
LAMP_TEST_PB — %I00005 Lamp Test PB
OIL_P_LOW_W_IN D — %Q00013 Low Oil Pressure Warning Indicator

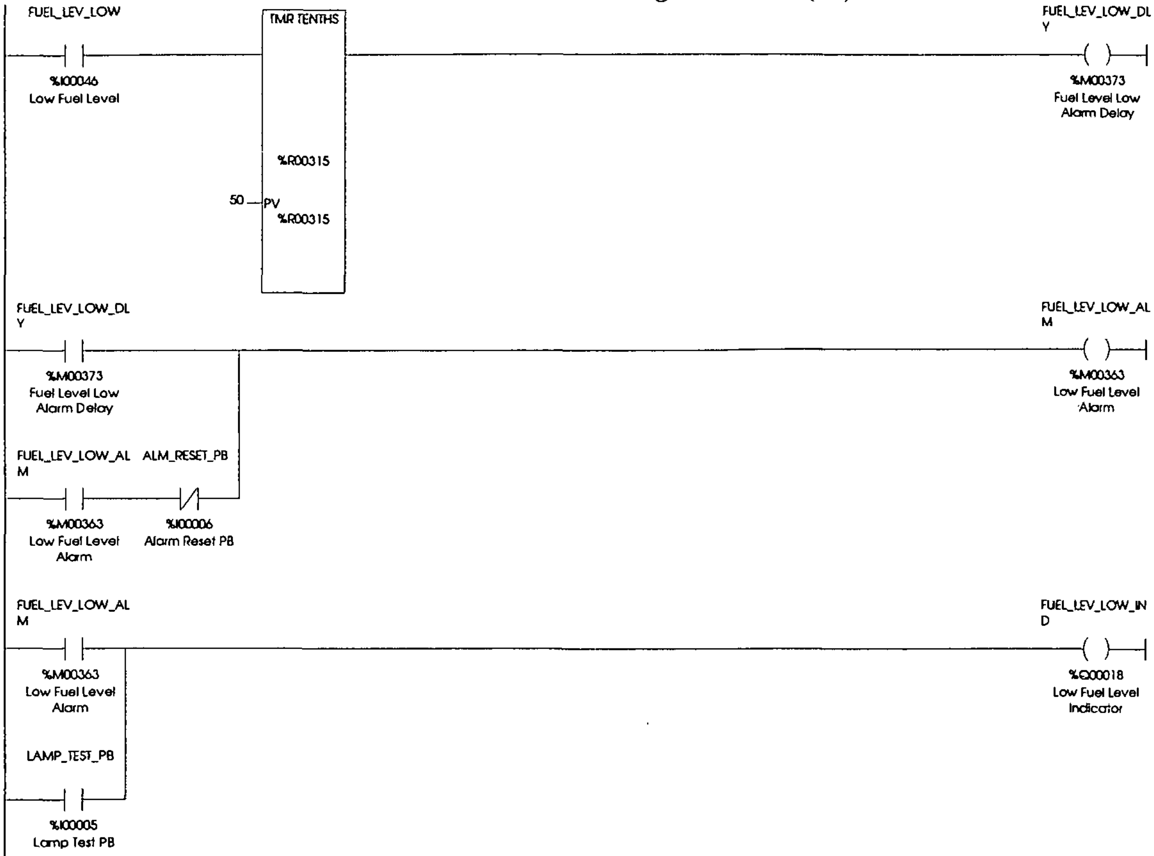
57
Generator High Engine Temperature Warning Alarm

58
ENG_T_HI_W — %I00044 High Engine Temperature Warning
STR_UP_DLY — %M00208 Startup Alarm Delay
ENG_T_W_ALM — %M00362 High Engine Temperature Warning Alarm
ALM_RESET_PB — %I00006 Alarm Reset PB
ENG_T_W_ALM — %M00362 High Engine Temperature Warning Alarm

59
ENG_T_W_ALM — %M00362 High Engine Temperature Warning Alarm
LAMP_TEST_PB — %I00005 Lamp Test PB
ENG_T_HI_W_IND — %Q00015 High Engine Temperature Warning Indicator

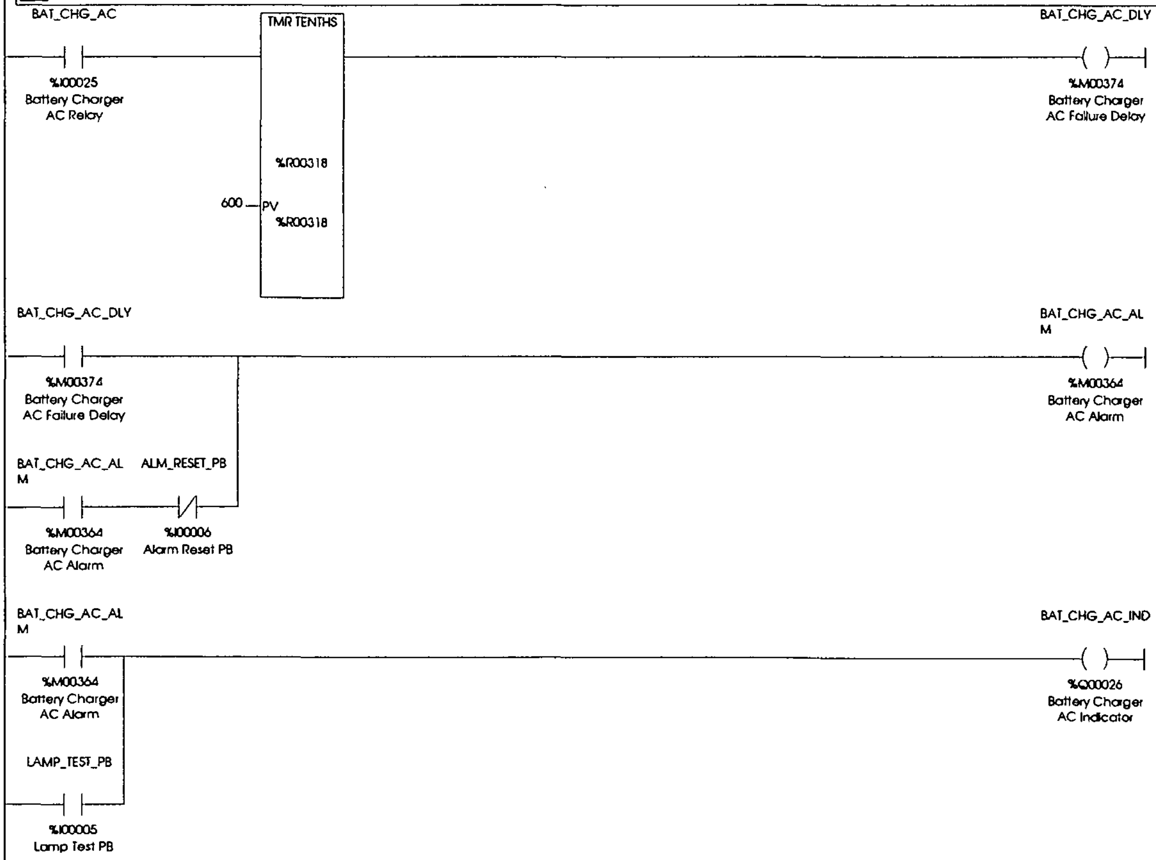
60
Generator Fuel Level Low Alarm

61 62 63

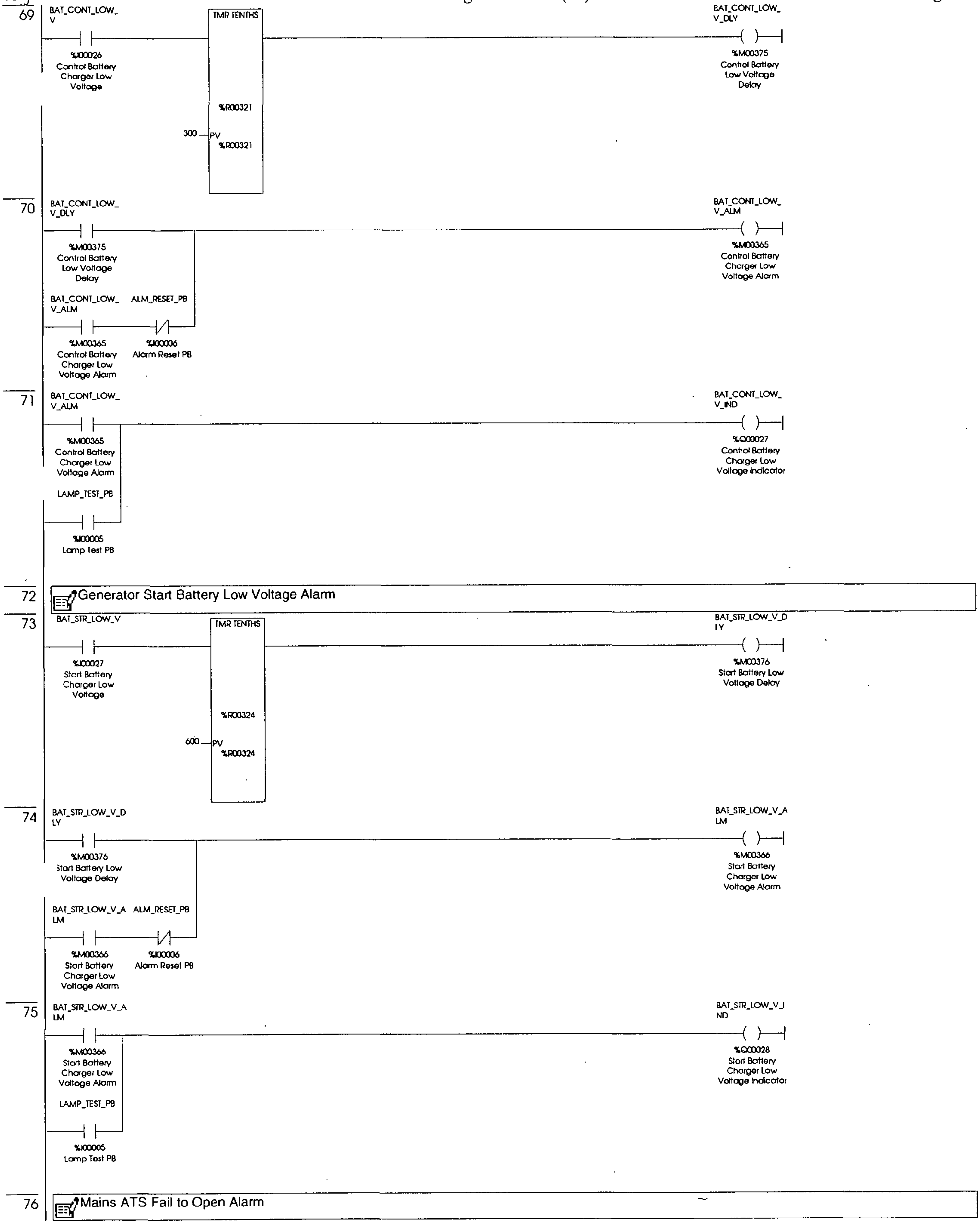


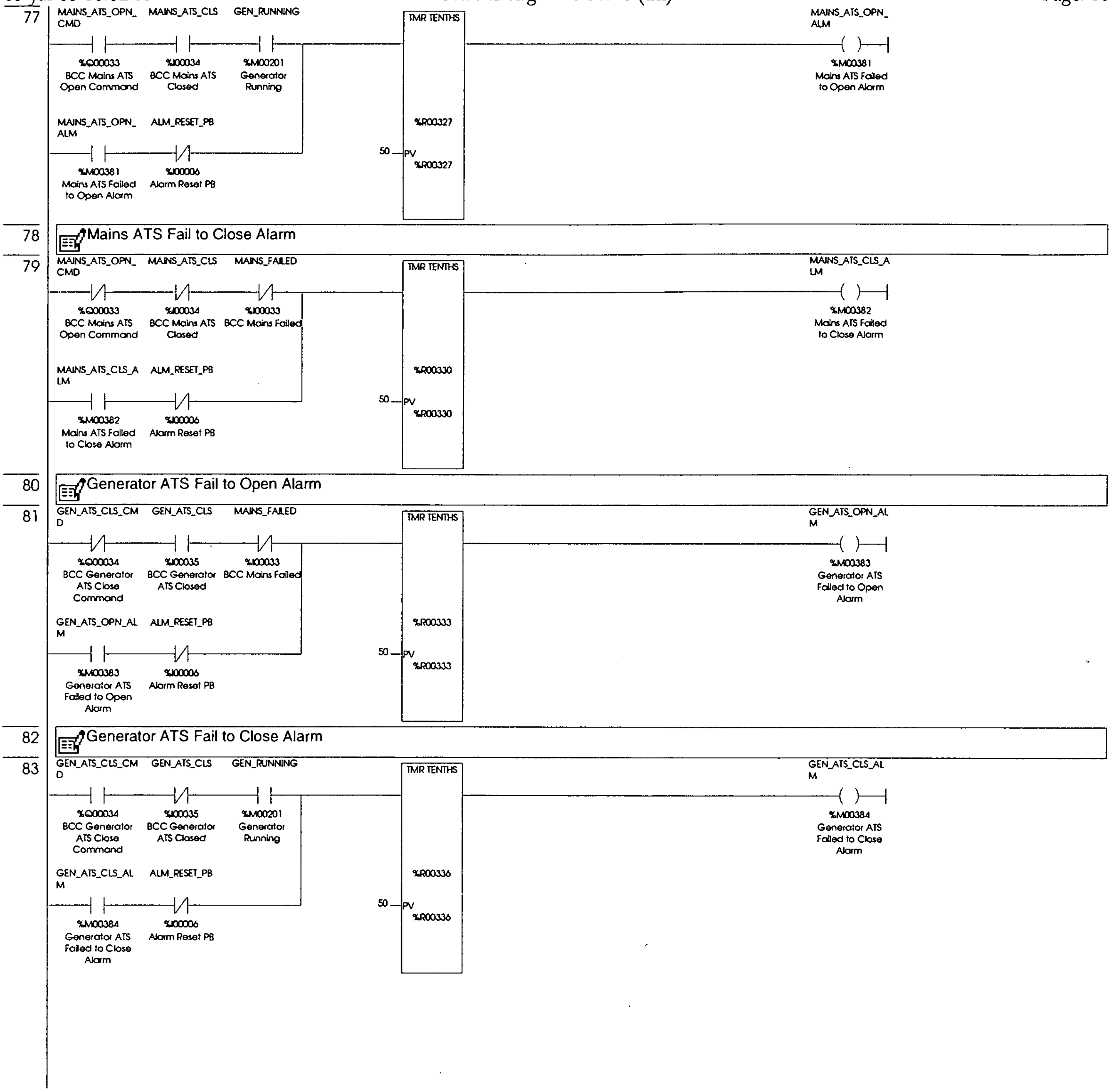
64 Generator Battery Charger AC Fail Alarm

65 66 67

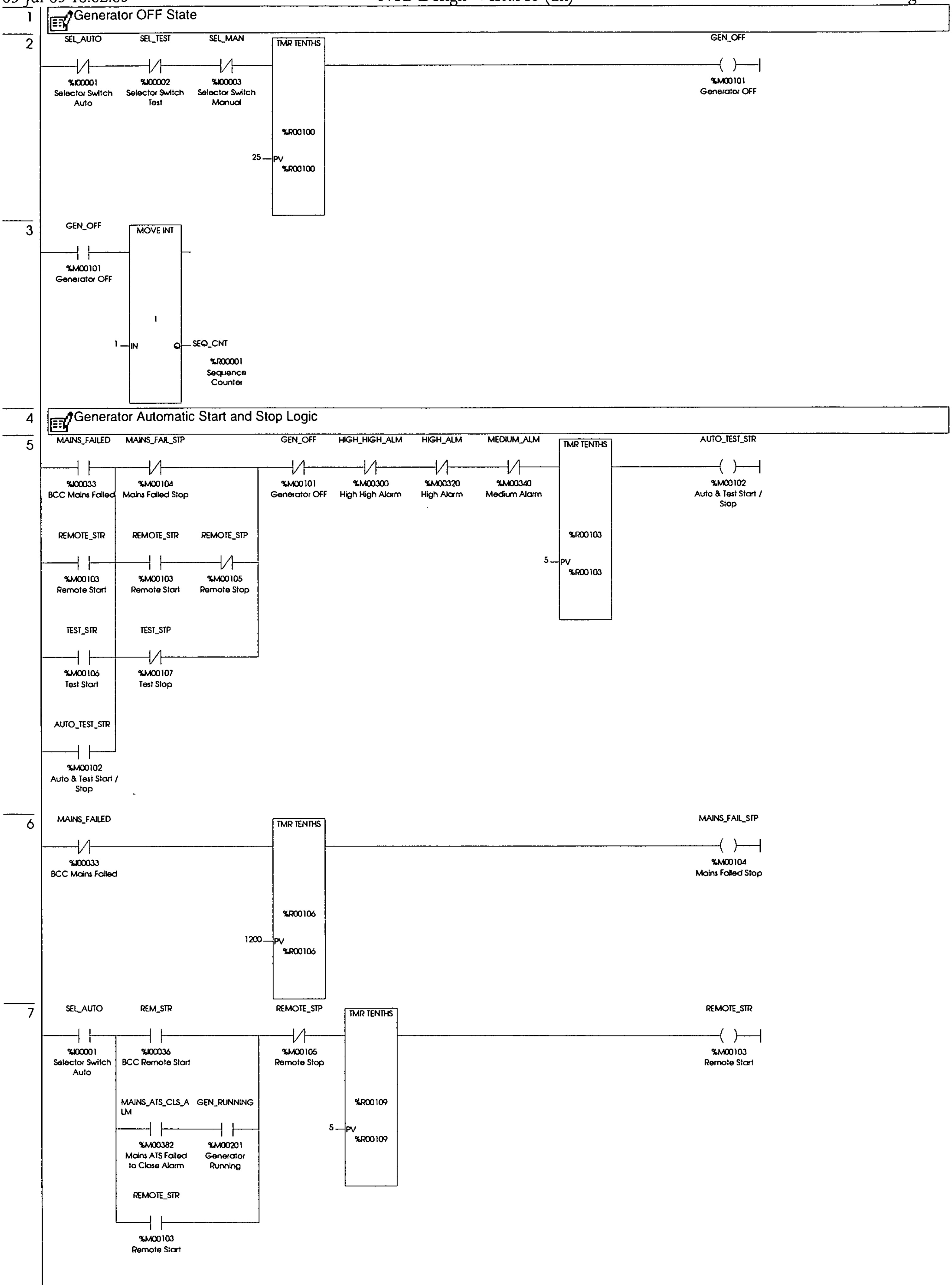


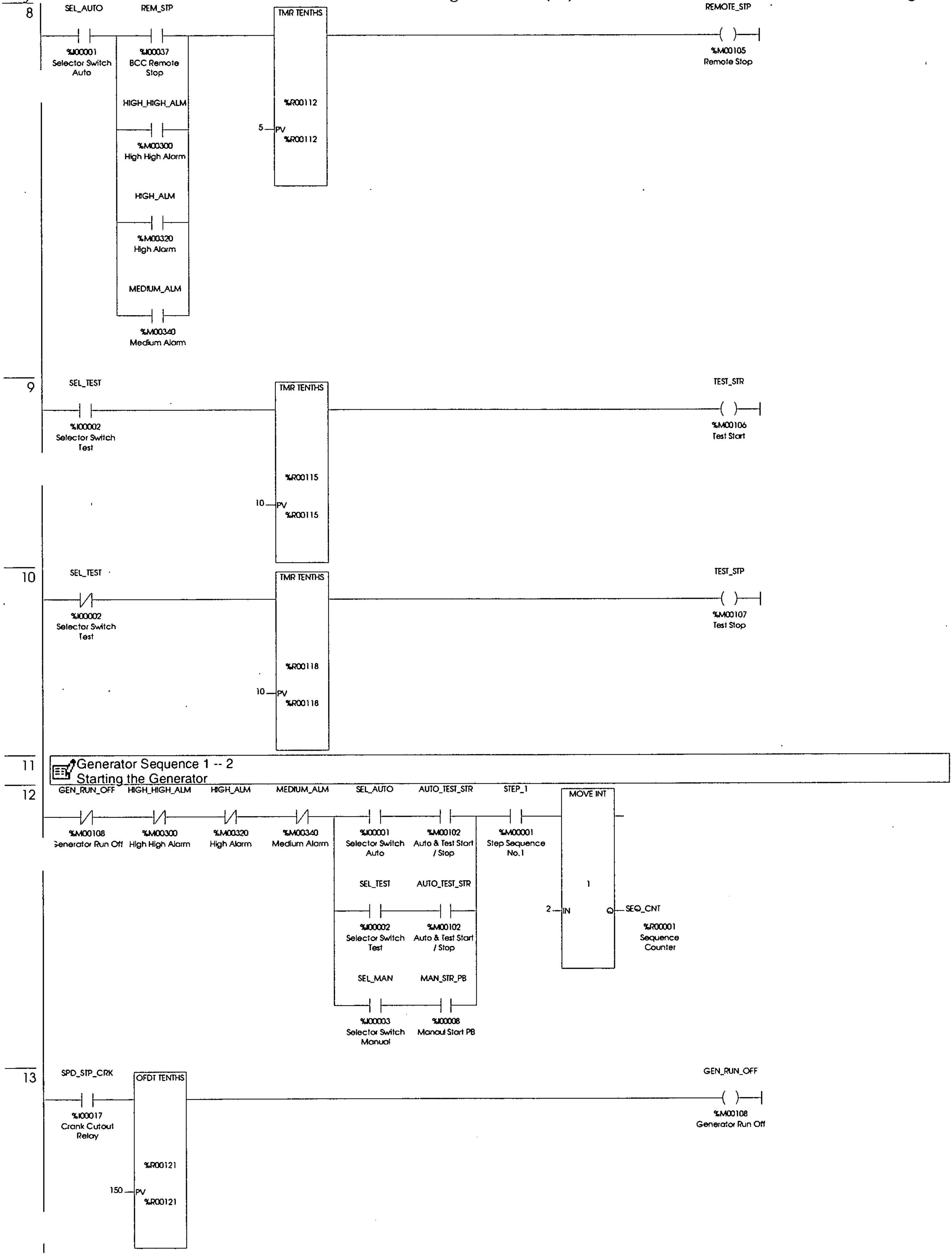
68 Generator Control Battery Low Voltage Alarm


69
BAT_CONT_LOW_V
%I00026
Control Battery Charger Low Voltage
TMR TENTHS
%R00321
300
PV
%R00321
BAT_CONT_LOW_V_DLY
%M00375
Control Battery Low Voltage Delay
70
BAT_CONT_LOW_V_DLY
%M00375
Control Battery Low Voltage Delay
BAT_CONT_LOW_V_ALM
ALM_RESET_PB
%M00365
Control Battery Charger Low Voltage Alarm
%I00006
Alarm Reset PB
BAT_CONT_LOW_V_ALM
%M00365
Control Battery Charger Low Voltage Alarm
71
BAT_CONT_LOW_V_ALM
%M00365
Control Battery Charger Low Voltage Alarm
LAMP_TEST_PB
%I00005
Lamp Test PB
BAT_CONT_LOW_V_IND
%Q00027
Control Battery Charger Low Voltage Indicator
72
Generator Start Battery Low Voltage Alarm
73
BAT_STR_LOW_V
%I00027
Start Battery Charger Low Voltage
TMR TENTHS
%R00324
600
PV
%R00324
BAT_STR_LOW_V_DLY
%M00376
Start Battery Low Voltage Delay
74
BAT_STR_LOW_V_DLY
%M00376
Start Battery Low Voltage Delay
BAT_STR_LOW_V_ALM
ALM_RESET_PB
%M00366
Start Battery Charger Low Voltage Alarm
%I00006
Alarm Reset PB
BAT_STR_LOW_V_ALM
%M00366
Start Battery Charger Low Voltage Alarm
75
BAT_STR_LOW_V_ALM
%M00366
Start Battery Charger Low Voltage Alarm
LAMP_TEST_PB
%I00005
Lamp Test PB
BAT_STR_LOW_V_IND
%Q00028
Start Battery Charger Low Voltage Indicator
76
Mains ATS Fail to Open Alarm


77
MAINS_ATS_OPN_CMD
MAINS_ATS_CLS
GEN_RUNNING
TMR TENTHS
MAINS_ATS_OPN_ALM
%Q00033 BCC Mains ATS Open Command
%I00034 BCC Mains ATS Closed
%M00201 Generator Running
%M00381 Mains ATS Failed to Open Alarm
MAINS_ATS_OPN_ALM
ALM_RESET_PB
%R00327
50 PV
%R00327
%M00381 Mains ATS Failed to Open Alarm
%I00006 Alarm Reset PB
78
Mains ATS Fail to Close Alarm
79
MAINS_ATS_OPN_CMD
MAINS_ATS_CLS
MAINS_FAILED
TMR TENTHS
MAINS_ATS_CLS_ALM
%Q00033 BCC Mains ATS Open Command
%I00034 BCC Mains ATS Closed
%I00033 BCC Mains Failed
%M00382 Mains ATS Failed to Close Alarm
MAINS_ATS_CLS_ALM
ALM_RESET_PB
%R00330
50 PV
%R00330
%M00382 Mains ATS Failed to Close Alarm
%I00006 Alarm Reset PB
80
Generator ATS Fail to Open Alarm
81
GEN_ATS_CLS_CMD
GEN_ATS_CLS
MAINS_FAILED
TMR TENTHS
GEN_ATS_OPN_ALM
%Q00034 BCC Generator ATS Close Command
%I00035 BCC Generator ATS Closed
%I00033 BCC Mains Failed
%M00383 Generator ATS Failed to Open Alarm
GEN_ATS_OPN_ALM
ALM_RESET_PB
%R00333
50 PV
%R00333
%M00383 Generator ATS Failed to Open Alarm
%I00006 Alarm Reset PB
82
Generator ATS Fail to Close Alarm
83
GEN_ATS_CLS_CMD
GEN_ATS_CLS
GEN_RUNNING
TMR TENTHS
GEN_ATS_CLS_ALM
%Q00034 BCC Generator ATS Close Command
%I00035 BCC Generator ATS Closed
%M00201 Generator Running
%M00384 Generator ATS Failed to Close Alarm
GEN_ATS_CLS_ALM
ALM_RESET_PB
%R00336
50 PV
%R00336
%M00384 Generator ATS Failed to Close Alarm
%I00006 Alarm Reset PB

Block Name:......SEQ.blk
Description:......Control Logic for the Generator Operation Sequences.
Block Type:......Ladder


1
Generator OFF State
2
SEL_AUTO
SEL_TEST
SEL_MAN
TMR TENTHS
GEN_OFF
%I00001
Selector Switch Auto
%I00002
Selector Switch Test
%I00003
Selector Switch Manual
%R00100
25
PV
%R00100
%M00101
Generator OFF
3
GEN_OFF
MOVE INT
%M00101
Generator OFF
1
1
IN
Q
SEQ_CNT
%R00001
Sequence Counter
4
Generator Automatic Start and Stop Logic
5
MAINS_FAILED
MAINS_FAIL_STP
GEN_OFF
HIGH_HIGH_ALM
HIGH_ALM
MEDIUM_ALM
TMR TENTHS
AUTO_TEST_STR
%I00033
BCC Mains Failed
%M00104
Mains Failed Stop
%M00101
Generator OFF
%M00300
High High Alarm
%M00320
High Alarm
%M00340
Medium Alarm
%M00102
Auto & Test Start / Stop
REMOTE_STR
REMOTE_STR
REMOTE_STP
%R00103
5
PV
%R00103
%M00103
Remote Start
%M00103
Remote Start
%M00105
Remote Stop
TEST_STR
TEST_STP
%M00106
Test Start
%M00107
Test Stop
AUTO_TEST_STR
%M00102
Auto & Test Start / Stop
6
MAINS_FAILED
TMR TENTHS
MAINS_FAIL_STP
%I00033
BCC Mains Failed
%M00104
Mains Failed Stop
%R00106
1200
PV
%R00106
7
SEL_AUTO
REM_STR
REMOTE_STP
TMR TENTHS
REMOTE_STR
%I00001
Selector Switch Auto
%I00036
BCC Remote Start
%M00105
Remote Stop
%M00103
Remote Start
MAINS_ATS_CLS_ALM
GEN_RUNNING
%R00109
5
PV
%R00109
%M00382
Mains ATS Failed to Close Alarm
%M00201
Generator Running
REMOTE_STR
%M00103
Remote Start


8
SEL_AUTO
%I00001
Selector Switch
Auto
REM_STP
%I00037
BCC Remote
Stop
HIGH_HIGH_ALM
%M00300
High High Alarm
HIGH_ALM
%M00320
High Alarm
MEDIUM_ALM
%M00340
Medium Alarm
TMR TENTHS
%R00112
5
PV
%R00112
REMOTE_STP
%M00105
Remote Stop
9
SEL_TEST
%I00002
Selector Switch
Test
TMR TENTHS
%R00115
10
PV
%R00115
TEST_STR
%M00106
Test Start
10
SEL_TEST
%I00002
Selector Switch
Test
TMR TENTHS
%R00118
10
PV
%R00118
TEST_STP
%M00107
Test Stop
11
Generator Sequence 1 -- 2
Starting the Generator
12
GEN_RUN_OFF
%M00108
Generator Run Off
HIGH_HIGH_ALM
%M00300
High High Alarm
HIGH_ALM
%M00320
High Alarm
MEDIUM_ALM
%M00340
Medium Alarm
SEL_AUTO
%I00001
Selector Switch
Auto
AUTO_TEST_STR
%M00102
Auto & Test Start
/ Stop
SEL_TEST
%I00002
Selector Switch
Test
AUTO_TEST_STR
%M00102
Auto & Test Start
/ Stop
SEL_MAN
%I00003
Selector Switch
Manual
MAN_STR_PB
%I00008
Manual Start PB
STEP_1
%M00001
Step Sequence
No.1
MOVE INT
1
2
IN
Q
SEQ_CNT
%R00001
Sequence
Counter
13
SPD_STP_CRK
%I00017
Crank Cutout
Relay
OFDT TENTHS
%R00121
150
PV
%R00121
GEN_RUN_OFF
%M00108
Generator Run Off

14
STEP_1 — %M00001 Step Sequence No.1
ENABLE_OFFLINE —(R)— %M00109 Enable Generator to go Offline

15
Generator Sequence 2 -- 3
Generator Running at Rated Speed
Generator Warmup Time

16
SEL_AUTO — %I00001 Selector Switch Auto
SEL_TEST — %I00002 Selector Switch Test
GEN_RUNNING — %M00201 Generator Running
STEP_2_E — %M00002 Step Sequence No.2
TMR TENTHS — %R00124 — 50 — PV — %R00124
MOVE INT — 1 — 3 — IN — Q — SEQ_CNT — %R00001 Sequence Counter

17
SEL_MAN — %I00003 Selector Switch Manual
GEN_RUNNING — %M00201 Generator Running
STEP_2_E — %M00002 Step Sequence No.2
TMR TENTHS — %R00127 — 50 — PV — %R00127
MOVE INT — 1 — 3 — IN — Q — SEQ_CNT — %R00001 Sequence Counter

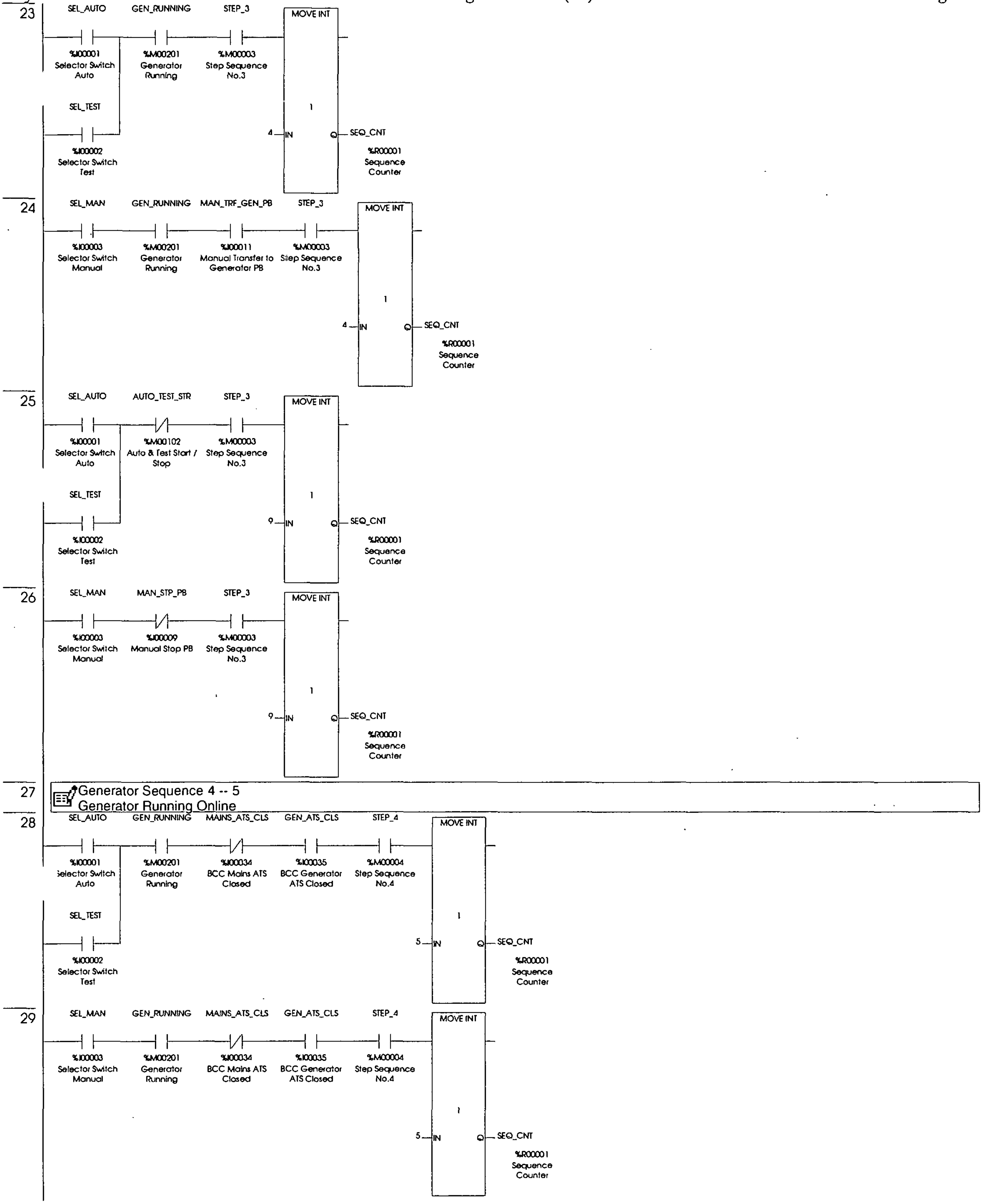
18
SEL_AUTO — %I00001 Selector Switch Auto
SEL_TEST — %I00002 Selector Switch Test
SPD_STP_CRK — %I00017 Crank Cutout Relay
AUTO_TEST_STR — %M00102 Auto & Test Start / Stop
STEP_2_E — %M00002 Step Sequence No.2
MOVE INT — 1 — 1 — IN — Q — SEQ_CNT — %R00001 Sequence Counter

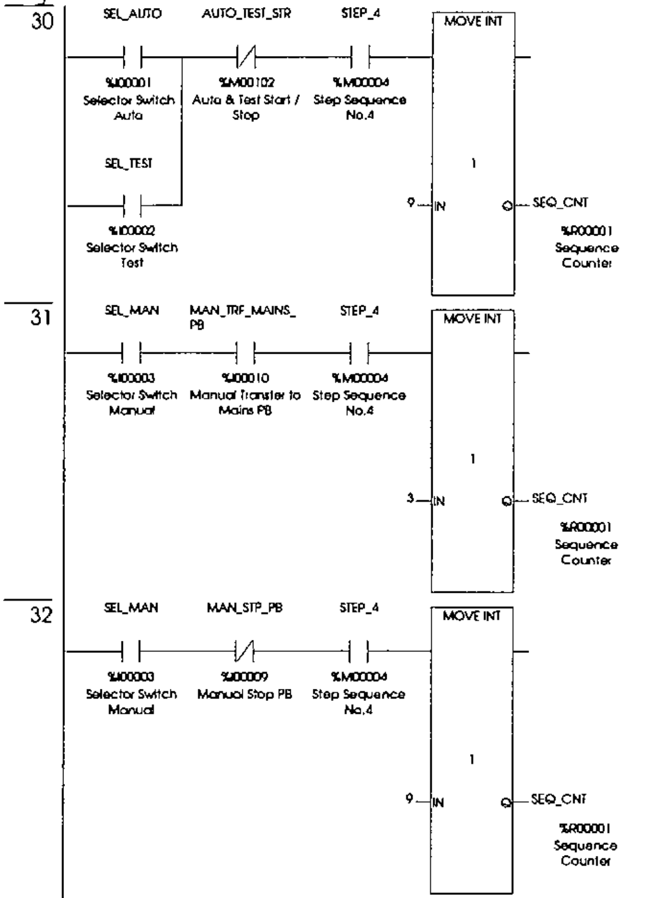
19
SEL_AUTO — %I00001 Selector Switch Auto
SEL_TEST — %I00002 Selector Switch Test
SPD_STP_CRK — %I00017 Crank Cutout Relay
AUTO_TEST_STR — %M00102 Auto & Test Start / Stop
STEP_2_E — %M00002 Step Sequence No.2
MOVE INT — 1 — 9 — IN — Q — SEQ_CNT — %R00001 Sequence Counter

20
SEL_MAN — %I00003 Selector Switch Manual
SPD_STP_CRK — %I00017 Crank Cutout Relay
MAN_STP_PB — %I00009 Manual Stop PB
STEP_2_E — %M00002 Step Sequence No.2
MOVE INT — 1 — 1 — IN — Q — SEQ_CNT — %R00001 Sequence Counter

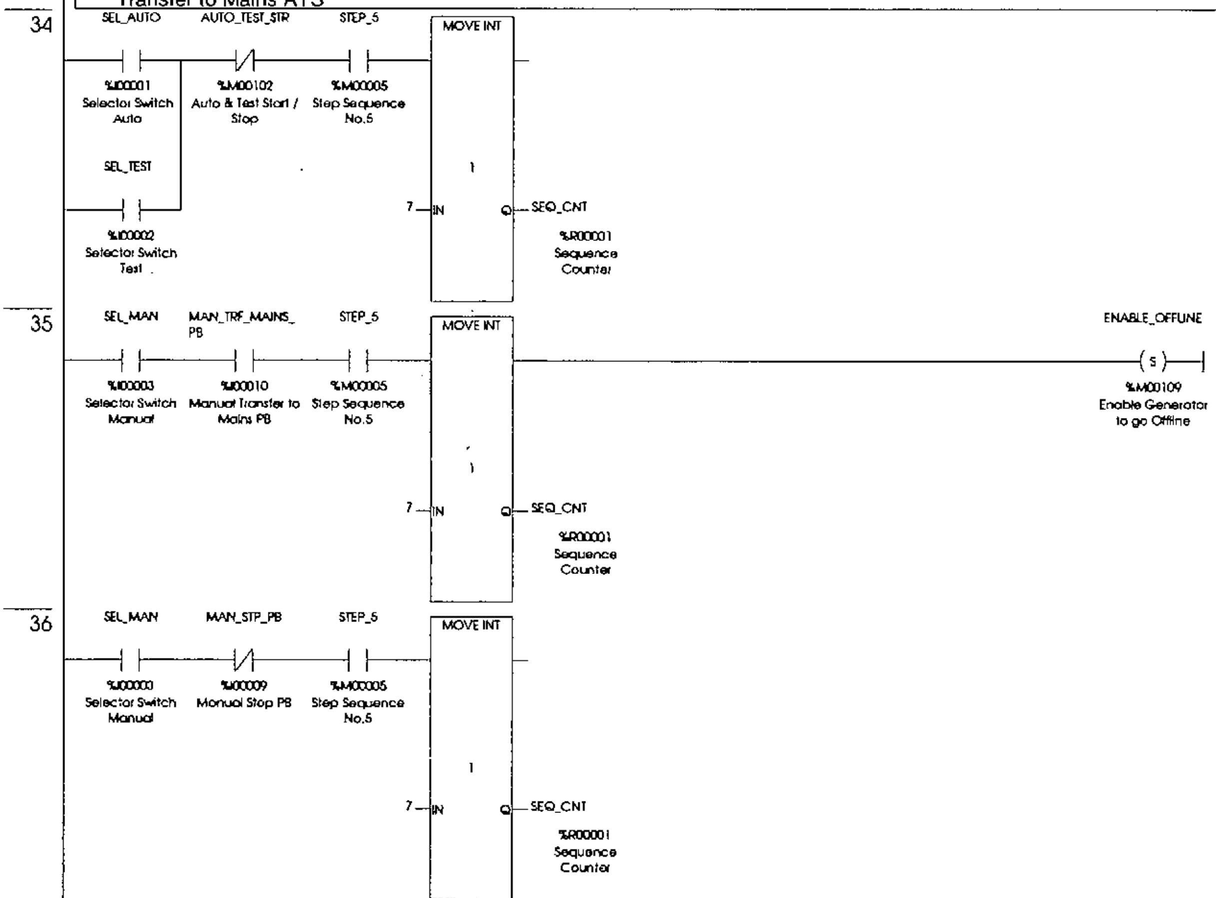
21
SEL_MAN — %I00003 Selector Switch Manual
SPD_STP_CRK — %I00017 Crank Cutout Relay
MAN_STP_PB — %I00009 Manual Stop PB
STEP_2_E — %M00002 Step Sequence No.2
MOVE INT — 1 — 9 — IN — Q — SEQ_CNT — %R00001 Sequence Counter

22
Generator Sequence 3 -- 4
Generator Running at Rated Speed
Transfer to Generator ATS

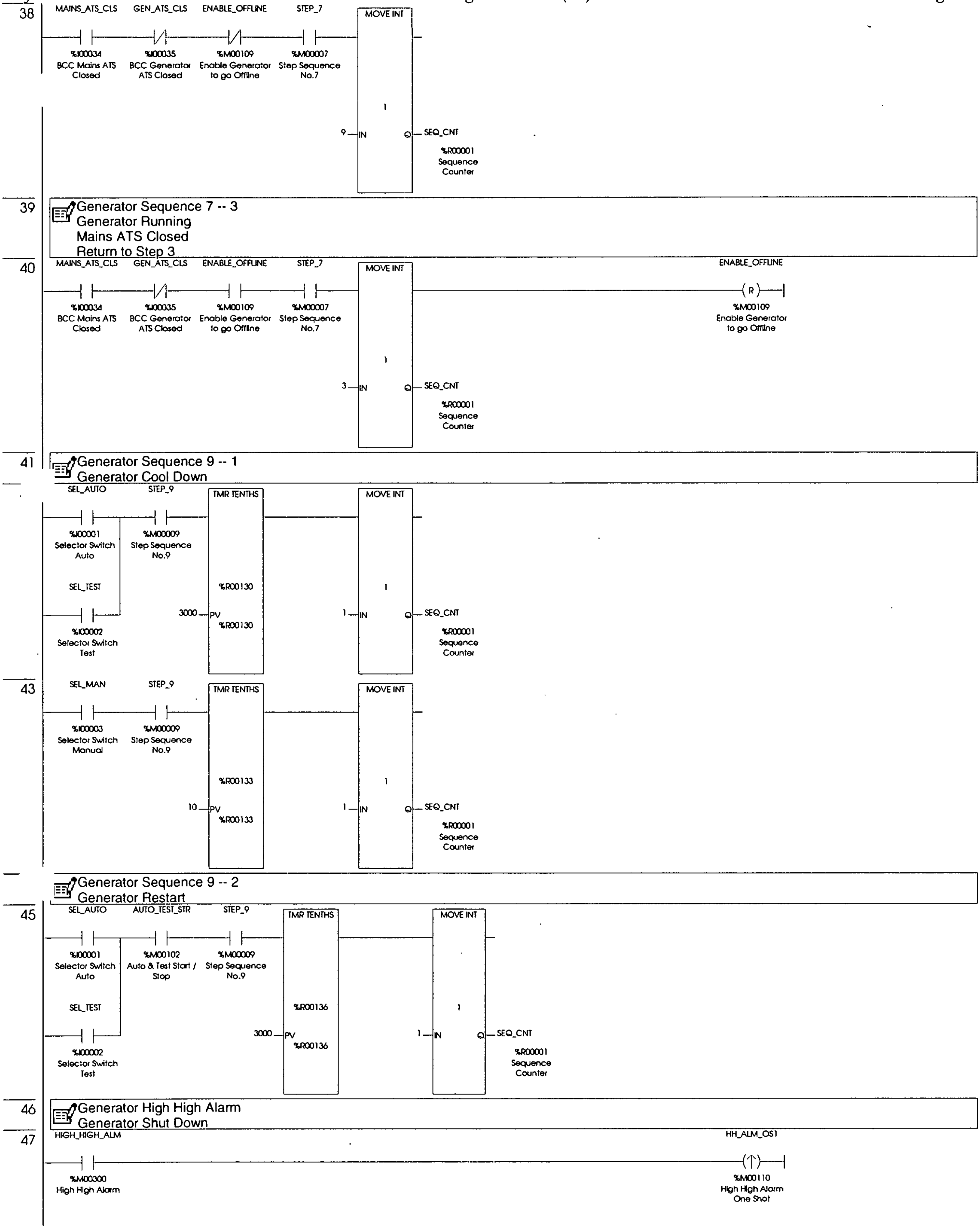

23
SEL_AUTO
GEN_RUNNING
STEP_3
MOVE INT
%I00001 Selector Switch Auto
%M00201 Generator Running
%M00003 Step Sequence No.3
SEL_TEST
1
4 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
24
SEL_MAN
GEN_RUNNING
MAN_TRF_GEN_PB
STEP_3
MOVE INT
%I00003 Selector Switch Manual
%M00201 Generator Running
%I00011 Manual Transfer to Generator PB
%M00003 Step Sequence No.3
1
4 IN Q SEQ_CNT
%R00001 Sequence Counter
25
SEL_AUTO
AUTO_TEST_STR
STEP_3
MOVE INT
%I00001 Selector Switch Auto
%M00102 Auto & Test Start / Stop
%M00003 Step Sequence No.3
SEL_TEST
1
9 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
26
SEL_MAN
MAN_STP_PB
STEP_3
MOVE INT
%I00003 Selector Switch Manual
%I00009 Manual Stop PB
%M00003 Step Sequence No.3
1
9 IN Q SEQ_CNT
%R00001 Sequence Counter
27
Generator Sequence 4 -- 5
Generator Running Online
28
SEL_AUTO
GEN_RUNNING
MAINS_ATS_CLS
GEN_ATS_CLS
STEP_4
MOVE INT
%I00001 Selector Switch Auto
%M00201 Generator Running
%I00034 BCC Mains ATS Closed
%I00035 BCC Generator ATS Closed
%M00004 Step Sequence No.4
SEL_TEST
1
5 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
29
SEL_MAN
GEN_RUNNING
MAINS_ATS_CLS
GEN_ATS_CLS
STEP_4
MOVE INT
%I00003 Selector Switch Manual
%M00201 Generator Running
%I00034 BCC Mains ATS Closed
%I00035 BCC Generator ATS Closed
%M00004 Step Sequence No.4
1
5 IN Q SEQ_CNT
%R00001 Sequence Counter



33 Generator Sequence 5 -- 7
Generator Running Online
Transfer to Mains ATS



37 Generator Sequence 7 -- 9
Generator Running
Mains ATS Closed


38
MAINS_ATS_CLS GEN_ATS_CLS ENABLE_OFFLINE STEP_7
MOVE INT
%I00034 BCC Mains ATS Closed
%I00035 BCC Generator ATS Closed
%M00109 Enable Generator to go Offline
%M00007 Step Sequence No.7
1
9 IN Q SEQ_CNT
%R00001 Sequence Counter
39
Generator Sequence 7 -- 3
Generator Running
Mains ATS Closed
Return to Step 3
40
MAINS_ATS_CLS GEN_ATS_CLS ENABLE_OFFLINE STEP_7
MOVE INT
ENABLE_OFFLINE
(R)
%I00034 BCC Mains ATS Closed
%I00035 BCC Generator ATS Closed
%M00109 Enable Generator to go Offline
%M00007 Step Sequence No.7
%M00109 Enable Generator to go Offline
1
3 IN Q SEQ_CNT
%R00001 Sequence Counter
41
Generator Sequence 9 -- 1
Generator Cool Down
SEL_AUTO STEP_9
TMR TENTHS
MOVE INT
%I00001 Selector Switch Auto
%M00009 Step Sequence No.9
SEL_TEST
%R00130
1
3000 PV
%R00130
1 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
43
SEL_MAN STEP_9
TMR TENTHS
MOVE INT
%I00003 Selector Switch Manual
%M00009 Step Sequence No.9
%R00133
1
10 PV
%R00133
1 IN Q SEQ_CNT
%R00001 Sequence Counter
Generator Sequence 9 -- 2
Generator Restart
45
SEL_AUTO AUTO_TEST_STR STEP_9
TMR TENTHS
MOVE INT
%I00001 Selector Switch Auto
%M00102 Auto & Test Start / Stop
%M00009 Step Sequence No.9
SEL_TEST
%R00136
1
3000 PV
%R00136
1 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
46
Generator High High Alarm
Generator Shut Down
47
HIGH_HIGH_ALM
HH_ALM_OS1
(↑)
%M00300 High High Alarm
%M00110 High High Alarm One Shot

48 HH_ALM_OS1 — %M00110 High High Alarm One Shot — MOVE INT 1 — 1 IN Q — SEQ_CNT %R00001 Sequence Counter

49 Generator High Alarm
Generator Not Running, Move to Stop Mode, Step 1

50 HIGH_ALM %M00320 High Alarm — SPD_STP_CRK %I00017 Crank Cutout Relay — H_ALM_OS1 %M00111 High Alarm One Shot

51 H_ALM_OS1 — %M00111 High Alarm One Shot — MOVE INT 1 — 1 IN Q — SEQ_CNT %R00001 Sequence Counter

52 Generator High Alarm
Generator Running, Move to Cool Down Mode, Step 9

53 HIGH_ALM %M00320 High Alarm — SPD_STP_CRK %I00017 Crank Cutout Relay — H_ALM_OS2 %M00112 High Alarm One Shot

54 H_ALM_OS2 — %M00112 High Alarm One Shot — MOVE INT 1 — 9 IN Q — SEQ_CNT %R00001 Sequence Counter

55 Generator Medium Alarm
Generator Not Running, Move to Stop Mode, Step 1

56 MEDIUM_ALM %M00340 Medium Alarm — SPD_STP_CRK %I00017 Crank Cutout Relay — M_ALM_OS1 %M00113 Medium Alarm One Shot

57 M_ALM_OS1 — %M00113 Medium Alarm One Shot — MOVE INT 1 — 1 IN Q — SEQ_CNT %R00001 Sequence Counter

58 Generator Medium Alarm
Generator Running, Move to Transfer to Mains ATS, Step 7

59 MEDIUM_ALM %M00340 Medium Alarm — SPD_STP_CRK %I00017 Crank Cutout Relay — M_ALM_OS2 %M00114 Medium Alarm One Shot

60
M_ALM_OS2
%M00114
Medium Alarm
One Shot
MOVE INT
1
7 — IN Q — SEQ_CNT
%R00001
Sequence
Counter

61
Mains ATS FAil To Close Alarm
Generator Not Running, Move to Generator Stopped, Step 1

62
GEN_RUNNING MAINS_ATS_CLS_ALM
%M00201
Generator
Running
%M00382
Mains ATS Failed
to Close Alarm
M_ATS_ALM_OS1
(↑)
%M00115
Mains ATS Alarm
One Shot

63
M_ATS_ALM_OS1
%M00115
Mains ATS Alarm
One Shot
MOVE INT
1
1 — IN Q — SEQ_CNT
%R00001
Sequence
Counter

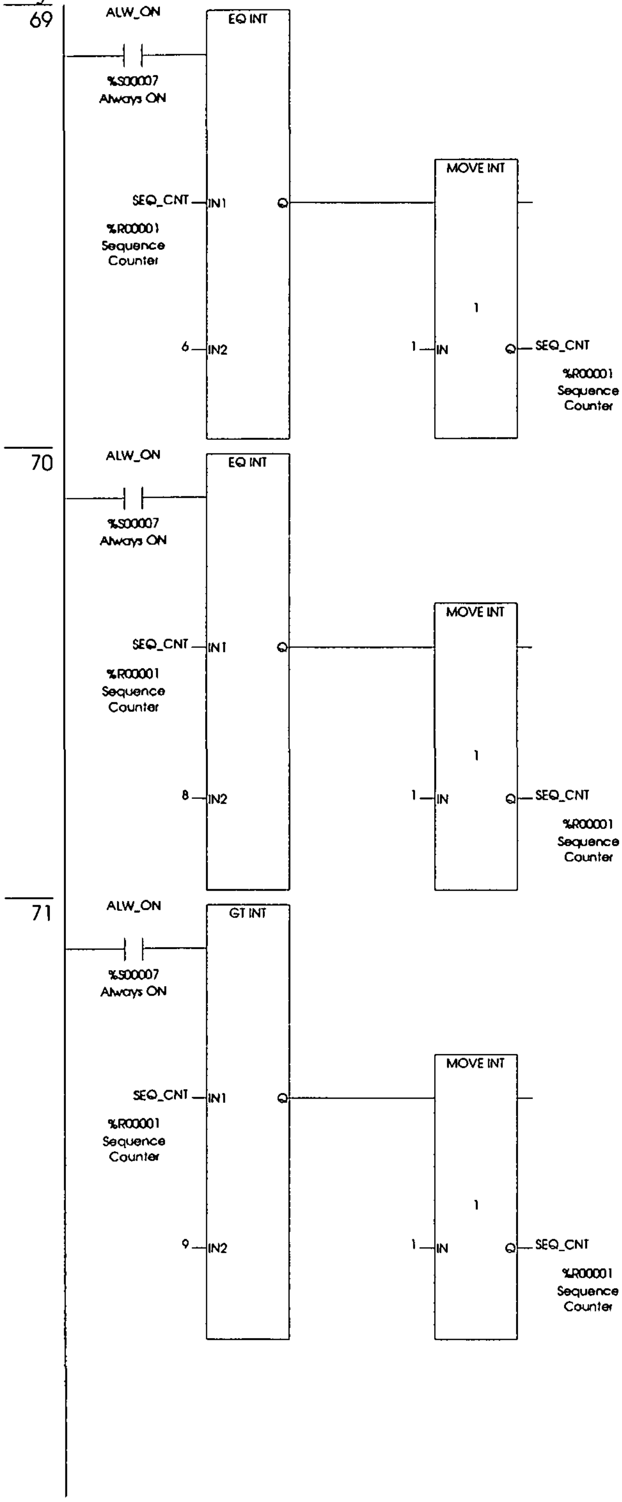
64
Mains ATS Fail To Close Alarm
Generator Running, Move to Transfer to Generator ATS, Step 4

65
GEN_RUNNING MAINS_ATS_CLS_ALM AUTO_TEST_STR
%M00201
Generator
Running
%M00382
Mains ATS Failed
to Close Alarm
%M00102
Auto & Test Start /
Stop
M_ATS_ALM_OS2
(↑)
%M00116
Mains ATS Alarm
One Shot

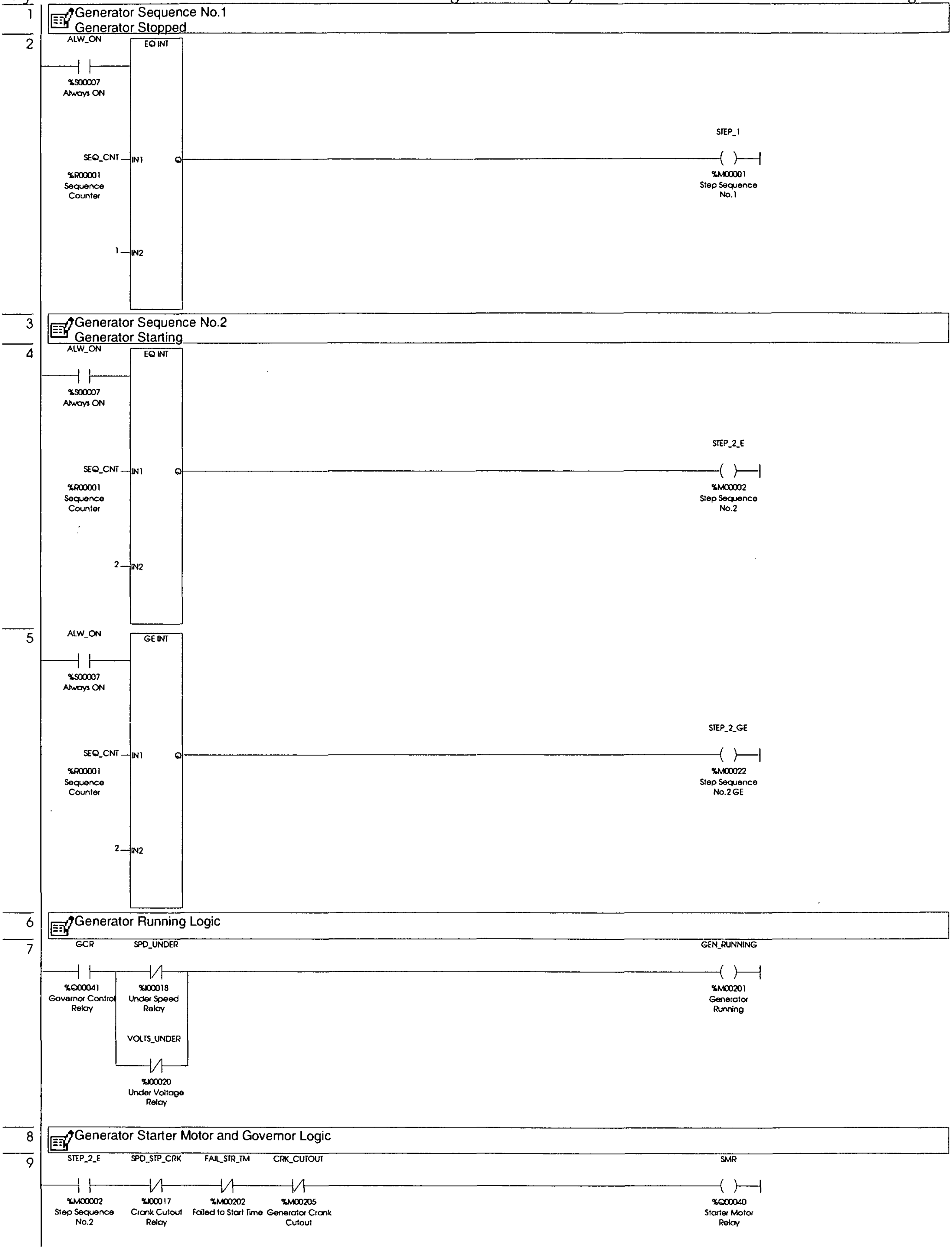
66
M_ATS_ALM_OS2
%M00116
Mains ATS Alarm
One Shot
MOVE INT
1
4 — IN Q — SEQ_CNT
%R00001
Sequence
Counter

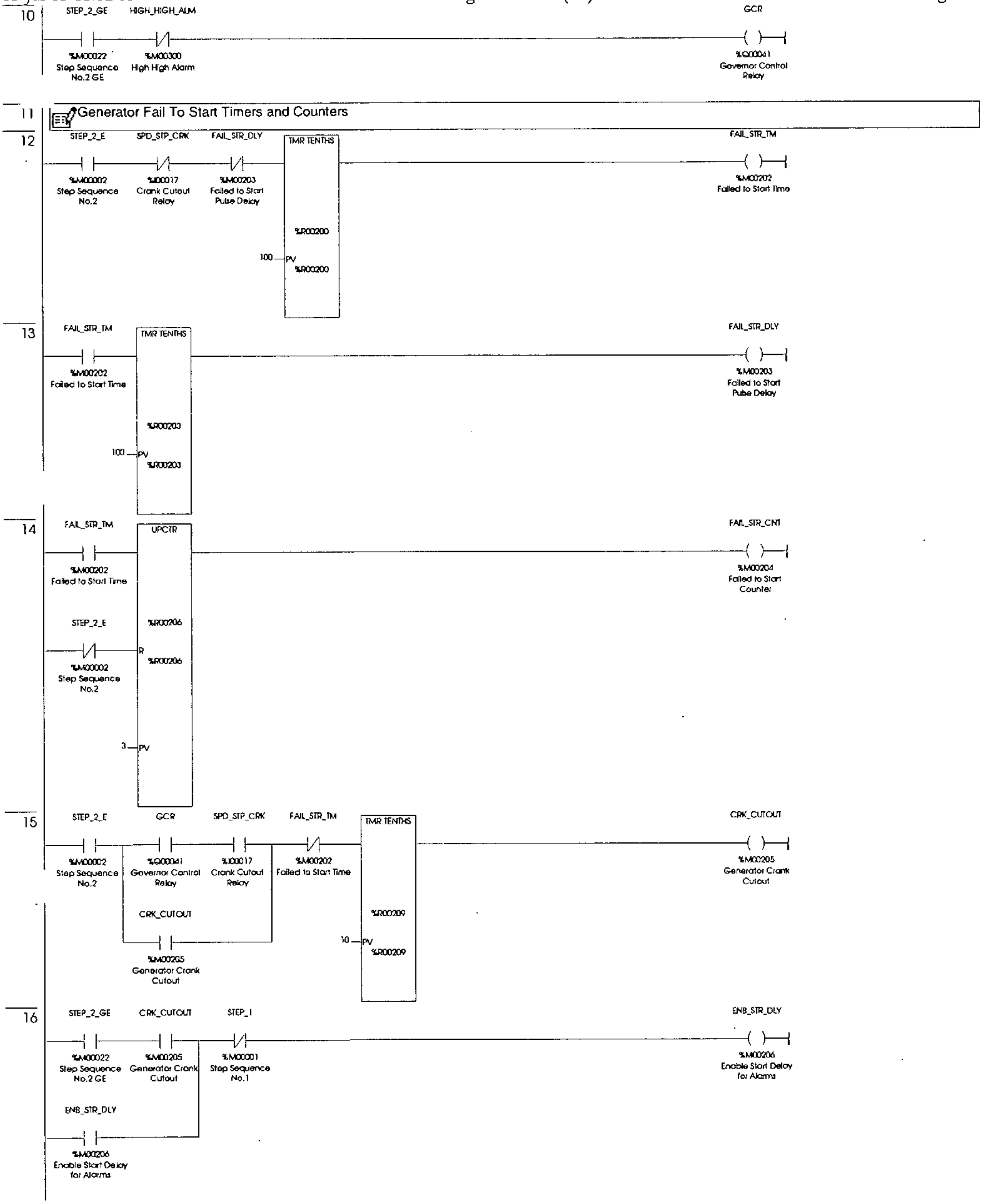
67
Generator Sequence Counter is Out of Range.
Reset to Step 1

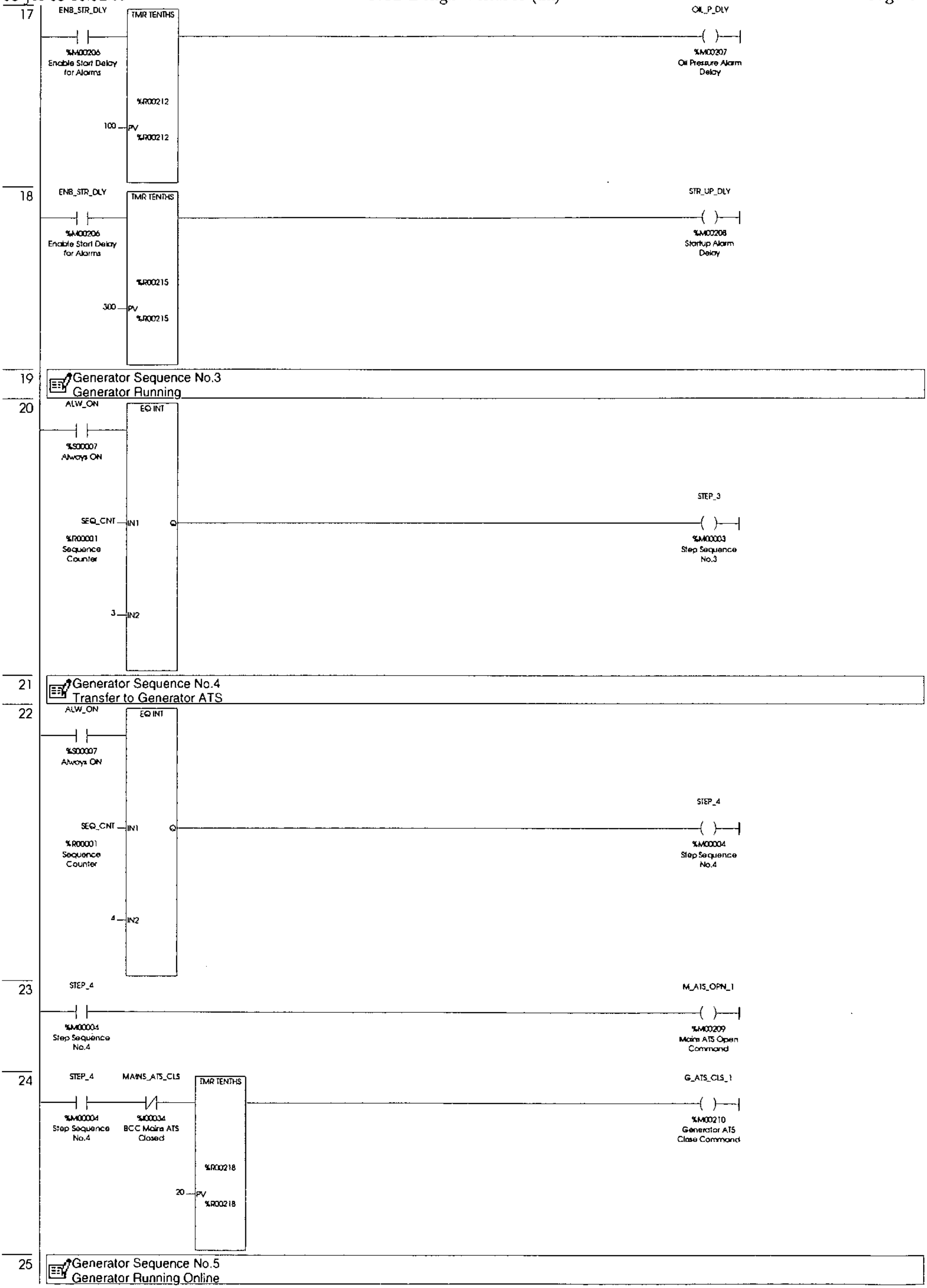
ALW_ON
%S00007
Always ON
LT INT
SEQ_CNT — IN1 Q
%R00001
Sequence
Counter
1 — IN2
MOVE INT
1
1 — IN Q — SEQ_CNT
%R00001
Sequence
Counter


69
ALW_ON
%S00007
Always ON
EQ INT
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
6
IN2
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter
70
ALW_ON
%S00007
Always ON
EQ INT
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
8
IN2
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter
71
ALW_ON
%S00007
Always ON
GT INT
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
9
IN2
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter

Block Name:.......... MAIN.blk
Description:.......... Control Logic for the Generator Sequence Steps.
Block Type:..........Ladder


1
Generator Sequence No.1
Generator Stopped
2
ALW_ON
EQ INT
%S00007
Always ON
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
1
IN2
STEP_1
%M00001
Step Sequence
No.1
3
Generator Sequence No.2
Generator Starting
4
ALW_ON
EQ INT
%S00007
Always ON
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
2
IN2
STEP_2_E
%M00002
Step Sequence
No.2
5
ALW_ON
GE INT
%S00007
Always ON
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
2
IN2
STEP_2_GE
%M00022
Step Sequence
No.2 GE
6
Generator Running Logic
7
GCR
%Q00041
Governor Control
Relay
SPD_UNDER
%I00018
Under Speed
Relay
VOLTS_UNDER
%I00020
Under Voltage
Relay
GEN_RUNNING
%M00201
Generator
Running
8
Generator Starter Motor and Governor Logic
9
STEP_2_E
%M00002
Step Sequence
No.2
SPD_STP_CRK
%I00017
Crank Cutout
Relay
FAIL_STR_TM
%M00202
Failed to Start Time
CRK_CUTOUT
%M00205
Generator Crank
Cutout
SMR
%Q00040
Starter Motor
Relay


10
STEP_2_GE
HIGH_HIGH_ALM
GCR
%M00022
Step Sequence No.2 GE
%M00300
High High Alarm
%Q00041
Governor Control Relay
11
Generator Fail To Start Timers and Counters
12
STEP_2_E
SPD_STP_CRK
FAIL_STR_DLY
TMR TENTHS
FAIL_STR_TM
%M00002
Step Sequence No.2
%I00017
Crank Cutout Relay
%M00203
Failed to Start Pulse Delay
%M00202
Failed to Start Time
%R00200
100
PV
%R00200
13
FAIL_STR_TM
TMR TENTHS
FAIL_STR_DLY
%M00202
Failed to Start Time
%M00203
Failed to Start Pulse Delay
%R00203
100
PV
%R00203
14
FAIL_STR_TM
UPCTR
FAIL_STR_CNT
%M00202
Failed to Start Time
%M00204
Failed to Start Counter
STEP_2_E
%R00206
R
%R00206
%M00002
Step Sequence No.2
3
PV
15
STEP_2_E
GCR
SPD_STP_CRK
FAIL_STR_TM
TMR TENTHS
CRK_CUTOUT
%M00002
Step Sequence No.2
%Q00041
Governor Control Relay
%I00017
Crank Cutout Relay
%M00202
Failed to Start Time
%M00205
Generator Crank Cutout
CRK_CUTOUT
%R00209
10
PV
%R00209
%M00205
Generator Crank Cutout
16
STEP_2_GE
CRK_CUTOUT
STEP_1
ENB_STR_DLY
%M00022
Step Sequence No.2 GE
%M00205
Generator Crank Cutout
%M00001
Step Sequence No.1
%M00206
Enable Start Delay for Alarms
ENB_STR_DLY
%M00206
Enable Start Delay for Alarms

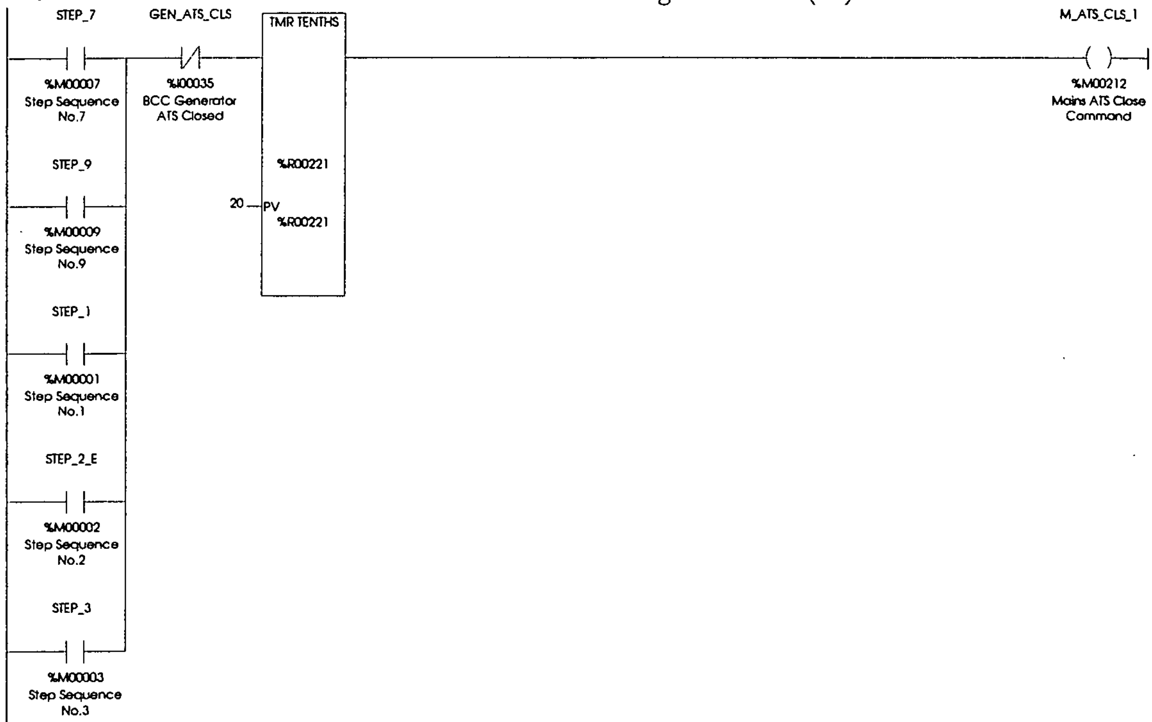

17
ENB_STR_DLY
TMR TENTHS
OIL_P_DLY
%M00206
Enable Start Delay for Alarms
%M00207
Oil Pressure Alarm Delay
%R00212
100
PV
%R00212
18
ENB_STR_DLY
TMR TENTHS
STR_UP_DLY
%M00206
Enable Start Delay for Alarms
%M00208
Startup Alarm Delay
%R00215
300
PV
%R00215
19
Generator Sequence No.3
Generator Running
20
ALW_ON
EQ INT
%S00007
Always ON
STEP_3
SEQ_CNT
IN1
Q
%R00001
Sequence Counter
%M00003
Step Sequence No.3
3
IN2
21
Generator Sequence No.4
Transfer to Generator ATS
22
ALW_ON
EQ INT
%S00007
Always ON
STEP_4
SEQ_CNT
IN1
Q
%R00001
Sequence Counter
%M00004
Step Sequence No.4
4
IN2
23
STEP_4
M_ATS_OPN_1
%M00004
Step Sequence No.4
%M00209
Mains ATS Open Command
24
STEP_4
MAINS_ATS_CLS
TMR TENTHS
G_ATS_CLS_1
%M00004
Step Sequence No.4
%I00034
BCC Mains ATS Closed
%M00210
Generator ATS Close Command
%R00218
20
PV
%R00218
25
Generator Sequence No.5
Generator Running Online

26
ALW_ON
%S00007
Always ON
EQ INT
SEQ_CNT IN1 Q
%R00001
Sequence
Counter
5 IN2
STEP_5
%M00005
Step Sequence
No.5

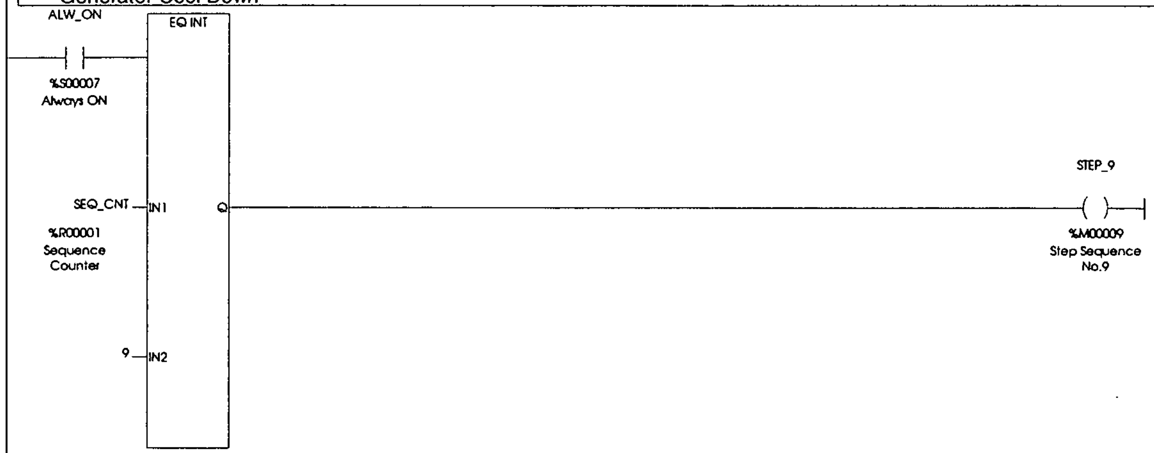
27
Generator Sequence No.7
Transfer to Mains ATS

28
ALW_ON
%S00007
Always ON
EQ INT
SEQ_CNT IN1 Q
%R00001
Sequence
Counter
7 IN2
STEP_7
%M00007
Step Sequence
No.7

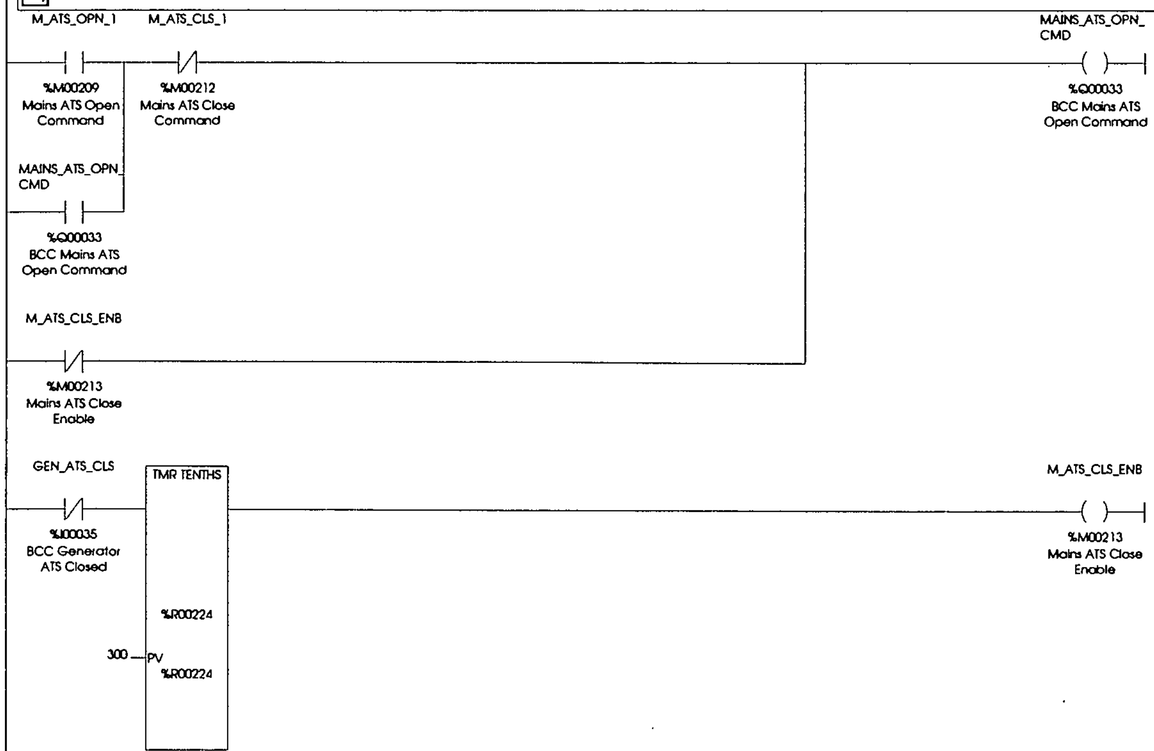
29
STEP_7
%M00007
Step Sequence
No.7
G_ATS_OPN_1
%M00211
Generator ATS
Open Command
STEP_9
%M00009
Step Sequence
No.9
STEP_1
%M00001
Step Sequence
No.1
STEP_2_E
%M00002
Step Sequence
No.2
STEP_3
%M00003
Step Sequence
No.3



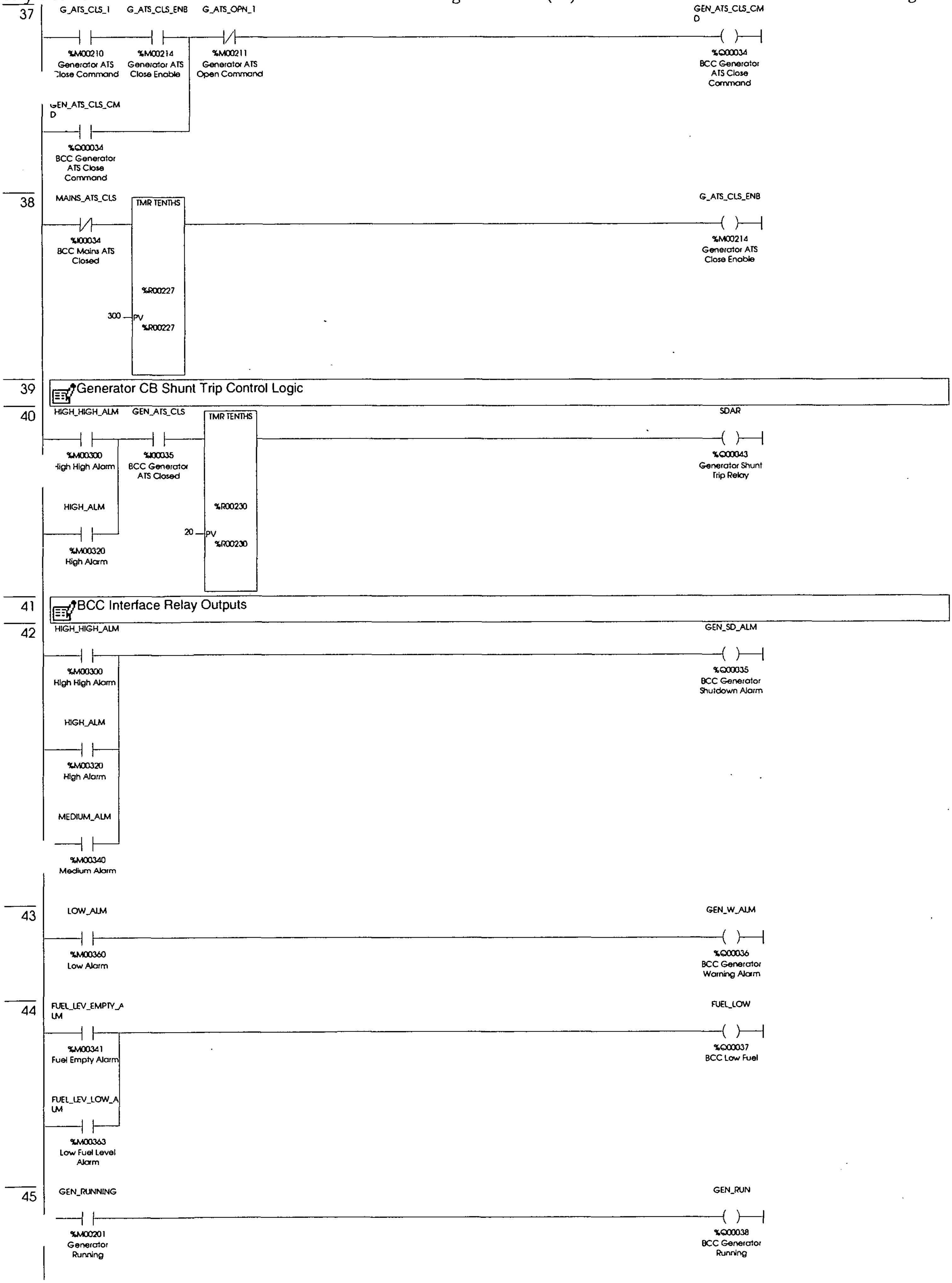
31 Generator Sequence No.9
Generator Offline
Generator Cool Down



33 Mains ATS Control Logic



36 Generator ATS Control Logic


37
G_ATS_CLS_I
%M00210 Generator ATS Close Command
G_ATS_CLS_ENB
%M00214 Generator ATS Close Enable
G_ATS_OPN_1
%M00211 Generator ATS Open Command
GEN_ATS_CLS_CMD
%Q00034 BCC Generator ATS Close Command
GEN_ATS_CLS_CMD
%Q00034 BCC Generator ATS Close Command
38
MAINS_ATS_CLS
%I00034 BCC Mains ATS Closed
TMR TENTHS
%R00227
300 PV
%R00227
G_ATS_CLS_ENB
%M00214 Generator ATS Close Enable
39
Generator CB Shunt Trip Control Logic
40
HIGH_HIGH_ALM
%M00300 High High Alarm
GEN_ATS_CLS
%I00035 BCC Generator ATS Closed
TMR TENTHS
%R00230
20 PV
%R00230
SDAR
%Q00043 Generator Shunt Trip Relay
HIGH_ALM
%M00320 High Alarm
41
BCC Interface Relay Outputs
42
HIGH_HIGH_ALM
%M00300 High High Alarm
GEN_SD_ALM
%Q00035 BCC Generator Shutdown Alarm
HIGH_ALM
%M00320 High Alarm
MEDIUM_ALM
%M00340 Medium Alarm
43
LOW_ALM
%M00360 Low Alarm
GEN_W_ALM
%Q00036 BCC Generator Warning Alarm
44
FUEL_LEV_EMPTY_ALM
%M00341 Fuel Empty Alarm
FUEL_LOW
%Q00037 BCC Low Fuel
FUEL_LEV_LOW_ALM
%M00363 Low Fuel Level Alarm
45
GEN_RUNNING
%M00201 Generator Running
GEN_RUN
%Q00038 BCC Generator Running

46 GEN_ATS_CLS — GEN_CON
%I00035 BCC Generator ATS Closed — %Q00039 BCC Generator Connected

47 Local Control Panel Indicators

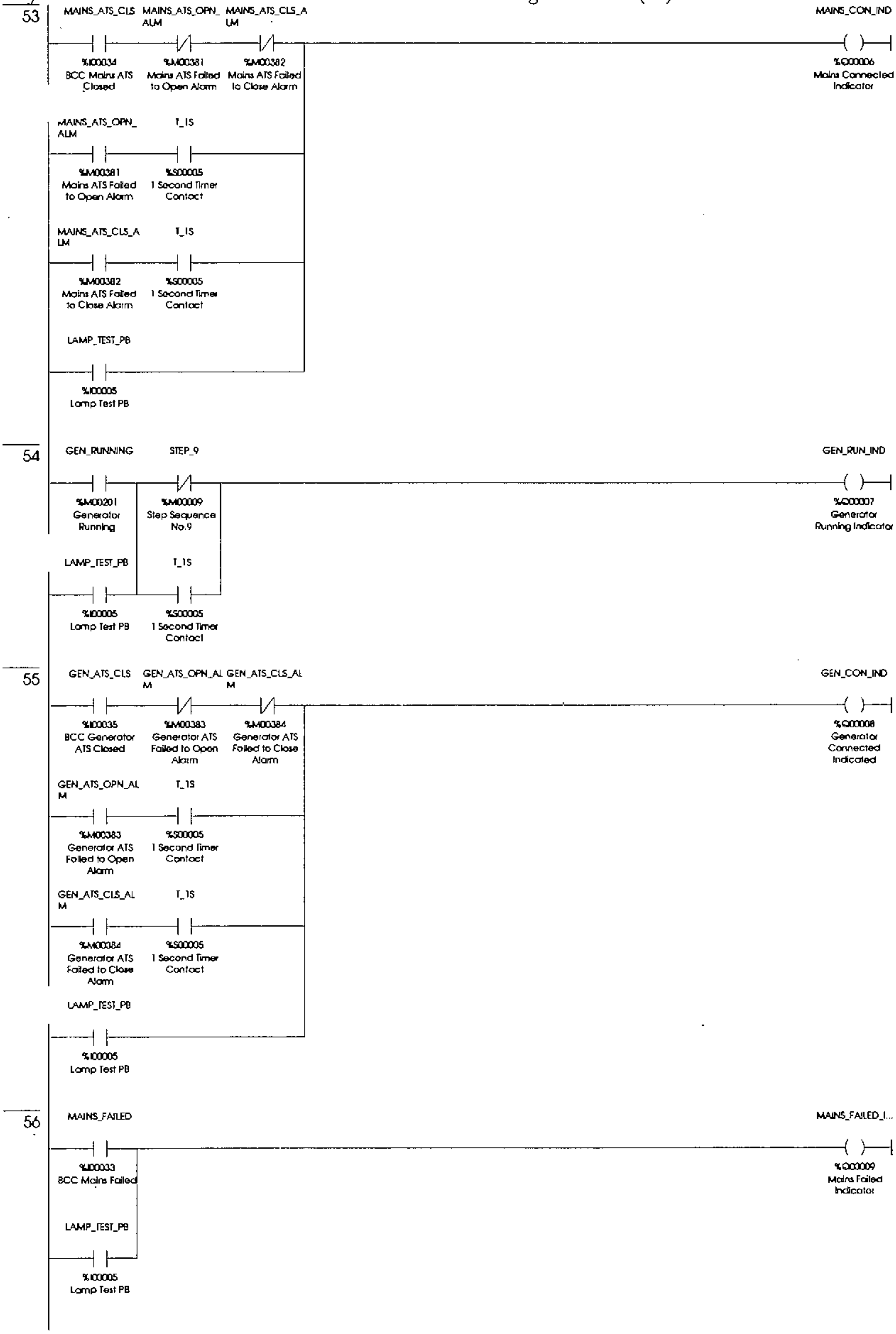
48 SEL_AUTO — AUTO_IND
%I00001 Selector Switch Auto — %Q00001 Controls In Auto Indicator
LAMP_TEST_PB
%I00005 Lamp Test PB

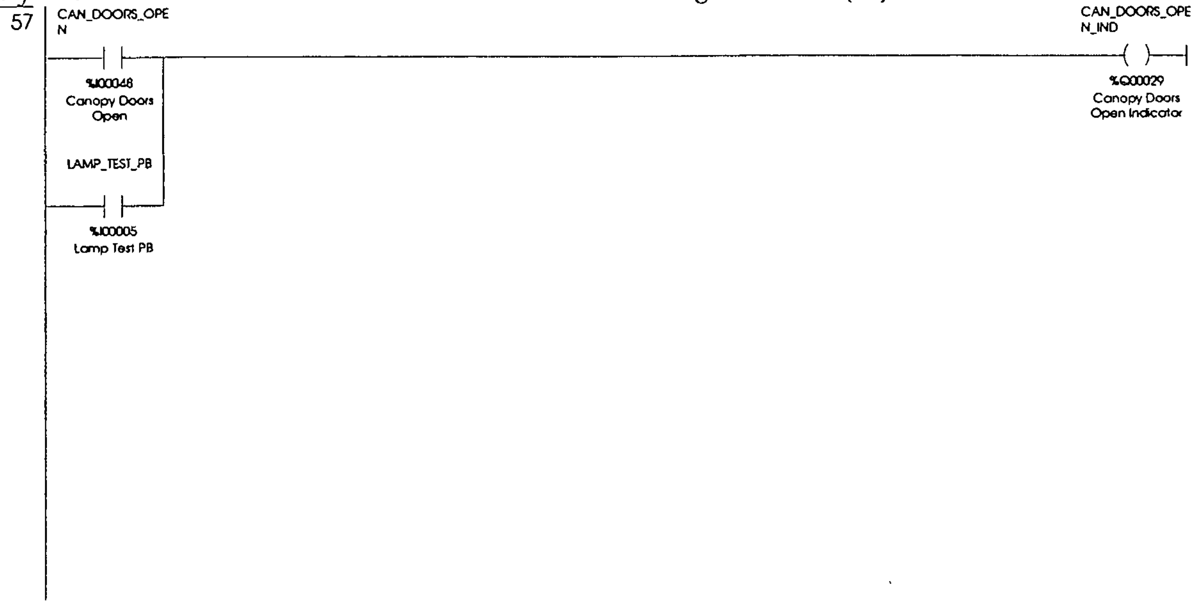
49 SEL_TEST — TEST_IND
%I00002 Selector Switch Test — %Q00002 Controls In Test Indicator
LAMP_TEST_PB
%I00005 Lamp Test PB

50 SEL_MAN — MAN_IND
%I00003 Selector Switch Manual — %Q00003 Controls In Manual Indicator
LAMP_TEST_PB
%I00005 Lamp Test PB

51 REMOTE_STR — REM_STR_IND
%M00103 Remote Start — %Q00004 Remote Start Indicator
LAMP_TEST_PB
%I00005 Lamp Test PB

52 MAINS_FAILED — MAINS_AVAIL_IND
%I00033 BCC Mains Failed — %Q00005 Mains Available Indicator
LAMP_TEST_PB
%I00005 Lamp Test PB


53
MAINS_ATS_CLS
MAINS_ATS_OPN_ALM
MAINS_ATS_CLS_ALM
MAINS_CON_IND
%I00034 BCC Mains ATS Closed
%M00381 Mains ATS Failed to Open Alarm
%M00382 Mains ATS Failed to Close Alarm
%Q00006 Mains Connected Indicator
MAINS_ATS_OPN_ALM
T_1S
%M00381 Mains ATS Failed to Open Alarm
%S00005 1 Second Timer Contact
MAINS_ATS_CLS_ALM
T_1S
%M00382 Mains ATS Failed to Close Alarm
%S00005 1 Second Timer Contact
LAMP_TEST_PB
%I00005 Lamp Test PB
54
GEN_RUNNING
STEP_9
GEN_RUN_IND
%M00201 Generator Running
%M00009 Step Sequence No.9
%Q00007 Generator Running Indicator
LAMP_TEST_PB
T_1S
%I00005 Lamp Test PB
%S00005 1 Second Timer Contact
55
GEN_ATS_CLS
GEN_ATS_OPN_ALM
GEN_ATS_CLS_ALM
GEN_CON_IND
%I00035 BCC Generator ATS Closed
%M00383 Generator ATS Failed to Open Alarm
%M00384 Generator ATS Failed to Close Alarm
%Q00008 Generator Connected Indicated
GEN_ATS_OPN_ALM
T_1S
%M00383 Generator ATS Failed to Open Alarm
%S00005 1 Second Timer Contact
GEN_ATS_CLS_ALM
T_1S
%M00384 Generator ATS Failed to Close Alarm
%S00005 1 Second Timer Contact
LAMP_TEST_PB
%I00005 Lamp Test PB
56
MAINS_FAILED
MAINS_FAILED_I...
%I00033 BCC Mains Failed
%Q00009 Mains Failed Indicator
LAMP_TEST_PB
%I00005 Lamp Test PB


57
CAN_DOORS_OPEN
%I00048
Canopy Doors Open
LAMP_TEST_PB
%I00005
Lamp Test PB
CAN_DOORS_OPEN_IND
%Q00029
Canopy Doors Open Indicator

Block Name:.. _MAIN.blk
Description:..Control Logic for the Call for Sub Routines.
Block Type:..Ladder

1 Written for EPAC.
Project: Brisbane City Council, Standby Generator Program.

2 FST_SCN —| |— PRESETS [CALL]
%S00001
Set to 1 when the current sweep is the first sweep

3 SEQ [CALL]

4 MAIN [CALL]

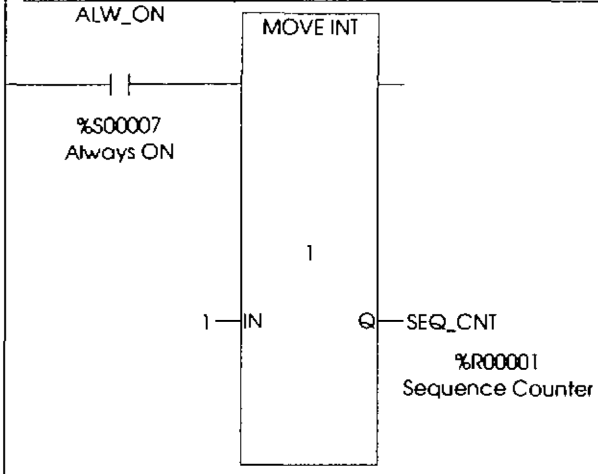
5 ALARM [CALL]

6 AUD_ALM [CALL]

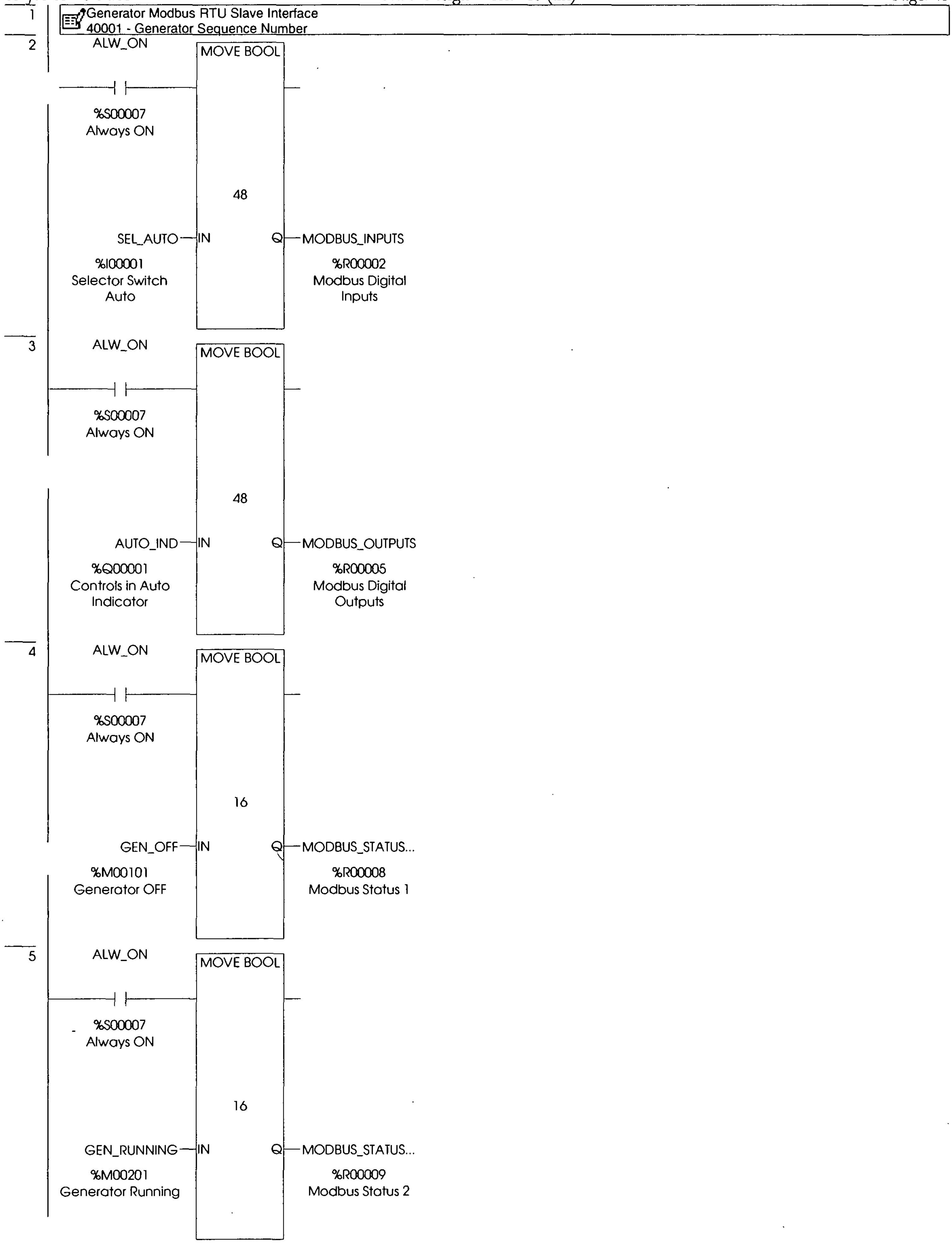
7 MODBUS [CALL]

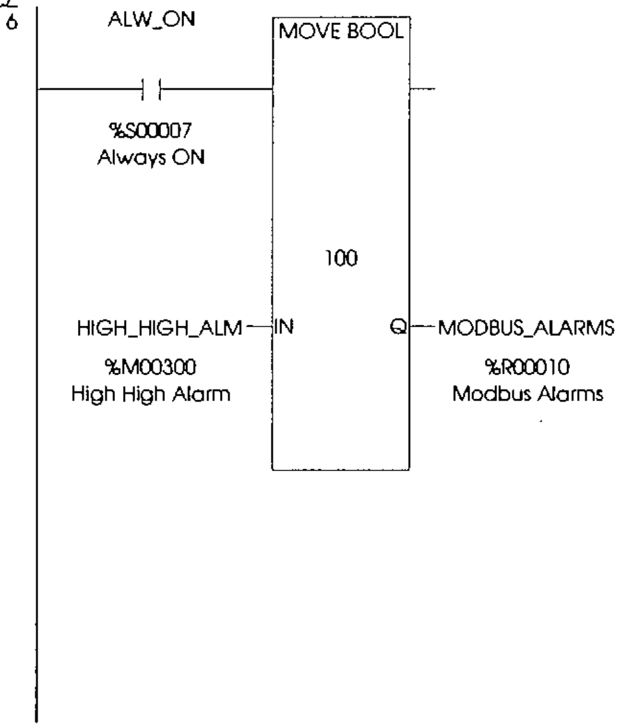
Block Name:...PRESETS.blk
Description:..Control Logic Generator Presets.
Block Type:...Ladder

1 Presets Routine
Move 1 to the Sequence Counter

2


Block Name:..MODBUS.blk
Description:.................................... Control Logic for the Modbus RTU Communications Data.
Block Type:...Ladder


1
Generator Modbus RTU Slave Interface
40001 - Generator Sequence Number
2
ALW_ON
%S00007
Always ON
MOVE BOOL
48
SEL_AUTO
IN
Q
MODBUS_INPUTS
%I00001
Selector Switch Auto
%R00002
Modbus Digital Inputs
3
ALW_ON
%S00007
Always ON
MOVE BOOL
48
AUTO_IND
IN
Q
MODBUS_OUTPUTS
%Q00001
Controls in Auto Indicator
%R00005
Modbus Digital Outputs
4
ALW_ON
%S00007
Always ON
MOVE BOOL
16
GEN_OFF
IN
Q
MODBUS_STATUS...
%M00101
Generator OFF
%R00008
Modbus Status 1
5
ALW_ON
%S00007
Always ON
MOVE BOOL
16
GEN_RUNNING
IN
Q
MODBUS_STATUS...
%M00201
Generator Running
%R00009
Modbus Status 2


6
ALW_ON
MOVE BOOL
%S00007
Always ON
100
HIGH_HIGH_ALM
IN
Q
MODBUS_ALARMS
%M00300
High High Alarm
%R00010
Modbus Alarms

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
SEI ITO	BIT	1	%I00001	Selector Switch Auto		Global	R		
SEI_ ST	BIT	1	%I00002	Selector Switch Test		Global	R		
SEL_MAN	BIT	1	%I00003	Selector Switch Manual		Global	R		
EM_STOP_PB	BIT	1	%I00004	Emergency Stop PB		Global	R		
LAMP_TEST_PB	BIT	1	%I00005	Lamp Test PB		Global	R		
ALM_RESET_PB	BIT	1	%I00006	Alarm Reset PB		Global	R		
ALM_MUTE_PB	BIT	1	%I00007	Alarm Mute PB		Global	R		
MAN_STR_PB	BIT	1	%I00008	Manaul Start PB		Global	R		
MAN_STP_PB	BIT	1	%I00009	Manual Stop PB		Global	R		
MAN_TRF_MAINS_PB	BIT	1	%I00010	Manual Transfer to Mains PB		Global	R		
MAN_TRF_GEN_PB	BIT	1	%I00011	Manual Transfer to Generator PB		Global	R		
SPD_STP_CRK	BIT	1	%I00017	Crank Cutout Relay		Global	R		
SPD_UNDER	BIT	1	%I00018	Under Speed Relay		Global	R		
SPD_OVER	BIT	1	%I00019	Over Speed Relay		Global	R		
VOLTS_UNDER	BIT	1	%I00020	Under Voltage Relay		Global	R		
VOLTS_OVER	BIT	1	%I00021	Over Voltage Relay		Global	R		
ALT_TEMP	BIT	1	%I00022	Alternator High Temperature Relay		Global	R		
GEN_CB_TRIP	BIT	1	%I00023	Generator CB Tripped		Global	R		
MEN_FLT	BIT	1	%I00024	MEN Fault Relay		Global	R		
BAT_CHG_AC	BIT	1	%I00025	Battery Charger AC Relay		Global	R		
BAT_CONT_LOW_V	BIT	1	%I00026	Control Battery Charger Low Voltage		Global	R		
BA 'R_LOW_V	BIT	1	%I00027	Start Battery Charger Low Voltage		Global	R		
MAINS_FAILED	BIT	1	%I00033	BCC Mains Failed		Global	R		
MAINS_ATS_CLS	BIT	1	%I00034	BCC Mains ATS Closed		Global	R		
GEN_ATS_CLS	BIT	1	%I00035	BCC Generator ATS Closed		Global	R		
REM_STR	BIT	1	%I00036	BCC Remote Start		Global	R		
REM_STP	BIT	1	%I00037	BCC Remote Stop		Global	R		
OIL_P_LOW_SD	BIT	1	%I00041	Low Oil Pressure Shutdown		Global	R		
OIL_P_LOW_W	BIT	1	%I00042	Low Oil Pressure Warning		Global	R		
ENG_T_HI_SD	BIT	1	%I00043	High Engine Temperature Shutdown		Global	R		
ENG_T_HI_W	BIT	1	%I00044	High Engine Temperature Warning		Global	R		
RAD_WATER_LOW	BIT	1	%I00045	Low Radiator Water Level		Global	R		
FUEL_LEV_LOW	BIT	1	%I00046	Low Fuel Level		Global	R		
FUEL_LEV_EMPTY	BIT	1	%I00047	Fuel Empty		Global	R		
CAN_DOORS_OPEN	BIT	1	%I00048	Canopy Doors Open		Global	R		
STEP_1	BIT	1	%M00001	Step Sequence No.1		Global			
STEP_2_E	BIT	1	%M00002	Step Sequence No.2		Global			
STEP_3	BIT	1	%M00003	Step Sequence No.3		Global			
STEP_4	BIT	1	%M00004	Step Sequence No.4		Global			
STEP_5	BIT	1	%M00005	Step Sequence No.5		Global			
STEP 6	BIT	1	%M00006	Step Sequence No.6		Global			
STI '	BIT	1	%M00007	Step Sequence No.7		Global			
STI _	BIT	1	%M00008	Step Sequence No.8		Global			
STEP_9	BIT	1	%M00009	Step Sequence No.9		Global			
STEP_2_GE	BIT	1	%M00022	Step Sequence No.2 GE		Global			
GEN_OFF	BIT	1	%M00101	Generator OFF		Global			
AUTO_TEST_STR	BIT	1	%M00102	Auto Test Start / Stop		Global			
REMOTE_STR	BIT	1	%M00103	Remote Start		Global			
MAINS_FAIL_STP	BIT	1	%M00104	Mains Failed Stop		Global			
REMOTE_STP	BIT	1	%M00105	Remote Stop		Global			
TEST_STR	BIT	1	%M00106	Test Start		Global			
TEST_STP	BIT	1	%M00107	Test Stop		Global			
GEN_RUN_OFF	BIT	1	%M00108	Generator Run Off		Global			
ENABLE_OFFLINE	BIT	1	%M00109	Enable Generator to go Offline		Global			
HH_ALM_OS1	BIT	1	%M00110	High High Alarm One Shot		Global			
H_ALM_OS1	BIT	1	%M00111	High Alarm One Shot		Global			
H_ALM_OS2	BIT	1	%M00112	High Alarm One Shot		Global			
M_ALM_OS1	BIT	1	%M00113	Medium Alarm One Shot		Global			
M_ALM_OS2	BIT	1	%M00114	Medium Alarm One Shot		Global			
M_ATS_ALM_OS1	BIT	1	%M00115	Mains ATS Alarm One Shot		Global			
M_ATS_ALM_OS2	BIT	1	%M00116	Mains ATS Alarm One Shot		Global			
GEN_RUNNING	BIT	1	%M00201	Generator Running		Global			
FAIL STR_TM	BIT	1	%M00202	Failed to Start Time		Global			
FAI rR_DLY	BIT	1	%M00203	Failed to Start Pulse Delay		Global			
FAI__ rR_CNT	BIT	1	%M00204	Failed to Start Counter		Global			
CRK_CUTOUT	BIT	1	%M00205	Generator Crank Cutout		Global			
ENB_STR_DLY	BIT	1	%M00206	Enable Start Delay for Alarms		Global			
OIL_P_DLY	BIT	1	%M00207	Oil Pressure Alarm Delay		Global			
STR_UP_DLY	BIT	1	%M00208	Startup Alarm Delay		Global			

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
M_ATS_OPN_1	BIT	1	%M00209	Mains ATS Open Command		Global			
G_ATS_CLS_1	BIT	1	%M00210	Generator ATS Close Command		Global			
G_ATS_OPN_1	BIT	1	%M00211	Generator ATS Open Command		Global			
M_ATS_CLS_1	BIT	1	%M00212	Mains ATS Close Command		Global			
M_ATS_CLS_ENB	BIT	1	%M00213	Mains ATS Close Enable		Global			
G_ATS_CLS_ENB	BIT	1	%M00214	Generator ATS Close Enable		Global			
HIGH_HIGH_ALM	BIT	1	%M00300	High High Alarm		Global			
EM_STP_ALM	BIT	1	%M00301	Emergency Stop Alarm		Global			
MEN_ALM	BIT	1	%M00302	MEN Alarm		Global			
OIL_P_SD_ALM	BIT	1	%M00303	Low Oil Pressure Shutdown Alarm		Global			
ENG_T_SD_ALM	BIT	1	%M00304	High Engine Temperature Shutdown Alarm		Global			
RAD_WATER_LOW_ALM	BIT	1	%M00305	Low Radiator Water Level Alarm		Global			
SPD_OVER_ALM	BIT	1	%M00306	Over Speed Alarm		Global			
RAD_WATER_LOW_DLY	BIT	1	%M00315	Radiator Water Level Low Delay		Global			
SPD_OVER_DLY	BIT	1	%M00316	Over Speed Delay Timer		Global	R		
HIGH_ALM	BIT	1	%M00320	High Alarm		Global			
SPD_UNDER_ALM	BIT	1	%M00321	Under Speed Alarm		Global			
VOLTS_UNDER_ALM	BIT	1	%M00322	Alternator Voltage Under Alarm		Global			
VOLTS_OVER_ALM	BIT	1	%M00323	Alternator Voltage Over Alarm		Global			
GEN_CB_TRIP_ALM	BIT	1	%M00324	Generator CB Tripped Alarm		Global			
ALT_TEMP_ALM	BIT	1	%M00325	Alternator High Temperature Alarm		Global			
SPD_UNDER_DLY	BIT	1	%M00331	Under Speed Alarm Delay		Global			
VOLTS_UNDER_DLY	BIT	1	%M00332	Under Voltage Alarm Delay		Global			
VOLTS_OVER_DLY	BIT	1	%M00333	Over Voltage Alarm Delay		Global			
MEDIUM_ALM	BIT	1	%M00340	Medium Alarm		Global			
FUEL_LEV_EMPTY_ALM	BIT	1	%M00341	Fuel Empty Alarm		Global			
FAIL_TO_STR_ALM	BIT	1	%M00342	Fail to Start Alarm		Global			
FUEL_LEV_EMPTY_DLY	BIT	1	%M00351	Fuel Level Empty Alarm Delay		Global			
LOW_ALM	BIT	1	%M00360	Low Alarm		Global			
OIL_P_W_ALM	BIT	1	%M00361	Low Oil Pressure Warning Alarm		Global			
ENG_T_W_ALM	BIT	1	%M00362	High Engine Temperature Warning Alarm		Global			
FUEL_LEV_LOW_ALM	BIT	1	%M00363	Low Fuel Level Alarm		Global			
BAT_CHG_AC_ALM	BIT	1	%M00364	Battery Charger AC Alarm		Global			
BAT_CONT_LOW_V_ALM	BIT	1	%M00365	Control Battery Charger Low Voltage Alarm		Global			
BAT_STR_LOW_V_ALM	BIT	1	%M00366	Start Battery Charger Low Voltage Alarm		Global			
FUEL_LEV_LOW_DLY	BIT	1	%M00373	Fuel Level Low Alarm Delay		Global	R		
BAT_CHG_AC_DLY	BIT	1	%M00374	Battery Charger AC Failure Delay		Global	R		
BAT_CONT_LOW_V_DLY	BIT	1	%M00375	Control Battery Low Voltage Delay		Global	R		
BAT_STR_LOW_V_DLY	BIT	1	%M00376	Start Battery Low Voltage Delay		Global	R		
MAINS_ATS_OPN_ALM	BIT	1	%M00381	Mains ATS Failed to Open Alarm		Global			
MAINS_ATS_CLS_ALM	BIT	1	%M00382	Mains ATS Failed to Close Alarm		Global			
GEN_ATS_OPN_ALM	BIT	1	%M00383	Generator ATS Failed to Open Alarm		Global			
GEN_ATS_CLS_ALM	BIT	1	%M00384	Generator ATS Failed to Close Alarm		Global			
NEW_ALM	BIT	1	%M00400	New Alarm		Global	R		
%M00401	BIT	1	%M00401	**No Description**		Global	R		
%M00402	BIT	1	%M00402	**No Description**		Global	R		
%M00403	BIT	1	%M00403	**No Description**		Global	R		
%M00404	BIT	1	%M00404	**No Description**		Global	R		
%M00405	BIT	1	%M00405	**No Description**		Global	R		
%M00406	BIT	1	%M00406	**No Description**		Global	R		
%M00421	BIT	1	%M00421	**No Description**		Global	R		
%M00422	BIT	1	%M00422	**No Description**		Global	R		
%M00423	BIT	1	%M00423	**No Description**		Global	R		
%M00424	BIT	1	%M00424	**No Description**		Global	R		
%M00425	BIT	1	%M00425	**No Description**		Global	R		

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
%M[illegible]41	BIT	1	%M00441	**No Description**		Global	R		
%M[illegible]42	BIT	1	%M00442	**No Description**		Global	R		
%M00461	BIT	1	%M00461	**No Description**		Global	R		
%M00462	BIT	1	%M00462	**No Description**		Global	R		
%M00463	BIT	1	%M00463	**No Description**		Global	R		
%M00464	BIT	1	%M00464	**No Description**		Global	R		
%M00465	BIT	1	%M00465	**No Description**		Global	R		
%M00466	BIT	1	%M00466	**No Description**		Global	R		
%M00481	BIT	1	%M00481	**No Description**		Global	R		
%M00482	BIT	1	%M00482	**No Description**		Global	R		
%M00483	BIT	1	%M00483	**No Description**		Global	R		
%M00484	BIT	1	%M00484	**No Description**		Global	R		
AUTO_IND	BIT	1	%Q00001	Controls in Auto Indicator		Global			
TEST_IND	BIT	1	%Q00002	Controls in Test Indicator		Global			
MAN_IND	BIT	1	%Q00003	Controls in Manual Indicator		Global			
REM_STR_IND	BIT	1	%Q00004	Remote Start Indicator		Global			
MAINS_AVAIL_IND	BIT	1	%Q00005	Mains Available Indicator		Global			
MAINS_CON_IND	BIT	1	%Q00006	Mains Connected Indicator		Global			
GEN_RUN_IND	BIT	1	%Q00007	Generator Running Indicator		Global			
GEN_CON_IND	BIT	1	%Q00008	Generator Connected Indicated		Global			
MAINS_FAILED_IND	BIT	1	%Q00009	Mains Failed Indicator		Global			
EM_STOP_IND	BIT	1	%Q00010	Emergency Stop Indicator		Global			
ME[illegible]LT_IND	BIT	1	%Q00011	MEN Fault Indicator		Global			
OI[illegible]LOW_SD_IND	BIT	1	%Q00012	Low Oil Pressure Shutdown Indicator		Global			
OIL_P_LOW_W_IND	BIT	1	%Q00013	Low Oil Pressure Warning Indicator		Global			
ENG_T_HI_SD_IND	BIT	1	%Q00014	High Engine Temperature Shutdown Indicator		Global			
ENG_T_HI_W_IND	BIT	1	%Q00015	High Engine Temperature Warning Indicator		Global			
RAD_WATER_LOW_IND	BIT	1	%Q00016	Low Radiator Water Level Indicator		Global			
FUEL_LEV_EMPTY_IND	BIT	1	%Q00017	Fuel Empty Indicator		Global			
FUEL_LEV_LOW_IND	BIT	1	%Q00018	Low Fuel Level Indicator		Global			
SPD_OVER_IND	BIT	1	%Q00019	Over Speed Indicator		Global			
SPD_UNDER_IND	BIT	1	%Q00020	Under Speed Indicator		Global			
FAIL_TO_STR_IND	BIT	1	%Q00021	Fail to Start Indicator		Global			
VOLTS_UNDER_IND	BIT	1	%Q00022	Alternator Voltage Under Indicator		Global			
VOLTS_OVER_IND	BIT	1	%Q00023	Alternator Voltage Over Indicator		Global			
ALT_TEMP_IND	BIT	1	%Q00024	Alternator High Temperature Indicator		Global			
GEN_CB_TRIP_IND	BIT	1	%Q00025	Generator CB Tripped Indicator		Global			
BA[illegible]HG_AC_IND	BIT	1	%Q00026	Battery Charger AC Indicator		Global			
BA[illegible]ONT_LOW_V_IND	BIT	1	%Q00027	Control Battery Charger Low Voltage Indicator		Global			
BAT_STR_LOW_V_IND	BIT	1	%Q00028	Start Battery Charger Low Voltage Indicator		Global			
CAN_DOORS_OPEN_IND	BIT	1	%Q00029	Canopy Doors Open Indicator		Global			
MAINS_ATS_OPN_CMD	BIT	1	%Q00033	BCC Mains ATS Open Command		Global			
GEN_ATS_CLS_CMD	BIT	1	%Q00034	BCC Generator ATS Close Command		Global			
GEN_SD_ALM	BIT	1	%Q00035	BCC Generator Shutdown Alarm		Global			
GEN_W_ALM	BIT	1	%Q00036	BCC Generator Warning Alarm		Global			
FUEL_LOW	BIT	1	%Q00037	BCC Low Fuel		Global			
GEN_RUN	BIT	1	%Q00038	BCC Generator Running		Global			
GEN_CON	BIT	1	%Q00039	BCC Generator Connected		Global			
SMR	BIT	1	%Q00040	Starter Motor Relay		Global			
GCR	BIT	1	%Q00041	Governor Control Relay		Global			
AAR	BIT	1	%Q00042	Audible Alarm Relay		Global			
SDAR	BIT	1	%Q00043	Generator Shunt Trip Relay		Global			
SEQ_CNT	WORD	1	%R00001	Sequence Counter		Global	R		
MODBUS_INPUTS	WORD	1	%R00002	Modbus Digital Inputs		Global	R		
MC[illegible]S_OUTPUTS	WORD	1	%R00005	Modbus Digital Outputs		Global	R		
MC[illegible]S_STATUS_1	WORD	1	%R00008	Modbus Status 1		Global	R		
MODBUS_STATUS_2	WORD	1	%R00009	Modbus Status 2		Global	R		
MODBUS_ALARMS	WORD	1	%R00010	Modbus Alarms		Global	R		
%R00100	WORD	3	%R00100	**No Description**		Global	R		
%R00103	WORD	3	%R00103	**No Description**		Global	R		

GLOBAL VARIABLES

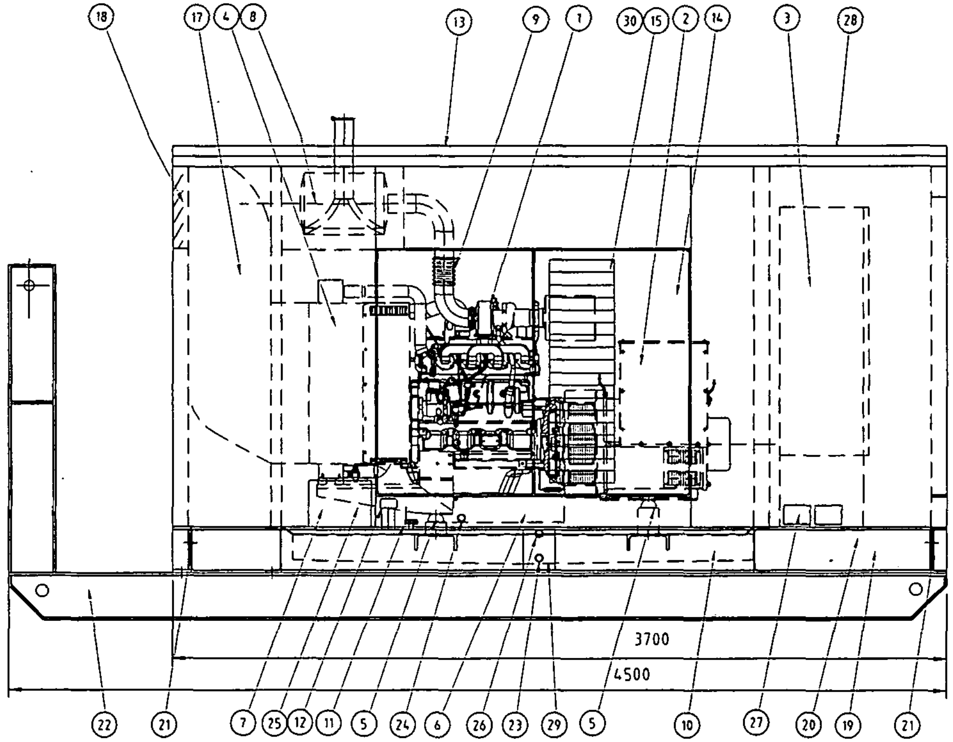
Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
%R00106	WORD	3	%R00106	**No Description**		Global	R		
%R00109	WORD	3	%R00109	**No Description**		Global	R		
%R00112	WORD	3	%R00112	**No Description**		Global	R		
%R00115	WORD	3	%R00115	**No Description**		Global	R		
%R00118	WORD	3	%R00118	**No Description**		Global	R		
%R00121	WORD	3	%R00121	**No Description**		Global	R		
%R00124	WORD	3	%R00124	**No Description**		Global	R		
%R00127	WORD	3	%R00127	**No Description**		Global	R		
%R00130	WORD	3	%R00130	**No Description**		Global	R		
%R00200	WORD	3	%R00200	**No Description**		Global	R		
%R00203	WORD	3	%R00203	**No Description**		Global	R		
%R00206	WORD	3	%R00206	**No Description**		Global	R		
%R00209	WORD	3	%R00209	**No Description**		Global	R		
%R00212	WORD	3	%R00212	**No Description**		Global	R		
%R00215	WORD	3	%R00215	**No Description**		Global	R		
%R00218	WORD	3	%R00218	**No Description**		Global	R		
%R00221	WORD	3	%R00221	**No Description**		Global	R		
%R00224	WORD	3	%R00224	**No Description**		Global	R		
%R00227	WORD	3	%R00227	**No Description**		Global	R		
%R00230	WORD	3	%R00230	**No Description**		Global	R		
%R00300	WORD	3	%R00300	**No Description**		Global	R		
%R00303	WORD	3	%R00303	**No Description**		Global	R		
%R00306	WORD	3	%R00306	**No Description**		Global	R		
%R00309	WORD	3	%R00309	**No Description**		Global	R		
%R00312	WORD	3	%R00312	**No Description**		Global	R		
%R00315	WORD	3	%R00315	**No Description**		Global	R		
%R00318	WORD	3	%R00318	**No Description**		Global	R		
%R00321	WORD	3	%R00321	**No Description**		Global	R		
%R00324	WORD	3	%R00324	**No Description**		Global	R		
%R00327	WORD	3	%R00327	**No Description**		Global	R		
%R00330	WORD	3	%R00330	**No Description**		Global	R		
%R00333	WORD	3	%R00333	**No Description**		Global	R		
%R00336	WORD	3	%R00336	**No Description**		Global	R		
%R00339	WORD	3	%R00339	**No Description**		Global	R		
FST_SCN	BIT	1	%S00001	Set to 1 when the current sweep is the first sweep		Global	R		
LST_SCAN	BIT	1	%S00002	Reset from 1 to 0 when the current sweep is the last sweep		Global	R		
T_10MS	BIT	1	%S00003	0.01 Second Timer Contact		Global	R		
T_100MS	BIT	1	%S00004	0.1 Second Timer Contact		Global	R		
T_1S	BIT	1	%S00005	1 Second Timer Contact		Global	R		
T_1M	BIT	1	%S00006	1 Minute Timer Contact		Global	R		
ALW_ON	BIT	1	%S00007	Always ON		Global	R		
ALW_OFF	BIT	1	%S00008	Always OFF		Global	R		
PLC_BAT	BIT	1	%S00014	Set to indicate a bad battery in the CPU		Global	R		
%R00133	WORD	3	%R00133	**No Description**		Global	R		
%R00136	WORD	3	%R00136	**No Description**		Global	R		

GLOBAL SUMMARY OF HIGHEST USED REFERENCE ADDRESSES

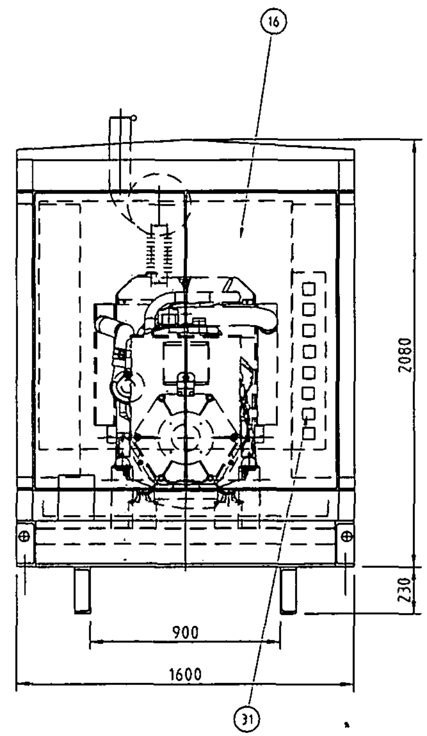
MEMORY AREA	ADDRESS
Analog Input (%AI)	None Used
Analog Output (%AQ)	None Used
Input (%I)	%I00048
Output (%Q)	%Q00048
Internal Memory (%M)	%M00484
Register (%R)	%R00341
Genius Global (%G)	None Used
Genius Global (%GA)	None Used
Genius Global (%GB)	None Used
Genius Global (%GC)	None Used
Genius Global (%GD)	None Used
Genius Global (%GE)	None Used
Temporary (%T)	None Used
System (%S)	%S00007
System (%SA)	None Used
System (%SB)	None Used
System (%SC)	None Used
Program (%P)	None Used

Table of Contents

LEGEND	
ITEM	DESCRIPTION
1	ENGINE JOHN DEERE 4045H
2a	ALTERNATOR STAMFORD UC274D
2b	ALTERNATOR STAMFORD UC274E
3	CONTROL SWITCHBOARD
4	RADIATOR
5	A/V MOUNTS (4 OFF)
6	ENGINE DRIP TRAY
7	STARTING BATTERY (382)
8	EXHAUST SILENCER (COWL TS30PR)
9	EXHAUST PIPE FLEXIBLE Ø75
10	FUEL TANK BASE FRAME 400 L
11	FUEL GAUGE (MECHANICAL)
12	FUEL FILL POINT (INSIDE ENCLOSURE)
13	ACOUSTIC ENCLOSURE (70dbA @ 7m)
14	SIDE ACCESS DOORS (2 OFF)
15	AIR INLET GRILL
16	SWITCHBOARD ACCESS DOOR
17	PLENUM CHAMBER
18	AIR OUTLET GRILL
19	CABLE ENTRY ZONE
20	ANCHOR POINT
21	LIFTING POINTS
22	TRANSPORT SKID
23	FUEL TANK DRAIN (LOCKABLE)
24	OIL DRAIN (LOCKABLE)
25	RADIATOR DRAIN HOSE
26	CATCHMENT TRAY DRAIN
27	CONTROL BATTERIES 2x12 VOLT
28	BATTERY CHARGING SOLAR PANEL
29	DRAIN POINT LOCKABLE COVER
30	INSECT SCREEN
31	OUTPUT & CONTROL SOCKETS T.B.A.



SIDE ELEVATION



ALTERNATOR END ELEVATION

NOTE
ENCLOSURE COLOUR : MIST GREEN
BASE TANK COLOUR : MIST GREEN
SKID BASE COLOUR : MIST GREEN

APPROVED FOR CONSTRUCTION

SP019	CENTENARY HIGHWAY	(USING ITEM 2)
SP081	WITTON ROAD	(USING ITEM 2)
SP119	MACQUARIE STREET	(USING ITEM 2)
S0049	KIANAWAH ROAD	(USING ITEM 2a)
SP040	SUNSET ROAD	(USING ITEM 2a)

Rev.	Date	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	Amendment
0	2.6.03				ISSUE FOR CONSTRUCTION
A	2.5.03				APPROVAL ISSUE

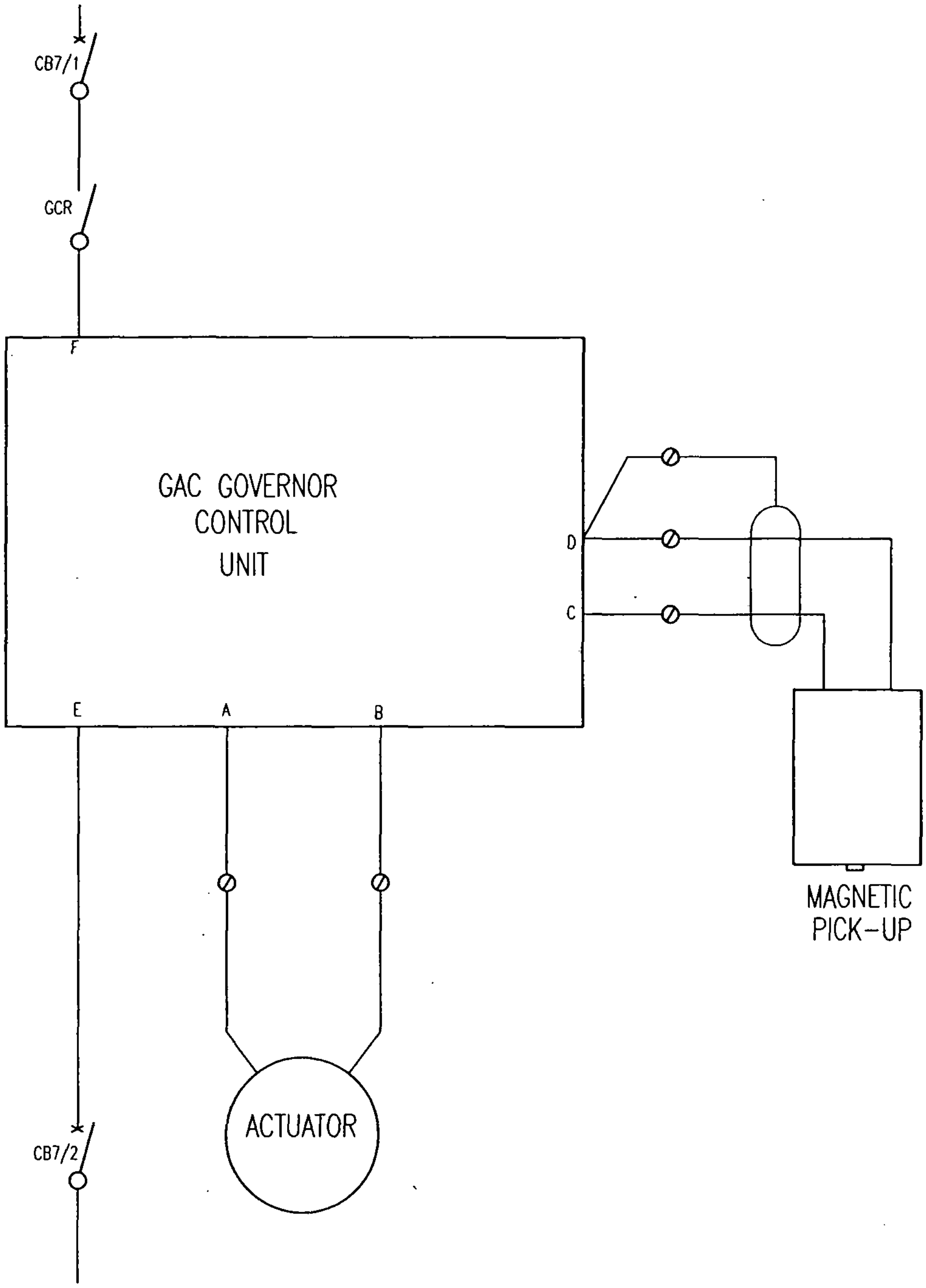
SE POWER EQUIPMENT
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
Facsimile: (07) 3390 4631

Client: BRISBANE WATER
Project: SEWAGE PUMP STATION BACKUP GENSETS

Drafter	Draft Check	Reviewed Project Manager	Approved Project Director
RSL			
Designed RSL	Design Review		

Title: SP019, SP081, SP119, SP049, SP040 ARRANGEMENT

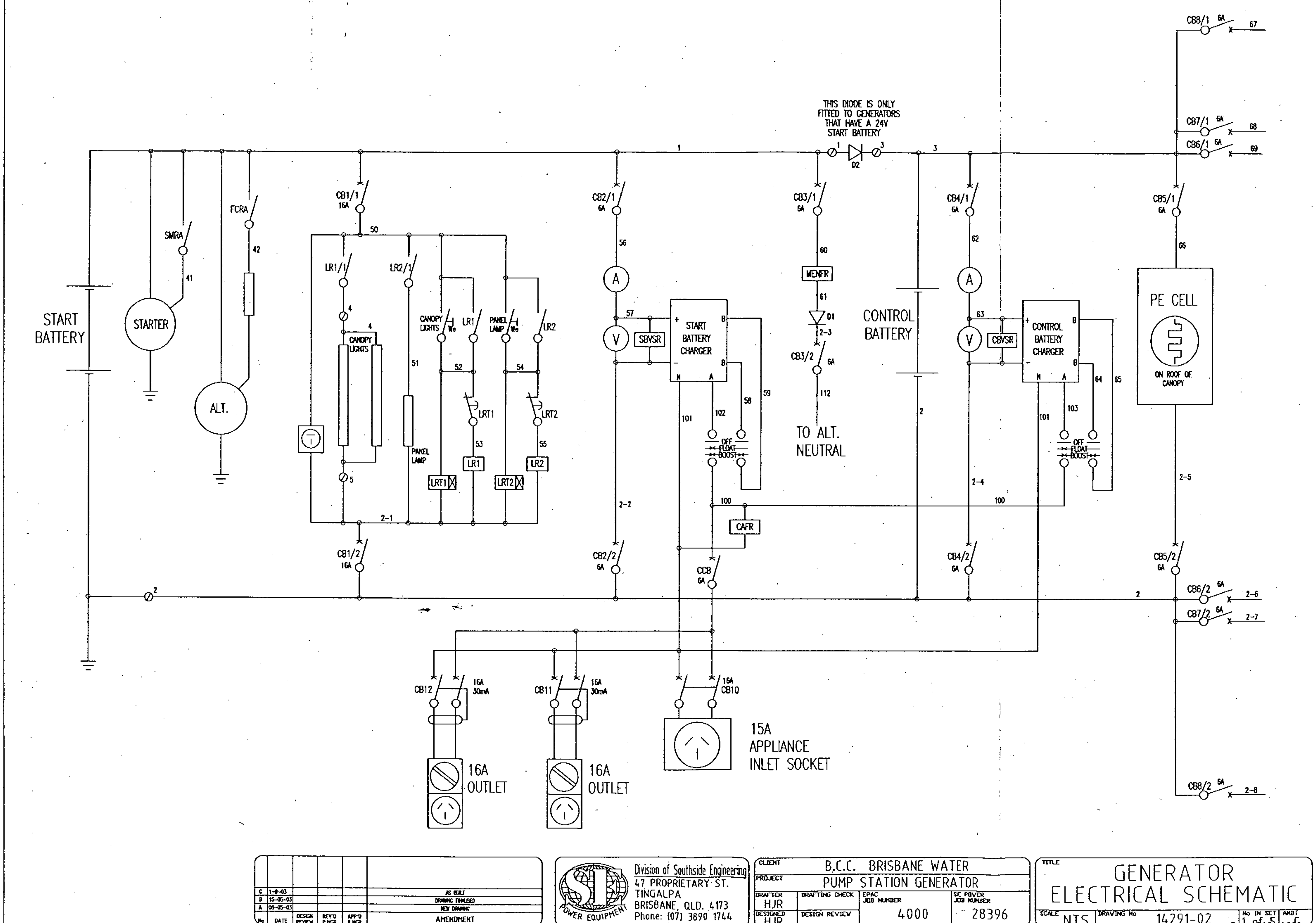
Scale	No in set	SE Ref No.	SE Job No	S.E. Drawing No.	AMDT
1:20	1	14291		14291-001	0
Engineer's Ref. No		Client Ref No. 30140-02/03			

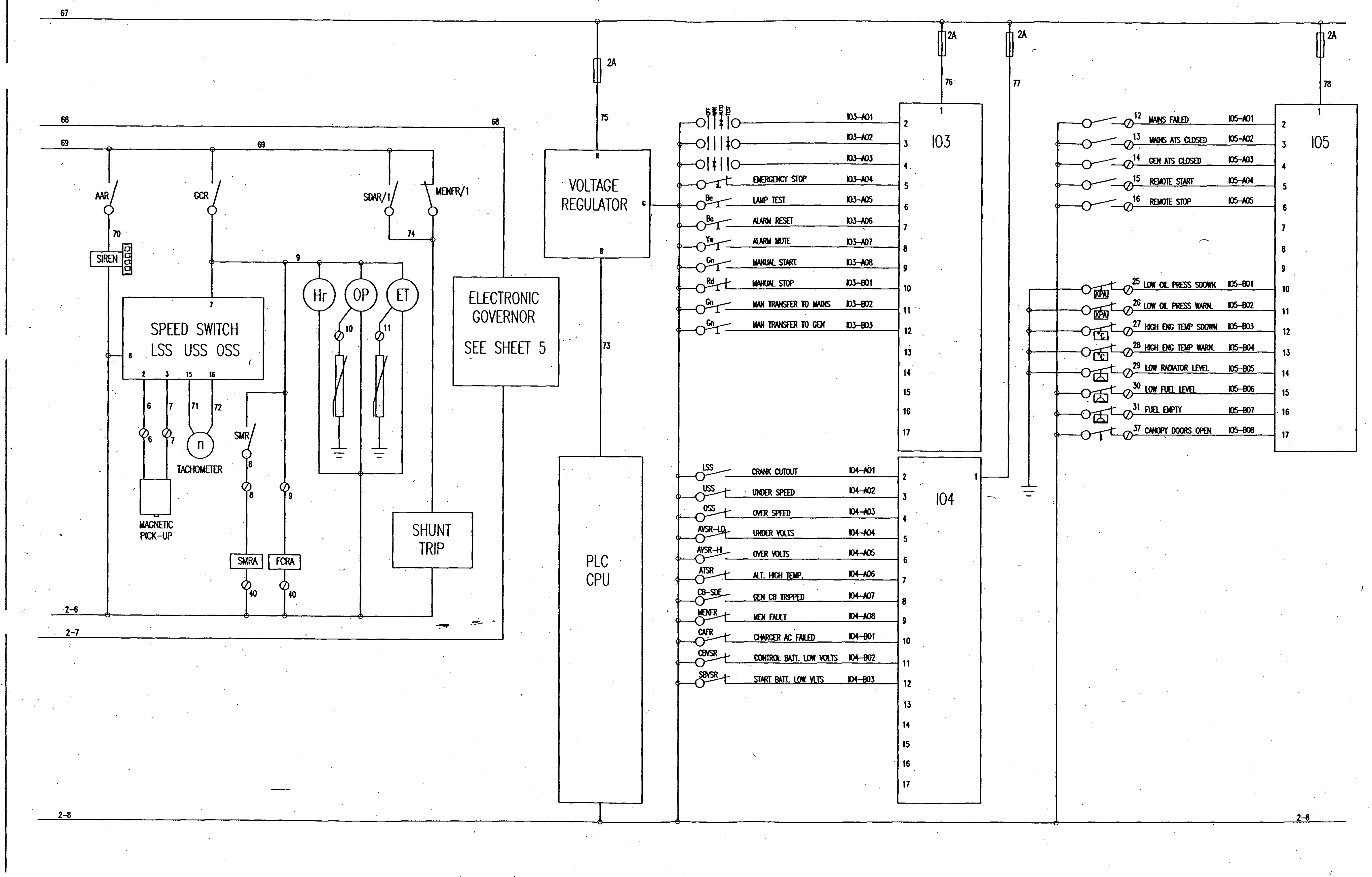


0 1.8.03 AS BUILT

EQUIPMENT DATA SHEET	REV No: 0	PROJECT No: 14291-605	DATE: 1.08.03
TITLE: BCC BRISBANE WATER PUMP STATION BACKUP GENSET GAC GOVERNOR CONTROLS		REF: / PREPARED BY: HJR / RSL	CHECKED BY:
		APPROVED FOR ISSUE JP	SCALE: 1:1

POWER EQUIPMENT


THIS DIODE IS ONLY FITTED TO GENERATORS THAT HAVE A 24V START BATTERY
START BATTERY
STARTER
SMRA
FCRA
ALT.
CB1/1 16A
LR1/1
LR2/1
CANOPY LIGHTS
PANEL LAMP
LR1
LR2
LRT1
LRT2
CB1/2 16A
CB2/1 6A
SBVSR
START BATTERY CHARGER
OFF FLOAT BOOST
CB2/2 6A
CAFR
CCB 6A
CB3/1 6A
MENFR
D1
D2
CB3/2 6A
TO ALT. NEUTRAL
CONTROL BATTERY
CB4/1 6A
CBVSR
CONTROL BATTERY CHARGER
CB4/2 6A
CB5/1 6A
PE CELL
ON ROOF OF CANOPY
CB5/2 6A
CB8/1 6A
CB7/1 6A
CB6/1 6A
CB6/2 6A
CB7/2 6A
CB8/2 6A
CB12 16A 30mA
CB11 16A 30mA
CB10 16A
16A OUTLET
16A OUTLET
15A APPLIANCE INLET SOCKET
C 1-8-03 AS BUILT
B 15-05-03 DRAWING FINALISED
A 08-05-03 NEW DRAWING
No DATE DESIGN REVIEW REV'D P.MGR APP'D P.MGR AMENDMENT
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
POWER EQUIPMENT
CLIENT B.C.C. BRISBANE WATER
PROJECT PUMP STATION GENERATOR
DRAFTER HJR
DESIGNED HJR
DRAFTING CHECK
DESIGN REVIEW
EPAC JOB NUMBER 4000
SE POWER JOB NUMBER 28396
TITLE GENERATOR ELECTRICAL SCHEMATIC
SCALE NTS
DRAWING No 14291-02
No IN SET 1 of 5
AMDT C

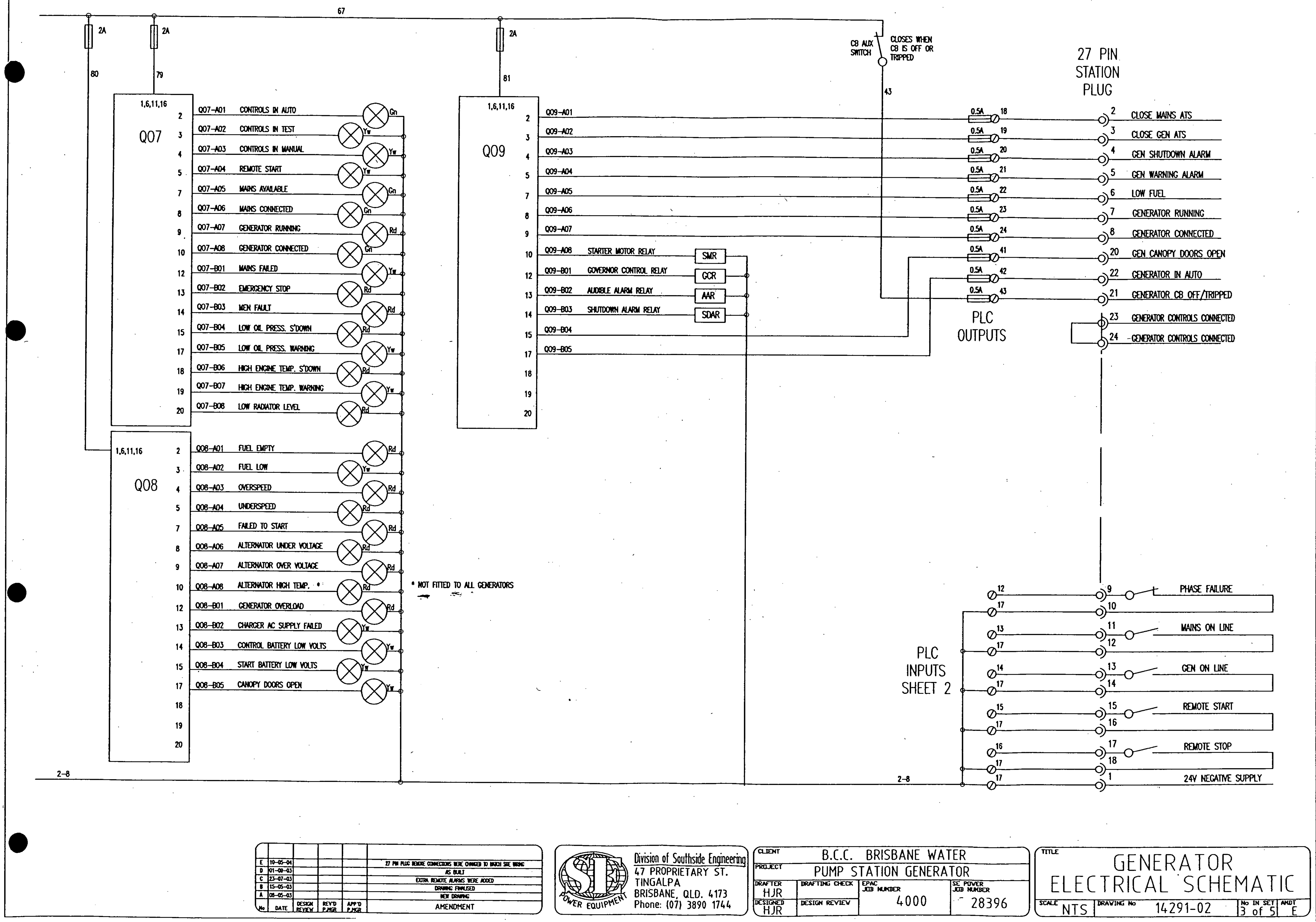


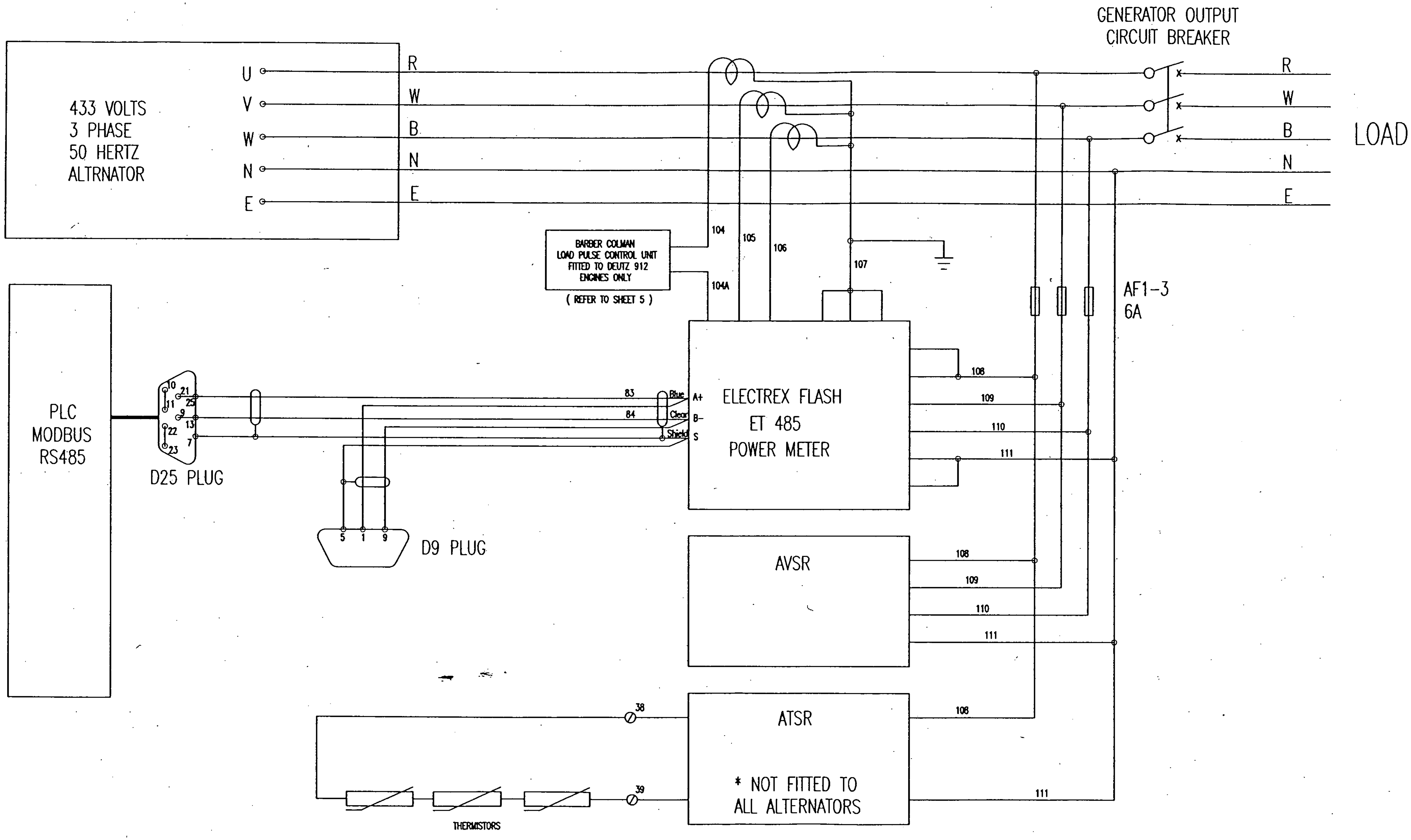
No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	AMENDMENT
C	1-8-03				AS BUILT
B	15-05-03				DRAWING FINALISED
A	08-05-03				NEW DRAWING

SE POWER EQUIPMENT
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

CLIENT: B.C.C. BRISBANE WATER
PROJECT: PUMP STATION GENERATOR
DRAFTER: HJR | DRAFTING CHECK | EPAC JOB NUMBER: 4000 | SE POWER JOB NUMBER: 28396
DESIGNED: HJR | DESIGN REVIEW

TITLE: GENERATOR ELECTRICAL SCHEMATIC
SCALE: NTS | DRAWING No: 14291-02 | No IN SET: 2 of 5 | AMDT: C


67
2A
2A
2A
80
79
81
CB AUX SWITCH
CLOSES WHEN CB IS OFF OR TRIPPED
43
27 PIN STATION PLUG
Q07
1,6,11,16
Q07-A01 CONTROLS IN AUTO
Q07-A02 CONTROLS IN TEST
Q07-A03 CONTROLS IN MANUAL
Q07-A04 REMOTE START
Q07-A05 MAINS AVAILABLE
Q07-A06 MAINS CONNECTED
Q07-A07 GENERATOR RUNNING
Q07-A08 GENERATOR CONNECTED
Q07-B01 MAINS FAILED
Q07-B02 EMERGENCY STOP
Q07-B03 MEN FAULT
Q07-B04 LOW OIL PRESS. S'DOWN
Q07-B05 LOW OIL PRESS. WARNING
Q07-B06 HIGH ENGINE TEMP. S'DOWN
Q07-B07 HIGH ENGINE TEMP. WARNING
Q07-B08 LOW RADIATOR LEVEL
Q08
1,6,11,16
Q08-A01 FUEL EMPTY
Q08-A02 FUEL LOW
Q08-A03 OVERSPEED
Q08-A04 UNDERSPEED
Q08-A05 FAILED TO START
Q08-A06 ALTERNATOR UNDER VOLTAGE
Q08-A07 ALTERNATOR OVER VOLTAGE
Q08-A08 ALTERNATOR HIGH TEMP. *
Q08-B01 GENERATOR OVERLOAD
Q08-B02 CHARGER AC SUPPLY FAILED
Q08-B03 CONTROL BATTERY LOW VOLTS
Q08-B04 START BATTERY LOW VOLTS
Q08-B05 CANOPY DOORS OPEN
* NOT FITTED TO ALL GENERATORS
Q09
1,6,11,16
Q09-A01
Q09-A02
Q09-A03
Q09-A04
Q09-A05
Q09-A06
Q09-A07
Q09-A08 STARTER MOTOR RELAY SMR
Q09-B01 GOVERNOR CONTROL RELAY GCR
Q09-B02 AUDIBLE ALARM RELAY AAR
Q09-B03 SHUTDOWN ALARM RELAY SDAR
Q09-B04
Q09-B05
PLC OUTPUTS
2 CLOSE MAINS ATS
3 CLOSE GEN ATS
4 GEN SHUTDOWN ALARM
5 GEN WARNING ALARM
6 LOW FUEL
7 GENERATOR RUNNING
8 GENERATOR CONNECTED
20 GEN CANOPY DOORS OPEN
22 GENERATOR IN AUTO
21 GENERATOR CB OFF/TRIPPED
23 GENERATOR CONTROLS CONNECTED
24 GENERATOR CONTROLS CONNECTED
PLC INPUTS SHEET 2
9 PHASE FAILURE
11 MAINS ON LINE
13 GEN ON LINE
15 REMOTE START
17 REMOTE STOP
1 24V NEGATIVE SUPPLY
2-8
2-8
E 10-05-04 27 PIN PLUG REMOTE CONNECTIONS WERE CHANGED TO MATCH SITE WIRING
D 01-08-03 AS BUILT
C 23-07-03 EXTRA REMOTE ALARMS WERE ADDED
B 15-05-03 DRAWING FINALISED
A 08-05-03 NEW DRAWING
No DATE DESIGN REVIEW REV'D P.MGR APP'D P.MGR AMENDMENT
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
POWER EQUIPMENT
CLIENT B.C.C. BRISBANE WATER
PROJECT PUMP STATION GENERATOR
DRAFTER HJR
DRAFTING CHECK
EPAC JOB NUMBER 4000
SE POWER JOB NUMBER 28396
DESIGNED HJR
DESIGN REVIEW
TITLE GENERATOR ELECTRICAL SCHEMATIC
SCALE NTS
DRAWING No 14291-02
No IN SET 3 of 5
AMDT E

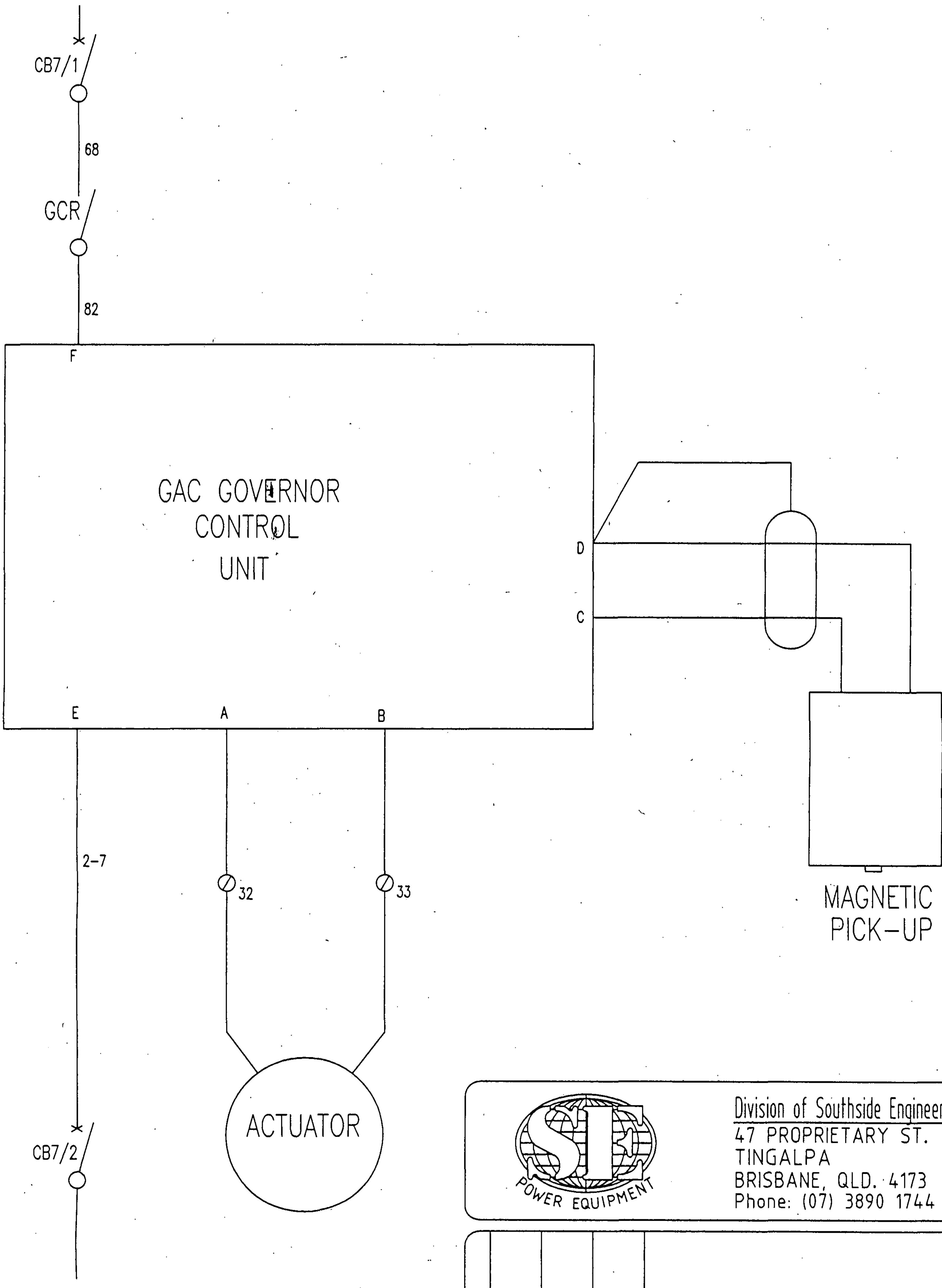


No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	AMENDMENT
C	1-9-03				AS BUILT
B	15-05-03				DRAWING FINALISED
A	08-05-03				NEW DRAWING

SE POWER EQUIPMENT
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

CLIENT: B.C.C. BRISBANE WATER
PROJECT: PUMP STATION GENERATOR
DRAFTER: HJR
DRAFTING CHECK:
EPAC JOB NUMBER: 4000
SE POWER JOB NUMBER: - 28396
DESIGNED: HJR
DESIGN REVIEW:

TITLE: ELECTRICAL SCHEMATIC
SCALE: NTS
DRAWING No: 14291-02
No IN SET: 4 of 5
AMDT: C



Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

POWER EQUIPMENT

No	DATE	DESIGN REVIEW	REV'D P.MGR	AMENDMENT
C	1-9-03			AS BUILT
B	15-05-03			DRAWING FINALISED
A	08-05-03			NEW DRAWING

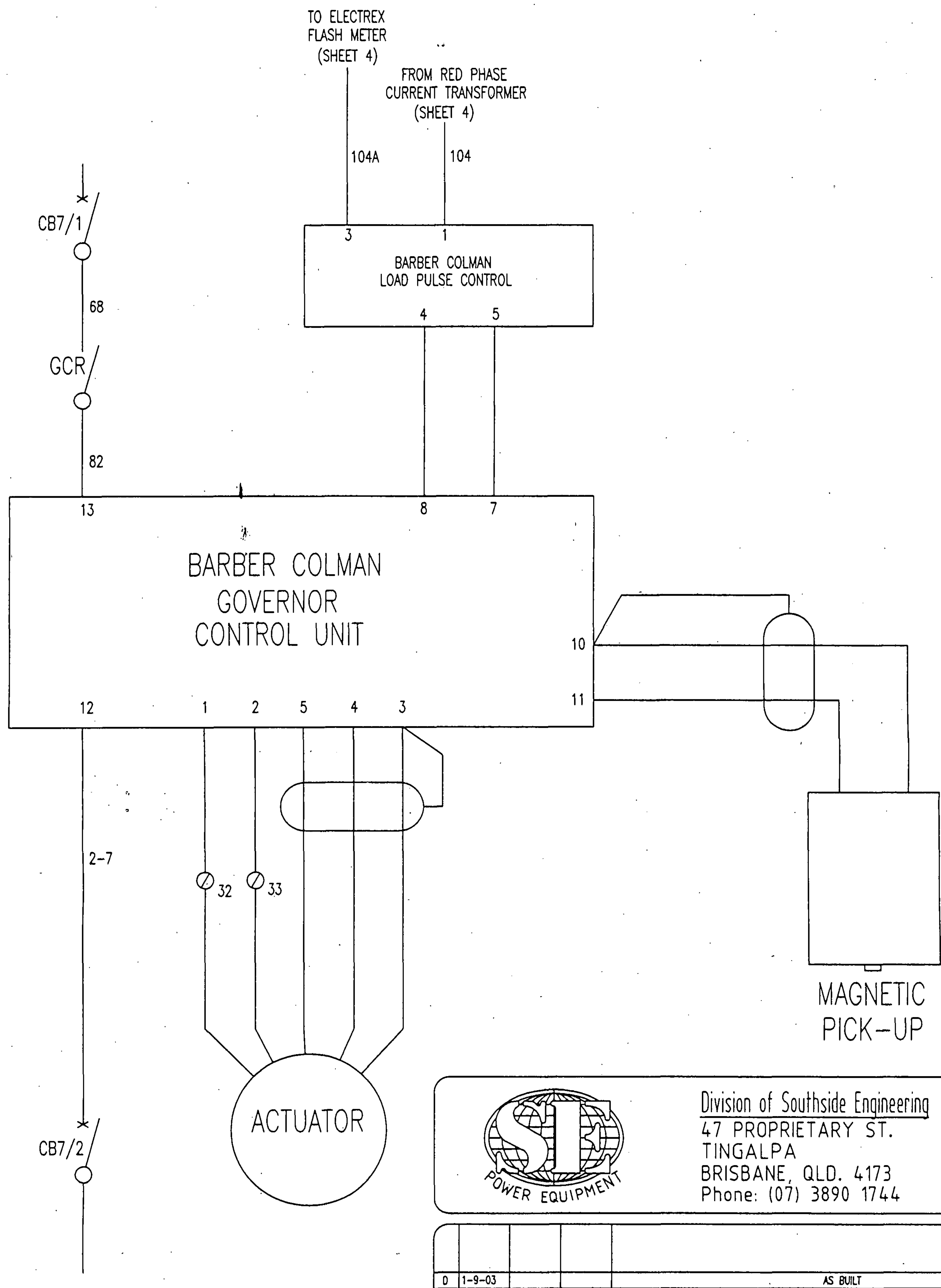
CLIENT: B.C.C. BRISBANE WATER

PROJECT: PUMP STATION GENERATOR

DRAFTER	DRAFTING CHECK	EPAC JOB NUMBER	SE POWER JOB NUMBER
HJR		4000	28396
DESIGNED: HJR	DESIGN REVIEW		

TITLE: GAC GOVERNOR CONTROLS

SCALE	DRAWING No	No IN SET	AMDT
NTS	14291-02	5 of 5	C



Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

SE POWER EQUIPMENT

No	DATE	DESIGN REVIEW	REV'D P.MGR	AMENDMENT
D	1-9-03			AS BUILT
C	14-06-03			LOAD PULSE CONTROL UNIT WAS ADDED
B	15-05-03			DRAWING FINALISED
A	08-05-03			NEW DRAWING

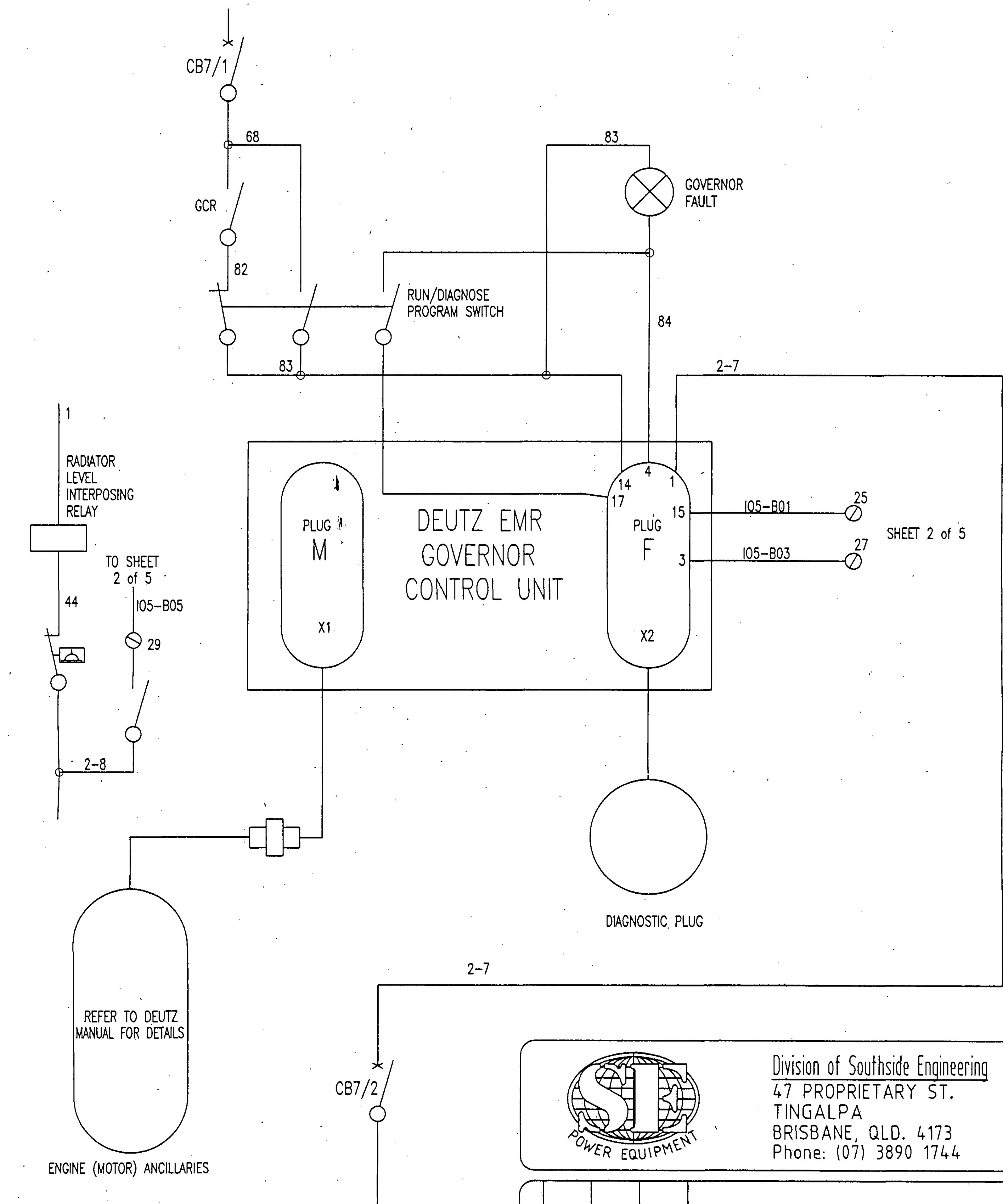
CLIENT: B.C.C. BRISBANE WATER

PROJECT: PUMP STATION GENERATOR

DRAFTER	DRAFTING CHECK	EPAC JOB NUMBER	SE POWER JOB NUMBER
HJR		4000	28396
DESIGNED HJR	DESIGN REVIEW		

TITLE: BARBER COLMAN GOVERNOR CONTROLS

SCALE	DRAWING No	No IN SET	AMDT
NTS	14291-02	5 of 5	D



Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

No	DATE	DESIGN REVIEW	REV'D P.MGR	AMENDMENT
D	1-9-03			AS BUILT
C	15-08-03			RADIATOR LEVEL INTERPOSING RELAY WAS ADDED
B	15-05-03			DRAWING FINALISED
A	08-05-03			NEW DRAWING

CLIENT: B.C.C. BRISBANE WATER

PROJECT: PUMP STATION GENERATOR

DRAFTER	DRAFTING CHECK	EPAC JOB NUMBER	SE POWER JOB NUMBER
HJR		4000	28396
DESIGNED HJR	DESIGN REVIEW		

TITLE: DEUTZ EMR GOVERNOR CONTROLS

SCALE	DRAWING No	No IN SET	AMDT
NTS	14291-02	4 of 5	D

SECTION 8

SE Power Equipment
47 Proprietary Street, Tingalpa, Qld 4173
Telephone: (07) 3890 1744
PO Box 3306 Tingalpa B.C. Qld 4173

DIESEL GENERATOR SET
CONTROL FUNCTION TEST REPORT

SEP 009/B

CLIENT: BRISBANE WATER SP019
DATE: 23/07/03
SERIAL NO: 0307006
JOB NO: 14291
ENGINE TYPE: 4045H
ENG. SERIAL NO: 706091
ALTERNATOR TYPE: 274D
ALT. SERIAL NO: X03B070235/1

GENSET CONTROL FUNCTIONS	FUNCTION	LAMP	REMARKS
Engine High Temp. Alarm	✓	✓	
Engine High Temp. Shutdown	✓	✓	
Low Water Level Alarm	✓	✓	
CB Tripped/Alt., Overload	✓	✓	
Low Oil Pressure Alarm	✓	✓	
Low Oil Pressure Shutdown	✓	✓	
Emergency Stop	✓	✓	
Start Fail Alarm	✓	✓	
Genset Running	✓	✓	
MEN Fault	✓	✓	
Starter Motor Relay	✓	✓	
Fuel Low	✓	✓	
Fuel Empty	✓	✓	
Engine Gauges	✓	✓	
Status Lamps/Controls	✓	✓	
Underspeed Shutdown	✓	✓	
Overspeed Shutdown	✓	✓	
Remote Start/Stop	✓	✓	
Lamp Test	✓	✓	
Alarm Shudown	✓	✓	
Alt Undervolts	✓	✓	
Alt Overvolts	✓	✓	
Charger AC Failed	✓	✓	
Control Batt. Low Volts	✓	✓	
Start Batt. Low volts	✓	✓	
Canopy doors Open	✓	✓	
Audible Alarm/Mute	✓	✓	
Remote ATS Controls	✓	✓	
Alternator High Temperature			not on this set.

CUSTOMER TESTING OFFICER:

TESTING OFFICER: PAUL HLAVKA
JOHN ROTH.

SE POWER EQUIPMENT

DIESEL GENERATOR SET LOAD TEST REPORT

SEP 0064/D

47 Proprietary Street
Tingalpa Q 4173
BRISBANE AUSTRALIA

CLIENT: BRISBANE WATER SP019 DATE: 23/7/03

SERIAL NO: 0307006 JOB NO/CONTRACT NO: 14291

ENGINE TYPE: 4045H ENG. SERIAL NO: 706091

ALTERNATOR TYPE: 274D ALT. SERIAL NO: X0380702351/1

GOVERNOR TYPE: G.A.C. STARTER MOTOR: STD.

OVERSPEED TYPE: PLC UNDERSPEED TYPE: PLC

SHUTDOWN SOLENOID: G.A.C. HIGH WATER: HOBBS

LOW OIL PRESSURE SHUTDOWN: HOBBS

A: 110 (+10%) KW: 79.0 (+10%)

TECHNICAN: INSPECTOR: PAUL HLAVKA

TIME	~~16~~·00	16·15	1630	1700	1730	1800	1830			
OIL PRESSURE	500 ~~350~~	350	320	300	300	300	350			
OIL TEMPERATURE	–	–	–	–	–	–				
JACKET WATER TEMPERATURE	–	70	80	85	85	85	80			
A'S	0	43	85	125	125	43	0			
VOLTS 416.9	241 241 240	240 241 240	241 241 241	241 241 241	241 241 241	241 241 241	241 241 241			
AMBIENT TEMPERATURE	19	19	19	19	19	19	19			
HZ	50.1	50.1	50.1	50.1	50.1	50.1	50.1			
KW	0	31.5	60	90.3	90.3	31.3	0			
LOAD%	0	40%	75%	110%	110%	40%	0			

REMARKS LOW OIL PRESSURE ON START UP.
TESTED. REPLACED PRESSURE SENDER SWITCH.

Generator_Load_Test_Report.doc

~~GAS~~ GENERATOR SET SOUND PRESSURE LEVEL TEST REPORT

SEP 0023/ D

47 Proprietary Street
Tingalpa Q 4173
BRISBANE AUSTRALIA

CLIENT: BRISBANE WATER SP019 DATE:

SERIAL NO: 0307006 JOB NO: 14291

ENGINE TYPE: 4045H ENG. SERIAL NO: 706091

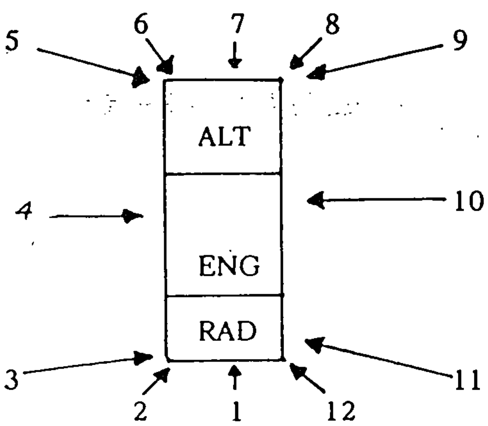
ALTERNATOR TYPE: 274D ALT. SERIAL NO: X03B070235/1

SOUND LEVEL INSTRUMENT: RION NL-04

Remarks:

Distance: 7 m

Height: 1·5 m



Position Layout

POSITION	SOUND LEVEL dB(A)	LOAD %				
		25	50	75	100	110
1				69		
2				68		
3				68		
4				67		
5				64		
6				64		
7				64		
8				64		
9				64		
10				67		
11				68		
12				68		
Average	66·25					

QUALITY ASSURANCE OFFICER:

CUSTOMER TESTING OFFICER:

TESTING OFFICER: D. COOPER

WITNESS TESTING OFFICER: PAUL HLAVKA

47 Proprietary Street
Tingalpa Q 4173
BRISBANE AUSTRALIA

SE POWER EQUIPMENT

SEP 0013

FINAL INSPECTION CHECKLIST

This form is to be completely filled out before any generating set leaves the factory.

It is to be signed by the person doing the inspection and by their immediate supervisor. In the case of a non-standard job it must also be signed by the Special Projects Manager or the Engineering Manager.

A copy of this form is to be sent out with the plant concerned.

Please neatly tick in the boxes provided where applicable and note any comments in the space provided.

MODEL: SP019 SERIAL NO: 0307006 ENGINE NO: 706091

JOB NO: 14291 DATE: ____________ CUSTOMER: B.W.

==

BASE

(1)	All welds continuous, neat and clean.	✓
(2)	All bolts tightened.	✓
(3)	Bearers completely secured.	✓
(4)	No sharp corners.	✓

RADIATOR

(1)	Radiator correctly mounted.	✓
(2)	All pipework included and secure.	✓
(3)	Drain plug in place.	✓
(4)	Water removed from radiator. FILLED	✓
(5)	Clamps on hoses tight.	✓

ENGINE

(1)	Fan is correctly mounted.	✓
(2)	All guards in place and secure.	✓
(3)	Wiring loom is correct to drawing, securely fixed and marked and is terminated in an appropriate terminal box.	✓
(4)	Battery leads attached and secure and long enough for termination to battery.	✓
(5)	Air cleaner is properly mounted.	✓
(6)	Magnetic pickup is fitted and set to correct depth.	✓
(7)	Exhaust pipe and silencer (where required) are fitted correctly.	✓
(8)	Dip stick in place.	✓
(9)	Oil removed from engine. CORRECT LEVEL.	
(10)	All fuel and oil unions completely tightened.	✓
(11)	All ordered options are fitted and function correctly.	✓
(12)	All parts secure, no damage.	✓
(13)	All earths less than 0.1 ohms.	✓
(14)	Cables and hoses secure for transport.	✓

CONTROL SYSTEM (where applicable)

(1)	Control functions as ordered.	✓
(2)	Control is mounted correctly.	✓
(3)	All leads, terminals, fuses, printed circuit boards and switchgear are completely secure and marked correctly.	✓
(4)	Dust seals are fitted around doors.	✓
(5)	Doors hinged correctly.	✓
(6)	All earths less than 0.1 ohms.	✓
(7)	Red Danger labels in cubicle	✓

CONTROL SYSTEM (cont)

(8) Perspex shield secure, clean and no sharp corners. N/A ✓
(9) Cables correct, no damage. ✓
(10) Locks and keys satisfactory. ✓

ALTERNATOR

(1) Alternator is correctly mounted. ✓
(2) Alternator leads are correctly mounted inside terminal box and marked correctly. ✓
(3) A.V.R. is mounted, connected properly and set to correct setting. ✓
(4) Coupling and adaptor are properly fastened between engine and alternator with correct size and tensile grade bolts. ✓
(5) All options ordered are fitted and function properly. ✓
(6) Alternator is correctly wired for the appropriate voltage as per either Order or Bills of Material. ✓
(7) Earth stud fitted. ✓

FINISH

(1) Plant is painted to correct colour. ✓
(2) All blemishes in finish, especially paint runs, are completely removed. ✓

GENERAL INSPECTION

(1) Genset is manufactured to correct engine/alternator/radiator/bases configuration as specified on Bill of Materials. ✓
(2) All documents are in a sealed plastic bag and secured inside alternator terminal box.
a) Engine Handbook
b) Alternator Handbook
c) Warranty Card
d) Packing List
e) Test Sheet
(3) No Oil/No Water label is attached to positive battery lead. N/A
(4) All labels are straight and in correct location. ✓

SIGNED: D. COOPER / PAUL HLAVKA INSPECTOR

________________ QUALITY ASSURANCE

COMMENTS:

SE POWER EQUIPMENT
47 Proprietary Street
Tingalpa Qld 4173
PH: (07) 3890 1744

SEP0084

TRANSIENT LOAD RESPONSE TEST SHEET

Transient response for load changes: Load PF 0.8

% Change Electrical kW	0-25	0-50	0-75	0-100	100-0	75-0	50-0	25-0
Change in Electrical kW	28	41	60			60	41	28
% Change HZ	.5	2.5	4.5			3.5	2.4	.7
% Change Volts	2	2	3			4	2	1
Recovery secs	2	2	3			2.5	2	2.

CLIENT: BRISBANE WATER

EQ. S/N: 0307006

ENGINE: 4045H

ALTERNATOR: 274D

GOVERNOR: GAC