IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions for the S4 Inverter Plant that must be followed during operation of the equipment.

WARNING: Opening enclosures expose hazardous voltages. Always refer service to qualified personnel only.

ATTENTION: L'ouverture des cabinets expose des tensions dangereuses. Assurez-vous toujours que le service ne soit fait que par des personnes qualifiées.

WARNUNG! Das öffnen der Gehäuse legen gefährliche Spannungen bloss. Service sollte immer nur von qualifizierten Personal durchgeführt werden.

WARNING: As standards, specifications, and designs are subject to change, please ask for confirmation of the information given in this publication.

ATTENTION: Comme les normes, spécifications et produits peuvent changer, veuillez demander confirmation des informations contenues dans cette publication.

WARNUNG! Normen, Spezifizierungen und Pläne unterliegen Änderungen. Bitte verlangen Sie eine Bestätigung über alle Informationen, die in dieser Ausgabe gemacht wurden.
NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. 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 user’s own expense.

WARNING: To reduce the risk of fire or electric shock, install in a temperature and humidity controlled indoor area free of conductive contaminant’s.

Attention: Pour réduire le risque d’incendie ou d’électrocution, installer dans une enciente intérieure contrôlée en température et humidité et sans contaminant’s conducteurs.

Ce matériel est destiné seulement pour des installations dans un EMPLACEMENT RESTREINT d’Accès.

WARNAUNG! Um die Gefahr von Feuer und elektrischem Schock zu reduzieren, muss das Gerät in einem temperatur - und feuchtigkeitskontrollierten Raum, frei von leitungsfähigen Verunreinigungen, installiert werden. Dieses Gerät ist nur für die Installation an einem Ort mit eingeschränkter Zugangserlaubnis vorgesehen.

Diese Ausrüstung ist nur für Anlagen in einem EINGESCHRÄNKTE ZUGRIFF STANDORT bestimmt.

WARNING: HIGH LEAKAGE CURRENT. Earth connection essential before connecting supply.

ATTENTION: COURANT DE FUITE ELEVE. Raccordement a la terre indispensable avant le raccordement au reseau.

WARNUNG! Hoher Ableitstrom Vor Inbetriebnahme Schutzleiterverbindung herstellen.
This manual covers these models:

Product:

<table>
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<tr>
<th>Model</th>
<th>kVA</th>
<th>Voltage</th>
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<td>7.0 kVA</td>
<td>120/240 Line to Neutral</td>
</tr>
<tr>
<td>6414-9FMDXY</td>
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X=0  Inverter Plant With AC Distribution Panel
X=1  Inverter Plant Without AC Distribution Panel
Y=  The number of Modules in the Inverter Plant
H=  Line to Line Units
Warranty

The liability of MGE UPS SYSTEMS, Inc. hereunder is limited to replacing or repairing at MGE UPS SYSTEMS, Inc.’s factory or on the job site at MGE UPS SYSTEMS, Inc.’s option, any part or parts which are defective, including labor, for a period of 12 months from the date of purchase. The MGE UPS SYSTEMS, Inc. shall have the sole right to determine if the parts are to be repaired at the job site or whether they are to be returned to the factory for repair or replacement. All items returned to MGE UPS SYSTEMS, Inc. for repair or replacement must be sent freight prepaid to its factory. Purchaser must obtain MGE UPS SYSTEMS, Inc.’s Return Materials Authorization prior to returning items. The above conditions must be met if warranty is to be valid. MGE UPS SYSTEMS, Inc. will not be liable for any damage done by unauthorized repair work, unauthorized replacement parts, from any misapplication of the item, or for damage due to accident, abuse, or Act of God.

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Revision History

S4 Inverter Plant Technical Manual

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How To Use This Manual:

This manual is designed for ease of use and easy location of information.

To quickly find the meaning of terms used within the text, look to the Glossary.

To quickly find a specific topic, look at the Table of Contents.

This manual uses Note lines and icons to convey important information.

Note lines and icons come in four varieties.

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<td>against safety hazards and possible equipment damage.</td>
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<td>CAUTION:</td>
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<tr>
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<td>Indicates information provided as an operating instruction or as a tip.</td>
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CAUTION

RECORD ALL SERIAL NUMBERS FOR THE S4 INVERTER PLANT AND COMPONENTS. THESE SERIAL NUMBERS WILL BE REQUIRED IF YOUR SYSTEM NEEDS SERVICE. KEEP THIS MANUAL IN A PLACE WHERE YOU CAN REFERENCE THE SERIAL NUMBERS IF SERVICE IS REQUIRED!

S4 INVERTER PLANT SERIAL NUMBER: ________________________________

MBPS SERIAL NUMBER: ____________________________________________

ACDP SERIAL NUMBER: ____________________________________________

ADDITIONAL MODULES SERIAL NUMBERS:

__________________________ ______________________________
__________________________ ______________________________
__________________________ ______________________________
__________________________ ______________________________
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1.0 Scope

This manual provides information required for installation, operation, and maintenance of the S4 Inverter Plant. Please read this manual thoroughly before installation. Please retain this manual for future reference.

The manual is divided into five sections:

Section 1 — Introduction

This section describes the S4 Inverter Plant. The electrical and mechanical specifications of the Inverter Plant are also included in this section.

Section 2 — Installation

This section describes the installation, including receiving, handling, and storage procedures for the S4 Inverter Plant.

Section 3 — Operation

This section describes the start up of the S4 Inverter Plant, including descriptions of all indicators, controls, and operating modes.

Section 4 — Maintenance Adjustment and Troubleshooting

This section describes the maintenance of the S4 Inverter Plant, including preventive maintenance routines, and troubleshooting tables.

Section 5 — Applications

Grounding

Appendices

ACDP, MBPS, Inverter Receiver, and Static Switch Wire Diagrams.

A glossary in the rear of this manual provides definitions of terms used within the text.

1.1 General Description - Inverter Plant

The MGE S4 Inverter Plant consists of an equipment rack, an inverter (rated 7kVA, 14kVA or 21kVA), a Maintenance Bypass Switch (rated 10kVA or 21kVA), and an optional AC Distribution Panel.

The inverter plant allows wide flexibility of configuration in a small-footprint, compact power plant installation.

Figure 1-1 shows the configuration of the 7kVA Inverter Plant.

Figure 1-2 shows the configuration of the 14kVA Inverter Plant.

Figure 1-3 shows the configuration of the 21kVA Inverter Plant.

Figure 1-6 on page 1-8, provides the inverter schematic that shows the wiring between the different system parts and the input/output wiring locations.
1.1.1 Inverter

The Inverter is modular and consists of one to six Inverter Modules that inverts the Input DC voltage to 120VAC output. The Inverter also includes a Static Switch that is used to connect the AC input to the load.

The Inverter Plant comes in three power levels:

P/N 6407-9FMDXY/H - A 7kVA inverter receiver. The “X” in the part number stands for the AC Power Distribution Panel. X=0 ACDP is included. X=1 ACDP is not included. The “Y” in the part number stands for the number of Inverter modules (3.5kVA each) installed in the Inverter receiver. In this configuration "Y" can be 1 or 2 Inverter modules. "H" is for Line to Line Units.

P/N 6414-9FMDXY/H - A 14kVA inverter receiver. The “X” in the part number stands for the AC Power Distribution Panel. X=0 ACDP is included. X=1 ACDP is not included. The “Y” in the part number stands for the number of Inverter modules (3.5kVA each) installed in the Inverter receiver. In this configuration "Y" can be 2, 3 or 4 Inverter modules. "H" is for Line to Line Units.

P/N 6421-9FMDXY/H - A 21kVA inverter receiver. The “X” in the part number stands for the AC Power Distribution Panel. X=0 ACDP is included. X=1 ACDP is not included. The “Y” in the part number stands for the number of Inverter modules (3.5kVA each) installed in the Inverter receiver. In this configuration "Y" can be 3, 4, 5 or 6 Inverter modules. "H" is for Line to Line Units.

1.2 Maintenance Bypass Switch

The MBPS allows powering the load from the AC Input while the inverter unit is taken off line for maintenance or other purposes.

The Bypass Switch (MBPS) comes in two power levels:

P/N 6410M-9 A 10.5 kVA Maintenance Bypass Switch (used in the 7 kVA inverter plant)

P/N 6421M-9 A 21 kVA Maintenance Bypass Switch (used in the 14 and 21 kVA inverter plant)

1.3 AC Distribution Panel

The AC Distribution Panel includes a 20/24-pole distribution panel board, and is used to distribute power to different loads.

The AC Distribution Panel comes in two power levels:

P/N 6210-0AD A 10.0kVA Power Distribution Panel (used in the 7 kVA inverter plant)

P/N 6421P-9 A 21kVA Power Distribution Panel (used in the 14 and 21 kVA inverter plant)
Figure 1-1: 7kVA Inverter Plant.
Figure 1-2: 14kVA Inverter Plant.

ACDP

MBPS

S4 INVERTER

BLANK PANEL

26.00" (66.04 cm)

84.00" (213.36 cm)

78.67" (119.82 cm)

58.15" (147.70 cm)

46.00" (116.84 cm)

14.53" (36.91 cm)

.00" (.00 cm)

14kVA
Figure 1-3: 21kVA Inverter Plant.

21kVA

AC DISTRIBUTION PANEL

BREAKER TRIP AC ON

REMOVING MODULE!

OPEN BREAKER BEFORE WARNING!

DC INPUT
GREEN = NORMAL
YELLOW = WARNING
RED = FAULT

STATUS TEMPERATURE
POWER MODULE

REMOVING MODULE!

OPEN BREAKER BEFORE WARNING!

DC INPUT
GREEN = NORMAL
YELLOW = WARNING
RED = FAULT

STATUS TEMPERATURE
POWER MODULE

84.00" (213.36 cm)
78.67" (199.82 cm)
58.15" (147.70 cm)
46.00" (116.84 cm)
Figure 1-4: Side View 7kVA, 14kVA, 21kVA Inverter Plant.
Figure 1-5: S4 Inverter Plant Single-Line Diagram.
Figure 1-6: S4 Inverter Plant Schematic.
2.0 Scope

This section describes the installation, including receiving, handling, and storage procedures for the S4 Inverter Plant.

2.1 Receiving

Although this equipment was thoroughly tested and inspected by MGE and carefully packed for shipment, damage in transit may have occurred. Follow the procedures below to receive the equipment from the freight carrier:

a. Inspect the shipping container for damage. If damaged, request that the carrier inspect the equipment.

b. Unpack the equipment. If the equipment is damaged, unpack it in the presence of the carrier’s inspector, and take photos if appropriate. A full report of the damage should be obtained by the claim agent and forwarded to MGE Systems, Inc.

c. After receiving the equipment notify MGE Customer Service of any damage within five days. After an inspection by the carrier and (if necessary) MGE, and upon receipt of a full damage report, MGE will advise the customer of proper claim and return procedures (if necessary). ALL CLAIMS FOR SHIPPING DAMAGE MUST BE FILED WITH THE CARRIER.

2.2 Handling

A spread bar must be used, to avoid bending the bolts or side panels, if the S4 Inverter Plant is to be lifted from the top using the eye-bolts.

The equipment may be lifted from the top, using the eye-bolts; however a spreader bar must be used to avoid bending the bolts or the side panels.
2.3 Storage

If the equipment is to be stored prior to installation, it should be stored in a cool, dry, well-ventilated area that is protected against rain, splashing water, chemical agents, etc. The equipment should be covered with a tarpaulin or plastic wrap to protect it against dust, dirt, paint, or other foreign materials.

2.4 Prerequisites to Installation

Successful installation depends on careful planning and site preparation. Installation of the equipment must be performed by skilled technicians and electricians familiar with high-energy electrical equipment. Do not allow unqualified personnel to handle, install, or operate the equipment. The installation must comply with both the requirements of the National Electrical Code (ANSI/NFPA 70, latest issue), and local codes.
2.4.1 Electrical Grounding

Suitable grounding is required to meet the safety and EMI requirements. Separate grounding electrode conductor sized per National Electrical Code (NEC) article 250-94 should be connected from the ground (GND) terminal to a nearby grounding electrode. The grounding electrode should be installed as near as possible to the equipment. DC and AC cables must be sized appropriately for the currents being carried and per the requirements of the NEC national and local codes. Current and voltage data is provided in Inverter manual.

2.4.2 Mechanical Mounting

The Equipment Rack must be mounted using the hardware supplied with the unit. To mount the Rack to the floor use heavy-duty anchors for zone 3 & 4 (not supplied with the unit) and torqued to 60 FT-LB, (81.35 Nm). The inverter plant requires back access for wiring and maintenance.

2.4.3 Environmental

The Inverter Plant is designed for installation in a controlled environment. Factors to be considered in selecting a location include ventilation, temperature, humidity, and accessibility. Install the plant in a clean, dry location where the airflow is not restricted. The equipment is cooled by forced air. Allow at least 6 inches of air space to the sides of equipment for proper cooling. To comply with NEBS requirement, allow 12" (30.48 cm) to the sides when installed next to other heat generating equipment.
2.5 Connections

2.5.1 Install Safety Grounding

For safety and proper operation of the unit, including maximum attenuation of electrical noise, suitable safety grounding is required. A separate safety grounding electrode conductor should be connected from the safety ground (GND) terminal to a nearby safety grounding electrode, and should be sized per National Electrical Code Article 250-94.

The safety grounding electrode should be grounded to structural metal, a metal water pipe, or a suitable ground rod (National Electrical Code 250-26). The safety grounding electrode should be as near as possible to the unit. The will accommodate two 1/0 gauge wire. Customer provides safety grounding system.

2.5.2 DC Input

Normal: -48VDC

Operating Range: -39.5 VDC to -57VDC

This system is designed for battery systems with the positive terminal Earth Ground. All DC breakers are in the negative DC lines. The system DC terminals are isolated from Earth Ground.

2.5.3 DC Input Circuit Breaker

Due to tremendous amounts of short circuit current available (in excess of 1000A for as long as several minutes!) from bank(s) of batteries, that supply electrical power to inverter systems, it is extremely important to connect a properly sized DC circuit breaker at the DC input cable that feeds the inverter system. The following table is provided as a guide for selecting the proper circuit breaker.

Suggested DC circuit breaker ratings:

<table>
<thead>
<tr>
<th>Inverter rating</th>
<th>7 kVA</th>
<th>14 kVA</th>
<th>21 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB rating</td>
<td>200A</td>
<td>400A</td>
<td>600A</td>
</tr>
</tbody>
</table>

2.5.4 Wiring The Unit

All DC input connections are made through the “knock-outs”, located in the top right or left side panel.

Make sure that the upstream source DC circuit breaker and AC circuit breaker (if applicable) supplying the inverter plant are in the off (or open) position.

DC input power cables should be sized such that the maximum voltage drop between inverter plant busbar terminals and battery terminals is less than 1.0 volt at the breaker current rating.

The unit can accommodate three positive wires and three negative wires up to 4/0. Two 3/8” hole lugs, compression type with hole spacing of 1” can be used.

DC Input Connections:

All DC Connections are made in the Maintenance Bypass Switch. See Figure 2-2.

1. Connect the DC safety ground to the “DC Earth” terminal.
2. Connect the DC positive (+) connection to E10.
3. Connect the DC negative (-) to E11.
Figure 2-2: Maintenance Bypass Switch Layout.

1. Check that all normal indicator lamps are on.
2. Turn maintenance bypass switch clockwise first to SBP, then to MBP position.
3. Check that DC input breaker has tripped and bypass lamp is on. DC input lamp will remain on for a few seconds due to charged capacitors in the inverter.

To return to normal operation:
1. Turn maintenance bypass switch counterclockwise first to SBP, then to normal position.
2. Reset DC circuit breaker by operating to off position, then to on position.
3. Check all normal indicators are on and bypass lamp is off.
4. Follow inverter startup instructions to turn on inverter.

For 3/4" (19 mm), 1" (25.4 mm), 1-1/2" (38.1 mm) conduits (typ).

Knockout for DC input wiring (external DC supply) (1" (25.4 mm), 2" (50.8 mm), 3" (76.2 mm) conduit).

Knockout for AC wiring/conduit, MBPS-inverter (1" (25.4 mm) conduit), (1-1/2" (38.1 mm) conduit), (3/4" (19 mm) conduit).

Knockout for AC wiring/conduit, MBPS-ACDP (1" (25.4 mm) conduit).

Bracket mounting holes for center mounting.

Bracket mounting holes for flush mounting.

Bracket mounting holes for center mounting.

Bracket mounting holes for flush mounting.

Top view with punch out holes for 3/4" (19 mm), 1" (25.4 mm), 1-1/2" (38.1 mm) conduits (typ).
2.5.5 AC Input Circuit Breaker

CAUTION: If utility line voltage is connected to the system, an appropriately rated AC circuit breaker MUST be installed between the supplying AC source and the inverter plant. Installation must comply with local/national electrical installation requirements.

Suggested circuit breaker ratings:

<table>
<thead>
<tr>
<th>Inverter voltage</th>
<th>7 kVA</th>
<th>14 kVA</th>
<th>21 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-120VAC AC breaker rating</td>
<td>80A</td>
<td>150A</td>
<td>225A</td>
</tr>
<tr>
<td>208-240VAC AC breaker rating</td>
<td>40A</td>
<td>80A</td>
<td>125A</td>
</tr>
</tbody>
</table>

2.5.6 Line to Neutral Units - Wiring and Setup

2.5.6.1 AC Input Connections

IMPORTANT: This section covers the AC connections and configuration for the Line to Neutral Units only. For Line to Line Units (part numbers ending with “H”) please skip to 2.5.7

AC input connections are made to Maintenance Bypass Switch at TB4. See Figure 2-2.

TB4 - Max wire size - 2/0:

- AC Input Line (L1) TO TB4-1
- AC Input Neutral (N) TO TB4-2
- AC Input Safety Ground (GND) TO AC P.E.

2.5.6.2 Description of Load Connections

For Inverter Plant with AC Distribution Panel, the Load connections are made to the Circuit Breakers at the AC Distribution Panel.

The panel board mounted in the ACDP accepts type QOXXX-2100 (10,000 A/C, 15A through 50A, one and two pole), and type QOXXXVH-2100 (22,000 AIC, 15A through 30A single pole and 15A through 50A two pole). These breakers should be ordered separately. Up to 10-12 one pole circuit breakers with alarm switches can be installed in ACDP for 110-120V application. Up to six two pole breakers with alarm switch can be installed in ACDP for 220-240V application.

The load side wiring of the branch breakers on the panel board must be connected to the intended load(s) through the knockout area.
For inverter plant units without AC Distribution Panel, AC output connections are made to the Maintenance Bypass Switch at TB4. See Figure 2-2.

TB4 - Max wire size is 2/0:

- AC output L1 TO TB4-6
- AC output N TO TB4-7
- Output Ground TO AC P.E. Terminal

2.5.6.3 AC Input/Output Voltage Selection

The inverter is preset at the factory for 120VAC input, ON-LINE, 120VAC, 60 Hz output. If the input voltage for your installation is different (220VAC to 240VAC), the following procedure MUST be followed. In the “Static Sw” area, there is a printed circuit board mounted to the right side panel. A multi-pin connector is located on the printed circuit board, close to the “Static Switch” front panel, identified as J23. This connector has 13 pins. Its mating plug has 12 positions, with interconnecting wires. This allows the jumper plug (P13) to be installed in one of two positions. When this jumper plug is in its most forward position (closest to the front panel), the unit is set for 110-120VAC operation. Removing the plug and installing it in its rear most position selects 220-240VAC operation. Verify that this plug is in the proper position before applying any voltage to the inverter system. See Figure 2-3.

2.5.6.4 EMI Filter Wiring

There are two separate inverter AC output EMI filters. Each filter provides one half of the output power to the system. These filters must be connected in parallel for 110-120VAC output or connected in series for 220-240VAC output. There are only two wires connected to these two filters. The “Neutral” wire, with the white band, is connected to the lower EMI filter left-hand stud. The “AC output” wire is connected to the upper EMI filter right-hand stud. In the 110-120VAC configuration, the left-hand studs of the EMI filters are connected together by a copper busbar strap and the two right-hand studs of the EMI filters are connected together by a busbar strap.

To change to the 220-240VAC connection, remove the wires and busbars from the output terminals of the EMI filter. Install the copper busbar between the lower EMI filter right-hand stud to the upper EMI filter left-hand stud. Reconnect the white “Neutral” wire to the lower EMI filter left-hand stud and the “AC output” wire to the upper EMI filter right-hand stud. Replace the hardware (flat washer, lock washer, and nut) and tighten the 10MM nuts to the prescribed torque, 35.4 inch-lbs (4 Nm). Refer to the decal on the cover plate of the static switch for strap positions. Again, verify that P23 plug on the “Static Switch” printed circuit board (located on the right side panel), is in the 240VAC, rear most position before applying any voltage to the inverter system. The extra copper busbar may be discarded. Replace the top cover of the “Static Switch” and secure it with the three previously removed 6-32x1/4” “Phillips” head screws.

DANGER!: Do not perform this procedure unless the configuration needs to be changed. The voltage section jumper plug position must agree with the software section. See Figure 2-3.
Figure 2-3: EMI and Busbar VAC Configurations.
2.5.6.5 Software Configuration Setup

A Lap-top Personal Computer (PC) with the “Field Service Set-up” software (supplied with the unit), for the inverter family must be available and connected to the DB-9 connector of the display panel via the appropriate cable. In systems that do not have the redundant controller printed circuit board, skip the dual and redundant controller setup.

2.5.6.6 Dual Controller Setup

The following procedure should be followed for reconfiguring systems that contain a redundant (second) microprocessor. Using a #2 Phillips screw driver, remove the four screws securing the display panel to the receiver rack. Using the Phillips screw driver, remove the two screws holding the microprocessor boards in place. The circuit board securing bracket is also a circuit board extractor. Using this bracket, pull the top microprocessor circuit board out slightly so that it is disengaged from its 70 pin edge plated connector. Return the display panel back to its vertical position and install the two screws to hold the panel in position. Do not tighten the screws very much, since they will be removed again.

2.5.6.7 System Personalization

Before installing the power modules into the receiver rack, Turn the MBP switch to SBP position and reset the DC breaker to the ON position. Apply the 48 DC input voltage. The controller (microprocessor) within the unit should become activated. The “Status” indicators on the display panel should sequence through their self test mode, changing from red to yellow to green, then momentarily off in approximately 4 seconds. After this, ignore all the LED displays. Using the lap-top PC, call up the Field Service Set-up program. In the Windows menu, select the desired AC output voltage, frequency, and modes of operation. The Windows menu will appear similar to the following.

Figure 2-4: Setup Screen.

After the selections are complete, click on the “Save” button. The data will be sent to the appropriate address in the controllers “EEROM”. Remove the applied 48VDC to the system by turning off the main DC feed circuit breaker.
2.5.6.8 Rack kVA Rating ID Label

For kVA rating see the inverter ID label. Use the label kVA rating, regardless of the number of inverter modules installed.

The processor will detect and display the number of modules installed and the number of modules that are “ON” and operating without fault.

2.5.6.9 On-Line Mode

On-line mode is the mode in which the load is powered by the inverter system, not the utility. It will get clean, transient free electrical power from the inverter system, which is producing the AC power from a DC power source. In the event of inverter failure, the static transfer switch will transfer the load to the utility power if available.

2.5.6.10 Off-Line Mode

Off-line mode is the mode in which the load is powered from the Utility power line (external AC input power). In the event of a power failure, a static transfer switch will connect the system output to the inverter and activate the inverter so as to provide continuous power to the load with no interruptions of power to the load.

2.5.6.11 Redundant Controller Set-Up

After making sure the 48VDC power has been removed from the unit, remove the two Phillips head screws from the display panel as above. Re-install the top controller printed board that was previously partially removed. Using the circuit board retaining bracket, disengage the bottom controller board from its connector. Replace the display panel and secure it with the two Phillips head screws previously removed. Repeat step 2.5.6.7 for this second controller. When the set-up is complete, remove the 48VDC applied to the system. Again open the front display panel and reseat the bottom controller circuit board. Replace the circuit board retaining bracket and secure it in its final position using the two 6-32 Phillips head screws. Replace the display panel and secure it to the rack using the two 8-32 x 3/8” Phillips head screws. Set up is complete.

2.5.6.12 Inverter Module Installation

The inverter modules are designed for a “hot swap”. However, for initial start up, all of the inverter modules should be installed. In a system where all of the module positions are not used, reinstall the previously removed blank panels in these locations. Install the inverter modules and tighten the four thumbscrews on each module. Before turning on the main source DC circuit breaker and utility AC circuit breaker (if used), make sure that all of the inverter module circuit breakers (upper left-hand corner) of each module is OFF. Also verify the “ON/Stand-by” switch on the display panel is in the “OFF” (down) position. The inverter plant usually supplies power to some type of distribution circuit breaker panel. Confirm that all of these circuit breakers (loads) are OFF before starting up the inverter. After the DC input cable, utility line cable, and output cable are properly connected and secured, the inverter system is ready to be turned “ON”.

Installation
**Important:** Turn off the Input DC Breaker before removing the inverter module. Wait 3 minutes before turning the Inverter Module ON after turning it off, to allow discharge of the input capacitors.

For Line to Neutral Units skip to section 2.5.8 Startup Sequence.
2.5.7 Line to Line Units - Wiring and Setup

2.5.7.1 AC Input Connections

**IMPORTANT:** This section covers the AC connections and configuration for the Line to Line Units only (part numbers ending with “H”). For Line to Neutral Units please refer to section 2.5.6.

AC input connections are made to Maintenance Bypass Switch at TB4. See Figure 2-2.

TB4 - Max wire size - 2/0:
- AC Input Line (L1) TO TB4-1
- AC Input Neutral (N)(L2) TO TB4-2
- AC Input Safety Ground (GND) TO AC P.E.

2.5.7.2 Description of Load Connections

For Inverter Plant with AC Distribution Panel, the Load connections are made to the Circuit Breakers at the AC Distribution Panel.

The panel board mounted in the ACDP accepts type QOXXXX-2100 (10,000 A/C, 15A through 50A, one and two pole), and type QOXXXVH-2100 (22,000 AIC, 15A through 30A single pole and 15A through 50A two pole). These breakers should be ordered separately. Up to six two pole breakers with alarm switch can be installed in ACDP for 208-240V application.

The load side wiring of the branch breakers on the panel board must be connected to the intended load(s) through the knockout area.

For inverter plant units without AC Distribution Panel, AC output connections are made to the Maintenance Bypass Switch at TB4. See Figure 2-2.

TB4 - Max wire size is 2/0:
- AC output L1 TO TB4-6
- AC output L2 TO TB4-7
- Output Ground TO AC P.E. Terminal.

2.5.7.3 AC Input/Output Voltage Selection

The inverter is preset at the factory for 240VAC input, ON-LINE, 240VAC, 60 Hz output. If the input voltage for your installation is different follow the software configuration setup instructions.

**NOTE:** Do not perform this procedure unless the configuration needs to be changed.
2.5.7.4 Software Configuration Set-Up

The factory default configurations of the inverter plant is: 240V, 60Hz, utility voltage connected and mode of operation is on-line. If the factory configuration is different the inverter plant will ship with marking that will describe the inverter plant configuration. Use the configuration set-up program when a different configuration is required or when a new processor is installed.

A lap-top Personal Computer (PC) with the “Field Service Set-up” software (supplied with the unit), for the inverter family must be available and connected to the DB-9 connector of the display panel via the appropriate cable. In systems that do not have the redundant controller printed circuit board, skip the dual and redundant controller setup.

2.5.7.5 Dual Processor Set-Up

The following procedure should be followed for systems that contain a redundant (second) microprocessor. Using a #2 Phillips screw driver, remove the four screws securing the display panel to the receiver rack. Using the Phillips screw driver, remove the two screws holding the microprocessor boards in place. The circuit board securing bracket is also a circuit board extractor. Using this bracket, pull the top microprocessor circuit board out slightly so that it is disengaged from its 70 pin edge plated connector. Return the display panel back to its vertical position and install the two screws to hold the panel in position. Do not tighten the screws very much, since they will be removed again.

2.5.7.6 System Personalization

Before installing the power modules into the receiver rack. Turn the MBP switch to SBP position and reset the DC Breaker to the ON position. Apply the 48 DC input voltage. The controller (microprocessor) within the unit should become activated. The status indicators on the display panel should sequence through their self test mode, changing from red to yellow to green, then momentarily off in approximately 4 seconds. After this, ignore all the LED displays. Using the lap-top PC, call up the “Field Service Set-up” program. In the windows menu, select the desired AC output voltage, frequency, and modes of operation. The “Windows” menu will appear similar to the following:

*Figure 2-7: Setup Screen.*

After the selections are complete, click on the “Save” button. The data will be sent to the appropriate address in the controllers “EEROM”. Remove the applied 48VDC to the system by turning off the main DC feed circuit breaker.
2.5.7.7 Inverter Receiver kVA Rating ID Label

For kVA rating see the inverter ID label. Use the label kVA rating, regardless of the number of inverter modules installed.

The processor will detect and display the number of modules installed and the number of modules that are “ON” and operating without fault. Mge is offering the 7, 14, and 21 kVA rating.

2.5.7.7.1 On-Line Mode

On-line mode is the mode in which the load is powered by the inverter system, not the utility. It will get clean, transient free electrical power from the inverter system, which is producing the AC power from a DC power source. In the event of inverter failure, the static transfer switch will transfer the load to the utility power if available.

2.5.7.7.2 Off-Line Mode

Off-line mode is the mode in which the load is powered from the Utility power line (external AC input power). In the event of a power failure, a static transfer switch will connect the system output to the inverter and activate the inverter so as to provide continuous power to the load with no interruptions of power to the load.

2.5.7.8 Redundant Controller Set-Up

After making sure the 48VDC power has been removed from the unit, remove the two Phillips head screws from the display panel as above. Re-install the top controller printed board that was previously partially removed. Using the circuit board retaining bracket, disengage the bottom controller board from its connector. Replace the display panel and secure it with the two Phillips head screws previously removed. Repeat step 2.5.7.6 for this second controller. When the set-up is complete, remove the 48VDC applied to the system. Again open the front display panel and reseat the bottom controller circuit board. Replace the circuit board retaining bracket and secure it in its final position using the two 6-32 Phillips head screws. Replace the display panel and secure it to the rack using the two 8-32 x 3/8” Phillips head screws. Set up is complete.

2.5.7.9 Inverter Module Installation

The inverter modules are designed for a hot swapped. However, for initial start up, all of the inverter modules should be installed. In a system where all of the module positions are not used, reinstall the previously removed blank panels in these locations. Install the inverter modules and tighten the four thumbscrews on each module. Before turning on the main source DC circuit breaker and utility AC circuit breaker (if used), make sure that all of the inverter module circuit breakers (upper left-hand corner) of each module is OFF. Also verify the ON/Stand-by switch on the display panel is in the OFF (down) position. The inverter plant usually supplies power to some type of distribution circuit breaker panel. Confirm that all of these circuit breakers (loads) are OFF before starting up the inverter. After the DC input cable, utility line cable, and output cable are properly connected and secured, the inverter system is ready to be turned ON.

Figure 2-8: Inverter Module.
2.5.8 Installation Check

Often, operation problems are caused by incorrect installation or setup. Before turning the system on, review Chapter 2 for instructions pertaining to your particular system.

If the system fails to operate properly after being turned on, recheck and verify to make sure things are connected correctly.

- DC input terminals have correct voltage polarity
- Utility input terminals have correct voltage connections
- AC output terminals voltage connections
- Input conductor size correct ampacity
- Output conductor size correct ampacity
- Correct output voltage selected in personalization
- Correct frequency selected
- On/Off Line Inverter is on-line
- Automatic or manual start is selected

Use the checklist Table 4-2 Troubleshooting Guide in Section 4.0, Maintenance Adjustment and Troubleshooting.

2.5.9 Start-Up Sequence

Confirm that all power modules’ ON/OFF circuit breakers are set to the OFF position. On the LCD display panel, be sure inverter switch SW1 is set to standby position.

Before applying any power to the MBPS, check to make sure all wiring is correct. Please refer to installation and wiring information above.

Do not close the circuit breakers that connect the inverter plant to the Load.

1. Turn the MBPS Switch to "NORMAL" position.
2. Switch the MBPS DC circuit breaker to the "ON" position.
3. Close the DC FEEDER circuit breaker to connect the DC supply to the inverter plant.
   - The Inverter display should be on.
   - The "DC INPUT" indicator on the MBPS unit should be on.
4. Close the AC FEEDER circuit breaker to connect the AC supply to the inverter plant.
   At this point the Input AC is connected to the MBPS and power distribution via the Inverter Static Switch.
   - The "AC INPUT" indicator on the MBPS unit should be on.
   - The "INV AC OUTPUT" indicator on the MBPS unit should be on.
   - The "AC ON" indicator on the AC Distribution Panel unit should be on.
   - "BYPASS" indicator on the Inverter display panel should be blinking green, Controller A&B. (Indicating that the AC supply is within acceptable limits).
5. The controller boards and LCD display panels are now energized. The following message will be displayed in the LCD:

Line 1: INV: off module
Line 2: BYP: static normal

If the system is equipped with two controllers, one controller will take control of the system, the other will be a back-up. Assuming Controller A takes control of the system, the Bypass Status LED (DS1) will be green, Inverter Status LED (DS2) will be out, Controller B Bypass and Inverter LED’s (DS3, DS4) will alternately blink on and off, green for Bypass, green for inverter. If Controller B takes control, its Status LED’s will be the same as Controller A above.

6. Turn the circuit breaker on each power module to the ON position. The LCD display panel is still displaying the above two lines, but ‘module’ will change to ‘normal’. Now, everything is ready and the inverter switch, SW1, (on the inverter display panel), can be turned ON (push-up). The status LED’s will be as above, except that the inverter indicator that was out will now be green if the system is functioning properly. The inverter is now supplying the power to the system. Using a voltmeter, verify that the proper voltage (110, 115, or 120VAC or 208, 220, 230, 240VAC) exist at the Power Distribution panel or MBPS TB4-6 and TB4-7, check display for load voltage. At this point you can apply load to the unit.

2.5.10 De-Energizing the System

If the system is equipped with an AC input, turn off the main feed circuit breaker. Then turn switch SW1 to the Standby position (push down). Next, turn all the power modules front panel circuit breakers OFF. Last, turn the DC input supply circuit breaker OFF.
IMPORTANT: Do not operate the inverter until you are familiar with the basic indicators, controls, and operational sequences, as described in the operation section 3.0 of this document.

WARNING: An AC output will be present at the output terminals immediately when AC input is energized.

ATTENTION: La tension alternative de sortie apparaît dès la mise sous tension de l’entrée.

WARNUNG! Eine Ausgangsspannung liegt an den Ausgangsklemmen, sobald der Netzeingang angeschlossen wird.

3.0 Scope
This section describes the operation of the S4 Inverter Plant, including descriptions of all indicators, controls, and operating modes.

3.1 Initial System Turn-on and Meter Panel Observations
The meter panel displays important information regarding the status or inputs, outputs, operating modes and fault conditions. If the system is not operating properly, complete and accurate observation of any and all normal and abnormal indications is very important before trying to analyze and localize the problem.
3.2 **Inverter Plant General Description**

This static modular inverter system series provides stable, distortion-free AC power from a DC input source at a selectable output voltage and frequency, for sensitive equipment. With a built-in static transfer switch, the inverter also forms a reliable and economical part of uninterruptible power supply systems in either on-line or off-line mode.

This series employed modular design to provide N+1 redundancy, and twin controller cards to double reliability. There are three distinctive parts in these tower inverter systems. The top part is a built-in module that houses the twin controller, alarm cards, LCD unit, and LED indicators. The center part is a built-in module that houses a static transfer switch where input and output connectors are located. It is easily recognized by twin fan front panel. Above and below this static switch module are individual inverter modules rated 3.5 kVA/3kW each (those with single fan front panel).

MGE S4 Inverters are available in three receiver cabinet configurations housing 1 to 6 inverters, a static transfer switch console and redundant microcontroller modules.

*Figure 3-1: Inverter Plant System Configurations.*
3.3 Standard Products and System Characteristics

Table 3-1: Inverter System Characteristics

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Power rating (kVA)</th>
<th>Nominal Input Voltage (VDC)</th>
<th>Input Voltage Range (VDC)</th>
<th>Maximum Input Current @ -40VDC (Amperes)</th>
<th>Maximum Output Amperes at selectable output voltage of:</th>
<th>Selectable Output Frequency Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>64074/H</td>
<td>7</td>
<td>(-48)</td>
<td>(-40 to -57)</td>
<td>176</td>
<td>58, 29</td>
<td>50 or 60</td>
</tr>
<tr>
<td>64144/H</td>
<td>14</td>
<td>(-48)</td>
<td>(-40 to -57)</td>
<td>353</td>
<td>116, 58</td>
<td>50 or 60</td>
</tr>
<tr>
<td>64214/H</td>
<td>21</td>
<td>(-48)</td>
<td>(-40 to -57)</td>
<td>529</td>
<td>174, 87</td>
<td>50 or 60</td>
</tr>
</tbody>
</table>

Table 3-2: Inverter Module Dimensions

<table>
<thead>
<tr>
<th>Inverter Module</th>
<th>HEIGHT (in/cm)</th>
<th>DEPTH (in/cm)</th>
<th>WIDTH (in/cm)</th>
<th>WEIGHT (lb/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>64004-9MSK1</td>
<td>5.18 / 13.16</td>
<td>15.12 / 38.4</td>
<td>15.76 / 40.03</td>
<td>46 / 20.86</td>
</tr>
</tbody>
</table>

Note: Weight: six-mod receiver = 135 lbs. 1 Inverter Module = 46 lbs.
Total Inverter System Weight, 21 kVA system = 411 lbs.

3.4 Electrical Specifications

Electrical Specifications are subject to revision without notice.

3.4.1 DC Input

Nominal: -48Vdc; Operating Range: -39.5Vdc to -57 Vdc

NOTE: An external DC circuit breaker or fuse should be used at the DC source.
3.4.2 AC Output (per module)

Voltage: 120Vrms or 240Vrms
Current: 25Arms or 12.5Arms
Frequency: 50Hz or 60Hz

Table 3-3: S4 AC Output Current Ratings.

Attention: Watts rating = 85% of the VA rating at 120/240 VAC.

<table>
<thead>
<tr>
<th>Vout (Vac)</th>
<th>Iout (A)</th>
<th>Output Power (W)</th>
<th>Output VA (VA)</th>
<th>Iout (A)</th>
<th>Output Power (W)</th>
<th>Output VA (VA)</th>
<th>Iout (A)</th>
<th>Output Power (W)</th>
<th>Output VA (VA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>58.33</td>
<td>6000</td>
<td>6416</td>
<td>116.66</td>
<td>12000</td>
<td>12833</td>
<td>175</td>
<td>18000</td>
<td>19250</td>
</tr>
<tr>
<td>115</td>
<td>58.33</td>
<td>6000</td>
<td>6708</td>
<td>116.66</td>
<td>12000</td>
<td>13416</td>
<td>175</td>
<td>18000</td>
<td>20125</td>
</tr>
<tr>
<td>120</td>
<td>58.33</td>
<td>6000</td>
<td>7000</td>
<td>116.66</td>
<td>12000</td>
<td>14000</td>
<td>175</td>
<td>18000</td>
<td>21000</td>
</tr>
<tr>
<td>208</td>
<td>29.17</td>
<td>6000</td>
<td>6066</td>
<td>58.33</td>
<td>12000</td>
<td>12133</td>
<td>87.5</td>
<td>18000</td>
<td>18200</td>
</tr>
<tr>
<td>220</td>
<td>29.165</td>
<td>6000</td>
<td>6416</td>
<td>58.33</td>
<td>12000</td>
<td>12833</td>
<td>87.5</td>
<td>18000</td>
<td>19250</td>
</tr>
<tr>
<td>230</td>
<td>29.165</td>
<td>6000</td>
<td>6708</td>
<td>58.33</td>
<td>12000</td>
<td>13416</td>
<td>87.5</td>
<td>18000</td>
<td>20125</td>
</tr>
<tr>
<td>240</td>
<td>29.165</td>
<td>6000</td>
<td>7000</td>
<td>58.33</td>
<td>12000</td>
<td>14000</td>
<td>87.5</td>
<td>18000</td>
<td>21000</td>
</tr>
</tbody>
</table>

Units configured to other than 120/240VAC are derated due to current limit.
The % Load reading on the display panel is always with reference to the 120/240 Vac WATT and VA ratings.

Efficiency: 85% minimum, 88% typical (on-line mode); 97% typical (off-line mode) at full kVA/Watt load.
Power Factor: Rated kVA is available over a power factor range of 0.6 lagging to 0.6 leading at nominal voltage. Watt rating should not be exceeded.
Total Harmonic Distortion: Less than 1% for linear load conditions, 3% maximum for crest factor loads up to 3:1.
Line Regulation: System output voltage variation, less than 1% over the DC voltage range.
Load Regulation: System output voltage variation, less than 1% from zero to full load at nominal DC input.
Output Frequency: User-selectable, 50Hz or 60Hz. Free run frequency stability shall be within +/-0.02% of the selected frequency.
Short Circuit Current: (SCC)300% minimum of rated load current for four cycles. A SCC is defined as a current that exceeds 150% of rated current.
Overload Capability: Continuous overload up to 108% of rated VA/watts at 50°C maximum.
Transient Deviation and Recovery: Within 20% of average value for any change in output current or step change in input voltage within specified limits. Recovery within 1 millisecond from zero to full load.
EMI Emission: Battery Bus less than 30dBm. FCC 47 CFR part 15 class A; EN 55022 class A; CISPR 22 class A.
3.4.3 Mechanical Specifications

Table 3-4: S4 Inverter Cabinet Mechanical Dimensions and Weights

<table>
<thead>
<tr>
<th>MODEL</th>
<th>7 kVA</th>
<th>14 kVA</th>
<th>21 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEIGHT (in/cm)</td>
<td>21 / 54</td>
<td>31.5 / 81</td>
<td>42 / 107.9</td>
</tr>
<tr>
<td>DEPTH (in/cm)</td>
<td>18.5 / 47.5</td>
<td>18.5 / 47.5</td>
<td>18.5 / 47.5</td>
</tr>
<tr>
<td>WIDTH (in/cm)</td>
<td>17 / 43.7</td>
<td>17 / 43.7</td>
<td>17 / 43.7</td>
</tr>
<tr>
<td>RECEIVER WEIGHT (lb/kg)</td>
<td>88 / 39.9</td>
<td>111 / 50.3</td>
<td>136 / 61.3</td>
</tr>
<tr>
<td>RECEIVER + MODULES WEIGHT (lb/kg)</td>
<td>182 / 82.6</td>
<td>299 / 135.6</td>
<td>418 / 189.6</td>
</tr>
<tr>
<td>RECEIVER SHIPPING WEIGHT (lb/kg)</td>
<td>100 / 45.4</td>
<td>123 / 55.8</td>
<td>148 / 67.1</td>
</tr>
</tbody>
</table>

3.5 Environmental Specifications

Operating Temperature
All models operate to specifications from -5°C to +50°C (+23°F to +122°F) for altitude up to 3,300 feet (1006 Meters), and -5°C to 35°C (+23°F to + 95°F) for up to 13,300 feet (4054 Meters).

Shipping Temperature
-40°C to +75°C (-40°F to +192°F) for shipping; Not recommended for storage.

Storage Temperature
-40°C to +60°C (-40°F to +166°F).

Operating Humidity
0 to 90% relative, without condensation.

Operating Altitude
200 feet below to 13,300 feet (4054 Meters) above sea level.

Audible Noise
Less than 59 dBA per Type 2, IEC and ANSI SI.4, when measured in a 40 dBA environment at a distance of 4 feet from any surface.

Cooling
Cooling is by forced air. Air intake is through the front of the unit, exhaust out the sides.

3.5.1 Thermal Dissipation

Heat rejection: 602.28 BTU/Hr for each rated KW of the inverter system. This is based on an inverter efficiency of 85% at full load and does not include load dissipation.

<table>
<thead>
<tr>
<th>kVA rating</th>
<th>3.5</th>
<th>7</th>
<th>10.5</th>
<th>14</th>
<th>17.5</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watts</td>
<td>529</td>
<td>1059</td>
<td>1582</td>
<td>2118</td>
<td>2647</td>
<td>3177</td>
</tr>
<tr>
<td>BTU/Hr</td>
<td>1807</td>
<td>3614</td>
<td>5421</td>
<td>7227</td>
<td>9034</td>
<td>10841</td>
</tr>
<tr>
<td>Est. A/C, TONS</td>
<td>0.151</td>
<td>0.301</td>
<td>0.452</td>
<td>0.602</td>
<td>0.753</td>
<td>0.903</td>
</tr>
</tbody>
</table>
Figure 3-2: S4 Inverter Components.

NOTE: Modules are shipped separately to receiver cabinet.
3.6 Indicators and Controls

There are six LED indicators divided into three groups – DS1 and DS2, DS3 and DS4, DS5 and DS6 - on the display front panel. DS1 and DS2 are indicators of controller A; DS3 and DS4 are indicators for controller B; DS5 and DS6 are for output capacitors fuse indicators. Failure of output capacitors will trip output fuses, and will activate DS5 and/or DS6 indicators.

At power-up, one of the two controller units will be up quicker than the other and will take control the system. The Stand By Controllers’ LED will be green, toggling on/off. Consequently DS1 or DS3 will be on blinking green, signaling that AC Input is available and the system output is ready to be turned on, through the Power Distribution breakers.

The inverter output voltage is turned ON or to Stand-by via switch SW1 located on the left side of the LCD display Panel. Pushing it up is to turn the inverter ON, and pushing it down is to turn the inverter OFF. WARNING: In the “Stand-by” position, if AC power is applied to the AC input terminal block, AC power will be on the output of the unit. When the Inverter voltage is on, DS2 (or DS4) indicator will be on green steadily, signaling that every thing is normal.

The system measurement information is displayed on the LCD display panel. Switch SW3 (scroll button, on the right side of the display panel), is pushed down (or up) to scroll the LCD screens for more information. Individual inverter module has only one control, an ON/OFF circuit breaker, located at the upper left corner of the front panel. This breaker is used to energize (or de-energize) the inverter module.

Note: For initial start-up the module circuit breakers must be turned on prior to turning the system inverter “ON”.

See Figure 3-2 on page 3-6 for the location of indicators and control switches.

3.6.1 LCD Readout

The LCD unit displays two lines (out of a total of seven lines) of information at a time. Each line can be scrolled up (or down) independently by toggling the scroll switch SW3.

Typical seven lines of information are shown below:

<table>
<thead>
<tr>
<th>Line</th>
<th>INV:</th>
<th>BYP:</th>
<th>LOAD:</th>
<th>AC IN:</th>
<th>DC IN:</th>
<th>LOAD:</th>
<th>INV:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>off</td>
<td>static</td>
<td>120V</td>
<td>120V</td>
<td>48.0V</td>
<td>03000 W</td>
<td>6 of 6</td>
</tr>
<tr>
<td>2</td>
<td>normal</td>
<td>normal</td>
<td>100%</td>
<td>60 Hz</td>
<td>073.5A</td>
<td>025.0A</td>
<td>60 Hz</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inverter off/on
Static bypass on/normal operation
AC Output/Load % of nominal
AC input voltage/frequency
DC voltage/DC current
Load Power (W)/Current (A)
Number of good modules out of # installed modules
Operation/Frequency.
3.7 Remote Alarm

The system provides three alarm signals, namely, Utility alarm, Minor alarm, and Major alarm.

- Utility alarm – Utility alarm is ON when utility input voltage is lost/out of tolerance.
- Minor alarm – The system sends out this signal to indicate something is not functioning properly, but inverter can still maintain the load.
- Major alarm – Whenever load is lost power and the system is energized.

For alarm connection, see Table 3-5.

3.7.1 Alarm Relays

There are three alarm relays. All relays are “form C” type, that is, the relay has a normally open and a normally closed contact set.

The Major Alarm relay will be energized when the system is operating properly, that is, power is being supplied to the load either from the inverter or from the utility. There are two sets of “form C” contact sets on the Major Alarm relay.

The Minor Alarm relay will be normally de-energized, and will be energized for the alarm condition. A Minor alarm will be issued if the system is not operating properly. Such an alarm will be issued during over load, battery voltage not within specified limits, power modules over temperature, module fault, and controller failure.

The Utility Alarm relay will be de-energized during normal operation and will be energized for the alarm condition. This alarm will be issued if the utility voltage is not within specified limits or the input frequency is not within proper limits.

The table below shows the alarm and the non-alarm terminal block connections. This terminal block is located in the top, left side of the receiver cabinet. The small front panel must be removed to gain access to the terminal block.

Table 3-5: Alarm Connections.

<table>
<thead>
<tr>
<th>J21 terminal block screw position ---</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAJOR ALARM ---</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAJOR ALARM ---</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Major Alarm ---</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Major Alarm ---</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor Alarm ---</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Minor Alarm ---</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility Alarm ---</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Utility Alarm ---</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“X” indicates a short circuit between J21 terminal block points.

For MBPS Alarm Connections see Table 3-7, and for ACDP Alarm Connections see Table 3-10.
3.7.2 Maintenance Bypass Switch

The MBPS is a three position rotary switch. Under normal operating conditions, the handle is in the “NORM” position. This indicates the inverter is providing power to the load (inverter or static switch mode). When the handle is placed clockwise in the “SBP” (static bypass) position, the DC breaker is tripped and the load is powered by utility via the inverter static bypass switch. When the handle is placed clockwise in the “MBP” position, power to the load is provided by the AC input directly through the MBPS, and all power sources to the inverter are electrically removed.

Figure 3-3 shows the MBPS front panel. The DC breaker provides input to the inverter. Under normal operating conditions, the handle is in the “ON” position. When the MBPS places the load in maintenance bypass, this circuit breaker is tripped and the handle goes to the “tripped” position. In order to place it back to the “on” position the handle must be reset to the “off” position first, then placed back in the “on” position.

**Figure 3-3: MBPS Front Panel.**

---

**NOTE:** When the bypass switch is placed in the static bypass (SBP) position, AC utility is still connected to the inverter. Work carefully whenever voltage is present.
### Table 3-6: MBPS Power Connections.

<table>
<thead>
<tr>
<th>From (external to MBPS)</th>
<th>To (internal to MBPS)</th>
<th>Description (internal to MBPS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Power Source(+)</td>
<td>+(E10)</td>
<td>DC Supply Return</td>
</tr>
<tr>
<td>DC Power Source(-)</td>
<td>-(E11)</td>
<td>DC Supply -48VDC</td>
</tr>
<tr>
<td>120/220/230/240VAC (L1)</td>
<td>TB4-1(L1)</td>
<td>AC Supply Line</td>
</tr>
<tr>
<td>Neutral (L2)</td>
<td>TB4-2(N, L2)</td>
<td>AC Supply Neutral(L2)</td>
</tr>
<tr>
<td>Safety Ground</td>
<td>TB4-3(G)</td>
<td>Safety Ground</td>
</tr>
<tr>
<td>Inverter DC + terminal</td>
<td>E10+</td>
<td>DC Supply Return</td>
</tr>
<tr>
<td>Inverter DC -terminal</td>
<td>E9-</td>
<td>DC Supply -48VDC</td>
</tr>
<tr>
<td>Inverter L-In</td>
<td>TB4-11</td>
<td>Bypass Input Line</td>
</tr>
<tr>
<td>Inverter N-In</td>
<td>TB4-12</td>
<td>Bypass Input Neutral</td>
</tr>
<tr>
<td>Inverter N-out</td>
<td>TB4-10</td>
<td>Output Neutral(L2)</td>
</tr>
<tr>
<td>Inverter L-out</td>
<td>TB4-9</td>
<td>Output Line</td>
</tr>
<tr>
<td>Inverter Safety Ground</td>
<td>TB4-8</td>
<td>Safety Ground</td>
</tr>
<tr>
<td>Load AC (L1)</td>
<td>TB4-6</td>
<td>AC Distribution Panel “AC Input Line”</td>
</tr>
<tr>
<td>Load Neutral (L2)</td>
<td>(L2)TB4-7</td>
<td>AC Distribution Panel”Return” (Neutral) (L2)</td>
</tr>
<tr>
<td>Load Safety Ground</td>
<td>TB4-5</td>
<td>AC Distribution Panel Safety Ground</td>
</tr>
</tbody>
</table>

**NOTE 1:** For Line to Neutral units equipment is preset at the factory for operation at 120 VAC. To configure for 220/230/240 VAC operation, remove the #16 AWG wire from TB2-1 and TB2-3. Refer to the schematic diagram (6421M-S) provided with this manual. See Appendices A-2.

For Line to Line units equipment is preset to 240VAC.

**NOTE 2:** The screw tightening torque for AC input and AC output terminal block (TB4) is 45-50 in. lb. (5.08 Nm - 5.65 Nm).

### Table 3-7: Control Connections.

<table>
<thead>
<tr>
<th>From (External to MBPS)</th>
<th>To (internal to MBPS)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote</td>
<td>TB3-1</td>
<td>N.O. contact</td>
</tr>
<tr>
<td>Alarm</td>
<td>TB3-2</td>
<td>Common</td>
</tr>
<tr>
<td>Circuit</td>
<td>TB3-3</td>
<td>N.C. contact</td>
</tr>
</tbody>
</table>

**NOTE:** Contact common- N.O. will be closed when S1 is switched to SBP or MBP position.
3.8 Front Panel Indicator Lamps

There are four indicator lamps on the front panel. Also see section 4.9 MBPS Maintenance, on page 4-8.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC INPUT</td>
<td>Green</td>
<td>ON when there is an AC voltage at the input terminals of the MBPS.</td>
</tr>
<tr>
<td>INV AC OUTPUT</td>
<td>Green</td>
<td>ON when the inverter is providing power to the load (inverter or bypass mode).</td>
</tr>
<tr>
<td>DC INPUT</td>
<td>Green</td>
<td>ON when DC Breaker is closed on the MBPS.</td>
</tr>
<tr>
<td>BYPASS</td>
<td>Red</td>
<td>ON when the AC utility is providing power to the load and the inverter is electrically isolated</td>
</tr>
</tbody>
</table>

Note that the “AC INPUT,” “INV AC OUTPUT,” and “DC INPUT” (grouped as “normal” on the front panel) will be on during normal operating conditions.

3.9 Procedure to Bypass the Inverter

1. Check that all normal indicator lamps are lit.
2. Turn the MBPS clockwise to the “SBP” position, then to the “MBP” position.
3. Check that DC breaker has tripped and bypass lamp is on.

NOTE: For your safety, the Maintenance Bypass Switch (MBPS) DC breaker remains tripped and cannot be turned on with the rotary bypass switch in the MBP position (See DC breaker trip reset jumper).

During this process, the form C contacts at TB3 change state. The common and NC terminals were closed prior to the operation and are opened after the operation. The common and N.O. terminals were open prior to, and are closed after the operation.

3.10 Procedure to Return to Normal (Inverter) Operation

1. Turn the maintenance bypass switch counter-clockwise to the “SBP” position, then turn to the “NORM” position.
2. Reset the DC breaker by toggling the handle from the “TRIP” position to the “OFF” position, then to the “ON” position.
3. Check that all normal indicator lamps are lit and the “BYPASS” lamp is off.
4. Verify that inverter modules turn on (green indicator). Verify that the inverter green indicator on the display panel is “ON”, Controller Status A or B.

During this process, the form C contacts at TB3 change state. The common and NO terminals were closed prior to the operation and are opened after the operation. The common and NC terminals were open prior to, and are closed after the operation.

3.11 DC Breaker Trip Reset Jumper

If your application requires DC power to the inverter during the maintenance, DC breaker trip feature may be disabled by removing the jumper on TB2-1&2 inside the MBPS.

When this jumper is removed, the DC breaker can be reset and turned on from tripped position with the rotary bypass switch in the MBP position during maintenance, while the load is supported by utility AC source.
3.12 Power Distribution

3.12.1 ACDP General Description

This section contains installation, operation, and maintenance information for the AC distribution panel (ACDP). This product is designed for use in the S4 Inverter Plant, which consists of the equipment rack, maintenance bypass switch, ACDP, and the inverter. The ACDP includes a 20/24-pole distribution panel board, used to distribute power to attached loads. It also includes lamps that indicate ‘AC POWER ON’ and ‘BREAKER TRIP’ conditions.

A schematic diagram of the ACDP is included in this manual (drawing number D6421P-S, See Appendices A-2.) Figure 3-4 shows the location of major internal components for 7 kVA, and Figure 3-5 shows the 14kVA and 21kVA location of major internal components.

3.12.2 ACDP Specifications

**Electrical:**

<table>
<thead>
<tr>
<th>Rating:</th>
<th>120/240VAC, 125 A, for 7 kVA units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20/240 VAC, 200 A, for 14 and 21 kVA units</td>
</tr>
<tr>
<td></td>
<td>65,000 A panel short circuit rating</td>
</tr>
</tbody>
</table>

| Wires: | Line, Neutral (L2) & Safety Ground |

| AC Output: | 120/240VAC, 125 A, for 7 kVA units |
|           | 120/240 VAC, 200 A, for 14 and 21 kVA units |

| Breaker Options: | 15-50 A, single pole, type QO 10,000 AIC. |
|                 | 15-50 A, two pole, type QO 10,000 AIC. |
|                 | 15-30 A, single pole, type QOXXXVH 22,000 AIC. |
|                 | 15-50 A, two pole, type QOXXXVH 22,000 AIC. |

All recommended square D circuit breakers are equipped with alarm switch.

| Wires: | Line, Neutral (L2) & Safety Ground |

**Mechanical:**

| Dimensions (in/cm): | For 7 kVA units; 19.25” (48.9 cm) H x 7.5” (19.05 cm) D x 17” (43.18 cm) W |
|                    | For 14 and 21 kVA units; 21.82” (55.4 cm) H x 7.5” (19.05 cm) D x 17” (43.18 cm) W |

| Mounting: | Shipped with mounting brackets for 19” (48.20 cm) 23” (58.42 cm) mounting. 25” (63.5 cm) mounting brackets available as an option |

| Weight (lb/Kg): | 42 lbs.(19 Kg) |
Figure 3-4: 7kVA ACDP Major internal Components and Mechanical Layout.

FOR 3/4" AND 1/2" CONDUITS (TYP)
FOR 1/2" CONDUITS (TYP)
FOR 3/4", 1", 1-1/2" CONDUITS (TYP)

TOP VIEW
WITH PUNCHOUT HOLES

CIRCUIT BREAKER
AC ON LAMP
BREAKER TRIP LAMP

FRONT VIEW
SHOWN WITHOUT COVER

GND
CHASSIS GND
TB2
TB3

TB1
K1

REAR VIEW
WITH PUNCHOUT HOLES

RIGHT SIDE
WITH PUNCHOUT HOLES
Figure 3-5: 14 and 21 kVA ACDP Major Internal Components and Mechanical Layout.
3.13 Input Connections

If purchased as part of a complete S4 Inverter Plant, the interconnect wiring to the input terminals of the panel is prewired at the factory.

For Line to Neutral units the panel is preset at the factory for 120 VAC operation. To configure for 220/230/240 VAC Line to Neutral operation, follow these steps:

**CAUTION:** The 220/240VAC Line to Neutral configuration is for European application only. Two pole breakers are used, one pole for line and one pole for neutral.

- Remove 2 AWG jumper connected between L1 and L2
- Move the neutral wire to L2
- Remove jumpers J1, and J2 from TB2
- Remove wire labeled number 4 (14 AWG) from neutral and connect it to TB1-3 (Top)

See Figure 1-6 and Appendices for schematic of the electrical connections, and the location of the terminal block. Table 3-9 provides details of input and output power connections.

3.14 Load Connections

The panel board mounted in the ACDP accepts type QOXXXX-2100 (10,000 AIC, 15A through 50A, one and two pole), and type QOXXXVH-2100 (22,000 AIC, 15A through 30A single pole and 15A through 50A two pole). These breakers should be ordered separately. Up to 10/12 one pole circuit breakers with alarm switch can be installed in ACDP for 110-120V application. Circuit breakers with an alarm switch require two pole spaces. Panels maximum current rating is 200A for the 14 and 21 kVA and 125A for the 7 kVA unit.

The load side wiring of the branch breakers on the panel board must be connected to the intended load(s) through the knockout area shown in Figure 3-4 and 3-5.

Table 3-9 provides details of all input and output power connections.

3.15 Trip Alarm Switch Wiring

Branch breakers with a bell alarm switch option will have two control wires extending from the frame of the breaker. Trip alarm switch wiring requires connecting the two wires of the trip alarm switch to TB1, terminals 1 and 2. See Figure A-2 schematic, and the location of the terminal block in Appendices.

Table 3-9 provides details of all control connections.

3.16 Trip Indicating Form “C” Contacts

To monitor the breaker trip indicating signal, three wires from TB3 must be routed to the external device(s) which will monitor the status of the breaker. The knock out area shown in Figure 3-5 can be used for routing the cables.

Table 3-9 and 3-10 provides details of all power and control wiring.
Table 3-9: Power Wiring.

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB4-6 MBPS</td>
<td>ACDP AC Input line, L1</td>
</tr>
<tr>
<td>TB4-7 MBPS</td>
<td>ACDP AC Input Neutral (N), for 120V/240V L-N units or (L2) for 208V/240V L-L units</td>
</tr>
<tr>
<td>TB4-5 MBPS (Ground)</td>
<td>Distribution Panel Safety Ground</td>
</tr>
</tbody>
</table>

Output connections:

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch CB L1</td>
<td>Load L1</td>
</tr>
<tr>
<td>Branch CB (N) L2</td>
<td>Load N for (220-240V) L-N units or (L2) for L-L units</td>
</tr>
<tr>
<td>Neutral Bus</td>
<td>Neutral for L-N units (120V)</td>
</tr>
<tr>
<td>Ground Bus</td>
<td>Safety Ground</td>
</tr>
</tbody>
</table>

Table 3-10: Control Wiring.

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch CB Trip Switch</td>
<td>TB1-1</td>
<td>Connected internal to Panel</td>
</tr>
<tr>
<td>Branch CB Trip Switch</td>
<td>TB1-2</td>
<td>Connected internal to Panel</td>
</tr>
<tr>
<td>TB3-1 (N.O.)</td>
<td>Remote CB Trip indication</td>
<td></td>
</tr>
<tr>
<td>TB3-3 (N.C.)</td>
<td>Remote CB Trip indication</td>
<td></td>
</tr>
<tr>
<td>TB3-2 Common</td>
<td>Remote CB Trip indication</td>
<td></td>
</tr>
</tbody>
</table>

3.17 Normal Operation

Under normal operating conditions, AC power from the output of the inverter or maintenance bypass switch is supplied to the input terminals of the ACDP.

Input power is internally distributed to the branch breakers which are mounted on the panel board.

The load is fed from the load side of individual distribution breaker.

System status: the panel has two indicator lamps on the front: AC ON, and Breaker Trip.

3.17.1 AC ON (Green)

The lamp labeled “AC ON” indicates the presence of AC input power on the input terminals of the panel.

3.17.2 Breaker trip (Red)

The specified branch breakers are equipped with bell alarm switches which change states when the corresponding breaker trips. These bell alarm switches are used to indicate the status of the breaker(s). If one of these breakers trips, relay K1 will energize and the ‘form C’ contact of K1 wired to terminal TB3 will change states. The red Breaker Trip lamp will be on.

The red Breaker Trip lamp indicates an abnormal condition. In case of the breaker trip lamp comes on, the cause of the breaker tripping should be determined. Output loading should be checked to make sure that the sum of all loads is within the power rating of the panel, and that individual loads do not exceed corresponding branch breaker rating.

After making sure that all conditions are normal, the tripped breaker can be reset and return to service.
4.0 Scope

This section describes the maintenance of the S4 Inverter Plant, including descriptions of replacement kits, safety instructions and service, preventive maintenance, routines with a troubleshooting guide.

4.1 Safety Instructions for Servicing

IMPORTANT SAFETY INSTRUCTIONS FOR INVERTER SERVICING SHOULD BE PERFORMED OR SUPERVISED BY QUALIFIED PERSONNEL ONLY.

**WARNING:** Opening enclosures expose hazardous voltages. Always refer service to qualified personnel only.

**ATTENTION:** L’ouverture des cabinets expose des tensions dangereuses. Assurez-vous toujours que le service ne soit fait que par des personnes qualifiées.

**WARNUNG!** Das öffnen der Gehäuse legen gefährliche Spannungen bloss. Service sollte immer nur von qualifizierten Personal durchgeführt werden.

**CAUTION:** DC input power to the inverter is normally from a bank of batteries with potentially high short circuit current capability. Accidental welding and severe burns are highly possible if mistake occurs during connecting or disconnecting these conductors.
4.2 Preventative Maintenance

The following preventive maintenance routines should be considered as a minimum requirement. Your installation and site may require additional preventive maintenance to assure optimal performance from your installed inverter and associated equipment. These routines should be performed twice a year (more often if required). We strongly recommend a contract with MGE Customer Support Field Services for preventive and remedial maintenance.

The technician or electrician performing preventive maintenance on the equipment must read and understand thoroughly this manual and be familiar with the indicators, controls, and operation of the equipment.

a. Isolate and de-energize the equipment for all maintenance operations.

b. Ensure that the equipment is clean and free of loose dust, dirt, and debris. The exterior of the enclosures can be cleaned with a mild solution of soap and water, lightly applied with a lint-free cloth.

c. Inspect the air intake and exhaust areas in the inverter module. Verify that air flows freely through the equipment. Clean the air intake and exhaust areas, and the enclosure interior, with a vacuum cleaner as required.

d. Initiate the start-up procedure.

e. Test the main operating sequences as applicable to your equipment configuration and installation.

4.3 Equipment Adjustment and Calibration

The equipment is factory adjusted and, normally, no further adjustments and calibration are required. However, in the course of repair, components may have to be changed that will require configuration of the equipment. These configurations should only be made by a qualified technician.
4.4 **AC Fan Replacement**

Every five years, replace the Static Switchs’ front panel, including fans (MGE part number 64004-0SSK1). This is accomplished by removing all the DC and AC power to the unit by turning the Maintenance Bypass Switch to the MBP position.

Perform the following steps:

1. Remove the front panel from the Static Switch panel (with two fans), using a #2 Phillips screw driver take out the four screws securing the panel to the receiver rack.

2. Unplug the two fan wires at the Static Switch printed circuit board.

3. Install the fan assembly onto the Static Switch, making sure to plug fans back into the Static Switch printed circuit board connectors.

4. Secure the front panel in place by using the four Phillips head screws previously removed.

5. Power up the system by switching the Maintenance Bypass Switch to SBP and to Normal.

6. Close DC Breaker and verify that the inverter is in normal mode - display panel inverter indicator should be green.

7. Verify that the Inverter output indicator on the Maintenance Bypass Switch display is “ON”.

4.5 **DC Fan Replacement**

Every five years, replace the DC fan in each power modules (MGE fan part number 64004-0FSK1). This is accomplished by removing the power module from the receiver.

Perform the following steps:

1. Remove the front panel from the power module by removing the six Phillips head screws securing the front panel to the chassis, the two screws securing the top cover to the front panel (6-32” Phillips head screws), and the two screws hold the DC circuit breaker to the front panel. It should not be necessary to remove the top cover.

2. Remove the front panel, being careful to unplug the fan from the printed circuit board.

3. Observe the orientation of the fan wires and the fan guard so that it will appear like all other power module front panels. Remove the fan from the front panel by removing the four screws holding the fan, panel, and fan guard together.

4. Install the new fan in the reverse order of disassembly. When installing the front panel onto the chassis, care must be taken to ensure the three LED’s project through the front panel. Install all ten flat head screws.

5. Make sure the circuit breaker on the front panel is in its OFF position.

6. Install the inverter module back into the receiver rack.
### 4.6 Replacement Parts

The MGE S4 Inverter Plant offers a complete spare parts kit for each model number. Spare parts kits include the power modules. Parts (those included in the spare parts kit) can be ordered individually or as a complete parts kit. To order on individual part, give the full description along with the complete model number and serial number of the inverter.

Table 4-1: Spare Parts and Kits.

<table>
<thead>
<tr>
<th>Mge Parts #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>64004-L1SK1</td>
<td>Level 1 Spares Kit</td>
</tr>
<tr>
<td></td>
<td>64004-0FSK1, 64004-0SSK1</td>
</tr>
<tr>
<td></td>
<td>6 x 038-003002-0000-15A Fuse for PCB-72-153594-OX</td>
</tr>
<tr>
<td>64004-L2SK1</td>
<td>Level 2 Spares Kit</td>
</tr>
<tr>
<td></td>
<td>Level 1 + 64004-9MSK1</td>
</tr>
<tr>
<td>64004-L3SK1</td>
<td>Level 3 Spares Kit</td>
</tr>
<tr>
<td></td>
<td>Level 2 + Static Switch PCB-72-153595-00 + 64004-03SK1</td>
</tr>
<tr>
<td>64004-L3SK2</td>
<td>Level 3 Spares Kit for Line to Line units</td>
</tr>
<tr>
<td></td>
<td>Level 2 + L-L static switch PCB-72-153842-00 + 64004-03SK1</td>
</tr>
<tr>
<td>64004-03SK1</td>
<td>LCD Display</td>
</tr>
<tr>
<td>64004-0SSK1</td>
<td>Static Switch Fan Assembly</td>
</tr>
<tr>
<td>64004-0FSK1</td>
<td>Inverter Module Fan</td>
</tr>
<tr>
<td>64004-01SK1</td>
<td>System Controller</td>
</tr>
<tr>
<td>6421M-9</td>
<td>Maintenance Bypass Switch</td>
</tr>
<tr>
<td>64004-9MSK1</td>
<td>Inverter Module</td>
</tr>
<tr>
<td>16289-MBSK2</td>
<td>Spare Lamp Kit</td>
</tr>
</tbody>
</table>
Troubleshooting the static inverter should be done only by qualified electronic technicians. Connecting and disconnecting the input and output power conductors in the course of troubleshooting should be done in accordance with the installation instructions in Section 2 of this document. External circuit breakers are essential for the protection of the source and for safely connecting and disconnecting the input power connectors. The internal DC circuit breakers in the system are for protection of the systems internal circuits only. External circuit breakers between the AC or DC source and the system are essential for the protection of the source and for safely connecting and disconnecting the input power connectors.

Le dépannage de l'inverseur statique devrait être fait seulement par les techniciens électroniques qualifiés. Relier et débrancher les conducteurs de puissance d'entrée et de sortie au cours du dépannage devraient être faits selon les instructions d'installation dans la section 2 de ce document. Les disjoncteurs externes sont essentiels pour la protection de la source et pour sans risque se relier et débrancher et les connecteurs de puissance d'entrée. Les disjoncteurs internes de C.C dans le système sont pour la protection des circuits internes de systèmes seulement. Les disjoncteurs externes entre la source à C.A. ou de C.C et le système sont essentiels pour la protection de la source et pour sans risque brancher et débrancher les connecteurs de puissance d'entrée.


NOTE 1: DC input power is normally from a battery system with a very high short circuit capacity. Accidental welding and severe burns can be caused by errors while connecting or disconnecting these conductors.

NOTE 2: Many operation problems are due to incorrect installation or setup. Before turning the unit on, review the installation and setup instructions which are associated with your system configuration.
4.7 **Redundant Microprocessor (72-153588-00) Installation/Configuration**

Follow this procedure to replace or add a microprocessor board to the S4 Inverter Plant. Only one microprocessor can be configured at a time. To configure a microprocessor, install only that microprocessor board in the inverter receiver.

The redundant microprocessor board is factory calibrated and pre-configured. Please see the configuration on the label. If this is the desired configuration, skip steps 6 to 10.

Before installing the microprocessor, disconnect all power sources that feed the inverter.

If a Maintenance Bypass Switch is installed – transfer the unit to MBP position.

If no Maintenance Bypass switch is installed – Turn the inverter off (Attention: No power to the load in this case), open the DC and AC breakers that feed the inverter.

1. Using a Phillips screwdriver, remove the four screws securing the display panel to the inverter receiver.
2. Remove the two screws securing the bracket in front of the Microprocessor board.
3. Use this bracket to pull out the old microprocessor.
4. Install the new microprocessor. Mount the display panel.
5. Verify that the unit is in “Standby” mode and the inverter modules are OFF.
6. Apply AC only to the inverter. Attention: The inverter output is powered.
   (Unit with Maintenance Bypass – move switch to SBP) The display should be ON.
7. Connect a PC through a RS232 cable to the communication port on the display panel.
8. Run the “Configuration Setup” program on the PC.
9. On the configuration screen, select the correct configuration for your unit: KVA rating, inverter voltage, inverter frequency, utility, mode and auto restart. Click on “Save” to send the configuration to the Microprocessors’ memory. Disconnect the AC power. (Unit with Maintenance Bypass – move switch to MBP)
10. To configure a second Microprocessor, repeat steps 1, and 3 to 9.
11. Mount the bracket and the display panel.
12. Restart the unit; follow start up instruction in the unit Manual.

*Figure 4-1: Redundant Microprocessor Component Location.*
4.8 Troubleshooting Guide

Should you encounter a problem in the operation of the inverter and need MGE Systems to service your equipment, it is recommended to leave the unit in its current state. Record message (if any) and color signals on the LCD display and LED indicators on the display panel, then call MGE Customer Support Services at 1-800-523-0142 for assistance. Leaving the unit in its current state will facilitate the field engineers to troubleshoot and bring your equipment back on-line more easily. If you cannot wait, you may want to consider the following troubleshooting tips.

If the system fails to operate properly and the installation, setup, and operation have been checked, use the Troubleshooting Table 4-2 to determine the probable cause and obtain suggestions on how to proceed. This table relates to the steps in section 2.5.9, “Start-Up Sequence.”

It is not possible to anticipate all symptoms in such a guide, but those listed are the most likely.

Table 4-2: Troubleshooting Table.

<table>
<thead>
<tr>
<th>Step</th>
<th>Symptom</th>
<th>Possible cause</th>
<th>Recommended procedure</th>
</tr>
</thead>
</table>
| 3    | “DC INPUT” indicator on the MBPS unit is off, and inverter display is not on. | No DC input to the unit | - Check if DC feeder is closed.  
- Check for correct polarity. |
| 3    | “DC INPUT” indicator on the MBPS unit is off, but the inverter display is on. | Bad “DC INPUT” indicator. | Replace the lamp. |
| 3    | “DC INPUT” indicator on the MBPS unit is on, but the inverter display is off. | Open or bad MBPS DC breaker | Check if the MBPS DC breaker is closed. |
| 4    | MBPS "AC INPUT" indicator is off. | - No AC input to the unit.  
- Bad "AC INPUT" indicator. | - Check if AC feeder is closed.  
- Replace the lamp. |
| 4    | MBPS "AC INPUT" indicator is on and "INV AC OUTPUT" indicator is off | - MBPS switch is not in the NORMAL position  
- Bad "INV AC OUTPUT" indicator.  
- No AC from the inverters static Switch | - Check switch position.  
- Replace the lamp.  
- Check Input voltage and Load voltage on the inverter display.  
If AC input present but no load voltage present then the inverter static switch is bad. |
| 4    | AC Distribution Panel "AC ON" indicator is off. | Bad "AC ON" indicator. | Replace the lamp. |
| 4    | Inverter display panel "BYPASS" indicator is Red. | AC Input voltage or frequency is not within acceptable limits. | Check AC Input voltage and frequency on the inverter display. |
| 6    | The Status indicator on any inverter module is off. | - Inverter module "DC INPUT" breaker open.  
- Bad inverter module. | - Close breaker.  
- Replace the inverter module. |
| 6    | Inverter display panel "INVERTER" indicator is Red. | - Left switch on the inverter display panel is on "STANDBY". | - Switch to "Inverter On" |
Table 4-3: Inverter Troubleshooting.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display panel not illuminated</td>
<td>No power to system</td>
<td>Check AC and DC power sources.</td>
</tr>
<tr>
<td>No output voltage</td>
<td>SW1 not ON</td>
<td>Turn SW1 ON</td>
</tr>
<tr>
<td>System starts, then shuts down</td>
<td>Overload, or shorted output.</td>
<td>Remove some of the load and restart the inverter.</td>
</tr>
<tr>
<td>Power module LED turn red</td>
<td>Module faulted</td>
<td>Reset by recycling circuit breaker</td>
</tr>
<tr>
<td>Module temp indicator on</td>
<td>Module fan failure</td>
<td>Replace module or cooling fan</td>
</tr>
</tbody>
</table>

4.9 MBPS Maintenance

MBPS has four indicator lamps on the front panel. These lamps can be removed from the front panel without interrupting power to the load. MGE offers a spare indicator lamp kit for this purpose:

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spare Lamp</td>
<td>16289MBSK2</td>
</tr>
<tr>
<td>Indicator Kit</td>
<td></td>
</tr>
</tbody>
</table>

If a front panel indicator lamp fails to operate properly and the installation, setup and operation of the MBS have been rechecked, replace lamp with a new one per the following instructions:

**WARNING:** High voltage is present at the P1 plug. Install or remove P1 by holding the plug on the sides. Do not touch plug if wires are exposed.

1. Remove four screws from indicator lamp plate.
2. Lift indicator lamp plate from the front panel.
3. Carefully disconnect P1 connector from J1. Remove lamp assembly away from MBPS.
4. Remove lamp shield from assembly. Remove quick-disconnect terminals from lamp to be replaced. Remove failed lamp(s). Replace with new lamp(s). Make sure new lamp manufacturer part number is correct. See Figures 4-2 and 4-3.
5. Reinstall quick-disconnect terminals (flat side close to the lamp) and secure lamp shield.
6. Carefully reconnect P1 to J1 connector.
7. Reinstall indicator lamp assembly to the front panel.

If further assistance is required, call MGE Customer Support Service hotline at 1-800-523-0142.
Figure 4-2: Indicator Lamp Plate Removal.
**Figure 4-3: Failed Indicator Lamp Replacement.**

- **LAMP, GREEN NEON 250V**
  - IDI PART NUMBER: 1053Q95

- **LAMP, GREEN INCAND 28V**
  - IDI PART NUMBER: 1090Q95-28V

- **LAMP, RED NEON 250V**
  - IDI PART NUMBER: 1051Q91

- **SHIELD, LAMP**
- **PLATE, LAMP**
- **P1**
- **6-32 KEPS NUT**
5.0 Grounding Applications

This section is intended to address when it is permissible (or not permissible, or mandatory) to tie the output neutral conductor to earth ground in some applications. Please reference NEC guide and related sections regarding the bonding of neutral to Earth Ground.

Reference load grounding requirements.

a) 120VAC output units

In 120VAC operation, the Neutral is passed through (i.e. no switching) from the input AC pair to the output AC pair. Only the hot (i.e. line) side is switched.

**NOTE:** As long as the 120VAC line-neutral pair is connected to the AC input of the Inverter, neutral is provided to the output of the Inverter and the load.

**CAUTION:** In applications with AC input to the inverter, before connecting AC input, remove green bonding jumper wire that is connected between AC input neutral, L2(N) at the TB4-2 of the Maintenance Bypass Switch, and the chassis ground. Bonding jumper wire is used for applications without AC inputs (AC free environment).

**NOTE:** An AC free environment is a mode of operation with no AC input to the inverter, (i.e. no AC wires are connected to L2(N) or L1 terminals).
(This page left blank intentionally)
A. UNITS ARE PRESET AT FACTORY FOR 120 VAC OPERATION.
B. TO CONFIGURE FOR 220/230/240 VAC:
1. REMOVE 4 AWG JUMPER FROM L1 AND L2.
2. REMOVE JUMPERS J1 AND J2 FROM TB2.
3. REMOVE BLACK WIRE 14 AWG WIRE #4 FROM NEUTRAL AND CONNECT IT TO TB1-3 (TOP)

1. CONTACT RATING FOR K1: 3 AMP, 240 VAC
2. TRIP ALARM WIRING AT TB1 DONE BY CUSTOMER
3. CIRCUIT BREAKER: SQUARE D TYPE QO, 10000 OR 22000 AIC, 15 - 50 AMP
   A. SINGLE POLE WITH TRIP ALARM SWITCH, UP TO 10 POSITIONS-SUPPLIED BY CUSTOMER.
   B. DOUBLE POLE WITH TRIP ALARM SWITCH, UP TO 6 POSITIONS-SUPPLIED BY CUSTOMER.

NOTES: UNLESS OTHERWISE SPECIFIED.

ACDP D6421P-S
Line to Line Inverter Receiver Block Diagram
STATIC SWITCH SECTION

AC & DC CONNECTIONS
Line to Neutral Units
AC & DC CONNECTIONS
Line to Line Units
<table>
<thead>
<tr>
<th>Symbols</th>
<th>Definition/Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>@</td>
<td>At.</td>
</tr>
<tr>
<td>/</td>
<td>And/or.</td>
</tr>
<tr>
<td>+/-</td>
<td>Plus or Minus.</td>
</tr>
<tr>
<td>≤</td>
<td>Equal to or less than.</td>
</tr>
<tr>
<td>#</td>
<td>Number.</td>
</tr>
<tr>
<td>°C</td>
<td>Degree Celsius.</td>
</tr>
<tr>
<td>°F</td>
<td>Degree Fahrenheit.</td>
</tr>
<tr>
<td>Ø</td>
<td>Phase angle.</td>
</tr>
<tr>
<td>Ω</td>
<td>Ohm; unit of resistance.</td>
</tr>
<tr>
<td>®</td>
<td>Trade Mark.</td>
</tr>
<tr>
<td>2nd</td>
<td>Second.</td>
</tr>
</tbody>
</table>

**ABC**  | Normal sequence of phase (clockwise) in three-phase power. |
**AC or ac** | Alternating current, also implies root-mean-square (rms). |
**Ambient Temp.** | Temperature of surrounding air. |
**Ambient noise** | Acoustical noise of surrounding environment. |
**ANSI** | American National Standard Institute. |
**AWG** | American Wire Gauge. |

**Automatic bypass the AC-power source.** | Automatic switch controlled by the UPS, used to connect the equipment directly to the AC-power source. |
**Automatic start following return of AC input power** | When AC input power returns following shutdown at the end of the battery backup time, UPS automatic start can be enabled or disabled. |
**Backup time** | Time that the connected equipment can operate on battery power. |
**Bar graph percent load.** | Device on the front panel indicating the percent remaining backup time or the percent load. |
**Battery circuit breaker** | DC-power circuit breaker that protects the battery circuit. |
**Battery test** | Internal UPS test on battery status. |
**Breaker** | Electrical circuit interrupter. |
**BTU or Btu** | British thermal unit. Defined as the amount of heat required to raise the temperature of one pound of water by 1°F. |
BYPASS See “Static Transfer switch”.

Bypass Maintenance bypass; wrap-around manual maintenance bypass using the optional bypass circuit breaker Q3BP in conjunction with circuit breaker Q4S and isolation circuit breaker Q5N.

Bypass AC Input Mains 2.

BYPASS mode See “off-line mode”.

Carrier The company or individual responsible for delivering goods from one location to another.

C Common.

CB Circuit breaker.

cm Centimeter.

Comm. Communication.

Conduit A flexible or rigid tube enclosing electrical conductors.

Cold start See “Start on battery power”.

Connection module Unit grouping the receptacles for connection to the AC-power source and the equipment.


Current rating The maximum current that a conductor or equipment can carry reliably without damage.

dB Decibels.

DC Direct current.

dBA Decibel Adjusted.

dBrnC Decibel above reference noise.

DC or dc Direct current, or voltage.

Digital Meter The LCD display on the front panel of inverter system.

Double conversion The power supplied to the connected equipment is completely regenerated by continuous double conversion, i.e. the AC power from the AC-power source is rectified (AC - DC), then converted back (DC - AC) to AC power.

Earth ground A ground circuit that has contact with the earth.

Electrician Refers to an installation electrician qualified to install heavy-duty electrical components in accordance with local codes and regulations. Not necessarily qualified to maintain or repair electrical or electronic equipment.

FET Field effect transistor.

Freq. Frequency.

Frequency slew rate The change in frequency per unit of time. Given in term of Hz per second (Hz/sec.).
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>Ground (safety).</td>
</tr>
<tr>
<td>Hz</td>
<td>Hertz, frequency measurement unit, 1Hz is one cycle per second.</td>
</tr>
<tr>
<td>Inverter mode</td>
<td>See “on-line” mode.</td>
</tr>
<tr>
<td>I</td>
<td>Current.</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission.</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronic Engineers.</td>
</tr>
<tr>
<td>Input branch circuit</td>
<td>The input circuit from the building power panel to the equipment.</td>
</tr>
<tr>
<td>Inverter</td>
<td>An electrical circuit that generates an AC voltage source from a DC voltage source.</td>
</tr>
<tr>
<td>IGBT</td>
<td>Insulated gate bipolar transistors</td>
</tr>
<tr>
<td>kVA</td>
<td>KiloVolt-Ampere; is equal to 1000 Volt-Ampere.</td>
</tr>
<tr>
<td>kVAR</td>
<td>KiloVolt-Amperes reactive.</td>
</tr>
<tr>
<td>kW</td>
<td>KiloWatt; a measure of real power, equal to 1000 watts.</td>
</tr>
<tr>
<td>L</td>
<td>Line.</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid-Crystal Display unit.</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode.</td>
</tr>
<tr>
<td>Load</td>
<td>Connected to the UPS output, such as computer systems or critical devices.</td>
</tr>
<tr>
<td>Low battery shutdown</td>
<td>The battery has reached the lowest permitted operating voltage, and the inverter has shutdown (disconnecting the load) to protect the battery from damage due to further discharge.</td>
</tr>
<tr>
<td>Mains or Mains 1</td>
<td>Main AC input source.</td>
</tr>
<tr>
<td>Mains 2</td>
<td>Bypass AC input source.</td>
</tr>
<tr>
<td>mA</td>
<td>Milliampere.</td>
</tr>
<tr>
<td>MAX.</td>
<td>Maximum.</td>
</tr>
<tr>
<td>MCM</td>
<td>Thousand circular mil; standard wire sizes for multiple stranded conductors over 4/0 AWG in diameter. M is from Roman numerical system indicating 1000.</td>
</tr>
<tr>
<td>M-M</td>
<td>Multi-Module.</td>
</tr>
<tr>
<td>Module</td>
<td>Refers to individual power inverter module.</td>
</tr>
<tr>
<td>N</td>
<td>Neutral.</td>
</tr>
<tr>
<td>NC</td>
<td>Normally close.</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code.</td>
</tr>
</tbody>
</table>
NO. or No.  Part number.
NO  Normally open.

Online mode  Inverter output power is the primary energy source to load.
Offline mode  Inverter output is off, and the load connected at the inverter output receives power from utility line via a static transfer switch or maintenance bypass relay.

OSHA  Occupational Safety and Health Agency.
PCA  Printed circuit assembly.
PCB  Printed circuit board.
P.F.  Power Factor.

PWM  Pulse Width Modulation.

Rectifier/Charger  Converts the AC input voltage from the utility source into DC voltage, supplying the inverter and regulating the charge of the battery system.

SCR  Silicon controlled rectifier.

Shipping damage  Any damage done to an article while it is in transit.
SPDT  Single Pole Double Throw.
SSC  Static Switch Cabinet (in shared systems).

Static Transfer Switch  A solid state switching mechanism electronically controlled to pass AC power directly from the utility to an output load.

Sync or synch  Synchronization.

Technician  Refers to an electronic technician qualified to maintain and repair electronic equipment. Not necessarily qualified to install electrical wiring.

Test connector  DB-9 type connector on the LCD panel allowing MGE UPS SYSTEMS Customer Support Service technician to access programmable and diagnostic features of the system.

Test/Maintenance Mode  Maintenance bypass circuit breaker is closed and system output circuit breaker is open.

UPS  Uninterruptible power system.
V  Volts.
VA  Volt amperes.

VA  Volt-amps, unit for apparent power measurement, equal V x I.
VAC or Vac  Voltage of AC type.
VDC or Vdc  Voltage of DC type.
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