Installation, Operations & Maintenance Manual

Invertronic 480 VAC

3P/0-80kVA Inverter System

028-0009-900 Rev. F

Benning Power Electronics

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This manual contains important safety instructions that should be followed during installation and maintenance of the Power System.

TABLE OF CONTENTS

Revision	Date	Originator	Approver
A	03.01.08	C. Tumey	D. Almond
B	01.27.09	C. Tumey	E. McDonald
C	02.24.09	C. Tumey	E. McDonald
D	07.01.09	C. Tumey	E. McDonald
E	11.01.09	C. Andrews/C. Tumey	C. Tumey
F	10.24.11	A. Waggott/ D. Anderson	D. Almond

Publication Document: Version 1.0

PASSWORD

PW Level 1: 001

PW Level 2: 002

The above passwords may be used with discretion on the Invertronic Operator Panel. Only trained service technicians should access internal settings with these passwords.

PREFACE

Congratulations and thank you for purchasing a Benning Invertronic 3Phase/120kVA Inverter System.

We at Benning are committed to supporting the needs of our customers by supplying the customer with the proper information and documentation needed to properly install and operate the unit purchased.

Important:

It is imperative that all the information be observed.

This avoids:

- ✓ Danger during installation and operation.
- ✓ Danger to operating personnel.
- ✓ Downtime.
- ✓ Increases the reliability and lifespan of the system.

This manual explains all the necessary information to unpack, install, and operate the Benning Invertronic 3P/0-120kVA Inverter System and related components. Refer questions outside the scope of this manual to our Customer Service Department.

Customer Service:

We are committed to excellence in dependability and customer satisfaction. If you have any questions or problems, please contact the Customer Service Department at: **1.800.910.3601 or 214.553.1444** for more information.

Please read all instructions before installing or operating the equipment and save these manuals for future reference.

1 INTRODUCTION

BENNING specialises in the development and production of inverter systems (INV systems). The criteria and methods applied by BENNING for development and production comply with the strictest quality standards. BENNING has been certified for all areas in accordance with the international quality standard ISO9001/EN29001.This manual provides information on INVERTRONIC modular inverter systems, their principle of operation and what has to be done in the event of operational faults. This manual also contains information relating to the transportation, storage, handling and installation of inverter systems. The planning guidelines in this manual relate only to the special requirements of inverter systems. It is essential that the national and local regulations for electrical installations be followed when installing the equipment.

The content of this equipment description may change due to advancing technology. We have endeavoured to make the content correct and clear. If errors should have occurred however, we would be grateful for information to that effect.

The inverter system is designed to protect sensitive electrical equipment against interference, which can occur due to poor AC supply quality, or even loss of supply. Sensitive systems require comprehensive protection against electrical faults. These can be external faults (e.g. thunderstorms, brownouts, or operational faults) or interference from adjacent equipment (e.g. motors, welding systems etc.). Mains faults can be summarised as follows:

- Fast and slow mains voltage peaks and variations
- Mains failure
- Fast and slow frequency peaks and variations
- Signals or transients superimposed on the supply

The inverter system isolates the loads from the mains voltage and ensures a high quality sinusoidal waveform and constant output voltage. Mains interference is therefore kept away from operationally critical equipment, and software and hardware cannot be damaged.

CAUTION!

THE INVERTER MUST ONLY BE INSTALLED AND OPERATED BY QUALIFIED PERSONNEL.

2 SYMBOLS USED IN THIS MANUAL

In this manual, the words converter and inverter are understood to have the same meaning.

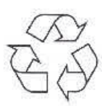
The following symbols are used in this manual:

Denotes instructions, which if not observed could present a risk to health, functional capability or safety.

Warning when handling batteries.

Warning against dangerous electrical voltage.

Denotes additional information and instructions.



Recycling mark

Identification of assemblies, which are subject to electronic scrapping regulations.

Identification of assemblies or parts, which must be disposed of in a specific manner. Never dispose of these components in the household waste.

Figure 1: Symbols

3 CABINET INSTALLATION

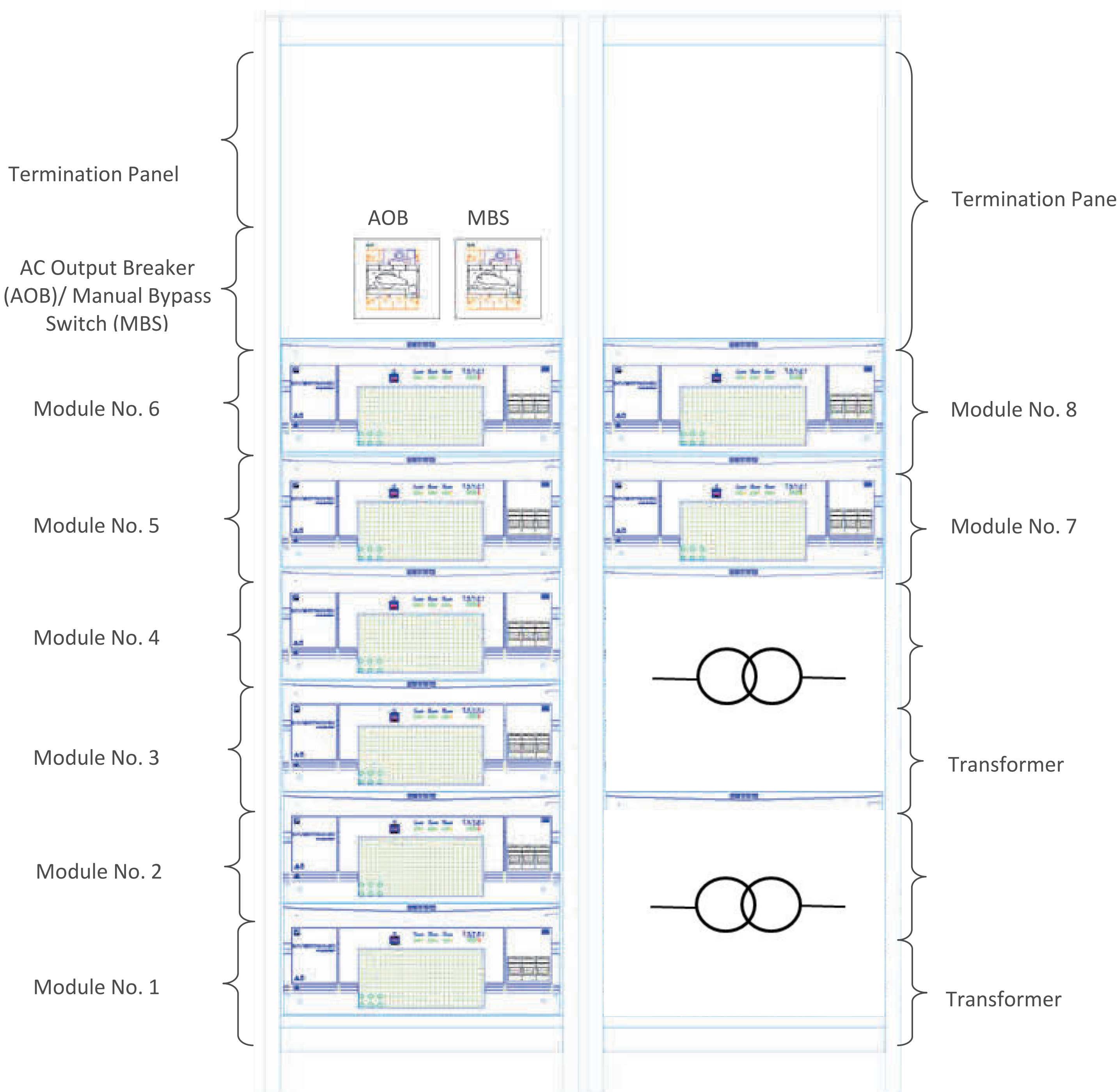
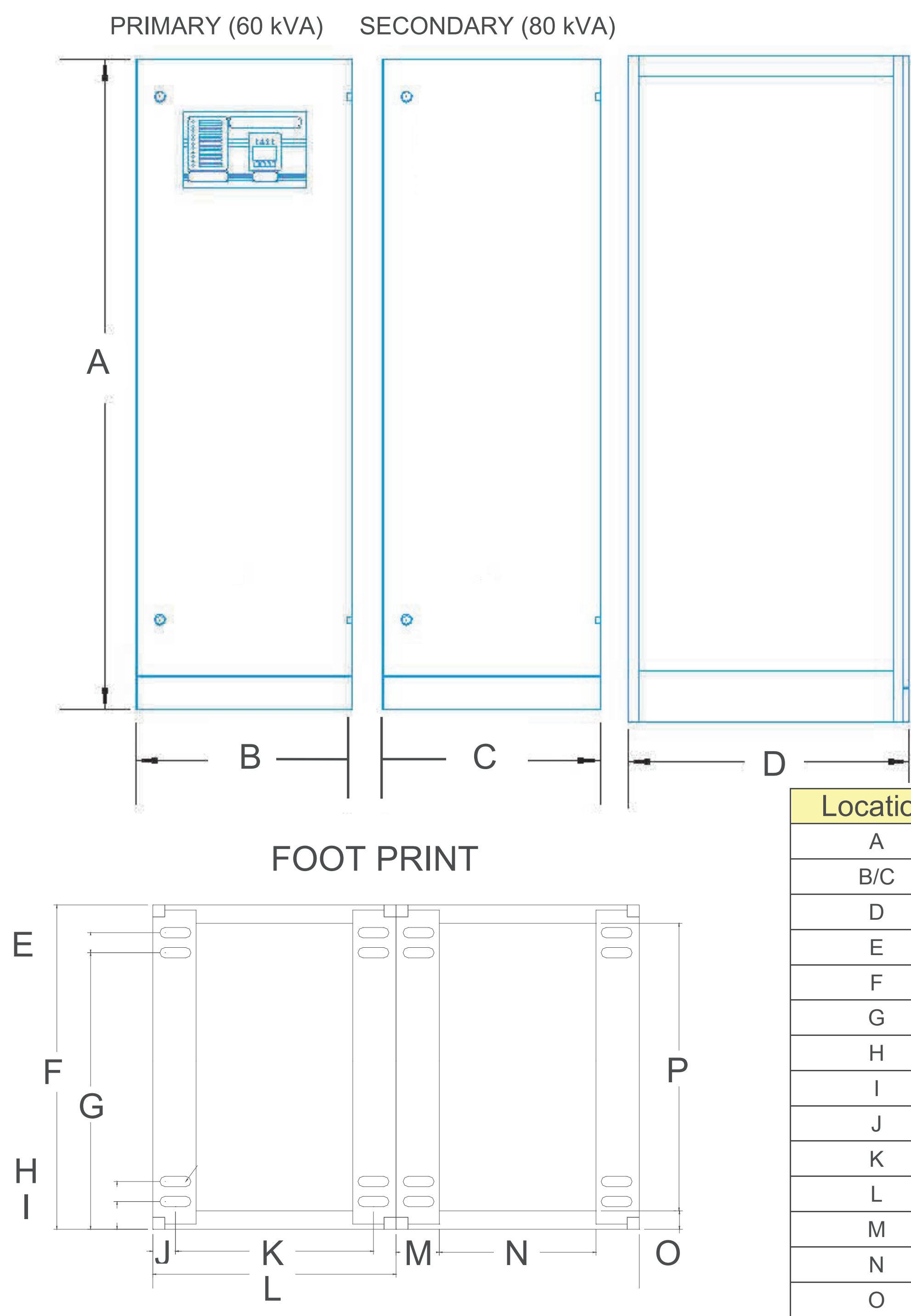


Figure 2: INVERTRONIC MODULAR layout

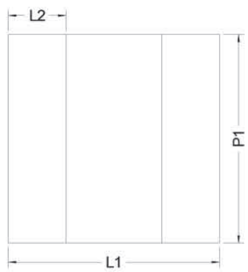
3.1 DIMENSIONS OF THE INVERTER SYSTEM



Location	Dimension
A	84in (2133mm)
B/C	23.6in (600mm)
D	31.5in (800mm)
E	1.94in (49mm)
F	31.42in (798mm)
G	26.79in (680mm)
H	1.94in (49mm)
I	2.69in (68mm)
J	2.19in (56mm)
K	19.17in (487mm)
L	23.54in (598mm)
M	4.19in (106mm)
N	15.17in (385mm)
O	1.78in (45mm)
P	27.85in (707mm)

Fig. 3: Dimensions (Primary and Secondary Cabinets)

3.2 WEIGHT



Cabinet type	**PSJ / 7feet**
L1	23.6in (600mm)
P1	31.5in (800mm)
L2	2.0in (50mm)
Weight without modules	528lb (240kg)
Weight per module	99lb (45kg)

Figure 4: Floor Area

3.3 RECOMMENDED INSTALLATION, MINIMUM CLEARANCES:

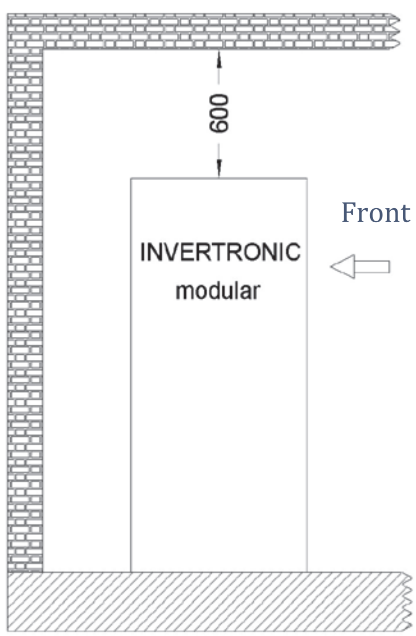


Figure 5: Inverter Cabinet – recommended installation

Note: No clearance is required behind cabinets. A 2" (50mm) clearance is recommended on left hand side to allow full door opening for module access.

4 INVERTRONIC MODULAR SYSTEM DESCRIPTION

4.1 SYSTEM OVERVIEW

Summary of General Inverter Data

System Maximum Capacity: 80kVA in two cabinets, Primary & Secondary

Module Output Power: 10 kVA / 8kW Three Phase, cos φ = 0.8 inductive

Salient Features:

True three-phase inverter using IGBT technology
Static Bypass Switch (SBS) built into each module
Manual Bypass Switch (MBS) in the primary Cabinet
Configurable voltage-free contact outputs in primary cabinet
RS 232 service interface in primary cabinet
Ethernet LAN interface for remote monitoring in Primary Cabinet

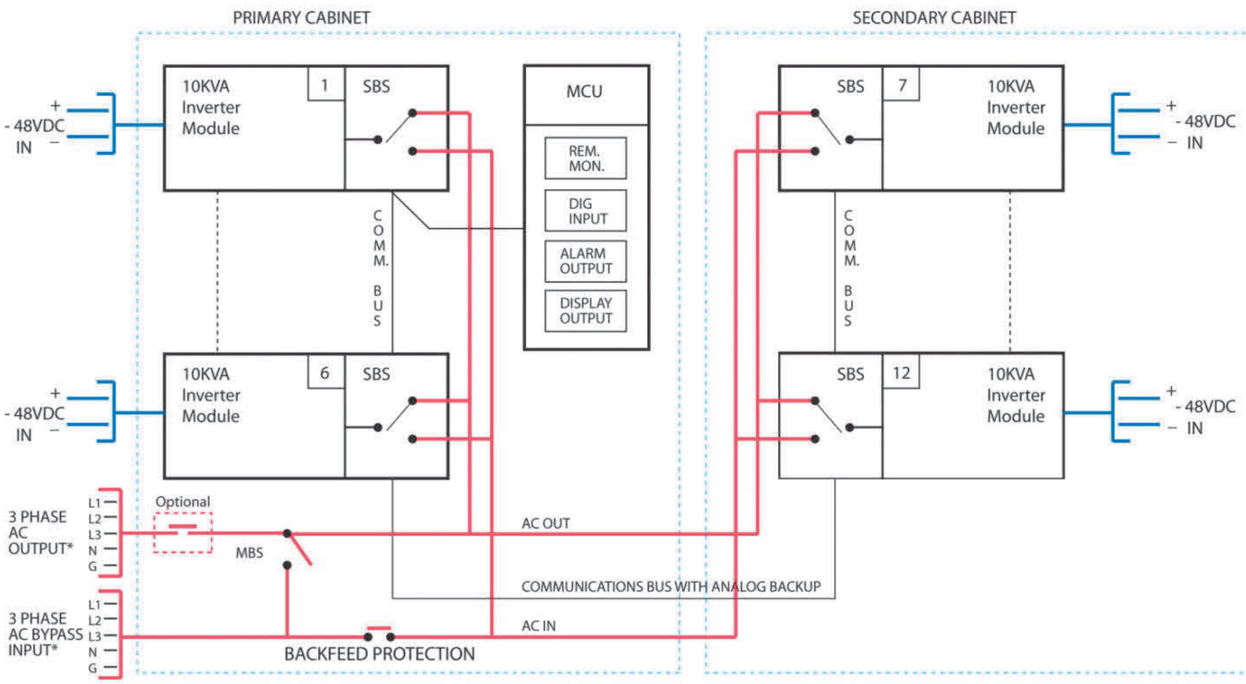
Hot swap 10kVA modules each with built-in SBS for scalability (80kVA systems in single cabinet; transformers in a second cabinet)

Static Bypass Switch (SBS)- 208VAC, 3 Phase SCR bridge built into each module

Input Voltage: - 48 VDC
Output Voltage: 480 VAC L-L, 120 VAC-L-N, 3-phase, 4-wire Y 60Hz
Bypass Input Voltage: 480 VAC 3PH (60Hz)

The system topology is shown in the diagram below. Two 4 wire AC buses exist in the system - the Inverter Module Outputs are connected together on the Inverter Output Bus and the AC Input (AC Mains back-up) Bus is distributed to the SBS‘s in each module.

TRUE THREE PHASE INVERTER SYSTEM BLOCK DIAGRAM & TOPOLOGY



NOTES:
1. * = Y CONNECTED
2. SBS = STATIC BYPASS SWITCH
3. MBS = MANUAL BYPASS SWITCH
4. MCU = MONITOR & COMMUNICATION UNIT
5. NOT ALL GROUNDS SHOWN
6. ALL ACTIVE ELECTRONICS ARE PLUG IN / CONNECTORIZED

Figure 6 Invertronic Modular Inverter System Block Diagram

The *INVERTRONIC MODULAR* static inverter system is a very high power density, high reliability AC power supply for powering critical applications in the telecommunication and industrial control fields.

Each module is a complete three phase inverter with built-in SBS. With this unique topology, the system is truly modular and scalable. The installed capacity can be expanded in 10kVA steps by plugging additional inverter modules into the pre-installed module carriers in the cabinets. An initial configuration can be as small as 20kVA plus redundancy in the primary cabinet. Normally the cabinet will be equipped with all necessary hardware for a full 120kVA system so only the modules need be added in the field. System states can be set up and monitored via the Operating Panel which consists of LED indicators and a LCD graphical display located on the front door of the cabinet. Measured values can be displayed for the mains supply, the load circuit, and the individual system components.

Via a manual bypass switch (MBS), the inverter system can be maintained, expanded and repaired without interrupting the supply to the connected loads.

The inverter system is controlled and monitored by digital signal processors (DSP), which are programmed with appropriate algorithms.

Individual components communicate with one another by means of a CAN-BUS system (Controller Area Network), which guarantees a high level of immunity against interference. For critical functions such as coordination of SBS operation, there is also redundant back-up analog control.

Many protective features have been designed into the system to make it very robust in the presence of abnormal conditions as follows:

-Inverter modules are protected against destructive overload, overtemperature and short circuit conditions

-The SBS in each module is protected against overtemperature and destructive steady state overcurrent conditions. The I^2t value of the SCRs in the SBS is higher than the I^2t value of the mains fuses. In case of a short circuit downstream exceeding the I^2t values of the fuses, the mains fuses will blow. They are front accessible and can be changed easily.

The system provides the following facilities for alarms and indications:

-Voltage-free relay contact outputs for bypass operation and common alarm

- Each module has the capacity to accommodate up to 64 faults and 64 states

-The system MCU can handle RELIO-cards with programmable relays via service software. Standard definitions of the 10 relays on the Relio card are:

  - Relay 1: Minor alarm
  - Relay 2: Major alarm
  - Relay 3: AC Mains failure
  - Relay 4: Inverter failure

- Relay 5: Bypass Operation
- Relay 6: Common fault
- Relay 7: Minor alarm
- Relay 8: Major alarm
- Relay 9: Circuit breaker open (AC Output Breaker)
- Relay 10: Aux. (unused)

- The MCU provides a serial service port for system debugging and parameter setting via MCU service software
- The MCU also provides an Ethernet connection and HTML page
- An SNMP adapter for the system interfaces to the MCU.

Each system consists of the main components described below.

4.1.1 INVERTER MODULES

General - The DC voltage is converted into a three-phase alternating AC voltage with constant amplitude and stable frequency in the inverter module. A high efficiency is achieved, even in the partial load range, using pulse width modulation and IGBT power transistors. The failure of a component in the power stage does not lead to an interruption in the supply to the load. The inverter is disconnected from the busbar and the load is switched to the mains supply without interruption by means of the Static Bypass Switch. A fault is indicated at the same time.

Output - The waveform (sine wave) of the output voltage is controlled by means of software by a microcontroller (DSP = digital signal processor). This keeps the distortion factor low, particularly in the case of a non-linear load. The output is fed via filter circuits and protected by means of fuses. In the event of a short circuit, the system switches to the bypass supply, if this is available, in order to quickly remove the short circuit. Otherwise, the short-circuit-proof inverter modules will deliver a short-circuit current of >200% and will switch off and remain off after 200 milliseconds.

Neutral conductor - The neutral conductor of the inverter output is electrically isolated from the cabinet.

Frequency control - The inverter output frequency is controlled by a PLL, which, depending on the operating state of the system, guarantees synchronisation with an internal clock pulse, the mains supply or parallel inverters.

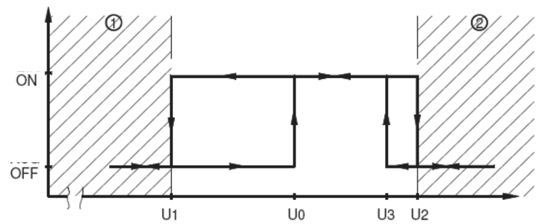
If the controlling frequency (bypass supply) deviates by more than the adjustable value of a minimum of ± 1% and a maximum of ± 5%, the system switches to the internal clock pulse and then ensures that the frequency remains constant ± 0.1%.

Inverter Module Specifications

	Output VA:	10000 VA at cos (φ) = 0.8 inductive, 8000W
	Load Power Factor:	0.7 inductive to 0.8 capacitive (with capacity reduction) operating range
1.	**Mechanical data**	
	W x D x H:	505 mm (20 in) x 450 mm (17.7in) x 222 mm (8.75in)
	Weight:	approximately 45 kg (99lb)
	Mounting:	Carrier for Benning PSJ cabinet
	Audible noise:	Fan noise only, load dependent, up to 65dBA at max. load and max. temp.; lower for lower load ratings
	Heat generation:	<5,000 BTUs /hour at full load per module
	Oper. Temp. Range:	0-40°C
2.	**DC Input**	
	Inrush current:	Soft start, inrush current less than 25% full load nominal input current
	Nominal Voltage :	48 V
	Minimum Voltage:	42 V
	Maximum Voltage:	60 V
	Current:	Approx. 228 A @ 42V at full load
		Approx. 274A @ 42V at 120% full load,
		Approx. 172A @ 54V at full load
		Internal Input fuse: approx.. 315 A FF

Low freq. reflected noise:	<2mV Psophometric
Topology:	full bridge DC / DC converter working on a DC link of + / - 200 V DC for the 208 V AC / 120 V AC model

The DC voltage applied to the inverter is monitored for **overvoltage** and **undervoltage**. The inverter supplies its output voltage within these limits.



The voltage settings U0 – U3 are programmable within the maximum limits via the operating & display panel.

3. AC Output

Waveform: Sinusoidal

Connection: 4 wires (Y) and GND

Inverter Output Voltage: Adjustable to 208VAC-LL / 120VAC-LN or 220VAC-LL / 127VAC-LN / 60Hz via display

Inverter Output current:

27.8 A nominal at cos (φ) = 0.8 inductive and 208 VAC-LL / 120 VAC-LN

26.3 A nominal at cos (φ) = 0.8 inductive and 220 VAC-LL / 127 VAC-LN

Regulation:

Static:	+ / - 1%
Dynamic:	+/- 5% for 100% step load change, <10ms settling time
Crest factor:	2.8 for nominal power (>3.0 possible with derated output power)
Efficiency :	>86 %

Distortion:	< 2% at linear load (resistive, inductive, capacitive)
Phase imbalance:	up to 100%
Overload:	125% for 10 minutes 200% for 4 seconds
Frequency:	60Hz +/-0.01% when crystal controlled 60Hz +/- Df when mains controlled The value for the maximum change in frequency, Df, for synchronization is programmable by means of the display (+/-1%, +/-2%, +/-3%, +/-4%, +/-5%). For mains frequencies outside the programmed range the inverters must synchronize to their own crystal.

4. Static Bypass Switch

Topology:	3 phase AC SCR Bridge
Priority:	Inverter priority, Mains priority **not** possible
Voltage tolerance:	+ / - 10% or + / - 15%, programmable via display
Frequency tolerance:	+/- Df, programmable in range + / -1% to + / - 5%
Overload:	1000% for half wave (8 ms.) on SBS bypass
Transfer time:	2 ms. typical 6 ms. max

System operated with inverter priority, bypass mains as backup source. The system cannot be set up to operate with bypass mains as priority

Conditions for switching from inverter to bypass:

- Switching to Bypass requested by user
- Inverter overloads exceeding the maximum specified value

- Overtemperature in the modules causes shutdown and overload
- Short circuit on the load. With the detection of an undervoltage and overcurrent on the load, the system switches to bypass. The high bypass overload capacity (1000% for 8 ms.) helps to clear the load fuse. If bypass is not available, the system stays on inverter and delivers 2 times nominal current for four seconds before switching off.
- Inverter output voltage out of range
- Rectifier mains not available and battery critical low

4.1.2 STATIC BYPASS SWITCHES (SBS)

The SBS's in each module automatically switch the loads between inverter output and ac mains input, depending on system conditions. An SBS consists of a static microprocessor-controlled (DSP) anti parallel semiconductor switch (thyristor). If the inverter output voltage deviates from the set values by an appropriate amount, e.g., due to an inverter fault, the connected load is switched automatically and without interruption to the bypass supply. The bypass has an overload capability of 150% for 10 min and 500% for 100 ms. The SBS thyristors are protected by fuses which are accessible externally from the front of each module.

The load is switched back to inverter output when normal operation is resumed (e.g. after an overload or a short circuit).

SBS load transfer can also be initiated manually from the front door – mounted operating & display panel.

The changeover from inverter to mains and back again takes place absolutely without load interruption in synchronous mode.

4.1.3 MANUAL BYPASS SWITCH (MBS)

The Manual Bypass Switch is used to switch the ac supply to the loads directly from the mains supply during maintenance or repair of the inverter system. The manual bypass switch is incorporated in the primary cabinet. The MBS is rated for 200A for single cabinet systems with maximum 60kVA system output. It is rated 400A for systems in single or dual cabinets, expandable to 120kVA output.

4.1.4 OPERATOR INTERFACE

The INVERTRONIC MODULAR system is operated by means of an Operator Panel consisting of a graphical LCD Display and membrane keypad with 4 function keys which control the display, four associated general LEDs above the display, and a vertical 13 LED Indicator strip displaying the status of critical elements of the system. The Operator Panel is shown in Figure 7 below.

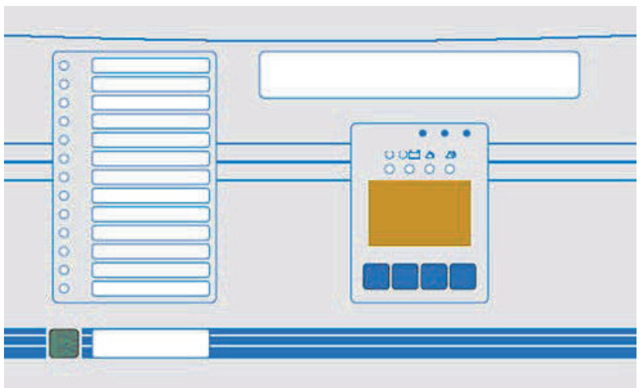


Figure 7: Operating Panel

In the default state, a mimic diagram in which the power flow is shown is displayed on the graphical LCD display. The LCD display is also used for reading of textual event and setting information, or, for clear guidance by means of the menu. Important menu items are protected by a password (default password: **001**).

Each menu item can be called with the four function keys under the display and settings can be made. However, some menu items are protected by a password. Return to the basic status takes place automatically from any menu item when no button has been actuated for about 1 minute.

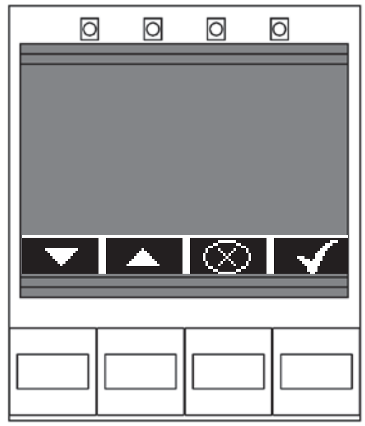
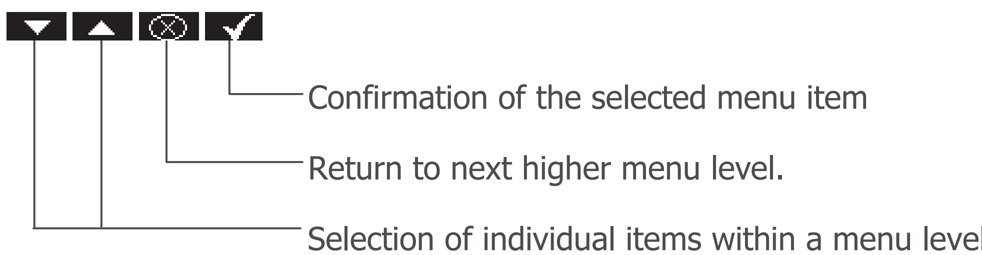
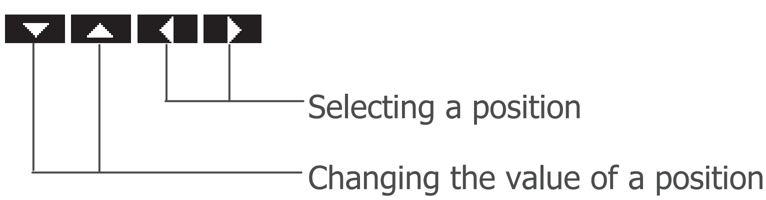


Figure 15: Display with function keys

Function Button Assignments for Selecting Individual Menu Items



Function Button Assignments for Entering the Password



The Operator Panel LCD display provides the following measurements:

Inverter: Output voltage, output current in each phase and frequency, apparent power, reactive power and active power

Bypass: Input phase voltages & currents, frequency of bypass supply

The event recorder in the MCU stores up to 250 events and tags them with date & time.

The 13 LEDs on the left-hand side indicate the following states as standard. The Green pushbutton, S1, is used for LED test and reset.

Ref.	Colour	Meaning
H1	green	Inverter operation (Load on Inverter Output)
H2	yellow	Bypass operation (Load on Bypass)
H3	yellow	Not used
H4	red	On Manual bypass
H5	red	Overload
H6	red	Mains failure bypass (AC Mains not available)
H7	red	Battery low voltage (Low DC Input Voltage
H8	red	Redundancy fault (no redundancy available)
H9	red	Fault (Common, active for all faults)
H10	red	Circuit Breaker Open (AC O/P Breaker Tripped, (if option installed)
H11	red	Back Feed Fault
H12	red	Not used
H13	red	Not used
S1	green	LED test (hold down) / flashing indicator reset

VERTICAL LED INDICATOR STRIP ASSIGNMENTS

4.1.5 EXTERNAL INTERFACES IN THE INVERTRONIC MODULAR CABINET

10 voltage-free changeover relays with the following assignments:

- Bypass operation
- Common alarm
- Minor alarm (2)
- Major alarm (2)
- AC Mains failure
- Inverter failure
- Circuit breaker open
- Aux. (unused)

Digital inputs for voltage-free relay contacts (normally open):

- Remote Shutdown

A further customer connection card with 4 freely selectable relay outputs is available as an option.

4.1.6 NETWORK AND SOFTWARE INTERFACES

Remote monitoring of all Invertronic Systems is available as a standard feature as a web-based function using TCP/IP by accessing the MCU with a LAN connection. A standard format of parametric information and alarms is available as a web page. The customer must assign his own IP address for the particular site and system. This can be done remotely on the LAN.

The default IP address for initial access is 10.10.10.10.

A username and password are required to modify this address. Contact technical support for this information.

Remote monitoring is also available as an optional feature using SNMP protocol. It requires the addition of a kit which includes a remote monitoring SNMP adaptor, necessary interconnect cable from MCU to adaptor, monitoring hardware, and a MIB. Consult the sales department. The kit can be installed at time of order of the system or for field retrofit.

The system also has the following communications interfaces:

- External ISDN, analogue or GSM modem for remote system monitoring with automatic call-back function and automatic alarm
- RCCMD shutdown software
- System management and troubleshooting via MCU service software. TEBE MCU Service Software is available for field service. It installs typically in a laptop computer which requires a null modem cable to interconnect with service port on MCU. Only trained service staff should use this software as inadvertent changes to settings can affect system operation. Contact factory for further information. Reference TEBE MCU Service Manual 028-0008-030.

4.1.7 AC MAINS BACKFEED PROTECTION

UL requires that a device be inserted in the Bypass AC Input to prevent the possibility of live AC being fed back into the external AC Input for any reason, when no external AC power source is present, such as during an external AC outage. A Backfeed Protection Disconnect and associated detection circuit module have been provided for this purpose. They are positioned as shown in Figure 6, downstream from the MBS in the primary cabinet.

4.1.8 OPTIONAL SYSTEM OUTPUT AC BREAKER

A moulded case three phase circuit breaker, rated 400A, will be provided when requested by customers who wish to have a manual means to disconnect the system output from their loads within the inverter system.

4.2 GENERAL PRINCIPLES OF OPERATION

All inverter modules operate in parallel. They are designed for continuous duty on line, load sharing, and are phase synchronized with each other. The load sharing and phase synchronizing are achieved by digital communications between modules. Usually the first module put into operation becomes the master module for communication purposes. If it is taken out of service, the adjacent module automatically becomes the master. The master module is signified by the green "synchronizing" LED flashing on the module front panel.

If a module fails, the other modules automatically increase output to compensate so no disturbance is seen by the loads. If the remaining capacity of the system is not able to support the loads, the SBSs in each of the modules perform a coordinated high speed, make-before-break, phase-synchronized transfer to back up ac.

The unique design of the Invertronic module is shown in simplified block diagram form below. The design incorporates a three phase inverter and the SBS all within the module itself.

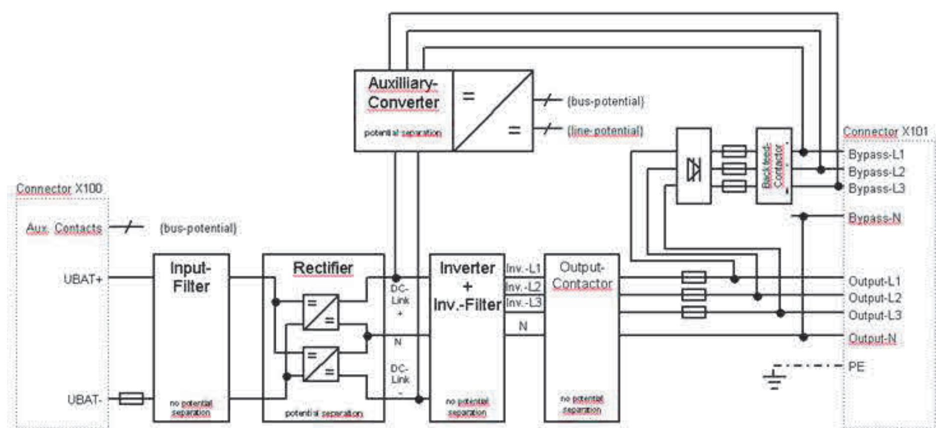


Figure 8: Block diagram of "Invertronic Modular" Inverter Module

Only inverters with the same rating and output voltage can be connected in parallel. In the case of simple parallel operation of inverters, the maximum system power is 80kVA.

4.3 BEHAVIOR UNDER SPECIAL OPERATING CONDITIONS

4.3.1 OVERLOAD

The inverter can supply 200% of its rated power supply for 4 seconds, 150% of its rated power for 30 seconds, and 125% of its rated power for 10 minutes. At higher overloads, the output current is limited to 150%. If the voltage on the secure bar (inverter output) drops below the permissible tolerance, the system switches to bypass. If the bypass mains supply is not available, the inverter switches off after three seconds.

(→LED on the operating panel; orange LED inverter output power)

4.3.2 SHORT CIRCUIT ON LOAD BAR

A short circuit occurring in the downstream load network must be isolated within 10 milliseconds to ensure that the other loads can continue operation without disruption.

In this case, the inverter system switches immediately to bypass to provide extra energy so that the load fuse will blow.

If the short circuit occurs during battery operation and if the bypass mains supply is not available at that time, the output current is limited to 2 x rated current (standard).

4.3.3 MAINS SUPPLY NOT IN TOLERANCE

In normal operation, the inverter is synchronised with the mains supply. As soon as the mains frequency goes outside the tolerance range of ±1 %, the inverter switches to the internal clock pulse. The return to normal operation is initiated by the control system.

4.3.4 SYSTEM FAULTS

CAUTION! **MAJOR ALARM IS NOT THE SAME AS MAJOR FAULT**

Inverter
if the inverter is unable to support the loads, the system switches to bypass without interruption. The system will automatically transfer back to inverter output if the fault corrects momentarily. However, after a permanent outage requiring maintenance action, the system has to be restarted manually. Each module must be restarted in turn via its front panel ON switch. The module will come up with its SBS in bypass position. When the system is ready to restart, all module SBS's will automatically transfer to inverter output. Note, if there is no bypass ac source present, automatic transfer to bypass will be inhibited, if the inverter output is still good.

4.3.5 FAN FAILURE

In the event of a fan failure, the inverter provides its output voltage until the overtemperature trip level is reached. After this, the system switches to bypass without interruption.

4.3.6 OPERATING FROM DC SOURCE ONLY

The system may be set up to operate from DC only (no AC bypass supply). If advised at the time of order, the factory will set up the alarm software, prior to shipment, to eliminate any nuisance alarms caused by the absence of the back-up AC source.

5 SAFETY

REFER TO THE INSTALLATION INFORMATION IN THIS MANUAL BEFORE CONNECTING TO THE POWER SUPPLY

The connection of the electrical equipment is part of an operational system. Note that the electrical installation and the connection of the inputs and outputs must be carried out in accordance with the local regulations. The system must be operated by experienced personnel.

Protective Earthing

⚠ The protective earth must be connected before the supply cables are connected. The system must not be operated without a protective earth.

Installation

This system must be installed by qualified specialists. Only UL/CSA-marked mains cables may be used to connect the inverter to the building installation. This also applies to the connection of the loads. Do not connect any loads to the inverter, which could overload the unit. Connecting cables should be kept as short as possible. Connect the system using cables of adequate cross section. Check the cables for damage to the insulation. Refer to Section 19 Parts List for the rating of the back-up fuse on the front panel of the inverter modules. Pay attention to the polarity of the DC cable connections. Make sure that a clockwise phase rotation is maintained. All cables must be fixed to the cable clamp rails and thus relieved from stress. Check that all contacts used are secure.

Hazards such as tripping, crushing, pinching etc. must be avoided.

Special conditions concerning fire fighting

Dangerous voltages are present within the inverter even when fuses have blown. In case of fire, DO NOT USE WATER to extinguish the fire.

Personnel training

All personnel must be trained to shut down the system in an emergency. To isolate the unit in an emergency, the main fuse in the mains input and the battery fuses (battery cabinet or external rack) must be removed. The system must be operated by experienced personnel.

5.1 GENERAL SAFETY INSTRUCTIONS

These operating instructions and the safety instructions contained therein must be carefully read before the system (also referred to as inverter or inverter system) is installed or put into operation. The operating instructions must be kept close to the unit for later reference.

Installation, operation, maintenance and repair of the inverter system may only be carried out by qualified and trained specialists.

Live parts may be exposed when you open the housing or remove covers; danger to life if touched!

BENNING takes no responsibility for consequential damage caused by work incorrectly carried out on the inverter system.

High fault currents (leakage currents):
A proper earth connection must be ensured before the mains is connected!

This inverter complies with inverter Class 3.

This is a product for commercial and industrial use in the second environment. Restrictions regarding the installation or additional measures may be necessary to prevent interference.

A suitable isolating device must be provided in the supply circuit (battery and bypass circuit).

The INVERTRONIC modular inverter must only be used on star networks with an earthed neutral conductor / star point. Once the unit has been installed and commissioned, at no time must the earthed mains point or neutral conductor be disconnected from the inverter.

⚠ As **standard**, the inverter system is suitable only for mounting on fire-resistant surfaces.

⚠ **CAUTION!**

The mains connection to the inverter must be protected by a fuse. We do not recommend the use of fault current circuit breakers for the incoming supply to the inverter. As a result of the RFI interference filter used, the leakage current to earth is fairly high and may possibly trigger the protective mechanism. The cable for the mains supply is connected to the inverter connecting terminals.

⚠ **Be sure to observe all the safety instructions!**

For connecting the INVERTRONIC modular, terminal strips for power connections (mains, load, and battery) are provided in the top third of the cabinet. Access to the terminals is obtained by undoing the screws and removing the front protective covers.

The cables can be routed to the cabinet from all four sides and fed in through the cabinet bottom. A double floor in the installation area is not absolutely essential. Please refer to the following tables and drawings for information on where the cables are to be connected and what size they must be in accordance to UL6950.

You must be absolutely sure that the phase sequence of the alternating current connections (clockwise rotating field) and the polarity of the battery connections are correct, as any incorrect connections will cause damage to the system.

⚠ **Please note that the modules must always be fitted from bottom to top!**

Within locked INVERTER operating rooms:

⚠ If the inverter is located in a locked operating room, a warning notice must be attached to all upstream isolating switches external to the inverter.

The warning notice should carry the following or similar wording:

SWITCH OFF THE SUPPLY TO THE INVERTER BEFORE STARTING WORK ON THIS EQUIPMENT.

Outside locked INVERTER operating rooms:

⚠ If the inverter is located outside a locked operating room, a warning notice must be attached to all upstream primary supply isolating switches external to the inverter to inform electricians that the circuit concerned feeds an inverter.

The warning notice should carry the following or similar wording:

SWITCH OFF THE INVERTER BEFORE STARTING WORK ON THIS CIRCUIT.

Available warning notices for purchase from Benning.

Part No.: 513287 – Warning notice within operating rooms

Part No.: 513288 – Warning notice outside operating rooms

Part No.: 513289 – Information at the point of connection

5.1.1 PERSONNEL SAFETY

The inverter must be installed in a room with limited access rights (qualified personnel as defined by standard EN62040-1-2).

The inverter is powered directly from a -48VDC battery source. There is no input breaker for the DC feeds to each module. Thus a hazardous DC voltage may be present at those inputs regardless of the state of the system or the presence/absence of the back-up AC power source. The upstream DC breakers must be switched off to isolate the system from DC power.

If the isolator for the primary supply cable is not located in the same room as the inverter, a warning notice must be attached to the inverter with the inscription:

ISOLATE THE INVERTER BEFORE WORKING ON THIS EQUIPMENT!

Dangerous voltages are present within the inverter. The unit must only be opened by qualified personnel.

The inverter must be grounded to earth.

When connected, all connectors on the back panel are at mains potential. Dangerously high voltages can also be present on the connectors even when disconnected due to charged capacitances within the unit.

Do not operate the inverter if the temperature and humidity exceed the specified maximum values

5.1.2 PRODUCT SAFETY

- The electrical supply cable must be protected by a backup fuse, which is accessible at all times.
- Do not install the inverter in the vicinity of liquids or in an environment with too high humidity.
- Do not allow liquids or foreign bodies to get into the system.
- Do not cover the air vents of the inverter.
- Do not subject the inverter to direct sunlight or other sources of heat.

5.1.3 SPECIAL SAFETY MEASURES

Be sure to observe the connection instructions in this manual. Check the information on the equipment rating label. This must correspond with your electrical supply network and the total power demand of the connected unit.

If the inverter should be put into storage before use, make sure that the storage location is clean and dry. The storage temperature must be in the range -10°C to +45°C. The inverter has been designed for normal ambient conditions such as those stated in the Appendix under installation altitude, operating temperature and relative humidity, and for the stated transportation and storage conditions.

Special protective measures must be taken if unusual operating conditions prevail:

- Moisture, steam, saline environment, dripping water or outdoor installation,
- Explosive mixtures of dust and gas,
- Severe temperature variations,
- Poor ventilation,
- Heat conducted or radiated from other heat sources,
- Strong electromagnetic fields,
- Radioactivity which exceeds the natural level of radiation,
- Fungi, insects, parasites, etc.

⚠ Parts, which can be drawn in by the suction of the ventilation fans, must not be stored in the vicinity of the inverter system. Blocking of the ventilation slots will lead to overheating and the risk of fire.

Do not cool overheated units with water. Switch off and allow to cool.

5.2 TRANSPORT AND STORAGE

The inverter must only be transported to the intended location in its original packaging. The same applies for removals or returns. The unit must only be transported and stored in an upright position. Safeguard the transport position during shipping, taking into account the centre of gravity. In the case of inverter systems, slight changes in position can lead to the units suddenly toppling due to the heavy weight. It must also be ensured that the units have a firm footing when placed in storage.

The unit is delivered complete from the factory (without modules). The unit must always be transported in an upright position. If the unit is transported with a forklift truck, then the forks must always be applied from the rear of the unit so that the front door with its instruments is not damaged.

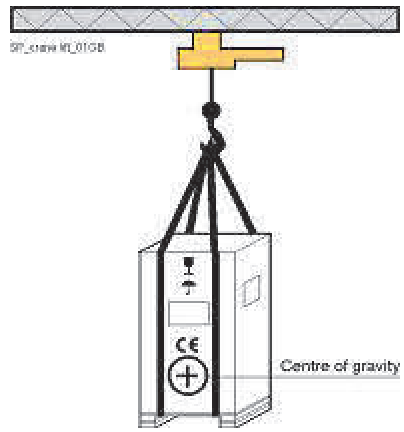


Figure 9: Transporting with forklift truck and crane

Unpacked units must only be transported in a closed truck or van. The units must always be securely anchored to prevent them from slipping or toppling over. In particular, it must be ensured that the paintwork is protected against scuffing and scratching. Lifting belts must be used when transporting the unit in an unpacked state. These must be positioned so that the instruments and switches on the front door cannot be damaged.

The information shown in Figure 10 must be observed when transporting the unit using lifting eyes.

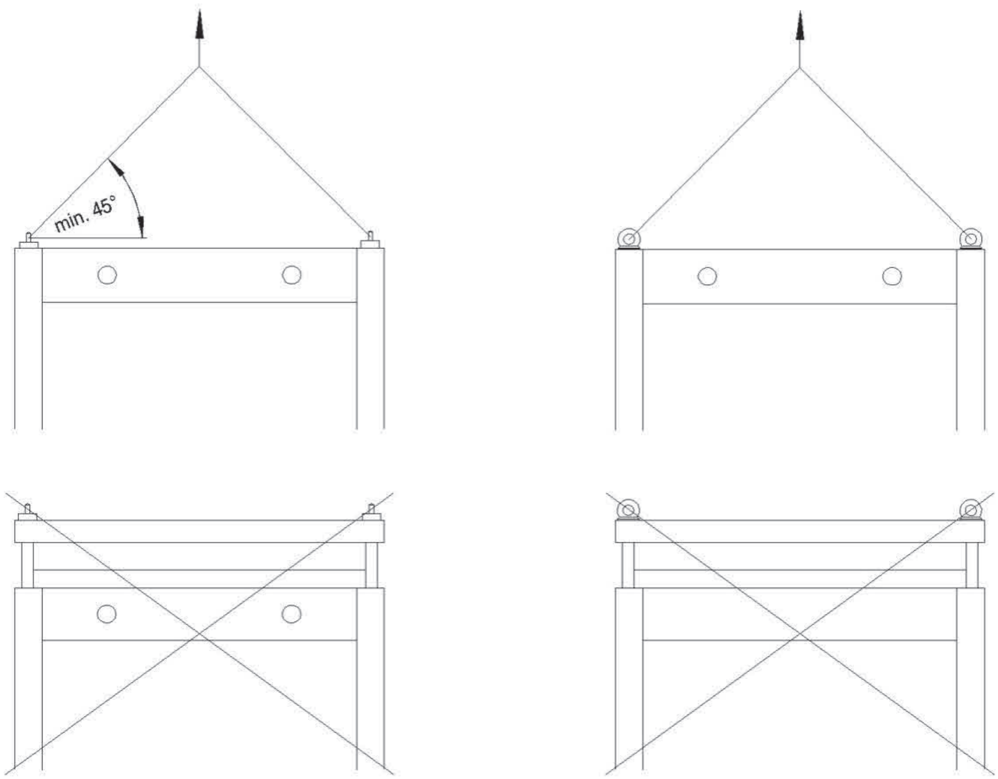


Figure 10: Use of lifting eyes

⚠ Lifting eyes must only be used with the protective cover and bolts removed.

When the units have been unloaded on site, they must be inspected immediately for possible damage. It must also be checked that all parts according to the packing list are present. In the event of damage, the responsible party must be identified – if possible – and in all cases a written report must be immediately sent to the supplier/manufacturer (within 6 working days).

5.2.1 STORING THE INVERTER SYSTEM

The ability of the units to be stored depends on the selected packaging.

Units with short-term packaging should be unpacked immediately on arrival at the intended location and stored in a suitable place. In doing so, the temperature must not be allowed to drop too low to allow condensation to form.

When the units are placed in store, the doors should be opened for a few hours to allow the units to adapt to the new temperature without the formation of condensation. If the units are placed into interim storage for an extended period, they must be covered with film and inspected for condensation from time to time.

When units are supplied with long-term packaging, they must be stored in this packaging. The packaging must first be checked for damage.

5.3 MAINTENANCE, SERVICE, AND FAULTS

⚠ **Caution – Risk of electric shock!**

When the load has been placed on manual bypass, the back-up ac mains supply is still delivered to the module backplanes and internal bus.. Also, when the inverter modules have been shut down, .the inverter system is still connected to the -48VDC battery circuits and is at a dangerous voltage potential. Therefore, disconnect the battery circuits and check that the equipment is de-energized before carrying out service or maintenance work.

All power electronics are contained within the inverter modules which are safely removable and replaceable in service with live power present in the cabinets.

The following safety rules must be observed generally when working on the inverter system:

- Watches, rings and other metal objects must be removed
- Use only insulated tools
- The inverter must not be dismantled

Although the system is generally maintenance free, if you require a system check at regular intervals for safety reasons, e.g. an annual inspection, then please contact us. We will be pleased to submit a quotation for an appropriate contract.

6 ENVIRONMENTAL

6.1 ENVIRONMENTAL COMPATIBILITY

BENNING is particularly concerned with the environmental compatibility of its products and therefore adopts an eco-project engineering approach for the whole life of the inverter.

6.2 PACKAGING

Please observe the relevant local regulations for the recycling of packaging material.

6.3 DISPOSING OF THE INVERTER AT THE END OF ITS LIFE

We recommend that the relevant local regulations for the disposal and recycling of the components be observed when the life of the inverter has expired.

7 ELECTRICAL CONNECTIONS AND ADDRESSING

For connecting the INVERTRONIC modular, terminal strips for power connections (mains, bypass, load, battery) are provided in the top third of the cabinet. The cables can be routed to the cabinet from all four sides. Cable entry/exit will normally be through the front half of the top of the primary cabinet. Conduit plate will be provided for AC terminations. Note, the rear half is reserved for exhaust airflow. Primary to secondary cabinet connections will be made directly through a cutout in the upper portion of adjacent sidewalls. **The cabinets MUST be installed side-by-side** for this reason with the primary cabinet normally on the left, unless specified otherwise at time of order.

⚠ Cabling to and from the inverter system must only be laid by qualified specialist personnel.

⚠ Be sure to observe the safety instructions in Chapter 5.

⚠ You must be absolutely sure that the phase sequence of the alternating current connections (clockwise rotating field) and the polarity of the battery connections are correct, as any incorrect connections will cause damage to the system.

7.1 CIRCUIT BREAKERS

For 60 kVA single cabinet systems, a **200A** breaker is recommended for the three phase 208VAC back-up AC Mains (Bypass) Source.

For 120 KVA dual cabinet systems, or, single cabinet systems expandable to dual 120kVA systems, a **400A** breaker is recommended.

7.2 TERMINAL CONNECTIONS

AC Terminal Blocks: Terminal blocks for applications using single conductor per phase AC Input and Output cable terminations are DIN rail-mount, compression style terminal blocks, and will accommodate up to **600MCM** cable.

NOTE: These blocks are rated for 600V/420A maximum per terminal, cable range of 600MCM to 2/0 AWG, and have a torque requirement of 275 in-lbs.

DC Terminal Blocks: The -48VDC power inputs can be configured as: a bulk 1800A feed per cabinet, a 600A feed per every two inverter modules, an 800A feed per every three modules, or a 250/300A feed per single inverter module (most reliable).

The 1800A feed generally requires 4x 750MCM cable sets.

The 800A feed requires 3x 500MCM cable sets.

The 600A feed requires 2x 500MCM cable sets.

The 300A feed requires 1x 500MCM cable set.

NOTE: The DC cables set(s) mentioned above refer to a feed and a plus return.

Narrow tongue two-hole lugs with 3/8" x 1" spacing and maximum width 1.3" should be used (terminals are rated 600V/380A max. per terminal, cable range of 500MCM to 2/0 AWG, and have a torque requirement of 192 in-lbs.).

***Panduit LCDXN500-38D-6 Narrow Tongue Standard Barrel Flex Lug**, standard barrel with window is suitable.

For customers requiring long barrel lugs: **Thomas & Betts 54879BENT0616PH – 500Flex, 2 hole, 3/8" x 1" spacing, Long Barrel, Narrow Tongue, with peep hole** (tongue width 1.25") is suitable.

Grounding: Each cabinet must be grounded radially to the central room ground plate or equivalent. Dual 3/8"dia. brass studs with 1" spacing have been provided for this purpose on the roof of the cabinet at the right hand edge. A 4/0 ground wire size with double hole lug is recommended.

Alarm Contact Outputs: Compression- type Terminal Blocks X3 and X4 on the left hand upper inside of the cabinet have been provided for the alarm outputs – see Table 2 for specific alarm connection assignments. These terminals accommodate a range of cable sizes from 14 AWG to 22 AWG. The alarm C contacts are rated: 240VAC/6A: 30VDC/180W: 300VDC/40W.

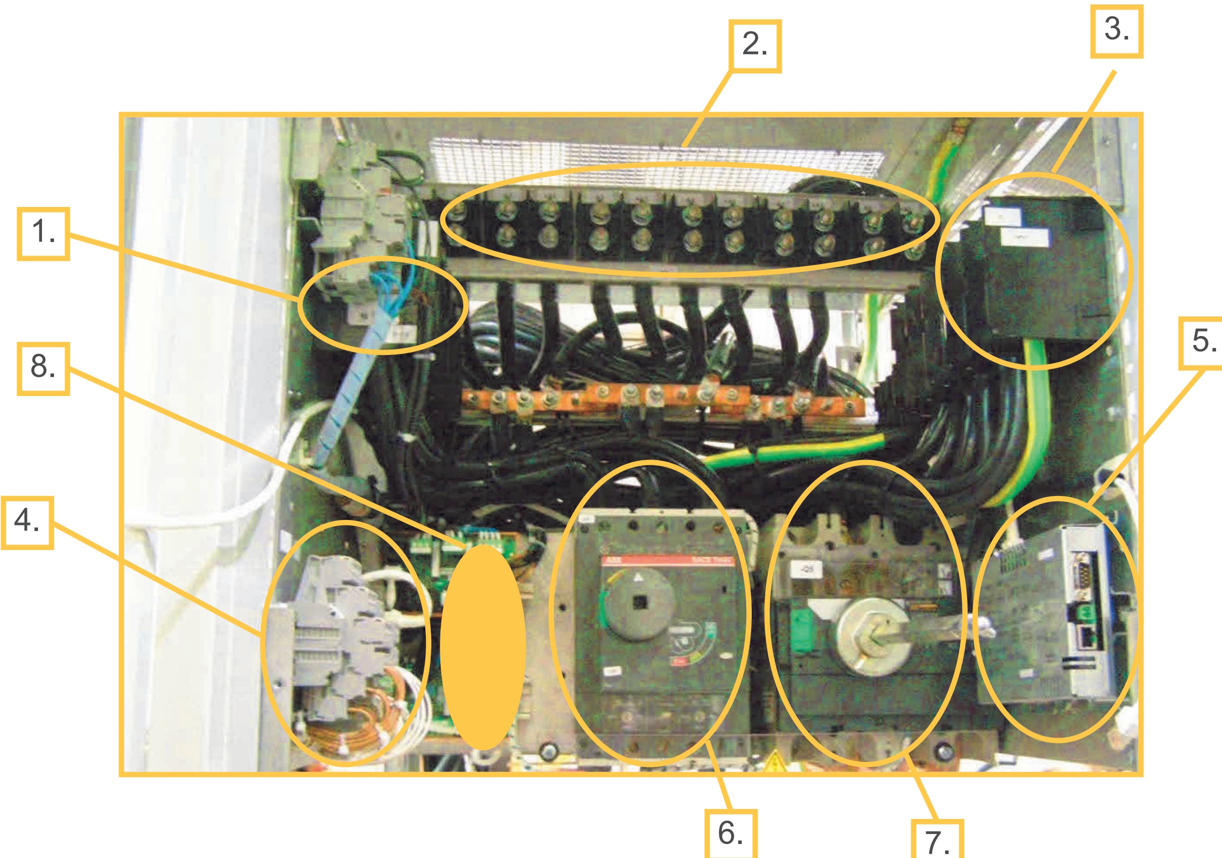


Figure 11: Terminal Connections in Primary Cabinet

1. AC Output Terminal Blocks (X6)
2. DC Input Terminal Blocks (X1)

   *DC terminations are in both Primary and Secondary Cabinets.

3. AC Bypass Input Terminal Blocks (X5)

4. Alarm Contact Output Terminal Blocks (X3, X4)

5. MCU 2500: Service Port (X110 on MCU) and LAN Network Connection for HTML Remote Monitoring (X5 on MCU). Optional SNMP Adaptor also plugs into X5 on MCU when used. Customer then connects LAN to port on SNMP Adaptor.

6. AC Output Breaker (AOB) (optional)

7. Manual Bypass Switch (MBS) (Q5)

8. 400 Amp Back Feed Contactor (not visible in photo)

Terminal / Connector				External connection
X1	B+			Battery + (6 places)
	B-			Battery - (6 places)
X5	L1			L1- Bypass
	L2			L2- Bypass
	L3			L3-Bypass
	N			N- Bypass
	PE			PE- Bypass
X6	L1			L1 – Out
	L2			L2 – Out
	L3			L3 – Out
	N			N – Out
	PE			PE – Out
X3	1 *Com*	2 *Not active*	3 *active*	Minor alarm
	4 *Com*	5 *Not active*	6 *active*	Major alarm
	7 *Com*	8 *Not active*	9 *active*	AC Mains failure
	10 *Com*	11 *Not active*	12 *active*	Inverter failure
	14 *Com*	13 *Not active*	15 *active*	Bypass operation
	17 *Com*	16 *Not active*	18 *active*	Common fault
X4	1 *Com*	2 *Not active*	3 *active*	Major alarm
	4 *Com*	5 *Not active*	6 *active*	Minor alarm
	7 *Com*	8 *Not active*	9 *active*	AC System Output Circuit breaker open
	10 *Com*	11 *Not active*	12 *active*	Backfeed Contactor

X10	1-2	Remote Shut-down unit
	3-4	Manual Bypass
	5-6	N/A
	7-8	Generator Operation
	9-10	Jumper installed
	11-12	N/A

Table 1: Terminal Connections

Alarm Matrix		
Event	**LED Display Status**	**Alarm Contact Condition**
NO ALARMS	INVERTER OPERATION	FROM TO MULTIMETER SHOW X4.1 X4.3 SHORTED • X4.4 X4.6 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.3 SHORTED • X3.4 X3.6 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.12 SHORTED • X3.13 X3.14 SHORTED • X3.16 X3.17 SHORTED •
Single Inverter Failure	REDUNDANCY ERROR FAILURE MINOR MAJOR	VARIOUS
Multiple Inverter Failure	REDUNDANCY ERROR FAILURE MINOR MAJOR	VARIOUS

Overload inverter > 100% Overload inverter > 125%	OVERLOAD REDUNDANCY ERROR FAILURE MINOR MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.2 SHORTED • X4.4 X4.5 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.2 SHORTED • X3.4 X3.5 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.11 SHORTED • X3.13 X3.14 SHORTED • X3.17 X3.18 SHORTED •
Overload bypass sbs > 100% Overload bypass sbs > 125%	BYPASS OPERATION OVERLOAD REDUNDANCY ERROR FAILURE MINOR MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.2 SHORTED • X4.4 X4.5 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.2 SHORTED • X3.4 X3.5 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.11 SHORTED • X3.14 X3.15 SHORTED • X3.17 X3.18 SHORTED •
Loss of Back-Up AC	MAINS FAILURE BYPASS REDUNDANCY ERROR FAILURE BACKFEED FAULT MINOR MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.2 SHORTED • X4.4 X4.5 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.11 SHORTED • X3.1 X3.2 SHORTED • X3.4 X3.5 SHORTED • X3.7 X3.8 SHORTED • X3.10 X3.11 SHORTED • X3.13 X3.14 SHORTED • X3.17 X3.18 SHORTED •
Transfer of SBS to Back-Up	BYPASS OPERATION FAILURE MINOR	FROM TO MULTIMETER SHOW X4.1 X4.3 SHORTED • X4.4 X4.5 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.2 SHORTED • X3.4 X3.6 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.12 SHORTED • X3.14 X3.15 SHORTED • X3.16 X3.18 SHORTED •

Transfer of MBS to Back-Up	BYPASS OPERATION MANUAL BYPASS FAILURE MINOR MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.2 SHORTED • X4.4 X4.5 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.2 SHORTED • X3.4 X3.5 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.12 SHORTED • X3.13 X3.15 SHORTED • X3.16 X3.17 SHORTED •
Loss of DC Input	BYPASS OPERATION BATTERY VOLTAGE LOW REDUNDANCY ERROR FAILURE BATTERY OPERATION MINOR MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.2 SHORTED • X4.4 X4.5 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.2 SHORTED • X3.4 X3.5 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.11 SHORTED • X3.14 X3.15 SHORTED • X3.17 X3.18 SHORTED •
Output Circuit Breaker Open	FAILURE CIRCUIT BREAKER OPEN MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.2 SHORTED • X4.4 X4.6 SHORTED • X4.7 X4.8 SHORTED • X4.10 X4.12 SHORTED • X3.1 X3.3 SHORTED • X3.4 X3.5 SHORTED • X3.7 X3.9 SHORTED • X3.10 X3.12 SHORTED • X3.13 X3.14 SHORTED • X3.16 X3.17 SHORTED •
Backfeed Contactor Open	MAINS FAILURE BYPASS REDUNDANCY ERROR FAILURE BACKFEED FAULT MINOR MAJOR	FROM TO MULTIMETER SHOW X4.1 X4.3 SHORTED • X4.4 X4.6 SHORTED • X4.7 X4.9 SHORTED • X4.10 X4.11 SHORTED • X3.1 X3.3 SHORTED • X3.4 X3.6 SHORTED • X3.7 X3.8 SHORTED • X3.10 X3.11 SHORTED • X3.13 X3.14 SHORTED • X3.17 X3.18 SHORTED •

Table 2: Alarm Matrix

7.3 REMOTE SHUTDOWN

The remote shutdown unit prevents the load from being supplied by the Inverter in any operating state.

⚠ Even when switched off, some of the components in the interior of the unit remain live. Only allow trained personnel to work on the system.

⚠ Be sure to avoid accidental operation of the remote shutdown switch.

The remote shutdown unit works only with a normally open contact, which on closing initiates the remote shutdown.

The remote shutdown terminals X1 are located behind the terminal compartment cover plate.

1. Use a 2-core double-screened cable (cross section 2x 0.6 mm^2), maximum length 25 m.
2. Connect the cable as shown in Figure 14.

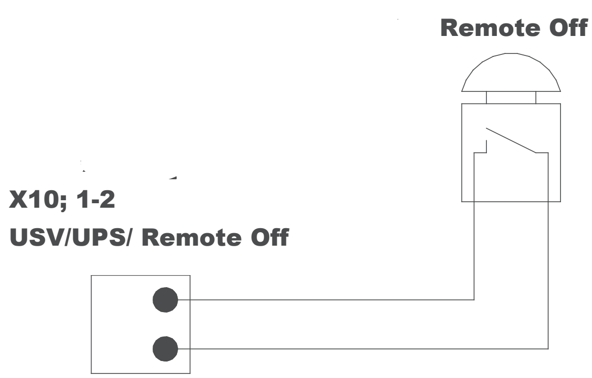


Figure 12: Remote Shutdown Unit Cabling

⚠ The upstream isolators must be opened in order to isolate the system from the supply sources (to make it completely dead).

7.4 CANBUS CONNECTION AND ADDRESSING

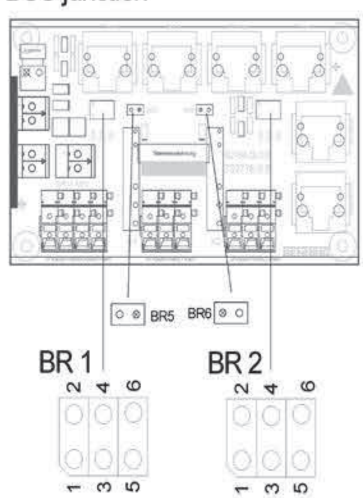
The information given in this section is useful to the user in case of changes in the field. However, the bus jumpers will be factory-installed for the configuration initially supplied.

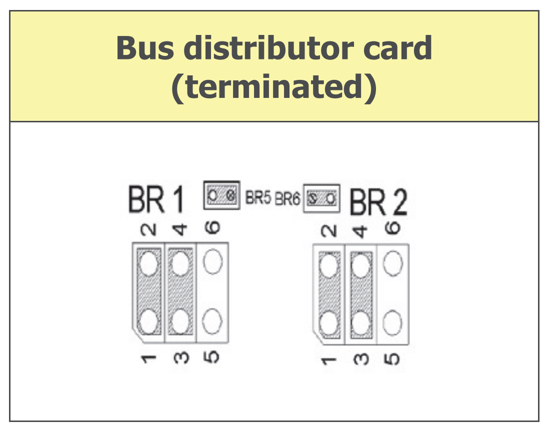
Only the first and last unit connected to the CAN bus, i.e. the bus distributor card (in the connection compartment of the cabinet) and the last bus card on the cable leg (behind the top module slot in the cabinet) must be fitted with a terminator. No other devices must be terminated. After making the electrical connections, check the following jumper settings:

1. Bus distributor card (termination required):

Jumpers BR1 and BR2 on the bus distributor must be checked (1-2 and 3-4). Also check that jumper links BR5 and BR6 are closed (1-2).

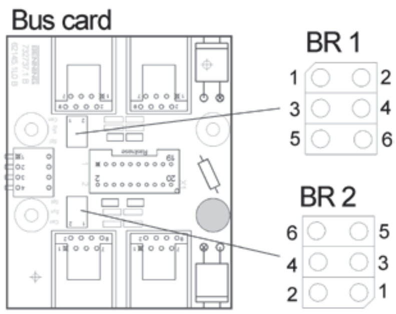
BUS junction



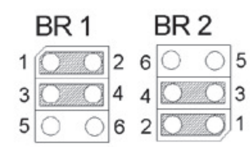


2. Last bus card on the cable leg (termination required)

Jumpers BR1 and BR2 on the last installed bus card (top module insert) must be fitted (1-2 and 3-4 / see illustration).

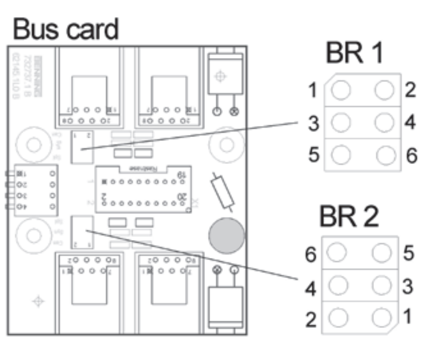


Last bus card on the cable leg (terminated)

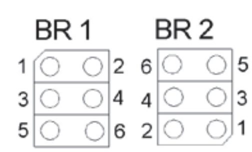


3. Remaining bus cards on the cable leg (must definitely not be terminated)

No jumpers must be fitted in the jumper blocks BR1 and BR2 on any of the installed bus cards (except for the bus card in the top module slot).



Bus cards on the cable leg (not terminated)



7.5 INVERTER MODULE ADDRESSING

DIP settings				Module No.	
1	2	3	4		
OFF	*OFF*	*ON*	*ON*	**12**	**Cabinet 2**
ON	*ON*	*OFF*	*ON*	**11**	
OFF	*ON*	*OFF*	*ON*	**10**	
ON	*OFF*	*OFF*	*ON*	**9**	
OFF	*OFF*	*OFF*	*ON*	**8**	
ON	*ON*	*ON*	*OFF*	**7**	
OFF	*ON*	*ON*	*OFF*	**6**	**Cabinet 1**
ON	*OFF*	*ON*	*OFF*	**5**	
OFF	*OFF*	*ON*	*OFF*	**4**	
ON	*ON*	*OFF*	*OFF*	**3**	
OFF	*ON*	*OFF*	*OFF*	**2**	
ON	*OFF*	*OFF*	*OFF*	**1**	

Table 3: Addressing

8 INVERTER MODULE DESCRIPTION

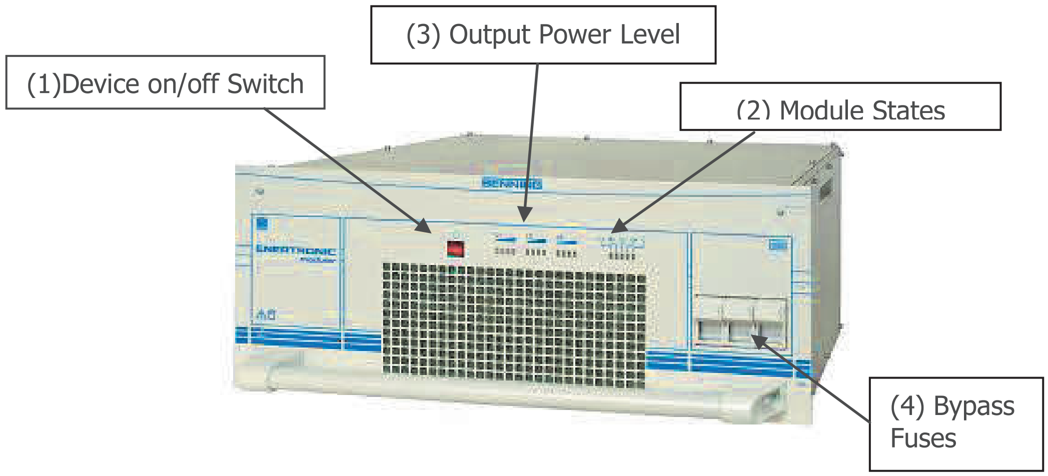


Figure 13: INVERTRONIC MODULAR module

1 ON/OFF Switch

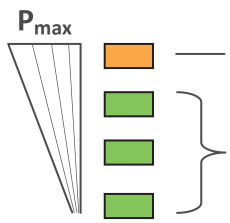
Each module can be switched on and off separately by means of the device switch. Note, this is not a breaker.

2 LEDs for indicating the module states

LED	Colour	Meaning
	red	Fault
	green	Output voltage present and connected to load / SBS
	green	LED continuous: The inverter output voltage is phase-synchronised with the other inverters in the system; parallel operation LED flashing: The inverter has MASTER functions
	green	Input voltage within the permissible range
	green	Inverter switched on

Table 4: Module Symbols

3 LEDs for indicating the current inverter output power



Orange: when this LED illuminates, the inverter is approaching the load limit >75%; when the LED flashes, the inverter module is overloaded.

Green: the illuminated LEDs indicate the load level up to 75%

4 Bypass Fuses

Three Front accessible, replaceable fuses, 50A, Buss Part Number C14G50, which protect the thyristors in the Static Bypass Switch in the event of excessive short circuit current duration

9 GRAPHICAL DISPLAY DESCRIPTION

All states and measured values of the power supply system can be interrogated by means of the 4 buttons on the graphic display. Safety-critical menu levels are accessible by means of passwords. The use of the input keys and the meaning of the displayed states will be explained later.

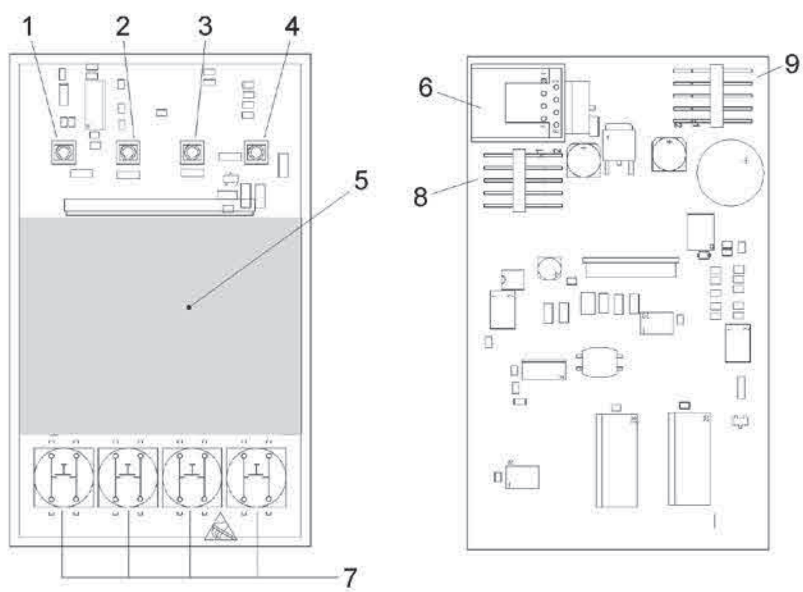
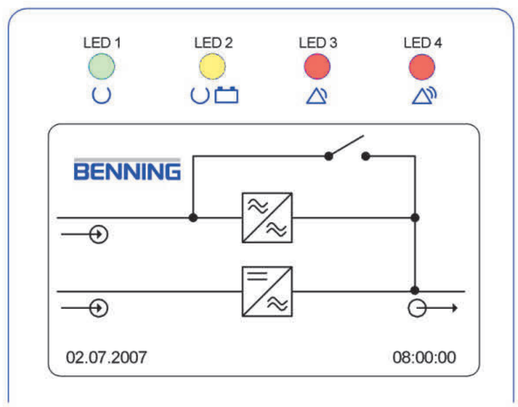


Figure 14: Graphical Display

1-4. The meaning of the 4 LEDs above the graphical display is fixed. Refer to Section 14 for derivation.

1.	Running	**2.**	Battery operation
3.	Alarm	**4.**	Urgent alarm

5. Graphical Display / Symbol



6. X2; RS485 bus interface (RJ45 plug)
5-pin plug for a pre-assembled data cable

7. Buttons for using the display menu

8. X3, I²C bus interface
5-pin plug for data cable

9. X4, I²C bus interface
5-pin plug for data cable (connector for LED card)

10 LED CARD DESCRIPTION

The meaning of the 13 LEDs is determined by a configuration file (filter) and depends on the system indication philosophy. However, the basic meaning is defined by the colour of the LEDs in accordance with IEC 73/DIN VDE 0199. as follows:

RED	Danger / Alarm	Warning of possible danger or conditions which require immediate intervention or careful observation of the condition
YELLOW	Caution	Changes or imminent changes to the normal operating states
GREEN	Safety	Indication of safe conditions or enabling of on-going operation

***If any LED is flashing, this indicator a condition occurred but no longer is present. Hold down the green button for 10 seconds to clear condition.**

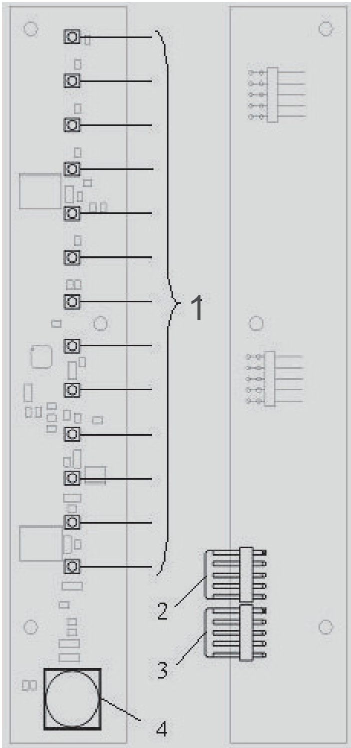


Figure 15: LED card

1 13 LEDs for the indication of fault and operating states; some programmable

2 – 3 X2, X1; I²C Bus interface
5-pin plug for data cable

4 RESET/LED TEST PUSHBUTTON
This button must be pressed for 3 seconds minimum in order to test the LEDs.Pressing it momentarily will turn off any indicators if underlying conditions are no longer in effect.

The LED card is pre-programmed as follows:

Ref.	Colour	Meaning
H1	green	Inverter operation (Load on Inverter Output)
H2	yellow	Bypass operation (Load on Bypass)
H3	yellow	Not used
H4	red	On Manual bypass
H5	red	Overload
H6	red	Mains failure bypass (AC Mains not available)
H7	red	Battery low voltage (Low DC Input Voltage
H8	red	Redundancy fault (no redundancy available)
H9	red	Fault (Common, active for all faults)
H10	red	Circuit Breaker Open (AC O/P Breaker Tripped, (if option installed)
H11	red	Back Feed Failure
H12	red	Not used
H13	red	Not used
S1	green	LED test / reset

Table 5: LED card pre-programming

11 INVERTRONIC MCU 2500 DESCRIPTION

The MCU is the heart of the monitoring and communications functions of the inverter system. It collects data from the inverter modules and digital input card and provides the logic for the LED and Graphic Displays and external alarm outputs. It performs no control, except allowing the operator to initiate a manual transfer of the MBS from the Display Panel on the front door. It can be swapped out while the system is running. During this time, an AC mains failure will not cause an outage. The design of the inverter modules enables them to stay on line responding to the load requirements independent of the MCU.

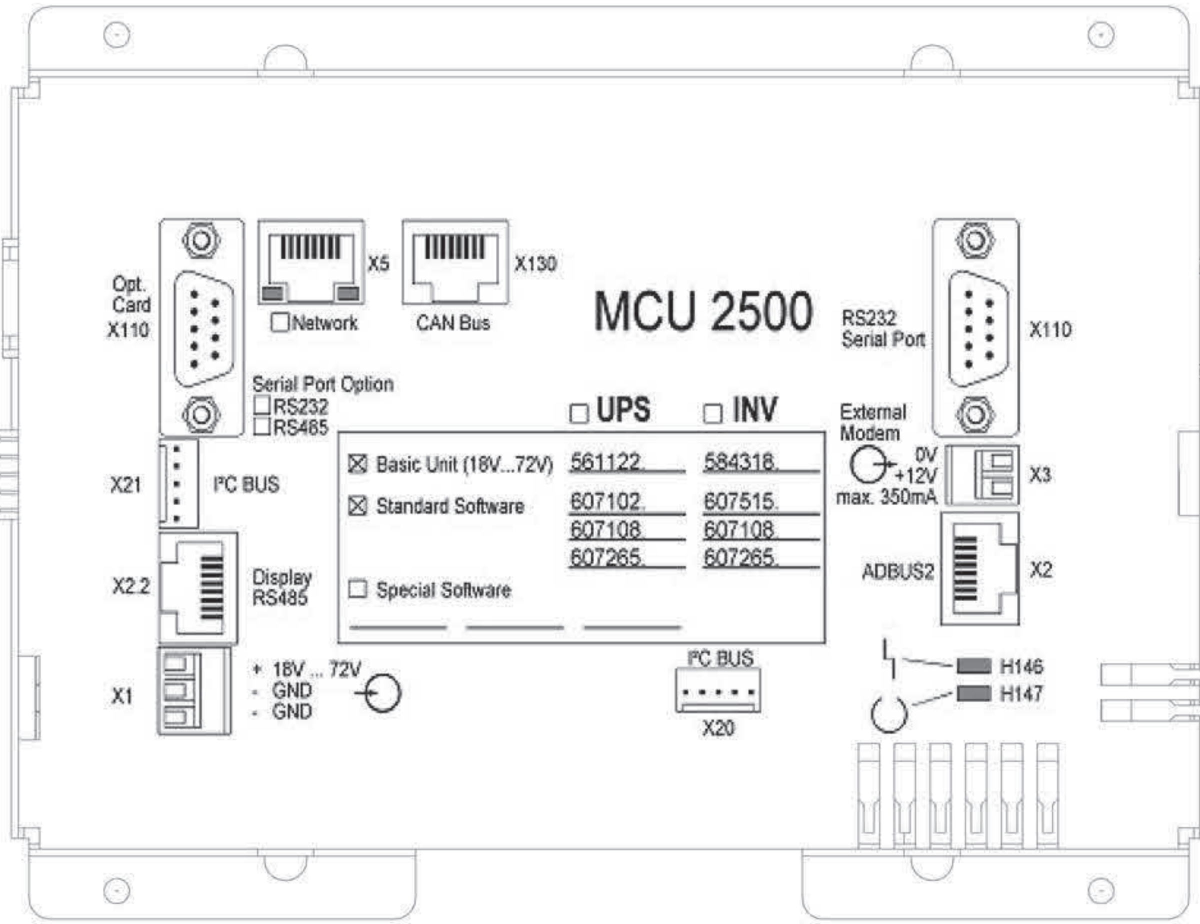


Figure 16: INVERTRONIC MCU 2500

⚠ **Caution!**

Make sure that the plugs are correctly connected when installing the MCU. The cables must be connected according to their identification.

⚠ The MCU connecting cables must be safely insulated with respect to the cables and busbars which carry dangerous voltages.

12 CONFIGURATION

A standardised installation procedure is shown based on the following configuration. This helps to understand complex parameters. The chosen settings provide a safe initial installation.

12.1 BASE TYPE

The base single cabinet model comprises:

- 1 x PSJ / 7 Foot cabinet
- 1-6 Modules (0-60 kVA, 10kVA each module)
- 1 x Invertronic MCU 2500
- 2 x REL I/O card (Alarm Outputs and Digital Inputs)
- Set-up: (n+1) redundancy
- Manual Bypass Switch (MBS)
- Front Door-mounted LED and Graphic Display

⚠ Please first check the configuration level of the inverter system to be installed. Be sure to pay attention to the enclosed terminal diagrams and, in case of doubt, compare these with the markings on the connecting terminals.

12.2 COMMISSIONING THE INVERTER SYSTEM

1. **Set manual bypass switch to OFF.**

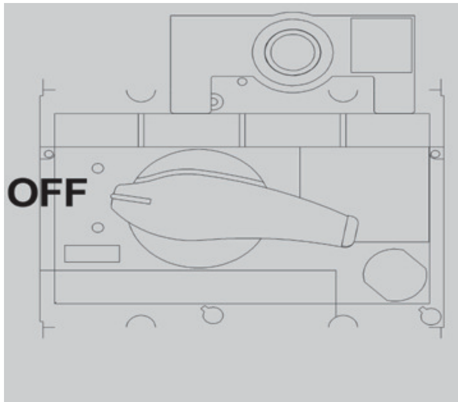


Figure 17: Manual Bypass Switch

2. **Insert modules**

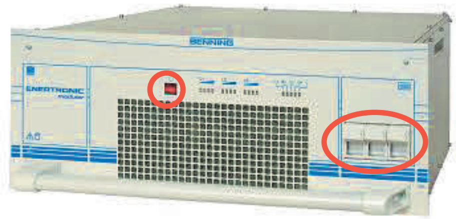
Note that the module slots must be populated from bottom to top (cf. Figure 1). Empty module slots must be covered with a blanking plate. These will be supplied by the factory for unused slots at time of shipment.

If it is desired to do the CANBUS jumper checking described in Section 7.4, it should be done at this time prior to inserting the modules. However, the jumpers should be pre-set correctly in the factory prior to shipment, but may require reconfiguration if the system is expanded in the field.

Carry out the following steps for each module:

Check that the module is switched off (OFF pushbutton). Then slide the module into the module slot and screw in place. If the rectifier circuit is already switched on, the associated fan will run briefly shortly after inserting the module. At the same time, the first load indicator LED in each case must flash.

Next check the three bypass fuses on the right-hand side of the module front. The fuses must be intact and the holders must be fully locked.



NOTE: When at least one module has reached this state, power will also be supplied to the MCU and the associated display on the front door of the base cabinet.

3. Configure the inverter using the Operator Panel:

a.) Assign modules to a leg (see menu structure, Chapter 10)

../Menu/System settings/Manage batteries/Modules<->Legs/Batt.Leg x/

Tick the modules to be associated with the leg and then return with ⨂.

b.) Check leg values and correct if necessary

../Menu/System settings/Manage batteries/Leg management/Batt.Leg x/

c.) Check overall system settings

../Menu/Overall system/..

4. Close battery isolator

Close the external upstream dc breaker.

5. Switch on the inverter system

It is recommended that all connections and settings be checked before putting the system into operation.

⚠ **Be sure to observe the start-up sequence below.**

Start up the inverter system by carrying out the following switch-on sequence:

1. Switch on the modules ("ON" pushbuttons on the modules). Note, this is an input to the module processor, not a breaker or power on/off switch.

2. Confirm "Switch on system" in the menu

Immediately after this, the load will initially be supplied via the bypass path.

After initialisation (inverter run-up) and appropriate changeover switching, the load will be supplied by the modular inverters.

3. Check the status LEDs

Finally – after a short waiting time – only LED H1 must be illuminated. Flashing LEDs (stored faults) are reset by pressing button S1 – LED test/reset - once.

12.3 ADDING AN INVERTER MODULE

1. DC Input Cables for the module position must be preinstalled and the correct polarity verified at input terminal block X1. Although modules are hot-swappable, it is best to ensure the upstream DC input breaker is off prior to installation.
2. Remove the blank coverplate in the carrier for the desired module position. Optionally, verify the module address on the CANBUS pcb located on the carrier.
3. Visually inspect the module, especially taking care that all connectors on the rear of the module and the carrier are free of any packing materials.
4. Partially insert module by carefully setting it on carrier slides using front handle and hinged handles on the side of the module. NOTE, module weighs 45kg (99 lb.). Slide module fully into slot by firmly pushing it until it is flush with adjacent modules.
5. Secure modules with the 4 rail-mount screws which were provided for the coverplate, Part Number 786232.
6. Turn on upstream DC input breaker to apply power to the module.

7. Push START button on module front to automatically start up the module. The process takes 1-2 minutes as the module communicates (synchronizes) with the master module and MCU.

8. Set parameters via the Operator Panel, if desired. An example follows:

Parameterisation example: Upgrading by adding one module to an existing battery leg
1. Assign module to a battery leg (string). 2. a) If the new module has already been ticked, the new module must be removed from the leg (i.e. remove tick) and added once more. (→ Background: The new module does not yet recognise the leg assignment) b) If the new module has not yet been marked, the module must be marked now √. 3. Copy the leg data and leg assignment from the MCU into the new module. To do this, select the module to be parameterised: *../Menu/Device management/INV MD Module x/* 4. Select "Module data sync" in the "Management" sub-menu and confirm the password request (Level 2) accordingly 5. Finally, re-confirm the process √ 6. Check the leg assignment *../Main menu/System settings/Manage batteries/Modules<->String overview/* An overview of the leg assignments will appear. Check these.

12.4 CHANGING A MODULE (E.G. AFTER A FAULT)

1. Switch off the module to be removed (OFF pushbutton) and withdraw it.

2. Log off the module
   /Menu/Device management/INV MD Module/Log off module/

3. Initially switch off the replacement module using ON/OFF pushbutton on module front)

4. Insert replacement module in the module slot according to procedure in Section 12.3.

5. Transfer data to the replacement module as follows:

   5.1 Go to the Operator Panel and select "Main Menu". Scroll to "Module Settings". Scroll to and select the desired module e.g., Module 3 (error) will appear.

   5.2 Scroll to and Select "Sync Module Data"" in the "Management" sub-menu and confirm the password request by entering the password (PW 002).

   5.3 Finally, re-confirm the process, when the prompt appears, to allow the process to be completed. √
   5.4 Wait 1-2 minutes while data is being copied from the MCU into the new module. The rotating wrench symbol will stop rotating upon completion.
   5.5 Scroll to "Clear all messages" and select for that module. Display should then indicate "Module (ok)".
   5.6 Push the START (ON/OFF) button on the module front to put the module into service.

12.5 CHANGING THE INVERTRONIC MCU 2500

Installing a new Invertronic MCU 2500:

Case 1: MCU not defective or only partially defective:

Read out the filter data for the MCU in the cabinet and store this temporarily on a PC / notebook

Case 2: MCU completely defective or cannot be interrogated

Request the filter data for the as-delivered state and store this temporarily on a PC / notebook

Steps:

1. **Remove MCU cable connections**

   Remove power supply cable (X1)
   Remove CAN bus cable (patch cable on X130)
   Remove display RS485 cable (patch cable on X2.2)
   (Optional) Remove Ethernet cable (patch cable on X2)
   Remove AD bus cable (patch cable on X2)

2. **Remove MCU**

   Undo the DIN rail catch with a screwdriver blade (bottom of MCU)
   Tilt the MCU up and away and remove from top-hat rail

3. **Install new MCU**

   Latch MCU onto top-hat rail from above
   Snap MCU into place by pressing gently on the bottom of the MCU

4. **Connect MCU cables**

   Connect CAN bus cable (patch cable on X130)
   Connect display RS485 cable (patch cable on X2.2)
   Connect optional Ethernet/SNMP Adaptor cable (patch cable on X5)
   Connect AD bus cable (patch cable on X2)
   Connect power supply cable (X1)

5. **Load filter data**

   Transfer filter data from the PC / notebook to the MCU (via X110 / on right-hand side of MCU)

6. **Load system parameter sets into the MCU using the operating panel**

   Select *Menu/Service portal/MCU MD data/*
   Respond accordingly to the request to enter the password (authentication)

7. **Check**

   After a short time, all battery configuration faults that will have previously appeared must be extinguished.
   Flashing LEDs (stored faults) are reset by pressing the "LED test/reset" button on the operating panel once.
   The indicator and status LEDs must now correspond with the normal state once more and must not show any faults.

12.6 USE OF A DIESEL GENERATOR TO FEED THE BYPASS INPUT

If the customer wishes to inhibit a transfer of loads to a diesel generator back-up source, then a generator signal is required at Terminals X10 9-10, which must fulfill the following requirements:

1. **Contact closed**

   "Contact closed" state means "generator not running"

2. **Contact open**

   "Contact open" state means "generator running"

   If a wire link is already fitted, this must be removed. The necessary cable connection must not exceed a length of 25 m. Note, the link will be installed as a default, prior to shipment from the factory

   Default MCU settings:

   With the contact open, automatic transfer to bypass supply is inhibited. Other configurations can be set up using the Operator Panel.

13 SWITCHING ON / OFF AND EMERGENCY STOP

13.1 SWITCH-ON SEQUENCE

No.	Operations
1	Check to ensure that the LEDs on the front of each module are illuminated green, indicating they are ready to take load. The inverter modules default to the bypass state on initial start-up. If all modules are ready, go to the main menu on the Operating Panel.
2	Select "System ON"
3	Enter the L1 password (default: 001) and then confirm it.
4	Confirm the safety prompt.
5	If the output contactor in each inverter module is closed (signifying that the module start-up is complete and it is ready to take load), the SBS in the module automatically transfers to Inverter Output. The LEDs on the Operator Panel illuminate as described in Section 14 for Normal operation.
6	The system is now in inverter mode.

Table 6: Switch-on Sequence

13.2 SWITCH OFF SEQUENCE

No.	Operations
1	Select "Switch system OFF" in the menu on the operating panel.
2	Enter the L2 password (default: 002) and then confirm it.
3	The system is now switched off.

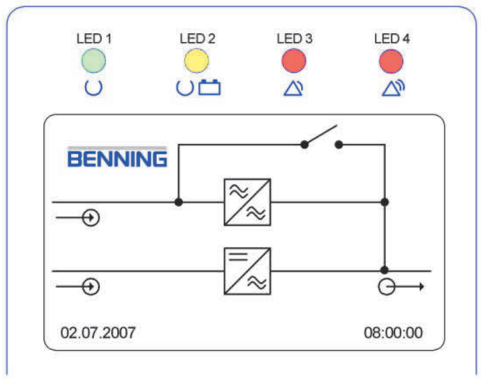
Table 7: Switch-off Sequence

13.3 REMOTE SHUTDOWN

If the customer wishes to implement an emergency stop, refer to Section 7.3 – Remote Shutdown. The inverter output is immediately switched off.

14 STATUS AND ALARM INDICATORS

A description of the derivation of all alarm and operating states displayed on the Operating Panel is given in the table below. This is followed by a description of the status and fault indicators.



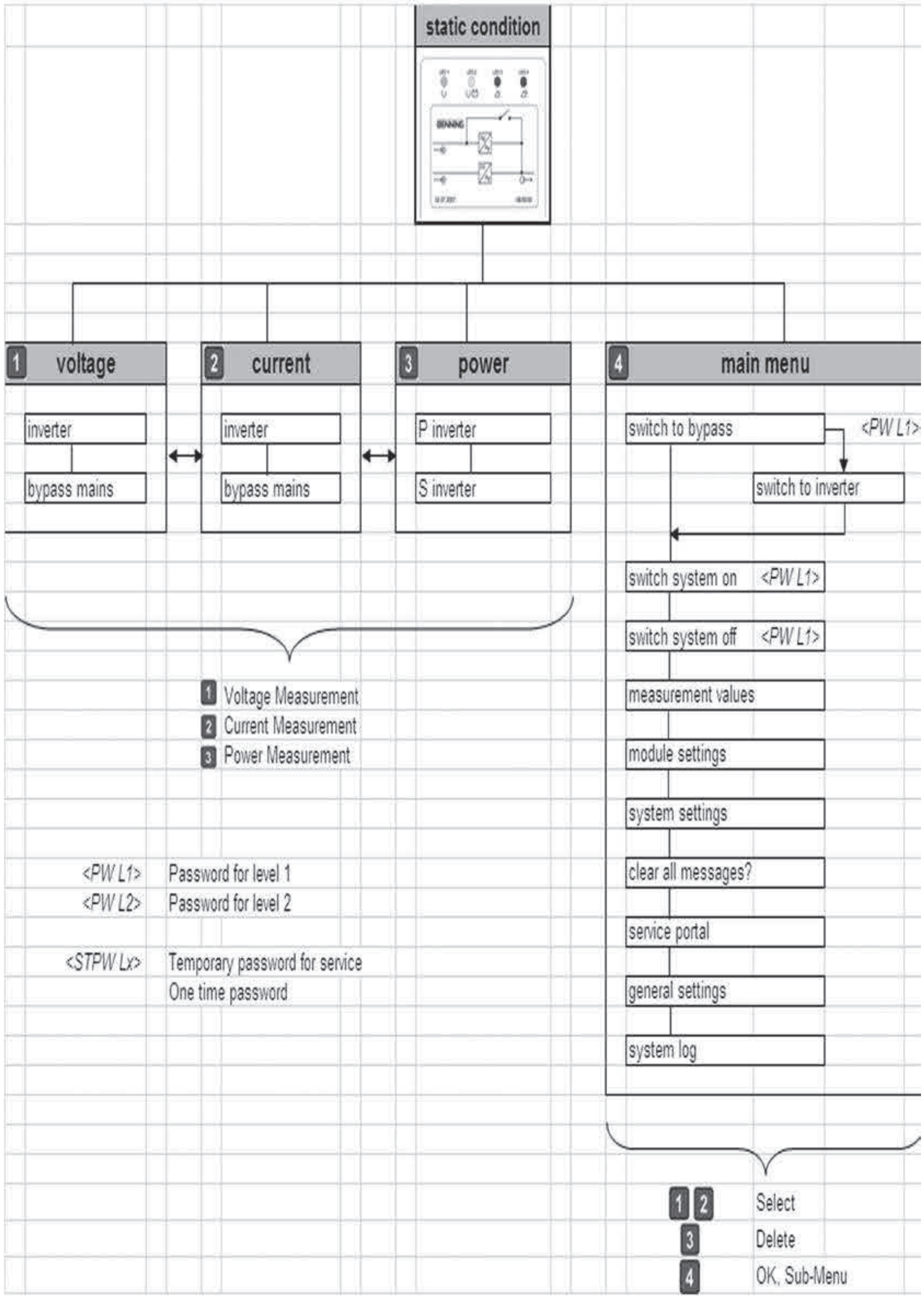
No.	Error messages	Reason for error message
0	Configuration Error	Configuration error in the battery or system configuration
1	-	
2	Contact error	Contact error in the input plug (bus address not recognised correctly)
3	-	
4	Can Master Error Bus off	Bus node switched off due to fault on master CAN bus
5	Can Slave Error Bus off	Bus node switched off due to fault on slave CAN bus
6	Sync Error Master	Synchronisation problems (master synchronisation line)
7	Sync Error Slave	Synchronisation problems (slave synchronisation line)
8	Reset Master uC	The master DSP controller has carried out a RESET
9	Reset Slave uC	The slave DSP controller has carried out a RESET
10	CAN Message lost Master	Master message to be received / transmitted not received / acknowledged in time
11	CAN Message lost Slave	Slave message to be received / transmitted not received / acknowledged in time
12	Overload Inverter	Load >100% in inverter operation
13	Overload Bypass	Load >100% in bypass operation
14	Overtemperature	Overtemperature on heat sink
15	Load Voltage Out of range	Output voltage not OK
16	Battery Test error	Fault with capacity test.
17	Inverter Voltage Out of range	Inverter output voltage not in specified range
18	Bypass Input out of range	Bypass input voltage not in specified range
19	Rectifier Input out of range	Rectifier input voltage not in specified range
20	Battery voltage out of range	Battery voltage not in specified range
21	Battery Circuit Test error	Battery circuit not OK or initial battery circuit test not yet complete
22	DC link voltage out of range	DC link voltage outside the specified range
23	AC Regulation Error	AC regulator fault / appearance of offset voltage on inverter output
24	DC Regulation Error	DC regulator fault
25	Bypass blocked	Bypass blocked / not possible to switch from inverter path to bypass path
26	Backfeed Error	
27	Auxiliary Voltage out of range	Internal supply voltage to modules not OK

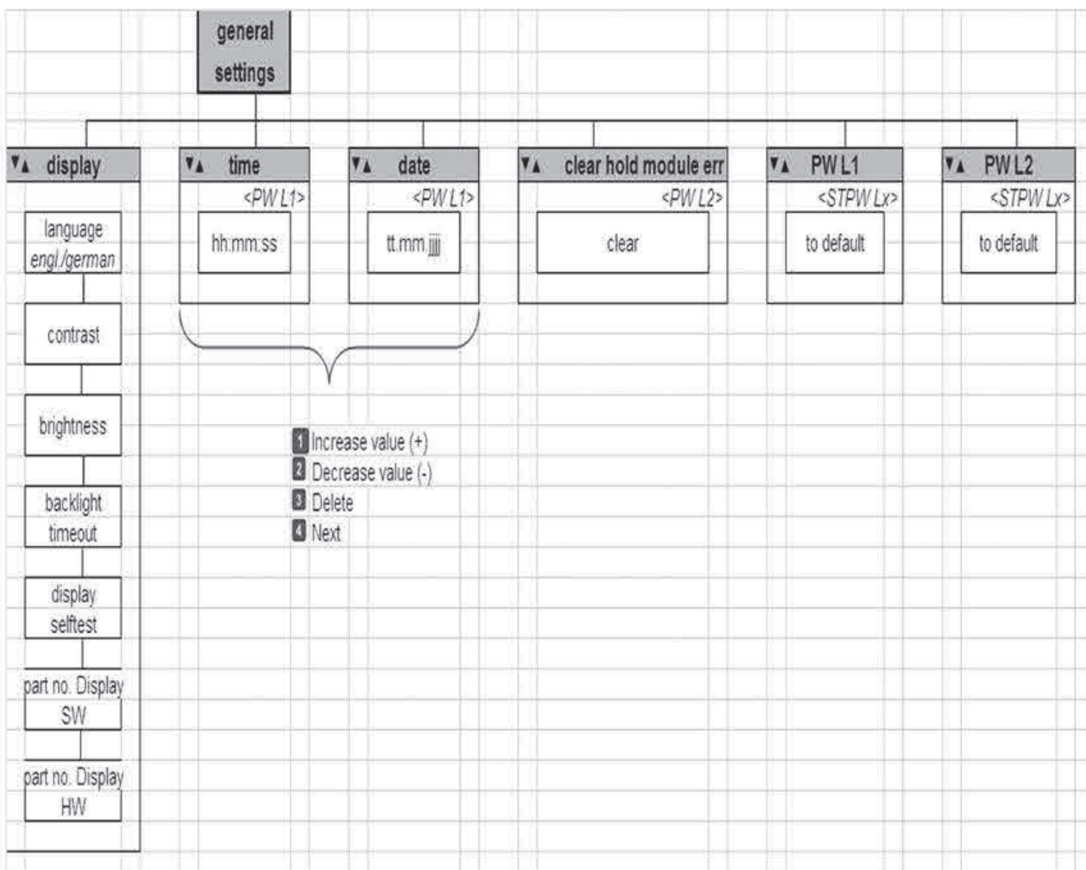
28	Output Contactor Error	Output contactor not energised although activated
29	-	
30	Rectifier Error	Mains input voltage not OK or step-up converter control fault
31	Battery Booster Error	Battery input voltage not OK or step-up converter control fault
32	Battery Charger Error	Fault in the battery chargers / battery charger not enabled
33	Inverter Error	Fault in inverter
34	Bypass Error	Fault in bypass circuit
35	-	
36	-	
37	-	
38	-	
39	SCI Error Master	Fault on the master DSP controller serial interface
40	SCI Error Slave	Fault on the slave DSP controller serial interface
41	Processor/peripheral error master	Fault on an internal peripheral of the master DSP controller
42	Processor/peripheral error slave	Fault on an internal peripheral of the slave DSP controller
43	Address Redundancy Error	Depending on the selected redundancy, not enough inverter modules or bypass modules available
44	Power Redundancy Error	The (power-related) redundancy is no longer guaranteed due to the load being exceeded.
45	Peripheral Module lost Error	A bus node but not a UPS module is no longer active
46		
47		
48		
49	internal Software error	Internal software fault
50	CAN Address error	An address has been read in twice or an address has not been recognised
51	CAN Member table mismatch	The table of existing master bus nodes differs from the table of existing slave bus nodes
52	Battery warning level reached	Battery undervoltage (battery voltage level ≤ set warning level)
53	Battery critical level reached	Battery undervoltage (battery voltage level ≤ set critical warning level)
54...	-	
...63	-	

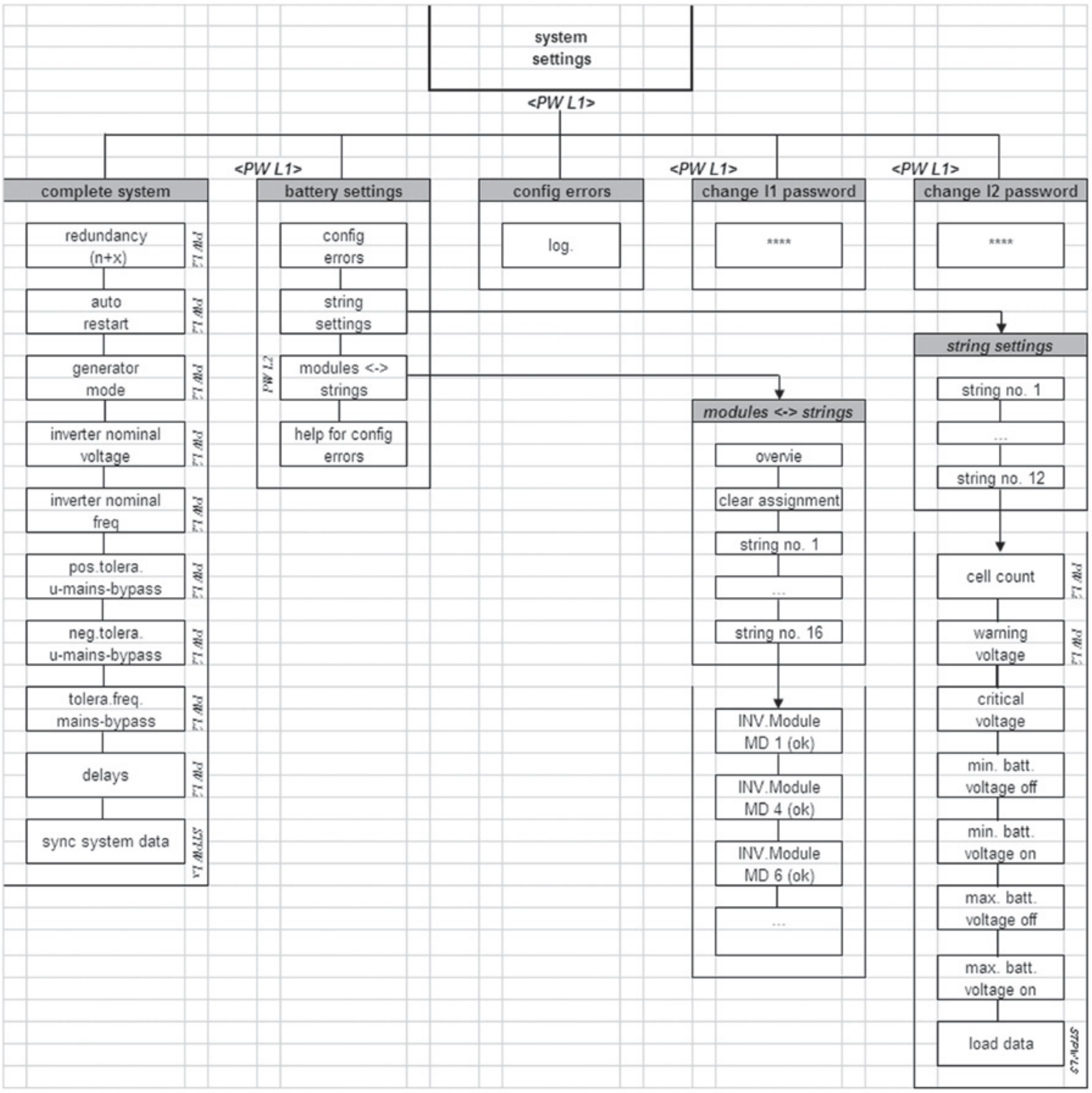
No.	Status messages	Reason for status message
64	program start master	This message is normally set when initialising the DSP controller.
65	-	
66	UPS on	Module has been switched on by means of the switch on the front
67	rectifier on and ok	The rectifier / step-up converter is switched on and is working OK
68	DC precharged mains op.	The two halves of the DC link circuit have been precharged from the mains
69	DC precharged batt op.	The two halves of the DC link circuit have been precharged from the battery
70	precharging cir. Enabled	The two halves of the DC link circuit have been charged from the mains using phase angle control
71	mains-SCR on	Input mains thyristors have been switched on.
72	battery-SCR on	Input battery thyristors have been switched on.
73	booster enabled	The DC link circuit step-up converter has been switched on.
74	battery charger is on	The battery charger has been switched on.
75	battery charger const I	Battery charging with constant current (I leg)
76	battery charger const U	Battery charging with constant voltage (U leg)

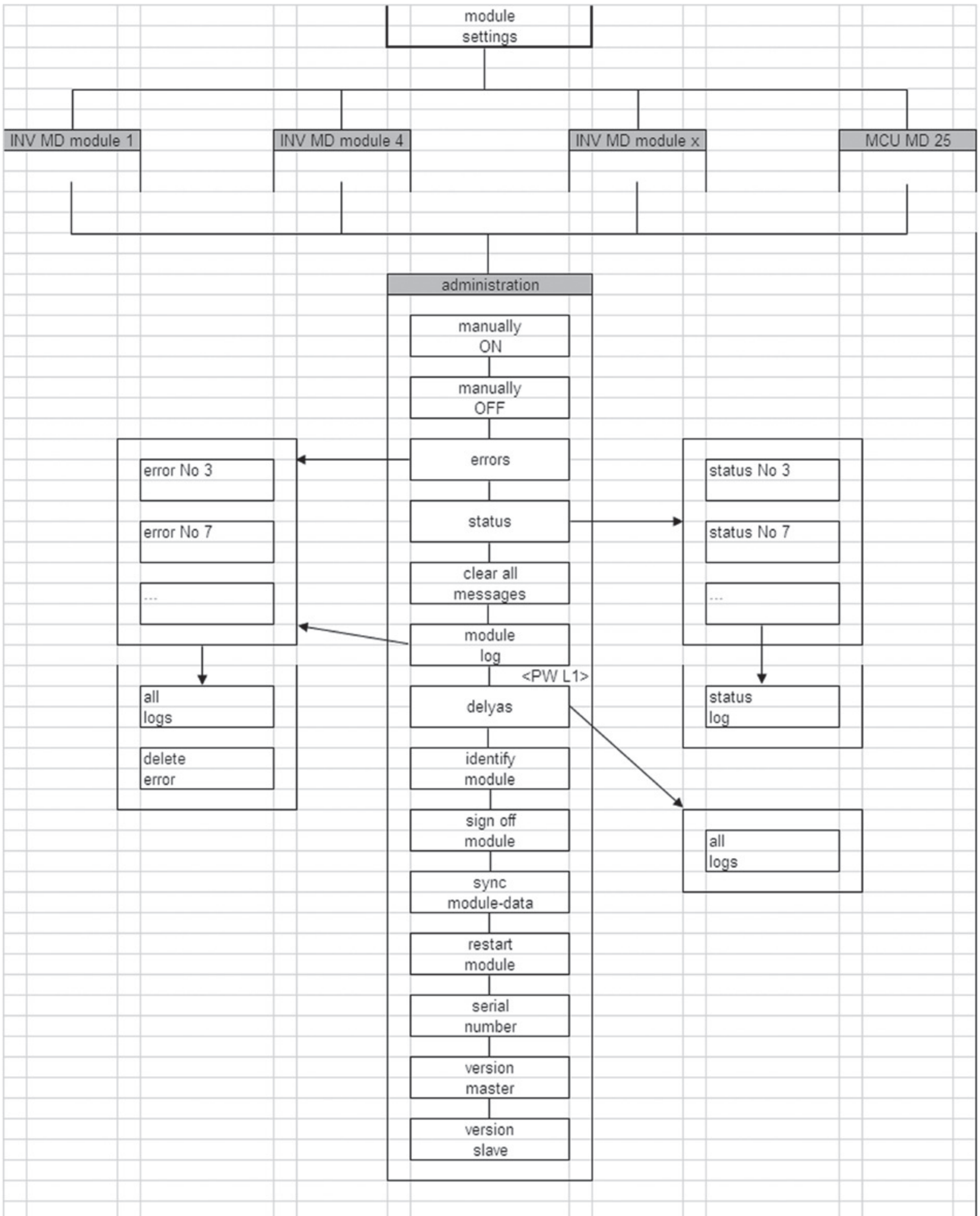
77	Free	
78	inverter stopped by slave	The inverter has been stopped by the slave controller from the additional redundant monitoring of various measurements due to an implausible measurement.
79	bypass stopped by slave	The bypass thyristors have been stopped by the slave controller from the additional redundant monitoring of various measurements due to an implausible measurement.
80	Free	
81	Free	
82	input voltage DC-link ok	The DC link circuit voltages are within their desired range
83	inverter enabled	The inverter is switched on
84	output voltages L-N ok	The output voltages between phase (L) and neutral (N) are within their desired range
85	output voltages L-L ok	The output voltages between phases (L-L) are within their desired range.
86	Free	
87	Free	
88	CAN master allowed	The module is ready to become master.
89	ready to make power	The module is ready to supply output power.
90	switng. out-cont possible	The inverter is able to supply output power.
91	PLL locked	The inverter output voltage is synchronised with the bypass input.
92	output contactor closed	The inverter output contactor is energised (contacts are closed)
93	Free	
94	rectifier operation	The mains input thyristors are switched on.
95	inverter operation	The output is being fed by the inverter.
96	bypass operation	The output is being fed by the bypass supply.
97	battery operation	The UPS is being supplied by the battery / power is being taken from the battery.
98	-	
99	man bypass switch closed	The manual bypass switch is closed.
100	bypass parallel operation	The unit is supplying power to the output in parallel with other modules.
101	-	
102	module became CAN-master	This status message is set when the module has become master.
103	Flash programming active	This status message is set when the DSP controller is being programmed.
104	time changed	The system time in the module has been reset.
105...	-	
...127	-	

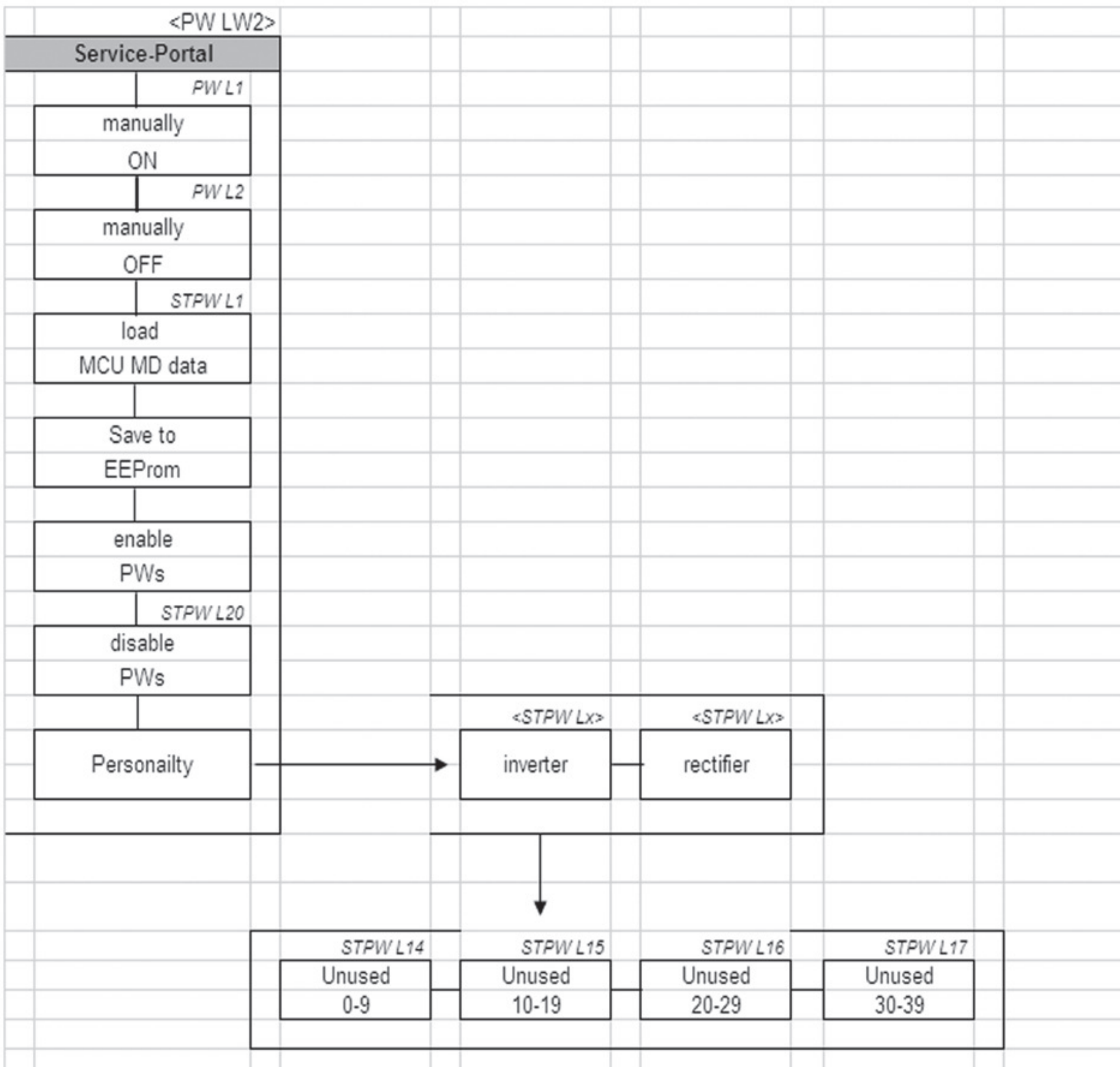
15 MENU STRUCTURE

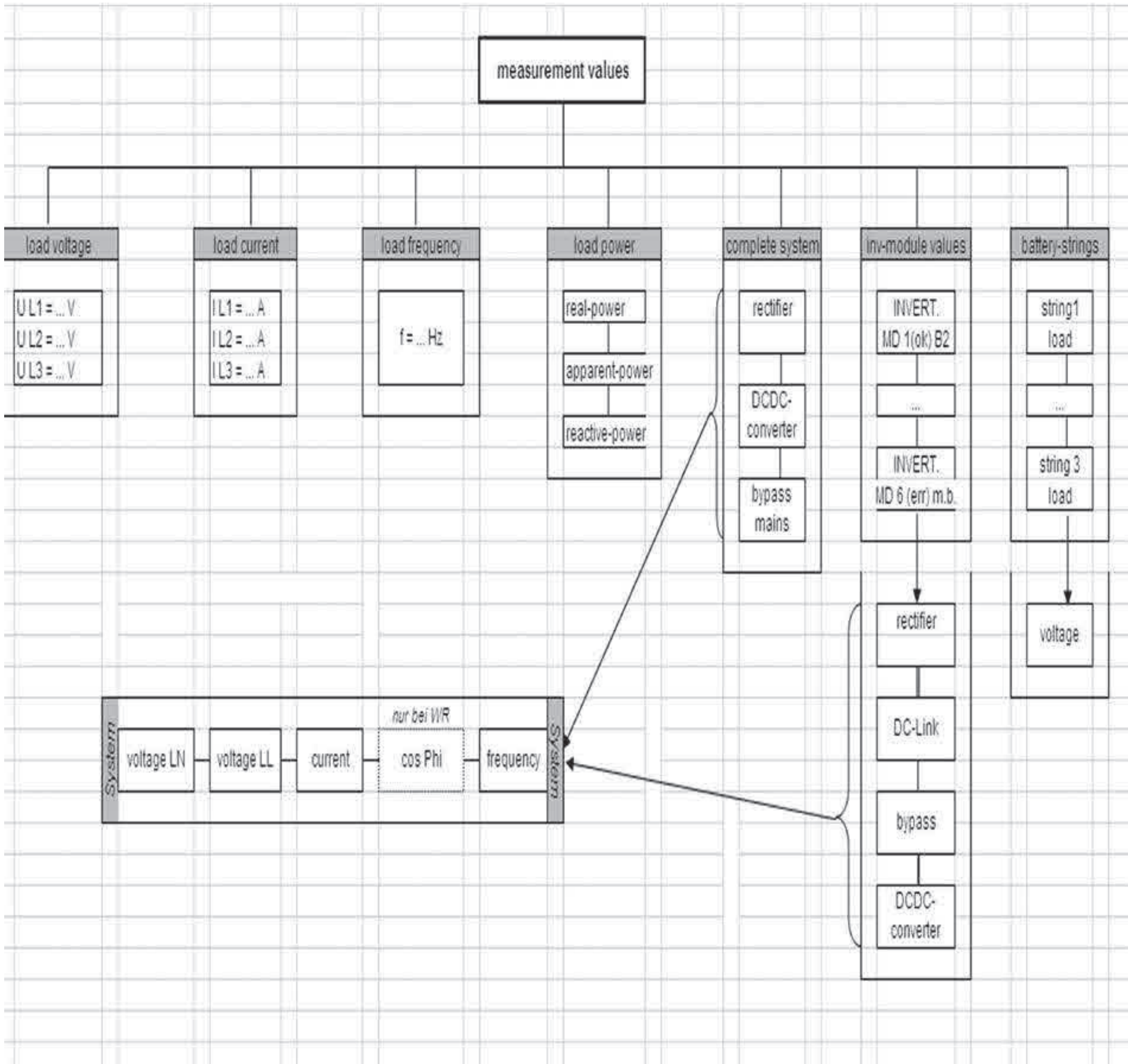



general settings
display
language engl./german
contrast
brightness
backlight timeout
display selftest
part no. Display SW
part no. Display HW
time
<PW L1>
hh:mm:ss
date
<PW L1>
tt.mm.jjjj
clear hold module err
<PW L2>
clear
PW L1
<STPW Lx>
to default
PW L2
<STPW Lx>
to default
1 Increase value (+)
2 Decrease value (-)
3 Delete
4 Next


system
settings
<PW L1>
complete system
redundancy
(n+x)
auto
restart
generator
mode
inverter nominal
voltage
inverter nominal
freq
pos.tolera.
u-mains-bypass
neg.tolera.
u-mains-bypass
tolera.freq.
mains-bypass
delays
sync system data
<PW L1>
battery settings
config
errors
string
settings
modules <->
strings
help for config
errors
PW L2
config errors
log.
<PW L1>
change l1 password
****
<PW L1>
change l2 password
****
string settings
string no. 1
...
string no. 12
cell count
warning
voltage
critical
voltage
min. batt.
voltage off
min. batt.
voltage on
max. batt.
voltage off
max. batt.
voltage on
load data
modules <-> strings
overvie
clear assignment
string no. 1
...
string no. 16
INV.Module
MD 1 (ok)
INV.Module
MD 4 (ok)
INV.Module
MD 6 (ok)
...


module
settings
INV MD module 1
INV MD module 4
INV MD module x
MCU MD 25
administration
manually
ON
manually
OFF
errors
status
clear all
messages
module
log
<PW L1>
delyas
identify
module
sign off
module
sync
module-data
restart
module
serial
number
version
master
version
slave
error No 3
error No 7
...
all
logs
delete
error
status No 3
status No 7
...
status
log
all
logs


<PW LW2>
Service-Portal
PW L1
manually ON
PW L2
manually OFF
STPW L1
load MCU MD data
Save to EEProm
enable PWs
STPW L20
disable PWs
Personailty
<STPW Lx>
inverter
<STPW Lx>
rectifier
STPW L14
Unused 0-9
STPW L15
Unused 10-19
STPW L16
Unused 20-29
STPW L17
Unused 30-39


measurement values
load voltage
U L1 = ... V
U L2 = ... V
U L3 = ... V
load current
I L1 = ... A
I L2 = ... A
I L3 = ... A
load frequency
f = ... Hz
load power
real-power
apparent-power
reactive-power
complete system
rectifier
DCDC-converter
bypass mains
inv-module values
INVERT. MD 1(ok) B2
...
INVERT. MD 6 (err) m.b.
rectifier
DC-Link
bypass
DCDC-converter
battery-strings
string1 load
...
string 3 load
voltage
System
voltage LN
voltage LL
current
nur bei WR
cos Phi
frequency
System

16. MAINTENANCE AND CUSTOMER SERVICE

In order to ensure trouble-free operation and longevity, we recommend that the air inlets in the front door and air outlet in the back half of the cabinet roof be checked at regular intervals (e.g. monthly) for obstructions, and cleaned if required, e.g. by vacuuming the grids and, if necessary, replacing the intake air filter in the cabinet doors.

Replacement filters can be obtained from BENNING. See Section 18- Parts List.

⚠ Do not use compressed air under any circumstance whatsoever, as dust particles may ingress into the inside of the INVERTER system and cause faults.

16.1 ACTIVATION OF SERVICE BYPASS VIA MANUAL BYPASS SWITCH (MBS)

The internal Manual Bypass Switch is used to continue to supply the load during maintenance or repair work. To do this, the bypass is first switched on at the operating panel (Menu/Switch to bypass). The manual bypass switch Q5 can then be closed. This switches AC supply 2 (bypass input) through to the system output. The system can now be completely switched off from the operating panel. The modules can now be removed (e.g. for servicing) without affecting the system output voltage. In doing so, it must be noted that **the module carriers continue to be supplied with ac voltage from the bypass.**

⚠ Caution!
When the service bypass is activated, the supply reliability of the loads depends directly on the quality and availability of the back-up ac supply network.

16.2 ENDING SERVICE BYPASS OPERATION (WITHOUT INTERRUPTION)

⚠ IMPORTANT!
Before switching back, it must be ensured that the number of modules fitted is sufficient to be able to supply the load power. All bypass fuses (on the front of the module) must be fitted and

"switched on". The fuses can be “switched on” by the AC Bypass circuit breaker located in the service panel.

The system must be switched on from the operating panel as described in Chapter 13.1. The mimic diagram in the LCD display must then be checked to see that the bypass energy path to the modules is activated (this can be seen from the arrow at the output of the module bypass symbol).

16.3 SERVICE HOTLINE

For technical support and information on INVERTRONIC modular or other products within our product range please contact

Benning Power Electronics

1220 Presidential Drive Suite 100

Richardson, TX 75081 USA

www.benning.us

800.910.3601

and follow the prompts for tech support

16.4 MAINTENANCE AND SERVICE CONTRACTS

If you require a system check at regular intervals for safety reasons, e.g. an annual inspection, please contact us. We will be pleased to submit a quotation for an appropriate contract.

Customer service:

For customer service requirements our service centre can be contacted under the telephone number

1 800.910.3601

17 Technical Specifications

Invertronic Modular 3 Phase Inverter		
AC OUT	Inverter Module Rating	10kVA / 8kW at 0.8 power factor inductive
	Maximum System Capacity	80kVA / 64kW at 0.8 power factor inductive
	Maximum Modules Per Cabinet	8
	Maximum Cabinets	2
	AC Output Volts	480 VAC 3 phase, 4 wire, Wye connected
	AC Output Amps	27.8A per phase at full load
	AC Output Frequency	60Hz +/- .01% on internal crystal; tolerance is programmable when synchronized to commercial AC bypass
	Maximum Allowable Phase Imbalance	100%, up to full load per phase current rating
	Load Power Factor Range	0.7 lagging (inductive) to 0.8 leading (capacitive), standard UPS de-rating
	Output Regulation	Static: +/- 1%; Dynamic: +/-5% max with 100% step load change, settling time: <10 msec
	Efficiency	>86% @ full load
	Crest Factor Accommodated	2.8 for nominal power (>3.0 possible with derated output power)
	Distortion	<2% THD into a linear load; pure sine wave output
	Overload Capability	125% for 10 minutes; 200% for 4 seconds
DC IN	Input Voltage	Nominal: 48VDC, Operating Range 42-60VDC
	Input Current	Maximum: 228A at 42VDC at full load, Nominal: 138A at 54VDC at 80% load
	Inrush Current	Soft-start circuit limits inrush to <25% of full load current
	Reflected Noise on DC Input	<2mV psophometric
SYSTEM	Static Bypass Switch (SBS)	208VAC, 3 Phase SCR bridge built into each module
	SBS Priority	Inverter Priority Only; Offline mode not possible
	Transfer Time	SBS is make-before-break; 2ms typical, 6ms maximum
	SBS Overload Capability	1000% for 8ms
	SBS Transfer Criteria	Overload, modules over temperature, short circuit on output, low DC voltage, manual initiation, output AC volts out of range
	External Alarming	10 Outputs include: Major, Minor, Mains Fail, DC Fail, Inverter Fail
	Metering	Phase voltages, currents, kW, kVA, kVAR
	Indicators	13 Programmable LEDs on front door display panel
MECHANICAL	Module Weight & Dimensions	99lbs. (45kg); 19.9” x 17.7” x 8.75” (5RU) (505 x 450 x 222 mm)
	Cabinet Weight & Dimensions (each)	1,200lbs. (544kg); 23.5” W x 31.5” D x 84” H (600 x 800 x 2134 mm)
	Transformer Cabinet W & D	1,900lbs. (862kg); 23.5” W x 31.5” D x 84” H (600 x 800 x 2134 mm)
	Heat Output	<5000 BTUs / hour / module, full load @ 54VDC input
	Operating Temperature Range	0-40°C
	Operating Humidity Range	0-95% relative humidity, non-condensing
	Elevation	Fully rated to 1000M, de-rated thereafter
DESIGN	Safety	cETLus Listed (ul60950, ul1778)
	Design	NEBS Level 3 Certified, Zone 4 cabinets available
	EMI Emissions	EN 62040-2 classification C3, FCC Class A
	EMI Immunity	EN 61000-4-4, EN 61000-4-5
	Electrostatic Discharge Immunity	EN 61000-4-2, (level: 4kV contact, 8kV air discharge)

18 PARTS LIST

Part Number	Part Description
120028	10kVA Invertronic inverter module, -48VDC input, 120/208VAC three phase output.
Buss C14G50	50A Fuse for SBS Protection in Invertronic Modules, 3 required.
707258	Cabinet Front Door Intake Air Filter

19 BILL OF MATERIAL

Lines

Item number	Index	Item name	Drawing number	Item group	Unit	Purchase Standard order quantity	Min. order quantity	Inventory Standard order quantity	Min. order quantity	Cost price	Price
6140029268	A	INVERTRONIC MODULAR, 40KVA, 4	0	FIG	PCS	1.00	0.00	1.00	0.00	13,166.50	0.00

Item number	Index	Item name	Drawing number	Item type	Position	Oper. No.	Quantity	Per series	Unit	Item destination	Norm
6140028413	A	INVERTRONIC CAB, 30KVA, TWO S 6140028413	0	BOM	10		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140017226		INVERTRONIC CABINET SUB-ASSE 807-0300-100	0	BOM	10		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140026016	3	FRAME, INVERTRONIC 6140026016	6140026016	Item	10		1.0000	1	PCS		BOM_Transfer 2012_04_30
530644		INVERTRONIC CABINET FRONT RE 530644	3	Item	20		2.0000	1	PCS		BOM_Transfer 2012_04_30
563630		CORNER RETURNING, 2133 563630	0	Item	30		2.0000	1	PCS		BOM_Transfer 2012_04_30
563631		SIDE PANEL ANGLE 2133 563631	0	Item	40		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140018386		BUSHING_HEYCO-3121 THICK PAN 861-1400-0019	861-1400-0019	Service			2.0000	1	PCS		
787505		NUT,CAPTIVE M6 787505	0	Service	60		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140028416	A	INVERTRONIC CAB, 30KVA, TWO S 6140028416	0	BOM	20		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140018645	2	PANEL, SIDE INVERTRONIC_84" x 861-3401-013	861-3401-013	Item	30		2.0000	1	PCS		BOM_Transfer 2012_04_30
563636		REAR PANEL WITH VENTIL. 2133X 563636	1	Item	40		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140014512	1	PANEL, INVERTRONIC MBS COVEI 530657-TOP	530657-TOP	Item	50		1.0000	1	PCS		BOM_Transfer 2012_04_30
746732		200A MBS HANDLE KIT 746732	0	Item	60		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140018498	1	KICK PLATE - FRONT, 4-INVERTRC 861-1500-070	861-1500-070	Item	70		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140018250	B	KICKPLATE, REAR (INVERTRONIC) 861-0183-240	861-0183-240	Item	80		1.0000	1	PCS		BOM_Transfer 2012_04_30
786547		SCREW, FLAT HEAD, 4MM, INVERT 786547	0	Service	90		2.0000	1	PCS		BOM_Transfer 2012_04_30
514076		Blanking plate 536x5HE 514076	62025.01M096A2	Item	130		2.0000	1	PCS		BOM_Transfer 2012_04_30
707079	00	LAMIMATION, SEGMENTAL 707079	0	Item	10		1.2000	1	KG		
6140017827		Extended Pallet Rack 849-0002-103	0	Service	140		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140006465	A	NAMEPLATE KIT, ETCHED PLASTI(151-3100-200	A	Item	150		1.0000	1	PCS		BOM_Transfer 2012_04_30
10001690	1	INVERTRONIC, FRAME PART 10001690	0	Item			8.0000	1	PCS		
6140018136		PLATE, SIDE MOUNTING-INVERTR 861-0183-120	861-0183-120	Item	30		2.0000	1	PCS		BOM_Transfer 2012_04_30
523876		STROM-SCHIENE (PE) 245X20X5 523876	61596.00M042A4	Item	40		1.0000	1	PCS		BOM_Transfer 2012_04_30
741032	00	Copper bar 5.0x 20.0x4000-SQRSH 741032	EN13599- 20.0* 5.0	Item	10		0.1900	1	M		
787542	00	Stud bolt M 8x25 787542	HFH M 8*25	Item	20		8.0000	1	PCS		
6140017224		SUBASSY,BREAKER/MBS/BACKFE 807-0300-020	0	BOM	50		1.0000	1	PCS		BOM_Transfer 2012_04_30
10046096	00	Switch-disconnector 690V 200A 3-pc 10046096	INV200	Item	20		1.0000	1	PCS	Q5, MBS	BOM_Transfer 2012_04_30
748238		Auxiliary contact Für LS Interpact. 1W 748238	29452	Item	30		2.0000	1	PCS		BOM_Transfer 2012_04_30
523876		STROM-SCHIENE (PE) 245X20X5 523876	61596.00M042A4	Item	50		3.0000	1	PCS		BOM_Transfer 2012_04_30
741032	00	Copper bar 5.0x 20.0x4000-SQRSH 741032	EN13599- 20.0* 5.0	Item	10		0.1900	1	M		
787542	00	Stud bolt M 8x25 787542	HFH M 8*25	Item	20		8.0000	1	PCS		
6140001272	A	Bus Bar 10001986-US	A	Item	60		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140001273	A	Bus Bar 10001987-US	A	Item	70		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140001274	A	Bus Bar 10001989-US	A	Item	80		1.0000	1	PCS		BOM_Transfer 2012_04_30
709243		Flex Cupper-Bar 0-180A 2 (250mm) 709243	0	Item	90		12.0000	1	PCS		BOM_Transfer 2012_04_30
6140011026		RELY, CONTACTOR, 3 PHASE, PAN 268-6600-200	0	Item	130		1.0000	1	PCS	BFC	BOM_Transfer 2012_04_30
6140018126		PLATE, MOUNTING, BREAKERS, X 861-0183-107	861-0183-107	Item			1.0000	1	PCS		

Lines

Item number	Index	Item name	Drawing number	Item type	Position	Oper. No.	Quantity	Per series	Unit	Item destination	Norm
6140010073		Standoff, Female - Female, M5 x 0.8, 246-7100-001	0	Item	60		38.0000	1	PCS		BOM_Transfer 2012_04_30
6140025326		SCREW, SET, M5-0.8 X 16MM CUP SCSSM0508016RS	0	Service	61			1	PCS		BOM_Transfer 2012_04_30
6140006981	0	STDOFF,INS,GLASTC,FE-FE,5/16DI 179-2001-080	0	Item	65		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140006980		STDOFF,INS,GLASTC,FE-FE,5/16DI 179-2001-064	0	Item	66		6.0000	1	PCS		BOM_Transfer 2012_04_30
516191		CROSS BRACE XXX6 PSJ 516191	4	Item	70		1.0000	1	PCS		BOM_Transfer 2012_04_30
561125		BUSVERTEILER ENERTRONIC 561125	0	Item	130		1.0000	1	PCS		BOM_Transfer 2012_04_30
718366		CABLE CAN BUS, RJ-45, 1M 718366	0	Item	140		4.0000	1	PCS		BOM_Transfer 2012_04_30
759190		PATCHKABEL KAT.5E S-UTP / 2M 759190	0	Item	150		5.0000	1	PCS		BOM_Transfer 2012_04_30
734833		Cable, Connect RJ45 90deg, .4M, Blu 734833	0	Item	160		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140029912		MASS BOM REPLACEMENT 6140029912		Service	170		2.0000	1	PCS		BOM_Transfer 2012_04_30
718773		TERMINAL BLOCK, TYPE ST2,5-3L 718773	0	Item	180		14.0000	1	PCS		BOM_Transfer 2012_04_30
718774		Cover 718774	0	Item	190		3.0000	1	PCS		BOM_Transfer 2012_04_30
720666		END CLAMP STOP DIN PAIL PHOEI 720666	0	Item	200		4.0000	1	PCS		BOM_Transfer 2012_04_30
530658		cover bottom modular 7feet 6x 530658	2	Item	210		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140014550		SUBASSY, INVERTRONIC,SHELF 548408-US	A	BOM	230		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140029151	1	SLIDING RAIL (LEFT) 6140029151	6140029151	Item	10		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140029152	1	SLIDING RAIL (RIGHT) 6140029152	6140029152	Item	20		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
514050		Sliding Rail, Invertronic Carrier 514050	1	Item	30		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
514065		GUIDE BAR, INVERTRONIC CARRIE 514065	0	Item	40		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786634		Screw, M3 x 6mm, PFH, Thread Rolli 786634	0	Service	50		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
709086		CONTACT SPRING 709086	0	Item	60		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140029140	1	BACK PLATE 6140029140	6140029140	Item	80		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
561167		Plug, Cable, Input, Invertronic Carrier 561167	0	Item	90		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
561168		Plug, Cable, Output, Invertronic Carrie 561168	0	Item	100		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
576590		BUS CARD ENERTRONIC, INVERTI 576590	0	Item	110		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140012069		CSA TYPE SIS 90 C 600 V 18 GA. W 294-5016-001	0	Service	130		1.0000	1	FT	Carrier	BOM_Transfer 2012_04_30
710700		CONNECTOR, 2 POLES 710700	0	Item	140		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
761598		CONTACT, SVH-21T-1.1L, JST 761598	0	Item	150		4.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
10000733	A	Copper Bar, input to invertronic modu 10000733	A	Item	160		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140010073		Standoff, Female - Female, M5 x 0.8, 246-7100-001	0	Item	170		6.0000	1	PCS	Temporary Change to use up Benning Side Panels	BOM_Transfer 2012_04_30
6140025326		SCREW, SET, M5-0.8 X 16MM CUP SCSSM0508016RS	0	Service	171		4.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140025325	1	SCREW, SET, M5-0.8 X 12MM CUP SCSSM0508012RS	1	Service	172		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786603		WASHER,FLAT 1/4" ST-ZN PLATED 786603	0	Service	180		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
514063		Guide Pin, Invertronic Carrier 514063	0	Item	190		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
721989		Mounting Screw, M4 x 7mm, Invertror 721989	0	Item	200		4.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140029108	1	REAR STRAP 6140029108	6140029108	Item	210		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786012		WASHER,FLAT A4.3 786012	0	Service	220		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
785521		WASHER,SPRING LOCK 785521	0	Service	230		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786403		NUT,HEX M4 786403	0	Service	240		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
709243		Flex Cupper-Bar 0-180A 2 (250mm)	0	Item	250		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30

Lines

709243

Item number	Index	Item name	Drawing number	Item type	Position	Oper. No.	Quantity	Per series	Unit	Item destination	Norm
715591		RIVET 715591	0	Item			6.0000	1	PCS	Carrier	
6140012971		SUPPORT ISOLATOR M6x25 FEM-F 321025	0	Item			4.0000	1	PCS	Temporary Change to use up Benning Side Panels	
759123	1	Cable, SAT Bus, RJ45 - RJ45, .5M, D 759123	1	Item			2.0000	1	PCS		
530535		STROMSCHIENE N 6X MODULAR L 530535	4	Item	240		1.0000	1	PCS		BOM_Transfer 2012_04_30
6140001275	A	Bus Bar 10001993-US	A	Item	250		1.0000	1	PCS		BOM_Transfer 2012_04_30
530531		STROMSCHIENE 6X MODULAR KU 530531	4	Item	260		4.0000	1	PCS		BOM_Transfer 2012_04_30
530530	A	BUS BAR,INVERTRONIC, 1434 (DO 530530	A	Item	270		3.0000	1	PCS		BOM_Transfer 2012_04_30
6140012069		CSA TYPE SIS 90 C 600 V 18 GA. W 294-5016-001	0	Service	280			1	FT		BOM_Transfer 2012_04_30
6140003412		Obsolete, Screw, HHCS, 3/8-16 x 1 1. 100301-146	0	Service	300			1	PCS		BOM_Transfer 2012_04_30
6140012971		SUPPORT ISOLATOR M6x25 FEM-F 321025	0	Item			2.0000	1	PCS		
786096		WASHER,FLAT BRASS M10 786096	0	Service	310			1	PCS		BOM_Transfer 2012_04_30
6140003495		Obsolete, Nut, 3/8, Brass 100305-005	0	Service	320			1	PCS		BOM_Transfer 2012_04_30
786842		WASHER,CONTACT 10MM 786842	0	Item	330		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140003515		Obsolete, Lockwasher, 3/8, Bronze 100308-010	0	Service	340			1	PCS		BOM_Transfer 2012_04_30
6140016373	1	CABLE, SEE DRAWING 705-XXXX-X 705-2211-090	705-XXX-XXX	Item			1.0000	1	PCS		
6140009105		WAGO, 3 CONDUCTOR, SPRING CI 222-413	0	Item			1.0000	1	PCS		
6140009105		WAGO, 3 CONDUCTOR, SPRING CI 222-413	0	Item			1.0000	1	PCS		
6140023436		INVERTRONIC, MCU2500INV CONT J-INVM-L12	A	BOM	20		1.0000	1	PCS		BOM_Transfer 2012_04_30
10000738		front door left 10000738	0	Item	10		1.0000	1	PCS		BOM_Transfer 2012_04_30
769077		HINGE, BLACK 769077	0	Item	20		3.0000	1	PCS		BOM_Transfer 2012_04_30
6140009974		PADLOCKABLE WINGKNOB LATCH 6140009974	0	Item	30		3.0000	1	PCS		BOM_Transfer 2012_04_30
6140009289		SINGLE POINT CAM, V-STYLE, SM 232111	0	Item	40		3.0000	1	PCS		BOM_Transfer 2012_04_30
6140018564	2	LABEL, DOOR, BENNING LOGO, BL 861-1600-001	861-1600-001	Item	70		1.0000	1	PCS		BOM_Transfer 2012_04_30
584318		INVERTRONIC SYSTEM INV MCU 584318	0	Item	80		1.0000	1	PCS		BOM_Transfer 2012_04_30
550703		Card, I/O RELIO ADBUS 2t 550703	0	Item	90		2.0000	1	PCS		BOM_Transfer 2012_04_30
548409		RAL7035, INVERTRONIC/ENVERTR 548409	DGMII RJ45	Item	100		1.0000	1	PCS		BOM_Transfer 2012_04_30
727141		*DON'T BUY* DOOR DAMPER 727141	0	Service	110		3.0000	1	PCS		BOM_Transfer 2012_04_30
10003653	0	BENNING EXTERNAL SNMP ADAPT 10003653	0	Item	120		1.0000	1	PCS		BOM_Transfer 2012_04_30
564061		Cover, 345 x 230 x x 564061	1	Item	130		1.0000	1	PCS		BOM_Transfer 2012_04_30
10006622		Board, Backfeed Detection Card 10006622	0	Item	140		1.0000	1	PCS		BOM_Transfer 2012_04_30
734624		RS232 NULL MODEM CABLE, PC LI 734624	0	Item	160		1.0000	1	PCS		BOM_Transfer 2012_04_30
762580	0	LEISTE, BUCHSE, 2-POLIG 762580	0	Item			1.0000	1	PCS		
709232		DIN RAIL CLIP, METAL 709232	0	Item			1.0000	1	PCS		
720582	0	LEISTE,BUCHSE, 3-POLIG 720582	0	Item			1.0000	1	PCS		
6140026647	A	INVERTRONIC, DUAL 200A OUTPU J-INVM-L26	0	BOM			1.0000	1	PCS		
6140008382		CIRCUIT BREAKER, TMAX 3 SERIE 212-1203-200	0	Item	10		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140025988	1	Breaker Filler Panel 6140025988	0	Item			1.0000	1	PCS		
6140025992	1	Terminal Block- mounting 6140025992	0	Item			2.0000	1	PCS		
6140025987	1	Panel, Invertronic Front Cover 6140025987	0	Item			1.0000	1	PCS		

Lines

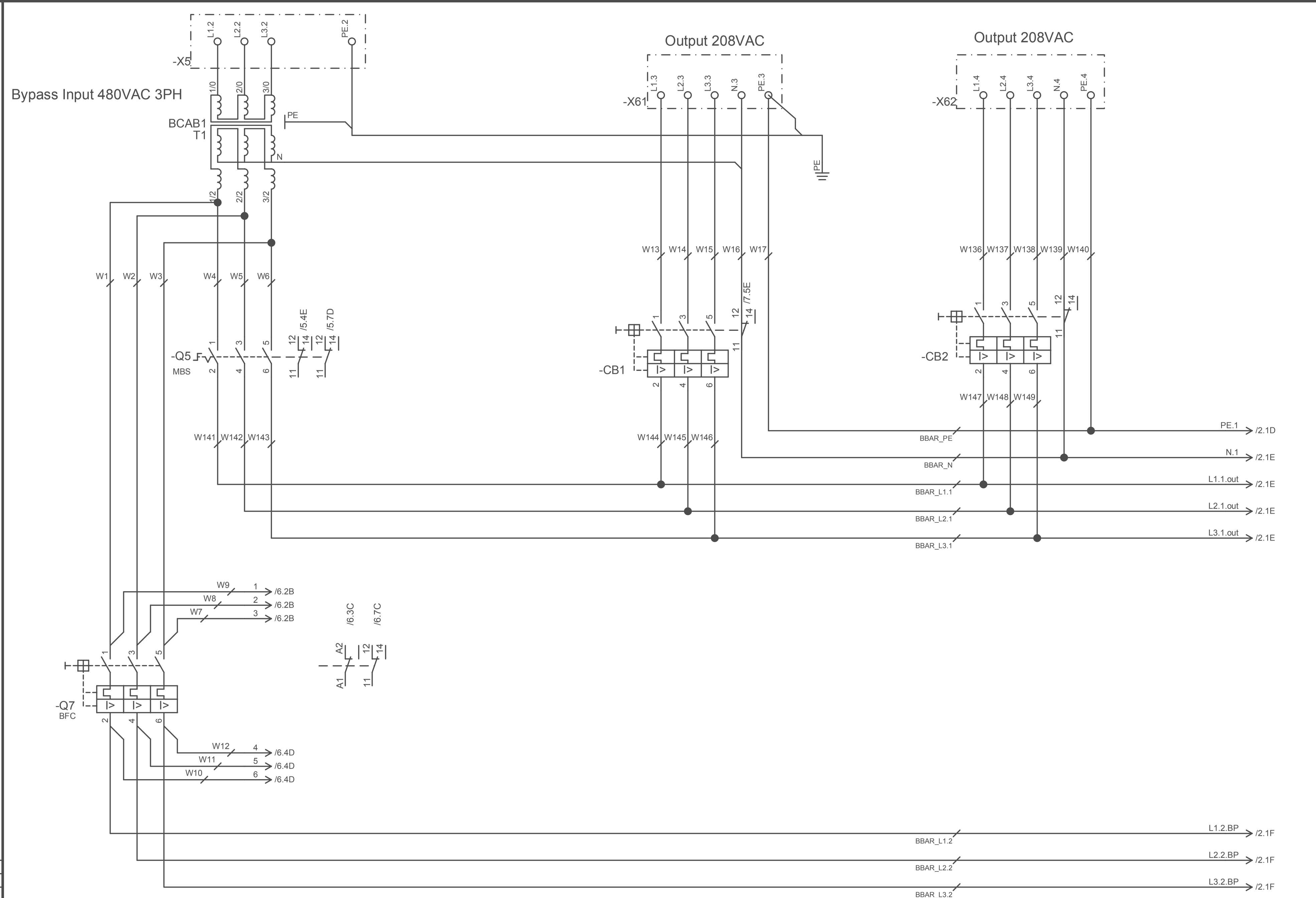
Item number	Index	Item name	Drawing number	Item type	Position	Oper. No.	Quantity	Per series	Unit	Item destination	Norm
6140008750		TERMINAL BLOCK, PANEL MOUNT 214-8701-003	0	Item	30		4.0000	1	PCS		BOM_Transfer 2012_04_30
6140008749		TERMINAL BLOCK, PANEL MOUNT 214-8701-002	0	Item	40		2.0000	1	PCS		BOM_Transfer 2012_04_30
6140008752		TERMINAL BLOCK COVER, HINGEI 214-8701-103	0	Item	50		3.0000	1	PCS		BOM_Transfer 2012_04_30
6140008751		TERMINAL BLOCK COVER, HINGEI 214-8701-102	0	Item	60		3.0000	1	PCS		BOM_Transfer 2012_04_30
6140022794	1	INVERTRONIC TOP HAT KIT, AC C(EC-775	EC-775	Item			1.0000	1	PCS		
6140028922	1	CONDUIT PANEL,INVERTRONIC 6140028922	6140028922	Item			1.0000	1	PCS		
6140028921	1	TOP, DUAL TB, INVERTRONIC 6140028921	6140028921	Item			1.0000	1	PCS		
6140018652	1	INVERTRONIC TOP HAT, REAR TOI 861-3401-020	861-3401-020	Item			1.0000	1	PCS		
6140029181		TRANSFORMER, ISOLATION, 480V. 070-121	0	Item			1.0000	1	PCS		
6140010061		LUG,CRMP,NON-INS,DUAL RING,4/ 246-6002-375	0	Service			2.0000	1	PCS		
6140008761		Marathon TB, 2 position, ST723B380: 214-8711-002	0	Item			4.0000	1	PCS		
10000724		MOUNTING PLATE 10000724	0	Item			1.0000	1	PCS		
6140028417	A	COVER FOR INVERTRONIC TRANS 6140028417	6140028417	Item			1.0000	1	PCS		
6140028418	A	MOUNTING BRACKETS FOR INVEF 6140028418	6140028418	Item			2.0000	1	PCS		
6140014550		SUBASSY, INVERTRONIC,SHELF 548408-US	A	BOM			2.0000	1	PCS		
6140029151	1	SLIDING RAIL (LEFT) 6140029151	6140029151	Item	10		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140029152	1	SLIDING RAIL (RIGHT) 6140029152	6140029152	Item	20		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
514050		Sliding Rail, Invertronic Carrier 514050	1	Item	30		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
514065		GUIDE BAR, INVERTRONIC CARRII 514065	0	Item	40		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786634		Screw, M3 x 6mm, PFH, Thread Rolli 786634	0	Service	50		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
709086		CONTACT SPRING 709086	0	Item	60		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140029140	1	BACK PLATE 6140029140	6140029140	Item	80		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
561167		Plug, Cable, Input, Invertronic Carrier 561167	0	Item	90		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
561168		Plug, Cable, Output, Invertronic Carri(561168	0	Item	100		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
576590		BUS CARD ENERTRONIC, INVERTF 576590	0	Item	110		1.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140012069		CSA TYPE SIS 90 C 600 V 18 GA. W 294-5016-001	0	Service	130		1.0000	1	FT	Carrier	BOM_Transfer 2012_04_30
710700		CONNECTOR, 2 POLES 710700	0	Item	140		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
761598		CONTACT, SVH-21T-1.1L, JST 761598	0	Item	150		4.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
10000733	A	Copper Bar, input to invertronic modu 10000733	A	Item	160		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140010073		Standoff, Female - Female, M5 x 0.8, 246-7100-001	0	Item	170		6.0000	1	PCS	Temporary Change to use up Benning Side Panels	BOM_Transfer 2012_04_30
6140025326		SCREW, SET, M5-0.8 X 16MM CUP SCSSM0508016RS	0	Service	171		4.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140025325	1	SCREW, SET, M5-0.8 X 12MM CUP SCSSM0508012RS	1	Service	172		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786603		WASHER,FLAT 1/4" ST-ZN PLATED 786603	0	Service	180		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
514063		Guide Pin, Invertronic Carrier 514063	0	Item	190		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
721989		Mounting Screw, M4 x 7mm, Invertror 721989	0	Item	200		4.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
6140029108	1	REAR STRAP 6140029108	6140029108	Item	210		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786012		WASHER,FLAT A4.3 786012	0	Service	220		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
785521		WASHER,SPRING LOCK 785521	0	Service	230		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
786403		NUT,HEX M4 786403	0	Service	240		6.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30
709243		Flex Cupper-Bar 0-180A 2 (250mm)	0	Item	250		2.0000	1	PCS	Carrier	BOM_Transfer 2012_04_30

Lines

709243

Item number	Index	Item name	Drawing number	Item type	Position	Oper. No.	Quantity	Per series	Unit	Item destination	Norm
715591		RIVET 715591	0	Item			6.0000	1	PCS	Carrier	
6140012971		SUPPORT ISOLATOR M6x25 FEM-F 321025	0	Item			4.0000	1	PCS	Temporary Change to use up Benning Side Panels	
759123	1	Cable, SAT Bus, RJ45 - RJ45, .5M, D 759123	1	Item			2.0000	1	PCS		
514076		Blanking plate 536x5HE 514076	62025.01M096A2	Item			3.0000	1	PCS		
707079	00	LAMIMATION, SEGMENTAL 707079	0	Item	10		1.2000	1	KG		
6140018643	1	SHELF, STABLIZER 861-3401-011	861-3401-011	Item			4.0000	1	PCS		
6140029812		UNISTRUT, A3300, 23" (600) 6140029812	6140029812-R2	Item			6.0000	1	PCS		
6140029288		UNISTRUT NUT, 5/16-18 6140029288	0	Item			4.0000	1	PCS		
6140018126		PLATE, MOUNTING, BREAKERS, X 861-0183-107	861-0183-107	Item				1	PCS		

20 DRAWINGS



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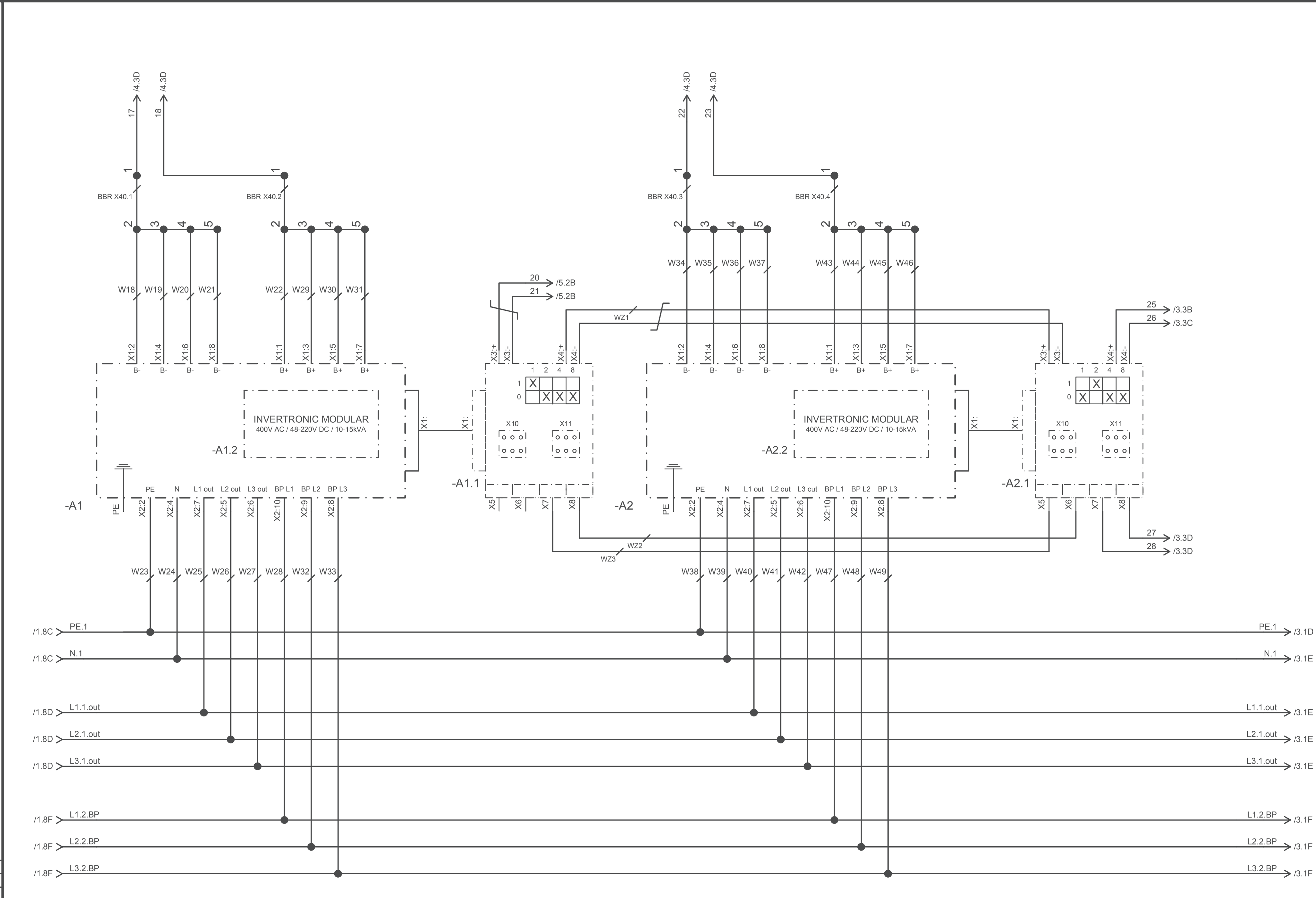
				Drawn	FCH	INVM-40kVA	Circuit Diagram
				Checked			6140029268.00E000
Rev.	Change	Date	Name	Approved			HP1

BENNING

Sheet 1
9 Sh.



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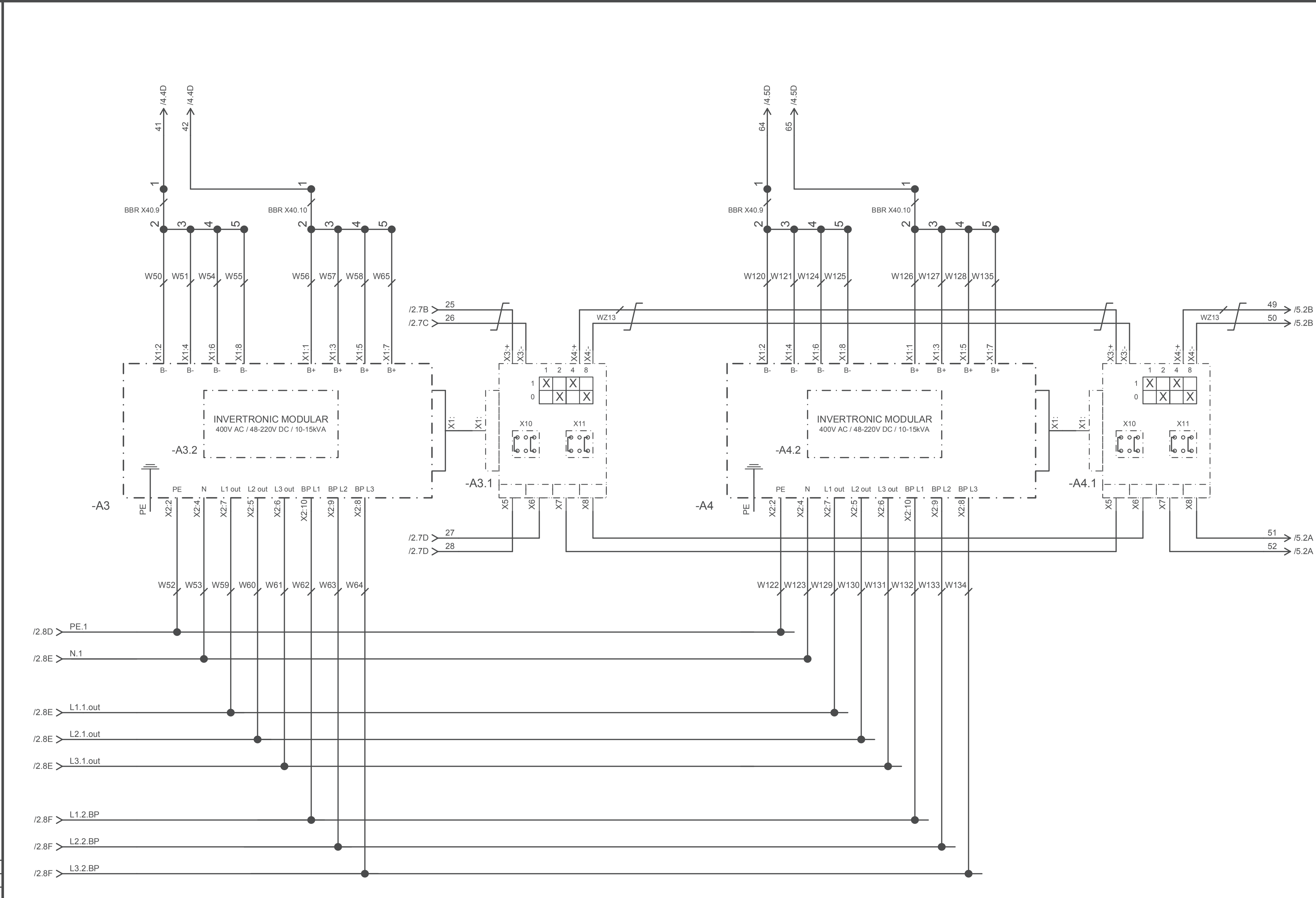
Rev. / Change / Date / Name / Approved		Orig. / Replaces	Replaced by		9 Sh.

Rev. intern



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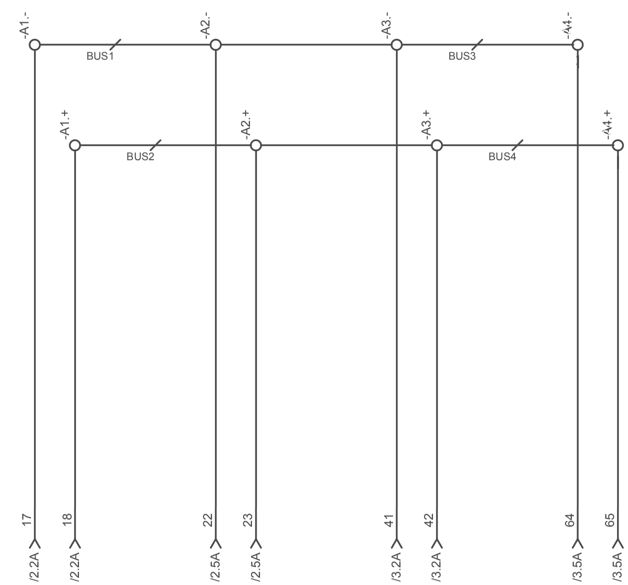
Rev.	Change	Date	Name	Approved	Orig.	Replaces	Replaced by		9 Sh.

BULK BATTERY INPUT 48VDC



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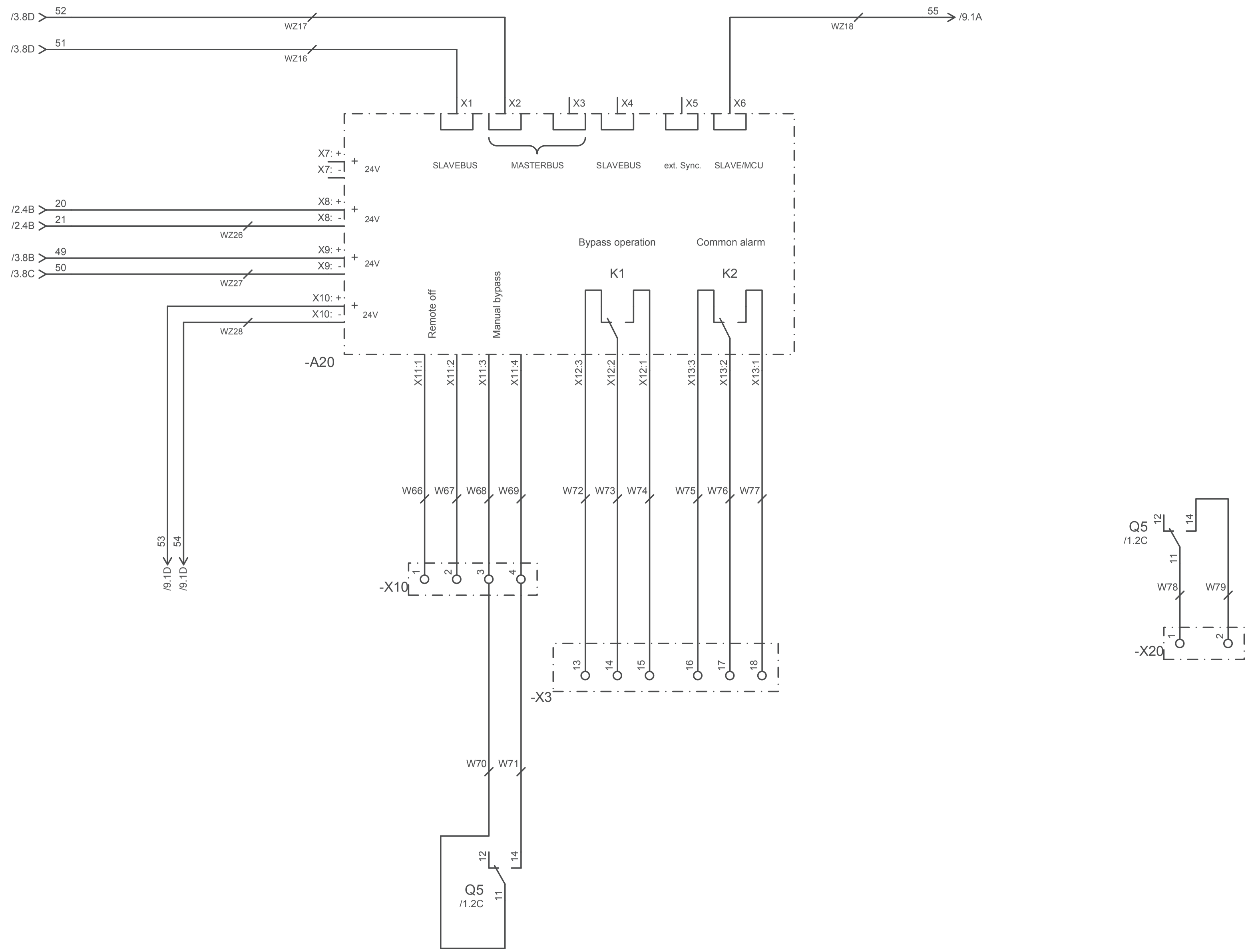
Rev. / Change / Date / Name / Approved					9 Sh.



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Rev.	Change	Date	Name	Approved		

BENNING

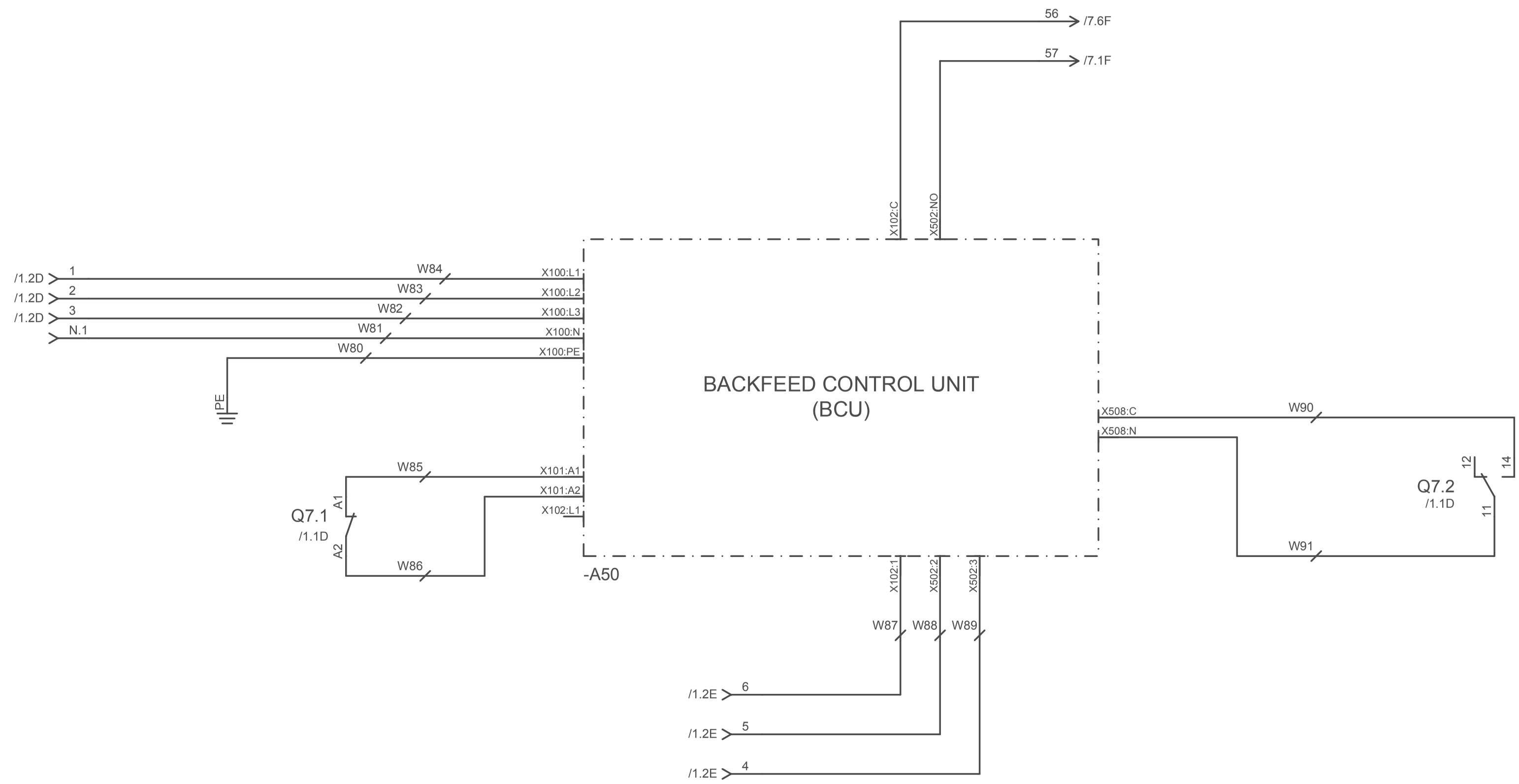
INVERTRONIC 40KVA 48VDC
Circuit Diagram

HP1

6140029268.00E000

Rev. intern

Sheet 5
9 Sh.



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Rev.	Change	Date	Name	Approved		

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INVERTRONIC 40KVA 48VDC
Circuit Diagram

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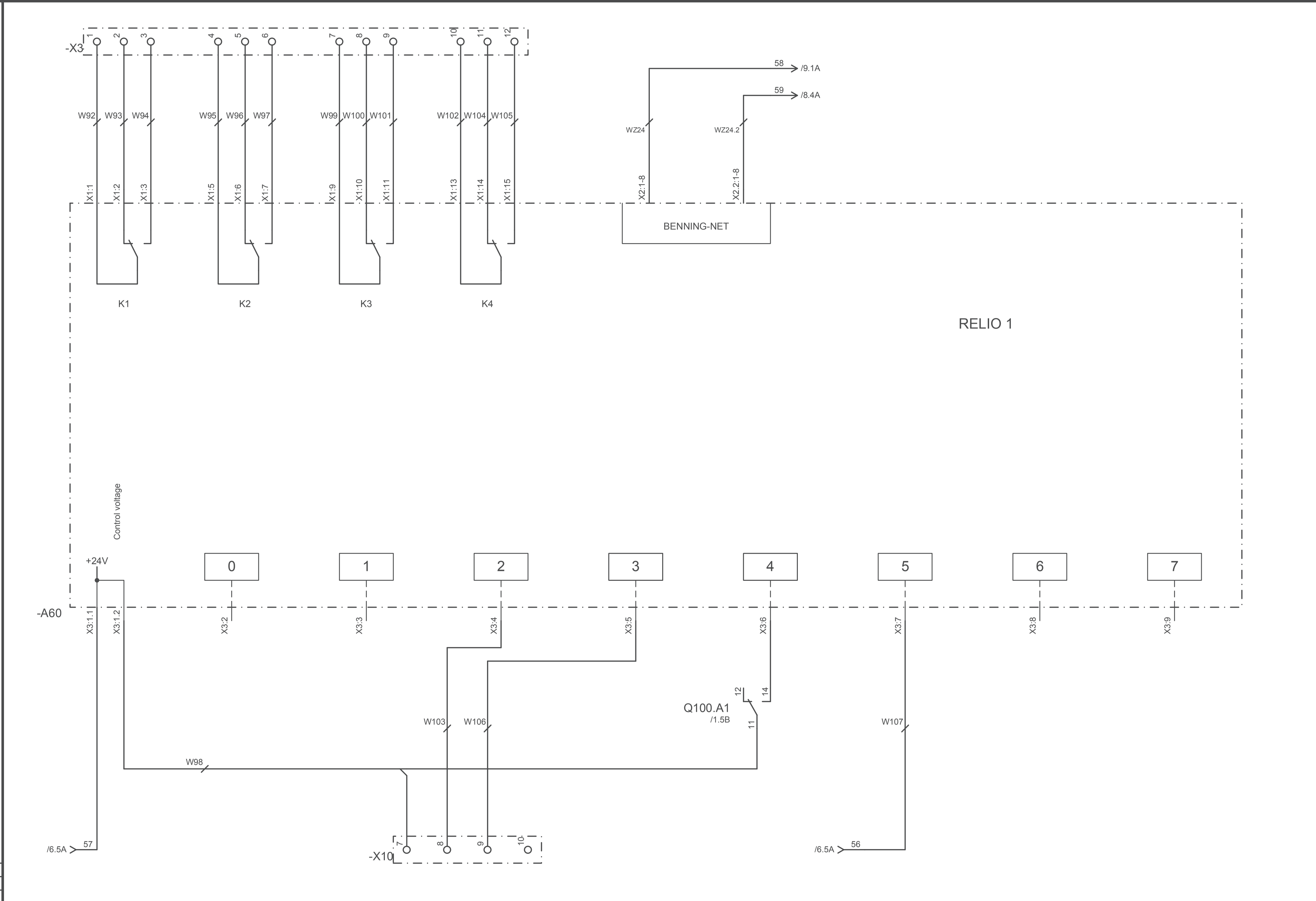
Sheet 6 / 9 Sh.



Rev.	Change	Date	Name		
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				Approved	

Rev. intern

6140032171

INVM-40kVA

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INVERTRONIC 40KVA 48VDC

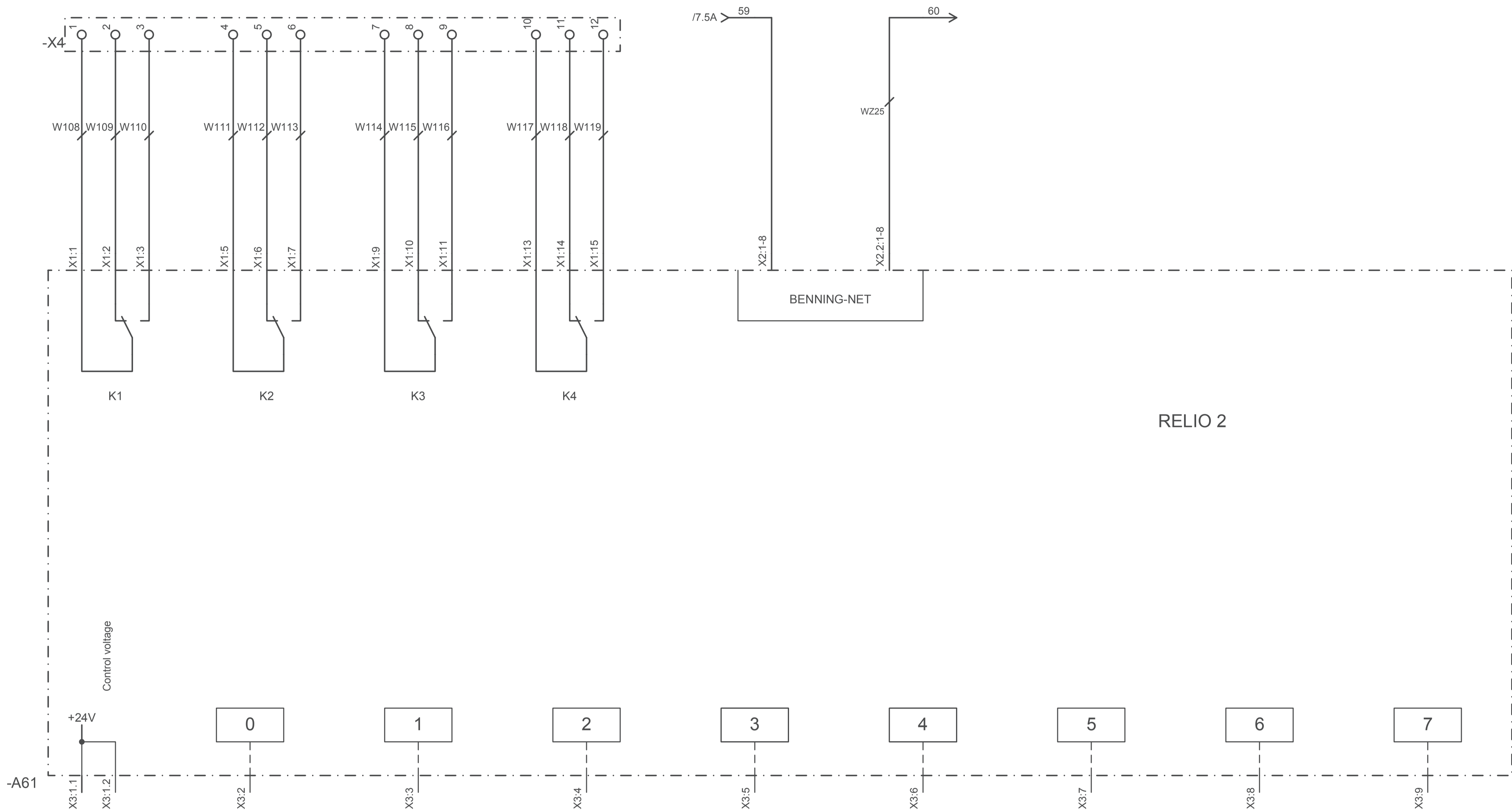
Circuit Diagram

HP1

6140029268.00E000

Sheet 7

9 Sh.



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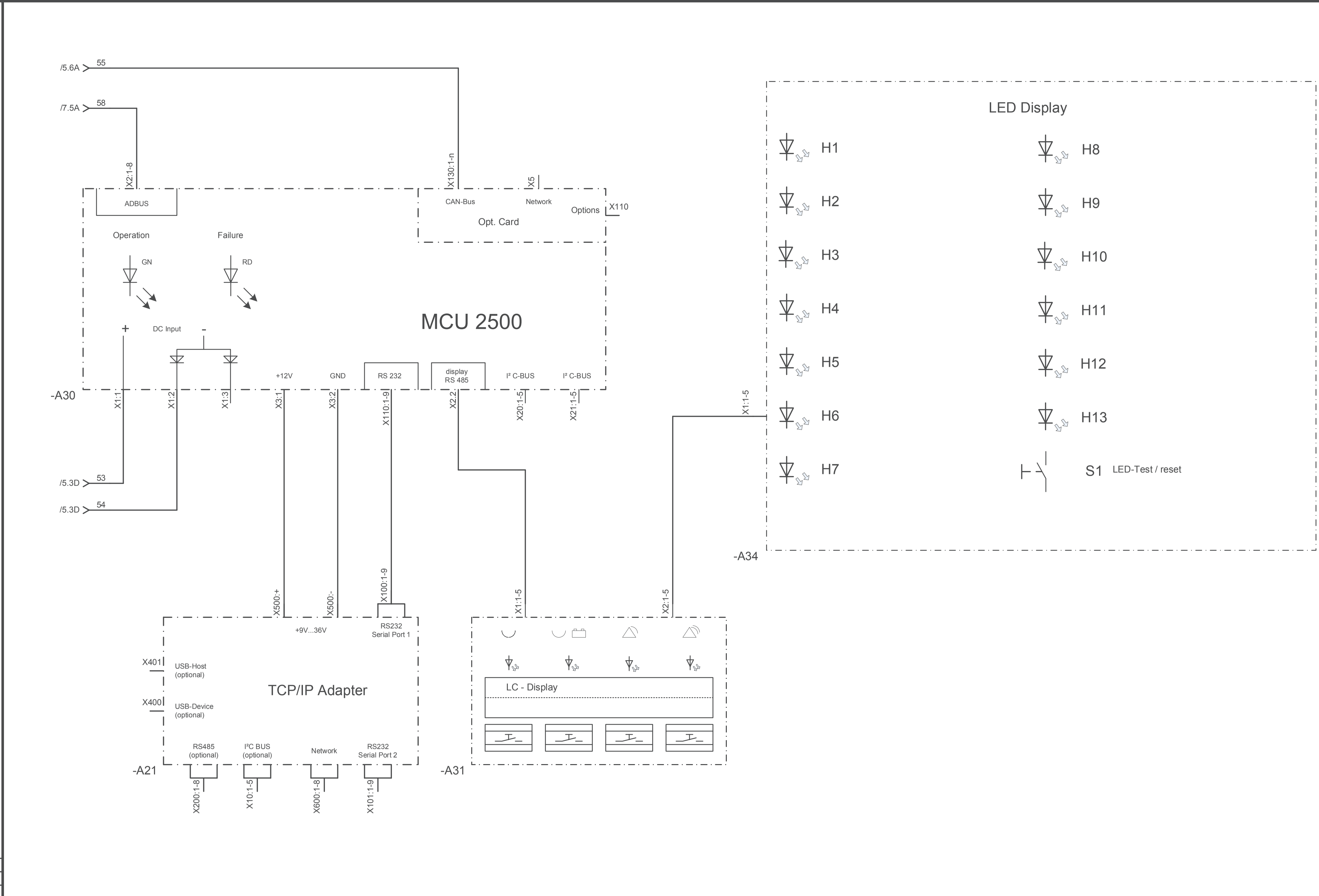
Rev. intern



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Checked					Sheet 9
Rev. / Change / Date / Name / Approved					9 Sh.

Notes

Notes

Notes

Benning Power Electronics
1220 Presidential Drive Suite 100
Richardson, TX 75081 USA
www.benning.us
800.910.3601

This manual contains important safety instructions that should be followed during installation and maintenance of the Power System.