it's all about connections

Manual

Hobart 2400 Compact
120 / 140 / 180 kVA

400 Hz Ground Power Unit

Serial no.	_____
Type	3GW -200/ -

ITW GSE HOBART • 11001 Us Highway 41 North • Palmetto, FL 34221 • U.S.A
T: (toll free in US): 800-899-1841 • T (International): + 1 941-721-1000 • E: technicalsupport@itwgse.us

IMPORTANT NOTE

We recommend that the battery that safeguards GPU settings etc. is changed **after 5 years** of use in order not to lose data.

The unit has an internal supervision that keeps track of time the battery has been in service and will display a warning when the battery needs to be changed.

Refer to section 8.2 for further information

Diagrams and drawings are subject to change without prior notice.
Latest diagram versions can be found at www.itwgse.com

Printed: December 2016

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1.0 Declaration of Conformity

CE

EU Declaration of Conformity

ITW GSE ApS
Smedebakken 31-33
5270 Odense N
Tel. +45 6318 6000

We declare under our sole responsibility that the following product type

Designation : 400 Hz Ground Power Unit

Type : 3GW….. (30 kVA to 180 kVA)

Description : Solid state power supply converting a three-phase mains supply into an isolated three-phase 400 Hz supply. Optionally in the range from 30 kVA to 90 kVA, the unit can be equipped with an additional 28 VDC output. The converter is typically applied as ground power for aircraft.

is in conformity with the following directives:

2014/35/EU	Low Voltage Directive
2014/30/EU	Electromagnetic Compatibility Directive
2006/42/EC	Machinery Directive

Conformity attained by complying with:

EN61558-2-6:2009	(LVD – Safety standard)
EN62040-1-1:2009	(LVD – Safety standard)
EN61000-6-2:2005	(EMC – Immunity standard)
EN61000-6-4:2007	(EMC – Emission standards)
EN1915-1:2013	(Machinery – General safety requirements)
EN1915-2:2009	(Machinery – General safety requirements)
EN12312-20:2009	(Machinery – Specific safety requirements)
EN60204-1:2006	(Machinery – Electrical safety requirements)

Odense, Denmark	27.06.2016	Søren R. Dahl
Place of issue	Date of issue	Søren R. Dahl, Development Manager

799.331 Rev. C

IMPORTANT SAFEGUARDS

DANGER – TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, CAREFULLY FOLLOW THESE INSTRUCTIONS

2.0 Safety Instructions

This unit is only intended to be installed, operated and maintained by competent persons having the necessary knowledge regarding delivery of external power to an aircraft.
Prior to use, service and maintenance, the competent person must be familiar with all relevant parts of this manual.

Electric Shock

To ensure personal health and safety, the electrical installation must fulfil all local regulations and legislation

- Touching live electrical parts can cause fatal shocks and severe burns.
- Internal parts where the voltage exceeds 50 V are covered and/or marked with:
- Keep all panels and covers securely in place.
- Have only qualified people remove covers for maintenance or troubleshooting.
- When connecting the unit to the aircraft, make sure that the output power is off.
- Frequently inspect the installation for damage and bare wiring – Repair/replace if necessary.

Moving Parts

- Keep away from fans.
- Have only qualified people remove covers for maintenance or troubleshooting.

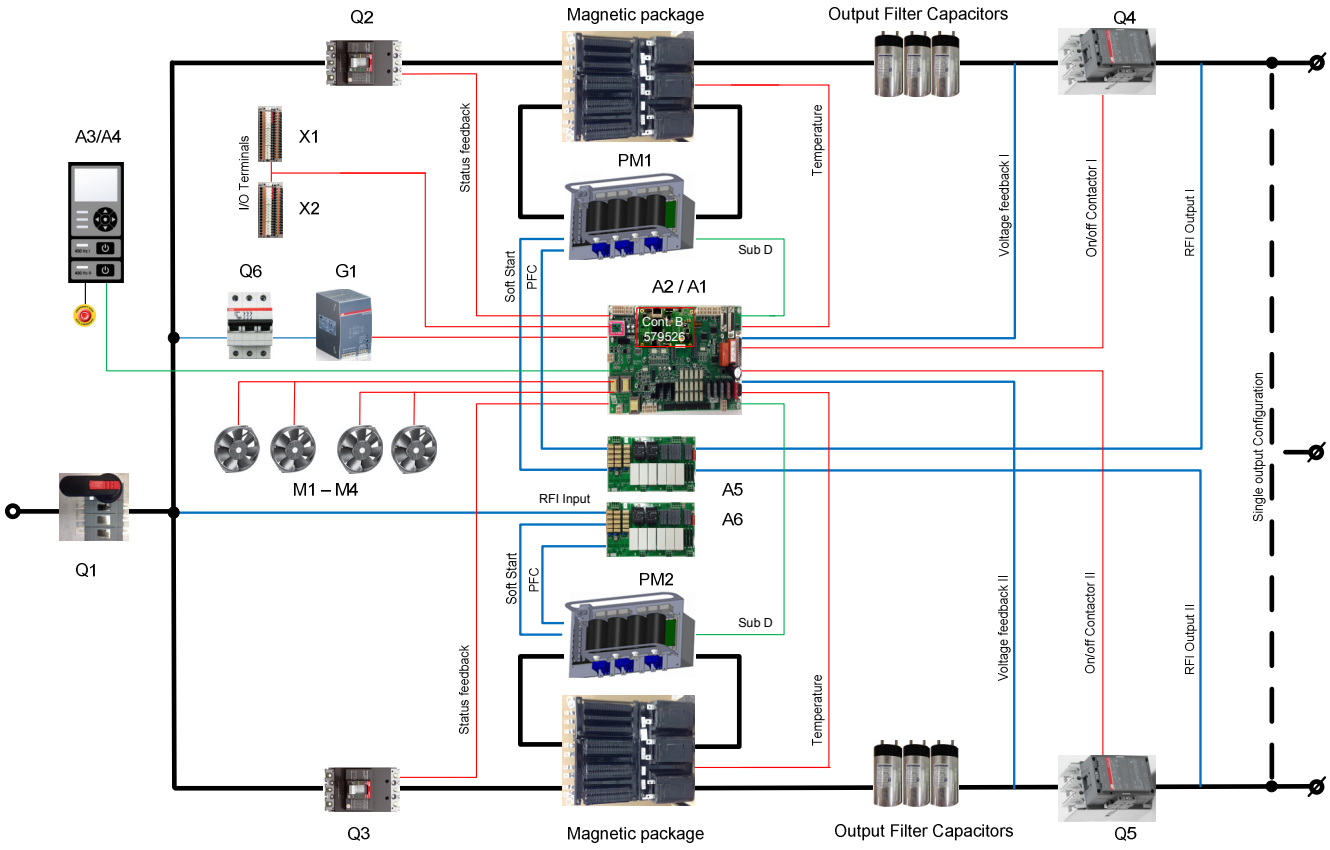
Hot Parts

- Do not touch hot magnetics.
- Allow a cooling period before doing maintenance.

SAVE THESE INSTRUCTIONS!

3.0 General Description

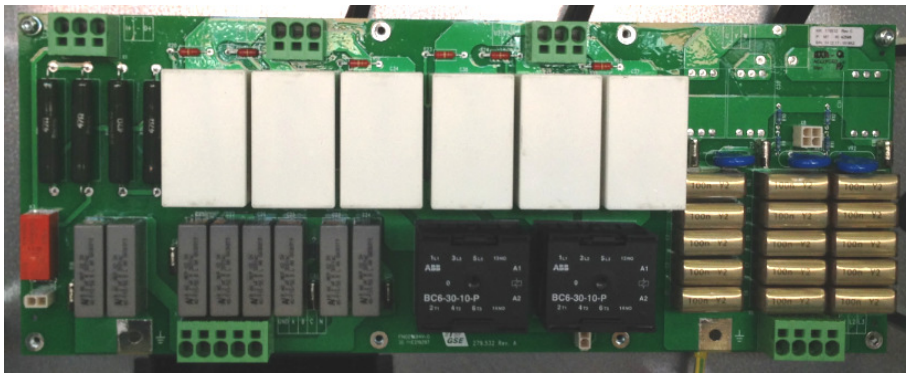
The figure below shows the basic principle of the AXA 2400 Compact Power unit. The 50/60 Hz utility voltage is converted into a galvanic isolated 3-phase, 400 Hz output voltage. A functional description of each part is given in the following sections.



3.1 Basic Principle

Input Disconnect (Q1):
The Input Disconnect disconnects all power to the ground power unit. Upon closing the switch disconnector/breaker, the power is distributed via the 2 MCB's (Q2 / Q3) to each converter and via Q6 to the internal 24 Volt power supply (G1). The ground power unit performs an initialization test and then goes into standby mode.

Capacitor Board (A5/A6):



These modules include the following functions:

- Input and Output RFI filters to reduce the EMI/EMC emission into the mains and output to such a level that surrounding equipment is not disturbed. In addition, the two filters prevent voltage transients from reaching vital parts in the ground power unit.
- Resistors in combination with the soft start contactors Q5 (PM1 / PM2).
- Magnetic Wave shaping circuit.
- Coil voltage for the output contactors, controlled via A2:QO1(X17) & QO2 (X18) on the Interface Board.

Input Choke & 12-pulse Transformer (L1 & T1 / L2 & T3):
The combination of the choke, the 12-pulse transformer, the magnetic wave shaping circuit and the rectifier situated at the inverter module, ensures an almost sinusoidal line current with a Total Current Harmonic Distortion of 5% (ITHD) at 180 kVA/kW and a unity power factor at all loads. This means less stress on the main supply network and the distribution transformers.

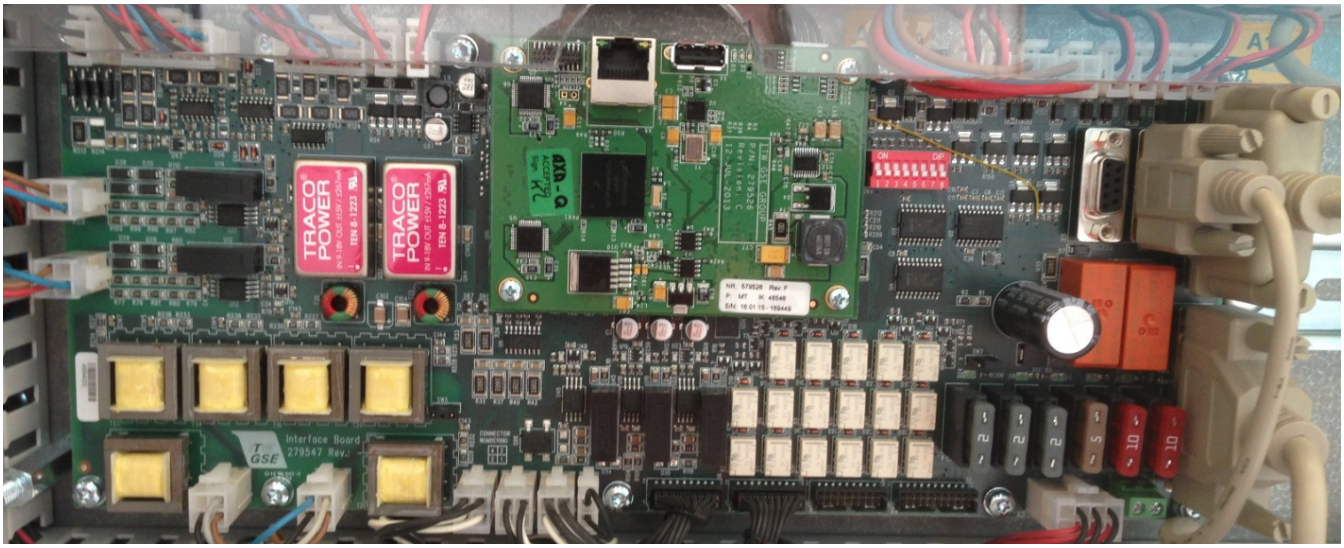
Inverter Modules (PM1 & PM2):
The Inverter Module includes the rectifier (V1-V6), the DC-filtering capacitors (C1-C6) and the soft start circuit (Q5) controlled via X11 (PM1) and X12 (PM2). The 3-phase inverter portion of the module generates a 400 Hz voltage system with a very low harmonic content and individual phase control. Two PCBs (gate drive top & gate drive bottom located under the DC-filtering capacitors) are used to interface between the control unit and the IGBTs. Voltage supervision of the DC-filtering capacitors is likewise performed at the gate drives via X26 (PM1) and X25 (PM2).

Output Transformer (T2/T4):
The output transformer ensures galvanic separation between input and output. It also transforms the voltages from the Inverter Module into the required aircraft voltage (3 x 200/115 V). The filter choke for the output AC-filter is an integral part of the transformer.

AC Filter Capacitors (C7-C9 / C10-C12):
The harmonic content of the inverter voltage is further reduced by means of the AC Filter, resulting in a total voltage distortion of less than 2%. In addition to the filter choke (integrated into the transformer) and the AC capacitors, the ground power unit is equipped with an RFI-filter that reduces the high frequency emissions from the ground power unit and from the aircraft.

Output Contactors (Q4/Q5):
The ground power unit is equipped with a 3-phase output contactor per output. The contactors are engaged at start-up of the corresponding output and are disengaged when the corresponding stop button is activated or a system error occurs. If the interlock voltage, provided by the aircraft, is not returned to the ground power unit within the delay settings (refer to chapter 6.3), the corresponding contactor also disengages.

Interface Board (A2):
The purpose of this board is to interface between the Control Board and the rest of the ground power unit. The interface module includes the following functions:



- Interface to the Display Board (CAN Bus, 24 VDC and EPO (External Emergency Stop))
- Fuse (F1 & F2) of the 24 VDC for I/O connections
- Fuse (F3) for Display Board (A3) and Operator Keyboard (A4)
- Fuse (F4) of the 24 VDC for interface
- Fuse (F5) PWM control (X15) of fans (M1-M2)
- Fuse (F6) PWM control (X16) of fans (M3-M4)
- User EPO input (X6)
- Measuring transformers for supervision of the 400 Hz output 1 voltage (X28)
- Measuring transformers for supervision of the 400 Hz output 2 voltage (X27)
- Interface for gate drive situated at the Inverter Module (PM1) via GD1 (X10)

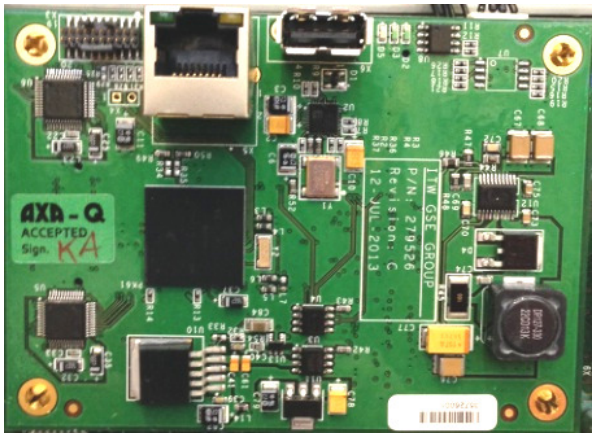
- Interface for gate drive situated at the Inverter Module (PM2) via GD2 (X7)
- Interface for current sensors situated at the Inverter Module (PM1) via I1 (X23)
- Interface for current sensors situated at the Inverter Module (PM2) via I1 (X22)
- Relay control of output contactors Q2 – Q3 (X16-X17)
- Soft-start control Inverter Module (PM1) via SS1 (X13)
- Soft-start control Inverter Module (PM2) via SS2 (X14)
- Control of Q5 & DC link measurement via DC1 (X26) for Inverter Module (PM1)
- Control of Q5 & DC link measurement via DC2 (X25) for Inverter Module (PM2)
- Input for temperature sensors T2 (X30)
- Input for temperature sensors T4 (X31)
- Input for Q2 / Q3 status (X29)
- I/O ports for remote control (Start, Stop etc.) output 1 (X1)
- I/O ports for remote control (Start, Stop etc.) output 2 (X2)
- Protected interface for interlock signals
- Interface for individual overload protection (X22 & X23)
- Neutral Voltage Supervision
- Door Interlock (X32)
- Earth Leakage Failure via (X24) and current sensor (T5) on ground wire from 400 Hz neutral
- Interface for RS232
- EEPROM (X19) contains the unique identity key of the unit

Supply Module (G1):

The generation of the 24 VDC/40 A (Adjusted from factory = 25 Volt) regulated control voltage is done by the Supply Module G1. This module has a wide input range (323-576 VAC). It is supplied via the capacitor module (A5) and pre-fused from the 3-phase circuit breaker Q6.

Control Board (A1):

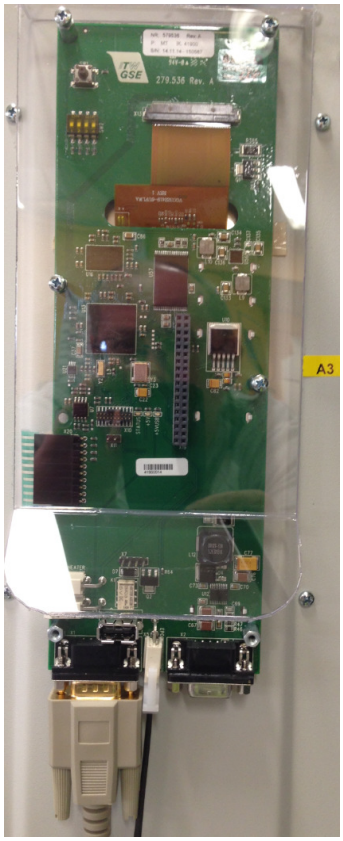
The Control Board is based on a micro-controller and a digital signal processor (DSP). Together they regulate, supervise and diagnose possible external and internal faults. As soon as the ground power unit is connected to the mains, and constantly during normal operation, the Control Board runs through a self-check program which checks all internal functions of the ground power unit. If an internal or external error is detected, the display shows the nature of the error. All immediate parameters related to a shut-down are stored in the ground power unit's memory. The Control Board has an on-board Ethernet RJ45 connector which can be used to communicate with the BMS (Building Management System) and USB host Type A connection to retrieve data from the converter or to update the software.



Display Board & Keyboard (A3 / A4):

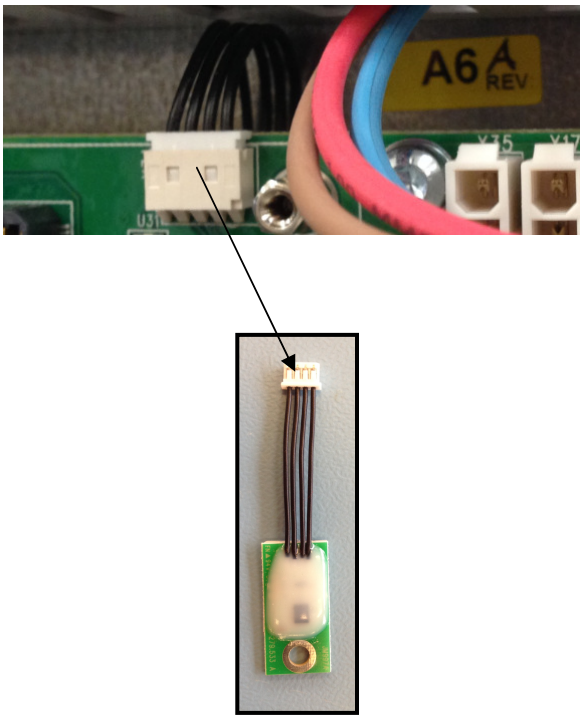
The display module serves as the interface for daily operation.

The display communicates with the Control Board via a CAN bus (Controller Area Network) and can be placed up to 100 m away from the unit when using the Remote Control Box. Furthermore, the display module includes a USB connection which can be used to download the Black Box and the Power Log and for update of the display software.



ID Chip (A7):

The ID Chip is connected to Interface Board A2 (X19) and is fixed to the I/O zone plate.
It contains information on the GPU configuration and stores all set-up values, Black Box / Power Log records.



3.1 Built-in features / protections

No Break Power Transfer:
The unit is protected against misalignment during the No Break Power Transfer.

Over/under voltage at input:
The input voltage supervision is based on the rectified DC. The supervision ensures that the unit does not trip even in case of an abnormal low input voltage level. This of course presupposes that the 400 Hz output level and quality, required by the aircraft, can still be maintained. If the rectified DC level gets too low or too high, the unit trips to protect itself.

Over/under voltage at output:
If the output voltage exceeds or is below the levels in the table below, the unit automatically shuts down and opens the output contactor.

Output Voltage U > 130V – 250ms
Output Voltage U > 140V – 15ms
Output Voltage U < 104V – 500ms

Overload:
If the output current exceeds the overload ratings in the table below, the unit shuts down to protect itself

- 125% for 600 seconds
- 150% for 60 seconds
- 200% for 30 seconds
- 300% for 10 seconds
- 400% for 1 second

Short circuit at output:
The unit has a built-in system to protect itself and the output cables, if the units output(s) are short circuited for some reason.

Internal high temperature:
If for some reason the internal temperature on the Inverter Module or the Output Transformer rises above the factory set temperature level, the unit shuts down, reporting either "***INVERTER TEMP TOO HIGH***" or "***TRANSFORMER TEMP TOO HIGH***"

Control voltage error:
If the control voltage supplied from G1 is < 20 VDC, the unit shuts down and reports
"CONTROL VOLTAGE LOW"

Aircraft Connector Insertion:
This feature verifies that the 90% switch / split "F" pin in the 400 Hz plug is activated. If not activated, the respective output cannot be engaged. This also includes a potential free output showing whether the Aircraft Connector is inserted or not. The feature is valid for ground power units with one or two outputs.
How to bypass/activate the function please refer to section 6.3
For detailed information/connection please refer to section 4.9

Neutral Voltage Supervision (NVS):
The unit is delivered with a jumper wire between the 400 Hz neutral and earth/ground. If the jumper wire for any reason (eg. Local regulation) is removed, the unit monitors the voltage between the 400 Hz neutral and earth. If this voltage exceeds 42 V (factory setting), the unit shuts down and reports "NVS failure". For change of setting please refer to section 6.3.

Neutral Voltage Displacement Supervision (NVD):
The combination of a grounded converter and an un-grounded aircraft might lead to an energized aircraft chassis. The reason is the neutral voltage displacement caused by an unbalanced load. In case the aircraft frame is or will be grounded during operation, a broken neutral might result in sparks as well as burned ground wires. The neutral voltage displacement of the aircraft chassis is measured as an AC voltage imposed on the EF interlock signal.
For change of setting please refer to section 6.3.

Earth Leakage Supervision (ELS)
In systems where the 400 Hz neutral is grounded and there is a break of the cable's 400 Hz neutral, the ELS system monitors the residual current in the internal neutral /earth connection. The supervision will shut down the unit in case the residual current reaches the pre-set level.
For change of setting please refer to section 6.3.

4.0 Transport and Installation

4.1 Storage Before Installation

To secure optimal storage conditions prior to installation, we recommend that the converter is stored inside. This protects the unit from rain and excessive humidity while it is left without power.
Only equipment in seaworthy packing should be stored outside.
For storage conditions please refer to section 5.0

4.2 Operational and Environmental Conditions after Commissioning

When the converter has been installed and commissioned, we strongly advise that the unit is always kept with input power on. This provides optimal conditions for the electronic components and prevents humidity in the form of condensed water from reaching vital parts. If for some reason the converter has been without input voltage for a period of time, a visual inspection should be carried out. If condensation on any internal parts is discovered, the parts have to be dry before the input voltage is again applied.

4.3 Transport

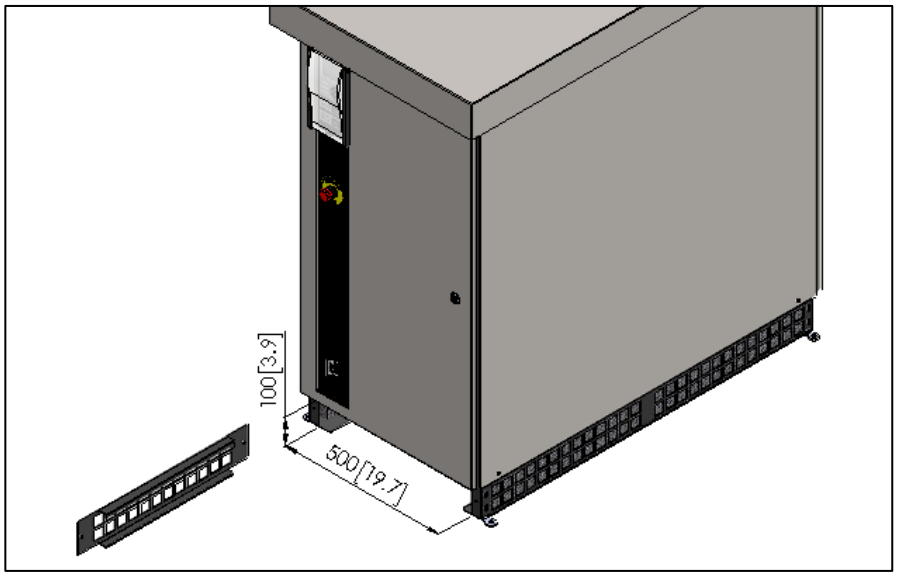
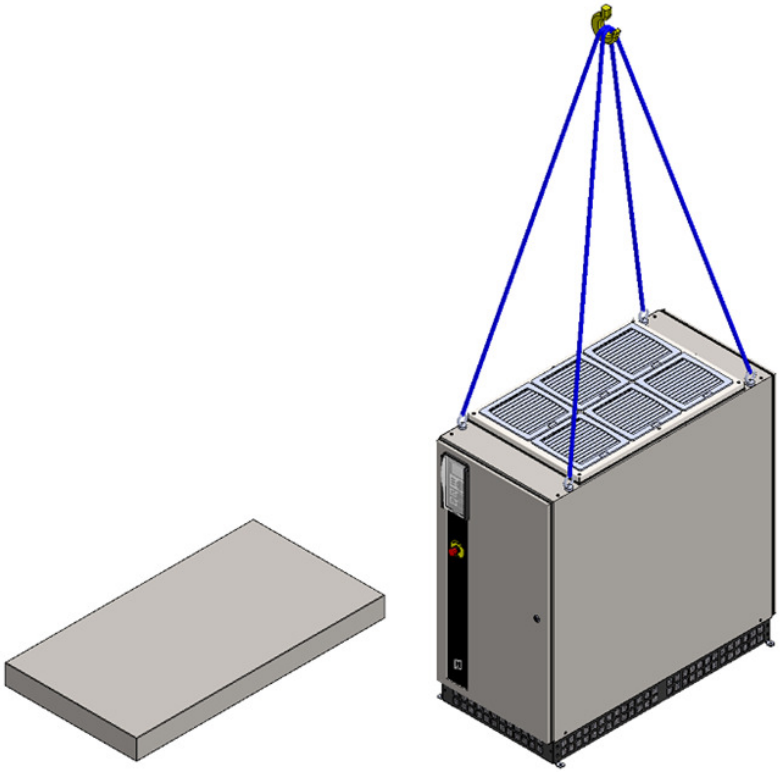


Fig. 4.3.1 Access for fork-lift, truck or similar
Lifting access can be gained by removing both the front and back of plinths



Adequate lifting gear is not part of the delivery.

Fig. 4.3.2 Lifting with crane
(Place M10 lifting rings at the 4 corners)

The AXA 2400 horizontal version (see below) is delivered on a specially designed wooden pallet. Transport and mounting of the AXA 2400 is carried out by lifting the unit by a fork-lift, truck or the like to the intended mounting position while it is still placed and firmly fixed to the pallet. For safety reasons, the passenger boarding bridge should be placed in a horizontal position at the lowest possible height above ground before lifting is started.

We recommend that you keep the original pallet for future dismantling in connection with service and maintenance.

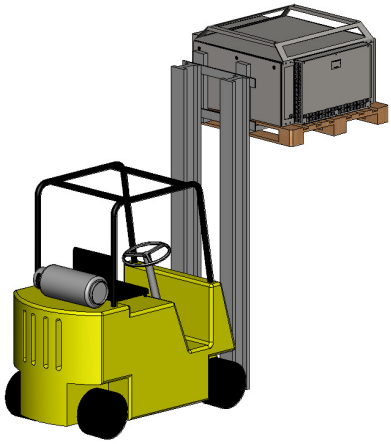


Fig. 4.3.3 Transport and mounting of the AXA 2400 by means of a fork-lift truck

The AXA 2400 must be fastened to the passenger boarding bridge with 4 M12 bolts with a minimum rating of 8.8 steel.

4.4 Installation and fastening instructions

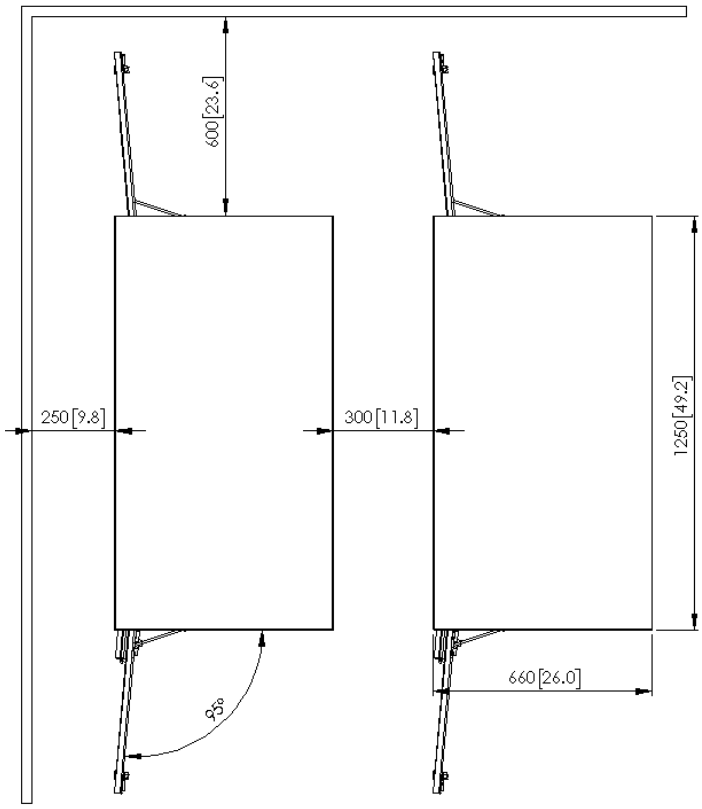


Fig. 4.4.1 Foot Print & Spacing (Fixed Unit)

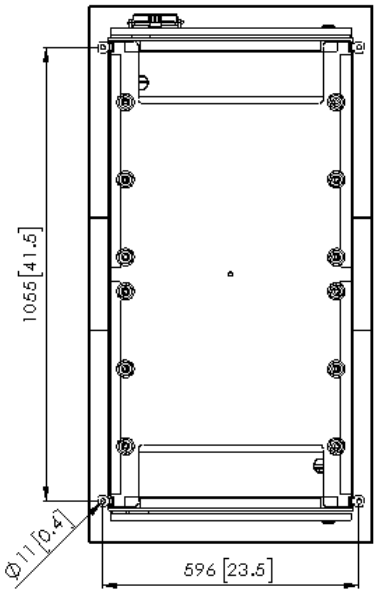


Fig. 4.4.2 Mounting Holes (Fixed Unit)

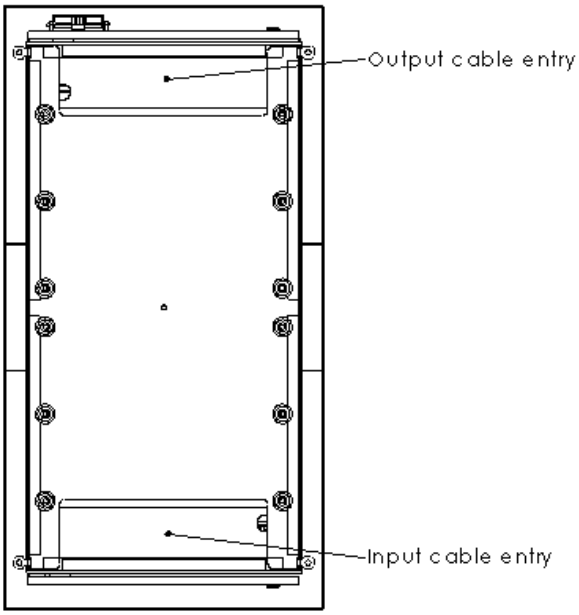


Fig. 4.4.3 Removable gland plates (Fixed Unit)

Made of alu-zink to prevent corrosion at the cable gland holes.

The gland plates are removed from inside the cubicle.

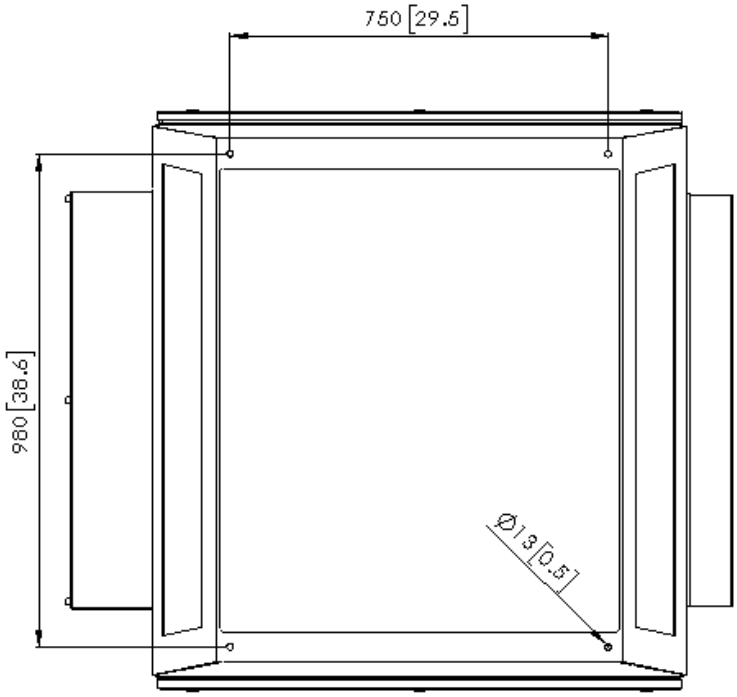


Fig. 4.4.5 Mounting Holes (Bridge-Mounted Unit)

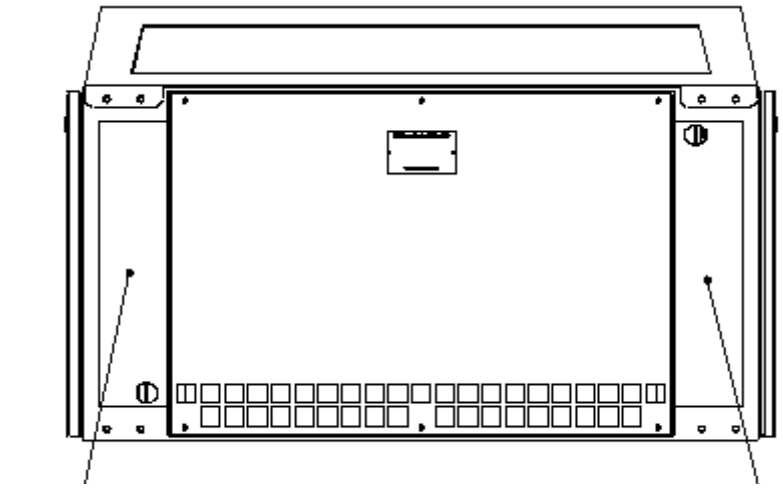


Fig. 4.4.6 Removable gland plates (Bridge-Mounted Unit)

Made of alu-zink to prevent corrosion at the cable gland holes.

The gland plates are removed from inside the cubicle.

Center of Gravity

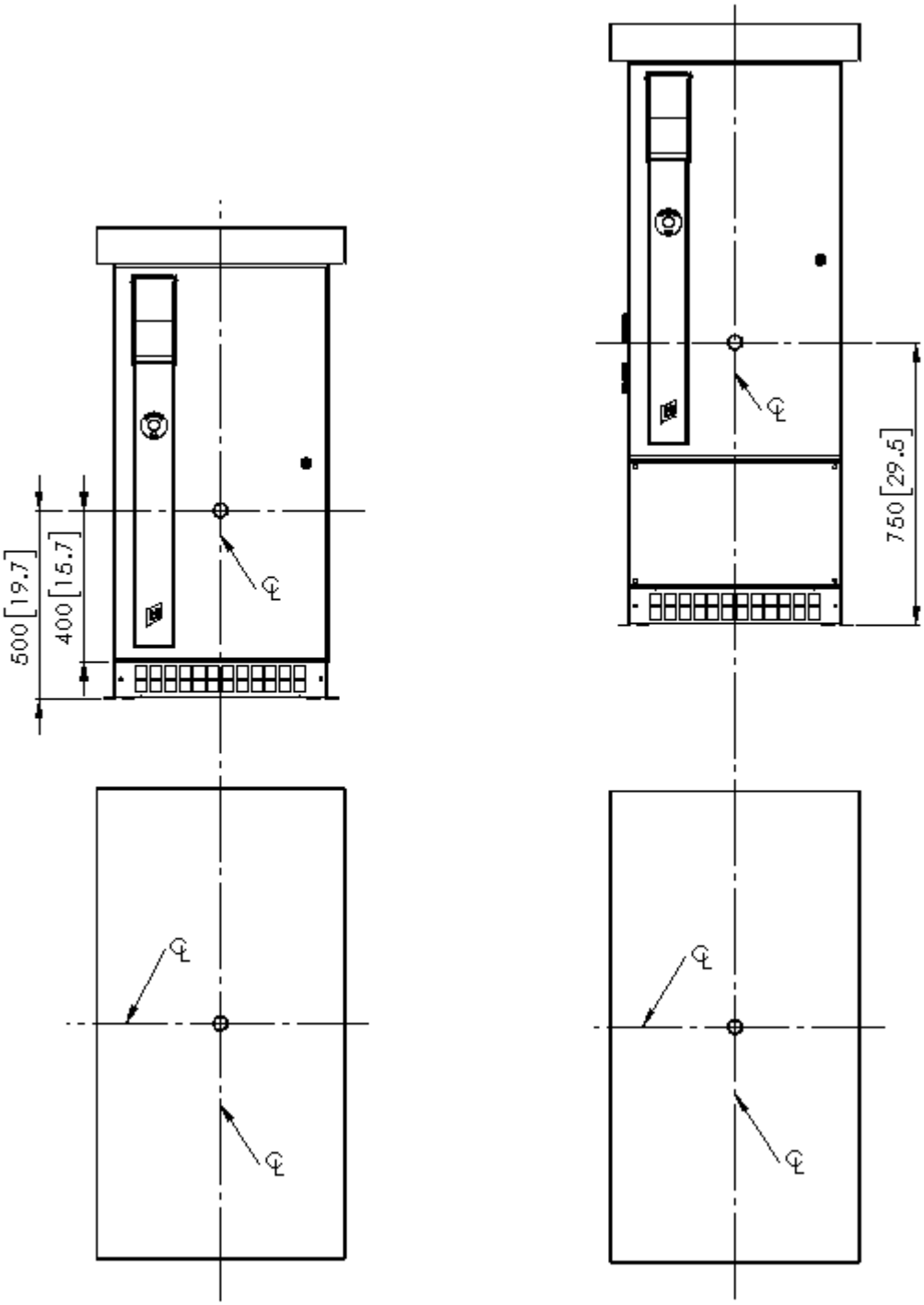


Fig. 4.4.7 Center of Gravity (Fixed Unit)

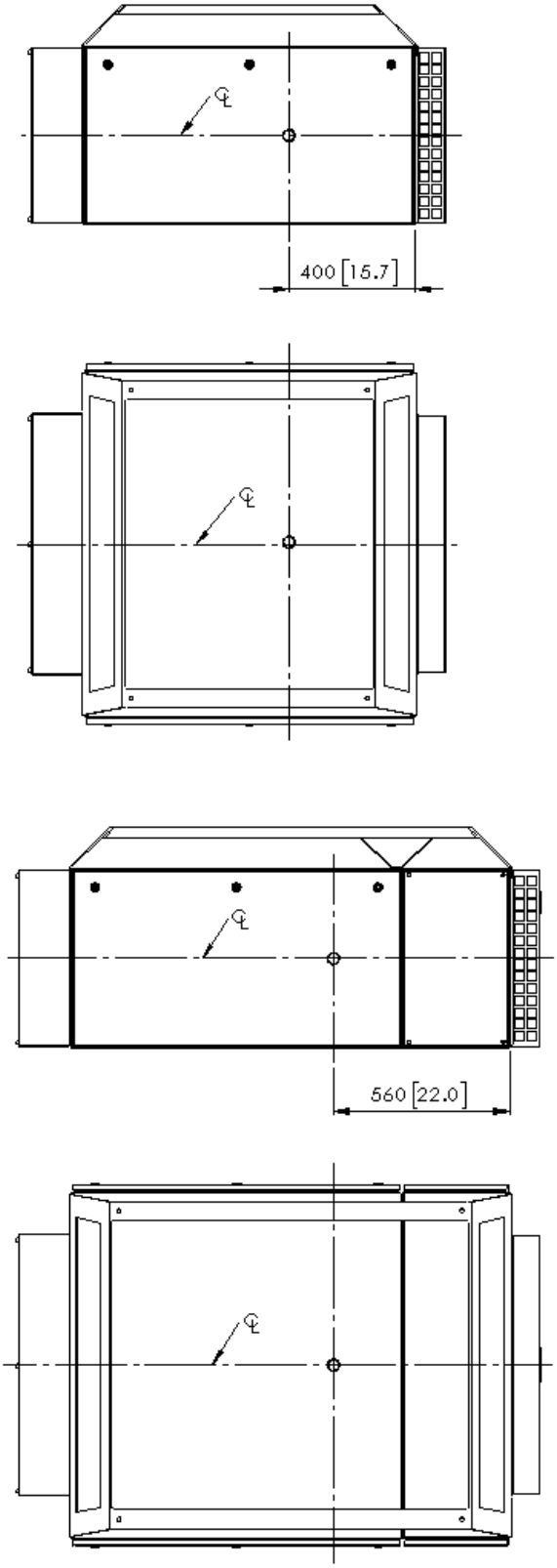
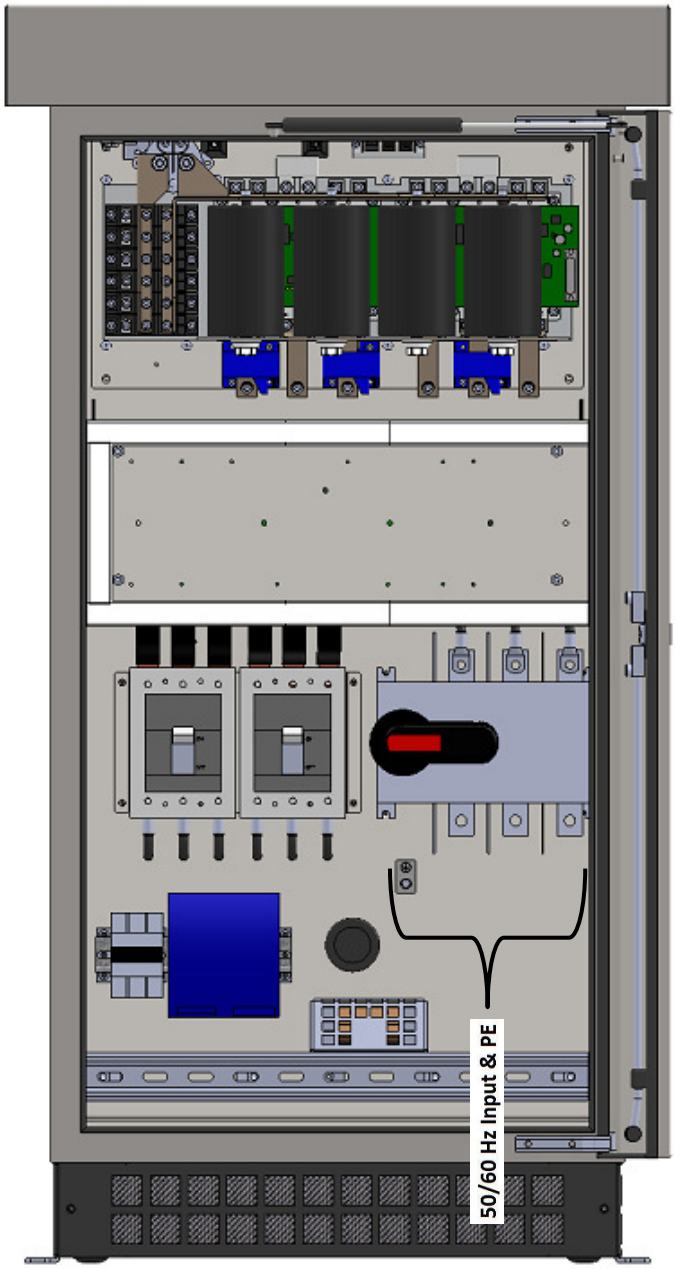


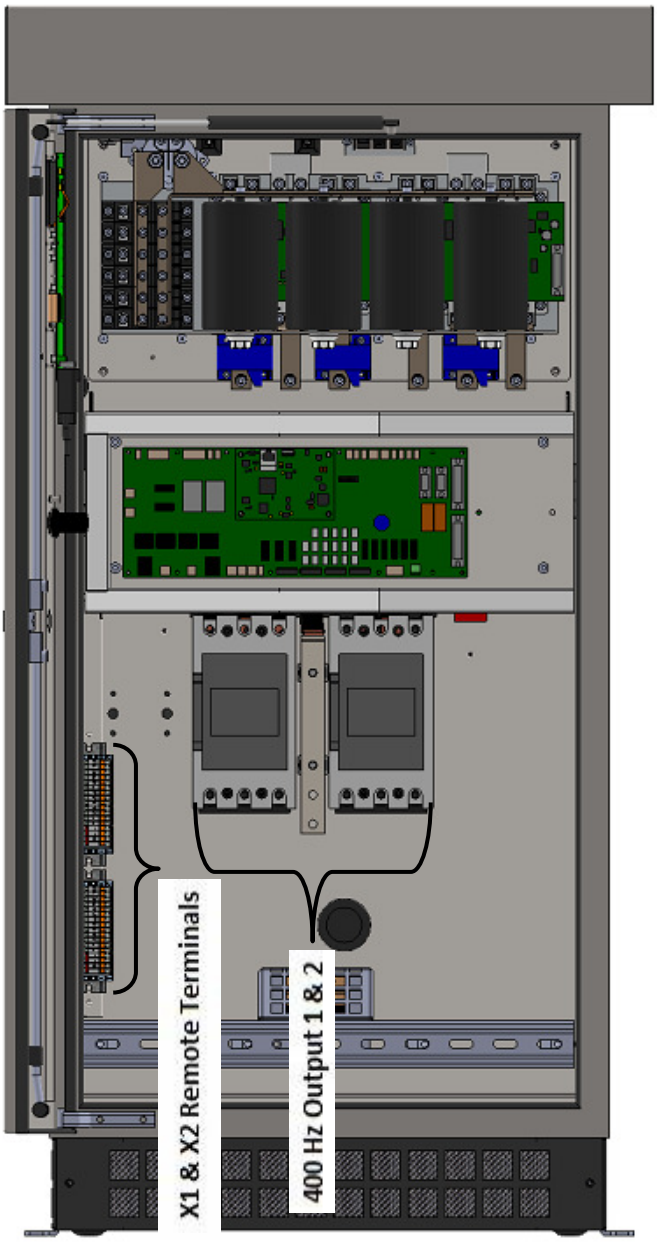
Fig. 4.4.8 Center of Gravity (Horizontal Unit)

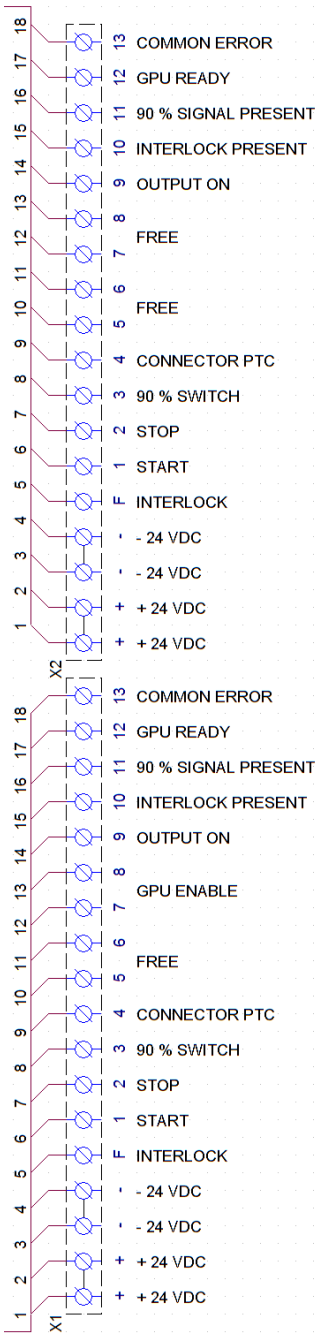
4.5 Connection of Cables



50/60 Hz Input terminals: 3 x M10/25mm 30-44 Nm (266-390 lb.in) (L1–L2–L3)
1 x M10 bolt 50 Nm (444 lb.in) (Ground/PE)

Fig. 4.5.1 Connection of Primary Power Cable





X1 & X2 Remote I/O terminals
(Please refer to **section 4.9** for connection of I/O terminals)

400 Hz Output terminals:	2 x 3 x M8 (A1-B1-C1/A2-B2-C2) & 1 x M8 (N1/N2) 25.4 Nm (225in-lb)
Remote I/O terminals:	2 x 17 x 0.4 - 4 mm² (AWG 21-11)

Fig. 4.5.2 Connection of Output Power Signal Cables

4.6 Utility Input

Due to personal health and safety, the AXA 2400 unit must always be protected by grounding the PE terminal (⏚).

The utility input connection to the unit should be externally pre-fused according to the table below:

100% load @ PF 0.8 Aircraft:

Rating	**120 kVA**	**140 kVA**	**180 kVA**
Line Current @ 400V/480V	150 / 125 A	175 / 150 A	230 / 195 A
Recommended Fuse Size	200 A	250 A	315 A
Maximum Fuse Size	400 A	400 A	400 A

100% load @ PF 1.0 Aircraft:

Rating	**120 kVA**	**140 kVA**	**180 kVA**
Line Current @ 400V/480V	190 / 160 A	220 / 185 A	285 / 240 A
Recommended Fuse Size	250 A	315 A	355 A
Maximum Fuse Size	400 A	400 A	400 A

Tightening torques:

Input disconnect: 30 Nm to 44 Nm (266 lb.in to 390 lb.in)
Output contactor: 17.6 Nm (156 lb.in)

Due to the RFI filter at the input, the leakage current for the AXA 2400 is > 40 mA.

4.7 400 Hz Output

At delivery, the 400 Hz neutral is connected to the Protective Earth terminal (PE). If a floating output is required, the green/yellow jumper wire must be removed.

Independent of installation method, it is mandatory to meet local regulations and legislation to ensure personal health and safety.

4.8 400 Hz Interlock

The interlock safety system ensures that the output contactor stays engaged as long as the aircraft connector is inserted into the aircraft receptacle. The aircraft provides 28 VDC on the F terminal with respect to the 400 Hz neutral terminal.

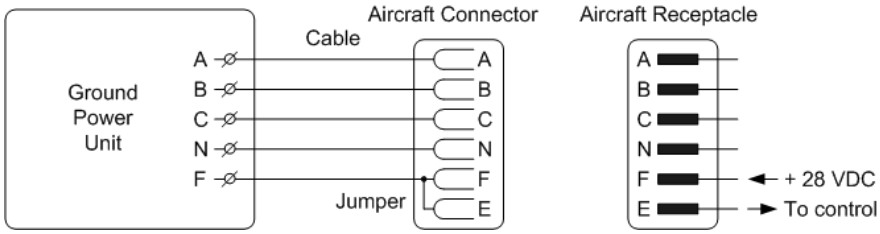


Fig. 4.8.1 Standard wiring diagram for civil aircraft

For service, maintenance and test purposes, the interlock system can be bypassed via the display active status. To ensure personnel health and safety, the ground power unit automatically returns to its initial interlock mode once it receives 28 VDC at the F terminal, e.g. when the ground power unit is connected to an aircraft.

To ensure personnel health and safety, the interlock safety system must always be activated unless the ground power unit is undergoing service, maintenance or test by qualified personnel.

4.9 Control Interface (Remote I/O Terminals)

Using the Remote I/O terminals, situated behind the front door to the left, it is possible to interface to:

- External Emergency Stop (EPO).
  The external EPO input A2: X6 is a 24 VDC input, either by using the internal 24 VDC supply or an external 24 VDC voltage. The SW1 “EPO JUMPER” (right hand side of the A2 Module, close to X7/X10) is then removed. Please refer to Fig. 4.9.1 for connection.
- E&F Interlock F Pin.
- External Start/Stop.
  Remote Start must be N.O. The remote Stop may be either N.O./N.C., this can be selected/changed using the Set-Up menu.
- 90 % Switch/split “F” pin in aircraft connector.
  The 90% switch (N.O. contact set) in the aircraft connector is supplied with +24 VDC from the AXA 2400. The voltage is returned once the plug is inserted at least 90% of the way into the aircraft receptacle.
- Aircraft Connector temperature supervision.
  The 3 x PTC resistors in series (one for each phase) is supplied with +24 VDC from the AXA 2400. They return a high signal (+24 VDC) to the input as long as the plug temperature is below the PTC resistors cut-off value.

- Key reader, bridge, cable drum etc. via GPU enable. Please refer to Fig. 4.9.1 for connection. The input can either be supplied from the AXA 2400 as shown below or supplied from an external supply as the input Terminals X1 (7&8) are insulated. Acceptable input range: 24 Volt ± 20%.
- Indications
  Lamps for GPU On, Interlock Present, Aircraft Connector inserted signal present, GPU Ready & Common Error

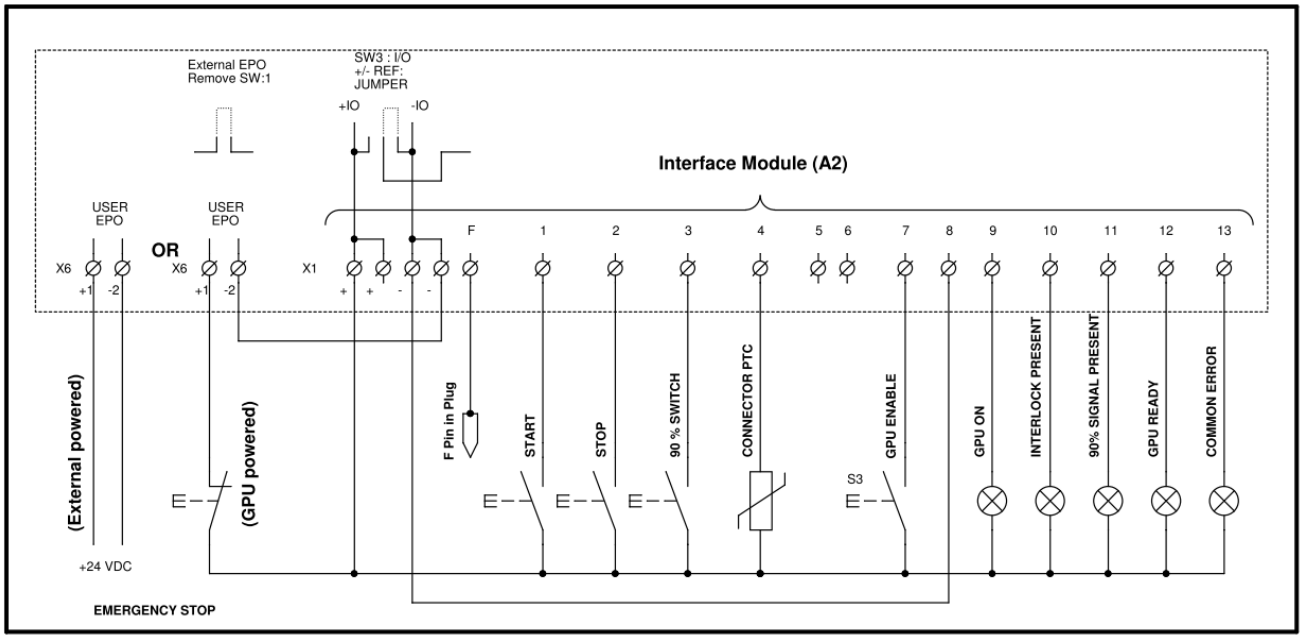


Fig. 4.9.1 Example of wiring for external control via the I/O terminal

From the factory, the jumper SW3 is set to position –IO which connects the internal minus to the common reference. If the +24 is wanted as reference, the jumper is moved to +IO.

Note!

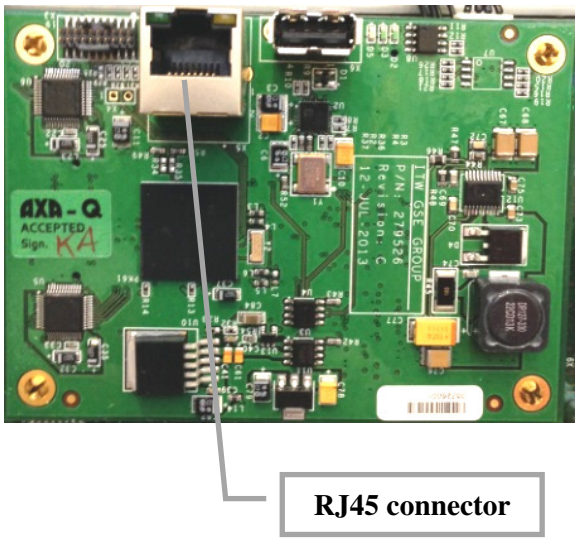
Terminal block X2 is identical to terminal block X1, except for the GPU enable signal, which is not present at X2. All other connections can be made as shown above.

Note!

For Dry Contact relays please refer to **(Optional - see section 11)**
Contacts V_{max} = 50 V AC/DC and I_{max} = 2 A

4.10 TCP/IP On-board Interface

The AXA 2400 is equipped with a TCP/IP (RJ45) communication port for supervision and monitoring of the Ground Power Unit (GPU) e.g. by the means of a central computer. The port is located on the Control Board (A1).



The protocol is limited to MODBUS TCP/IP. The data available from the GPU is comprehensive and should meet most requirements.

Supported Modbus Function Codes

The AXA 2400 implements a subset of the Modbus Application Protocol Specification V.1.1b.

The following function codes are supported in Modbus requests:

- 03 (0x03) Read Holding Registers
- 04 (0x04) Read Input Registers
- 06 (0x06) Write Single Register
- 16 (0x10) Write Multiple Registers

In the following section, the different kinds of data available are:

- System in use, system in standby and system in fault.
- The GPU provides a comprehensive range of internal and external parameter measurements and information e.g. voltages, currents, temperatures, time, date etc.
- The GPU provides two kinds of logs:
- The Black Box which contains the last 100 errors detected together with all relevant parameters and status information available in connection with a shut-down.
- The Power log which contains the time in use and the power consumption for the last 100 operations.

Note!
Detailed information on the Modbus Communication and available parameters can be found in the document 999.008, which can be obtained from ITW GSE AXA Power on request.
Please refer to section 6.3 for communication set-up.

5.0 Technical Specifications

Standards:

ISO 6858	Aircraft ground support electrical supplies - general requirements
BS 2G 219	General requirements for ground support electrical supplies for aircraft
SAE ARP 5015	Ground equipment – 400 Hz ground power performance requirement
MIL-704F	Aircraft electric power characteristics
DFS 400	Specification for 400 Hz aircraft power supply
EN2282	Aerospace series characteristics of aircraft electrical supplies
EMC & Safety standards	Please refer to the declaration of conformity, chapter 1

Solid State Ground Power Unit:

Input:

Voltage	3 x 400 (480) V ± 15 % or according. to customers spec.		
Frequency	50 / 60 Hz ± 5 Hz		
Rectification	12-pulse		
Rating	**120 kVA**	**140 kVA**	**180 kVA**
Line Current PF 0.8	150 A (125 A)*	175 A (150 A)*	230 A (195 A)*
Line Current PF 1	190 A (160 A)*	220 A (185 A)*	285 A (240 A)*
Maximum Fuse size	400 A	400 A	400 A
Line Current Distortion	9 %	7 %	5 %
Power Factor @ nom. load	0.99	0.99	1
Inrush current	None		
Interruption ride-through	20 ms		

Output:

Power	120 / 140 / 180 kVA, cos(φ) = 1
Voltage	3 x 200/115 V
Power factor	0.7 lagging to 0.95 leading
Voltage regulation	< 0.5 % for balanced load and 30 % unbalanced load
Voltage transient recovery	ΔU < 8 % and recovery time < 10 ms at 100 % load change
Total harmonic content	< 2 % at linear load (typically < 1.5 %)
	< 2 % at non-linear load according to ISO 1540
Crest factor	1.414 ± 3 %
Voltage modulation	< 1.0 %
Phase angle symmetry	120° ± 1° for balanced load
	120° ± 2° for 30 % unbalanced load
Frequency	400 Hz ± 0.001 %
Overload	100 % continuous
	125 % for 10 minutes
	150 % for 60 seconds
	200 % for 30 seconds
	300 % for 10 seconds
	400 % for 1 second

Efficiency:

Overall efficiency	0.93 at 180 kW load PF 1
at cos φ = 0.8	0.93 at 180 kVA load PF 0.8
Stand-by losses	150 W
No-load losses	4.4 kW

Protections:

Input over and under voltage
Leakage current supervision
Control voltage error
Internal high temperature
Output over and under voltage
Overload at output
Short circuit at output
No Break Power Transfer
Neutral Voltage supervision
Broken Neutral supervision

Miscellaneous:

Physical:

Dimensions	Please refer to the outline drawing on the following pages
Weight	
Fixed	645 kg (1422 pounds)
Fixed + Module**	30 kg (66 pounds)
Bridge-Mount	650 kg (1433 pounds)
Bridge-Mount + Module**	35 kg (77 pounds)
Mobile	Pending
Mobile + Module**	Pending

Environmental:

Storage temperature	+10 to +35°C (50 F to 95 F) / 20 to 70% RH
Operating temperature	-40°C to + 56°C (-40 F to 133 F)
Relative humidity	10-100 % (non-condensing)
Noise level	< 65 dB (A) @1m
Ingress protection	IP55 electronic section

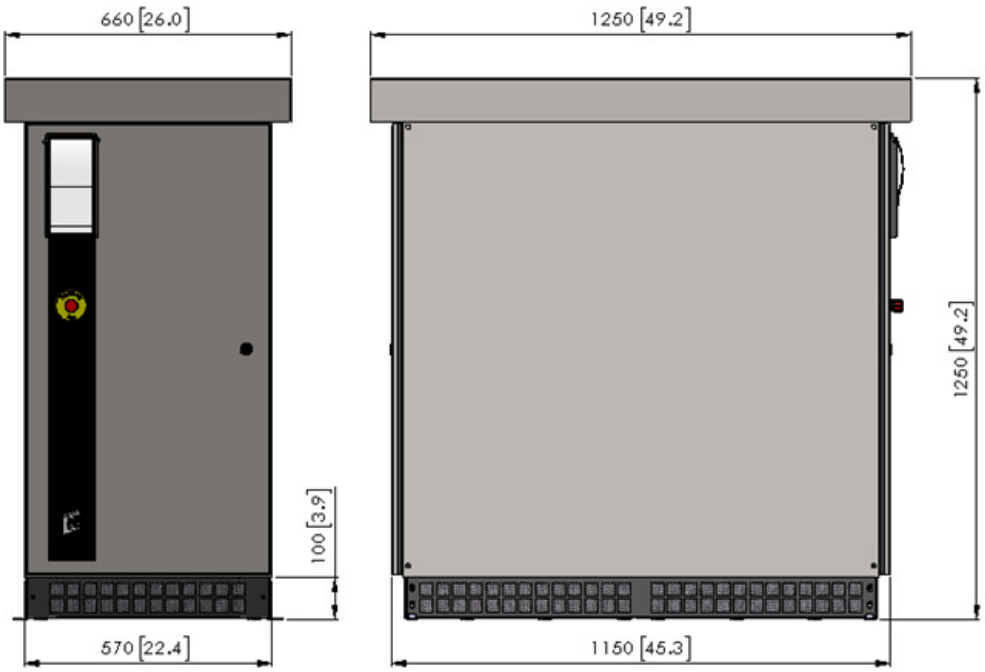
Miscellaneous:

Colour	RAL 7035 standard, other colors on request
MTTR	Max. 20 minutes

* Rounded to next 5 A value

**Assumed additional Module is empty

Fixed



Horizontal

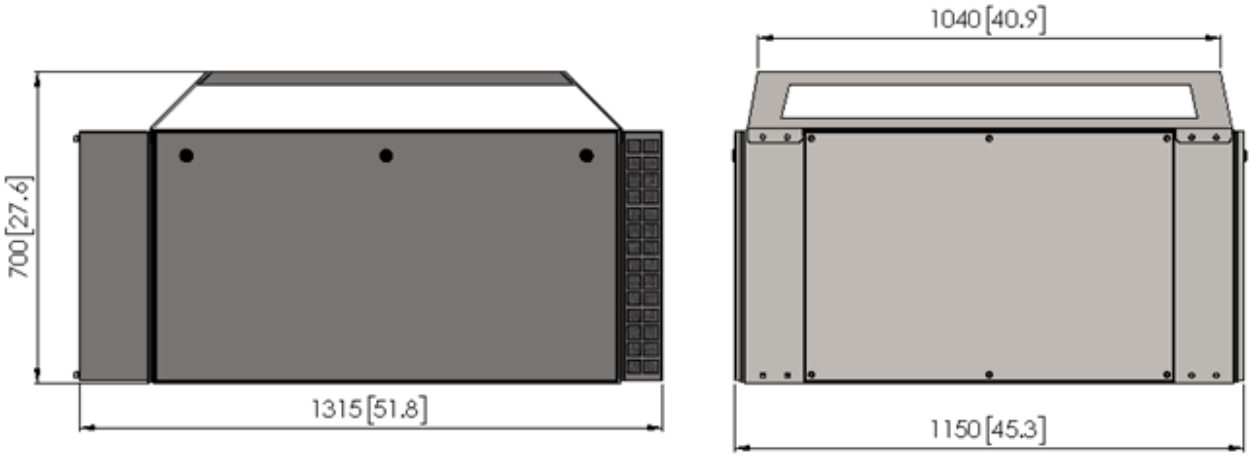


Fig. 5.0.1 Fixed and Bridge-Mounted

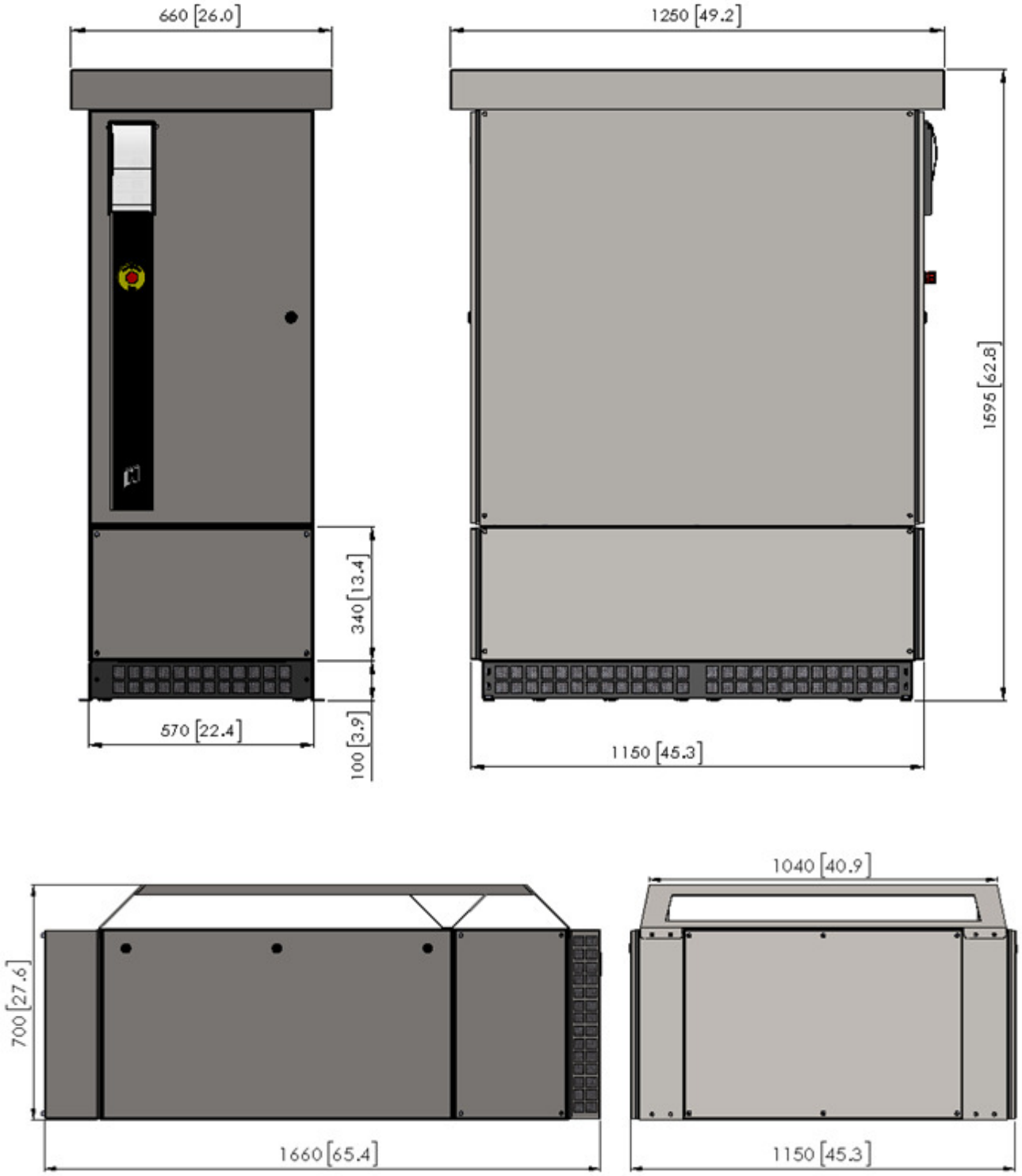


Fig. 5.0.2 Fixed and Bridge-Mounted with Base Module

6.0 Operator's Instructions (Display/LED/Keypad layout)

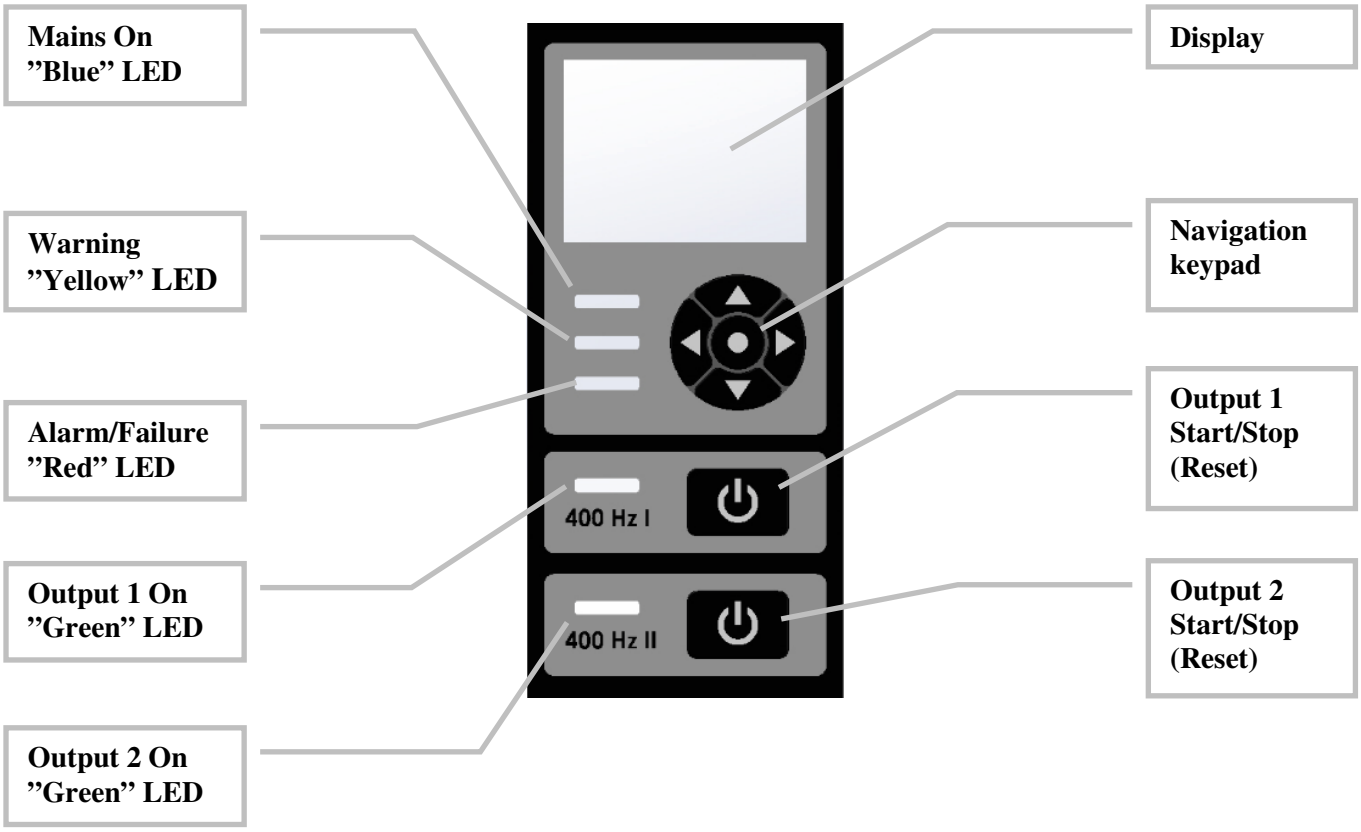


Fig. 6.0.1 - 400 Hz Standard layout

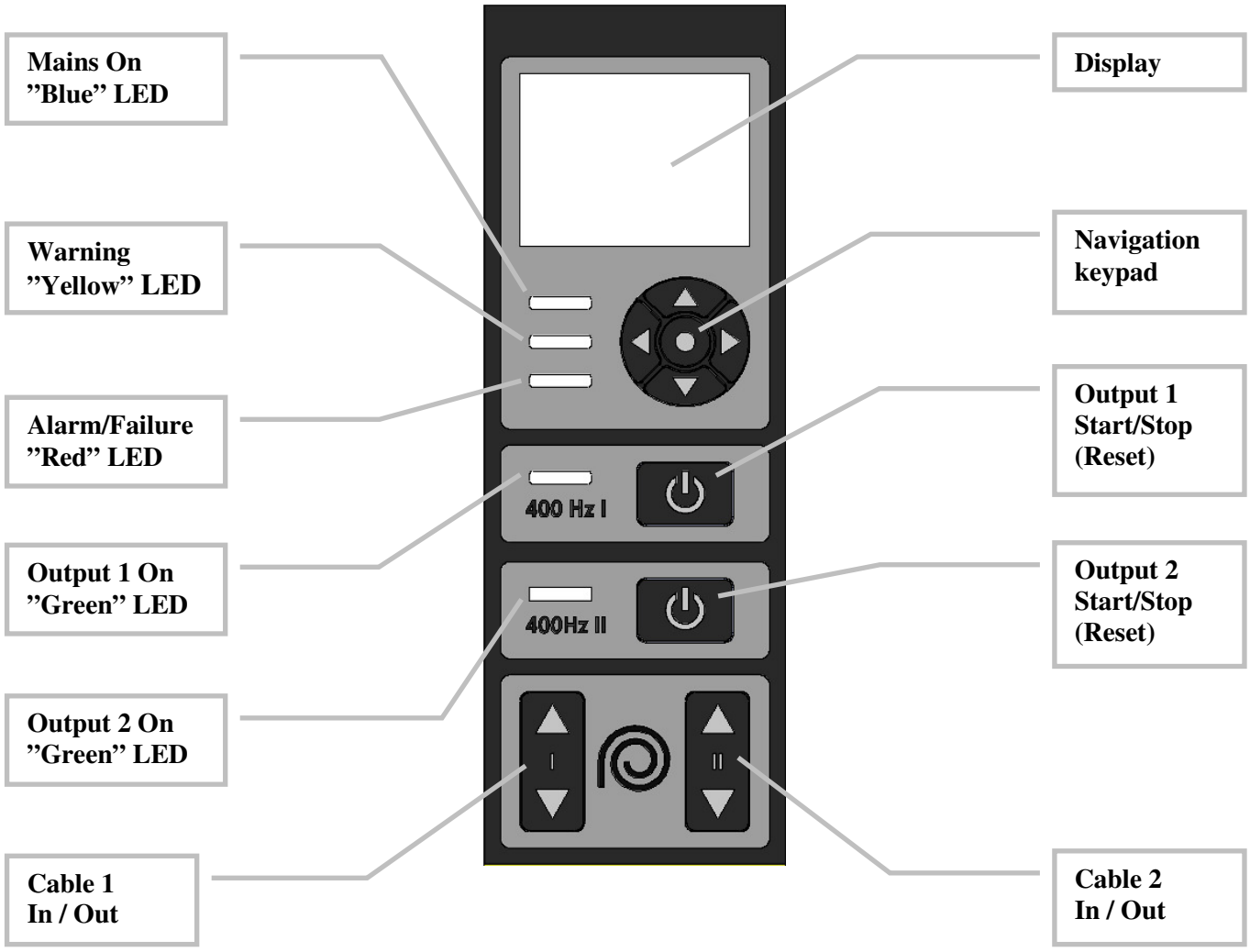


Fig. 6.0.2 - 400 Hz layout with cable system

6.1 Using the Display/Keypad:

To enable a smooth and easy operation, the operator control panel has a simple layout. The LED display is located at the top. It is used to provide information during operation /service/maintenance. It either shows operational data, warnings or failure information in plain text combined with a time stamp and a 4 digit code which can be used in combination with the manual to show more detailed information on the reported message.

3 x LED indications

Blue LED:
As soon as the main power is connected and the unit is switched on, this LED is illuminated.

Yellow LED:
If any warnings are reported, this LED is illuminated to draw the operator's attention. *

Red LED:
This LED is illuminated as soon as the unit shuts down due to a failure.

Navigation keypad equipped with ***4 arrows*** and ***1 select*** push button.

Single push buttons for Start/Stop Output 1 & 2 of the unit.
The 400Hz LED turns **"Green"** when the unit is supplying power at the output.
The push button also functions as a reset button.

Fig. 6.1.1 Display / Operator panel

Note!
Please refer to section **6.0** for the various push button layouts.

*
A warning will be issued if any of the following occur during operation of the unit:

Cable 1 Temperature Too High / Cable 2 Temperature Too High
Neutral Conductor Rupture Output 1 / Neutral Conductor Rupture Output 2
EF Signal Drop Out – Output 1 / EF Signal Drop Out – Output 2
Aircraft Connector not inserted – Output 1 / Aircraft Connector not inserted – Output 2

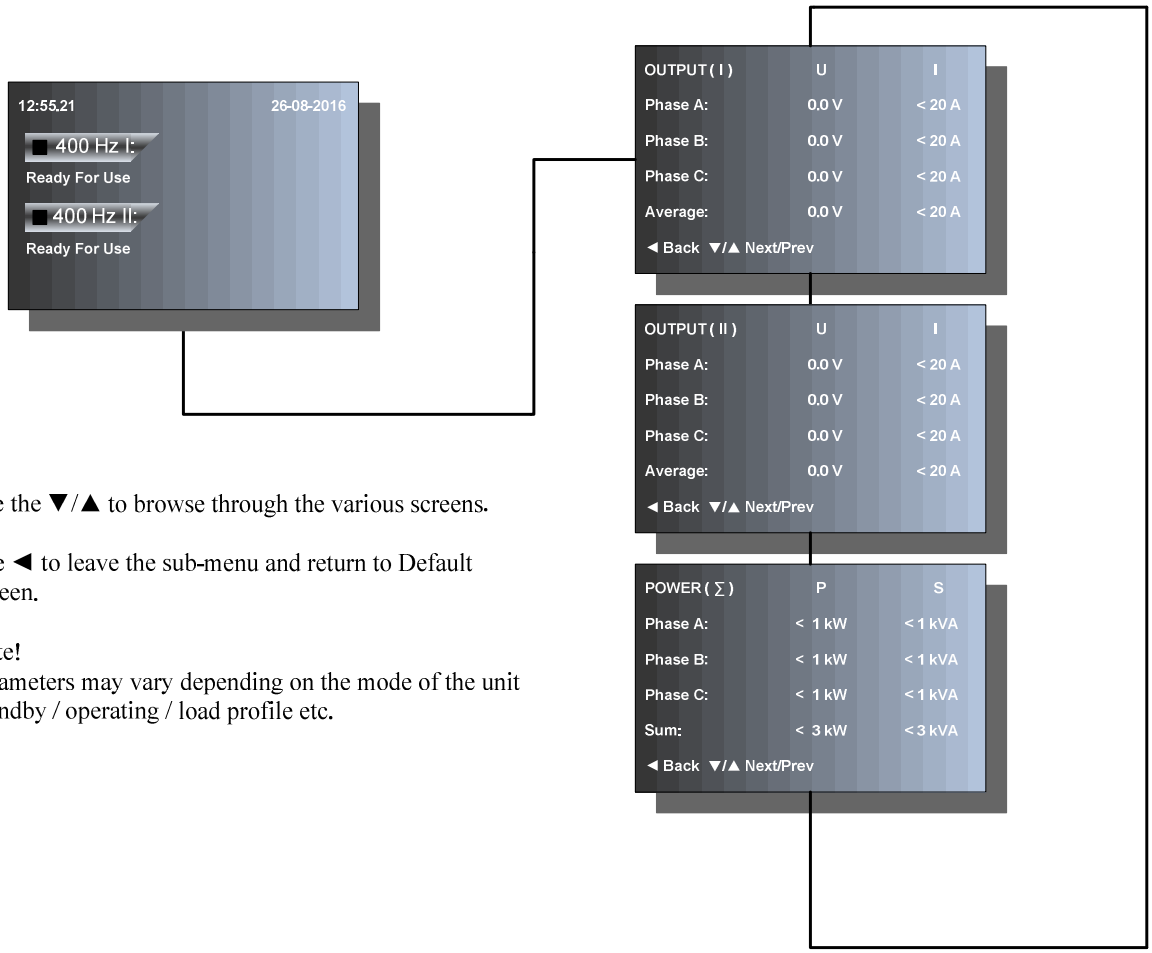
The unit will report an error if only one output is active and a failure signal present, otherwise it will issue a warning about any of the above issues.

6.2 Operating the unit:

- Insert the aircraft cable 1 or 2 / both into the aircraft. Make sure the cable(s) are fully inserted Some cables have a line on the connector head to indicate when the head is fully inserted. The plug may be equipped with a 90% switch/split "F" pin. In this case, the unit will not function if the plug not is fully inserted.
- Press the corresponding Start/Stop button
- The unit is now in operation and ready to supply the aircraft with power. This is also indicated via the green LED located close to the Start/Stop button(s).

- If the unit shuts off and is no longer supplying power to the aircraft, this is reported in clear text in the display. Also a corrective action is displayed.
- From the default display screen and during operation, various parameters can be viewed via the display. Use the navigation keys ▼▲ to browse through the available screens:

Default Display Screen Standby

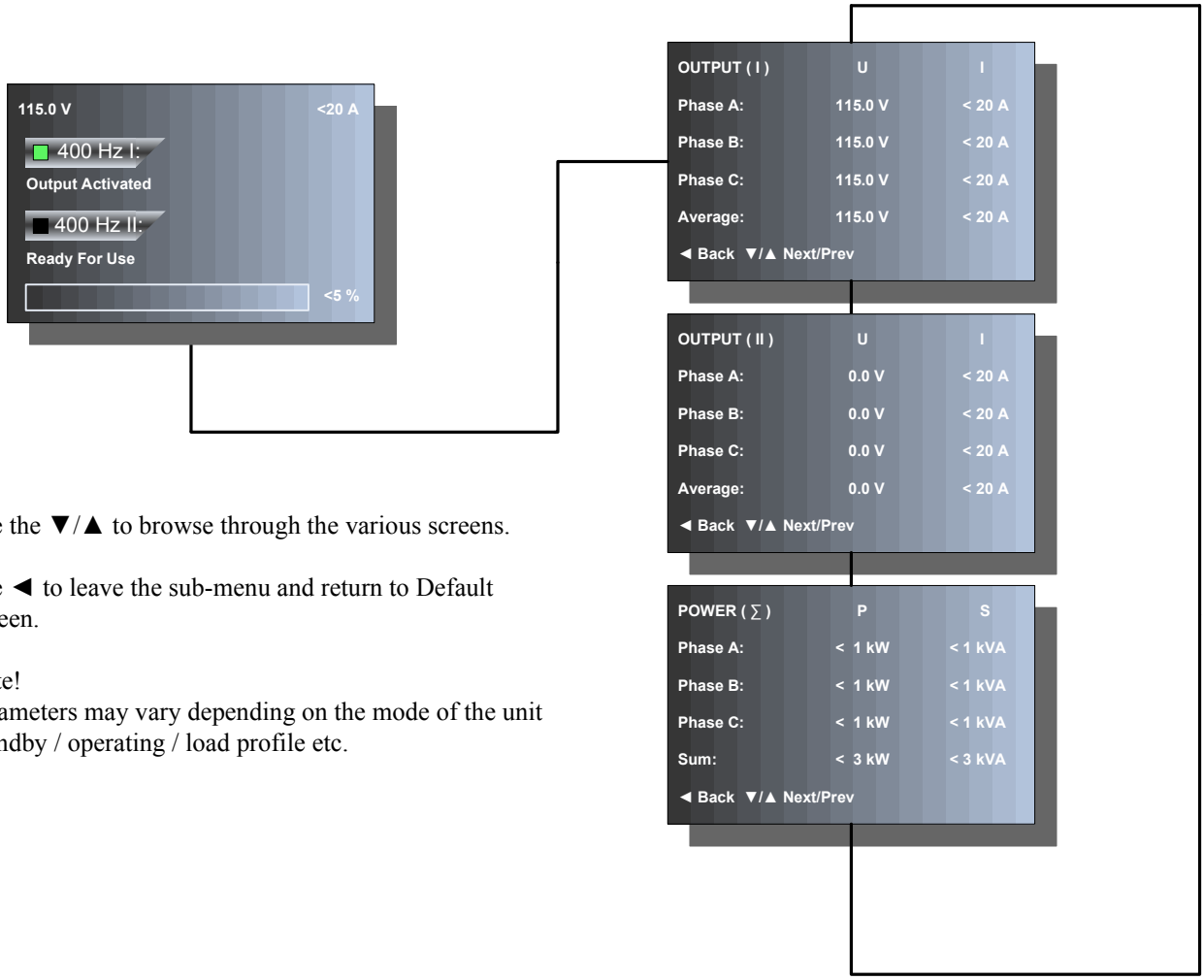


Use the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to Default Screen.

Note!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Default Display Screen Operating



Use the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to Default Screen.

Note!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

- After operation, the output(s) has to be turned off before removing the aircraft plug.

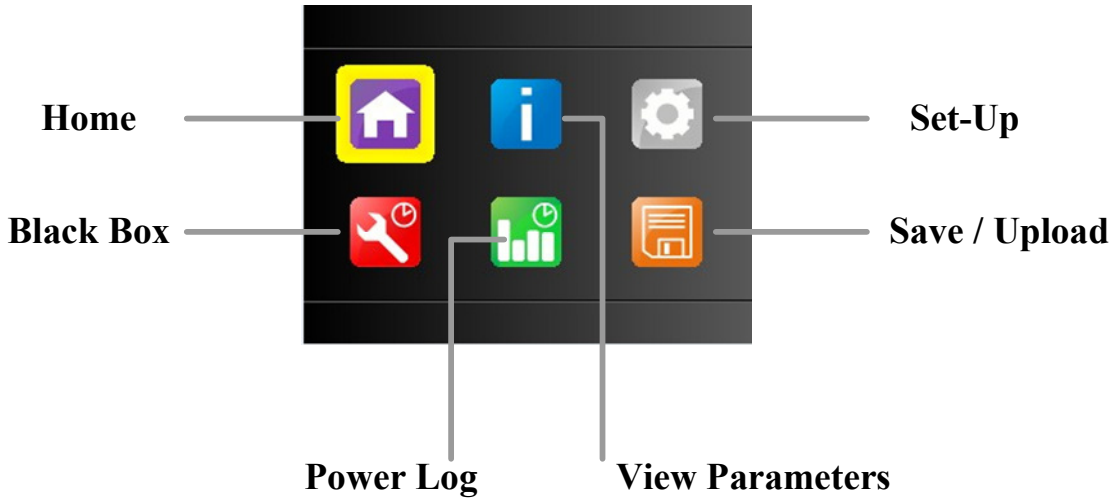
  Press the Start/stop button

- The aircraft cable(s) can now be safely removed from the aircraft and placed at the cable rest position.

Note!
Please notice that the Start/Stop button also functions as a Reset push button.

If, for some reason, the unit stops due to an error / failure, press the Start/Stop/Reset to reset the unit.

6.3 Basic Menu:



The basic Icon Menu is shown above with the available sub-menus.

To enter the Icon Menu, press the ● from the default menu and hold it down for approximately 10 seconds.

To Select a sub-menu, simply use the navigation keys ◄▼▲► to highlight the icon and then press the ● to enter the sub-menu.

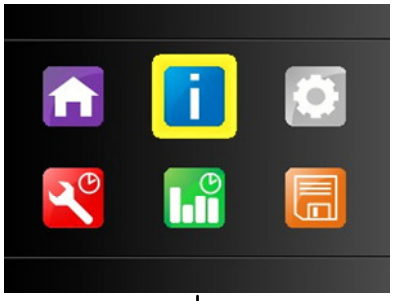
To leave the Icon Menu highlight the "Home" icon and press ●

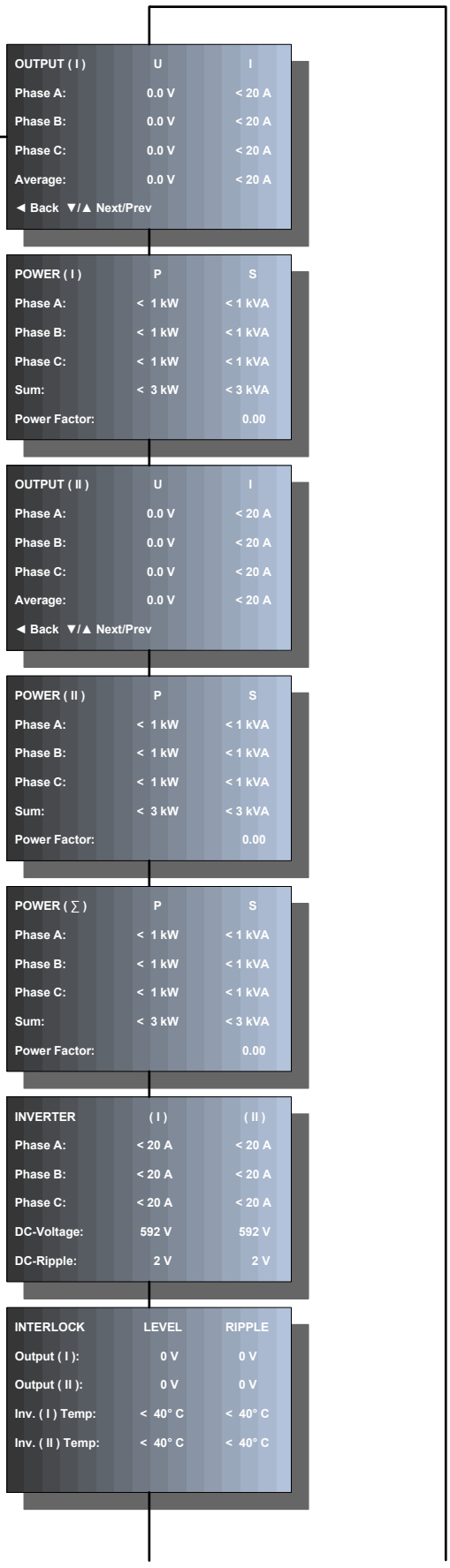
Icon explanation:

- Back to Default screen
- Viewing actual converter parameters
- Set-up menu for changing converter parameters
- Black Box with last 100 failures / errors
- Power Log with last 100 operations
- Save "Black Box" / "Power Log" records or update software *

*
Detailed instructions on the Software Update function can be found in the document 699.135 which can be obtained from ITW GSE AXA Power on request.

6.3.1 Parameters – Menu structure





Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "View parameters" sub-menu.

Use the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

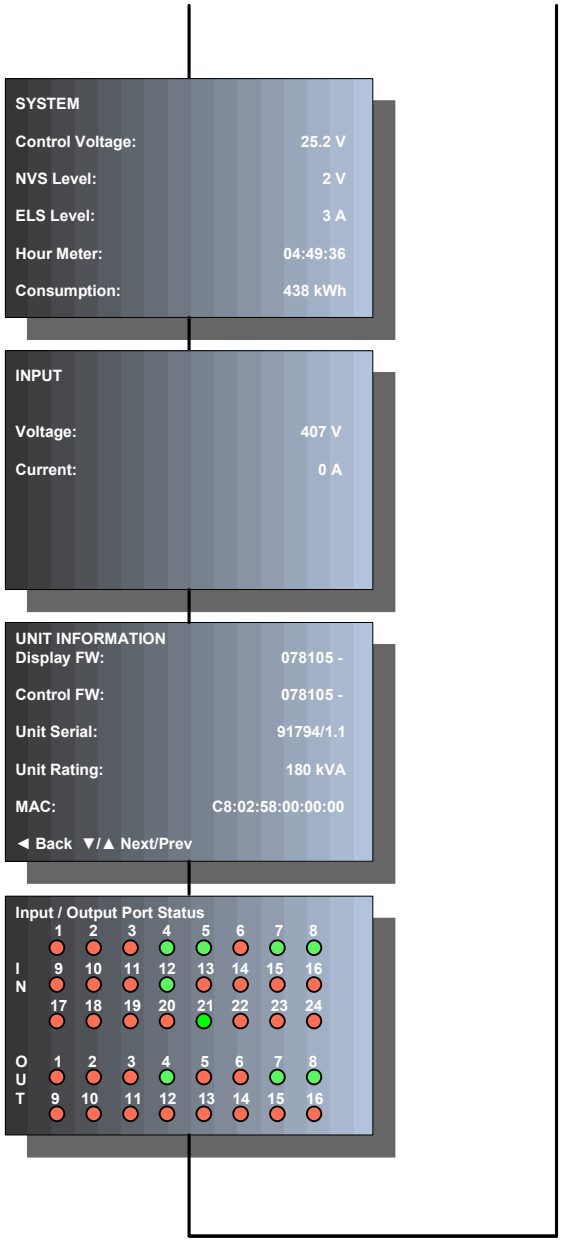
Parameters (continued) – Menu structure

Use the ▼/▲ to browse through the various screens.

- = Active
- = Not Active

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
I/O Port status may vary depending on the mode of the unit Standby / operating etc.

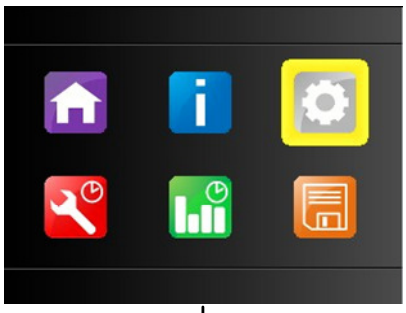


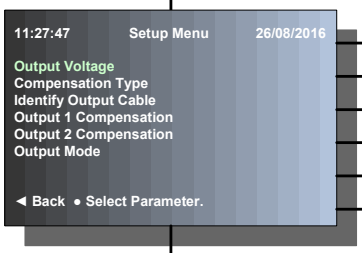
Standard I/O configuration:

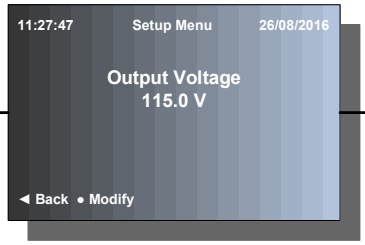
Inputs							Outputs					
No	**Function**	**Ref.**	**No**	**Function**	**Ref.**		**No**	**Function**	**Ref.**	**No**	**Function**	**Ref.**
1	Start/Reset (1)	X1: I1	**13**	*Not used*	X1: I13		**1**	400 Hz 1 On	X1: O1	**9**	GPU Running	X3: O9
2	Stop (1)	X1: I2	**14**	*Not used*	X2: I14		**2**	Interlock 1 present	X1: O2	**10**	Bridge Interlock	X3: O10
3	Aircraft Connector Insertion (1)	X1: I3	**15**	*Not used*	X4: I15		**3**	Aircraft Connector Inserted (1)	X1: O3	**11**	GPU Ready / Com. Errror	X3: O11
4	Connector Temp. (1)	X1: I4	**16**	*Not used*	X4: I16		**4**	GPU ready / Com. Error	X1: O4	**12**	*Not used*	X3: O12
5	*Not used*	X1: I5	**17**	*Not used*	X4: I17		**5**	400 Hz 2 On	X2: O5	**13**	*Not used*	X4: O13
6	GPU Enable	X1: I6	**18**	*Not used*	X4: I18		**6**	Interlock 2 present	X2: O6	**14**	*Not used*	X4: O14
7	Remote EPO	X6: I7	**19**	MCB1 trip	X29: I19		**7**	Aircraft Connector Inserted (2)	X2: O7	**15**	*Not used*	X4: O15
8	Door Interlock	X32: I8	**20**	MCB2 trip	X29: I20		**8**	GPU Ready / Com. Error	X2: O8	**16**	*Not used*	X4: O16
9	Start/Reset (2)	X2: I9	**21**	Trafo temp 1 warning	X30: I21							
10	Stop (2)	X2: I10	**22**	Trafo temp 1 high	X30: I22							
11	Aircraft Connector Insertion (2)	X2: I11	**23**	Trafo temp 2 warning	X31: I23							
12	Connector Temp. (2)	X2: I12	**24**	Trafo temp 2 high	X31: I24							

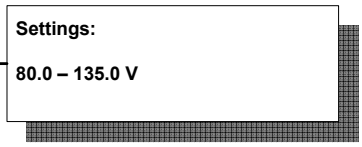
Note: please refer to schematic for further information.

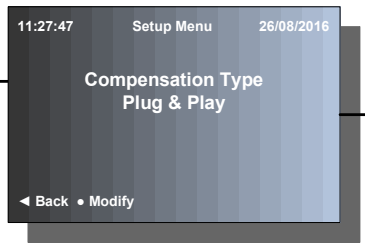
6.3.2 Setup – Menu structure

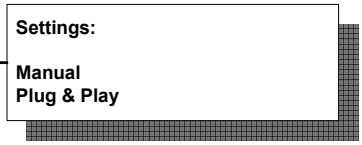


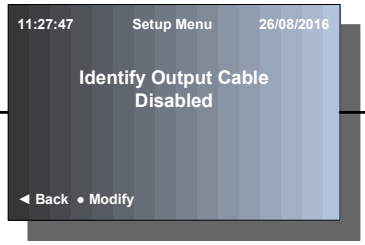


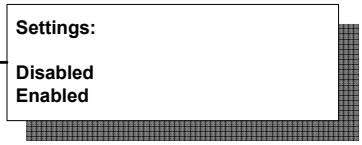


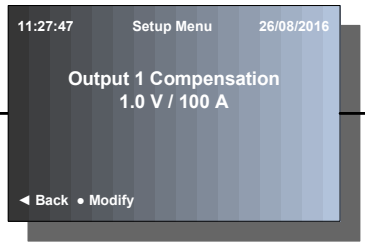


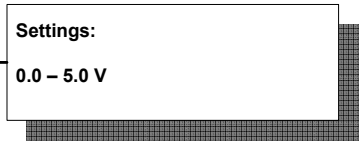


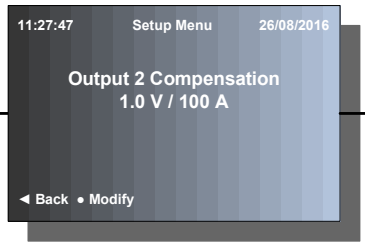


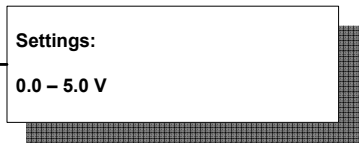


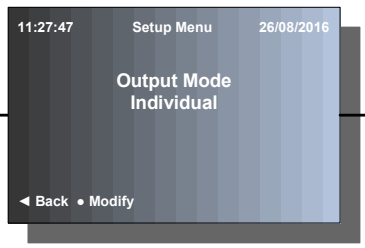


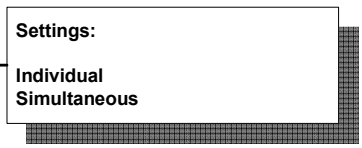












Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "Setup" sub-menu.

Use the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the ▼/▲ to adjust parameter.

Press ● to save changes.

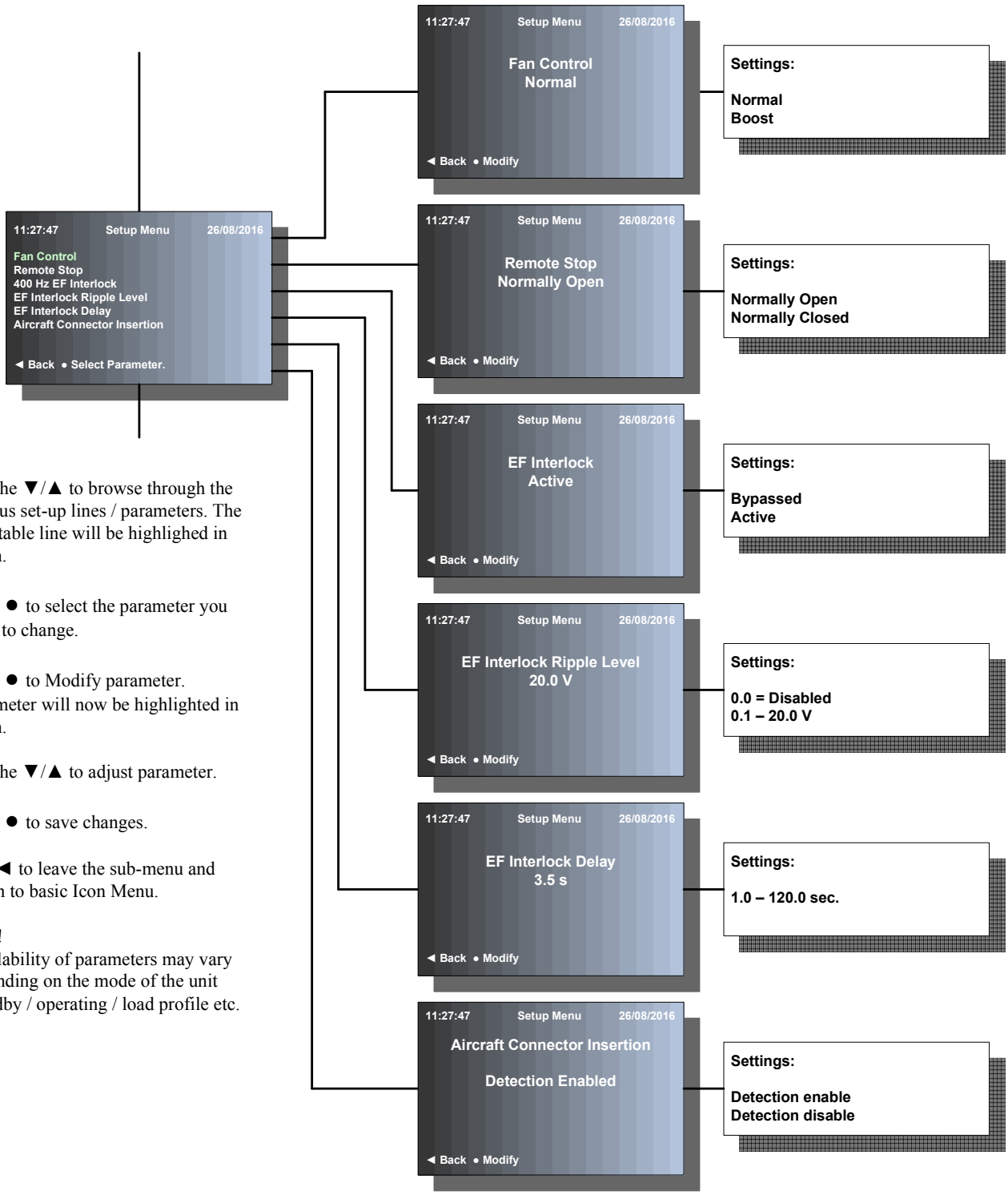
Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
Availability of parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Operation Manual - Hobart 2400 Compact – 120 / 140 / 180 kVA

Operator's Instructions

Setup (continued) – Menu structure



Use the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the ▼/▲ to adjust parameter.

Press ● to save changes.

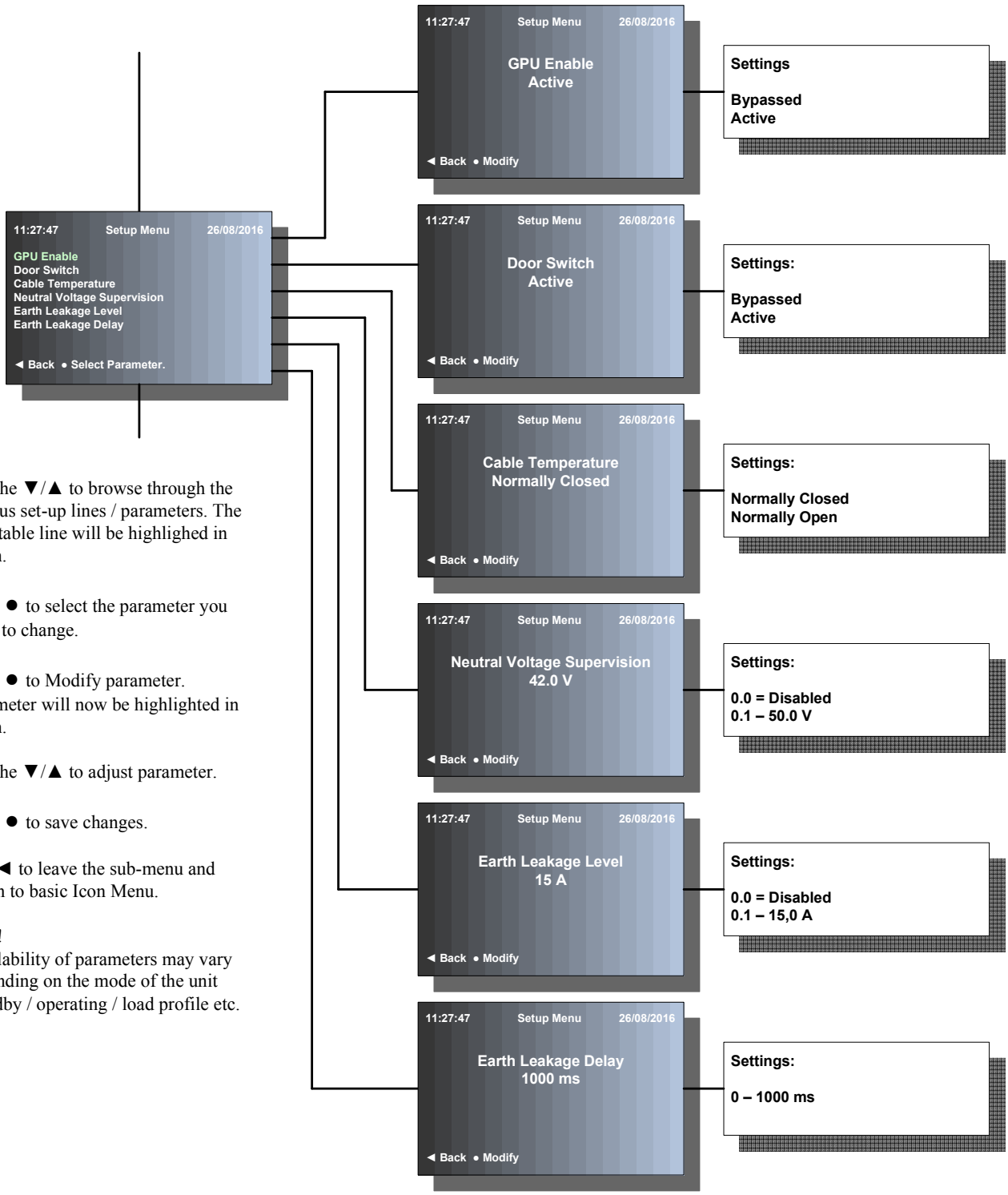
Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
Availability of parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Operation Manual - Hobart 2400 Compact – 120 / 140 / 180 kVA

Operator's Instructions

Setup (continued) – Menu structure



Use the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the ▼/▲ to adjust parameter.

Press ● to save changes.

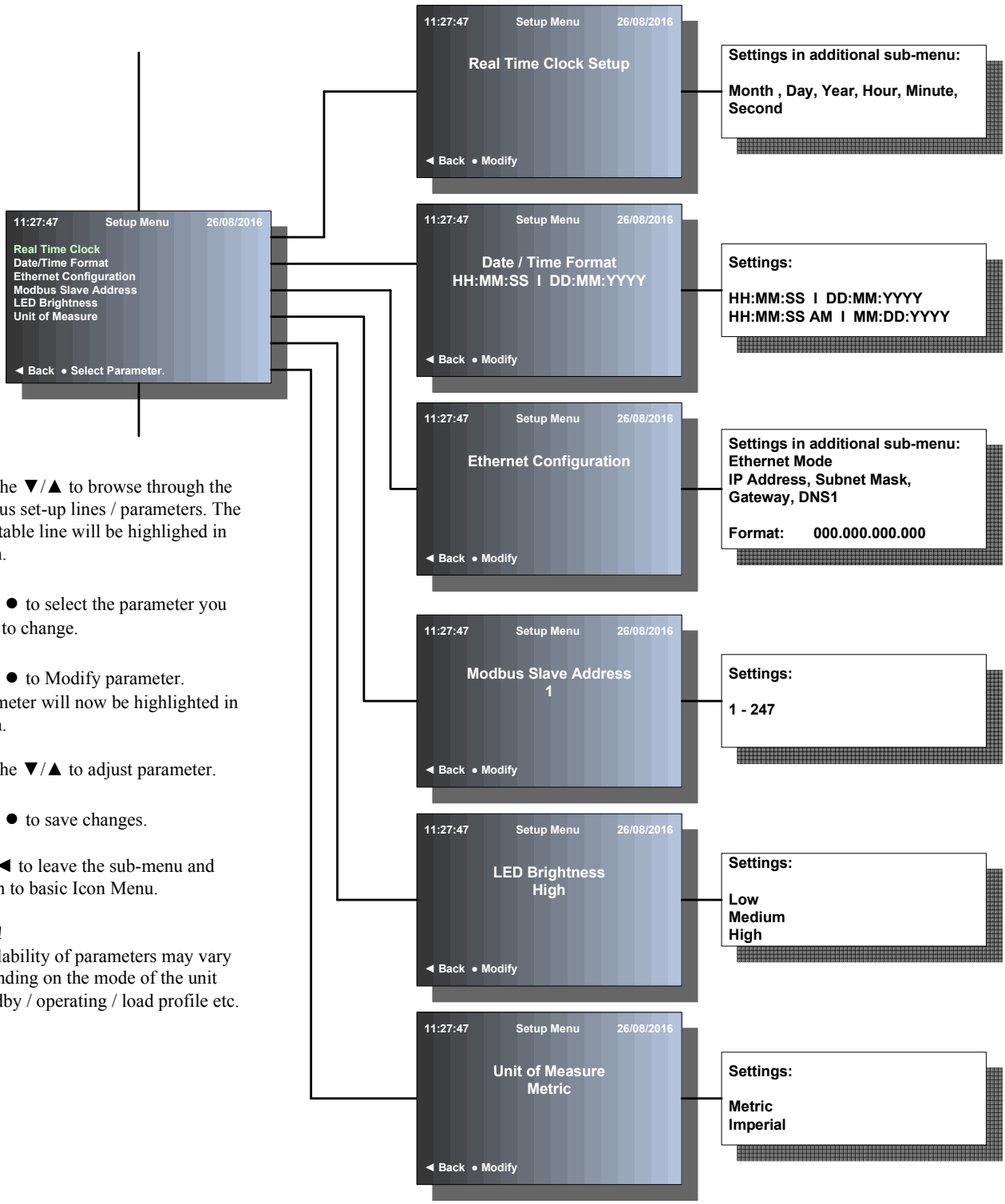
Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
Availability of parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Operation Manual - Hobart 2400 Compact – 120 / 140 / 180 kVA

Operator's Instructions

Setup (continued) – Menu structure



Use the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the ▼/▲ to adjust parameter.

Press ● to save changes.

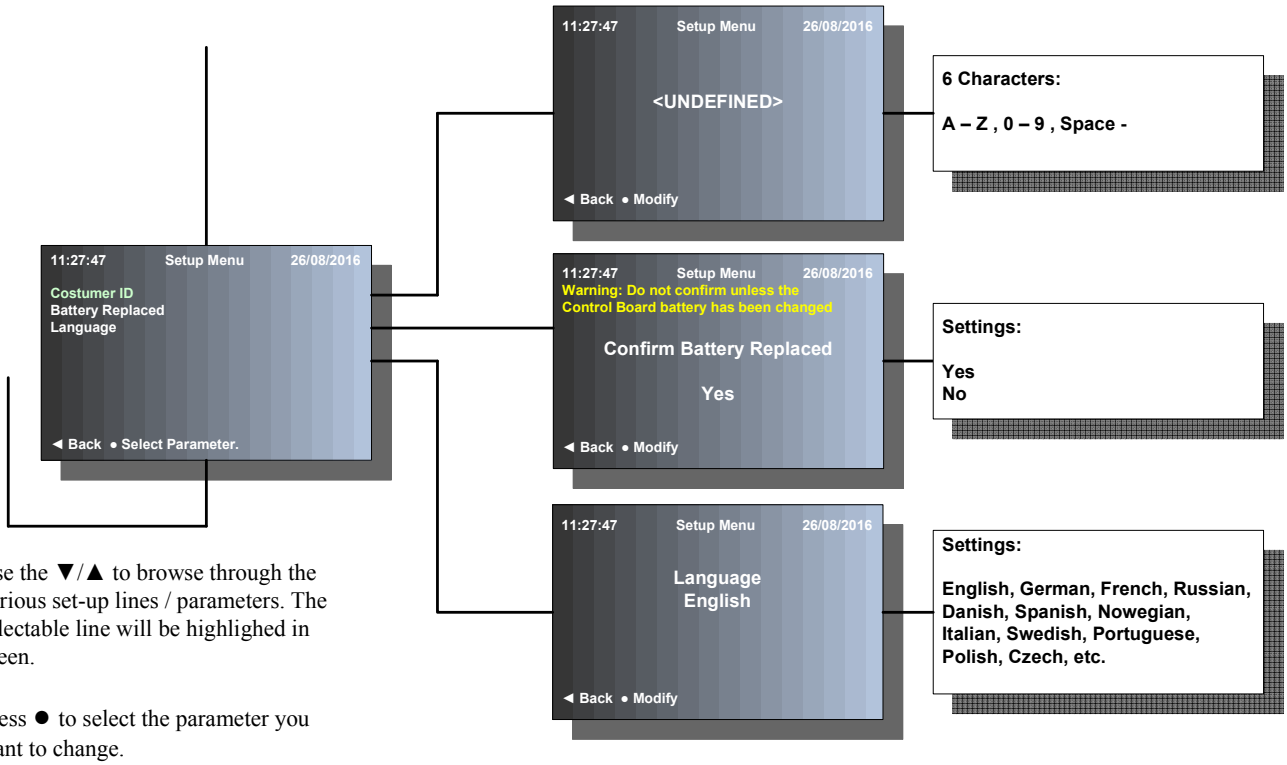
Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
Availability of parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Operation Manual - Hobart 2400 Compact – 120 / 140 / 180 kVA

Operator's Instructions

Setup (continued) – Menu structure



Use the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the ▼/▲ to adjust parameter.

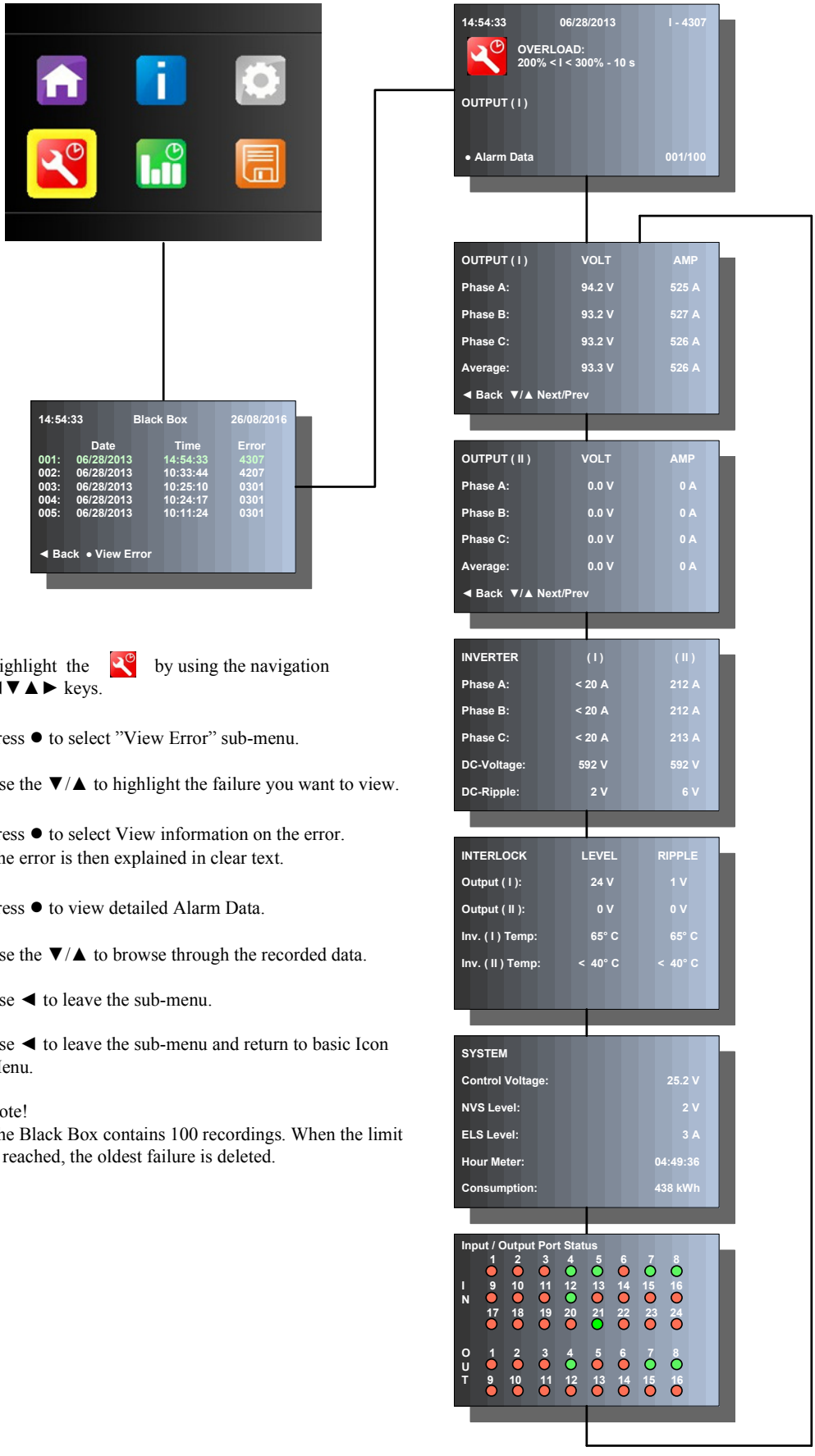
Note!
◄► can be used when entering Costumer ID

Press ● to save changes.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
Availability of parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

6.3.3 Black Box – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "View Error" sub-menu.

Use the ▼/▲ to highlight the failure you want to view.

Press ● to select View information on the error.
The error is then explained in clear text.

Press ● to view detailed Alarm Data.

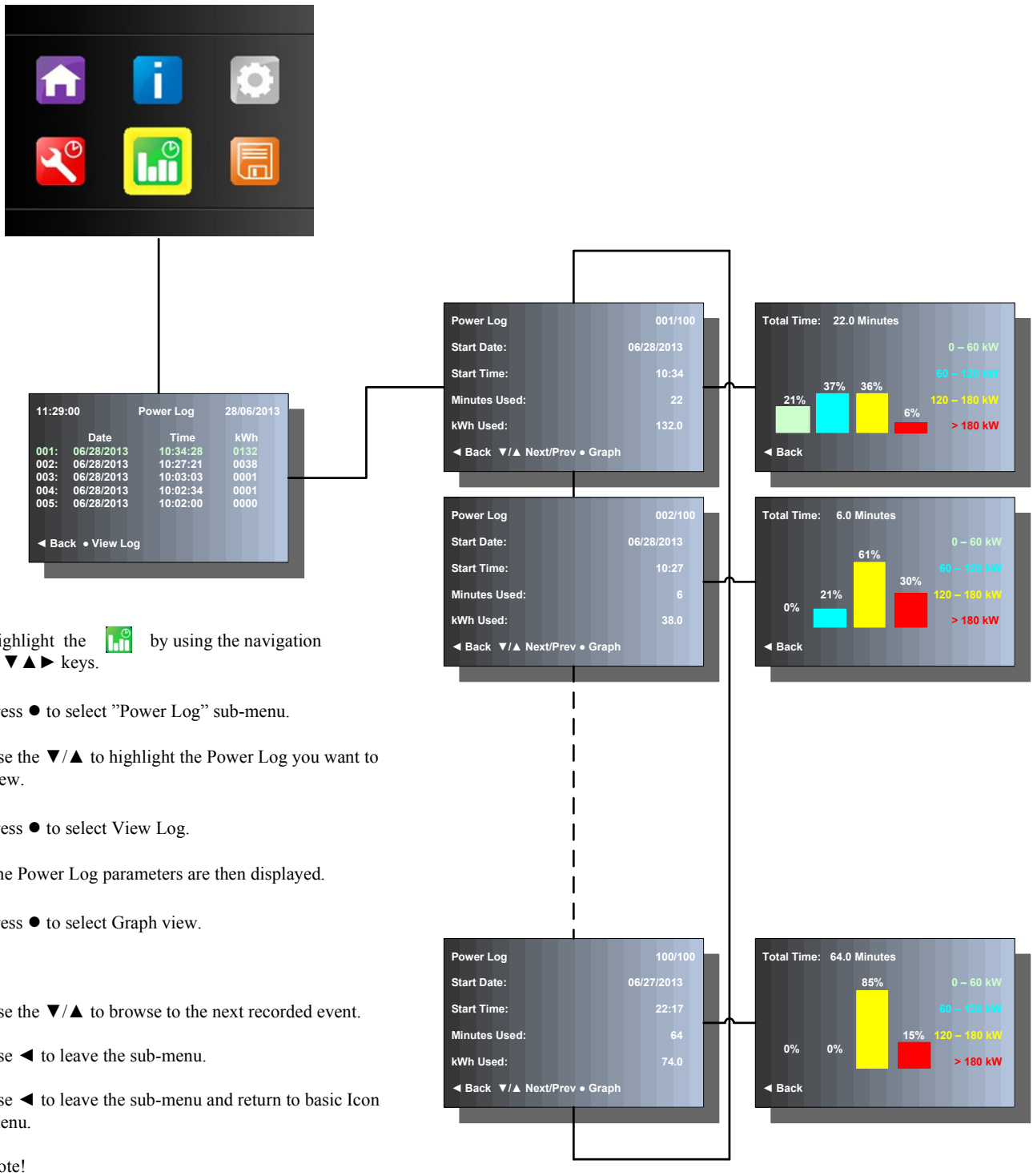
Use the ▼/▲ to browse through the recorded data.

Use ◄ to leave the sub-menu.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
The Black Box contains 100 recordings. When the limit is reached, the oldest failure is deleted.

6.3.4 Power Log – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "Power Log" sub-menu.

Use the ▼/▲ to highlight the Power Log you want to view.

Press ● to select View Log.

The Power Log parameters are then displayed.

Press ● to select Graph view.

or

Use the ▼/▲ to browse to the next recorded event.

Use ◄ to leave the sub-menu.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Note!
The Power Log contains 100 recordings. When limit is reached, the oldest Log is deleted.

6.3.5 Save/Upload – Menu structure

Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "USB Menu" sub-menu.

The default, green highlighted function is: "Update Display Software" otherwise use the ▼/▲ to highlight the function "Update Display Software".

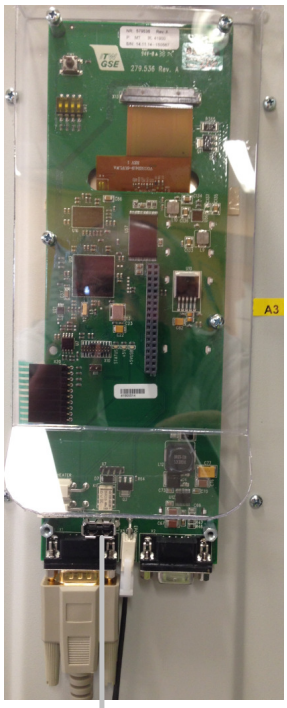
Before pressing ● to select "Update Display Software", please remember to insert a USB stick into the USB port on the Display (located on the back of the front door).

Press ● to select function.

Press ● to confirm update firmware.

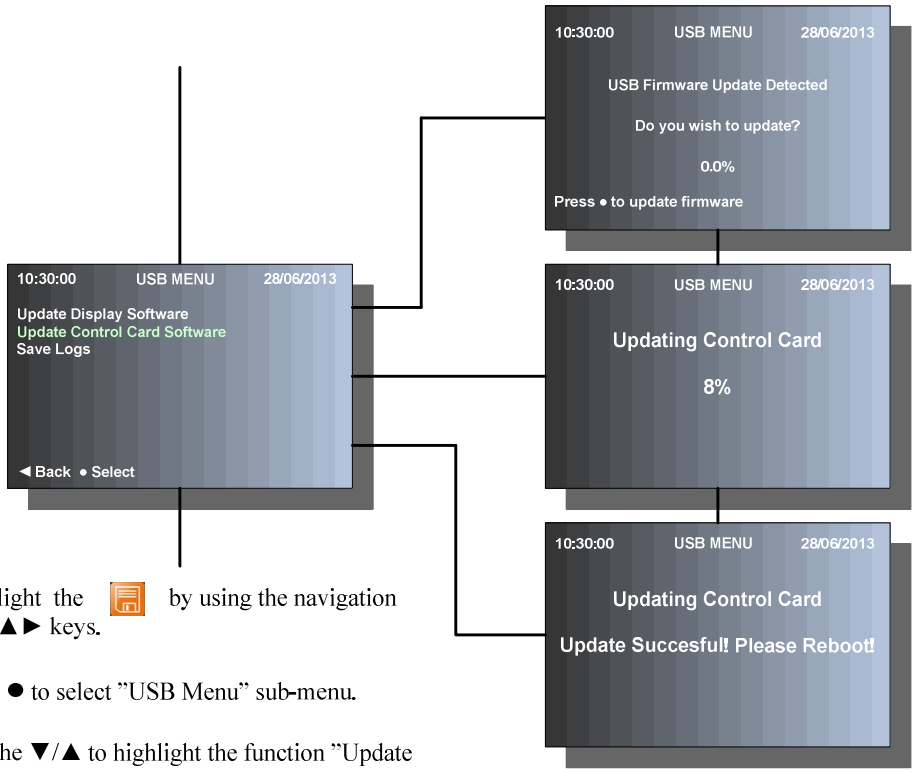
The firmware is now being uploaded to the display card. Upload % is counting from 0% to 100% and **"Update Succesful! Please reboot"** is displayed, when the update has been completed.

To Reboot the unit, press ● button.



USB connection Display

Save/Upload (continued) – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "USB Menu" sub-menu.

Use the ▼/▲ to highlight the function "Update Control Card software".

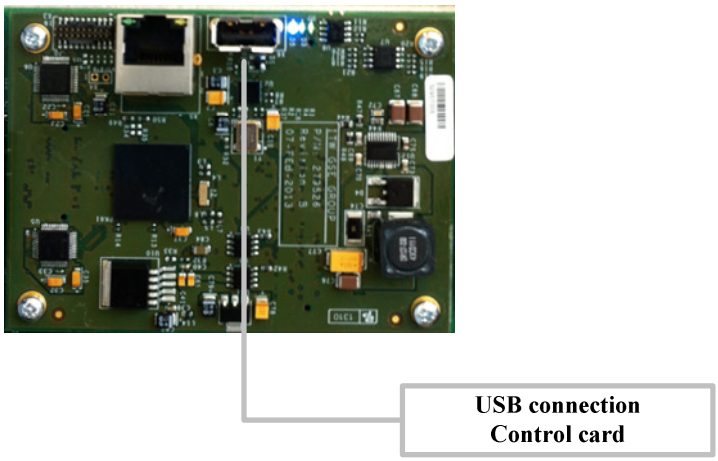
Before pressing ● to select "Update control card software", please remember to insert an USB stick into the USB port on the control card (located on the interface board).

Press ● to select function.

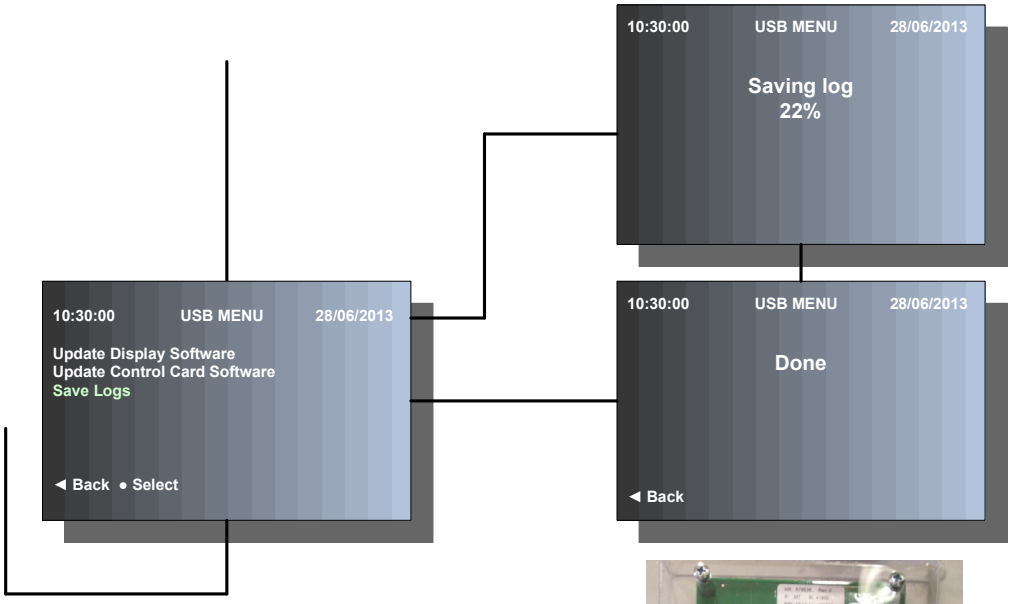
Press ● to confirm update firmware.

The firmware is now being uploaded to the control card. Upload % is counting from 0% to 100% and "Update Succesful! Please reboot" is displayed, when the update has been completed.

To Reboot the unit, press ● button.



Save/Upload(continued) – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "USB MENU" sub-menu.

Use the ▼/▲ to highlight the function "Save Logs".

Before pressing ● to select Save logs, please remember to insert a USB stick into the USB port on the display (loacted on back of the front door).

Press ● to select function.

The logs are now saved to the USB stick. Saving log % is counting from 0% to 100% and "Done" is displayed, when the saving has been completed.

The logs are saved as one CSV File and can be viewed with the **ITW GSE Service Tool**.

Note!
The USB stick can be inserted while the unit is connected to the power.

USB connection Display

6.4 Default Factory Settings:

Output Voltage (V):	115.0
Compensation Type:	Manual (Plug & Play if GPU supplied with cables)
Output 1 Compensation (V):	0.0 (Set if the GPU is supplied with cable)
Output 2 Compensation (V):	0.0 (Set if the GPU is supplied with cable)
Output Mode:	Individual (Depending on configuration)
Fan Control:	Normal
Remote Stop:	Normally Closed for units shipped/built in the America's
EF Interlock:	Bypassed (Active if GPU supplied with cables)
EF Interlock Ripple Level (V):	20.0
EF Interlock Delay (sec.):	3.5
Aircraft Connector detection:	Disabled (Enabled if supplied with cable & 90% Switch/split "F" pin)
GPU Enable:	Bypassed
Door Switch:	Bypassed (Active with option 578853)
Plug Temperature:	Normally Open
Neutral Voltage Supervision (V):	42.0
Earth Leakage Level (A):	15.0
Earth Leakage Delay (ms):	1000
Real Time Clock Setup:	Actual (Manufacturer's location)
Ethernet Configuration:	192.168.1.100
Modbus Slave Address:	1
LED Brightness:	Medium
Date/Time Format:	HH:MM:SS & DD:MM:YYYY
Unit of Measure:	Metric
Language:	Actual

7.0 Set-up Lock / Output Mode / Compensation

7.1 Preventing changes of set-up parameters

To avoid unintentional modification of the Set-up parameters, it is possible to block the access to the Set-up Mode, by means of a DIP switch situated at the Display Board A3.

Note!
If the DIP switch is set to blocked, pressing the SW1 enables the user to enter the set-up menu within 10 seconds. After the time elapses the menu will be blocked again.

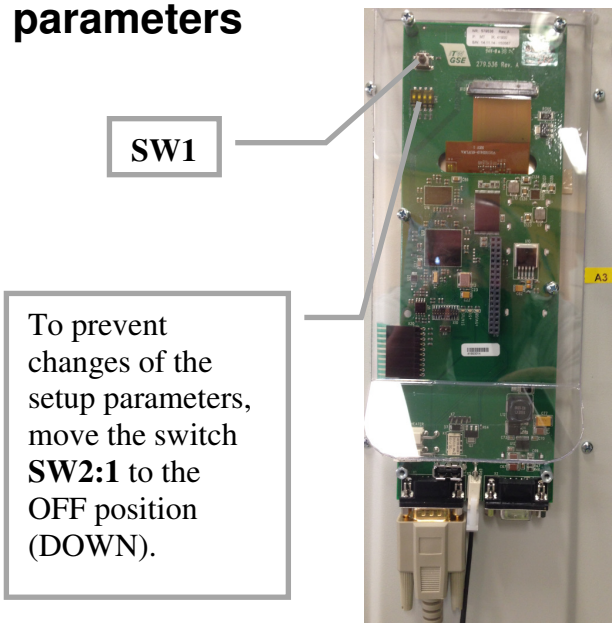


Fig. 7.1.1 Display Board A3

7.2 Output Voltage

This Setup submenu allows the output voltage to be adjusted between 80.0 VAC and 135 VAC using the UP and DOWN navigation buttons. (Please note that the acceptable voltage range for all commercial aircraft is 115V ±3V. This range is even tighter for some aircraft.)

Enter the Setup Menu and then scroll up or down to the Output Voltage submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.3 Plug & Play Cable compensation

The unique Plug & Play compensation system automatically identifies all relevant cable parameters to keep the voltage at the aircraft connector constant, at all aircraft loads.

1. With the output off, short circuit the aircraft connector using the Auto Calibration Plug (P/N 591100).

2. Enter the Compensation Type submenu and select “PLUG & PLAY”.

3. Enter the “IDENTIFY OUTPUT” submenu and select “ENABLE”.

4. Initiate the cable identification process by pressing the output's START button.
5. Within a few seconds, the cable parameters are identified and the ground power unit returns to Standby Mode.

6. Remove the Auto Calibration Plug and the ground power unit is ready for use.

Note! The unit is equipped with 2 outputs, Plug & Play compensation must be set for each output. Please refer to 7.5 section regarding Output Mode selection.

7.4 Manual Compensation

This is the traditional method of cable compensation. The output voltage is increased in proportion to the load current (Volt/100 A). This method is used where the influence of non-symmetrical cables, unbalanced load and varying power factor can be neglected or the Auto Calibration tool isn't available. Manual compensation is typically used for ground power units equipped with two outputs that are used at the same time.

1. Apply full load to output 1.

2. Enter the Compensation Type submenu and select "MANUAL".

3. Enter the "OUTPUT 1 COMPENSATION" submenu. Press the center button to allow the value to be adjusted.

4. Adjust the compensation using the vertical arrow buttons until the voltage at the aircraft connector equals the no load value. Press the ● button to accept this value

As the unit is equipped with a second output, repeat the above steps for "OUTPUT 2".

7.5 Output Mode

The unit is typically delivered with 2 individual outputs. The outputs can be selected as "Individual" and then only one output can be operated at a time. If "Simultaneous" mode is chosen both outputs can be operated simultaneously or individually.

Configured as single output, both output contactors operate/close together and the menu point will not be available.

To obtain the correct operation of the voltage compensation, it is essential that both types of compensation (Plug & Play and Manual Compensation) have been set beforehand - and for each output.

Note!
An aircraft requires an input voltage of 115V ±3V. The unit can only compensate for a maximum voltage drop of 14 V since the highest output voltage is limited to 129 V. When extremely long 400 Hz distribution cables are used, it might be necessary to use parallel output cables to stay within the required aircraft voltage.

7.6 Fan Control

The default is set to Normal. This allows the software to control the speed of the fan based on the internal temperature of the unit. Boost mode should be selected when the GPU is running in a high ambient temperature area at full load and the unit is used more or less continuously due to short turnaround times at the gate. When the Boost mode is selected, the fans keep running for 20 minutes after use in order to cool down the magnetics. This ensures that the starting temperature for the magnetics will be close to the ambient temperature before starting the next cycle of operation.

Enter the Setup Menu and then scroll up or down to the Fan Control submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.7 Remote Stop

In the United States the Remote Stop push button contacts must be Normally Closed. This is not the case in other parts of the world. This setting is used to match what is being used at the site.

Go into the Setup Menu and then scroll up or down to the Remote Stop submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.8 EF Interlock

The EF interlock is a personnel and equipment safety feature that is found in all commercial aircraft. This 28VDC signal will not be present until the SSFC closes its output contactor and provides 400 Hz power to the aircraft. The aircraft will evaluate the 400 Hz power and if it is within the aircraft's tolerance limits it will then close a relay in the aircraft to provide a 28VDC signal to the "F" pin/wire in the power connector plug/cable.

Some load banks do not provide this EF Interlock so the EF Interlock function in the unit has to be bypassed. Do not set this value to Bypassed for normal operation with aircraft. This setting is only to be used by qualified personnel for testing the SSFC unit or when the unit will be providing power to equipment outside of an aircraft.

Note! The value will be automatically reset to Active if the unit detects 28 volts on the "F" pin input of the I/O board.

Go into the Setup Menu and then scroll up or down to the EF Interlock submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.9 EF Interlock Ripple Level

The EF Interlock Ripple Level is part of the Neutral Voltage Displacement circuit. If an aircraft has a large unbalanced load and the aircraft power cable has a broken neutral, then it is possible for the aircraft frame to be energized to a dangerous level. This condition will result in an AC voltage induced onto the EF DC signal.

This submenu sets the trip level for the AC ripple on the DC EF interlock signal for both cables. The default value is 20.0 volts and a setting of 0.0 volts disables the function.

Go into the Setup Menu and then scroll up or down to the EF Interlock Ripple Level submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.10 EF Interlock Delay

Some of the newer aircraft take a longer time between when 400 Hz power is supplied to the aircraft and when the aircraft returns the 28 VDC EF Interlock signal. This setting allows the adjustment of the amount of time the unit will wait until determining that the EF signal is not present and that the output power should be shut off. The default value is 3.5 seconds.

Go into the Setup Menu and then scroll up or down to the EF Interlock Delay submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.11 Aircraft Connector Insertion

Some aircraft power cables are equipped with a micro-switch or split "F" pin in the connector. This device sends a 28 VDC signal to the unit when the connector is inserted at least 90% of the way into the aircraft power receptacle. Set this submenu value to Enable when such cables are connected to the unit. The default value is set to Disable and applies for both cables.

Go into the Setup Menu and then scroll up or down to the Aircraft Connector Insertion submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.12 GPU Enable

Some airports utilize a key card reader or key lock to keep track of who is using the GPU. This feature prevents the GPU from turning on the output unless the GPU Enable signal is present. The default value is Bypassed.

Go into the Setup Menu and then scroll up or down to the GPU Enable submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.13 Door Switch

Some GPU units have a door interlock switch installed on the front & back door. If either the front or back door is opened the unit will shut off when this submenu is set to Active. Use this submenu to bypass the door switches during maintenance operations.

Go into the Setup Menu and then scroll up or down to the Door Switch submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.14 Cable Temperature

Some aircraft cables have temperature sensors installed in the connector. This submenu allows the unit to accept Normally Opened or Normally Closed temperature sensor switches to be used and applies for both cables.

Go into the Setup Menu and then scroll up or down to the Cable Temperature submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.15 Neutral Voltage Supervision

If the output Neutral wire is not connected to the chassis ground then the unit can monitor the voltage difference between aircraft neutral and ground. If the voltage is greater than the set value (typically 42 volts) an unsafe condition exists and the unit will shut off the output power. The default value is 42 volts and the function is disabled if the value is set 0.0 volts and applies for both cables.

Go into the Setup Menu and then scroll up or down to the Neutral Voltage Supervision submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.16 Earth Leakage Level

If the output Neutral wire is connected to the chassis ground and the neutral wire breaks while there is an unbalanced aircraft load then an unsafe condition exists. This function monitors the current in the ground wire. If the current exceeds the set value (typically 15 A) for a set time (set in the Earth Leakage Delay submenu), an unsafe condition exists and the unit will shut off the output power. The default value is 15 A. The function is disabled if the value is set to 0.0 A and applies for both cables.

Go into the Setup Menu and then scroll up or down to the Earth Leakage Level submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.17 Earth Leakage Delay

This submenu is used in conjunction with the Earth Leakage Level submenu. The default value is 1000 ms.

Go into the Setup Menu and then scroll up or down to the Earth Leakage Delay submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.18 Real Time Clock Setup

This set of submenus allows the user to adjust the internal clock to the correct local time.

Go into the Setup Menu and then scroll up or down to the Real Time Clock Setup submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.19 Date/Time Format

The date and time format that is displayed on all of the screens and reports can be adjusted using this submenu. The selection is a 24 hour clock and DD:MM:YYYY date format or a 12 hour clock with the MM:DD:YYYY date format.

Go into the Setup Menu and then scroll up or down to the Date/Time Format submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.20 Ethernet Configuration

This set of submenus allows the user to enter the Ethernet IP address, Subnet Mask, Gateway address and DNS1 values for TCP/IP communications with a BMS or RMS central monitoring system.

Go into the Setup Menu and then scroll up or down to the Ethernet Configuration submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.21 Modbus Slave Address

If the unit will be part of an RS-485 Modbus RTU BMS/RMS monitoring system, it must be assigned a Modbus Slave Address. This submenu allows the user to enter the slave address.

Go into the Setup Menu and then scroll up or down to the Modbus Slave Address submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.22 LED Brightness

The unit status LED's have three brightness levels. The default is set to medium.

Go into the Setup Menu and then scroll up or down to the LED Brightness submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.23 Unit of Measure

This submenu is used to set the unit of measurements to Metric or Imperial.

Go into the Setup Menu and then scroll up or down to the Unit of Measure submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.24 Costumer ID

This submenu allows the user to assign a name to the unit for reporting purposes when Fault or Power Log files are saved to a USB stick or drive.

Go into the Setup Menu and then scroll up or down to the Costumer ID submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.25 Battery Replaced

This submenu allows the user to update/reset internal counter for battery replacement warning.

Go into the Setup Menu and then scroll up or down to the Battery Replaced submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

7.26 Language

This submenu is used to change the language that all of the display screens, messages, alarms and reports are displayed in. The unit comes with English, German, French, Russian, Danish, Spanish,

Norwegian, Italian, Swedish, Portuguese, Polish, Czech etc. The default is set to English.

Go into the Setup Menu and then scroll up or down to the Language submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

8.0 Service, Maintenance, Overhaul

To make certain that the unit is always ready for use it must be maintained on a regular basis.

Only qualified personnel should remove covers for service, maintenance or overhaul purposes.

8.1 Recommended Maintenance Schedule

• Check aircraft connectors.	Daily / upon use
• Check output cables for damaged insulation.	Weekly
• Verify function of the Aircraft Connector Insertion, if present.	Quarterly
• Check air-filters - Wash or change as appropriate.	Quarterly
• Check that all fans are running properly.	Yearly
• Check rubber seals at front door, rear door.	Yearly
• Check internal bolt/screw and wire connections.	Yearly
• Visual inspection of PCB's - control unit/gate drive.	Yearly
• Verify proper operation of the output contactors' contact sets and coil	Yearly
• Verify the output voltage at aircraft connector(s) with and without load	Yearly

Especially for mobile units

• Check tires for wear and tear	Yearly
• Check correct air pressure (4.3 Bar = 62 PSI)	Quarterly

8.2 Battery back-up & replacement

Situated on the back of the control board is a coin type lithium battery which ensures that Firmware/Set-up data etc. are not lost during mains drop-outs. The expected life of the battery is approximately 7 years. However, a low battery voltage does not affect the internal safety system of the GPU that monitors the output voltage, among others. Thus aircraft connected to the GPU are not exposed to any danger. To avoid loss of data and Control Board lock up *, we recommend changing the battery after **5 years** of use.

To ensure high reliability of the back-up battery, the only type of battery that can be used on the Control Board is the Panasonic BR-2032

How to change the battery:

Before removing the Control Board and to avoid any static discharge to the Control Board during the replacement of the battery, please take ESD (Electro Static Discharge) precautions.

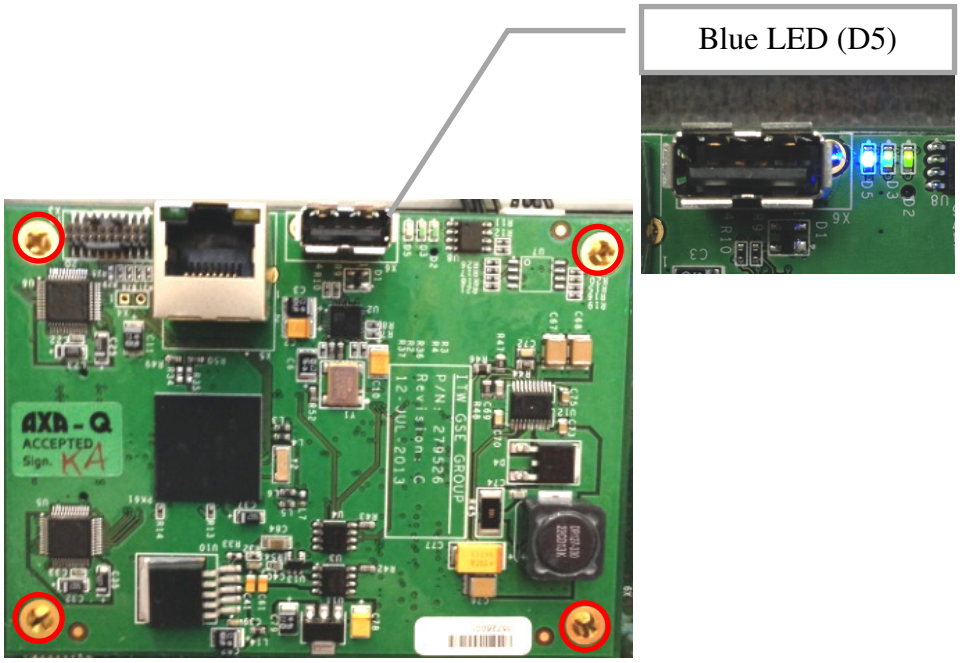


Fig. 8.2.1 Control Board (front view)

To replace the battery, **Switch OFF** the unit by means of Q1. Remove the 4 screws that hold the Control Board, marked with a ○. Place the PCB on an insulated surface, with the back side face up.

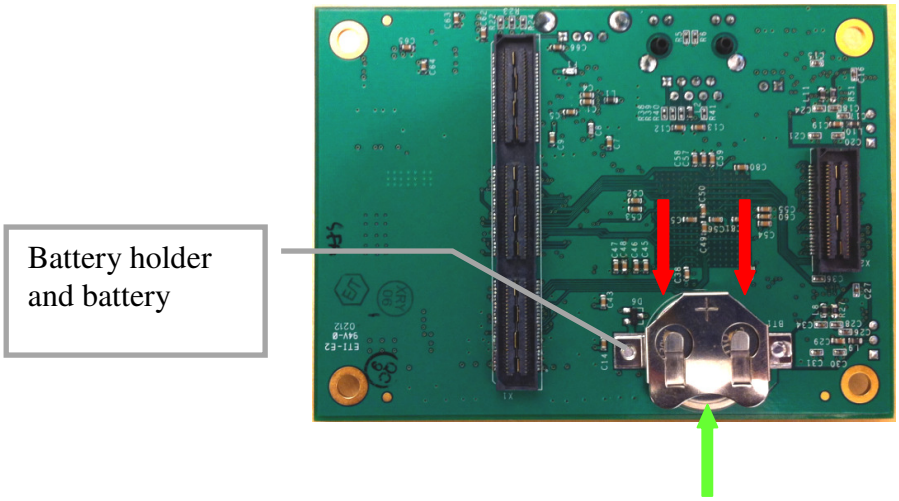


Fig. 8.2.2 Control Board (rear view)

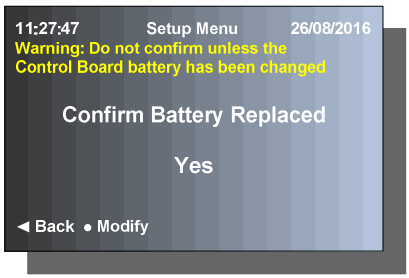
Before you remove the battery from the holder, make sure that the replacement battery is within reach, as the **Control Board must not be without battery power for more than 30 seconds**.
Otherwise, all firmware and the setup data will be erased. *

Remove the battery from the holder using a small insulated screwdriver to push out the battery, direction indicated by the red arrows and insert the new battery in the direction of the green arrow.

Mount the control board on the interface board again by gently pressing the PCB to its rest on the Interface Board. Make sure that all 4 corners are fully pressed towards the Interface Board.

Switch on the unit via the input switch Q1 and close the door. The unit now passes through the initialization test and goes into standby mode.

Enter the setup menu and select menu item “Battery Replaced” to confirm new battery installation.



* Important Note!

If the blue LED on the Control Board (location can be found on the Fig. 8.1.1) flashes with approximate 2 flashes per second and the display reports “Communication Error”, the firmware on the Control Board has been erased. The Control Board must be sent to ITW GSE to be reloaded.

9.0 Trouble Shooting & Repair

Only have qualified personnel remove covers for troubleshooting and repair. Please be aware that the DC capacitors can remain charged to a dangerous voltage **up to 5 minutes** after the mains input power has been disconnected.

Usually the display text provides sufficient information to get the ground power unit into operation again. In case the display is blank, please check Q6 (Circuit Breaker) and fuse F3 at the Interface Board A2 (corresponding LED D8). The following fuses are located on the Interface Board (A2):

Fuse #	Applicable for	Type	Rated voltage	Amp rating
F1 (D24)	I/O Fuse	ATO Blade Fuse	32 V	2 A
F2 (D24)	I/O Fuse	ATO Blade Fuse	32 V	2 A
F3 (D8)	Display Fuse	ATO Blade Fuse	32 V	2 A
F4 (D2)	Interface Fuse	ATO Blade Fuse	32 V	5 A
F5 (D4)	Fans 1 Fuse	ATO Blade Fuse	32 V	10 A
F6 (D5)	Fans 2 Fuse	ATO Blade Fuse	32 V	10 A

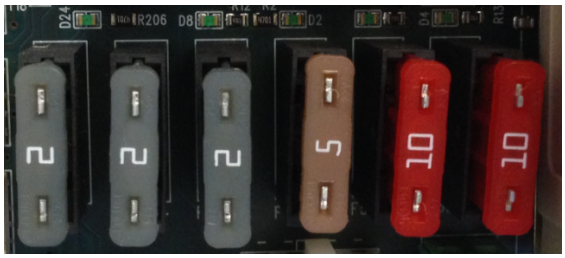


Fig. 9.0.1 Fuses F1-F6 and LED indication (A2 Interface Board)

If the displayed text does not provide sufficient information to solve the problem, Table 1, Table 2 and Table 3 (section 9.1) suggest corrective actions to be carried out for each error code.
Additional error information regarding the output voltage, overload, covering the error codes area can be derived from the error code according to the following directions:

Output Voltage : 30xx / 31xx / 35xx
Overload : 40xx / 41xx / 42xx / 43xx / 44xx / 45xx / 46xx

Phase code:
xx01 = Phase A
xx02 = Phase B
xx03 = Phase A & B
xx04 = Phase C
xx05 = Phase A & C
xx06 = Phase B & C
xx07 = Phase A, B & C

Examples: Error Code 3501 refers to “Output Voltage Too Low” at phase A.
Error Code 4407 refers to “Overload I > 300% - 1 sec.” at all 3 output phases.

9.1 Fault Guidance

In case you need to contact us for further fault guidance, please do not forget to enter the serial number of the GPU (found at the rating plate) and the actual error code on the fault finding form that can be downloaded from www.itwgse.com/axapower

List below shows the complete list of error codes and first corrective action:

Error code	Error text in display	Help text	1st. Corrective action
0	NO ERRORS		
100	LOGGING UNSUCCESSFUL		
200	CONTROL BOARD FAILURE	Watchdog Timeout	Press start to reset
201	CONTROL BOARD FAILURE	CRITICAL: Memory Error	Contact ITW GSE
202	WRONG SOFTWARE VERSION		Install correct software version
250	DISPLAY UPDATE RESET		
300	CONTROL VOLTAGE LOW	Control Voltage < 20V (Running)	Press start to reset
301	CONTROL VOLTAGE LOW	Control Voltage < 20V (Standby)	
400	EMERGENCY STOP ACTIVATED		Release emergency stop and press start to reset
700	CONTROL BOARD BATTERY FAILURE		Press start to reset
750	REAL-TIME CLOCK NOT SET	Please set to current time and date	
1000	SOFTSTART ERROR	DC Voltage < 400V	
1100	DC VOLTAGE TOO LOW	DC Voltage < 300V - 30ms	
1200	DC VOLTAGE TOO HIGH		
1201	DC VOLTAGE TOO HIGH	DC Voltage > 800V – 30 s	
1202	DC VOLTAGE TOO HIGH	DC Voltage > 850V - 2.5ms	
1300	DC CAPACITOR SHARING ERROR	DC Voltage > 850V	
1400	DC RIPPLE TOO HIGH	DC Ripple > 20V – 3 minutes	
1450	DC RIPPLE TOO HIGH	DC Ripple > 10V – 5s	
1501	INVERTER TEMP TOO HIGH	IGBT 1 Temperature > 110 °C	
1502	INVERTER TEMP TOO HIGH	IGBT 2 Temperature > 110 °C	
2000	GATE VOLTAGE ERROR		
3000	OUTPUT VOLTAGE TOO HIGH	Voltage > 130V - 250ms	
3100	OUTPUT VOLTAGE TOO HIGH	Voltage > 140V - 15ms	
3500	OUTPUT VOLTAGE TOO LOW	Voltage < 104V - 500ms	
4000	OVERLOAD: 100% < I < 125% - 600 s	Phase X	
4100	OVERLOAD: 125% < I < 150% - 60 s	Phase X	
4200	OVERLOAD: 150% < I < 200% - 30 s	Phase X	
4300	OVERLOAD: 200% < I < 300% - 10 s	Phase X	
4400	OVERLOAD: I > 300% - 1 s	Phase X	
4500	SHORT CIRCUIT AT OUTPUT		Remove short circuit and press start to reset
4600+code	FILTER CURRENT TOO LOW	Phase X	Press start to reset
4700	FILTER CURRENT TOO HIGH		
4800	INVERTER SOFTSTART FAILURE		
5000	TRANSFORMER TEMP TOO HIGH		
5100	EARTH LEAKAGE FAULT AT OUTPUT		
5101	EARTH LEAKAGE FAULT AT OUTPUT		
5200	NEUTRAL VOLTAGE FAULT AT OUTPUT		
5300	MCB TRIPPED		
6000	EF OUTPUT 1 RIPPLE TOO HIGH	Ripple Voltage Exceeded Limit	
6100	CABLE TEMPERATURE TOO HIGH		
6300	EF SIGNAL DROP OUT	EF Signal Disappeared	
9000	END OF FACTORY TEST		
9100+code	PLUG & PLAY FAILED - OUTPUT X		
9110+code	PLUG & PLAY FAILED - OUTPUT X		
9200+code	PLUG & PLAY COMPLETED - OUTPUT X		

List below shows the complete list of error codes and next corrective actions:

Error code	2nd. Corrective action	3rd. Corrective action	4th. Corrective action
0			
100			
200	Replace Control Board A1		
201	Verify ID Chip inserted	Contact ITW GSE AXA Power	
202			
250			
300 - 301	Check input voltage	Check Q6 & G1	
400	Check emergency stop	Check user EPO (A2:X14)	Replace Control Board A1
700	Replace Battery on Control Board A1	Replace Control Board A1	
750			
1000	Check input voltage	Check DC softstart charging voltage > 400 V	Replace Interface Board A2 Replace Capacitor Module A5 Replace Control Board A1
1100	Check input voltage	Check Q5	Replace Control Board A1 Replace Interface Board A2
1200			
1201	Check input voltage	Replace Control Board A1	Replace Interface Board A2
1202	Check input voltage	Replace Control Board A1	Replace Interface Board A2
1300	Check DC sharing voltage at R1	Replace Control Board A1	Replace Interface Board A2
1400	Check input voltage	Check equal voltage across V1 – V6	Replace Control Board A1 Replace Interface Board A2
1450	Check input voltage	Check equal voltage across V1 – V6	Replace Control Board A1 Replace Interface Board A2
1501	Check fuse F5	Set fans to ”Boost” and check voltage Between + & – and PWM & – at fan terminals (10 V)	Check dust filters Replace Control Board A1 Replace Interface Board A2
1502	Check fuse F5	Set fans to ”Boost” and check voltage Between + & – and PWM & – at fan terminals (10 V)	Check dust filters Replace Control Board A1 Replace Interface Board A2
2000	Replace Control Board A1	Replace Interface Board A2	Replace Inverter Module
3000	Check voltage set-up value	Replace Control Board A1	Replace Interface Board A2
3100	Replace Control Board A1	Replace Interface Board A2	
3500	Check voltage set-up value	Replace Control Board A1	Replace Interface Board A2
4000	Remove overload and press start	Replace Control Board A1	Replace Interface Board A2
4100	Remove overload and press start	Replace Control Board A1	Replace Interface Board A2
4200	Remove overload and press start	Replace Control Board A1	Replace Interface Board A2
4300	Remove overload and press start	Replace Control Board A1	Replace Interface Board A2
4400	Remove overload and press start	Replace Control Board A1	Replace Interface Board A2
4500	Disconnect load / output cable	Replace Control Board A1	Replace Interface Board A2
4600+code	Check output filter capacitors C7-C9	Check output transformer T2	Replace Control Board A1 Replace Interface Board A2

Table continues on next page

Continued from previous page

Error code	2nd. Corrective action	3rd. Corrective action	4th. Corrective action
4700	Check output filter capacitors C7-C9 Check output filter capacitors C10-C12	Check output transformer T2	Replace Control Board A1 Replace Interface Board A2
4800	Check DC voltage	Check output voltage/feedback voltage	Replace Control Board A1 Replace Interface Board A2 Replace Inverter Module
5000	Let the unit cool down and press start to reset	Check dust filters and fans	Check(short circuit sensor) replace sensor TH if necessary Replace Control Board A1 Replace Interface Board A2
5100	Check set-up value	Remove load and check output cabling	Replace T5 Replace Control Board A1 Replace Interface Board A2
5101	Check / Replace Output Capacitors		
5200	Check set-up value	Remove load and check output cabling for insulation failure	Replace Control Board A1 Replace Interface Board A2
5300	Reset MCB	Replace Control Board A1	Replace Interface Board A2
6001	Check set-up value	Remove load and check output 1 plug / cabling	Replace Control Board A1 Replace Interface Board A2
6002	Check set-up value	Remove load and check output 2 plug / cabling	Replace Control Board A1 Replace Interface Board A2
6100	Remove load and let plug (s) cool down	Check connector / output cabling for any malfunction	Replace Control Board A1 Replace Interface Board A2
6300	Verify that output cables is correct inserted	Check / correct installation	Replace Control Board A1 Replace Interface Board A2
9000			
9100+code	Repeat cable Identification		
9110+code	Repeat cable Identification		
9200+code			

Note!

Before changing any PCB's/Inverter Module check corresponding connection and wiring.

Please observe!

To prevent PCB damage from electrostatic discharge, wear ESD wrist strap when servicing/replacing.

10.0 Illustrated Parts List

Please refer to **www.itwgse.com/axapower** for recommended list of spare parts. It is also possible to find diagrams and drawings of the unit at this website.

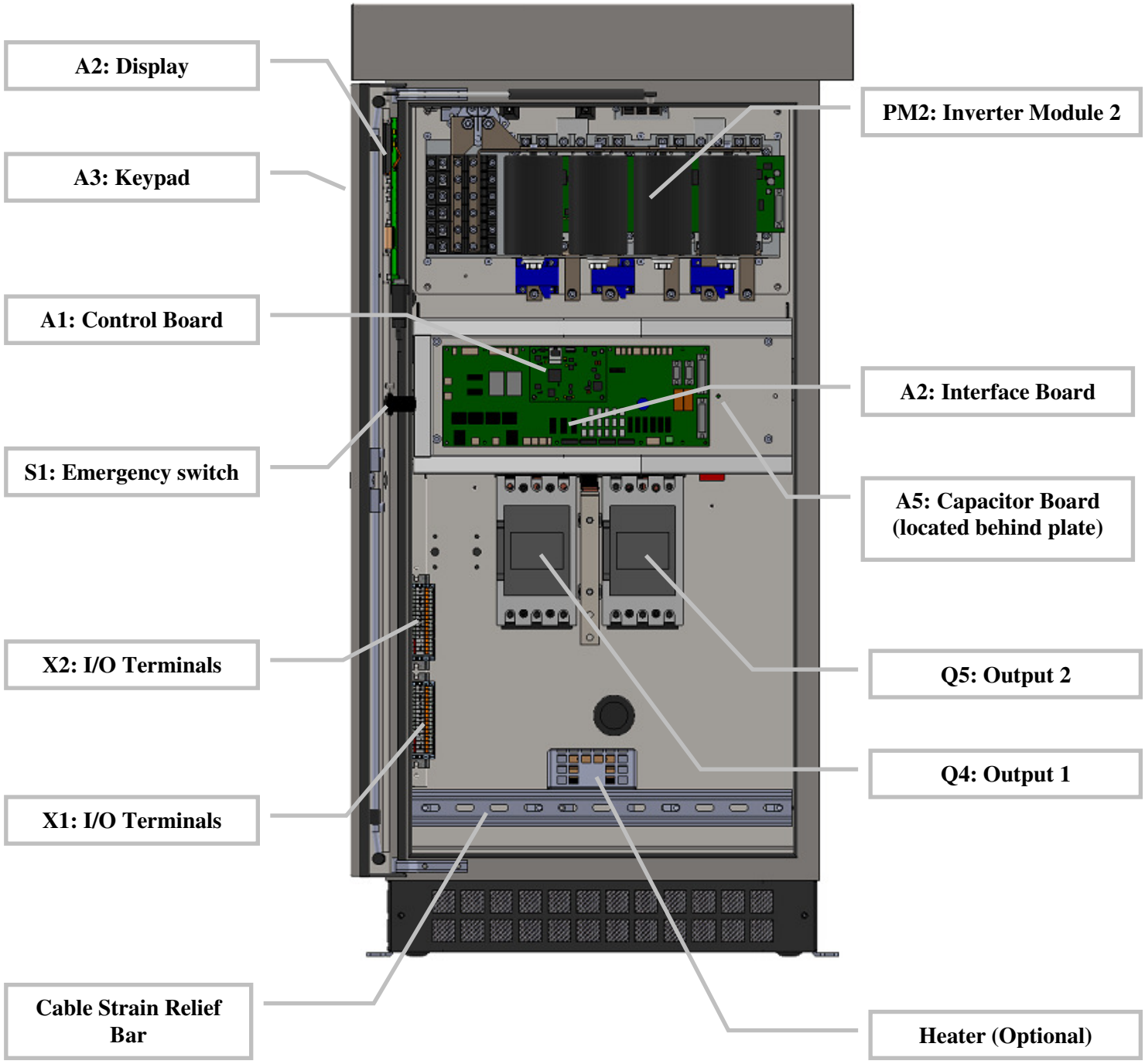


Figure: 10.0.1 Front View

Note!

In mobile and bridge mounted units, the display module and the emergency stop button are situated in a separate box.

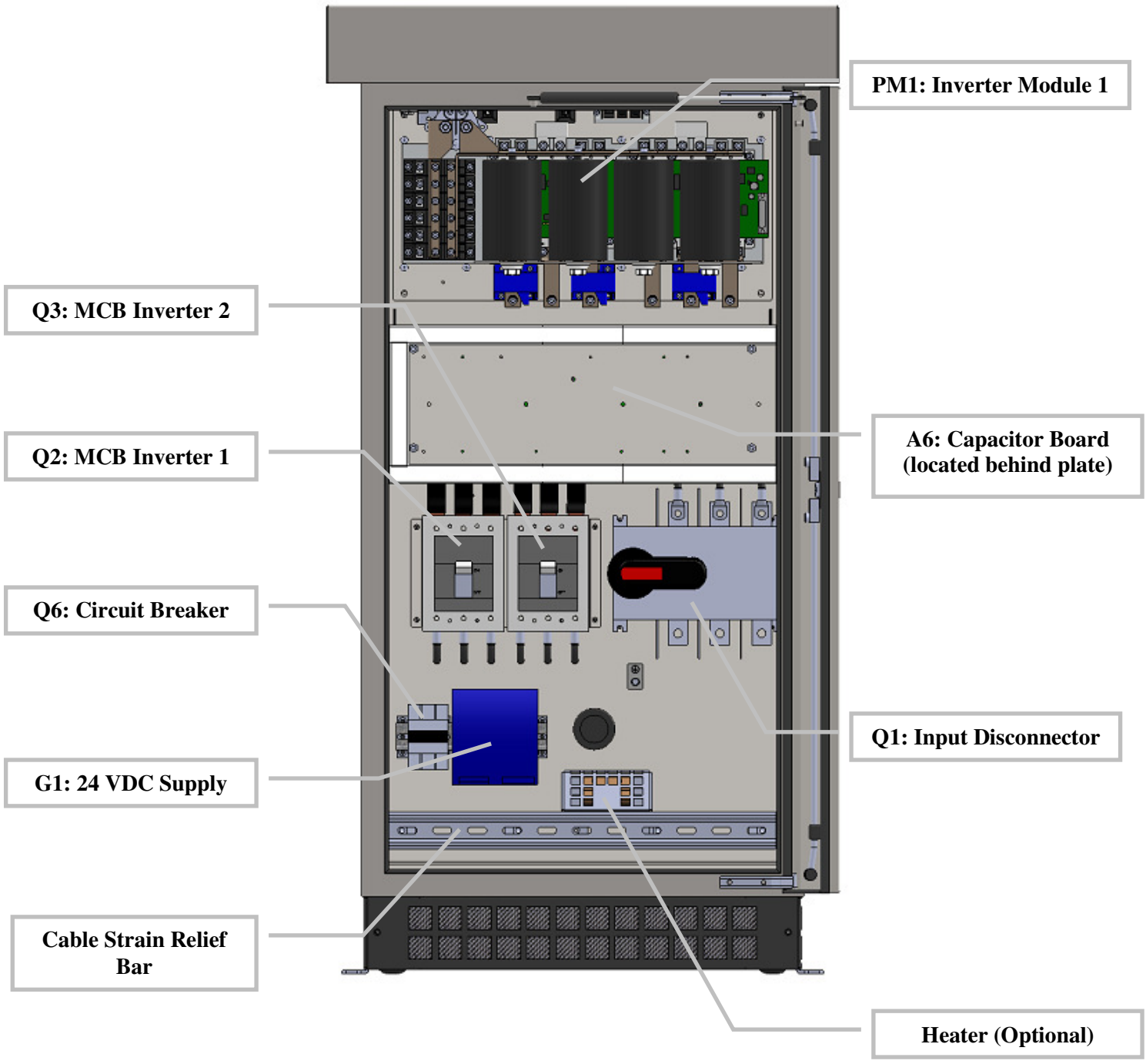


Figure 10.0.2 Rear View

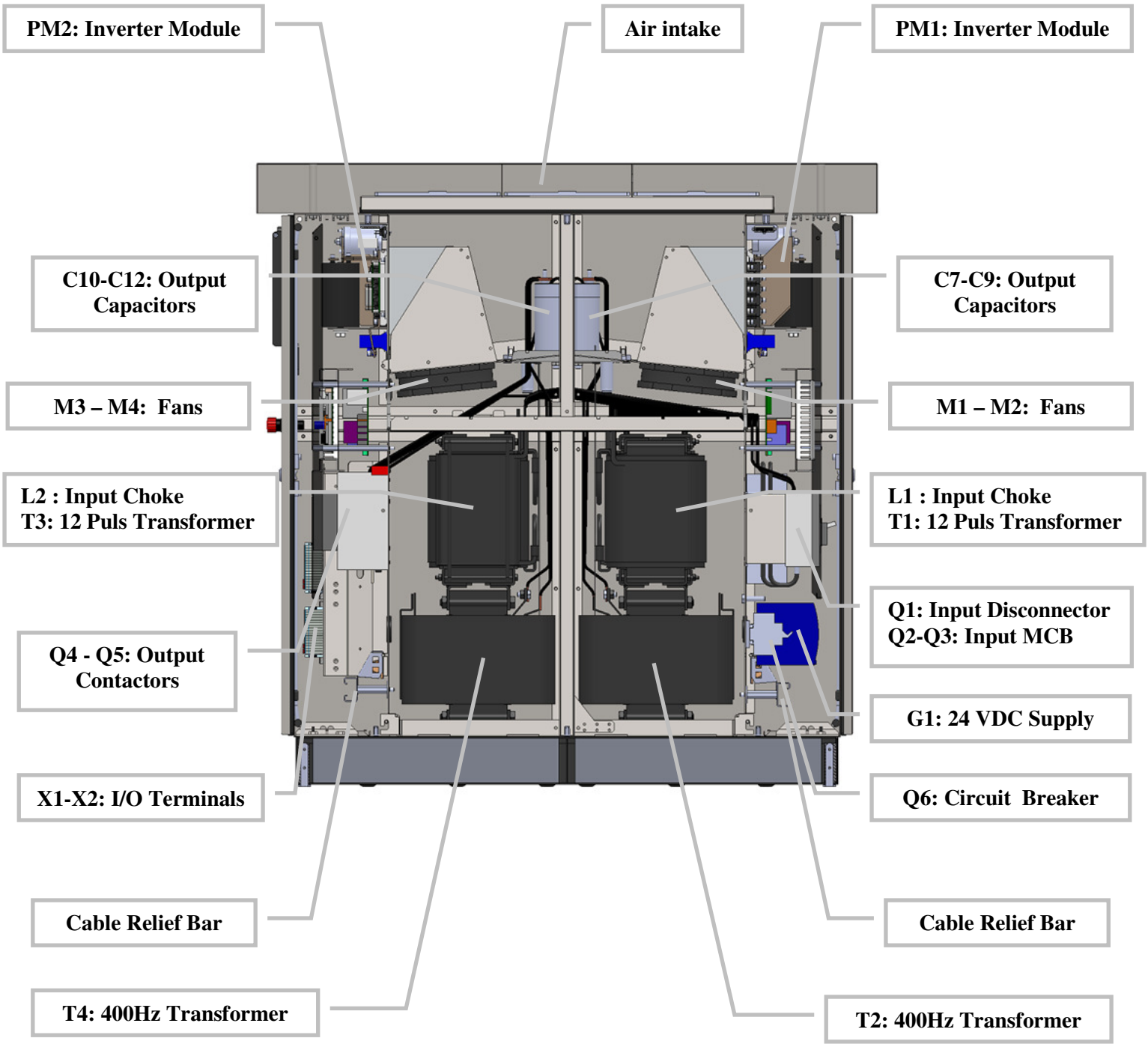


Figure 10.0.3 Side View cut

11.0 Options

578808 Dry Contacts (Diagram 478850)

If dry contacts are needed for additional indication/to the PBB or to a BMS system, this option offers the following dry contact relays:

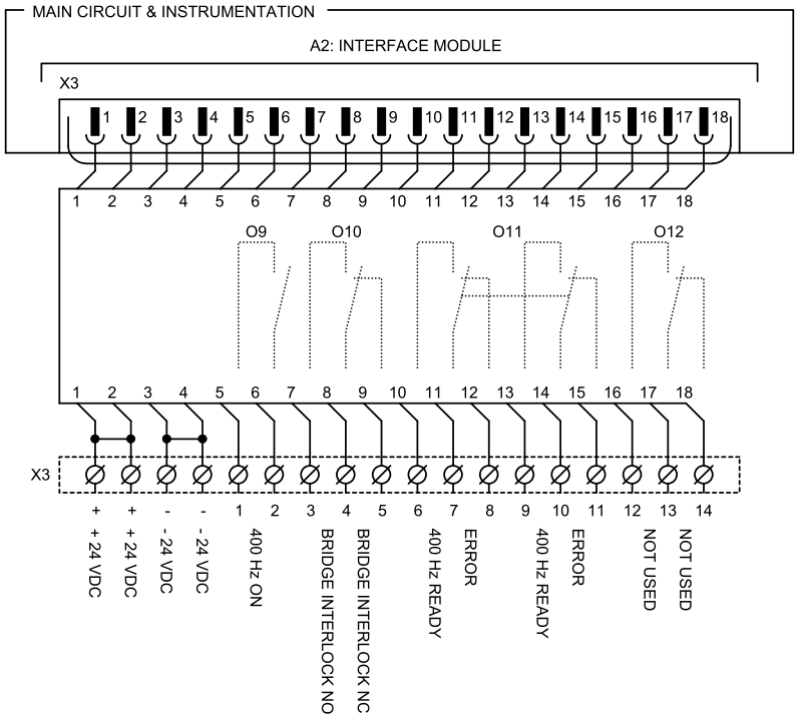
Q9 400 Hz On (N.O.)

Q10 Bridge Interlock (N.O.)
Bridge Interlock (N.C.)

Q11 400 Hz Ready (N.O.)
Error (N.C.)

Q11 400 Hz Ready (N.O.)
Error (N.C.)

Q12 Not Used (N.O.)
Not Used (N.C.)



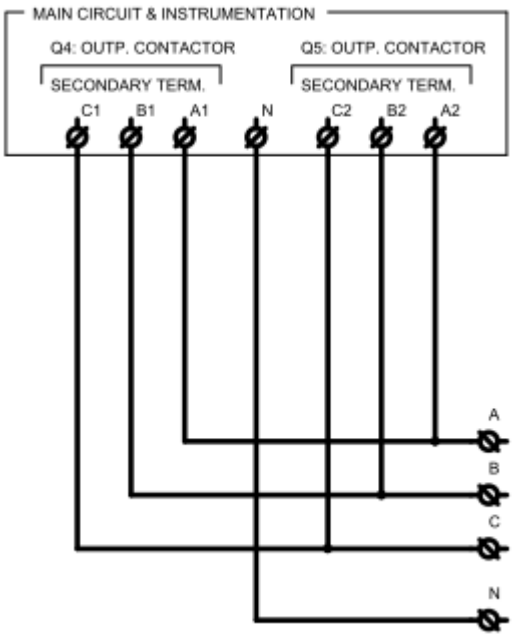
Note!
Contacts V_{max} = 50 V AC/DC and I_{max} = 2 A

578850 Base module (Drawing 278430)

Additional base module which extends the height/length of the ground power unit by 340 mm (13.4”) and the weight by 30 kg / 66 lbs. (Refer to drawings section 5)

578852 Single Output (Diagram 478850)

The option is used in an installation where there is a desire to have the device as a single output unit.
Both output contactors close simultaneously.
(One push-button Start/Stop at operator's panel)

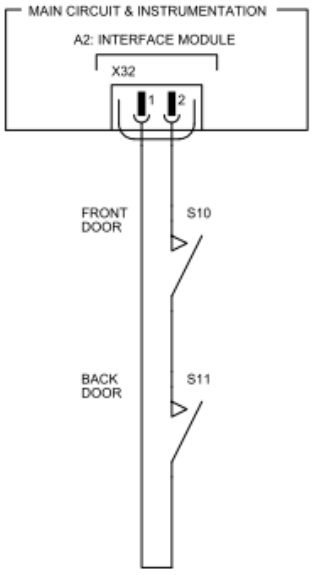


Note!

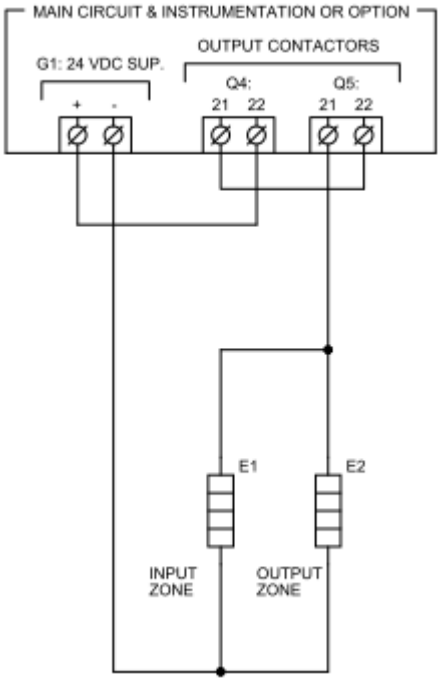
If the Single Output option (GPU) is linked up with Remote Control Box please remember to order option 578806 (Remote Control Box single output)

578853 Door Interlock (Diagram 478850)

The door interlock ensures that the ground power unit's output contactors open and the unit immediately returns to standby mode if one of the doors (front/back) is opened.



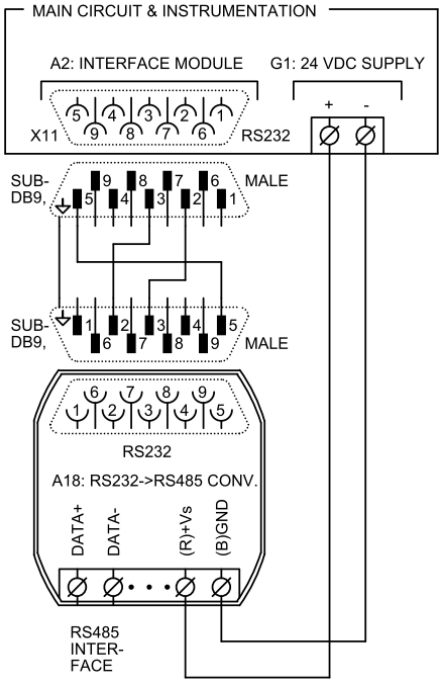
578854 Anti-Condensation Heater (Diagram 478850)



In areas with high relative humidity, temperature drops cause formation of dew inside the enclosure of the GPU. On a long-term basis this can affect components such as relays, switchgears and printed circuit boards (PCBs). Dew formation can however, be avoided by installation of heating elements in the GPU.

During operation the waste heat from the circuits prevents dew from arising. In stand-by mode where the internal losses are insignificant, two 30 W anti-condensation heaters automatically switch on and prevent condensation from arising.

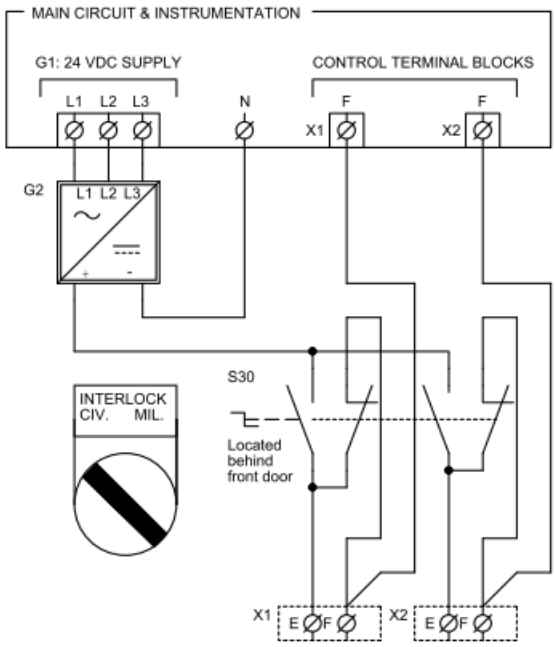
578855 RS485 Interface (Diagram 478850)



All units are supplied with connections for RS232.
The RS485 Interface option provides a galvanic isolated RS485 connection and allows for multi-point connection.

578856 Military Interlock (Diagram 478850)

For military aircraft, the interlock system must be switched from civil interlock to military interlock by means of selector switch (S30) behind the front door. The GPU thereafter delivers 28 VDC on the E pin and this voltage is returned to the F pin by the aircraft.



Standard wiring diagram for military interlock

Note!
This option requires a 400 Hz cable **without** the E&F jumper in the connector head.

578857 Lockable Door (Fixed)

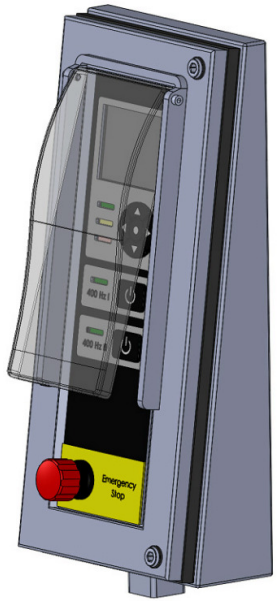
As a standard, the GPU is supplied with a quarter-turn lock intended for a double bit 5 mm pin key. One key is supplied per ground power unit.

On an optional basis, the ground power unit can be supplied with a lockable swing handle at the front and back door. The handle is locked by a profile square 6 mm cylinder according to DIN 18252/18254 (depth = 40 mm). Each ground power unit is supplied with 2 identical DIRAK 1333 keys.

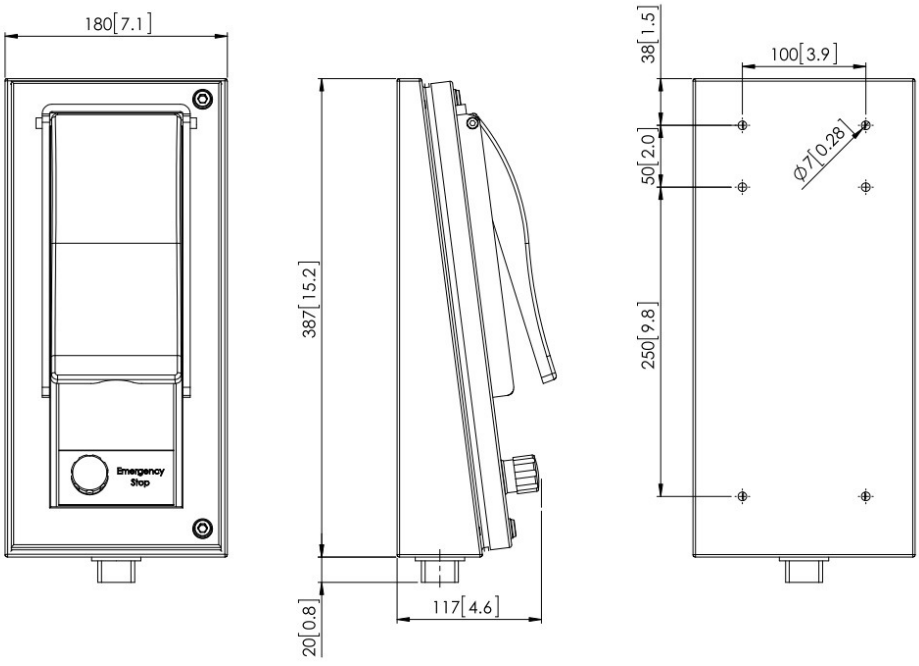
578xxx Remote Control Box

578806 Single 400 Hz output
578818 2 x 400 Hz Outputs
578858 2 x 400 Hz Outputs & controls for Retriever/Hoist

2 x 400 Hz Outputs / Retriever or Hoist

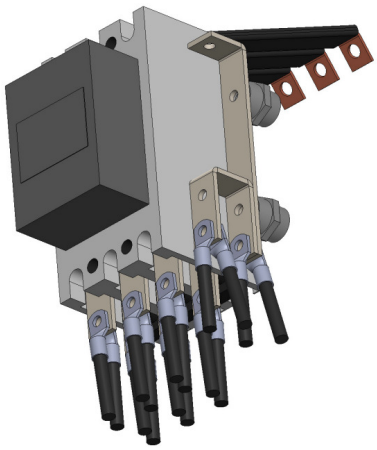


2 x 400 Hz Outputs



The control box is used for operation of the ground power unit when the GPU is located away from the aircraft parking position, placed under or on the side of a passenger boarding bridge or on a trailer.

578814 Terminal Extension



If more than 2 x cables per output phase are needed, for instance 2 ‖ 7 x 35 mm², the terminal extension allows connection of up to 4 x cables per phase.

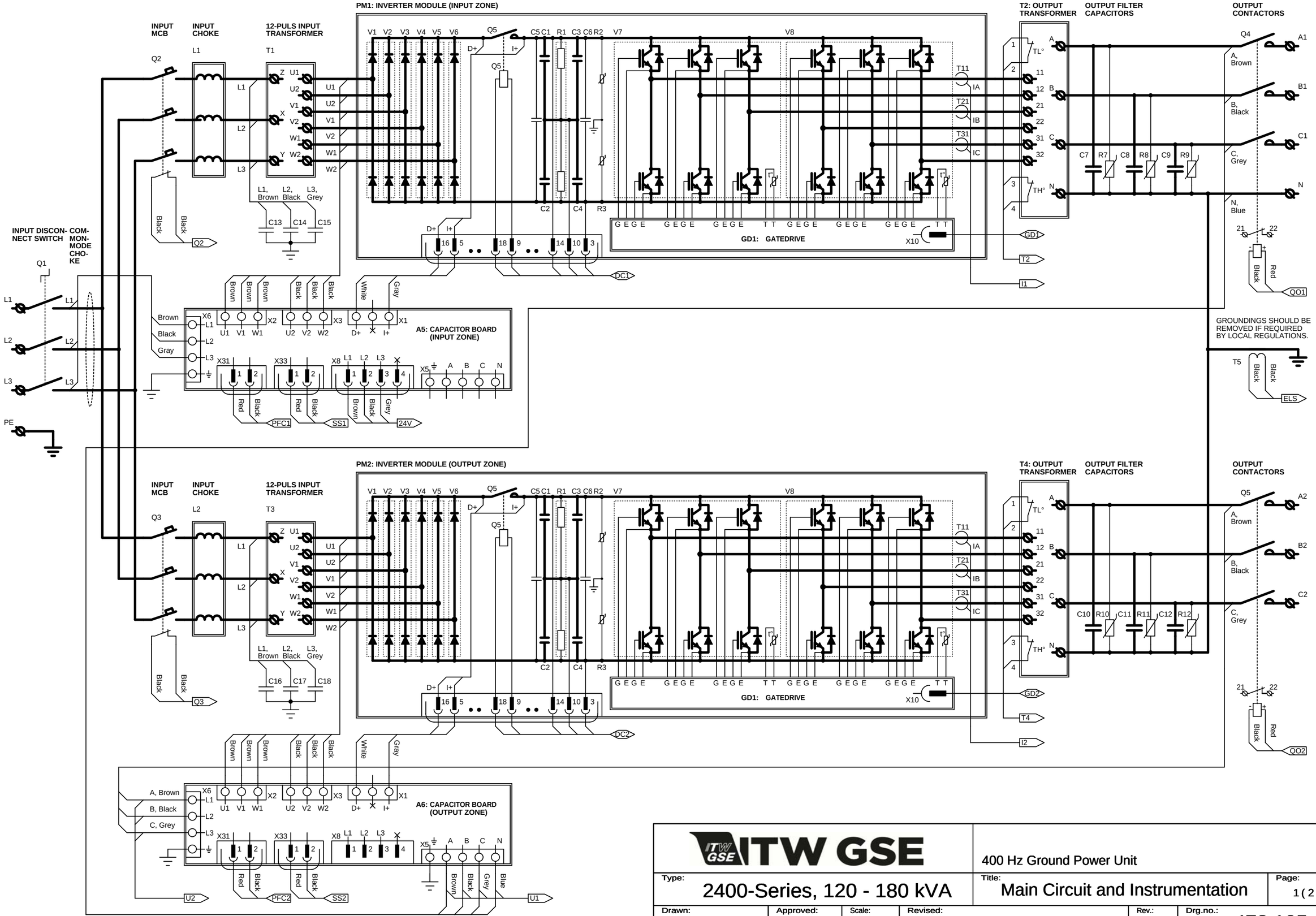
The kit consists of:

4 x extension bars (A1-B1-C1 / A2-B2-C2)
1 x extension bar (N1-N2)
Bolts, washers, spring washer and nuts.

Note!
2 x 578814 are ordered to cover both outputs.

591100 Auto Calibration Plug

Required for Plug & Play set-up.
See section 7.



ITW GSE					400 Hz Ground Power Unit	
Type: 2400-Series, 120 - 180 kVA					Title: Main Circuit and Instrumentation	Page: 1(2)
Drawn: 13.06.16	RA	Approved: RA	Scale: A3	Revised:	Rev.: -	Drg.no.: 478.105

OPERATOR INTERFACE:

(OPTIONALLY LOCATED IN REMOTE CONTROL BOX)

A4: OPERATOR KEYBOARD — X1 — X4

A3: DISPLAY BOARD — X1 IF | X2 CAN | X3 USB | X6 1 2 | X5 1 2

S1 — EMERGENCY STOP

24V — Brown / Black / Grey — Q6 — Common Mode Choke — 2 Turns — G1 (L1, L2, L3, +, -)

Violet — M1 (Blue, Red) — M2 (Red, Blue, Violet) — PWM

Violet — M3 (Blue, Red) — M4 (Red, Blue, Violet) — PWM

DC1 — Red, Brown, Blue, Red, Black — X26 (+, M, -) UDC1 — X11 — X9 DISPLAY — X32

DC2 — Red, Brown, Blue, Red, Black — X25 (+, M, -) UDC2 — X12

Q3 — Q2 — Grey, Grey, Black, Black — X29 — I19, I20 — QIN1, QIN2

ELS — Black, Black — X24 — ELS

Red, Red, Red, Black, Black, Black — X5 — +24 (FUSED)

T2 — White, White, Black, Black — X30 (TL, TH) — I21, I22 — TOUT1 THERMO

Red, Blue, Brown — X15 — FAN FUSE — FANS1

T4 — White, White, Black, Black — X31 (TL, TH) — I23, I24 — TOUT2 THERMO

Red, Blue, Brown — X16 — FAN FUSE — FANS2

A7:EEPROM — X19 EEPROM

X8 RS232

GD1 — X10 GATEDRIVE1

GD2 — X7 GATEDRIVE2

Q1 — F3 — I8 — QDC1, DISPLAY FUSE, DI

Q10 — QDC2

F2 — I/O FUSES — F1 — F4 — INTERFACE FUSE — +IO, -IO, +IN, +IF

I8 — I/O FUSES — I9 — I10 — I11 — I12 — I13 — I14 — I15 — I16 — I17 — I18

F5 — FAN FUSE — FANS1

F6 — FAN FUSE — FANS2

X28 — U1 — UA1, UB1, UC1, UN — Brown, Black, Gray, Blue — OUTP. VOLT1

SW5: N JUMPER

X27 — U2 — UA2, UB2, UC2, UN — Brown, Black, Gray — OUTP. VOLT2

QO1 — X17 — Red, Black — Q2

QO2 — X18 — Red, Black — Q3

PFC1 — X21 — Red, Black — Q5

PFC2 — X20 — Red, Black — Q9

SS1 — X13 — Red, Black — Q4

SS2 — X14 — Red, Black — Q8

A2: INTERFACE BOARD

A1: CONTROL BOARD

X5: ETHERNET, RJ45

X6: USB HOST, TYPE A

I1 — X23 — +15V, IA, -15V, +15V, IB, -15V, +15V, IC, -15V — Red, Black, Blue, Red, Black, Blue, Red, Black, Blue — CURRENT1

I2 — X22 — +15V, IA, -15V, +15V, IB, -15V, +15V, IC, -15V — Red, Black, Blue, Red, Black, Blue, Red, Black, Blue — CURRENT2

SW3: I/O +/- REF. JUMPER

X1 — +IO, -IO, F1 — I1 I2 I3 I4 I5 I6 O1 O2 O3 O4

X2 — +IO, -IO, F2 — I9 I10 I11 I12 I13 I14 O5 O6 O7 O8

X3 — +IO, -IO — O9 O10 O11 O12

X4 — I15 I16 I17 I18 O13 O14 O15 O16

SW1: EPO JUMPER

USER EPO (I7) 24 VDC COIL — X6

X1: + + 24 VDC, + + 24 VDC, - - 24 VDC, - - 24 VDC, F INTERLOCK, 1 START, 2 STOP, 3 90 % SWITCH, 4 CONNECTOR PTC, 5 FREE, 6 GPU ENABLE, 7 8 9 10 11 12 13 OUTPUT ON, INTERLOCK PRESENT, 90 % SIGNAL PRESENT, GPU READY, COMMON ERROR

X2: + + 24 VDC, + + 24 VDC, - - 24 VDC, - - 24 VDC, F INTERLOCK, 1 START, 2 STOP, 3 90 % SWITCH, 4 CONNECTOR PTC, 5 FREE, 6 FREE, 7 8 9 10 11 12 13 OUTPUT ON, INTERLOCK PRESENT, 90 % SIGNAL PRESENT, GPU READY, COMMON ERROR

ITW GSE

400 Hz Ground Power Unit

Type:	Title:	Page:
2400-Series, 120 - 180 kVA	Main Circuit and Instrumentation	2(2)

Drawn:	Approved:	Scale:	Revised:	Rev.:	Drg.no.:
13.06.16 RA	RA	A3		-	478.105