it's all about connections

Manual

Hobart *PoWerMaster*® 2400
400 Hz Ground Power Unit

With 28 VDC outlet (optional)

Series: 578650

Serial no.	_____
Type	SX240

OM2249 February 02, 2015

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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.

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: January 2015

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1.0 Declaration of Conformity

CE

CE Declaration of Conformity

The declaration covers:

Designation : 400 Hz Ground Power Units

Type : 3GW…… (30 kVA to 90 kVA)

Description : Solid state power supply converting a three-phase mains supply into an isolated three-phase 400 Hz supply. Optionally, these units can be equipped with an additional 28 VDC output. The converters are typically applied as ground power for aircraft.

Complying with following directives:

73/23/EEC (2006/95/EC)	(LVD)
2004/108/EC	(EMC)
2006/42/EC	(Machinery)

Conformity attained by complying with:

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

20.10.2014
Date

Søren R. Dahl, Development Manager

799.331AB

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.

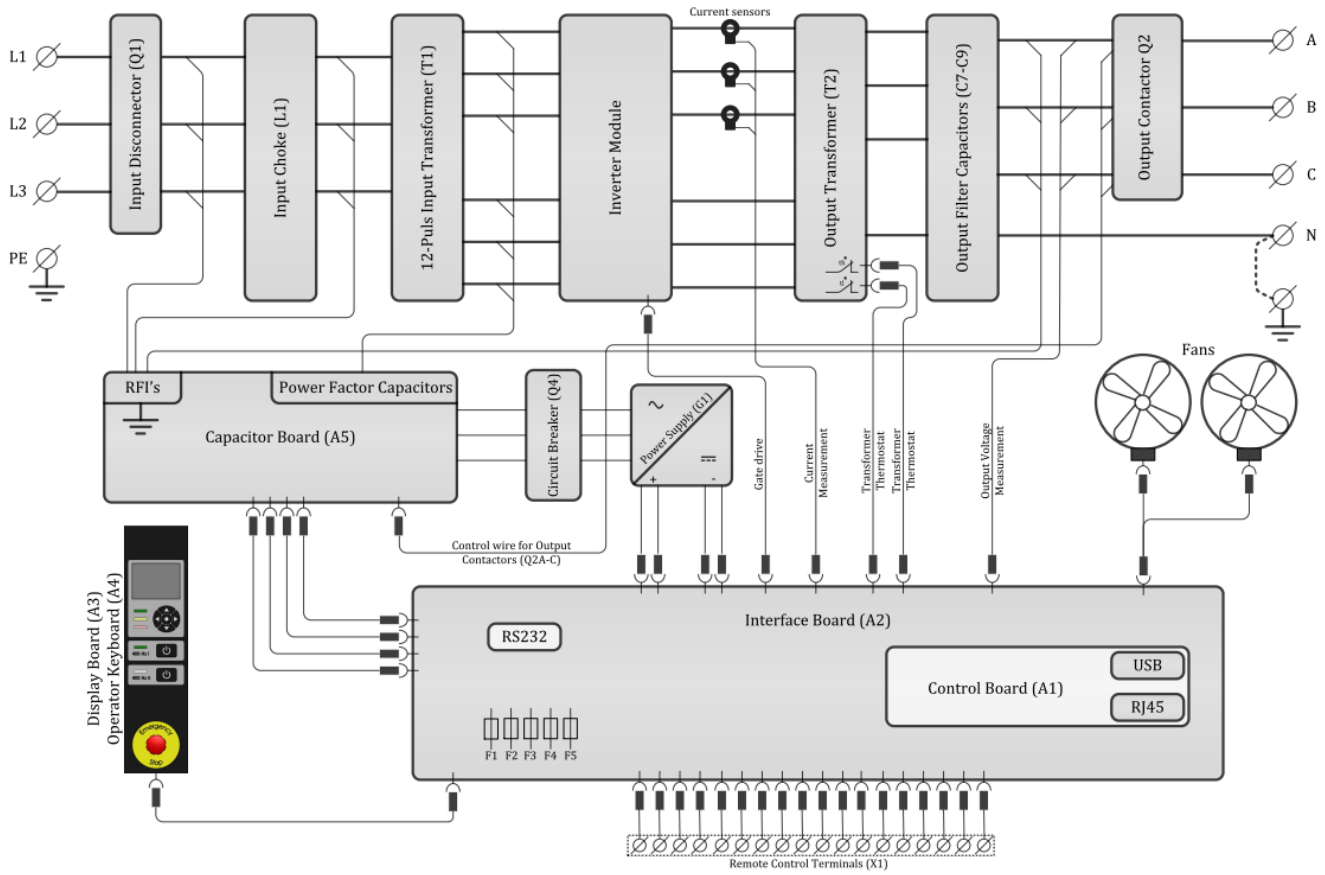
Hot Parts

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

SAVE THESE INSTRUCTIONS!

3.0 General Description

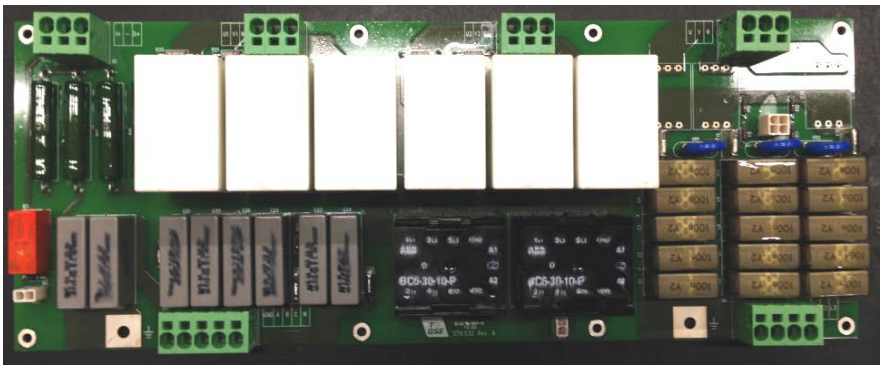
The figure below shows the basic principle of the Hobart *PoWerMaster*® 2400 unit. The 50/60 Hz mains voltage is converted into a galvanic isolated 3-phase, 400 Hz output voltage. A functional description of each part is given in the following sections.



3.1 Basic Principle

Input Disconnector (Q1):
The Input Disconnect/circuit breaker, disconnects all power to the ground power unit. Upon closing the switch disconnect/circuit breaker, the ground power unit passes through an initialization test and then into standby mode.

Capacitor Board (A5):



This module includes 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 contactor (Q5).
- Magnetic Wave shaping circuit.
- Link from the main supply phases L1-L2-L3 to the Supply Module (G1) via the breaker (Q4).
- Coil voltage for the output contactor(s), controlled via A2:Q1 on the Interface Board.

Input Choke & 12-pulse Transformer (L1 / T1):
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 90 kVA/kW and a unity power factor. This means less stress on the main supply network and the distribution transformers.

Inverter Module:
Beside the rectifier (V1-V6), the DC-filtering capacitors (C1-C6) and the soft start circuit (Q5) controlled via X12, the module consists of a 3-phase inverter which generates a 400 Hz voltage system with a very low harmonic content and individual phase control. Two PCBs (gate drive top & gate drive bottom) 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 X19.

Output Transformer (T2):
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):
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 or from the aircraft.

Output Contactor(s):
The ground power unit is equipped with a 3-phase output contactor per outlet. The contactor(s) is engaged at start-up of the corresponding output, and it is disengaged, when the 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 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 (X10) of fans (M1-M2) situated above the magnetics.
- User EPO input (X14).
- Measuring transformers for supervision of the 400 Hz output voltage (X26)
- Interface for gate drives situated at the Inverter Module (X13).
- Interface for current sensors situated at the Inverter Module (X23).
- Relay control of output contactor(s) Q2 – Q3 (X16-X17).
- Soft start control of Q5 (X12)
- Input for temperature sensors (X18).
- I/O ports for remote control (Start, Stop etc.), single output (X1).
- I/O ports for remote control (Start, Stop etc.), second output (X2) when installed.
- Protected interface for interlock signals.

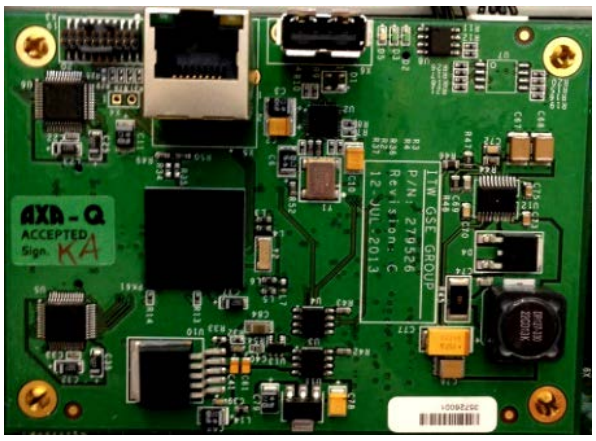
- Interface for individual overload protection (X20).
- Neutral Voltage Supervision.
- Neutral Conductor Rupture supervision.
- Door Interlock (X27).
- Earth Leakage Failure via (X22) and current sensor on ground wire from 400 Hz neutral.
- Interface for RS232.
- EEPROM (X34) contains the unique identity key for the Hobart *PoWerMaster*® 2400

Supply Module (G1):

The generation of the 24 VDC / 10 A (Adjusted from factory to 25 Volt) regulated control voltage is done by the Supply Module G1. This module has a wide input range (340-575 VAC). It is supplied via the capacitor module and pre-fused from the 3-phase circuit breaker Q4.

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 up-date 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 log and the Power Log files and for update of the display software.

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 the 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 & 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"

90% Insertion Switch Interlock:
This feature verifies that the 90% Insertion switch in the 400 Hz plug is activated. If not activated, the respective outlput cannot be engaged. This also includes a potential free output showing whether the 90% signal is present or not. The feature is valid for ground power units with one or two outputs.
To Bypass / Activate the function Refer to Section 6.3 & 7.11
For detailed information / connection. Refer to chapter 4.9

Neutral Voltage Supervision (NVS):
As a standard, the unit is delivered with a jumper wire between the 400 Hz neutral and earth/ground. If the jumper wire is removed for any reason (eg. Local regulation), the unit monitors the voltage between the 400Hz neutral and earth/ground.
If this voltage exceeds 42 V (factory setting), the unit shuts down and reports "NVS failure".
To change the setting please refer to Section 6.3 &7.15

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 arcing 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.
To change of setting please refer to Section 6.3 & 7.9

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 or ground connection. The supervision will shut down the unit in case the residual current reaches the pre-set level.
To change the setting please refer to Section 6.3 & 7.17 & 7.17

Note!
An additional protection method offered by ITW GSE as an option is the Neutral Conductor Rupture (NCR). The supervision is based on the presence of an injected current in the neutral conductor (i.e. as long as the injected current is present, the neutral is intact). The advantage of this method is that a broken neutral will be detected immediately.

In general ITW GSE does not recommend the NCR option for the following reasons:

1) The need for an additional control wire, which is likely to be the first to break.

2) The difficulties of implementing the method in existing installations if a free control wire is not present

3) The standard protections built into the Hobart *PoWerMaster*® 2400 series are considered adequate to safeguard against hazards related to a broken neutral.

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

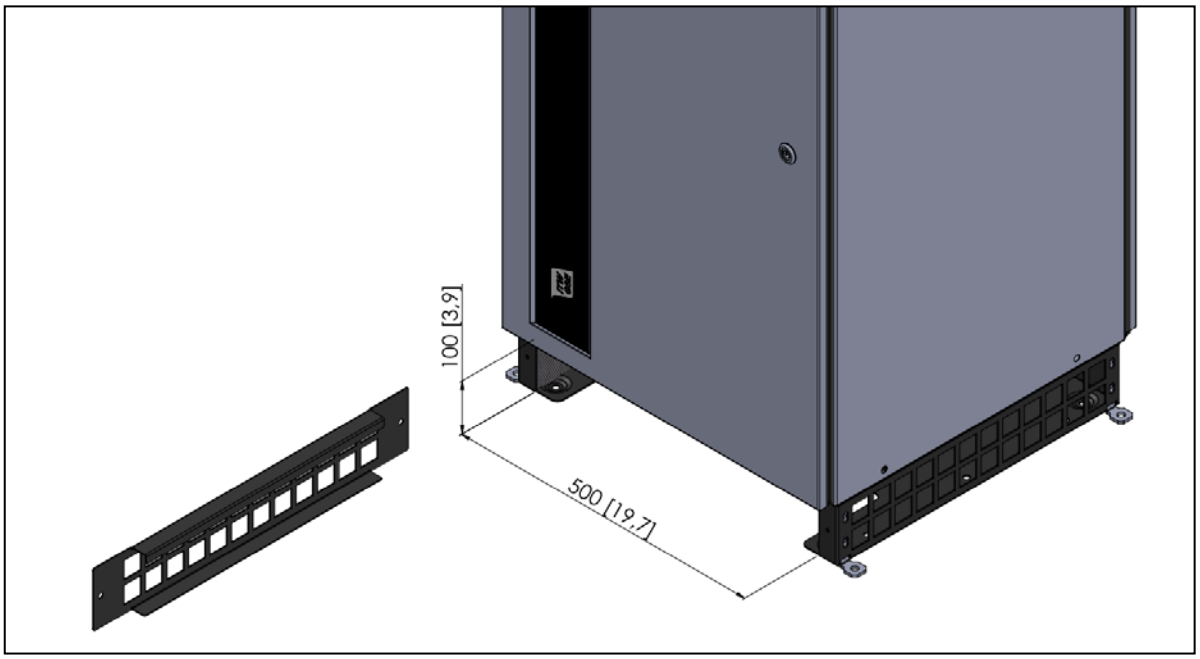


Fig. 4.3.1 Access for fork-lift, truck or similar
The access requires removal of 2 screws.

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 Hobart *PoWerMaster*® 2400 horizontal version is delivered on a specially designed wooden pallet. Transport and mounting of the Hobart *PoWerMaster*® 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 on 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 AXA2400 by means of a fork-lift truck

The Hobart *PoWerMaster*® 2400 must be fastened to the passenger boarding bridge with 4 M12 bolts of minimum rating of 8.8 steel.

4.4 Installation and fastening instructions

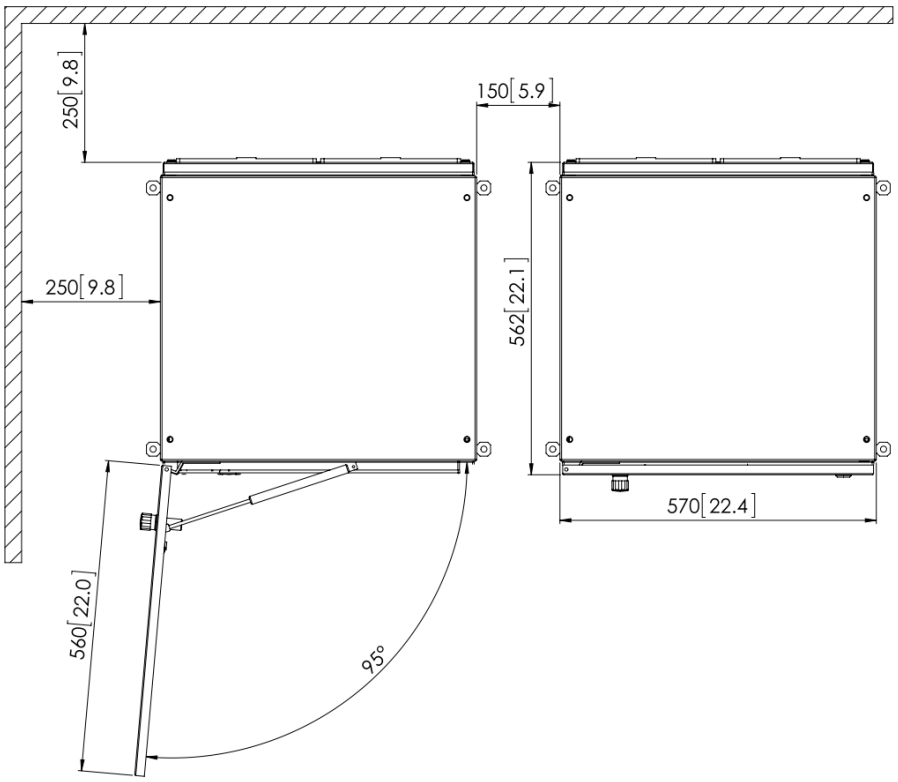


Fig. 4.4.1 Foot Print & Spacing, Fixed Unit

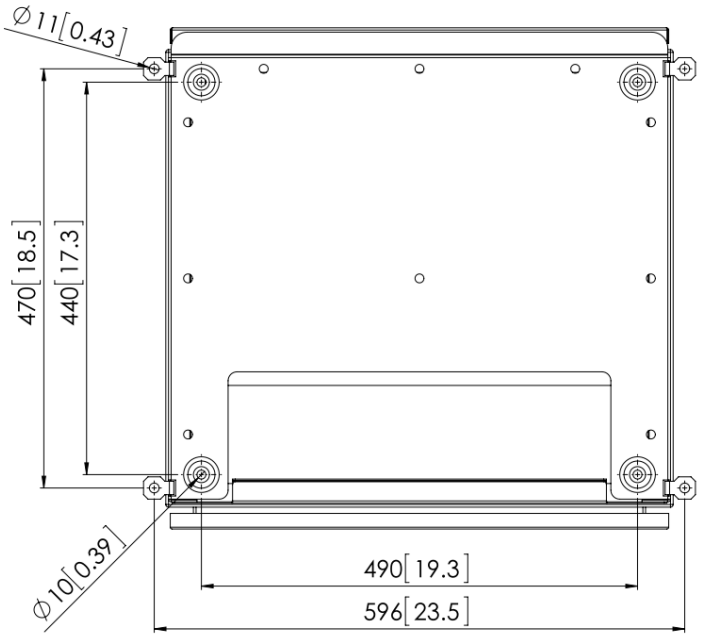


Fig. 4.4.2 Mounting Holes, Fixed Unit

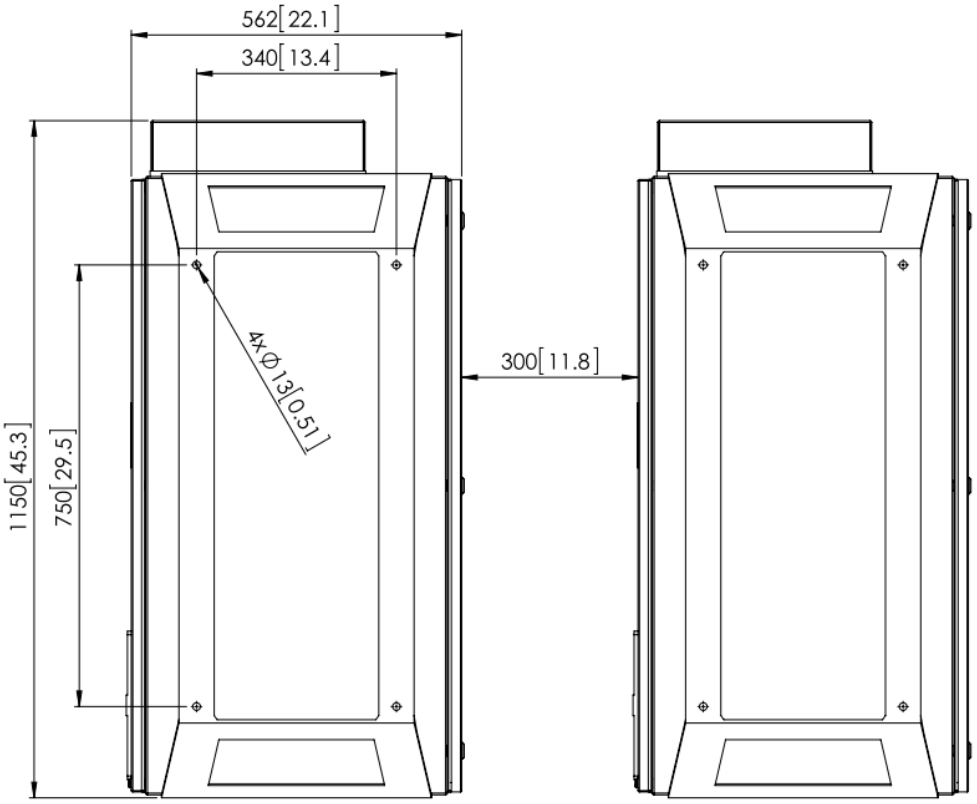


Fig. 4.4.3 Mounting Holes & Spacing, Bridge-Mounted Unit

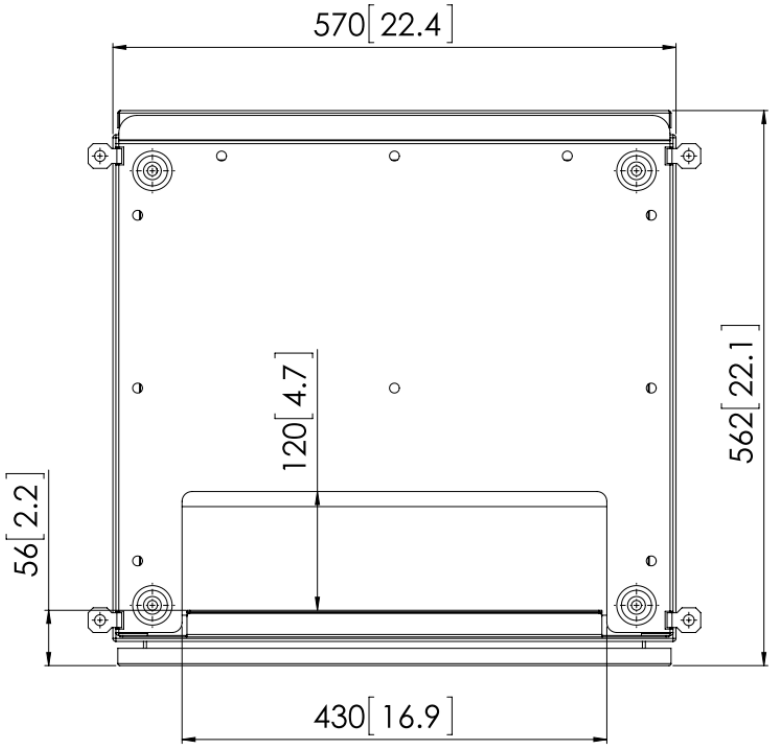


Fig. 4.4.4 Removable gland plate

made of alu-zink to prevent corrosion at the cable gland holes. The gland plate is situated inside the cubicle.

Center of Gravity

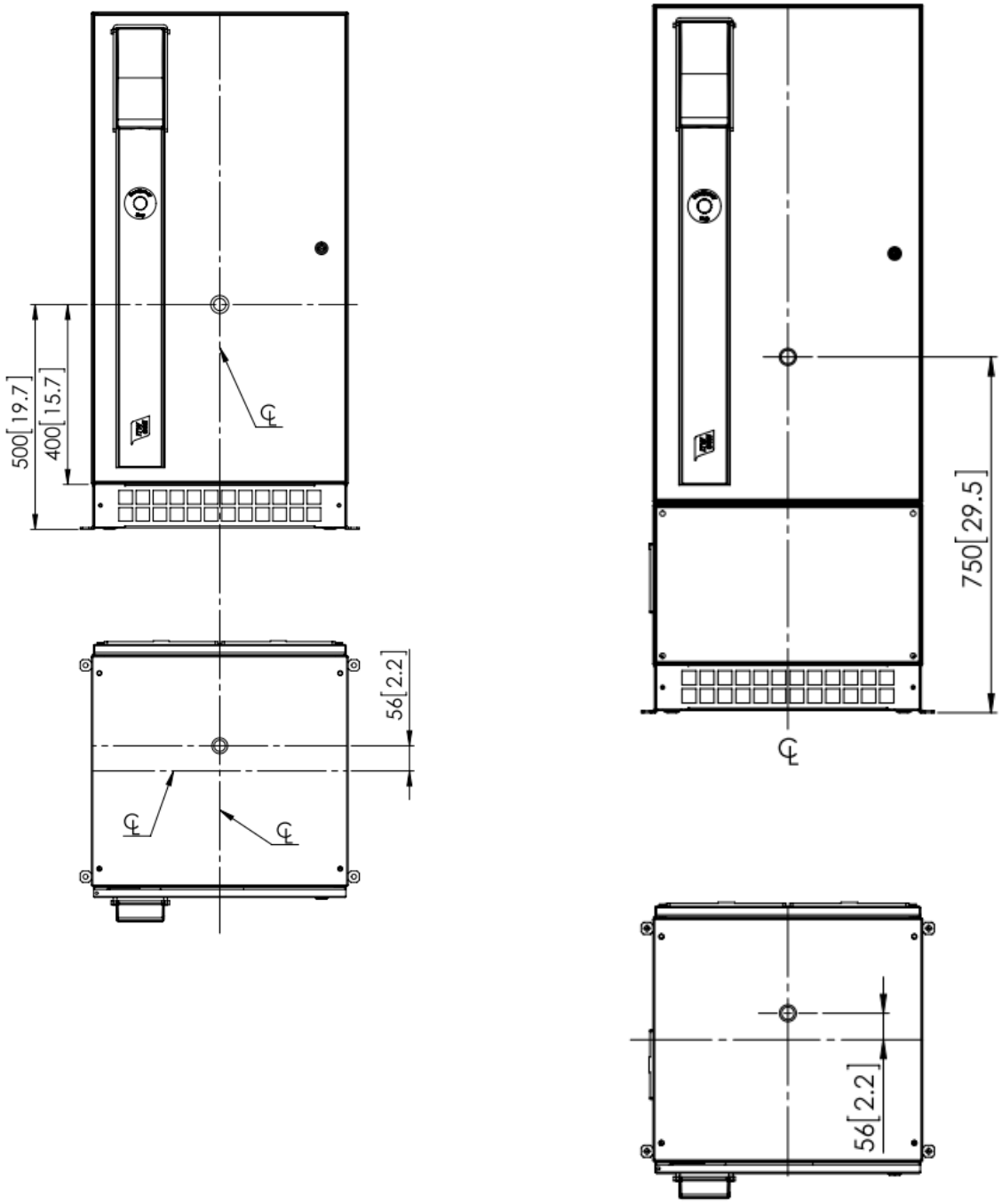


Fig. 4.4.5 Center of Gravity Fixed

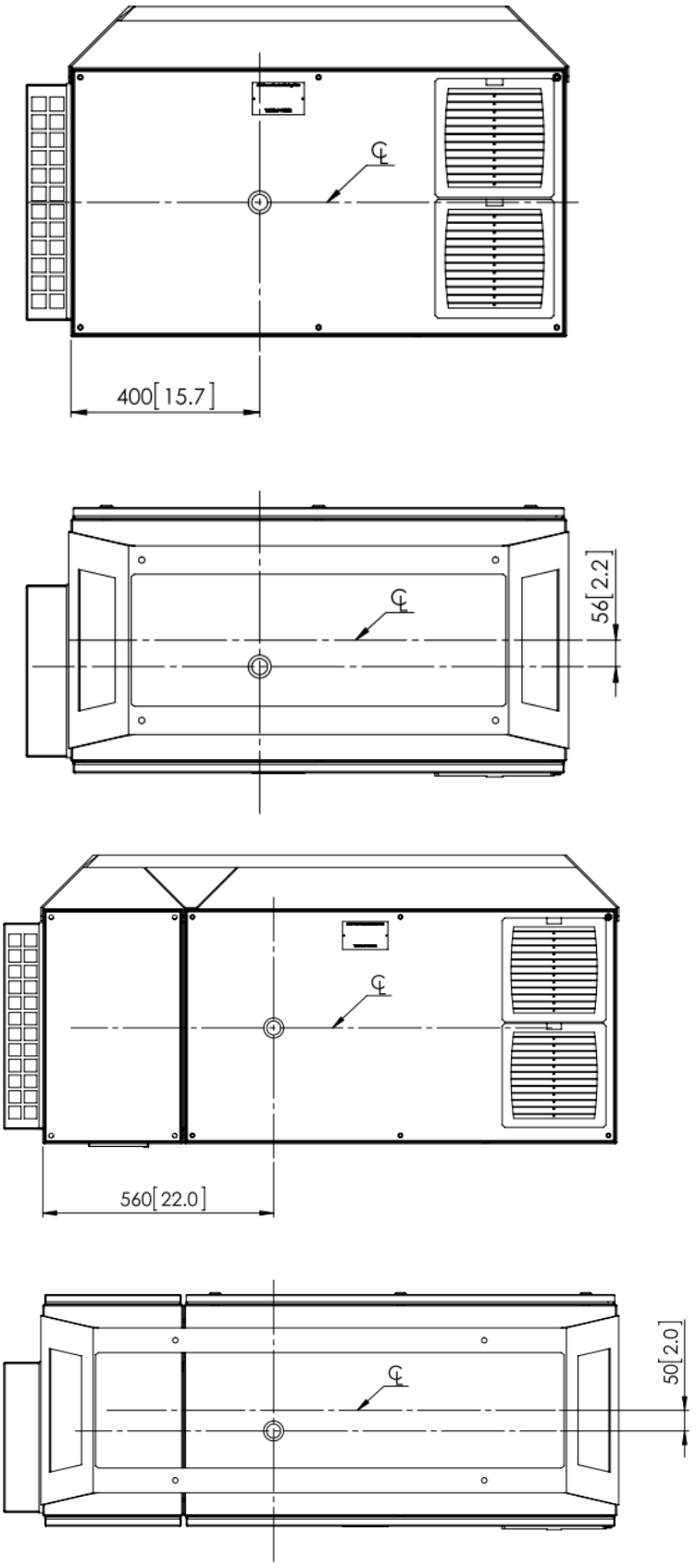
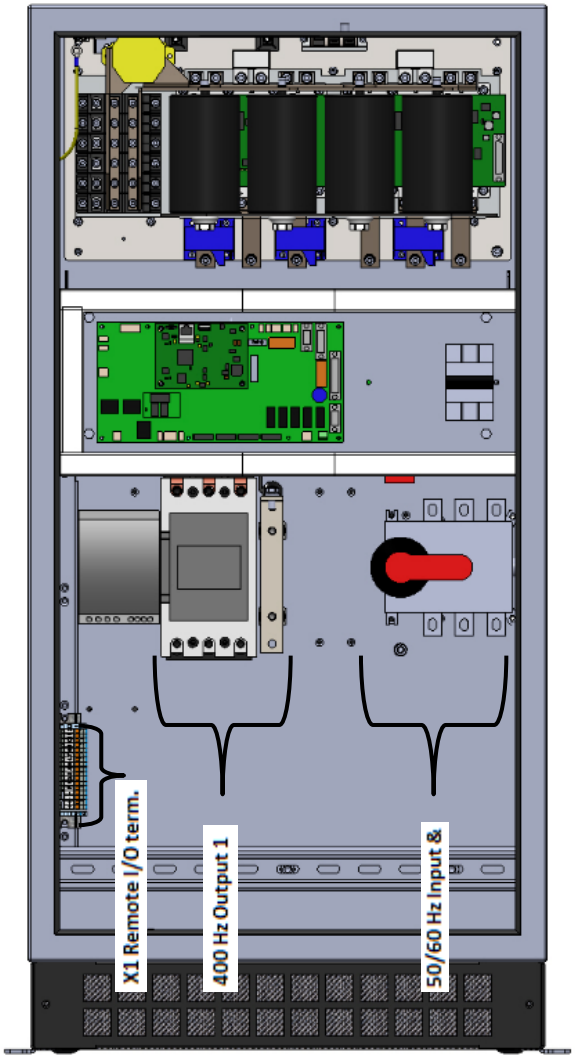
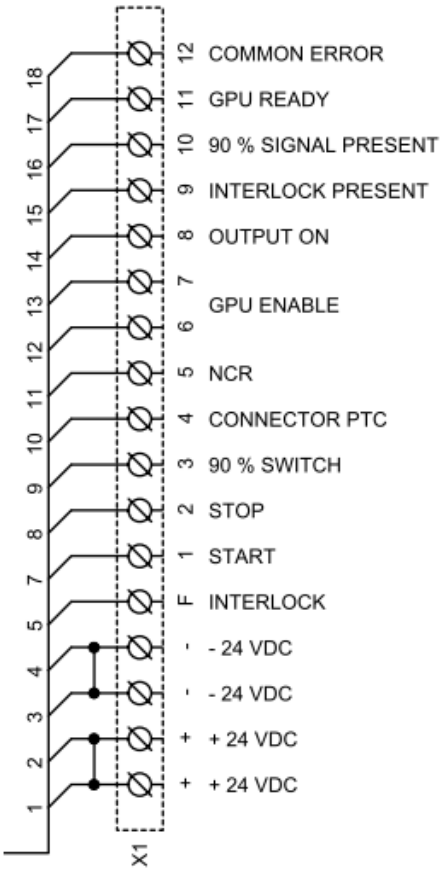


Fig. 4.4.6 Center of Gravity Horizontal

4.5 Connection of Cables

Standard Remote I/O terminals
(refer to **section 4.9** for connection of I/O terminals)





50/60 Hz Input terminals:	3 x ¼-20 by 1” (M8/25mm) 225in-lb (25.4 Nm) (L1–L2–L3) 1 x M10 bolt 444 in-lb (50 Nm) (Ground/PE)
400 Hz Output terminals:	4 x M8 (A–B–C–N) 225in-lb (25.4 Nm)
Remote I/O terminals:	17 x 0.4 - 4 mm² (AWG 21-11)

Fig. 4.5.1 Connection of Cables

4.6 Mains Input

Due to personal health and safety, the Hobart *PoWerMaster*® 2400 unit must always be protected by grounding the PE terminal (⏚).
NOTE: The minimum ground wire size is #6 AWG. Consult local authorities to ensure this meets local requirements.

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

100% load @ PF 0.8 Aircraft:

Rating	**30 kW**	**45 kW**	**60 kW**	**90 kW**
Line Current @ 400V/460V	38/33 A	58/50 A	75/66 A	112/98 A
Recommended Fuse Size	63 A	63 A	100 A	125 A
Maximum Fuse Size	160 A	160 A	200 A	200 A
Minimum Input Wire size	#8	#6	#4	#2
Minimum Output Wire size*	#6	#4	#2	2/0

*Based on single wire at 30 feet, consult the factory for recommendations on different lengths.

100% load @ PF 1.0 Aircraft:

Rating	**30 kW**	**45 kW**	**60 kW**	**90 kW**
Line Current @ 400V/460V	49/43 A	70/61 A	96/84 A	140/122 A
Recommended Fuse Size	63 A	100 A	125 A	160 A
Maximum Fuse Size	160 A	160 A	200 A	200 A
Minimum Input Wire size	#6	#4	#2	#1
Minimum Output Wire size*	#6	#4	#2	2/0

*Based on single wire at 30 feet, consult the factory for recommendations on different lengths.

Tightening torques:

Input disconnect: 8 Nm to 17.6 Nm (72 in-lbf to 156 in-lbf)
Input circuit breaker: 14.9 Nm to 21.7 N-m (132 in-lbf to 192 in-lbf)
Output contactor: 17.6 Nm (156 in-lbf)

Due to the RFI filter at the input, the leakage current for the unit 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.

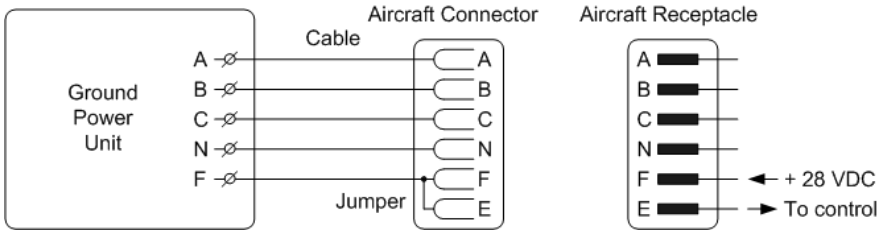


Fig. 4.8.1 Standard wiring diagram for civil aircraft

For service, maintenance and test purposes, the interlock system can be by-passed via the display setup. To ensure personal 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 personal 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:X14 is a 24 VDC input, either by using the internal 24 VDC supply or an external 24 VDC voltage. The SW1 “EPO JUMPER” (at the top right corner of the A2 Module) is then removed. 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 % Insertion Switch in aircraft connector.
  The 90% Insertion switch (N.O. contact set) in the aircraft connector is supplied with +24 VDC from the Hobart *PoWerMaster*® 2400. The voltage is returned to the input once the plug is inserted at least 90% of the way into the aircraft receptacle.

- Aircraft Connector temperature supervision **(Optional - see section 11).**
  The 3 x PTC resistors in series (one for each phase) are supplied with +24 VDC from the Hobart *PoWerMaster*® 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.
- Neutral Conductor Rupture **(Optional - see section 11).**
  Feedback wire from the aircraft plug's 400 Hz Neutral. The input references the 400 Hz neutral internally.
- Key reader, bridge, cable drum etc. provides a contact closure to enable the *PoWerMaster*® 2400 to operate via GPU enable **(Optional - see section 11)**
  The input can either be supplied from the Hobart *PoWerMaster*® 2400 as shown below or supplied from an external supply as the input Terminals X1(6&7) are insulated. Acceptable input range: 24 Volt ± 20%.

- Indications
  Lamps for GPU On, Interlock Present, 90% signal present, GPU Ready & Common Error

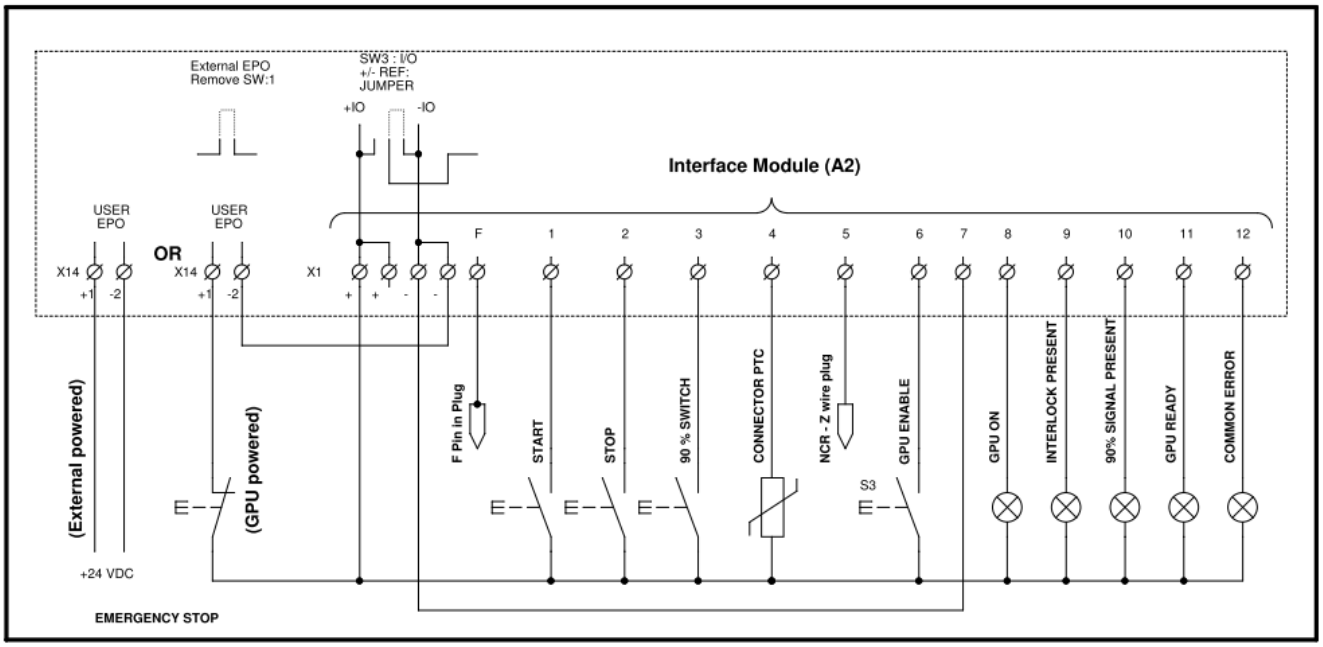


Fig. 4.9.1 Example of wiring for external control via the I/O terminal

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.

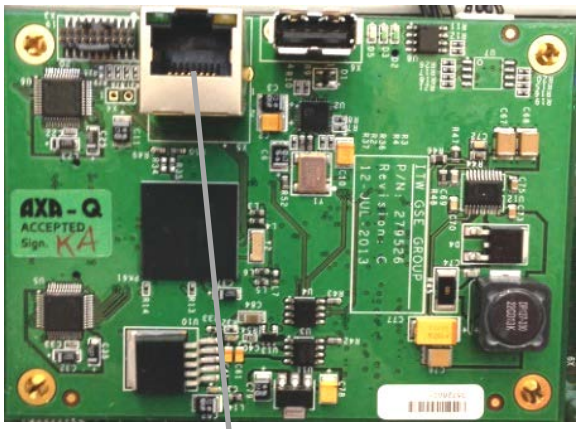
Note!

The terminal block X2 is only installed if the additional output contactor option has been ordered. 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.

For Dry Contact relays please refer to **(Optional - see section 11)**

4.10 TCP/IP On-board Interface

The Hobart *PoWerMaster*® 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 are comprehensive and should meet most requirements.

Supported Modbus Function Codes.

The Hobart *PoWerMaster*® 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 found in the document 999.008, which can be obtained from ITW GSE on request.
Refer to chapter 6.3 and section 7.19 & 7.20 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:

Model	Amps (0.8)	Amps (1.0)	Hertz	Voltage	Max. Fuse	Line Current Dist.	PF at nominal load
30SX240	38 A	49 A	45-65	400 ± 15%	160 A	< 12%	> 0.97
	31.6 A	40 A	45-65	480 ± 15%			
	25.3 A	32 A	45-65	600 ± 15%			
45SX240	58 A	71 A	45-65	400 ± 15%	160 A	< 10%	> 0.99
	48.3 A	59 A	45-65	480 ± 15%			
	38.6 A	47.3 A	45-65	600 ± 15%			
60SX240	75 A	93 A	45-65	400 ± 15%	200 A	< 9%	> 0.99
	62.5 A	77.5 A	45-65	480 ± 15%			
	50 A	62 A	45-65	600 ± 15%			
90SX240	111 A	141 A	45-65	400 ± 15%	200 A	< 5 %	1
	92.5 A	117.5 A	45-65	480 ± 15%			
	74 A	94 A	45-65	600 ± 15%			

Phase	ABC or CBA
Rectification	12 pulses
Inrush current	None
Power interruption	20 ms

Output:

Power	30, 45, 60 or 90 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	> 0.94 at 35-90 kVA load PF 0.8
at cos φ = 0.8	> 0.90 at 25 kVA load PF 0.8
Stand-by losses	< 50 W
No-load losses	< 2 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 outline drawing at following pages
Weight	
Fixed and Bridge-Mount	683 lbs. (310 kg)
Mobile	1,014 lbs. (460 kg)
ARU	Add 220 lbs. (100kg)

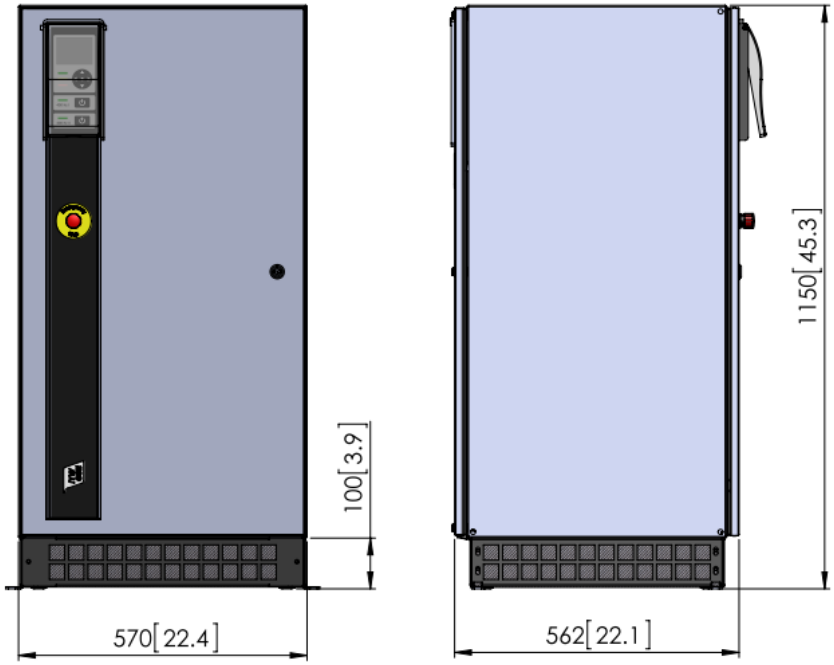
Environmental:

Storage temperature	50°F to 95°F (+10 to +35°C) / 20 to 70% RH
Operating temperature	-40°F to + 132°F (-40°C to +56°C) (+140°F at aircraft load)
	-40°F to + 113°F (-40°C to +45°C) with ARU
Relative humidity	10-100 % (non condensing)
Noise level	< 65 dB (A) @1m
Ingress protection	IP54 (NEMA 3R) Overall unit
	IP55 (NEMA 4) Electronic section

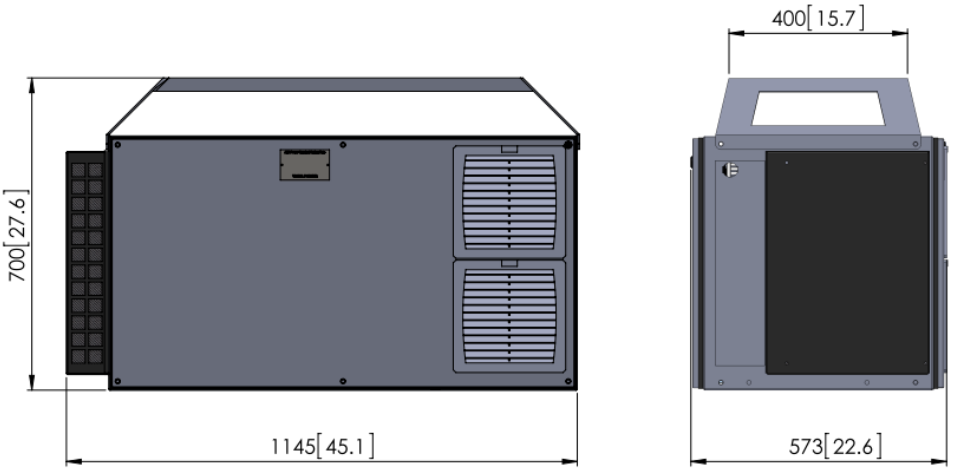
Miscellaneous:

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

Fixed



Horizontal



Mobile

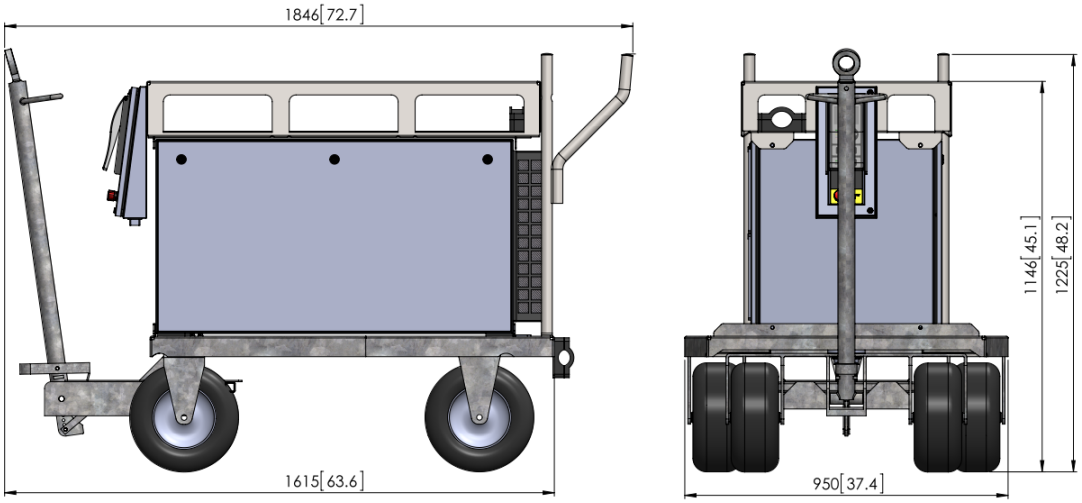


Fig. 5.0.1 Fixed, Bridge-Mounted and Mobile Unit

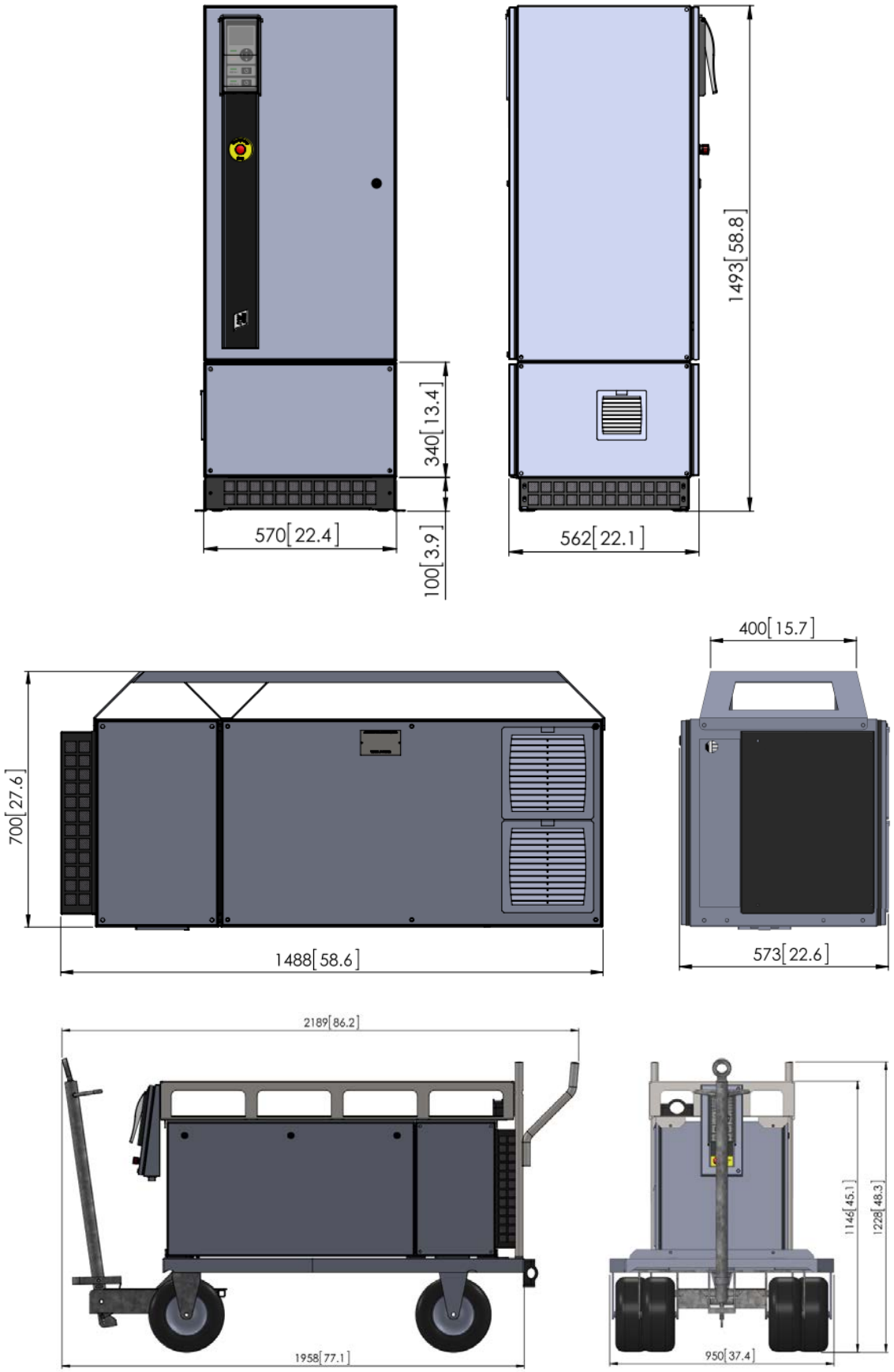
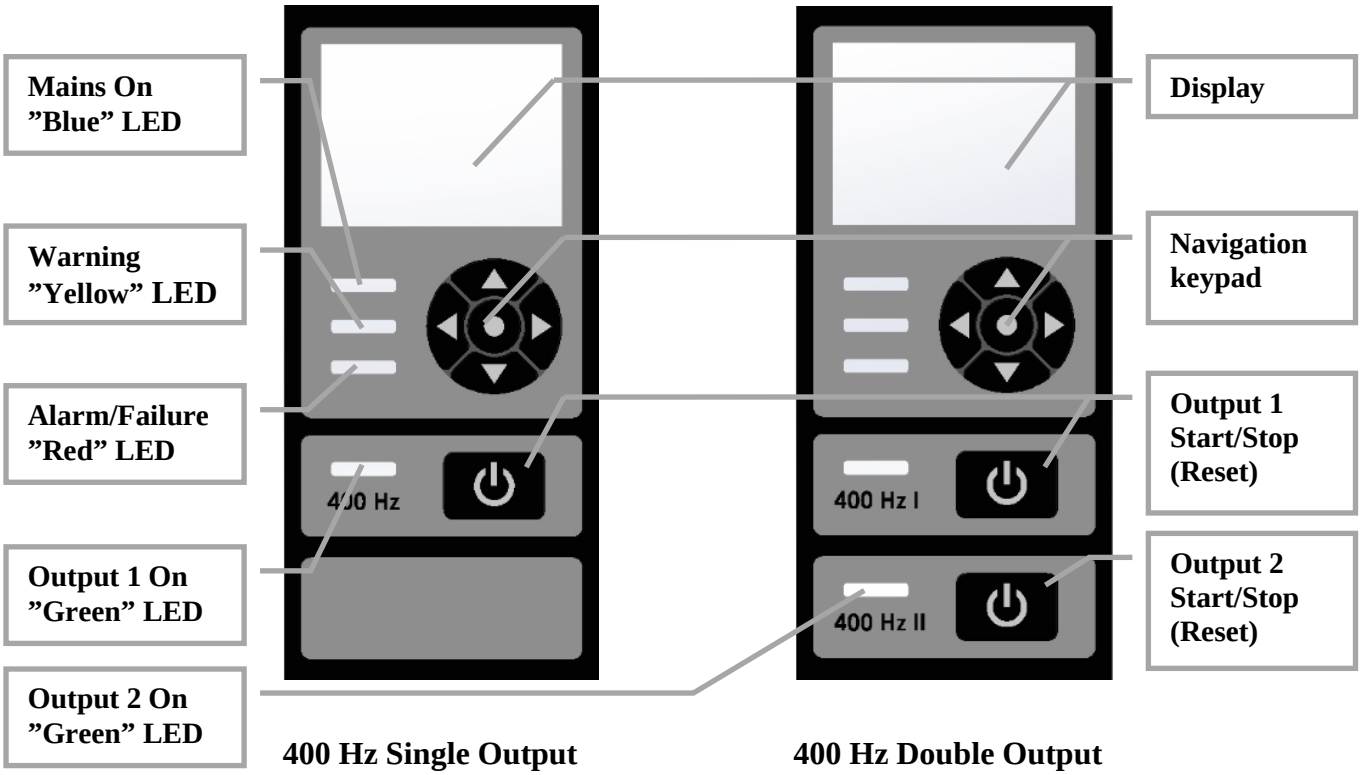
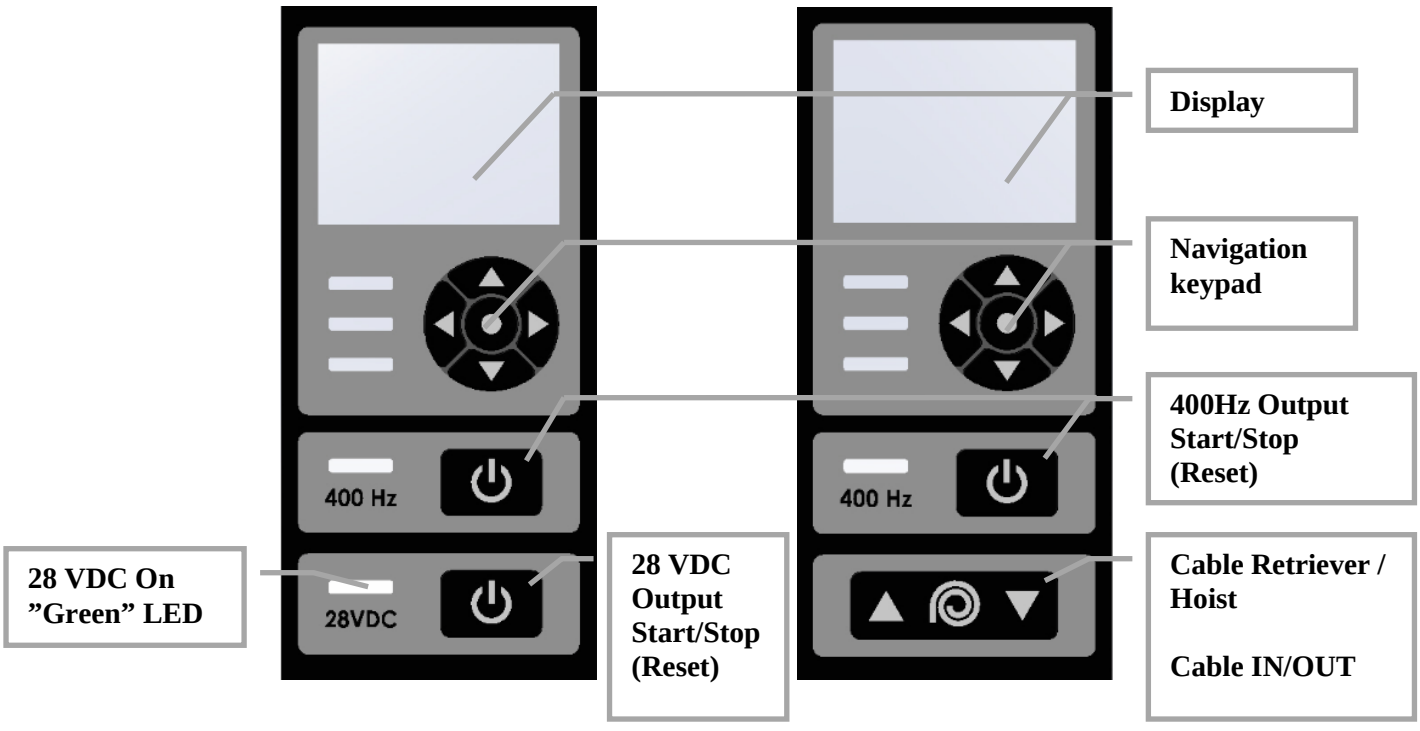


Fig. 5.0.2 Fixed, Bridge-Mounted and Mobile Unit with base Module / ARU

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



400 Hz Single Output **400 Hz Double Output**



400 Hz / 28 VDC Output **400 Hz with Cable Retriever / Hoist**

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 button, for Start/Stop 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.

*
Warning may arise during operation for the following issues:

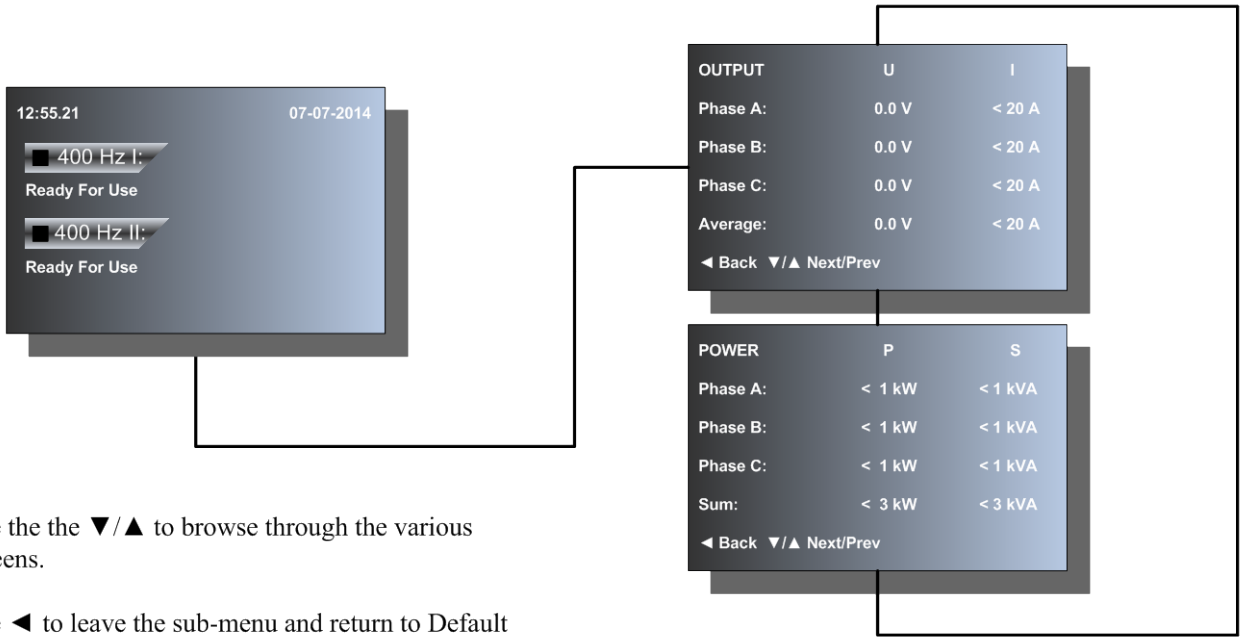
Plug 1 Temperature Too High / Plug 2 Temperature Too High
Neutral Conductor Rupture Output 1 / Neutral Conductor Rupture Output 2
EF Signal Drop Out – Output 1 / EF Signal Drop Out – Output 2
90% Signal Drop Out – Output 1 / 90% Signal Drop Out – Output 2

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 into the aircraft. Make sure the cable is inserted till you feel a natural resistance. The plug may be equipped with a 90% switch. In this case, the unit will not function if the plug not is fully inserted.
- Press the 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 
- 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

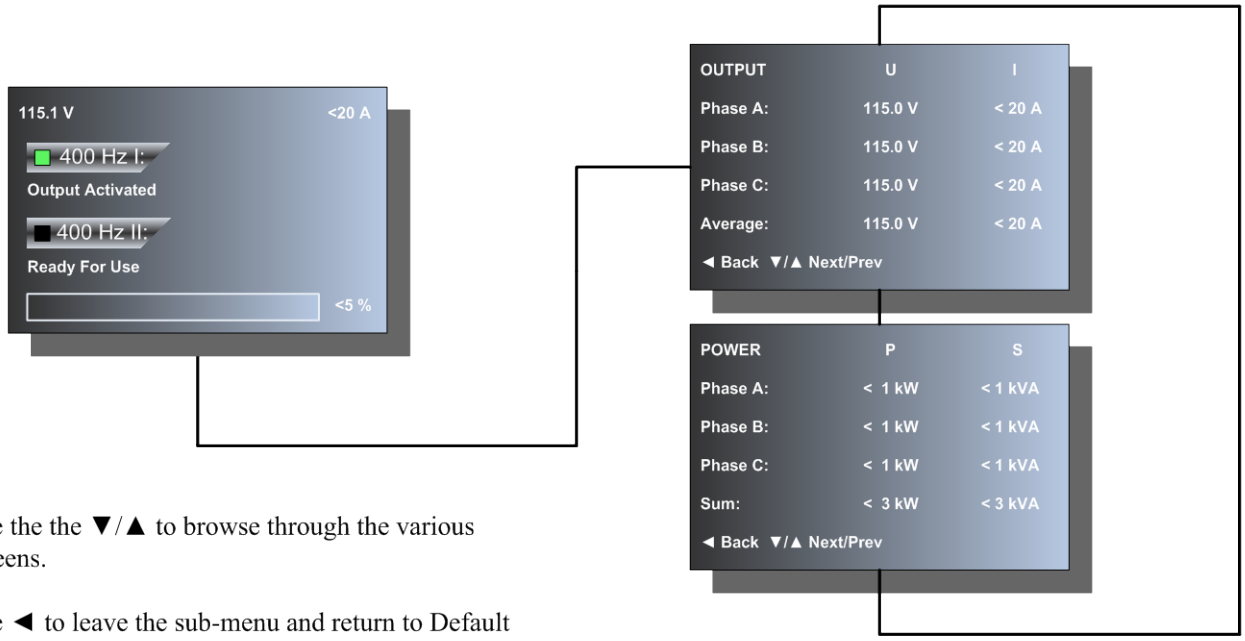


Use the the ▼/▲ to browse through the various screens.

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

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

Default Display Screen Operating



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

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

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

- After operation, the unit has to be turned off before removing the aircraft plug.

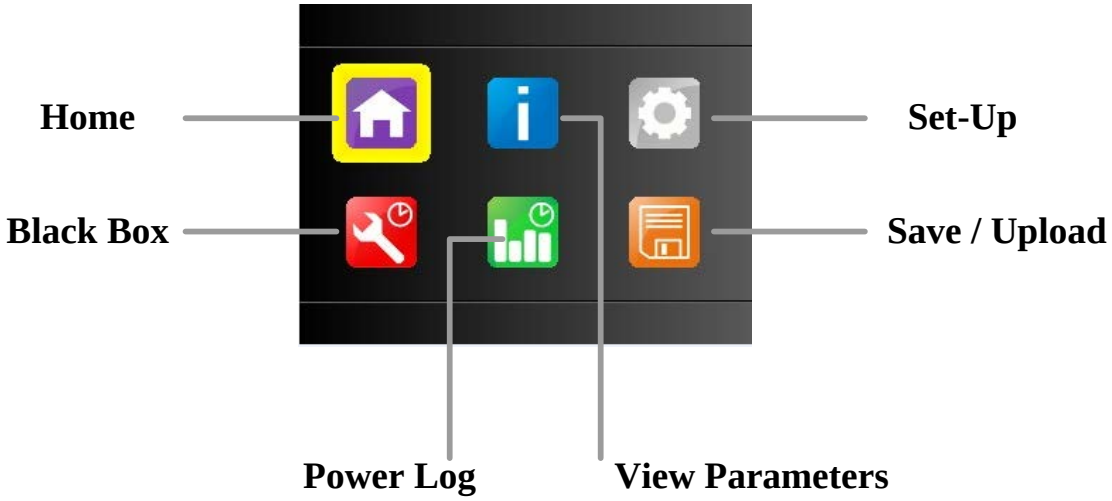
  Press the Start/stop button 

- The aircraft cable can now be 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.

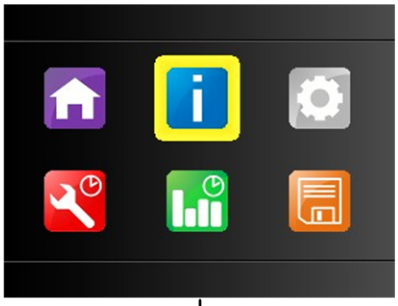
To Select a sub-menu, simply use the navigation keys ◄▼▲► to highlight the icon and then press the ● to enter the sub-menu.

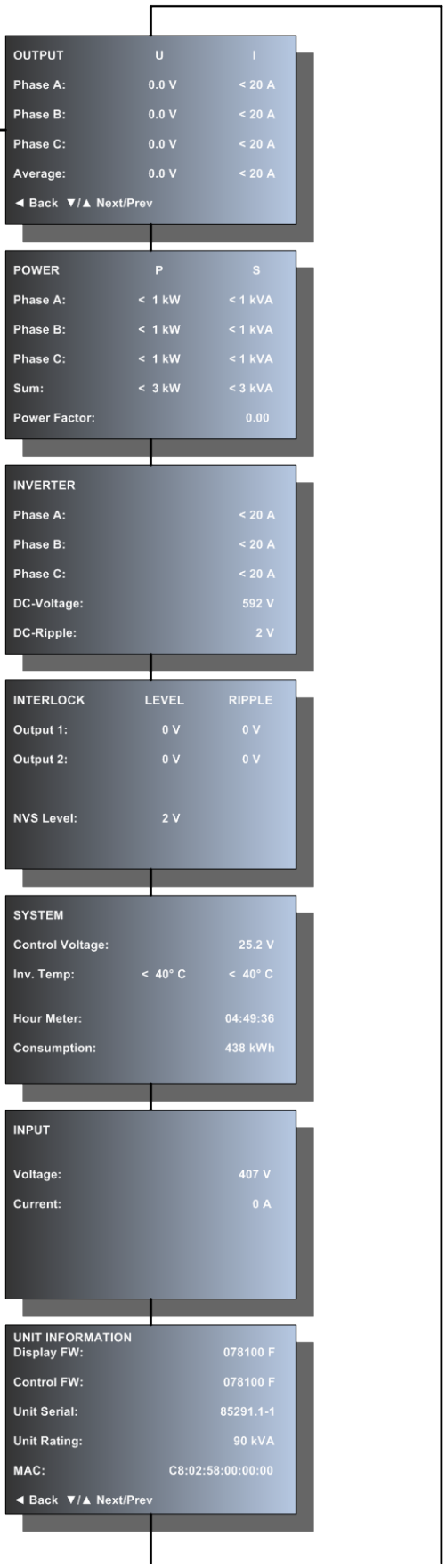
To leave the Icon Menu highlight the "Home" icon and press ●

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 control card software

6.3.1 Parameters – Menu structure





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

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

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

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

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

Parameters (continued) – Menu structure

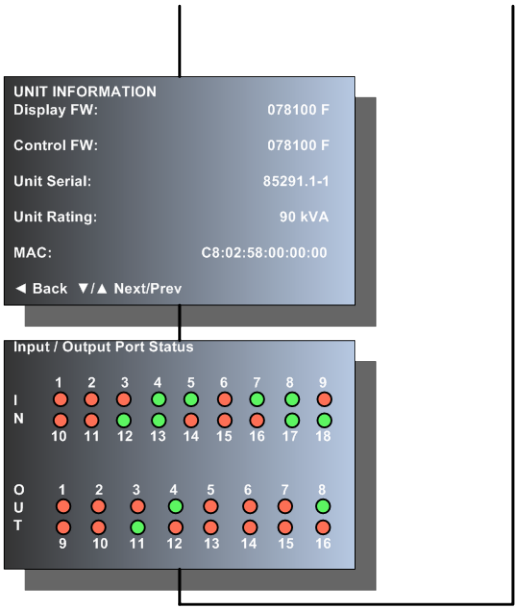
Use the the ▼/▲ to browse through the various screens.

● = Active

● = Not Active

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

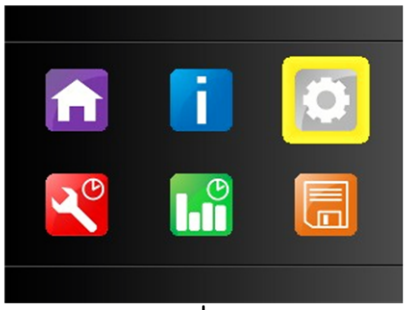
Notice!
I/O Port status may vary depending on the mode of the unit Standby / operating etc.

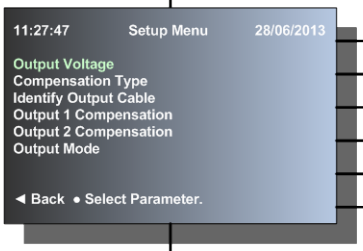


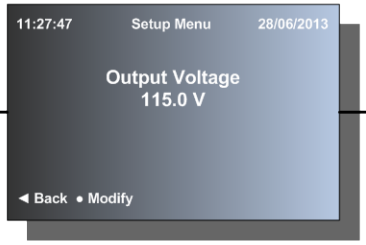
Inputs						Outputs					
No	**Function**	**Ref.**	**No**	**Function**	**Ref.**	**No**	**Function**	**Ref.**	**No**	**Function**	**Ref.**
1	Start/Reset (1)	X1: I1	**10**	Stop (2)	X2: I10	**1**	400 Hz 1 On	X1: O1	**9**	GPU Running	X3: O9
2	Stop (1)	X1: I2	**11**	90% Switch (2)	X2: I11	**2**	Interlock 1 present	X1: O2	**10**	Bridge Interlock	X3: O10
3	90% Switch (1)	X1: I3	**12**	Connector Temp. (2)	X2: I12	**3**	90% Signal 1 present	X1: O3	**11**	GPU Ready / Com. Errror	X3: O11
4	Connector Temp. (1)	X1: I4	**13**	NCR (2)	X21: I13	**4**	GPU ready / Com. Error	X1: O4	**12**	*Not used*	X3: O12
5	NCR (1)	X21: I5	**14**	*Not used*	X2: I14	**5**	400 Hz 2 On	X2: O5	**13**	*Not used*	X4: O13
6	GPU Enable	X1: I6	**15**	*Not used*	X4: I15	**6**	Interlock 2 present	X2: O6	**14**	*Not used*	X4: O14
7	Remote EPO	X14: I7	**16**	*Not used*	X4: I16	**7**	90% Signal 2 present	X2: O7	**15**	*Not used*	X4: O15
8	Door Interlock	X27: I8	**17**	*Not used*	X4: I17	**8**	GPU ready / Com. Error	X2: O8	**16**	*Not used*	X4: O16
9	Start/Reset (2)	X2: I9	**18**	*Not used*	X4: I18						

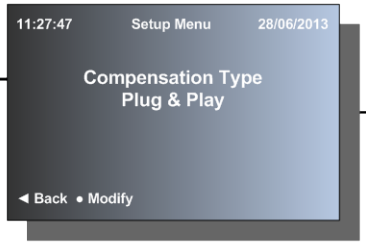
Note: please refer to schematic for further information.

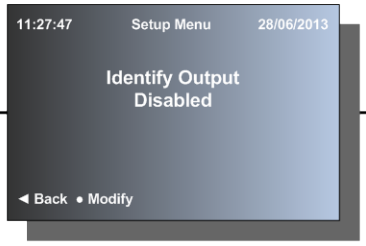
6.3.2 Setup – Menu structure











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

Press ● to select "Setup" sub-menu.

Use the 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.

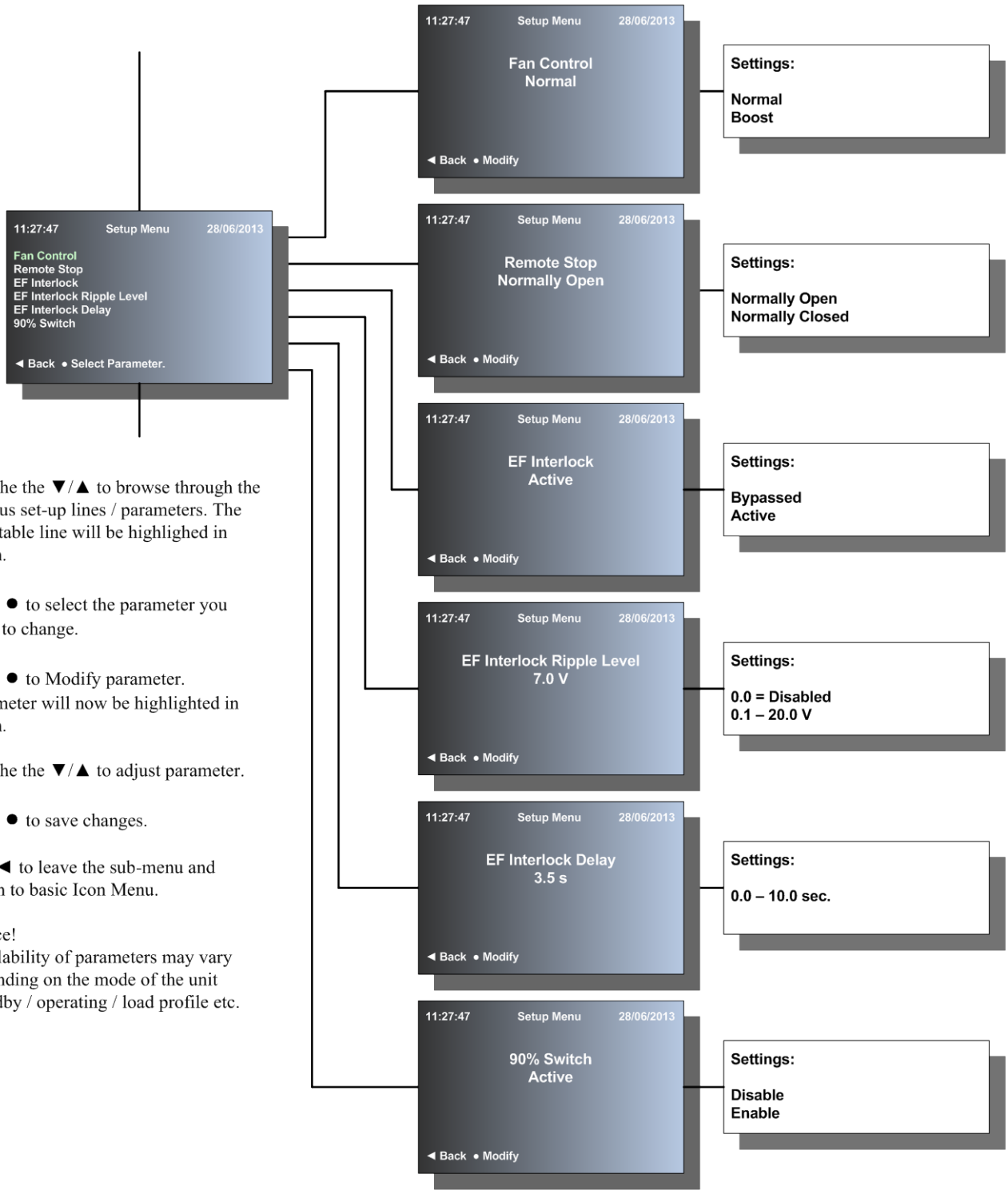
Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

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

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

Setup (continued) – Menu structure



Use the 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.

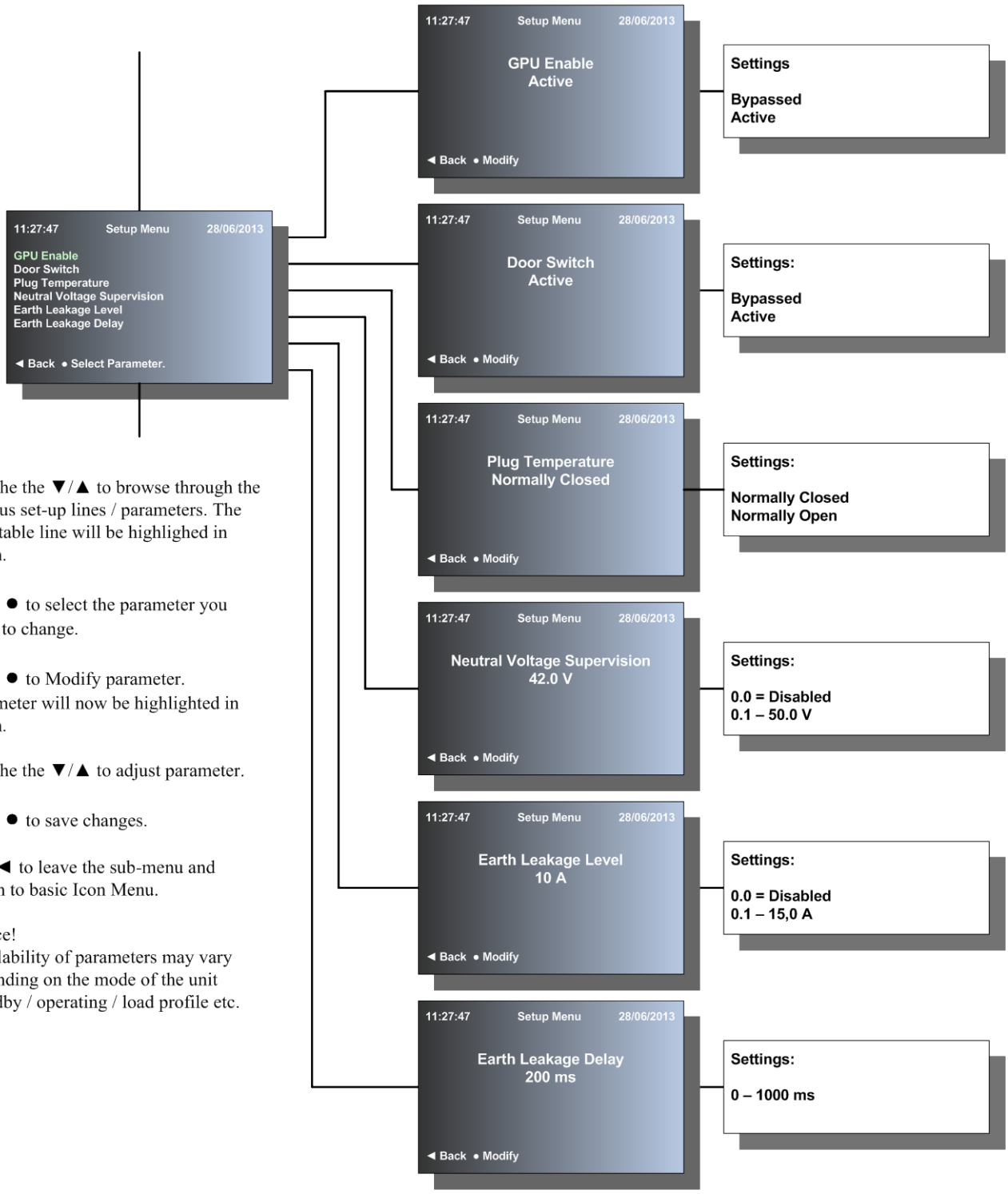
Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

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

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

Setup (continued) – Menu structure



Use the 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.

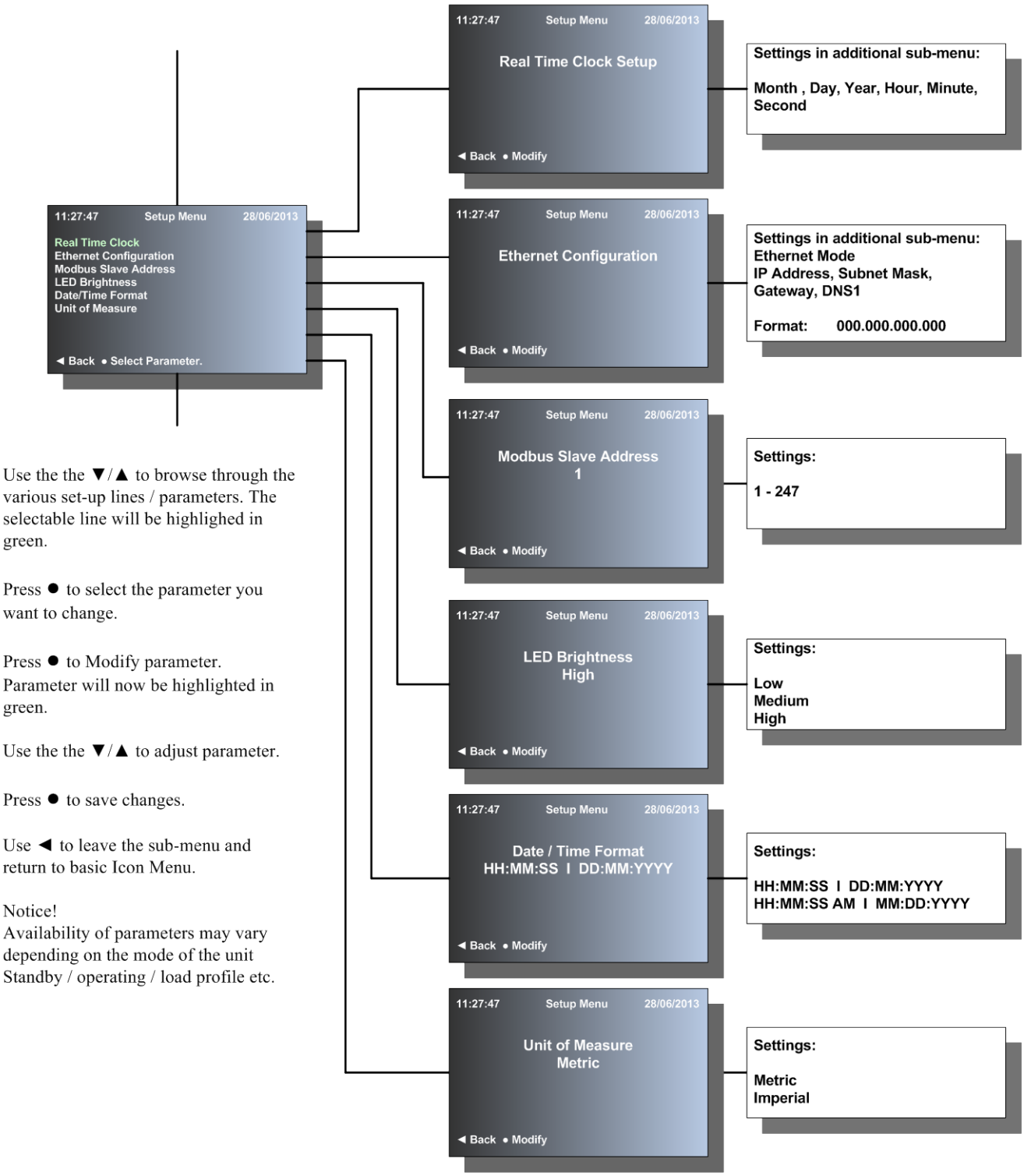
Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

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

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

Setup (continued) – Menu structure



Use the 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.

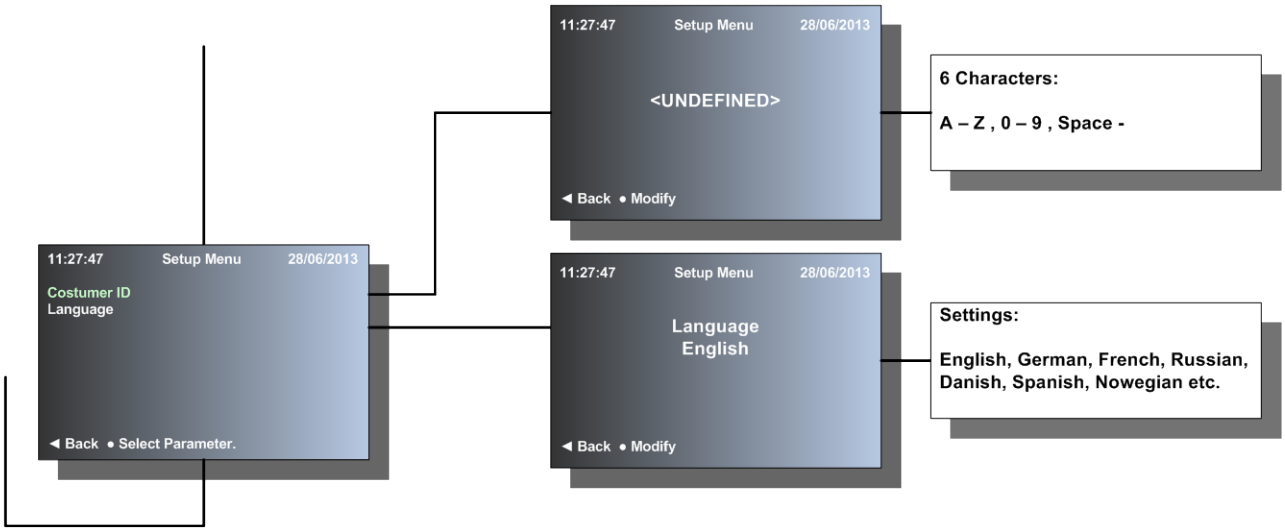
Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

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

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

Setup (continued) – Menu structure



Use the 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 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.

Notice!
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 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.

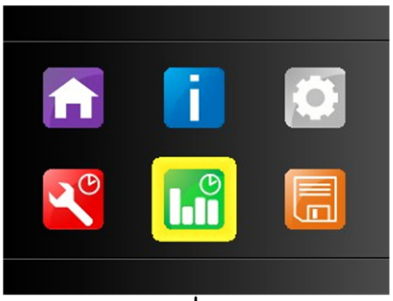
Use the the ▼/▲ to browse through the recorded data.

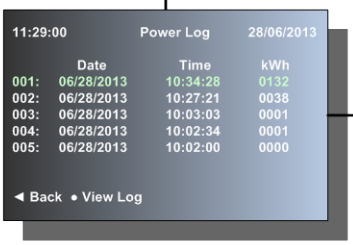
Use ◄ to leave the sub-menu.

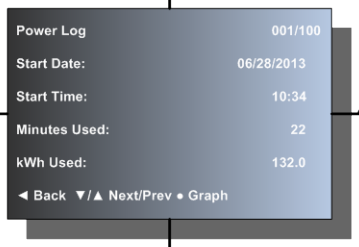
Use ◄ to leave the sub-menu and return to basic Icon Menu.

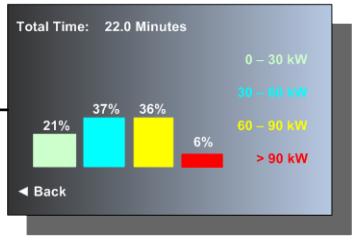
Notice!
The Black Box contains 100 recordings. When the limit is reached, the oldest failure is deleted.

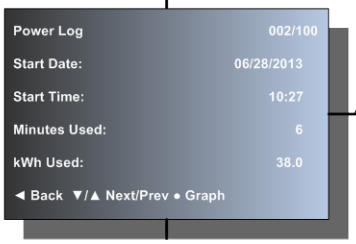
6.3.4 Power Log – Menu structure

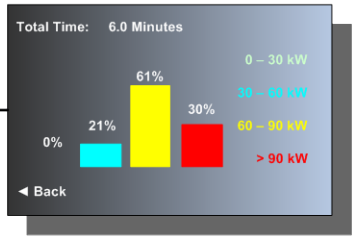


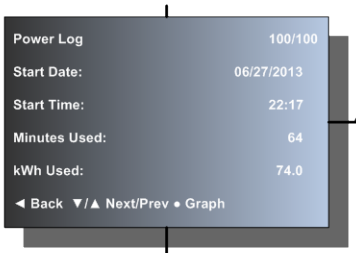


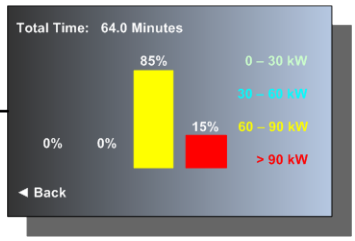












Highlight the  by using the navigation ◄▼▲► keys.

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

Use the 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

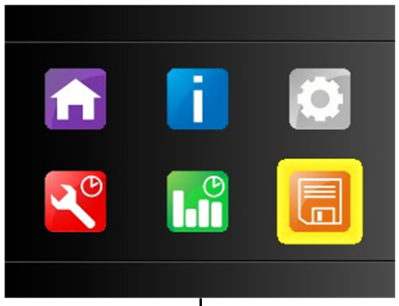
Use the the ▼/▲ to browse to the next recorded event.

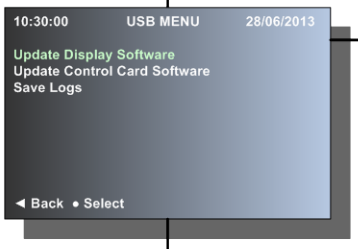
Use ◄ to leave the sub-menu.

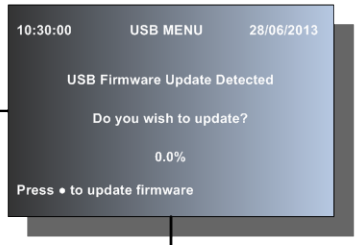
Use ◄ to leave the sub-menu and return to basic Icon Menu.

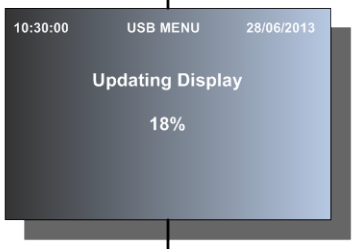
Notice!
The Power Log contains 100 recordings. When limit is reached, the oldest Log is deleted.

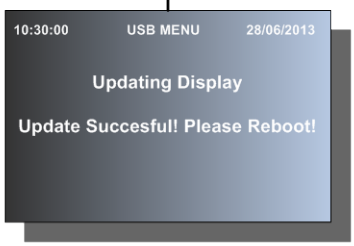
6.3.5 Save/Upload – Menu structure











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 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.

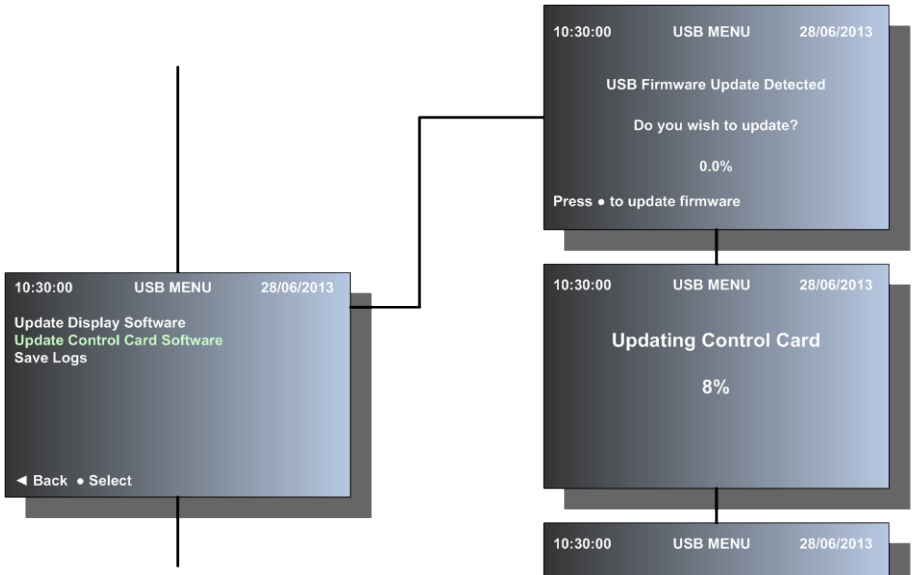
Press ● to confirm update firmware.

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

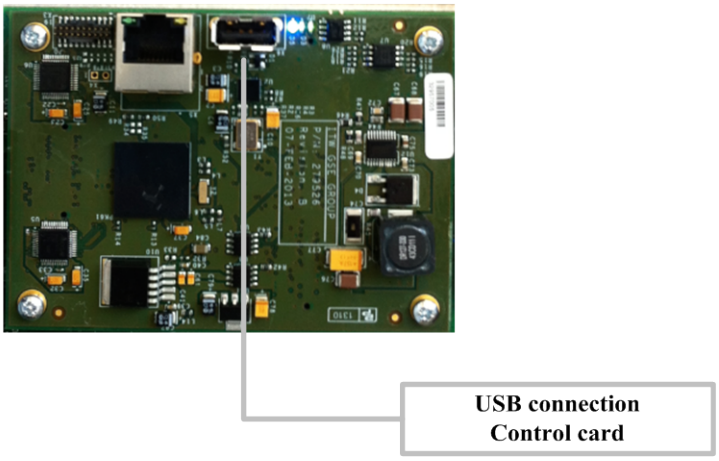
Before pressing ● to select "Update control card software", please remember to insert an USB stick into the USB port on the control card (located on the interface board).

Press ● to select function.

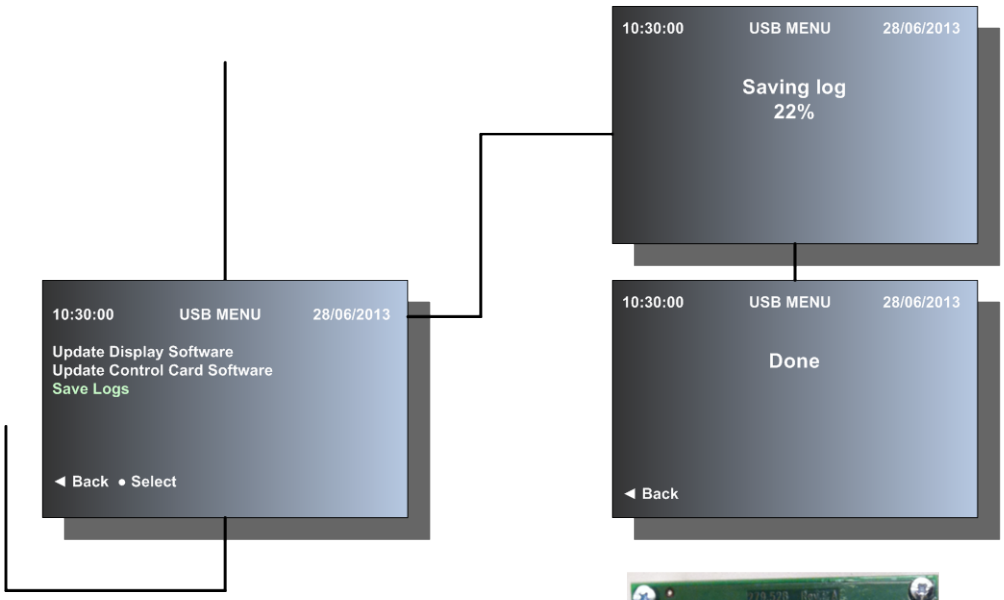
Press ● to confirm update firmware.

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

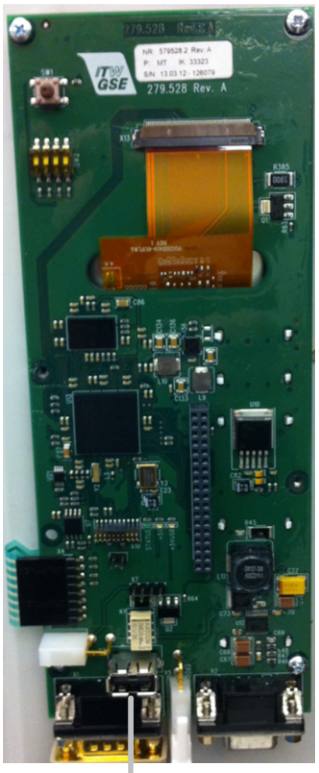
Before pressing ● to select Save logs, please remember to insert a USB stick into the USB port on the display (loacted on back of the front door).

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**.

Notice!
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 cable)
Output 1 Compensation (V):	0.0 (Set if the GPU are supplied with cable)
Output 2 Compensation (V):	0.0
Output Mode:	Individual (Depending on configuration)
Fan Control:	Normal
Remote Stop:	Normally Open
EF Interlock:	Bypassed (Active if GPU supplied with cable)
EF Interlock Ripple Level (V):	20.0
EF Interlock Delay (sec.):	3.5
90% Switch:	Disabled (Enabled if GPU supplied with cable & 90% Switch)
GPU Enable:	Bypassed
Door Switch:	Bypassed (Active with option 578809)
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:	Imperial
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.

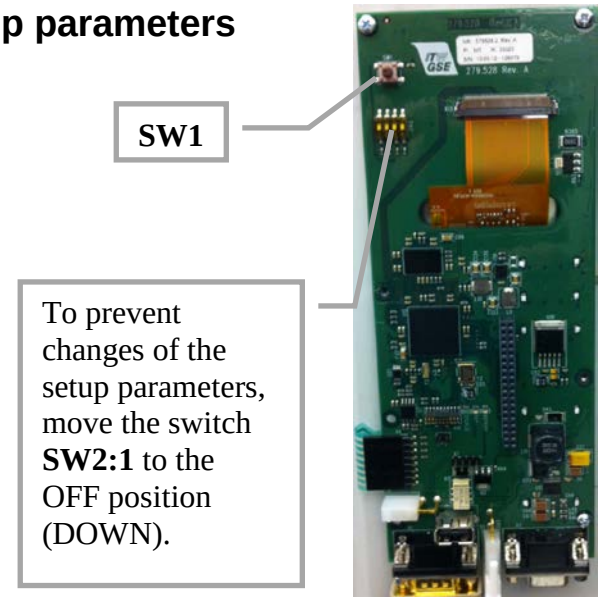


Fig. 7.1.1 Display Board A3

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 AP-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 ground power unit'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! If the unit is equipped with 2 outputs, Plug & Play compensation must be set for each output. Please refer to the previous 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

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

7.5 Output Mode:

When the unit has 2 outputs, the "Output Mode" submenu is used to set either "Individual" or "Simultaneous" mode of operation.

If the output mode has been set to "Individual", the outputs can be used individually and the unit uses Plug & Play compensation, if it has been set up (See paragraph 7.3).

If the output mode has been set to "Simultaneous", both outputs can be used at the same time. If only 1 output is used, the unit uses Plug & Play compensation. When both outputs are used at the same time, the unit uses manual compensation.

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.

Enter the Setup Menu and then scroll up or down to the Output Mode 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.

7.6 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 turn around times at the gate. When the Boost mode is selected, after the unit has been used, the fans keep running for 20 minutes 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 aircrafts 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 sub-menu sets the trip level for the AC ripple on the DC EF interlock signal. The default value is 7.0 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 90% Insertion Switch

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 sub-menu value to Enable when such a cable is connected to the unit. The default value is set to Disable.

Go into the Setup Menu and then scroll up or down to the 90% Insertion 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.

7.12 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 door. When the front door is opened the unit will shut off when this sub-menu is set to Active. Use this sub-menu to bypass the door switch 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 Plug Temperature

Some aircraft cables have temperature sensors installed in the connector. This sub-menu allows the unit to accept Normally Opened or Normally Closed temperature sensor switches to be used.

Go into the Setup Menu and then scroll up or down to the Plug 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.

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 sub-menu), 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.

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 sub-menu is used in conjunction with the Earth Leakage Level sub-menu. 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 sub-menu s 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 Ethernet Configuration

This set of sub-menu s 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.

7.20 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 sub-menu 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.

7.21 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.

7.22 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.

7.23 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 Client

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 Client 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 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 Danish, English, German, French and Spanish already installed. 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 connector.	Daily / upon use
• Check output cable for damaged insulation.	Weekly
• Verify function of the 90% Switch, if present.	Quarterly
• Check air-filters - Wash or change as appropriate.	Quarterly
• Check that all fans are running properly. (use Boost mode in Fan Control setup submenu)	Yearly
• Check rubber seals at front door, rear panel.	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. However 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.

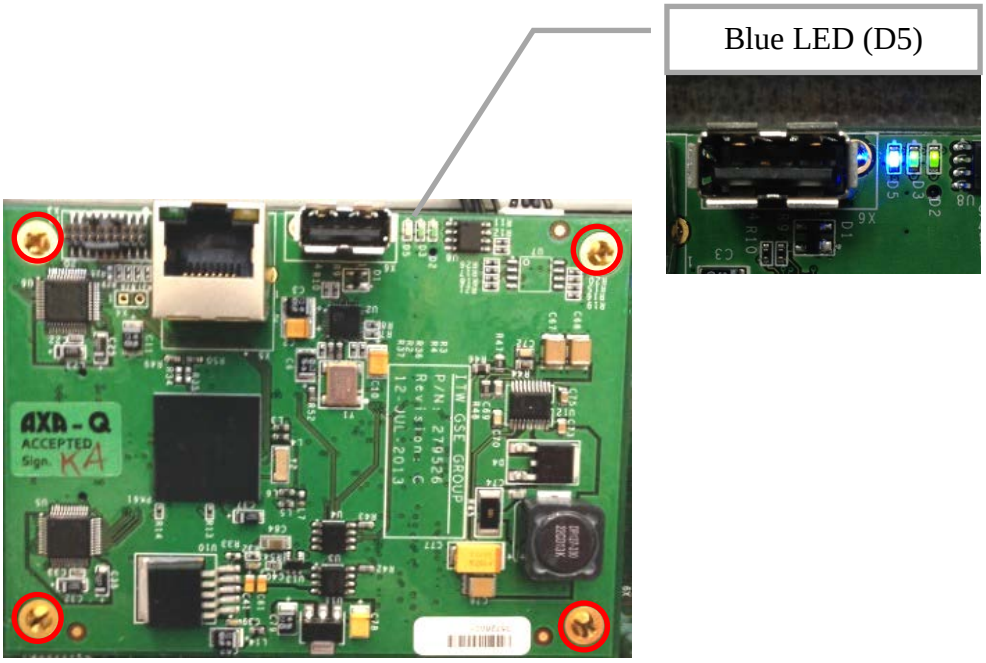


Fig. 8.2.1 Control Board (front view)

To replace the battery, **Switch OFF** the unit by means of Q1. Remove the Control Board from its 4 posts marked with a ○ in Figure 8.2.1. Place the PCB on an insulated surface, with the back side face up.

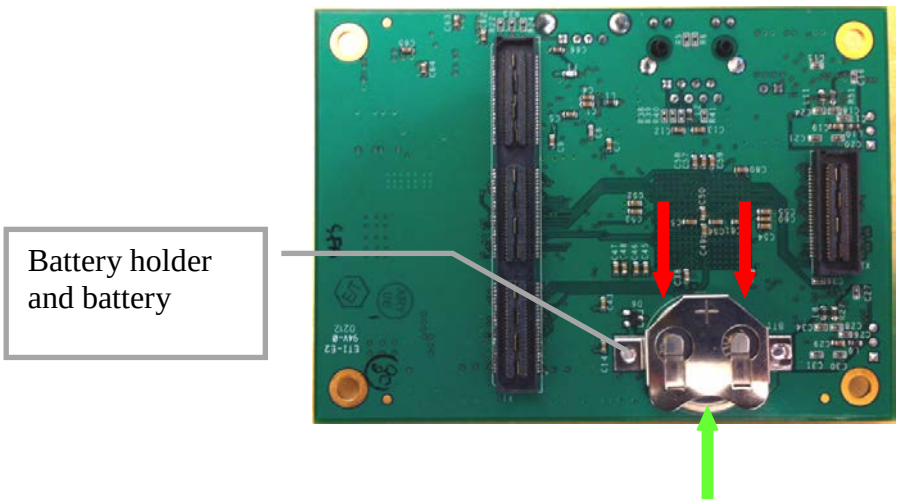


Fig. 8.2.2 Control Board (rear view)

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 software 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 two red arrows on Figure 8.2.1 and insert the new battery in the direction of the singe green arrow on Figure 8.2.2.

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.

* Important Note!

If the blue LED on the Control Board (location can be found on the Fig. 8.2.1) flashes with approximate 2 flashes per second and the display reports “Communication Error”, the software 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 Q4 (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)	Fan Fuse	ATO Blade Fuse	32 V	10 A

Fig. 9.0.1 Fuses F1-F5 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 and overload, 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 / 47xx

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/hobart (pls. refer to section Customer Support)

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		Press start to reset
200	CONTROL BOARD FAILURE	Watchdog Timeout	
201	CONTROL BOARD FAILURE	CRITICAL: Memory Error	
300	CONTROL VOLTAGE LOW	Control Voltage < 20V (Running)	
301	CONTROL VOLTAGE LOW	Control Voltage < 20V (Standby)	
350	F1 OR F2 FUSE BLOWN		Replace fuse F1 and press start to reset
400	EMERGENCY STOP ACTIVATED		Release emergency stop and press start to reset
1000	SOFTSTART ERROR	DC Voltage < 400V	Press start to reset
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	
1501	INVERTER TEMP TOO HIGH	IGBT 1 Temperature > 110 °C	
1502	INVERTER TEMP TOO HIGH	IGBT 2 Temperature > 110 °C	
2000	GATE VOLTAGE ERROR	CPLD Unknown Fault	
2000+code	GATE VOLTAGE ERROR	IGBT XY Ready	
2000+code	GATE VOLTAGE ERROR	IGBT XY Fault	
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+code	SHORT CIRCUIT AT OUTPUT	Phase X	
4600+code	FILTER CURRENT TOO LOW	Phase X	
4700+code	FILTER CURRENT TOO HIGH	Phase X	
4800	INVERTER SOFTSTART FAILURE		
5000	TRANSFORMER TEMP TOO HIGH		
5100	EARTH LEAKAGE FAULT AT OUTPUT		
5200	NEUTRAL VOLTAGE FAULT AT OUTPUT		
6001	EF OUTPUT 1 RIPPLE TOO HIGH	Ripple Voltage Exceeded Limit	
6002	EF OUTPUT 2 RIPPLE TOO HIGH	Ripple Voltage Exceeded Limit	
6101	PLUG 1 TEMPERATURE TOO HIGH		
6102	PLUG 2 TEMPERATURE TOO HIGH		
6201	NEUTRAL CONDUCTOR RUPTURE OUTPUT 1		
6202	NEUTRAL CONDUCTOR RUPTURE OUTPUT 2		
6301	EF SIGNAL DROP OUT - OUTPUT 1	EF Signal Disappeared at Output 1	
6302	EF SIGNAL DROP OUT - OUTPUT 2	EF Signal Disappeared at Output 2	
6401	90% SIGNAL DROP OUT - OUTPUT 1	90% Signal Disappeared at Output 1	
6402	90% SIGNAL DROP OUT - OUTPUT 2	90% Signal Disappeared at Output 2	
7000	OUTPUT VOLTAGE TOO HIGH	Voltage > 32V - 4s	
7100	OUTPUT VOLTAGE TOO HIGH	Voltage > 40V - 1s	
7200	OUTPUT VOLTAGE TOO LOW	Voltage < 20V - 4s	
7300	SHORT CIRCUIT AT 28V OUTPUT	>75kW	
7500	28V RECTIFIER TEMP TOO HIGH		
8000	ACR SUPPLY VOLTAGE MISSING		
8001	ACR ERROR		
9000	END OF FACTORY TEST		
9100+code	PLUG & PLAY FAILED - OUTPUT X		
9200+code	PLUG & PLAY COMPLETED - OUTPUT X		

Note: The second through fourth suggested corrective actions are shown below for the above codes.

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	
300 - 301	Check input voltage	Check Q4 & G1	
350	Check wires attached to X1 (X2 /X3)		
400	Check emergency stop	Check user EPO (A2:X14)	Replace Control Board A1
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
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 - 2024	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+code	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
4700+code	Check output filter capacitors C7-C9	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
5200	Check set-up value	Remove load and check output cabling for insulation failure	Replace Control Board A1 Replace Interface Board A2
6001	Check set-up value	Remove load and check output cabling	Replace Control Board A1 Replace Interface Board A2
6002	Check set-up value	Remove load and check output cabling	Replace Control Board A1 Replace Interface Board A2
6101	Remove load and let plug cool down	Check connector / output cabling for any malfunction	Replace Control Board A1 Replace Interface Board A2
6102	Remove load and let plug cool down	Check connector / output cabling for any malfunction	Replace Control Board A1 Replace Interface Board A2
6201	Check / correct installation	Replace NCR Board A10	Replace Control Board A1 Replace Interface Board A2
6202	Check / correct installation	Replace NCR Board A10	Replace Control Board A1 Replace Interface Board A2
6301	Verify that output cable is correct inserted	Check / correct installation	Replace Control Board A1 Replace Interface Board A2
6302	Verify that output cable is correct inserted	Check / correct installation	Replace Control Board A1 Replace Interface Board A2

6401	Verify that output cable is correct inserted	Check / correct installation	Replace Control Board A1 Replace Interface Board A2
6402	Verify that output cable is correct inserted	Check / correct installation	Replace Control Board A1 Replace Interface Board A2
7000	Check output voltage setup value	Check ARU Module and wiring	
7100	Check output voltage setup value	Check ARU Module and wiring	
7200	Check output voltage setup value	Check ARU Module and wiring	
7300	Remove short circuit	Check output cables	
7500	Let the unit cool down and reset	Check airflow / air filters / fan	Check temp. sensor at rectifier heat sink.
8000	Check ACR Supply Q6		
8001	Reset ACR	Check ACR VFD	
9000			
9100+code	Repeat cable Identification		
9200+code			

Note!

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

10.0 Illustrated Parts List

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

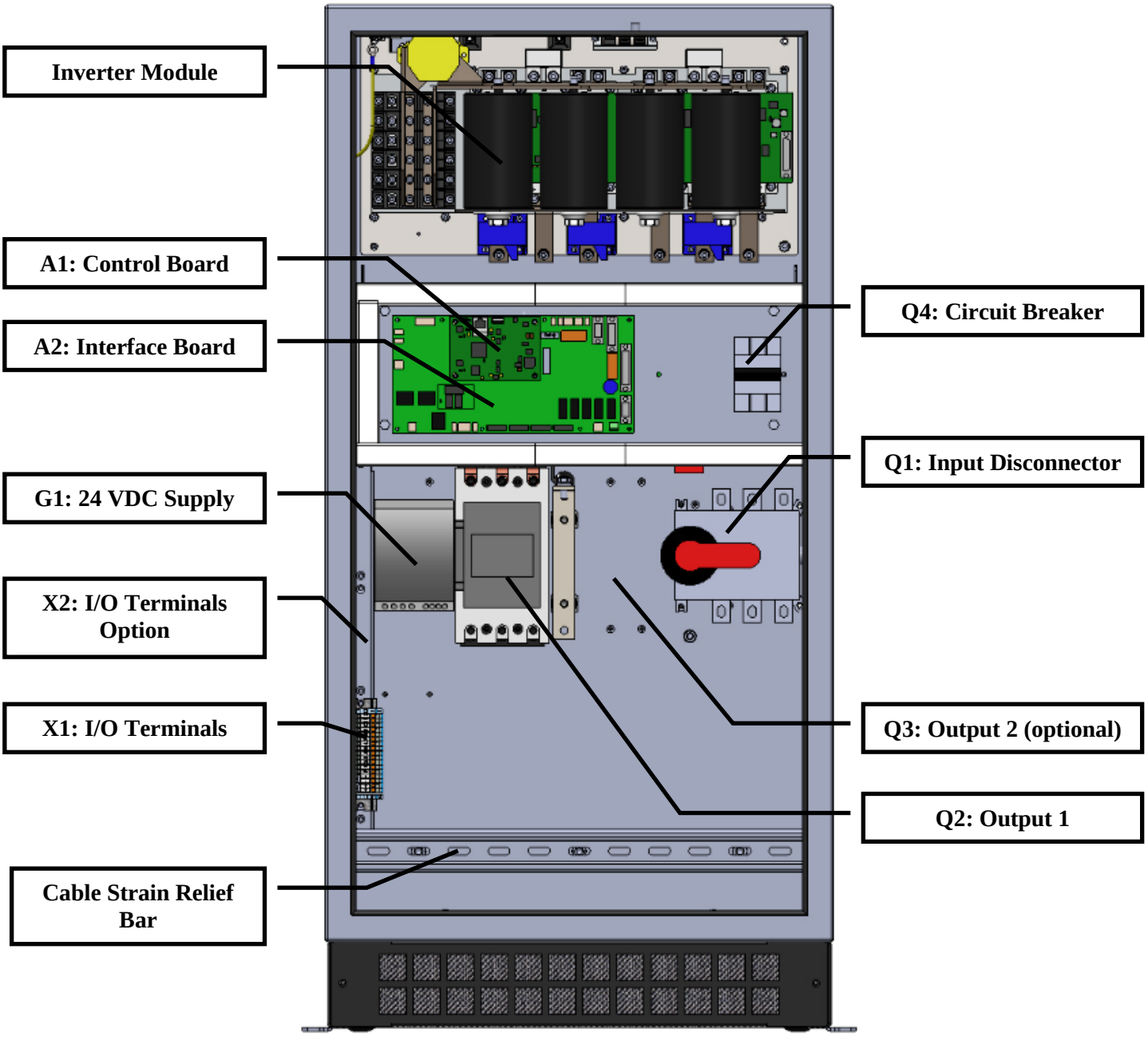


Figure: 10.0.1 Front View

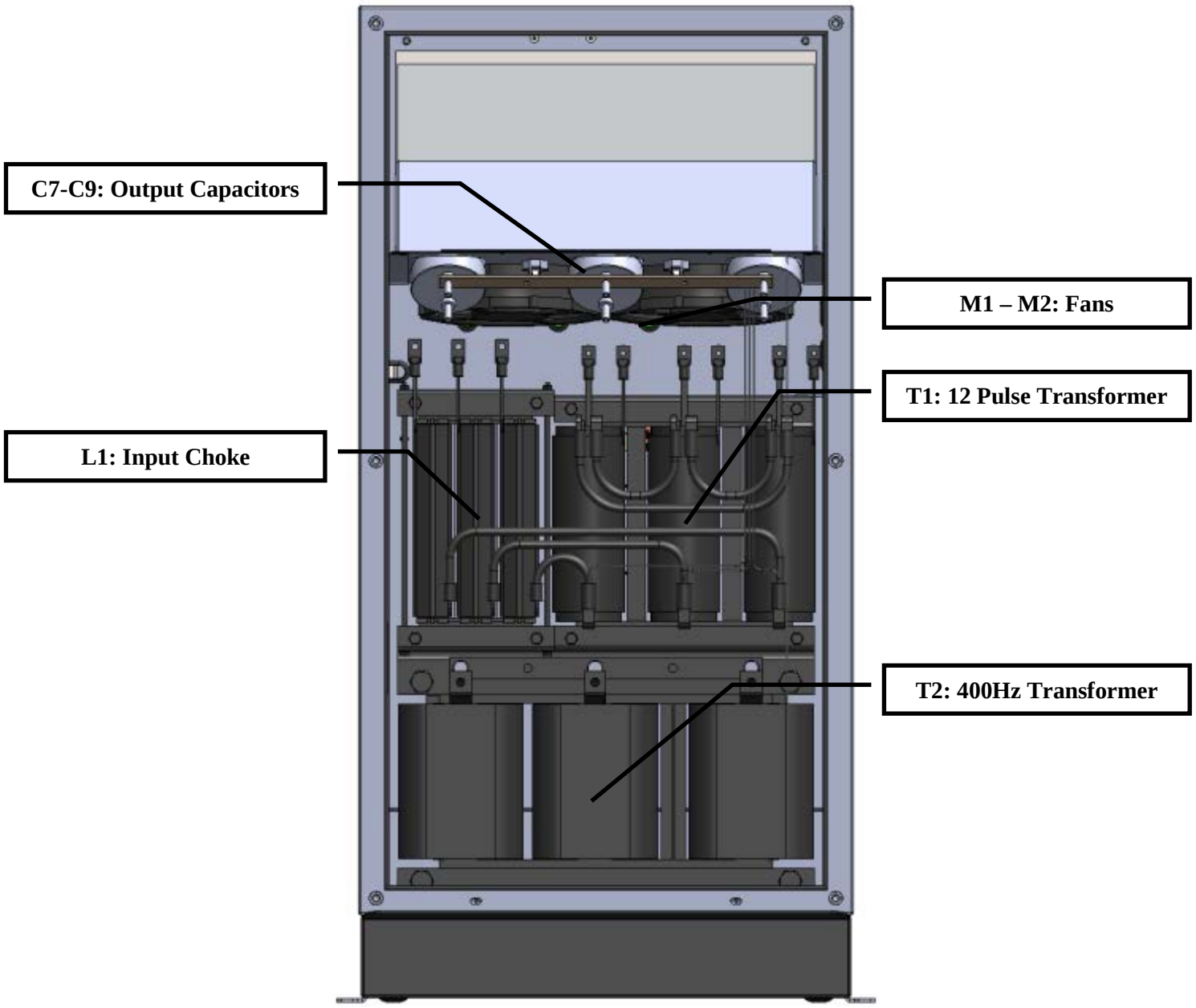


Figure 10.0.2 Rear View

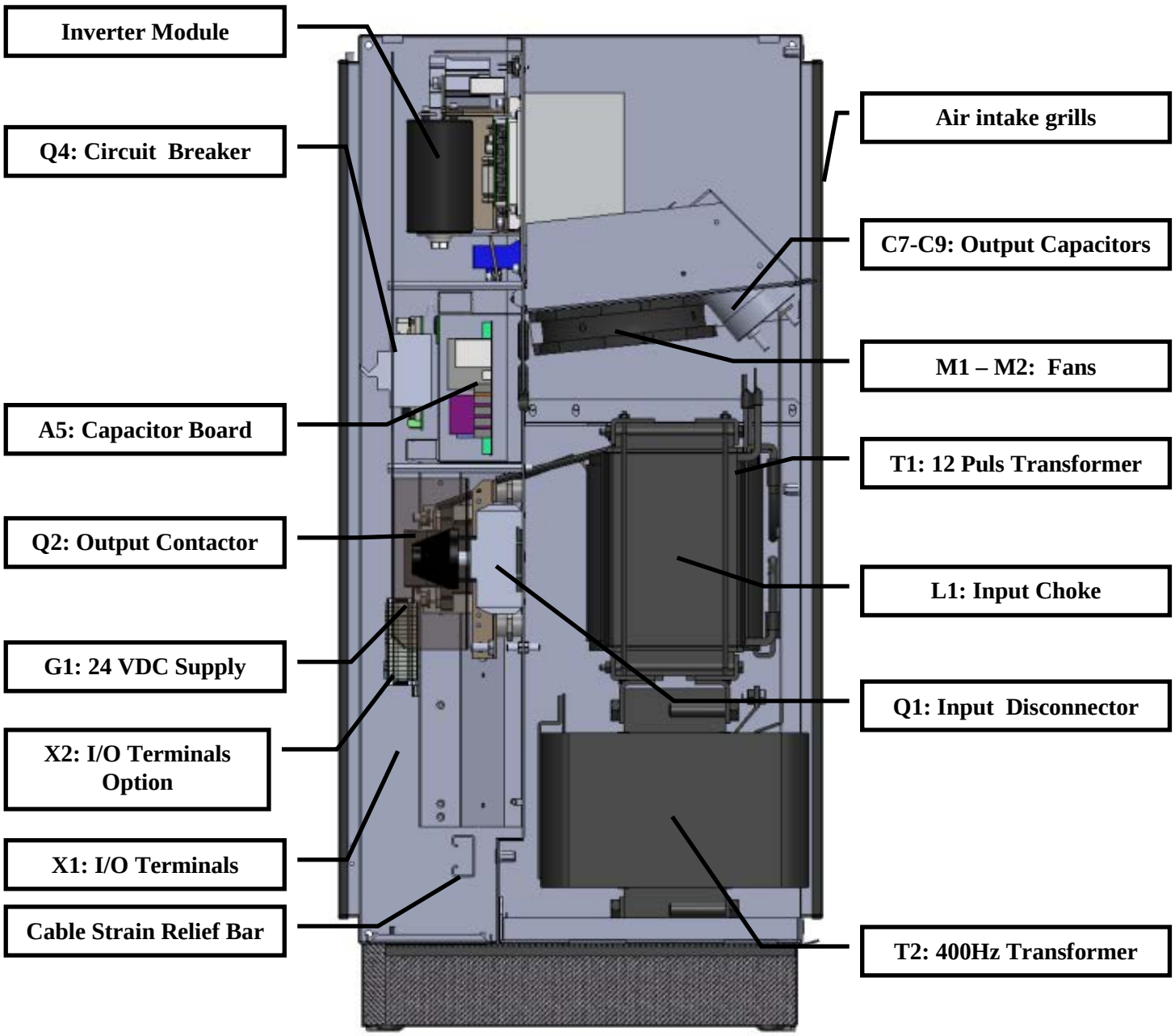


Figure 10.0.3 Side View cut

Note!

In mobile and bridge mounted units, the display module and the emergency stop button are situated in a separate box. (See Section 12.0 Options item 578xxx Remote Control Boxes)

11.0 Options

578803 Base module

Additional base module, which extends the height /length of the ground power unit by 340 mm and the weight by 20 kg/51 lbs. (Refer to drawings section 5)

578804 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 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.

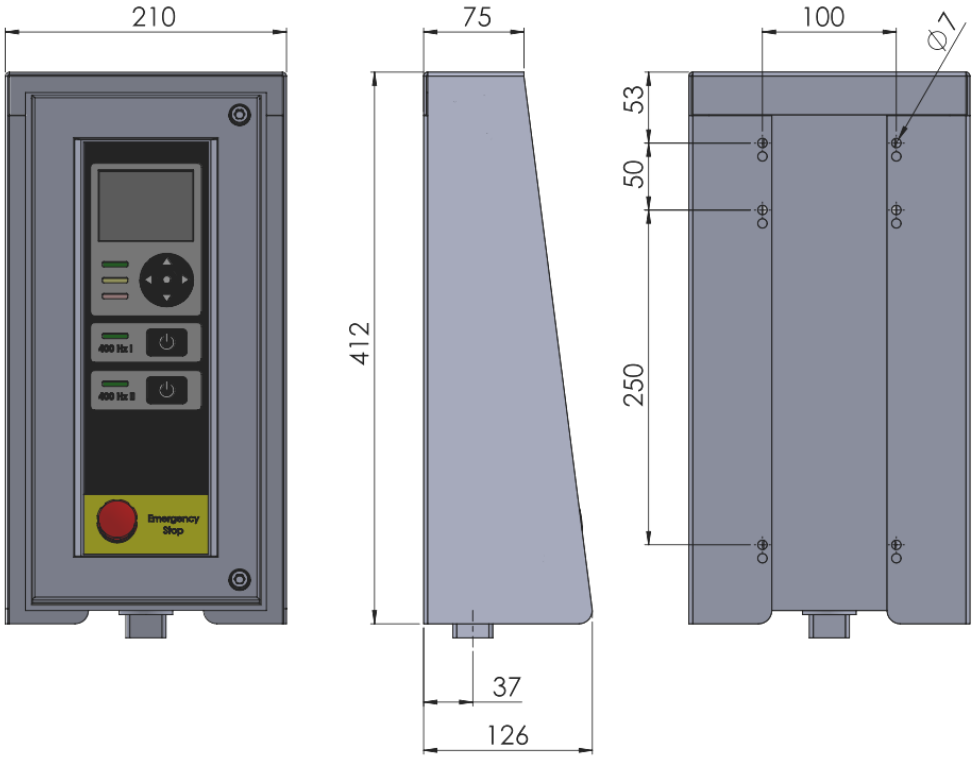
5788xx Remote Control Boxes available:

578806 1 x 400Hz Output

578818 2 x 400Hz Output

578819 1 x 400Hz & 1 x 28VDC Output

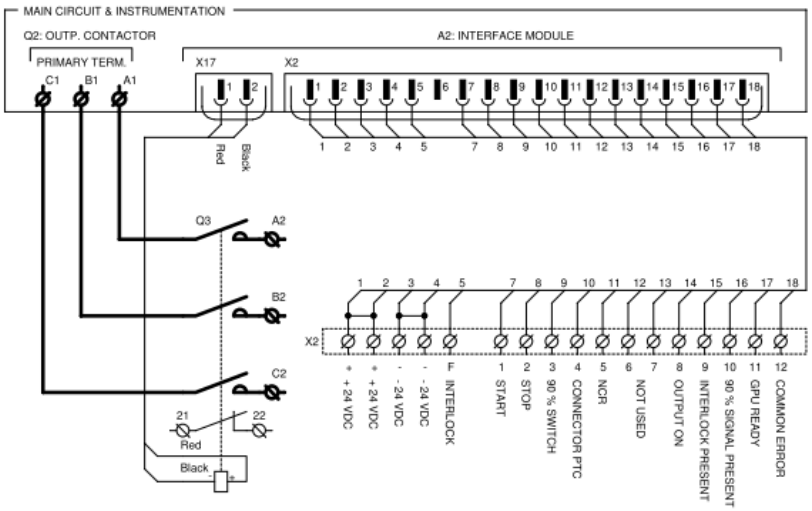
578820 1 x 400Hz Output & controls for Retriever/Hoist



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. (Above picture shows the configuration with 2 x 400Hz output).

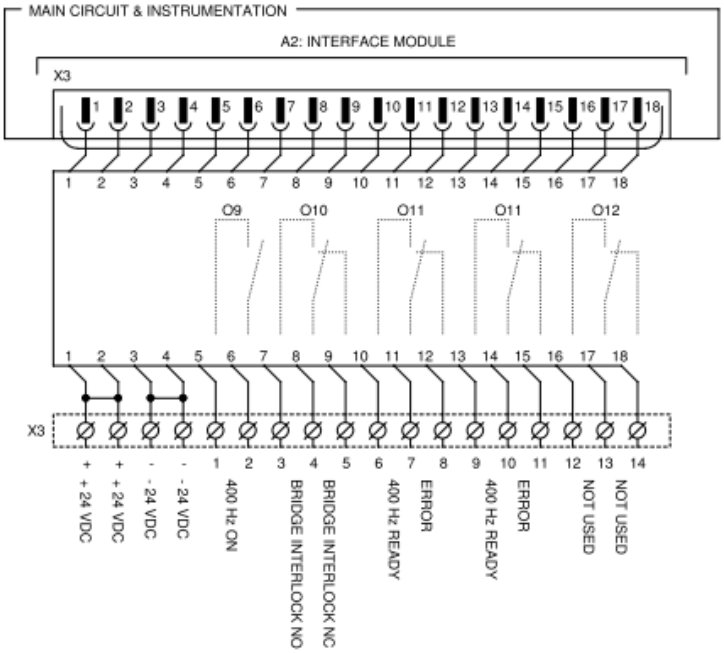
578807 Additional Output Contactor (Diagram 478801)

All units are equipped with one output contactor.
All models are, however, prepared for an additional output contactor and I/O terminal block X2.
Please refer to chapter 7.0 for Output Mode / Compensation possibilities.



578808 Dry Contacts (Diagram 478801)

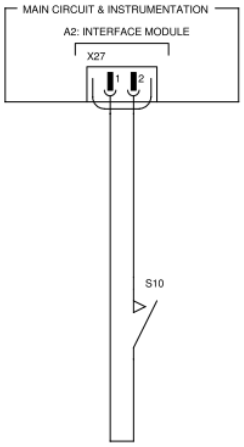
If dry contacts are needed for additional indication / to the PBB or to a BMS system, this option offers the following dry contact relays:



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} = 65 V AC/DC and I_{max} = 2 A

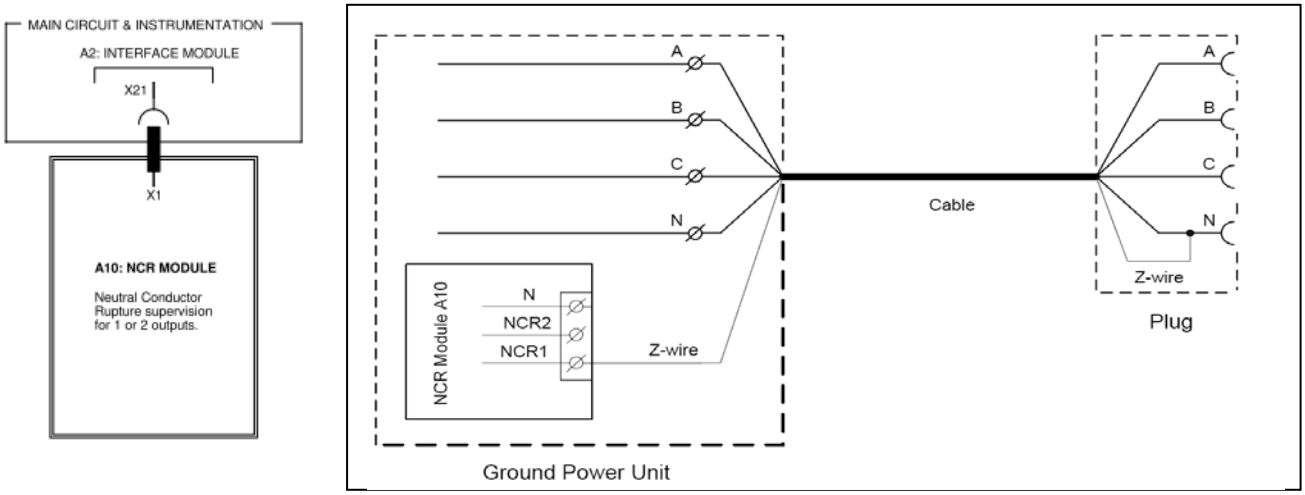
578809 Door Interlock (Diagram 478801)



The door interlock ensures that the ground power units output contactor(s) open and the unit immediately returns to standby mode if the door is opened.

578810 Neutral Conductor Rupture Supervision

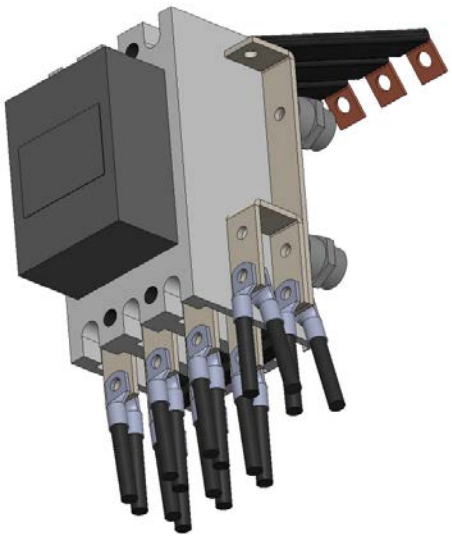
A broken neutral conductor in the 400 Hz cable combined with an unbalanced aircraft load could lead to a destructive phase-neutral voltage in the aircraft and to hazardous voltages between the aircraft chassis and ground. The NCR option ensures that a broken neutral will be detected immediately.



Principle wiring diagram for Neutral Conductor Rupture Supervision

Unbalanced voltage at the aircraft connector due to a broken neutral would add a 400 Hz voltage to the 28 VDC interlock voltage measured at the ground power unit. If the injected AC voltage exceeds approx. 10 VAC the output is disconnected. This type of error is recognised as an interlock failure by the ground power unit. Since the disconnection is a reaction to a heavy unbalanced voltage at the aircraft connector, it means that this type of supervision does **not** protect sensitive equipment in the aircraft. The NCR option protects personnel as well as the aircraft in case of a broken neutral.

578814 Terminal Extension



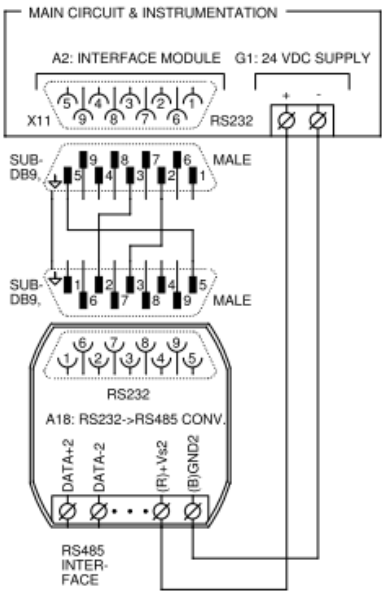
If more than 2 x cables per output phase are needed, for instance 2 ‖ 7 x 35 mm², the terminal extension allows connection of up to 4 x cables per phase.

The kit consists of:

4 x extension bars
Bolts, washers, spring washer and nuts

578815 RS485 Interface (Diagram 478801)

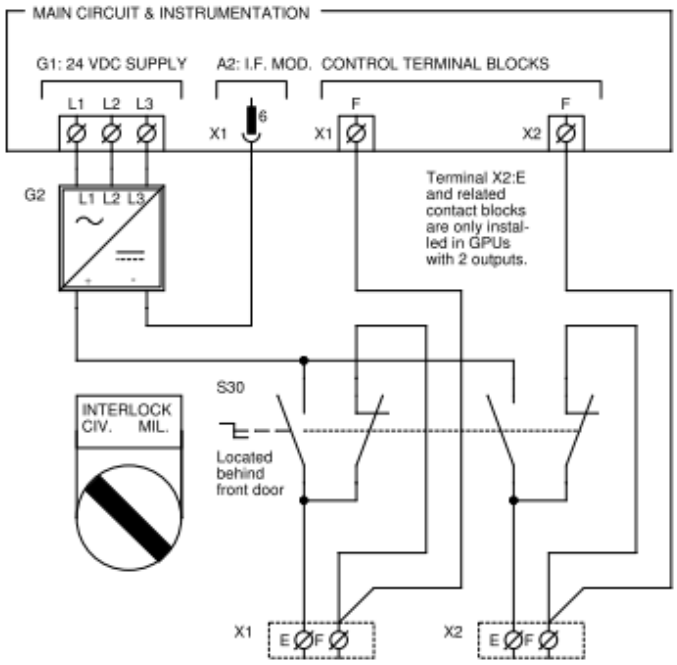
All units are supplied with connections for RS232. The RS485 Interface option provides a galvanic isolated RS485 connection and allow for multi-point connection.



PIN Assignment for RS485 Interface

578817 Military Interlock (Diagram 478801)

For military aircraft, the interlock system must be switched from civilian 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.



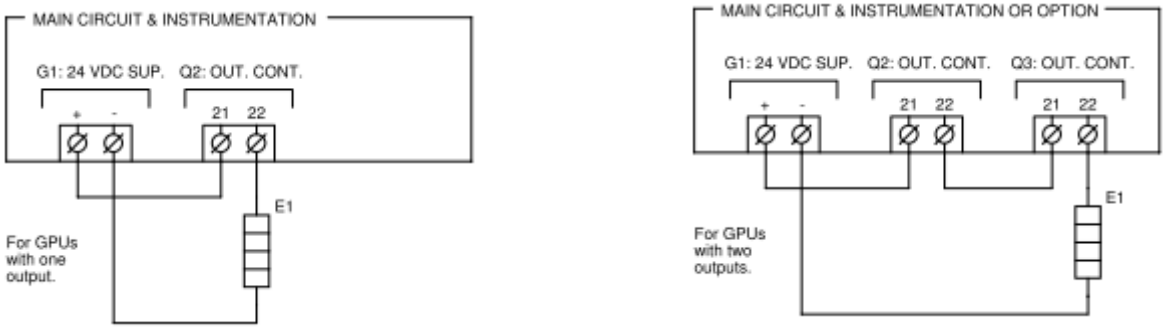
Standard wiring diagram for military interlock

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

578829 Anti-Condensation Heater (Diagram 478801)

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, one 30 W anti-condensation heater automatically switch on and prevent condensation from arising.



Schematic for Heater connection

591100 Auto Calibration Plug

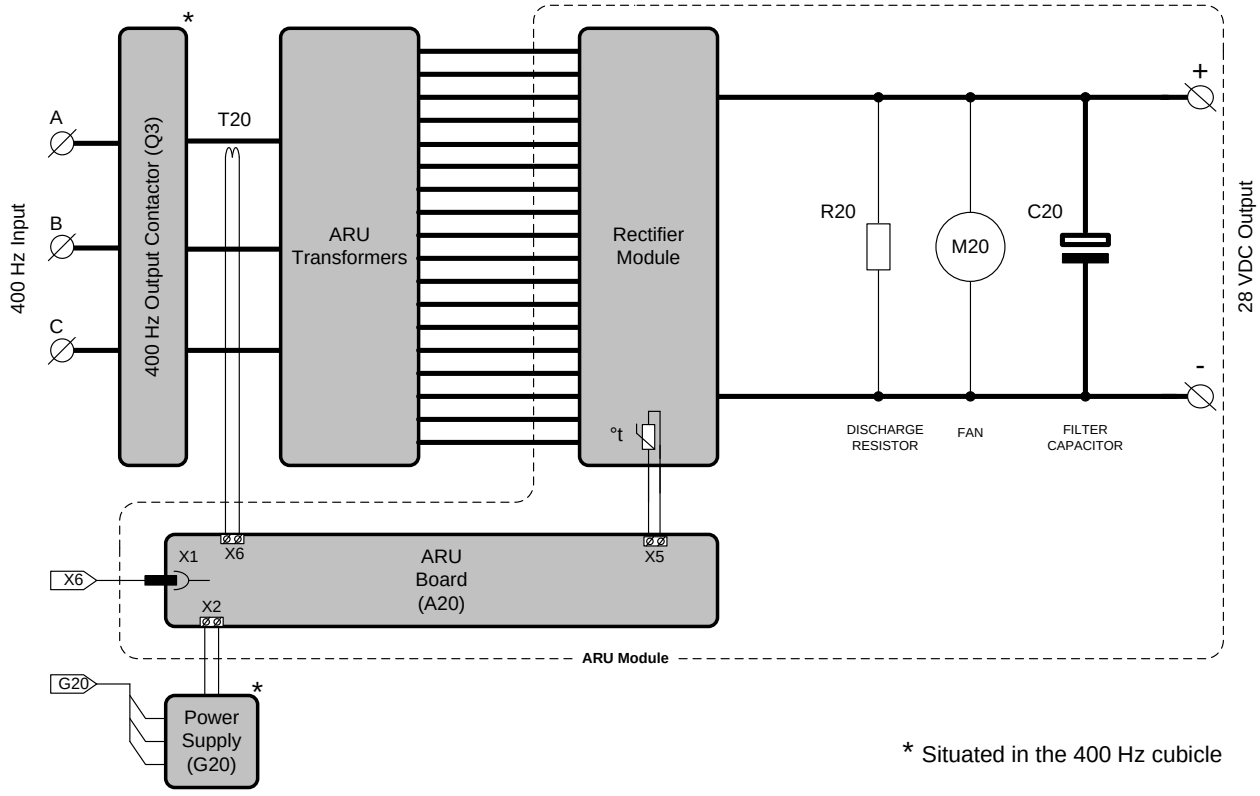
Required for Plug & Play set-up.
See section 7. 3

12.0 For GPUs with 28 VDC Active Rectifier Unit

All Hobart *PoWerMaster*® 2400 units from 30 kVA to 90 kVA can be equipped with a 28 VDC **A**ctive **R**ectifier **U**nit (ARU) output.

Both 400 Hz & 28 VDC outputs can be used simultaneously. The total continuous amount of power from the unit is calculated as the sum of 400 Hz and 28 VDC output and cannot exceed the total 400 Hz power rating of the unit.

12.1 General Description



12.1.1 Principle of 28 VDC ARU

The 28 VDC part is basically an Active Rectifier Unit and supplied from the 400 Hz part, where the 28 VDC output voltage is controlled regardless of the varying 400 Hz input voltage. The DC output current is calculated very precisely on the basis of the 400 Hz parameters and via the current transformer T20, located in phase A at the main power input.

Please refer to Figure 5.0.2 for outline drawings.

Input Contactor(Q3):
The 400 Hz input power to the ARU is supplied and controlled via Q3.

Power Supply (G20):
24 VDC / 10 A (Factory adjustment = 25 Volt) regulated control voltage is supplied from the Power Supply G20. This module has a wide input range (340-575 VAC). It is supplied via the capacitor module and pre-fused from the 3-phase circuit breaker Q4 (shared with G1) and located in 400 Hz part. Refer to Figure 16.0.1.for location diagram.

ARU Transformers (T20):
The ARU transformers steps down the 3 phased 400 Hz voltage (3 x 200 Vac) to an appropriate level for obtaining 28 VDC at the output.

ARU Rectifier (PM20):
The output voltage is kept at 28 VDC by using thyristors, regardless of the input voltage level and the load.

ARU Board (A20):
The ARU Board interfaces with the processor board and the rest of the 28 VDC unit.

- Supplied from G20 (X2)
- Connection to ARU control input on A2 (X1)
- Control of thyristors.
- Measures the output voltage.
- Interface for heatsink thermostat (X5)
- Input for current transformer T20 (X6)

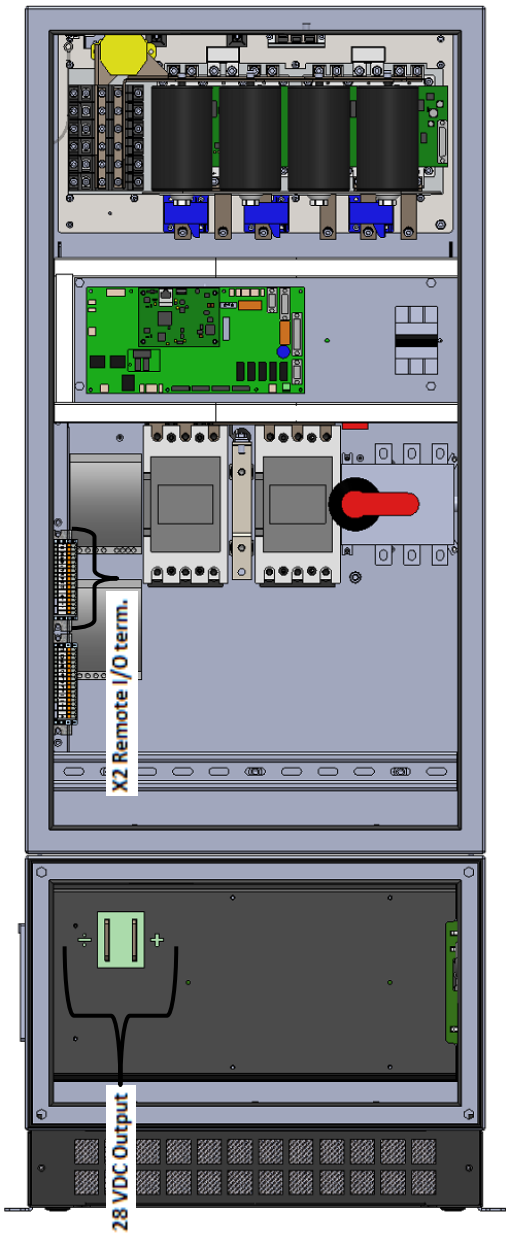
Resistor (R20):
The discharge resistor R20 is part of the output filter stage and discharges the capacitor C20, when the unit is turned off.

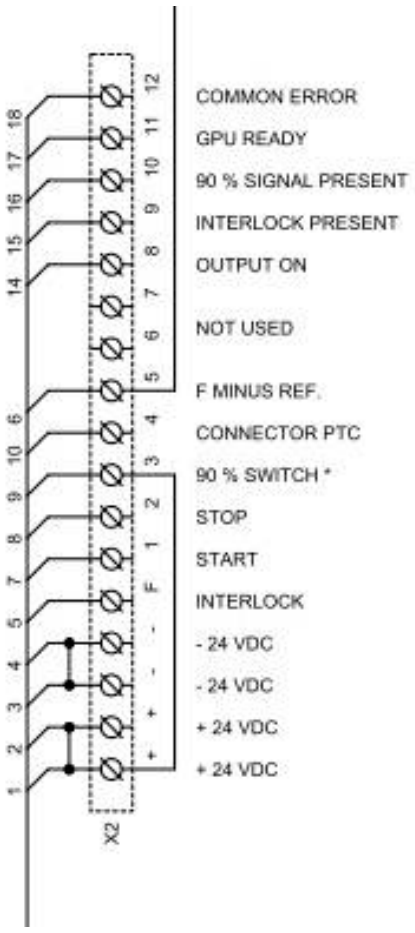
Filter Capacitors (C20)
The output filter capacitors are also part of the output filter stage and secures that the AC ripple is kept to a minimum, less than 2% at the output.

Fan (M20)
The fan M20 is part of the total forced cooling of the unit, the primary task for the fan is to cool down the rectifier module. The air is drawn in via the filter grill on the left hand side of the base module. The ARU transformers are cooled by the fans located in the 400 Hz part.

12.2 Connection of Cables

Standard Remote I/O terminals
(refer to **section 4.9** for connection of I/O terminals)





* THE 90% SWITCH IS AS STANDARD BY-PASSED BY CONNECTING TERMINAL + & 3.

28 VDC Output terminals: 2 x 4 x ø11 3/8 bolt (M10 bolt) 444 in-lb (50 Nm)
Remote I/O terminals: 15 x 0.4 - 4 mm² (AWG21 – 11)

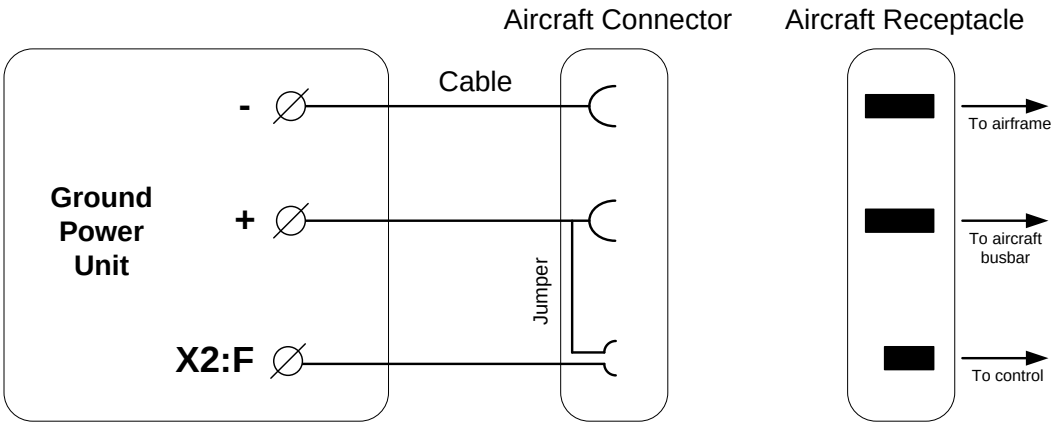
Fig. 12.2.1 Connection of Cables

Note!

Recommended output cable dimension to the aircraft is 2 x 4/0 (95 mm²) for continuos loads up to 400 amps and 4 x 4/0 (95 mm²) for higher continuous loads.

12.3 Interlock

To ensure personnel health and safety, the converter is equipped with an interlock system. The system ensures that the output only stays engaged as long as the plug is inserted into the aircraft receptacle. I.e. as long as 28 VDC is present at terminal X2:F.



12.3.1 Standard wiring diagram

For service, maintenance and test purposes, the interlock system can be by-passed via the display setup. To ensure personnel health and safety, the converter automatically returns into normal mode once it receives a 28 VDC voltage at terminal F2. E.g. when the plug is connected to an aircraft.

The 28 VDC output can be operated remotely via the I/O terminals related to Output 2. Please refer to section 4.9

*This option requires a “split-F” connector, which is typically a special order from most aircraft manufactures.

Note!
The 90% switch is as standard by-passed by connecting terminal + & 3 (X2)

12.4 Operator's Instruction

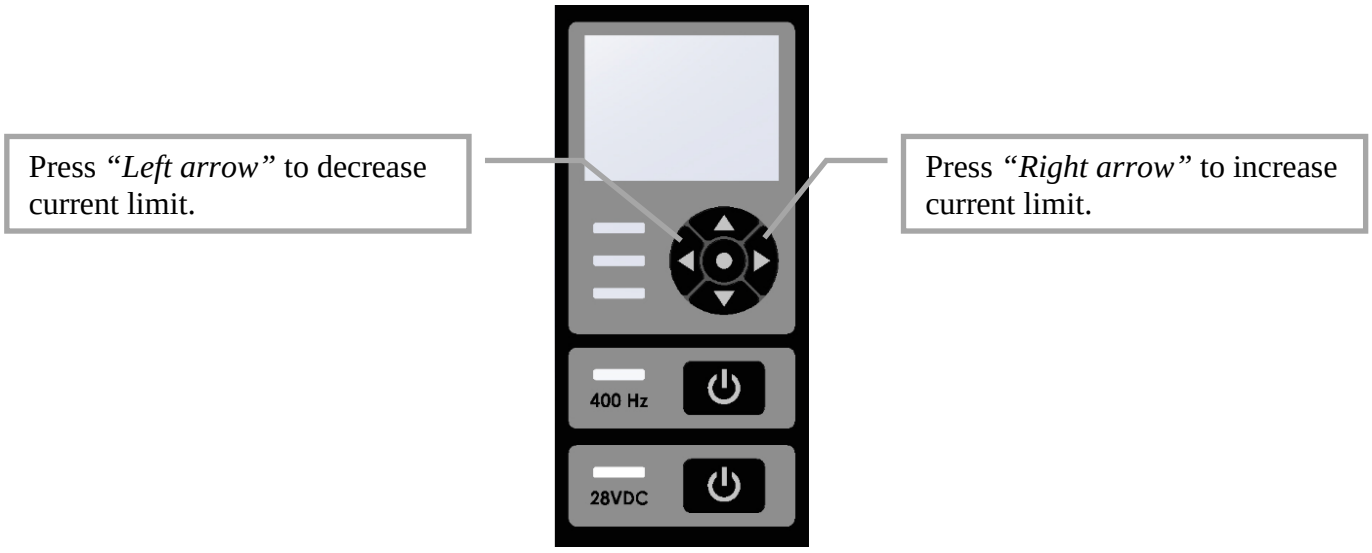
The 28 VDC ARU is operated by means of the Display / Keyboard Interface.
Please refer to section **6.0** (Operators Instructions) and **6.1** (Using the Display/Keypad).

12.5 Operating the unit

- To adapt the 28 VDC output power to different types of aircraft, it is possible to set a maximum DC current level in steps of 200 Amp (400 A unit) and 300 A (600 A unit). Depending on the rating of the GPU:

  400 A rating e.g. 200, 400, 600, 800, 1000, 1200, 1400, 1600 Amp
  600 A rating e.g. 300, 600, 900, 1200, 1500, 1800, 2100, 2400 Amp

  To ensure hassle-free starting of the aircraft engine, the current limit function is delayed 0.7 seconds.

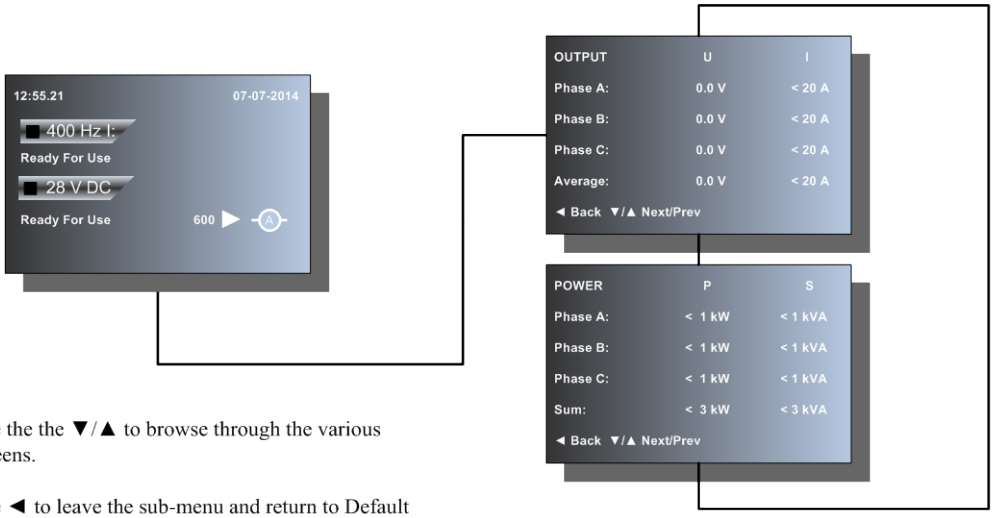


- Insert the aircraft cable into the aircraft. Make sure the cable is inserted till you feel a natural resistance. The plug may be equipped with a 90% Insertion switch. In this case, the unit will not function if the plug is not fully inserted.
- Press the 28 VDC Start/Stop button 
- The unit is now in operation and ready to supply the aircraft with power. This is also indicated via the green LED located close to the 28 VDC Start/Stop button 

- If the unit shuts off and no longer is supplying power to the aircraft, this is reported in clear text in the display. Also a corrective action is displayed.

- During operation, various parameters can be viewed via the display. Use the navigation keys ▼▲ to browse through the available screens:

Default Display Screen Standby

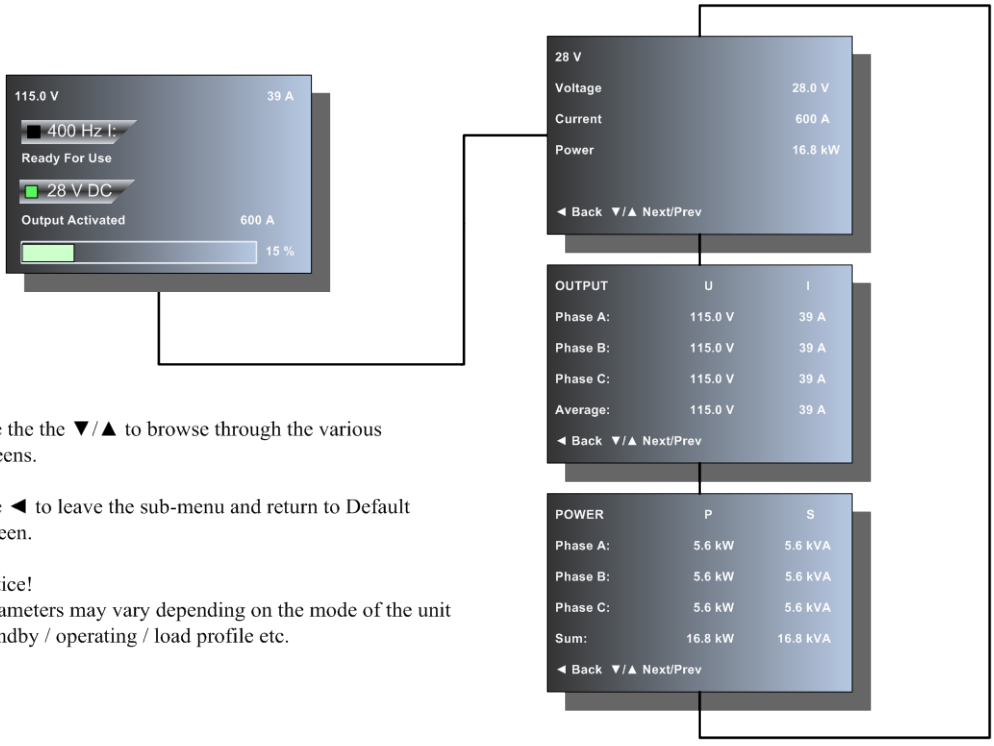


Use the the ▼/▲ to browse through the various screens.

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

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

Default Display Screen Operating



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

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

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

- After operation, the unit has to be turned off before removing the aircraft plug.

  Press the 28 VDC Start/Stop button 

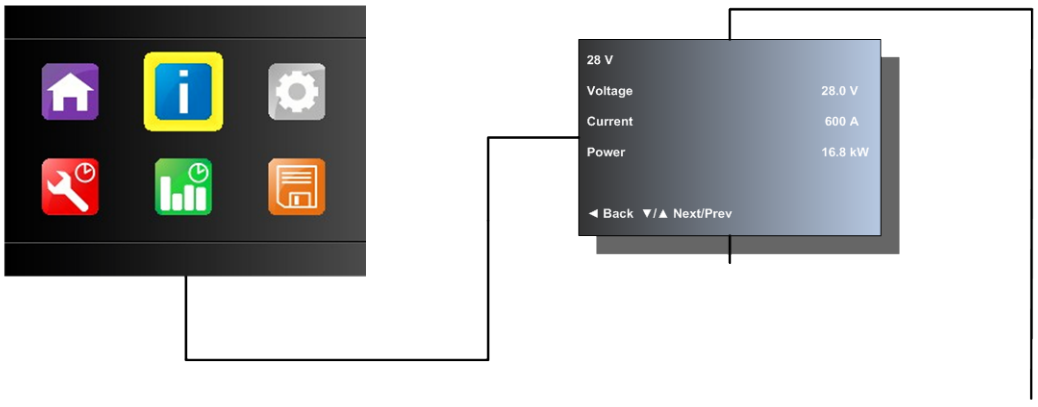
- The aircraft cable can now be removed from the aircraft and placed at the cable rest position.

Note!
Please note that the 28 VDC 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, once the fault number and message have been recorded and reported to maintenance. Note that this will remove the fault message from the screen if it is no longer active. (The Black Box will still have a record of the actual fault)

12.6 Additional menu items for ARU

Parameters – ARU additional parameters

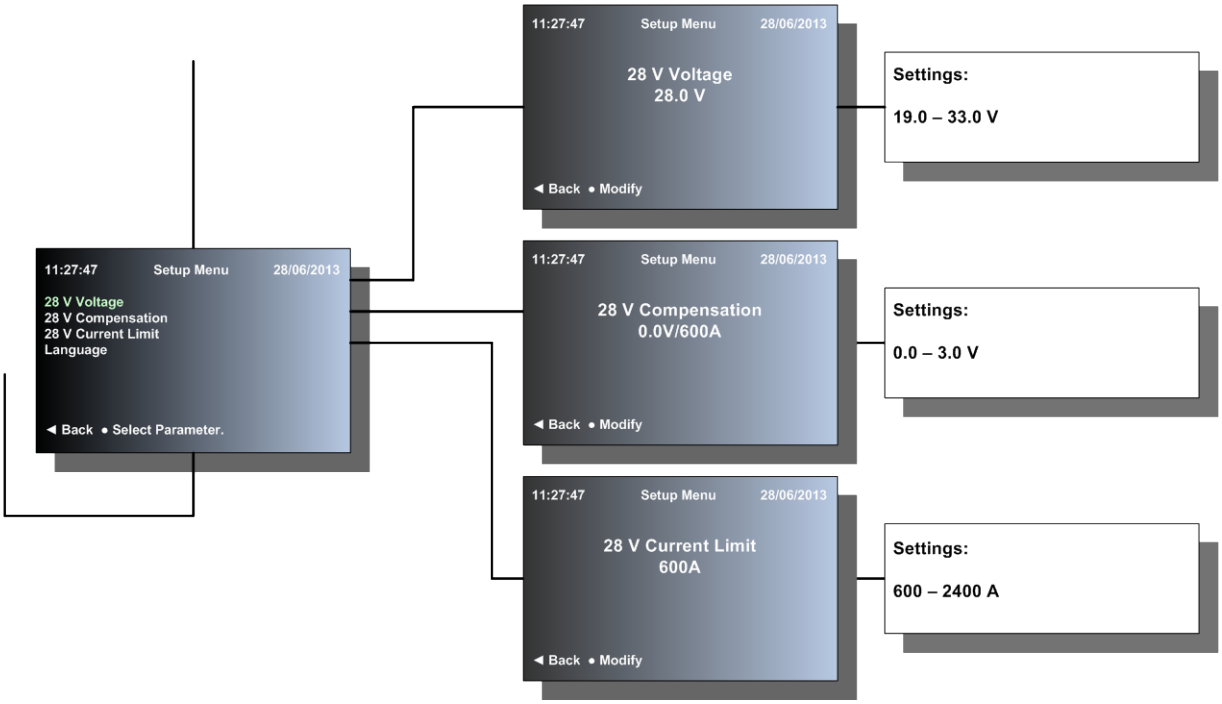


Use the the ▼/▲ to browse through the various screens.

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

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

Setup – ARU additional parameters



Please refer to section **6.1** (Using the Display/Keypad).

12.7 ARU Default Factory Settings:

28 V Voltage (V):	28.0
28 V Compensation (V/600 A):	0.0 (Set if GPU is supplied with cable)
28 V Current Limit (A):	1000 /1500 (400A / 600 A)
Output Mode:	Simultaneous
Fan Control:	Normal
Plug Temperature:	Normally Open

12.8 28V Voltage:

This Setup submenu allows the 28 volt output to be adjusted between 19.0 VDC and 33.0 VDC using the UP and DOWN navigation buttons. (Please note that the acceptable voltage range for all commercial DC powered aircraft is 26V to 29V.

Enter the Setup Menu and then scroll up or down to the 28V 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.

12.9 28V Compensation:

DC voltage drops quickly as the current increases over a given length of cable. This Setup submenu allows the 28 volt output to be automatically adjusted as the load increases. The allowed setting is between 0.0 and 3.0 VDC at the rated continuous load of the unit. Note that the maximum output voltage of the unit is 33 VDC.

Enter the Setup Menu and then scroll up or down to the 28V Compensation 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.

12.10 28V Current Limit:

If too much current is supplied to an engine, it is possible for the engine to shear the engines propeller shaft. This Setup submenu is used to set the default limit for the amount of current that the 28 VDC module will supply to start the aircrafts engine. Typically this value is set to the maximum current of the smallest aircraft the unit will service. If more current is required for larger aircraft, then the operator can adjust the current limit using the UP and Down buttons at the bottom of the operator panel. The current limit settings are from 200 amps to 1600 amps for the 400 amp version of the unit and from 400 amps to 2400 amps for the 600 amp version.

Enter the Setup Menu and then scroll up or down to the 28V Current Limit 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.

13.0 Specifications

Output:

Voltage	: 28 VDC	
Current	: 400 A / 600 A continuously	
Voltage regulation	: < 0.5%	
Voltage ripple	: < 2%	
Voltage transient recovery	: Complies with ISO 6858 / MIL-704E	
Overload capability :	**400 A**	**600 A**
	800 A	1200 A for 30 seconds
	1200 A	1800 A for 10 seconds
	1400 A	2100 A for 5 seconds
	1600 A	2400 A for 2 seconds

To protect the aircraft, the output voltage is decreased by 1 V per 300 A in the overload range (400-2400 A).

Setup:

Output voltage	: 19-33 V
Voltage compensation	: 0-3 V per 600 A
Current limit	: 200-1600 A in steps of 200 A (400 A version)
	400-2400 A in steps of 200 A (600 A version)

Protections:

Rectifier temperature to high

Short circuit at output

Over-and under voltage at output in case:

U < 20 VDC for more than 4 seconds

U > 32 VDC for more than 4 seconds

U > 40 VDC for more than 150 ms

Physical:

Additional weight to 400 Hz unit: 100 kg (220 pound)

For dimension please refer to Figure 5.0.2 (e.g. units equipped with base module).

Ambient:

Operating ambient for the 400 Hz and 28 VDC combination unit is -40°C to 45°C (-40 F to 113 F)

14.0 Trouble Shooting & Repair

Please refer to section 9.1 for Fault Guidance

Additional 28 VDC ARU related failures:

6102	Plug 2 temperature too high
6302	EF signal drop out – Output 2
6402	90% signal drop out – Output 2
7000	Output voltage too high (>32 V – 4 sec.)
7100	Output voltage too high (>40 V – 150 ms.)
7200	Output voltage too low (<20 V – 4 sec.)
7300	Short circuit at 28 V output
7500	28 V rectifier temp. too high

15.0 ARU illustrated parts list

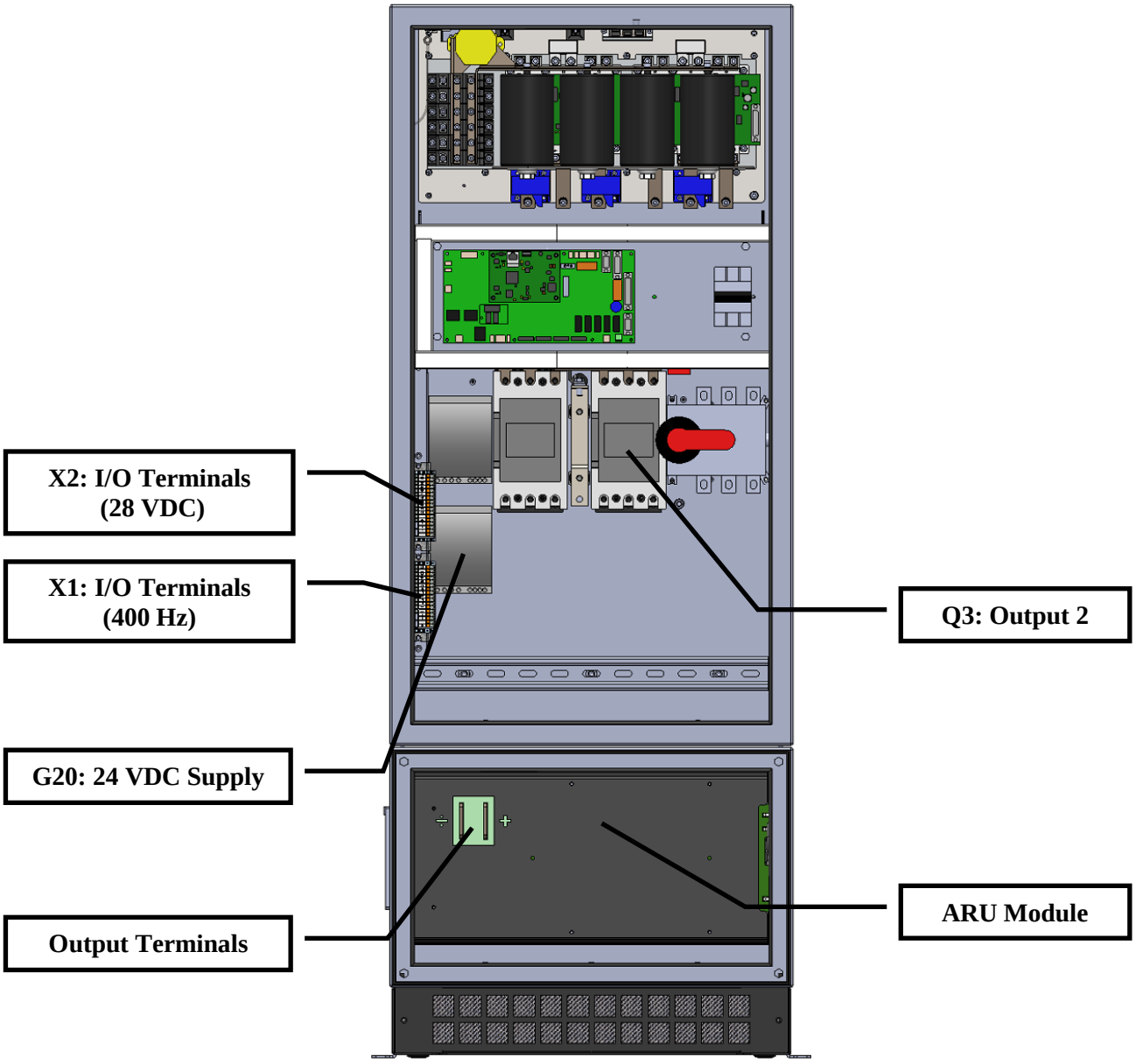


Figure: 15.0.1 Front View (complete unit)

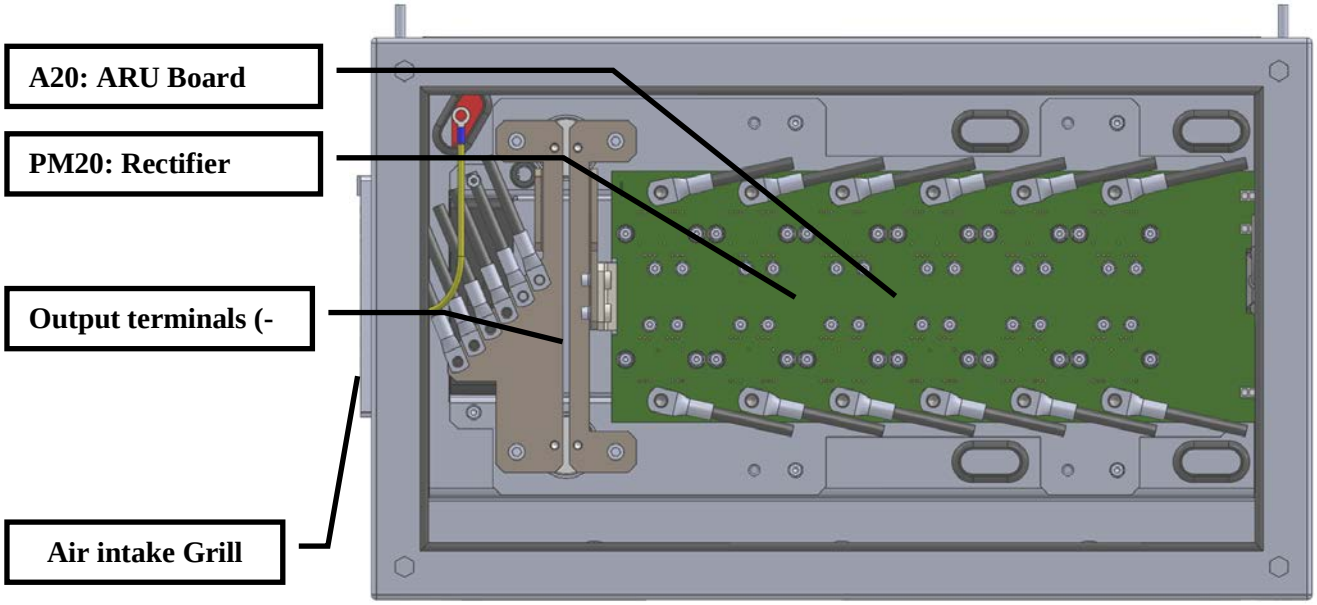


Figure 15.0.2 Front View (ARU)

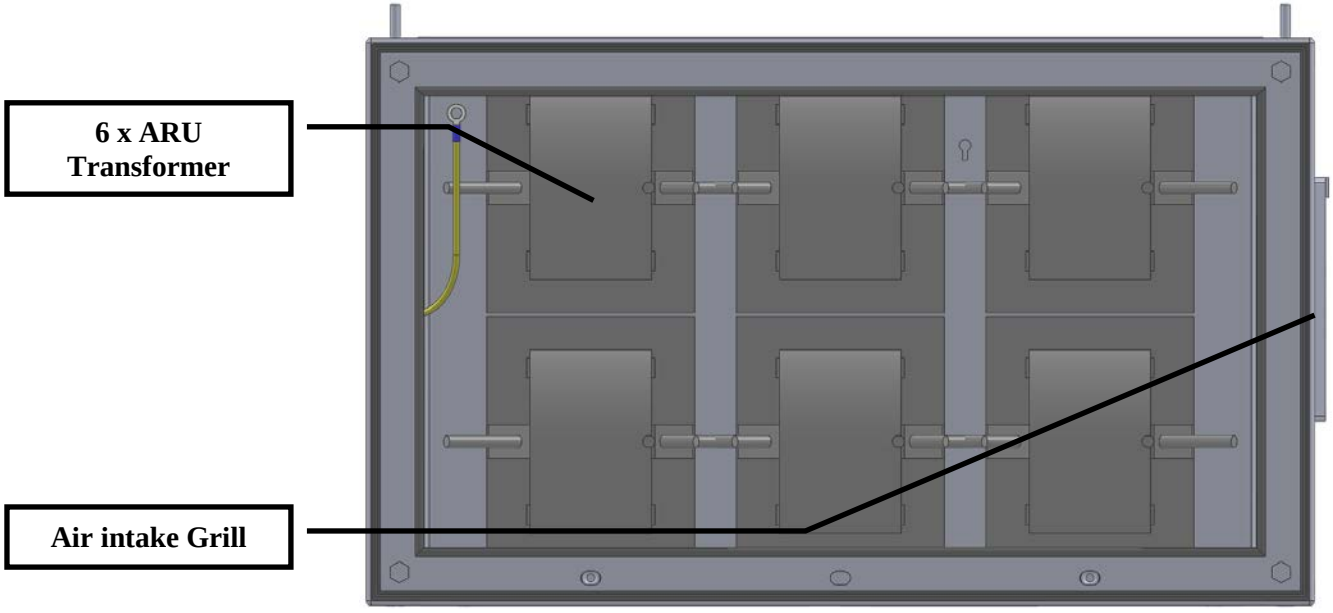


Figure 15.0.3 Rear View (ARU)

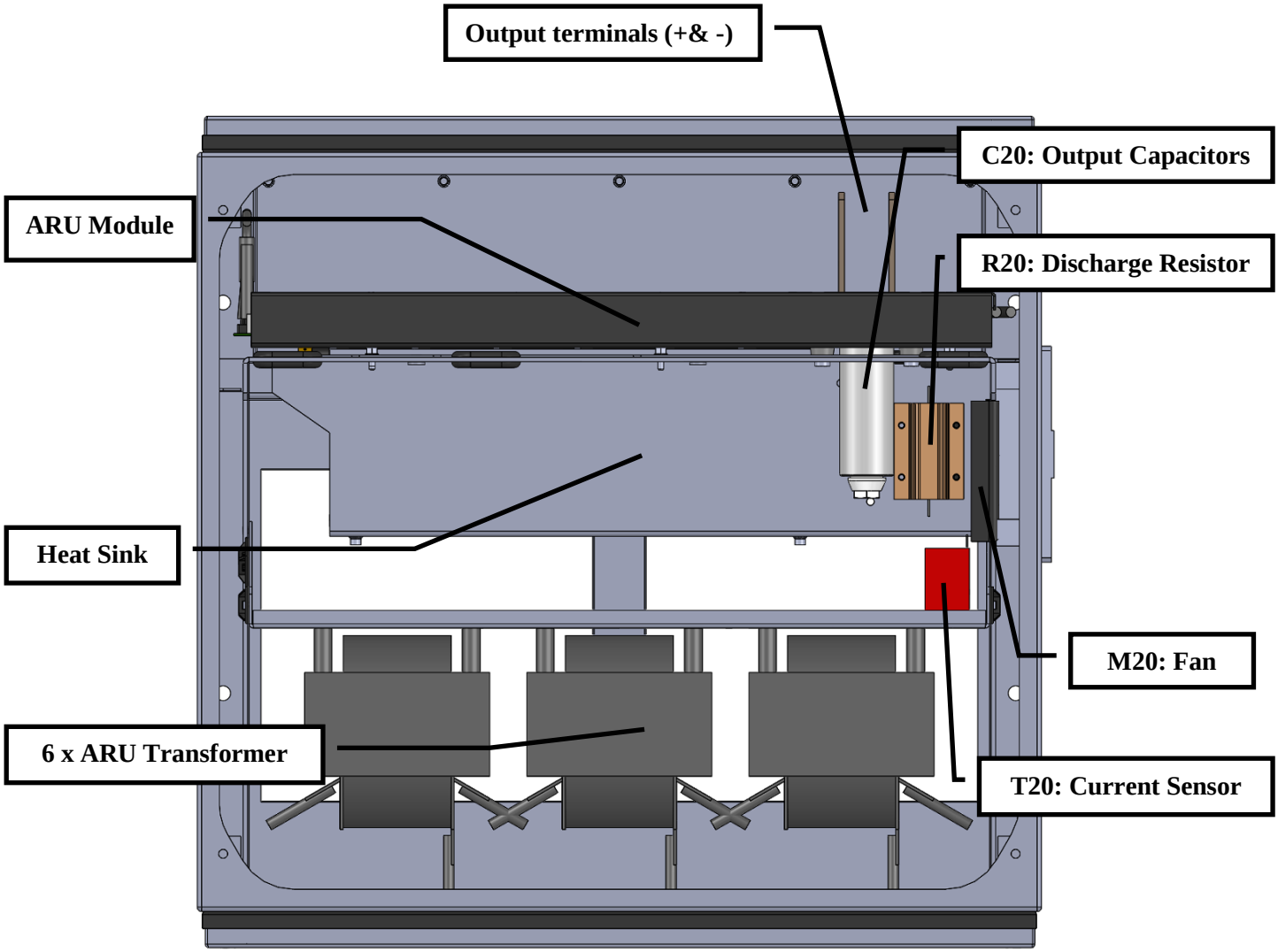


Figure 15.0.4 Top View (ARU)