It's all about connections

Original User Manual
ITW GSE 1400
400 A & 600 A

28 VDC Ground Power Unit

Type	3GW - 28 /

IMPORTANT NOTE

Only qualified personnel may carry out Service/Troubleshooting/Maintenance/Repair to the ITW GSE 1400 GPU.

Refer to ITW GSE webpage
https://itwgse.com/
or
contact ITW GSE
for further information.

IMPORTANT NOTE

We recommend that the battery that safeguards GPU settings etc.
is changed **after 5 years** of use in order to prevent data loss.

Refer to section 8.3
for further information

Diagrams and drawings are subject to change without prior notice.

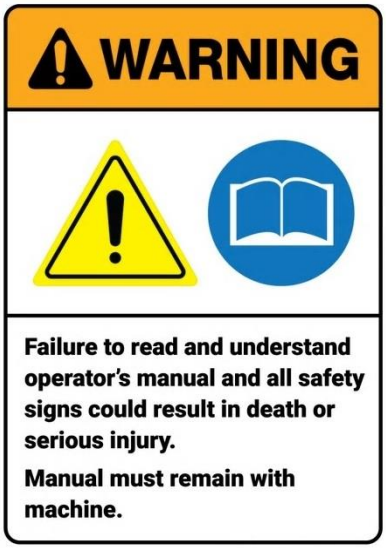
Printed: August 2021

About this user manual

INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR ITW GSE GROUND POWER UNITS.

This manual provides information about ITW GSE 1400 Ground Power Unit.
The manual covers the range of the 1400 series and options described in section 11.

If you have any questions regarding this manual please contact your local agent or contact details can be found at www.itwgse.com



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Abbreviations

ACR	Advanced Cable Retriever
ARU	Active Rectifier Unit
AWG	American Wire Gauge
BMS	Building Management System
CAN	Controller Area Network
DIP	Dual In-Line Package
DSP	Digital Signal Processor
ELS	Earth Leakage Supervision
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPO	Emergency Power Off
ESD	Electro Static Discharge
GPU	Ground Power Unit
GSE	Ground Support Equipment
IGBT	Insulated Gate Bipolar Transistor
I/O	Input/Output
ITW	Illinois Tool Works
LED	Light-Emitting Diode
MMI	Man Machine Interface
MTBF	Mean Time Before Failure
MTTR	Mean Time To Repair
NCR	Neutral Conductor Rupture
NC	Normally Closed
NO	Normally Open
NVD	Neutral Voltage Displacement
NVS	Neutral Voltage Supervision
PBB	Passenger Boarding Bridge
PCB	Printed Circuit Boards
PWM	Pulse Width Modulation
PE	Protective Earth
PF	Power Factor
RFI	Radio Frequency Interference
RTU	Remote Terminal Unit
PTC	Positive Temperature Coefficient
QR	Quick Response
RCB	Remote Control Box
RH	Relative Humidity
SSFC	Solid State Frequency Converter
TCP/IP	Transmission Control Protocol/Internet Protocol
USB	Universal Serial Bus
VFD	Variable Frequency Drive

Pictograms used in manual


General warning sign


Electricity hazard


Crushing of hands


Hot surface


Battery


Electrostatic sensitive devices

Overview of standard Types and Ratings

Type	Rating	Mounting	Part number	Schematic	Input voltage
3GWF-28/400-N	400 A	Fixed	543.355 (DK) 543.351 (DK) 543.347 (DK) 543.343 (DK) 543.302 (US)	443.400	3 x 200V -6% / +15% 3 x 208V -10% / +15% 3 x 230V -10% / +15% 3 x 400V -10% / +15% 3 x 480V ±10%
3GWT-28/400-L	400 A	Mobile	543.356 (DK) 543.352 (DK) 543.348 (DK) 543.344 (DK) 543.303 (US)	443.400	3 x 200V -6% / +15% 3 x 208V -10% / +15% 3 x 230V -10% / +15% 3 x 400V -10% / +15% 3 x 480V ±10%
3GWT-28/600-S	600 A	Skid	543.314 (US)	443.400	3 x 480V ±10%
3GWT-28/600-S	600 A	Skid	543.315 (US)	443.400	3 x 208V ±10%
3GWF-28/600-N	600 A	Fixed	543.353 (DK) 543.349 (DK) 543.345 (DK) 543.341 (DK) 543.300 (US)	443.400	3 x 200V -6% / +15% 3 x 208V -10% / +15% 3 x 230V -10% / +15% 3 x 400V -10% / +15% 3 x 480V ±10%
3GWT-28/600-L	600 A	Mobile	543.354 (DK) 543.350 (DK) 543.346 (DK) 543.342 (DK) 543.301 (US)	443.400	3 x 200V -6% / +15% 3 x 208V -10% / +15% 3 x 230V -10% / +15% 3 x 400V -10% / +15% 3 x 480V ±10%

Note
Other ratings / part numbers may be applicable due to client's specification.

CONTENTS

1.0 Declaration of Conformity

CE

EU Declaration of Conformity

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

We declare under our sole responsibility that the following product type

Designation : 28 V Ground Power Unit.

Type : 3GWx-28/XXX

Description : Power supply unit converting AC-Voltage into a galvanic separated DC-Voltage. The converter is mainly used as external power supply for aircraft.

is in conformity with the following directives:

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

Conformity attained by complying with:

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

Odense, Denmark	30.06.2016	Søren R. Dahl
Place of issue	Date of issue	Søren R. Dahl, Development Manager

799.334 Rev. -

IMPORTANT SAFEGUARDS

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

2.0 Safety Instructions

This unit is only intended to be installed, operated and maintained by qualified 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.
- Only allow qualified people remove covers for maintenance or troubleshooting.

Hot Parts

- Do not touch hot magnetics.
- Allow parts to cool off before performing maintenance.

KEEP THESE INSTRUCTIONS!

3.0 General Description

The figure below shows the basic principle of the ITW GSE 1400 Ground Power unit. The 50/60 Hz mains/utility voltage is rectified and via PWM sent to a galvanic isolated transformer. From the secondary of the transformer it's rectified into a 28 VDC. A functional description of each part is given in the following sections.

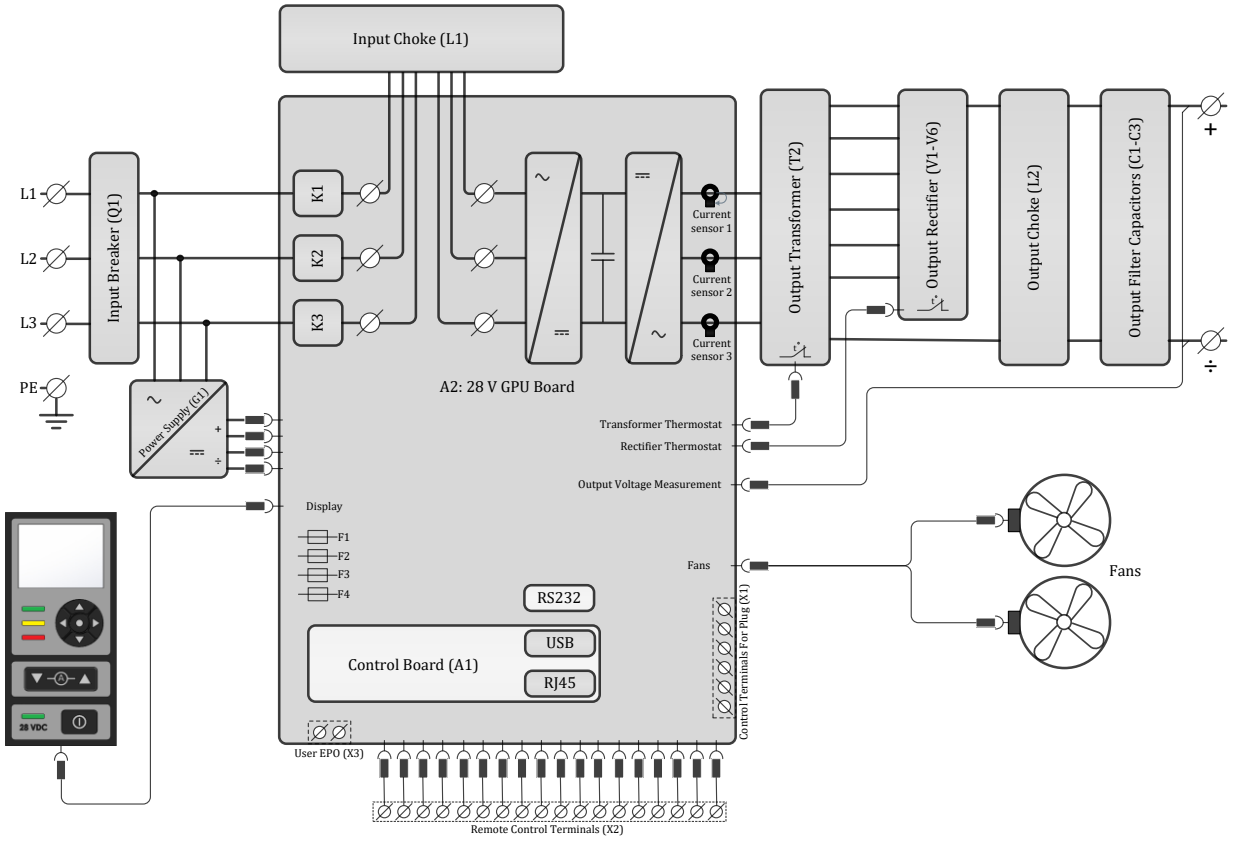
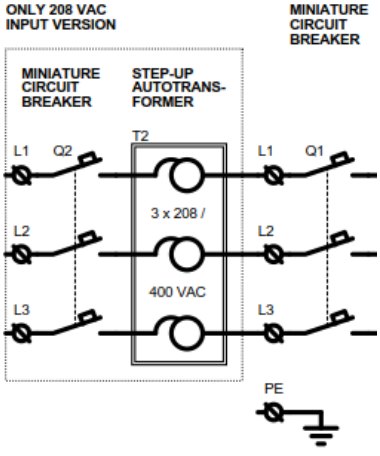


Fig. 3.0.1 - Basic Principle

Input MCB (Q1):
The Input Miniature Circuit Breaker, disconnects all power to the ground power unit. Upon closing the breaker, the ground power unit passes through an initialization test and then into standby mode. If the input breaker is overloaded (40 A / 50A) it automatically disconnects the main supply.

Input MCB (Q2):
If the unit is supplied with input transformer, the input section is equipped with additional MCB Q2 (80A / 100A).
(shown with 208 V input Step-up transformer)



Input Choke (L1):
The input filter choke primary is fed from the 28 V GPU Board (X9) and the secondary is connected back to the board (X10).

28 V GPU Board / Inverter Module (A2):

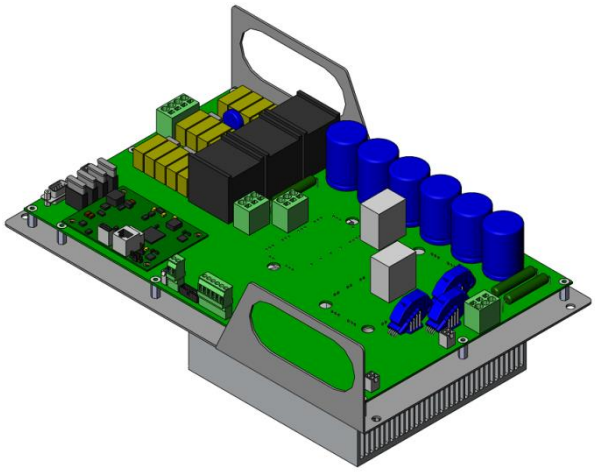


Fig. 3.0.2 - 28 V GPU Board / Inverter Module

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 Emergency Stop) (X6)
- Fuse (F1) for FANS M1 – M2 (X13)
- Fuse (F2) for INTERFACE
- Fuse (F3) for Display Board (A3) and Operator Keyboard (A4)
- Fuse (F4) of the 24 VDC for I/O connections.
- User EPO input (X3).
- Output voltage feedback (X4)
- Unique EEPROM (A6) identity key connection (X5)
- Interface for IGBT's Q6 situated at the Heat Sink.
- Input for temperature sensors (X12).
- I/O ports for remote control (Start, Stop etc.), single output (X2) when installed.
- I/O ports for remote control (Start, Stop etc.), second output (X2) when installed.
- Protected interface for interlock signals.
- Input RFI filters to reduce the EMI/EMC emission into the mains/utility to such a level that surrounding equipment is not disturbed. In addition, the filter prevents voltage transients from reaching vital parts in the ground power unit.
- EPO Contact Function
- Input & output for L1
- Soft Start via R98 / U16 and the half controlled rectifier bridge
- Input Rectification
- DC Capacitors
- Inverter
- Current sensors (C31 – C33)

Output Transformer (T1):
The output transformer ensures galvanic separation between input and output. It also transforms the voltages from the Inverter Module into the required level for the output rectifier.

Output Filter Choke & Output Filter Capacitors (L2 & C1):
The output ripple is reduced to < 2% (RMS) at full load by the filter choke (L2) and the capacitors (C1) located after the output rectifier.

Supply Module (G1):
The generation of the 24 VDC / 10 A (Adjusted from factory = 25 Volt) regulated control voltage is done by the Supply Module G1. This module has a wide input range (340-575 VAC). The output from G1 is lead to 28 V GPU Board (X7).

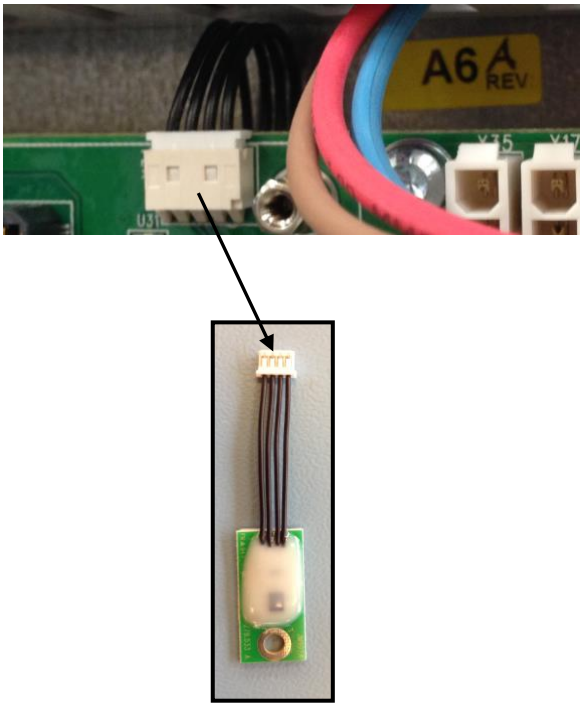
Control Board (A1):
The Control Board is based on a micro-controller. It regulates, supervises and diagnoses possible external and internal faults. As soon as the ground power unit is connected to the mains/utility, and constantly during normal operation, the Control Board runs through a self-check program 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 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 and can be placed up to 100 m away from the unit, when using the Remote Control Box. Furthermore, the display module includes a USB connection, which can be used to download the Black Box and the Power Log and for update of the display software.

ID Chip (A6):

The ID Chip is connected to interface board A2 and is fixed to the I/O zone plate.
It contains information on the GPU configuration and stores all setup values, black box and power log records.



3.1 Built in features / protections

Over/under voltage at input:
The input voltage supervision is based on the rectified DC. The supervision ensures that the unit does not trip even in case of an abnormal low input voltage level. This of course presupposes that the 28 VDC output level and quality required by the aircraft can still be maintained. If the internal 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 > 40 V – 150 ms
Output Voltage U > 32 V – 4 seconds
Output Voltage U < 20 V – 4 seconds

Overload Protection:
Current exceeding > 100% (400 A/600 A depending on model) for more than 60 seconds will result in unit tripping and report overload failure 4000 (failure code) as per rating below.

400 A Rating	**600 A Rating**
> 400 A for 60 seconds	> 600 A for 60 seconds

Note
For operating / maximum current limit information, see section 6.1 / 6.2 & 7.3
For Fault Guidance, see section 9.1

Short circuit at output:
The unit has a built-in system to protect itself and the output cables, if the unit's 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/output rectifier module, rises above the factory set temperature level, the unit shuts down, reporting either:
"***INVERTER TEMP TOO HIGH***"
"***TRANSFORMER TEMP TOO HIGH***"
"RECTIFIER TEMP TOO HIGH"

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

Aircraft Connector Insertion:
This feature verifies that the 90% switch in the 28 VDC plug is activated. If not activated, the unit is blocked from operating.
How to bypass/activate the function, see section 6.3 and 7.8
For detailed information/connection, see section 4.10

4.0 Transportation 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 Disposal of packaging material

The ITW GSE 1400 Ground Power Unit is supplied with cardboard, plastic and wooden packaging. These materials can be recycled and must be disposed according to the applicable laws and regulations in each country. All wood used in the packaging of the ITW GSE 1400 are in compliance with ISPM-15 and is not subjected to any chemical conservation treatment.

4.3 Disposal of unit (end of life)

All ITW GSE products are marked with the crossed-out wheelie bin symbol, and state the date of manufacture on the nameplates/rating plates in accordance with EU Directive 2012/19/EU on waste electrical and electronic equipment (WEEE).

The Directive states that electrical and electronic equipment (EEE) on reaching the end of its life must not be disposed of as unsorted municipal/local waste. WEEE must be disposed of at appropriate collection points and not in the normal waste stream. WEEE covers all EEE used by consumers and EEE intended for professional use.

The ITW GSE 1400 consists of metal (steel plates), non-ferrous metals (copper and aluminium), electronic components (PCBs, capacitors, fuses, chargers, MCBs and contactors), wires and cables.

Non-recyclable materials must be disposed of according to applicable environmental laws and regulations in each country. The waste and recycling service providers must be properly authorised by national environmental agencies to carry out these activities.

4.4 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.

4.5 Transportation and Mounting

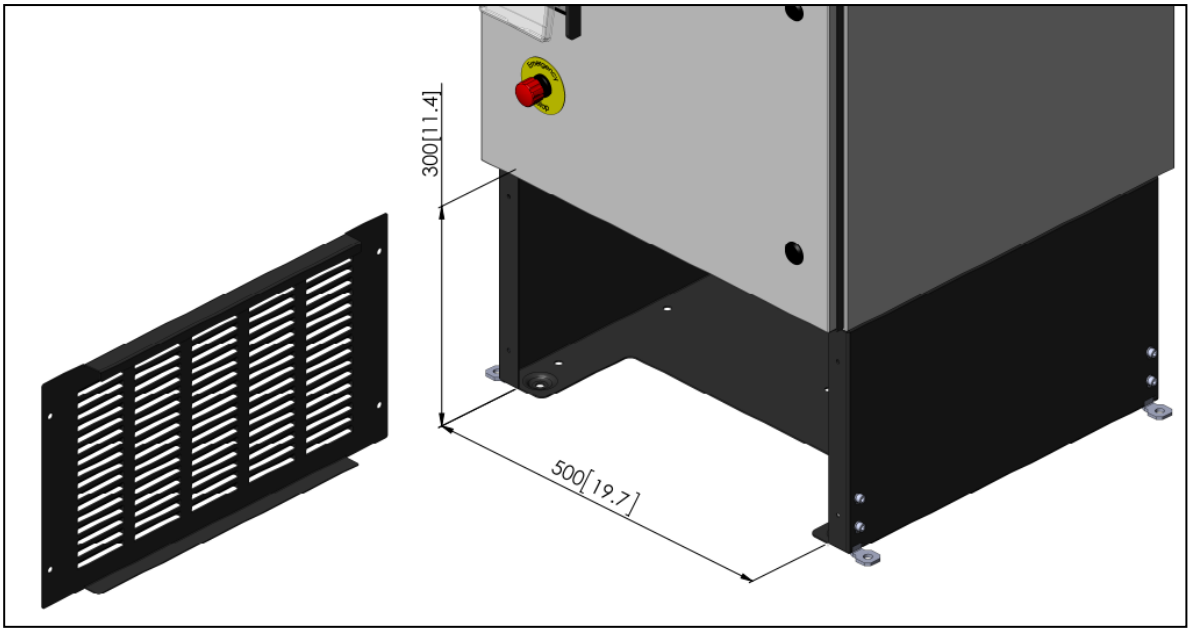
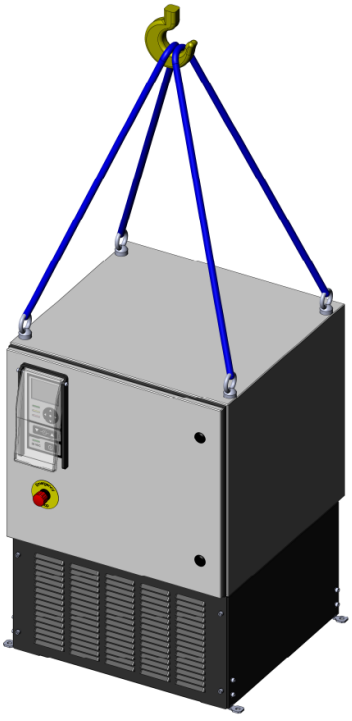


Fig. 4.5.1 - Access for fork-lift, truck or similar
The access requires removal of 4 screws.



Adequate lifting gear is not part of the delivery.

Fig. 4.5.2 - Lifting with crane
(Place M10 lifting rings at the 4 corners)

4.6 Installation and fastening instructions

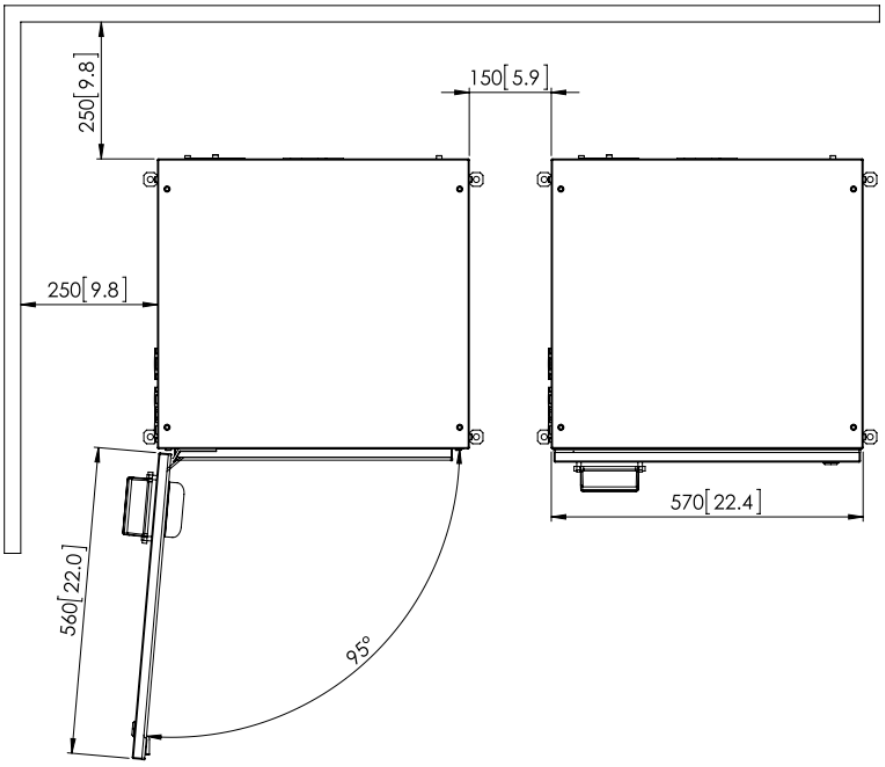


Fig. 4.6.1 - Footprint & spacing, fixed unit

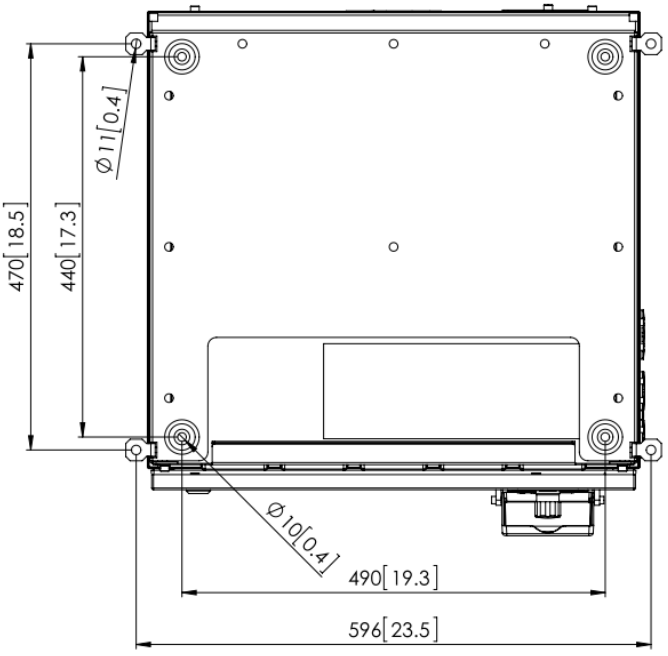


Fig. 4.6.2 - Mounting holes, fixed unit

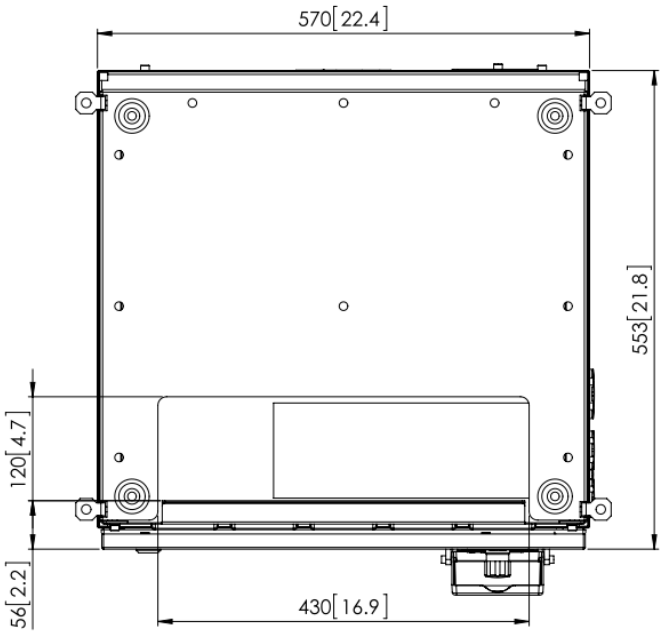


Fig. 4.6.3 - Cable entry point in base module

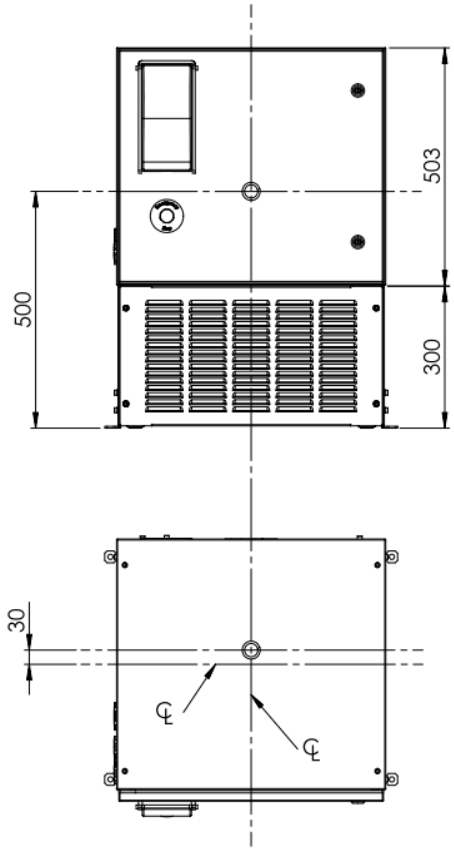


Fig. 4.6.4 - Centre of gravity

4.7 Connection of Cables

X1/ X3 is standard (X2 is optional)
Standard Remote I/O terminals
(refer to **section 4.10** for connection of I/O terminals)

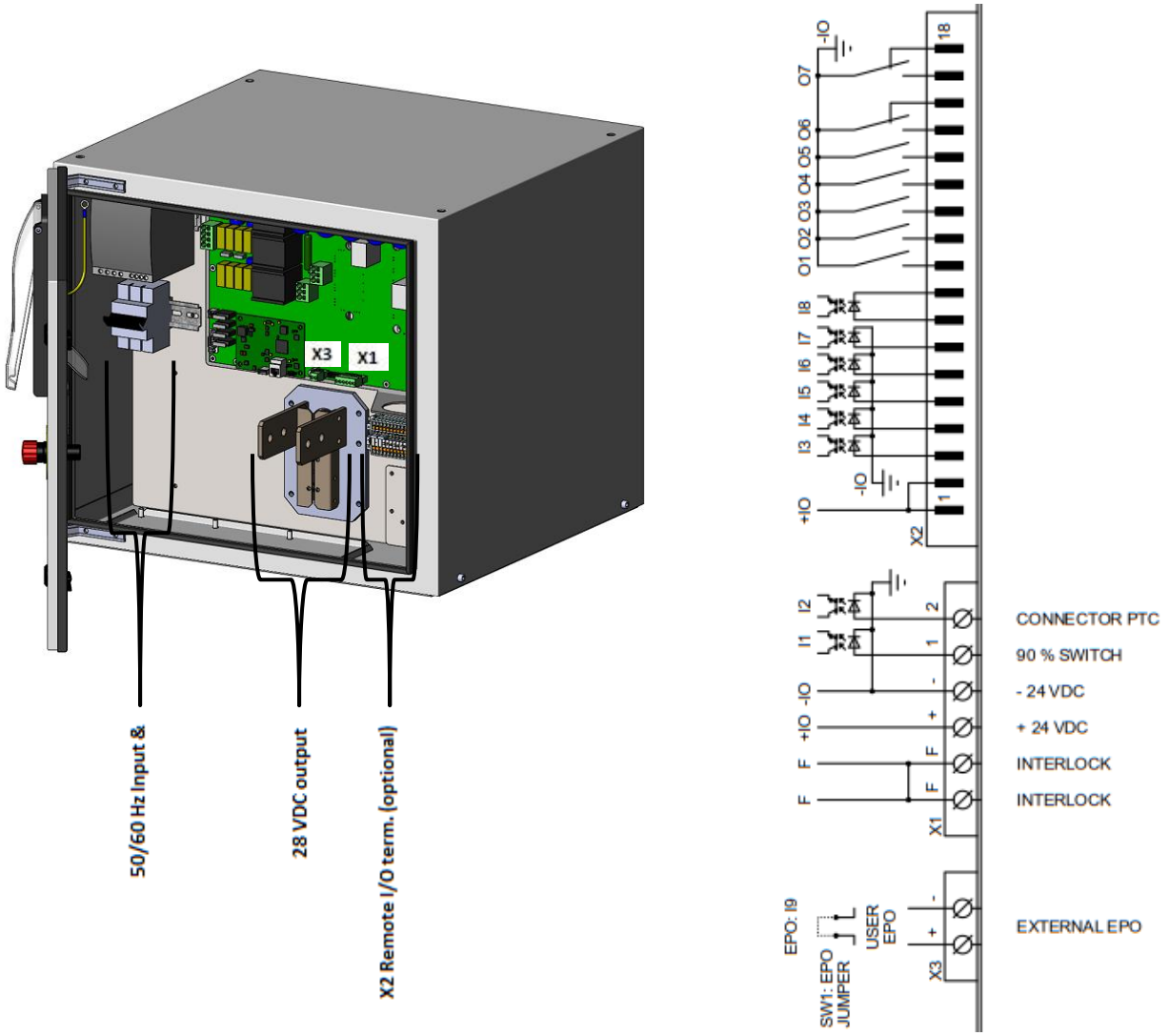


Fig. 4.7.1 - Connection of cables

50/60 Hz Input terminals:	3 x 35mm² (Solid) or 3 x 25 mm² (Flexible) (L1–L2–L3) 1 x 2.5 – 25 mm² terminal (PE) 1 x 1.5 – 16 mm² terminal (N)
28 VDC Output terminals:	8 x M10 (4 x Plus / 4 x Minus terminals)
Terminals X1 / X3:	6 x 2.5 mm² / 2 x 2.5 mm²
Remote I/O terminals X2 (Optional):	18 x 0.4 - 4 mm²

Note
In cases, when the unit is equipped with alternative input voltage (special input transformer), the input cables are connected to the additional input MCB Q2.

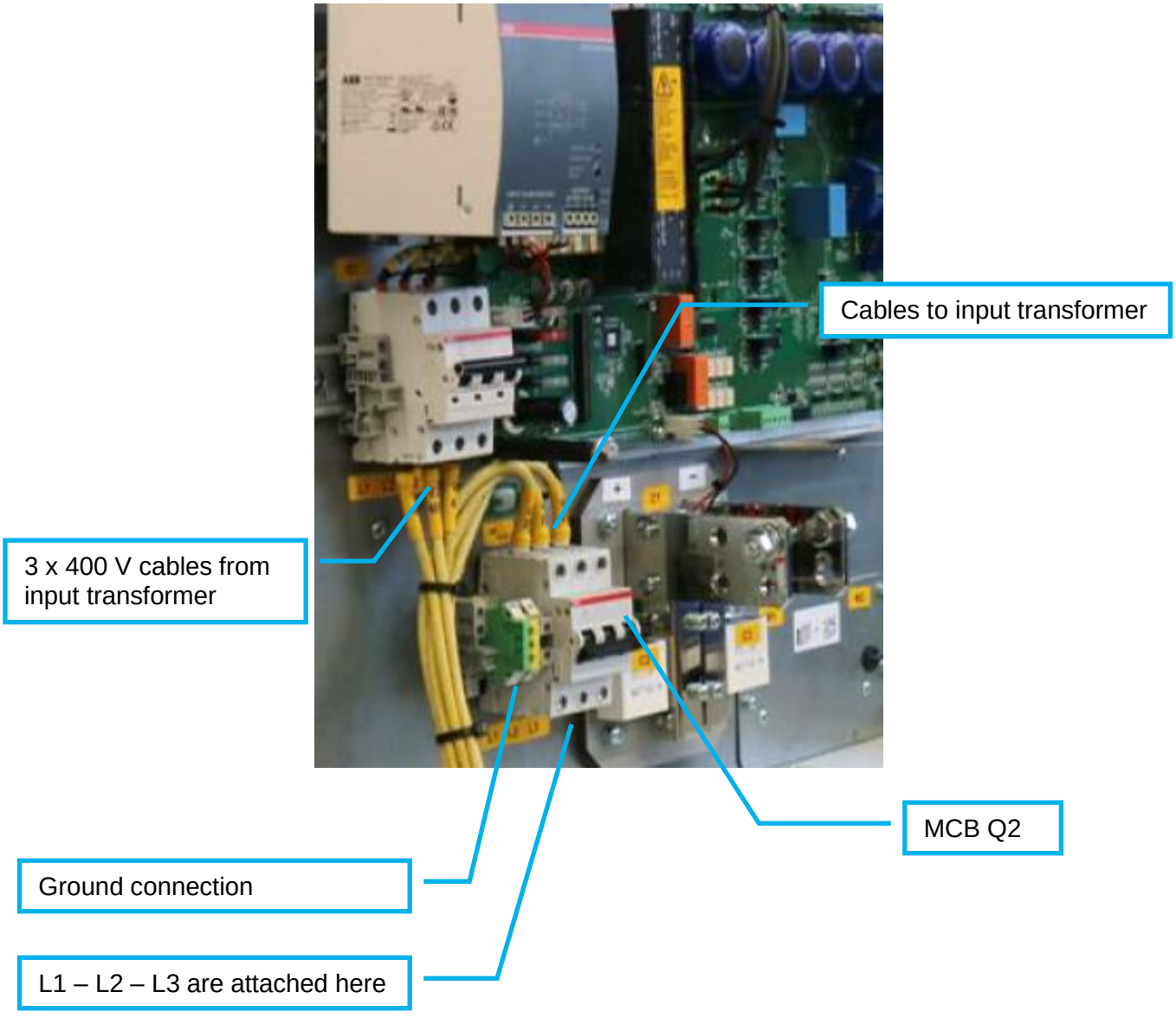


Fig. 4.7.2 - Connection of cables (with input transformer)

4.8 Mains/utility Input

Due to personal health and safety, the ITW GSE 1400 unit must always be protected by grounding the PE terminal (⏚).

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

Rating	**400 A**	**600 A**
Line Current @ 208 V	36 A	54 A
Recommended Fuse Size	80 A	100 A
Maximum Fuse Size	125 A	125 A
Line Current @ 400/480V	19/16 A	28/23 A
Recommended Fuse Size	35 A	50 A
Maximum Fuse Size	63 A	63 A

Due to the RFI filter at the input, the leakage current for the ITW GSE 1400 is > 135 mA.

4.9 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 X1:F.

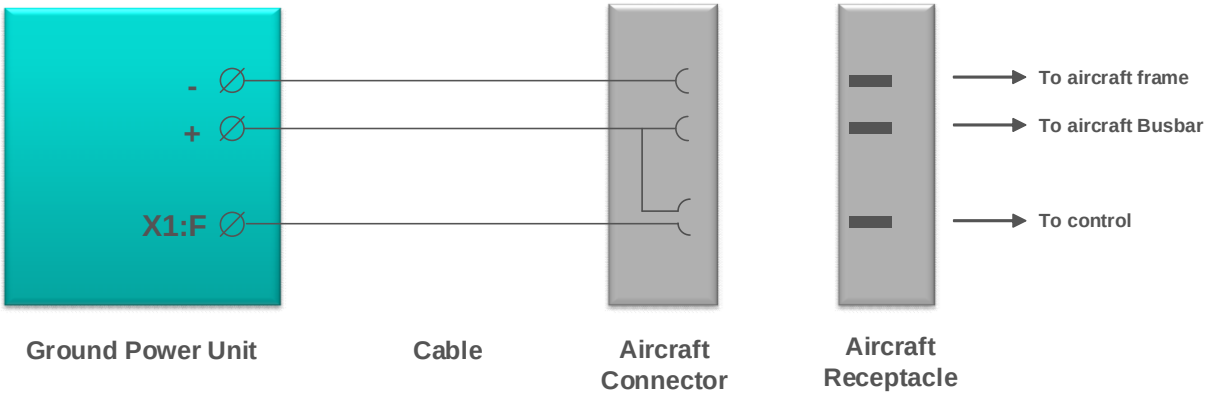


Fig. 4.9.1 - Standard wiring diagram

For service, maintenance and test purposes, the interlock system can be By-Passed / Disabled 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 X1:F. E.g. when the plug is connected to an aircraft.

4.10 Control Interface (Remote I/O Terminals)

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

- External Emergency Stop (EPO).
  The external EPO input A2:X3 is a 24 VDC input, either by using the internal 24 VDC supply or an external 24 VDC voltage. The SW1 "EPO JUMPER" (lower centre of the A2 Module) is then removed. Refer to Fig. 4.8 for connection.
- Interlock F Pin.
- External Start/Stop 1, Start/Stop 2. Remote Start/Stop must be N.O. **(Optional).**
- Aircraft Connector Insertion in aircraft connector **(Optional).**
  The 90% switch (N.O. contact set) in the aircraft connector is supplied with +24 VDC from the ITW GSE 1400. The voltage is returned once the plug is inserted at least 90% of the way into the aircraft receptacle.
- Aircraft Connector temperature supervision **(Optional).**
  The 2 x PTC resistors in series (one for each power pin) is supplied with +24 VDC from the ITW GSE 1400. They return a high signal (+24 VDC) to the input as long as the plug temperature is below the PTC resistors cut-off value.
- Indications, lamps for Output ON 1, Output ON 2, GPU Ready & Common Error, which could be relevant, as Start/Stop is momentary **(Optional).**

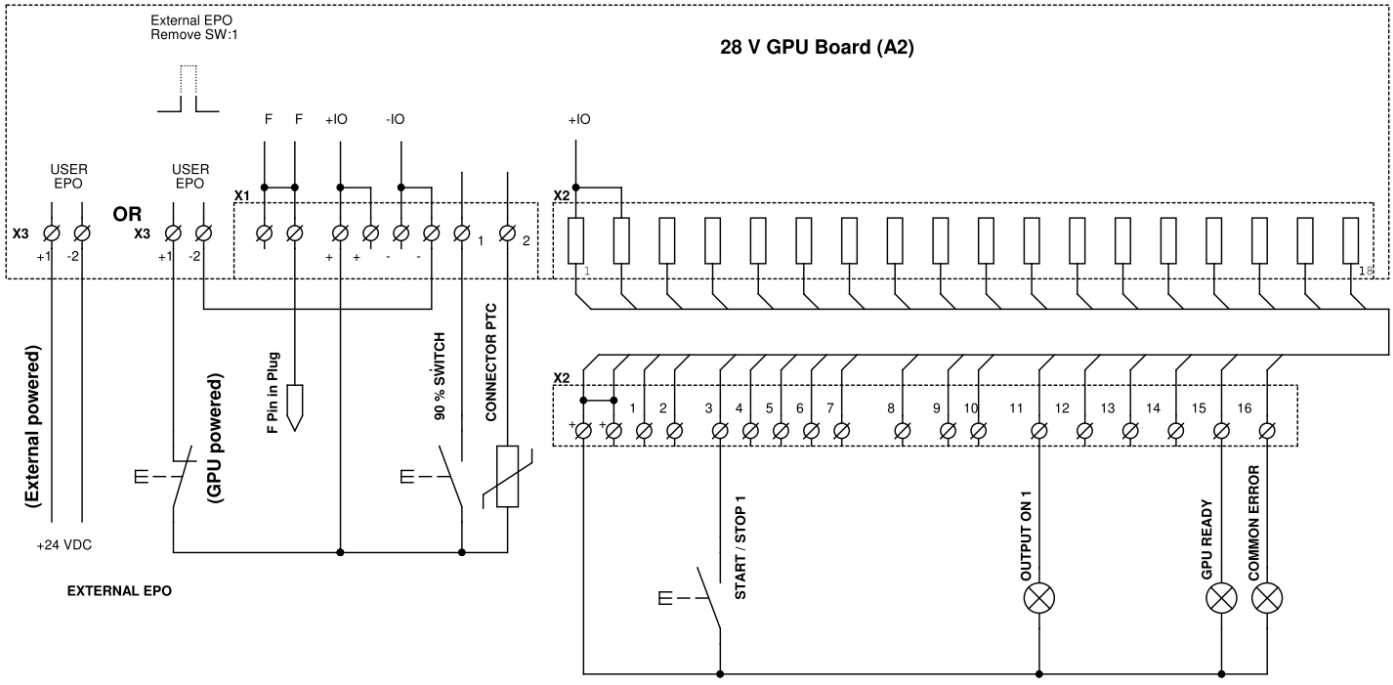


Fig. 4.10.1 - Example of wiring for external control via the I/O terminal

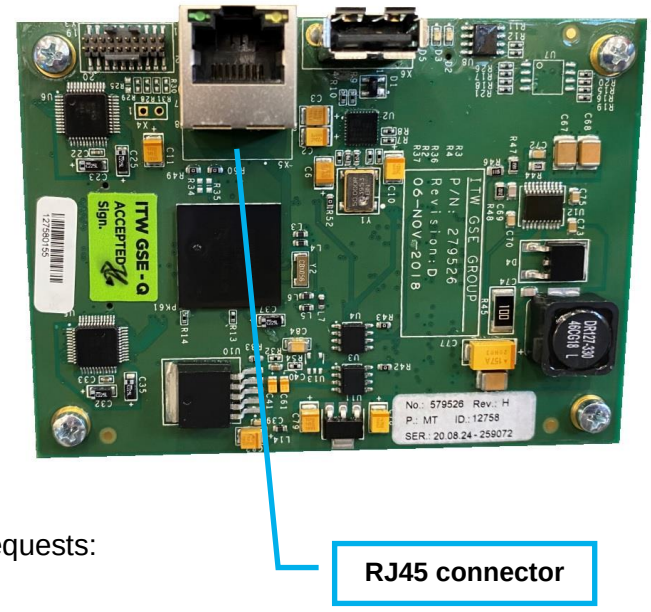
Note!

Input Logic high = 16 - 32 VDC & Output Contacts Vmax = 50 V AC/DC and Imax = 2 A

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

4.11 TCP/IP On-board Interface

The ITW GSE 1400 is equipped with a TCP/IP (RJ45) communication port for supervision and monitoring of the GPU by the means of a central computer, for example. The port is located on the Control Board (A1).



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

Supported Modbus Function Codes

The ITW GSE 1400 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 shutdown.
    - The Power log, which contains the time in use and the power consumption for the last 100 operations.

Note!
Refer to chapter 6.3 for communication set-up.

5.0 Technical Specifications

Standards:

ISO 6858:2017(E)	Aircraft ground support electrical supplies - general requirements
BS 2G 219	General requirements for ground support electrical supplies for aircraft
MIL-704F	Aircraft electric power characteristics
EN 1915- 1&2	Machinery – General safety requirements
EN 12312-20	Machinery – Specific safety requirements
EN60204-1	Machinery – Electrical safety
EN 62040-1-1	LVD – Safety standards
EN 61558-2-6	LVD – Safety standards
EN 61000-6-2	EMC – Immunity standards
EN 61000-6-4	EMC – Emission standards

Solid State Ground Power Unit:

Input:

Voltage	3 x 400 -10/+15% / 3 x 480 ± 10% or according. to customers spec.	
Frequency	50 / 60 Hz ± 5 Hz	
Rectification	6-pulse	
Rating	400 A	600A
Line Current	19/16 A	28/23 A
Maximum Fuse size	63 A	63 A
Line Current Distortion	41 %	33 %
Power Factor @ nom. load	0.90	0.91
Inrush current	None, soft start	

Output:

Nominal Output Voltage	28 VDC
Output Current	600 A continuously (400 A)
Output ripple	< 2 % (RMS)at full load
Voltage regulation	< 0.5 % from no load to full load
Transient performance	Acc. to MIL704 & ISO6858
Voltage Compensation	3 V @ 600 A (400 A), manual or voltage feedback via Interlock
Engine Start capability	28 V @ 2000 A (Nominal input voltage)

Overload Capacity	**400 A**	**600 A**	
	> 400 A – 800 A	> 600 A – 1200 A	for 60 seconds
	> 800 A – 1200 A	> 1200 A – 1800 A	for 30 seconds
	> 1200 A – 1400 A	> 1800 A – 2100 A	for 10 seconds
	> 1400 A – 1600 A	> 2100 A – 2400 A	for 5 seconds
	> 1600 A, maximum	> 2400 A, maximum	for 2 seconds

Efficiency:

Overall efficiency	0.87
Stand-by losses	130 W
No-load losses	330 W

Protections:

Input over-and under voltage
Control voltage error
Internal high temperature
Output over-and under voltage
Overload at output
Short circuit at output
Prepared for 90% switch in aircraft connector
Prepared for temperature switch in aircraft connector

Physical:

Dimensions	Please refer to the outline drawing at following pages
Weight	
Fixed	120 kg (265 pounds)
Mobile	240 kg (529 pounds)

Environmental:

Storage temperature	+10 to +35°C (50 F to 95 F) / 20 to 70% RH
Operating temperature	-40°C to + 56°C (-40 F to 133 F)
Relative humidity	10-100 % non condensing
Noise level	< 65 dB (A) @1m
Ingress protection	IP55 / IP23 (electronic zone / other)

Miscellaneous:

Colour	RAL 7035 / 9005 standard, other colours on request
MTTR	Max. 20 minutes

Fixed

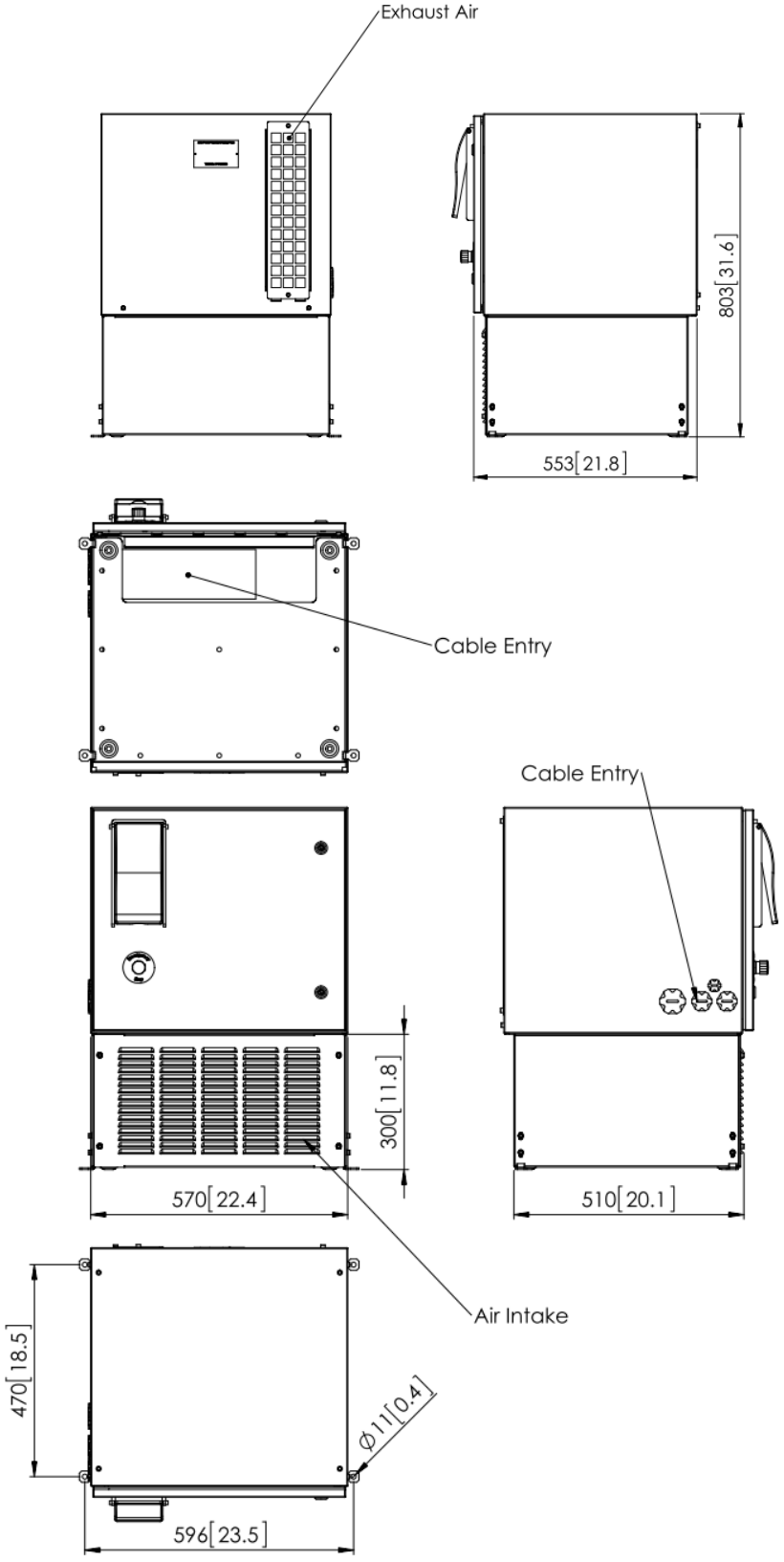


Fig. 5.0.1 - Fixed unit

Mobile

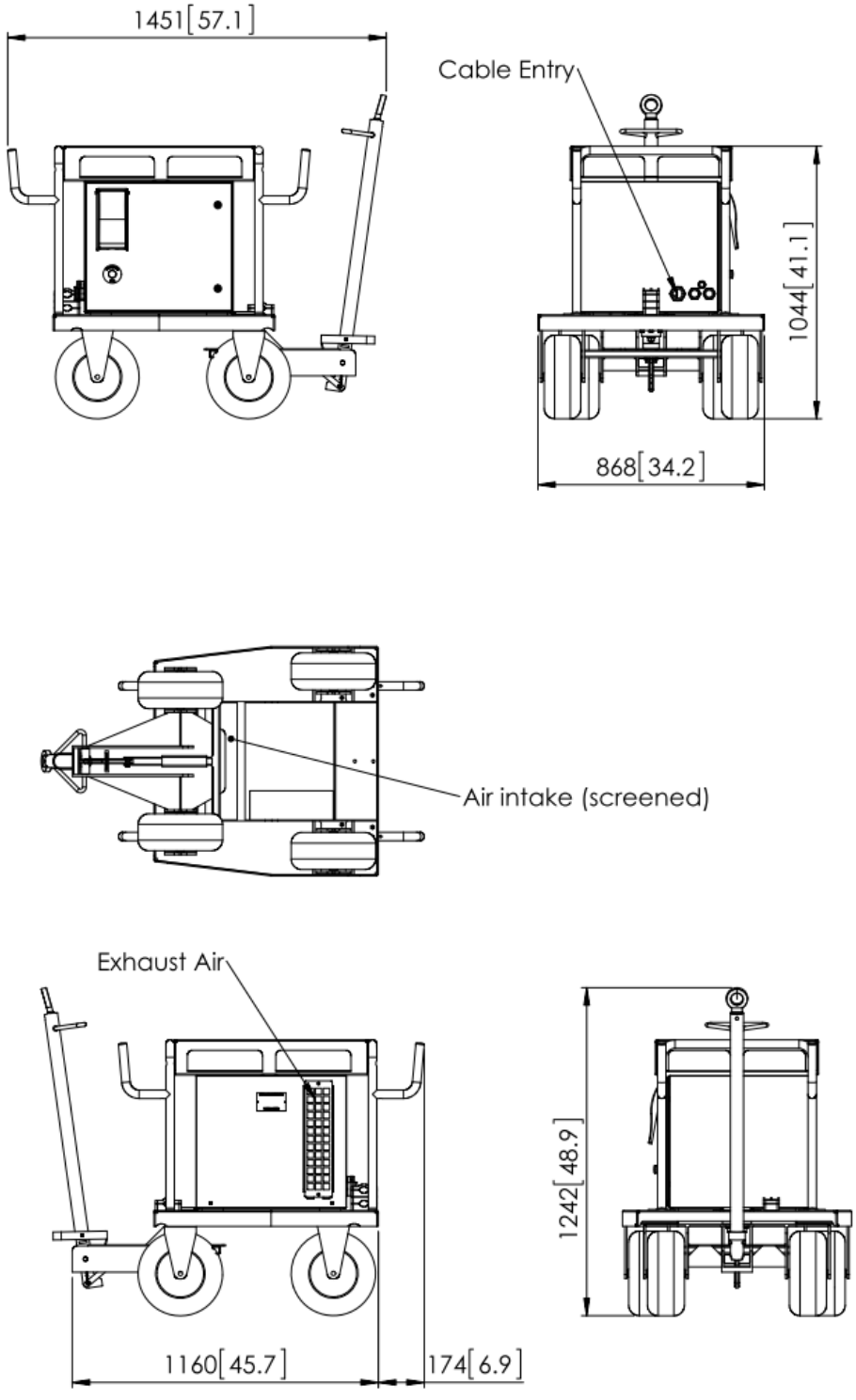


Fig. 5.0.2 - Mobile unit

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

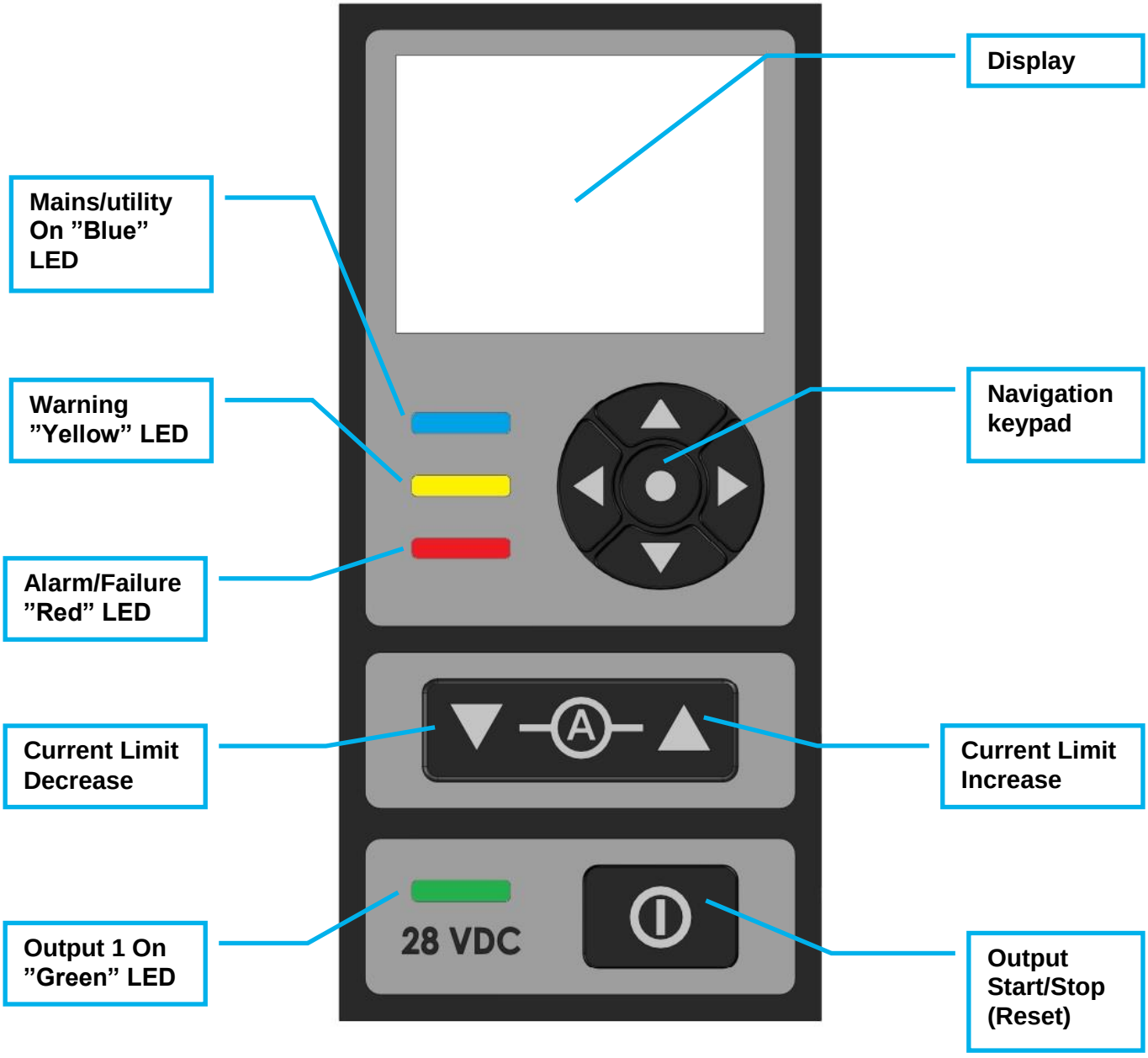


Fig. 6.0.1 - 28 VDC Operator panel layout

Note.
Warning may arise during operation on following issues:

EF signal missing
90% signal missing

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 and provides information during operation, service and 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.

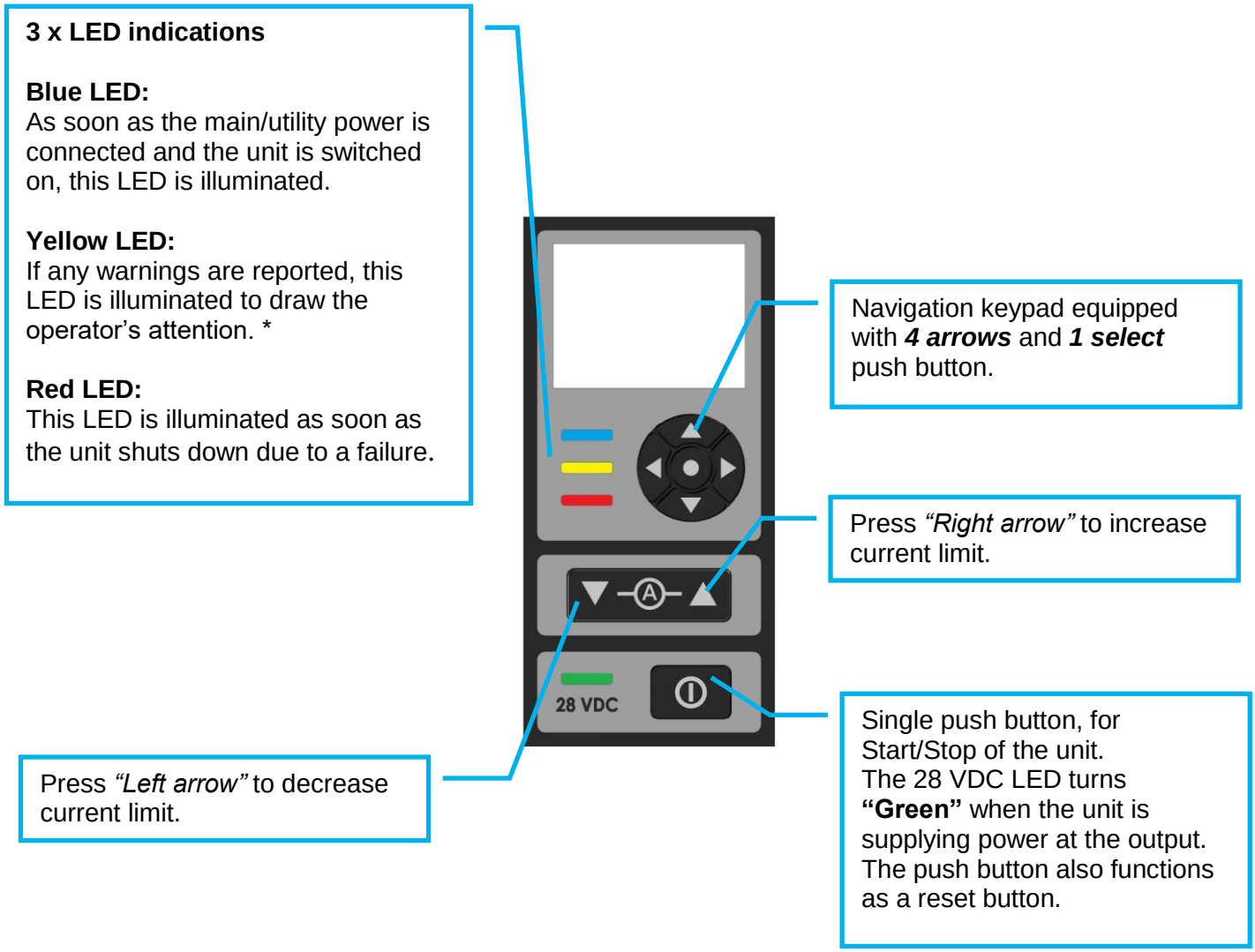


Fig. 6.1.1 - Display / Operator panel

6.2 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 Version) / 300 Amp* (600 A version) using the button  depending on the rating of the GPU:

- Depending on the rating of the GPU:
  400 A rating e.g. 200 to 1600 Amp (in selected increment step*)
  600 A rating e.g. 300 to 2400 Amp (in selected increment step*)

  *****Increment steps can be set via the set-up menu.

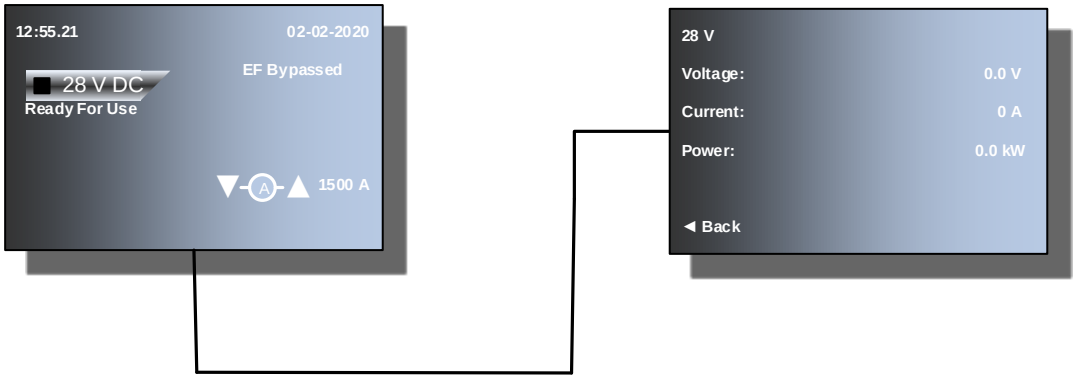
  Note
  Current limit is adjusted by using the arrows shown at figure 6.1.1.
  Pressing the Start/Stop button stores the selected Current Limit.

  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% 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 during operation 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

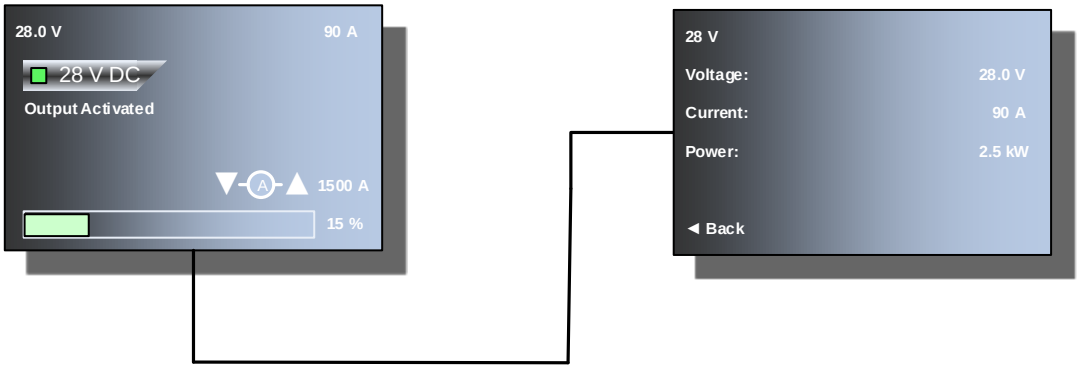


Use the ▼/▲ to browse through the various screens.

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

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

Default Display Screen Operating



Use the /▲ to browse through the various screens.

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

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

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

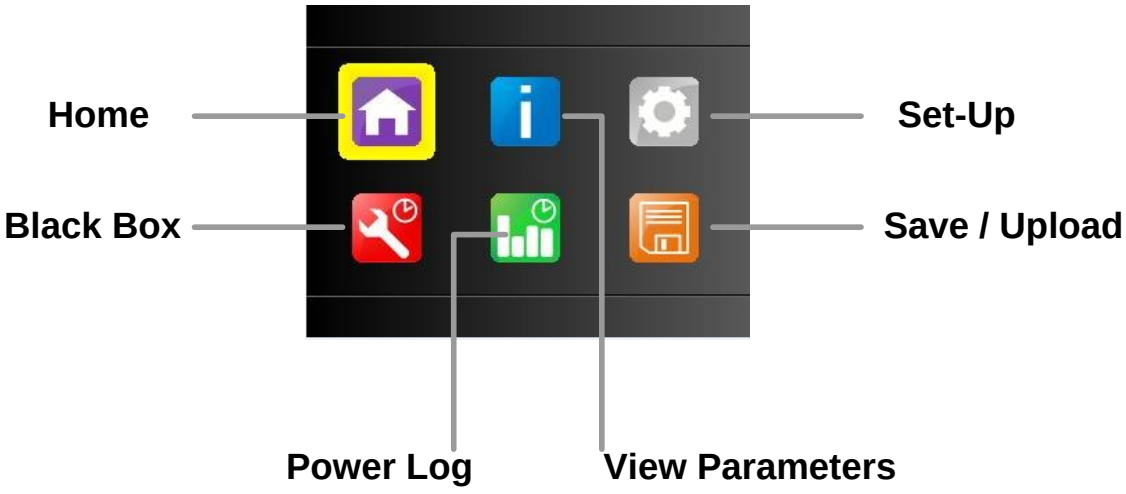
  Press the Start/stop button 

- 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.

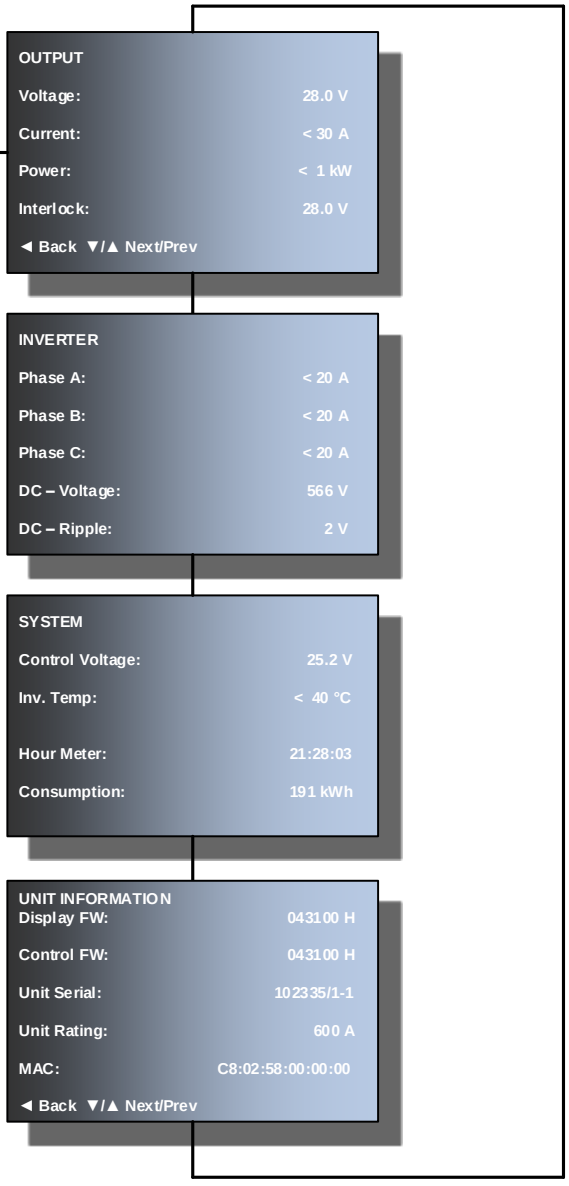
To Select a sub-menu, simply use the navigation keys ◄▼▲► to highlight the icon and then press the ● to enter the sub-menu.

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 software

6.3.1 Parameters – Menu structure



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

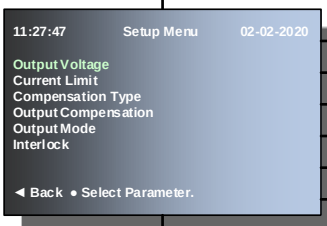
Press ● to select "View parameters" sub-menu.

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

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

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

6.3.2 Setup – Menu structure



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

Press ● to select "Setup" sub-menu.

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

Press ● to select the parameter you want to change.

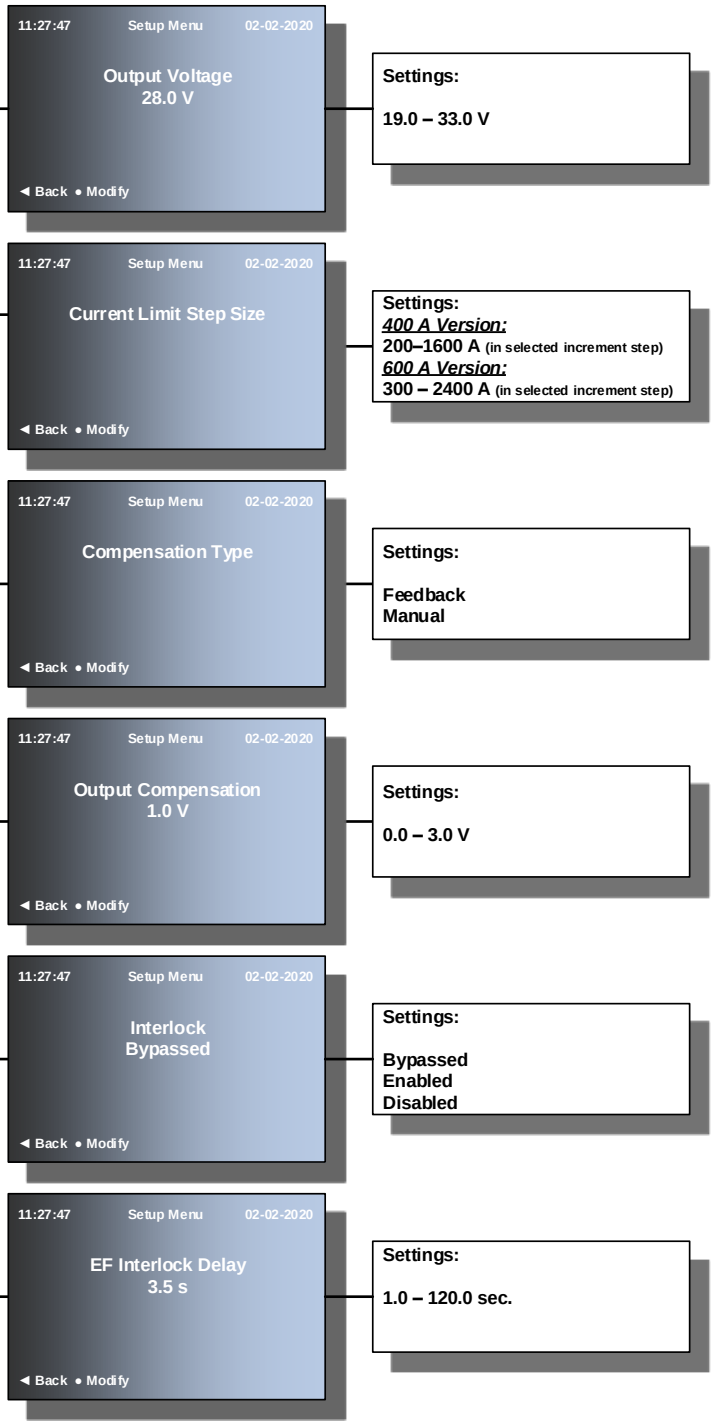
Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the ▼/▲ to adjust parameter.

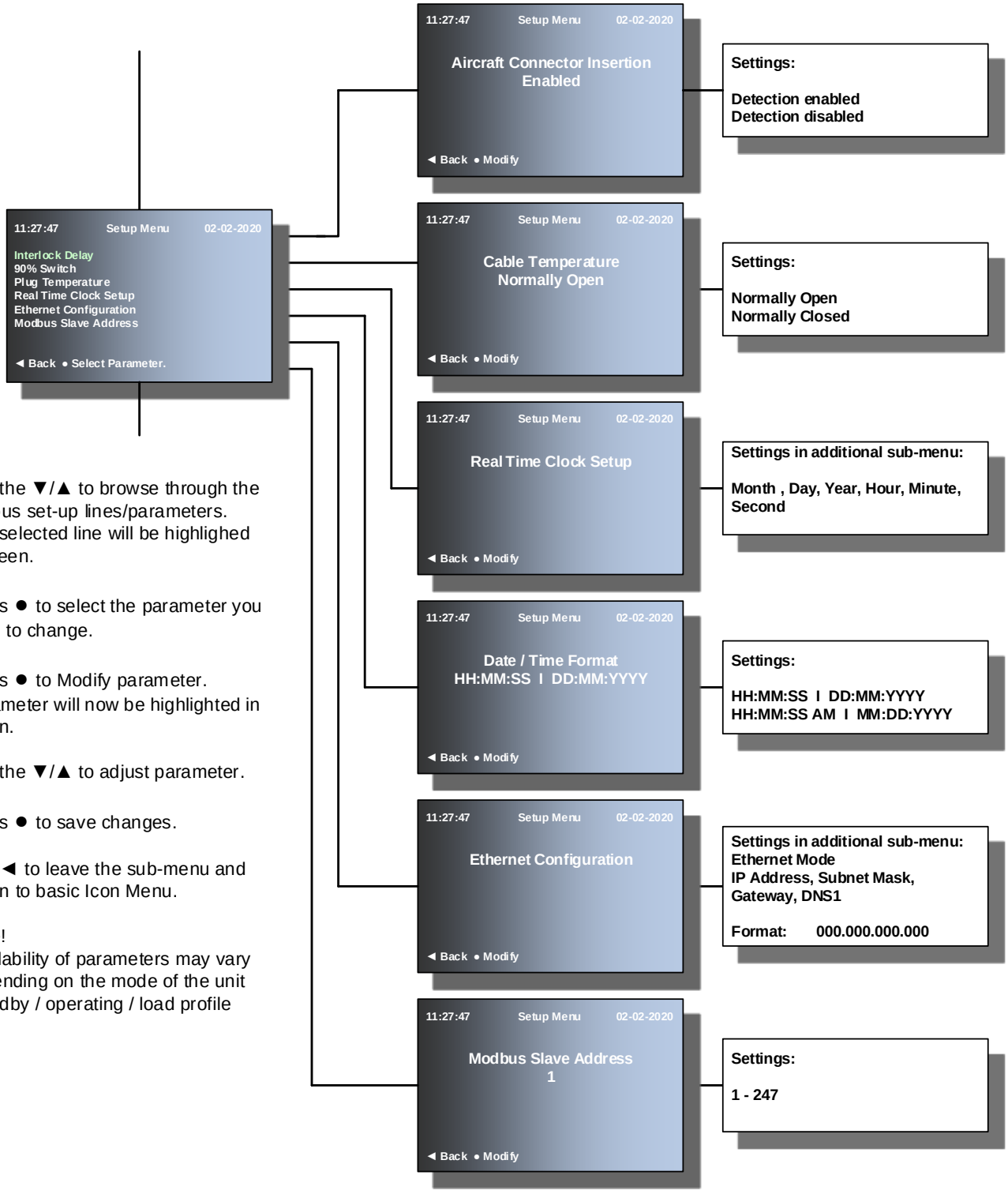
Press ● to save changes.

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

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



Setup – Menu structure (continued)



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

Press ● to select the parameter you want to change.

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

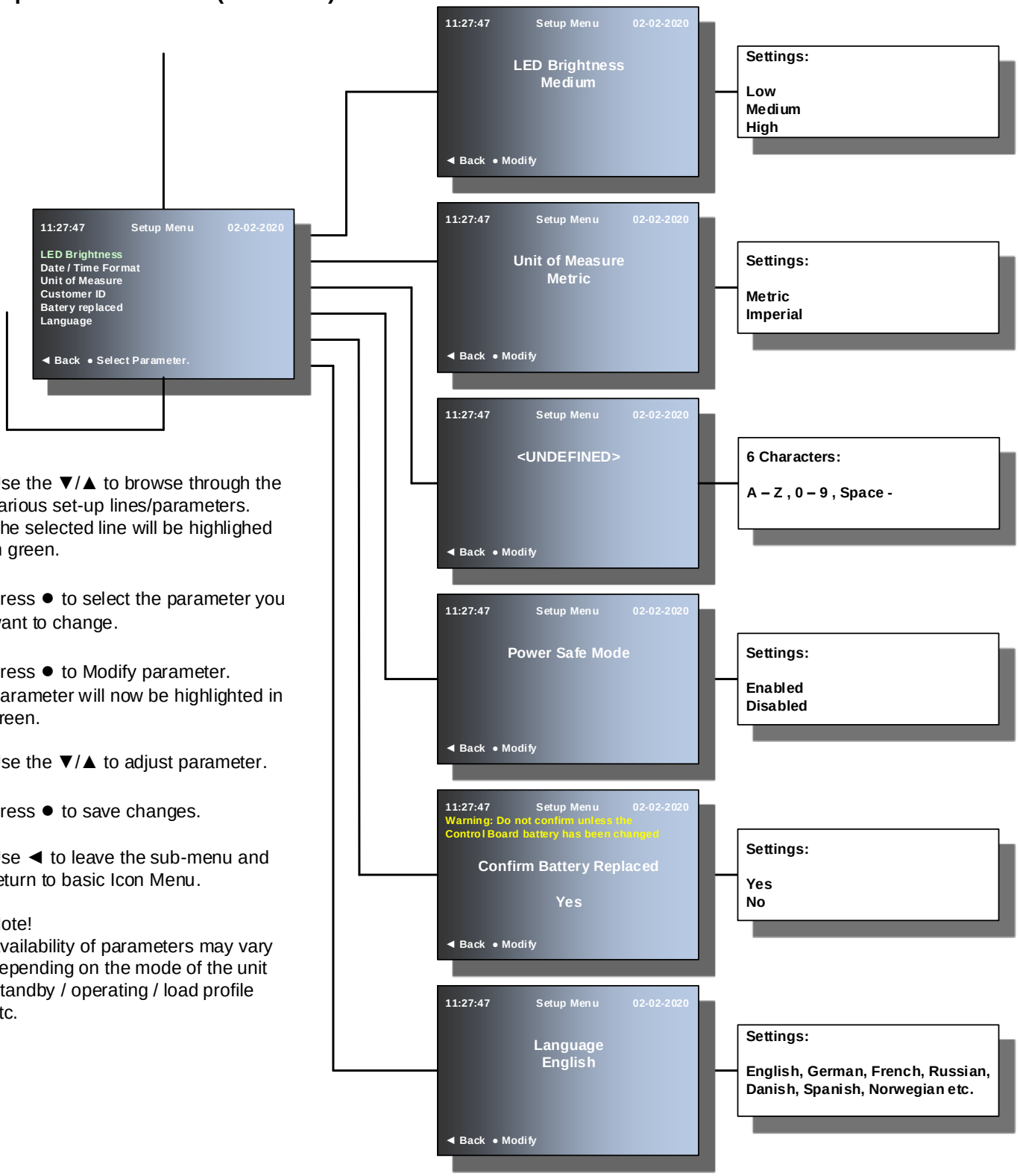
Use the ▼/▲ to adjust parameter.

Press ● to save changes.

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

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

Setup – Menu structure (continued)



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

Press ● to select the parameter you want to change.

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

Use the ▼/▲ to adjust parameter.

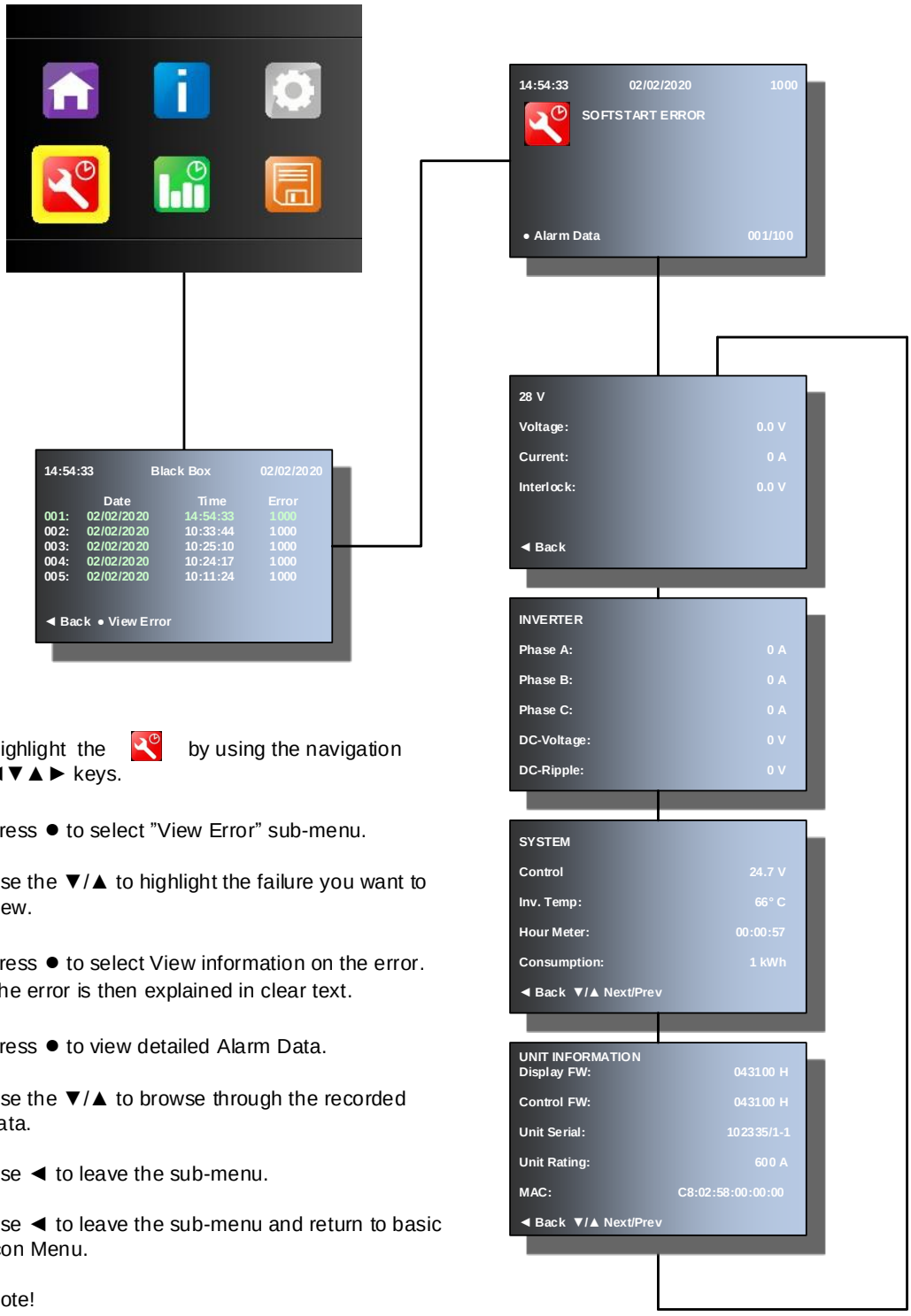
Press ● to save changes.

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

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

Note!
Values changed in the setup menu are not stored in non-volatile memory before you exit the setup menu. If you disconnect power to the unit without first exiting the setup menu, any changes will be lost.

6.3.3 Black Box – Menu structure



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

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

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

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

Press ● to view detailed Alarm Data.

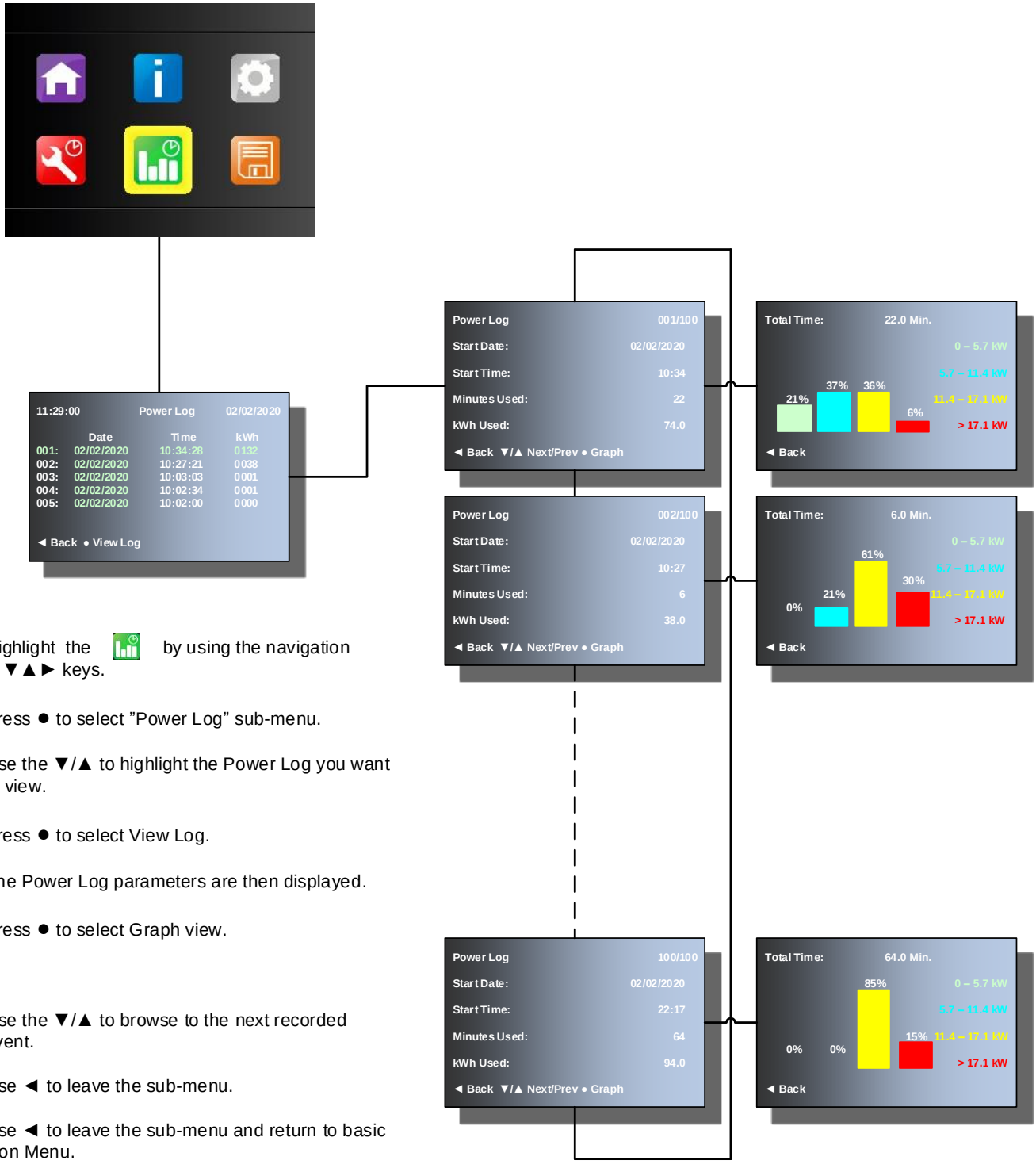
Use the ▼/▲ to browse through the recorded data.

Use ◄ to leave the sub-menu.

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

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

6.3.4 Power Log – Menu structure



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

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

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

Press ● to select View Log.

The Power Log parameters are then displayed.

Press ● to select Graph view.

or

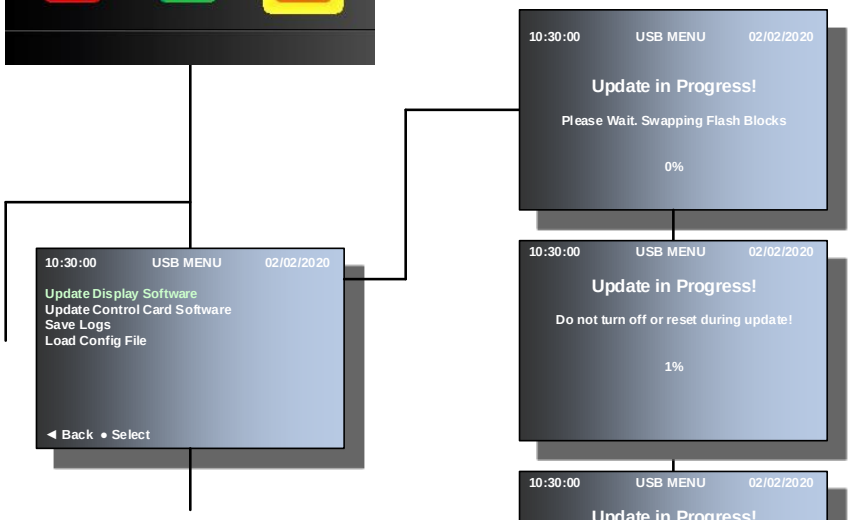
Use the ▼/▲ to browse to the next recorded event.

Use ◄ to leave the sub-menu.

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

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

6.3.5 Update Software / Save Logs / Load Config File



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

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

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

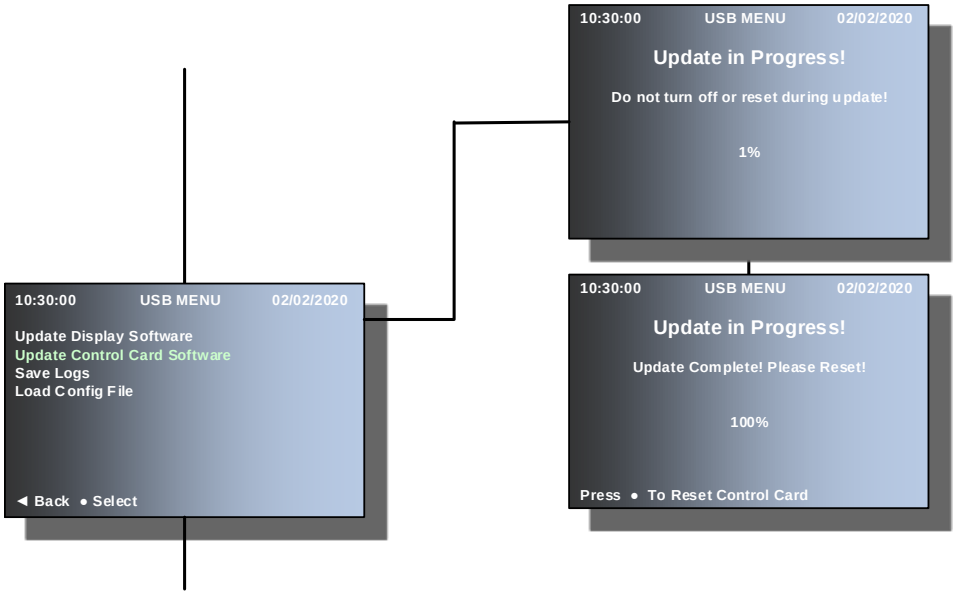
Before pressing ● to select "Update Display Software", please remember to insert a USB stick into the USB port on the Display (located on the back of the front door).

Press ● to select function and update firmware.

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

To Reboot the unit, press ● button.

Update Software / Save Logs / Load Config File (continued)



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

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

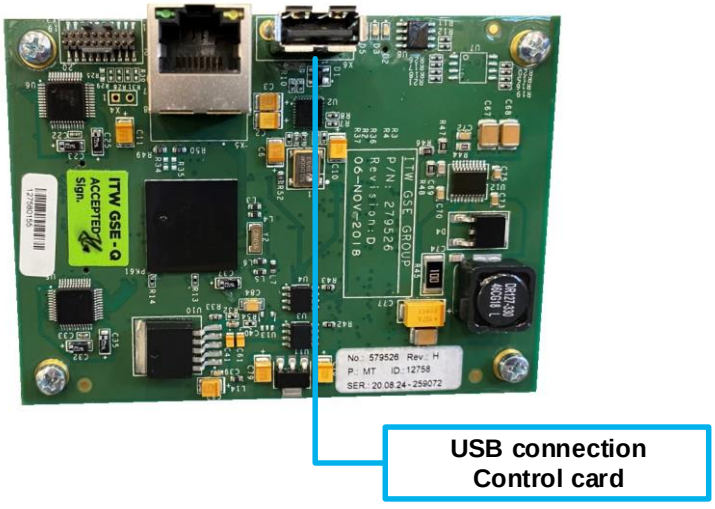
Use the ▼/▲ to highlight the function "Update Control Card software".

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

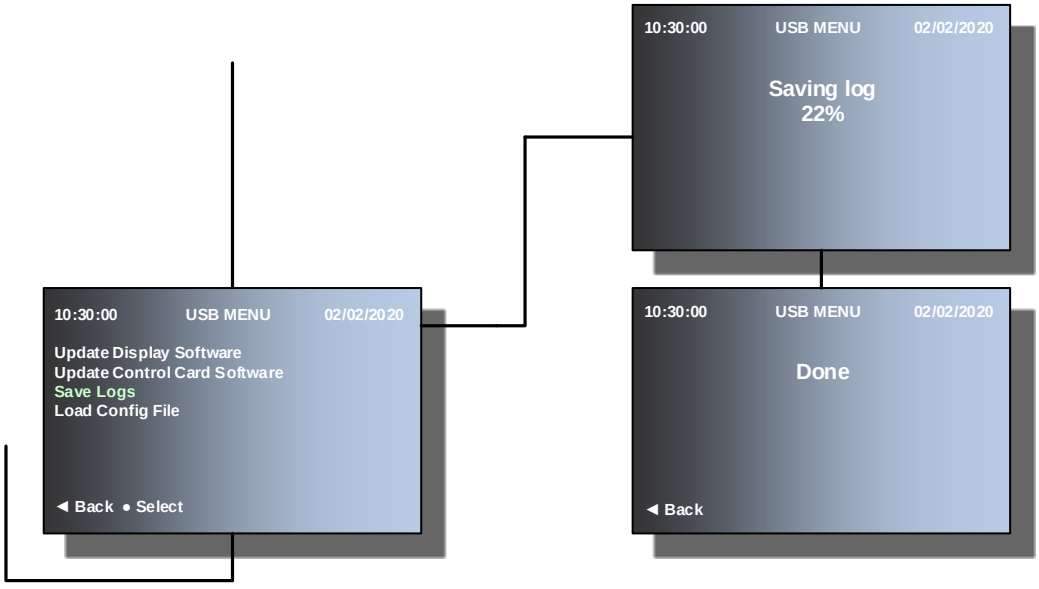
Press ● to select function and update firmware.

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

To Reset the unit, press ● button.



Update software / Save Logs / Load Config File (continued)



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

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

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

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

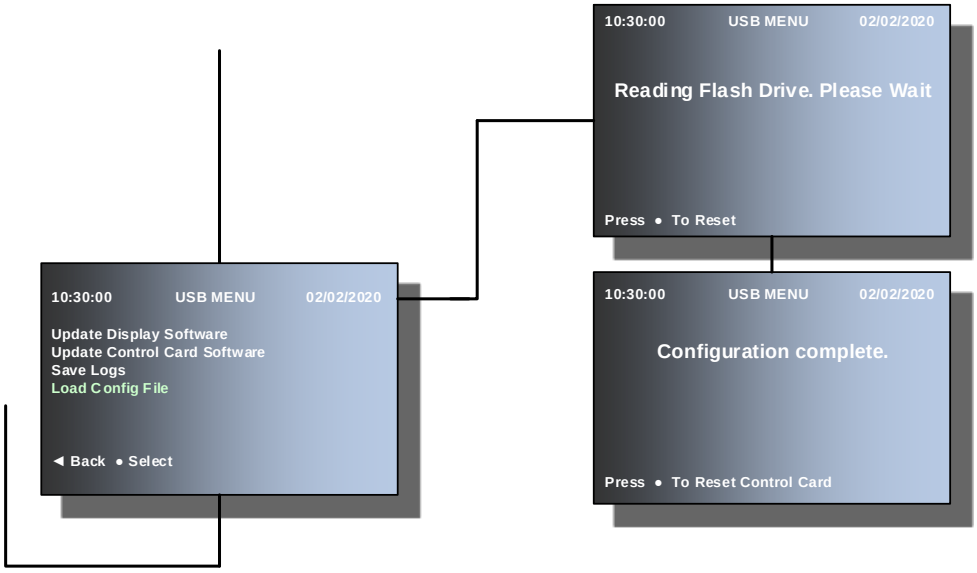
Press ● to select function.

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

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

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

Update software / Save Logs / Load Config File (continued)



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

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

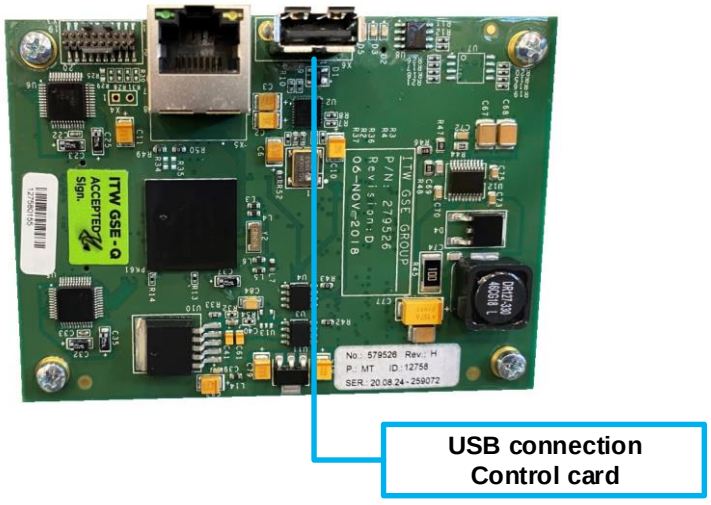
Use the ▼/▲ to highlight the function "Load Config File".

Before pressing ● to select Load Config File, please remember to insert a USB stick, with the configuration file you received from ITW GSE, into the USB port on the Control Card (loacted on the Interface Board).

Press ● to select function.

The new configuration of the unit are now uploaded from the USB stick and "Configuration complete" is displayed, when uploading has been completed.

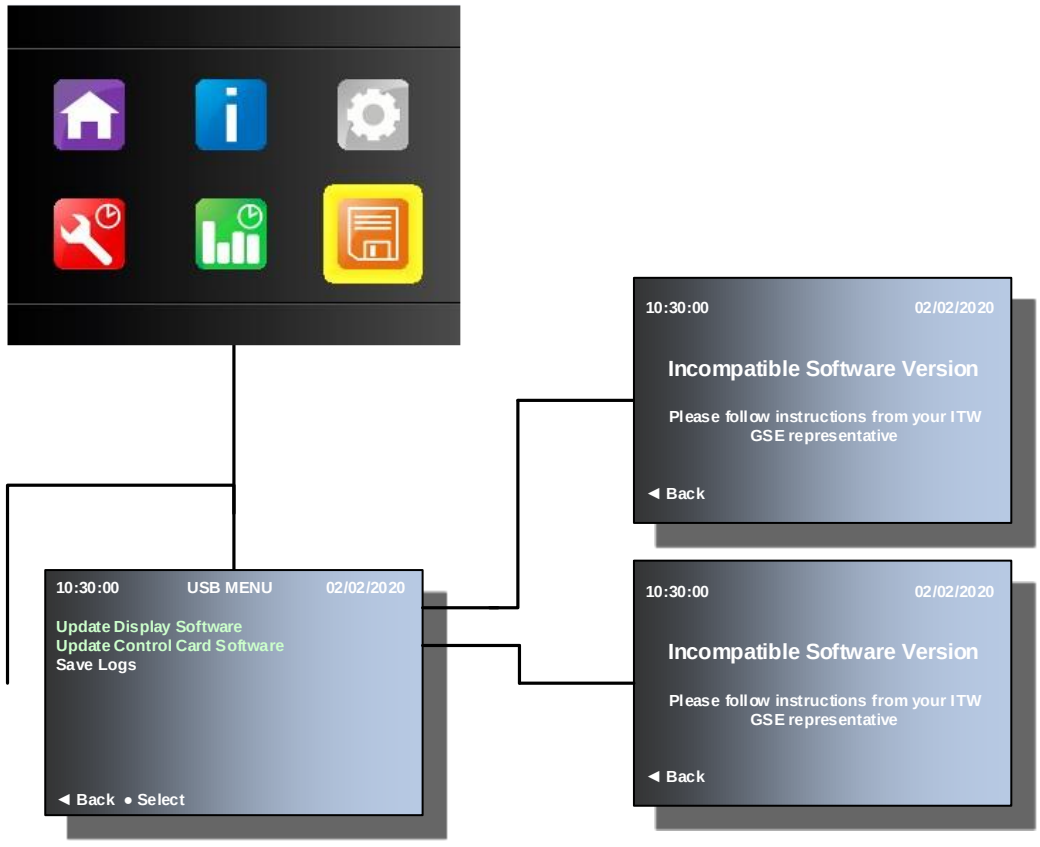
Press ● to reset Control Card.



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

6.3.6 Incompatible Software Version

If you try to install ***Special Software*** (Display Board or Control Card) in a unit with ***Standard Software*** or vice versa**,** you will be prompted **"Incompatible Software Version".**



Before changing software versions consult ITW GSE or if your intention really is to continue, as you already contacted / received the software files from ITW GSE, use below guidance to update software:

1. Press ▼&▲ simultaneously for 5 seconds, software will start automatically and will be updated.
2. Repeat step number 1 for updating the other Board / Card.

6.4 Default Factory Settings

Output Voltage (V):	28.0
Current Limit (A):	1600 (400 A Version) / 2400 (600 A version)
Compensation Type:	Manual (Feedback if GPU supplied with cable)
Output Compensation (V):	0.0 (Set if the GPU are supplied with cable)
Output Contactor Mode:	Simultaneous (Depending on configuration)
Interlock:	Bypassed (Active if GPU supplied with cable)
EF Interlock Delay (sec.):	3.5
Aircraft Connector Insertion	Bypassed (Active if GPU supplied with cable & 90% Switch / split "F" pin)
Plug Temperature:	Normally Open
Real Time Clock Setup:	Actual (Manufacturer's location)
Ethernet Configuration:	192.168.1.100
Modbus Slave Address:	1
LED Brightness:	Medium
Date/Time Format:	HH:MM:SS & DD:MM:YYYY
Unit of Measure:	Metric (International / Imperial (Americas)
Customer ID:	<UNDIFINED>
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 setup mode, by means of a DIP switch situated on the display board A3.

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

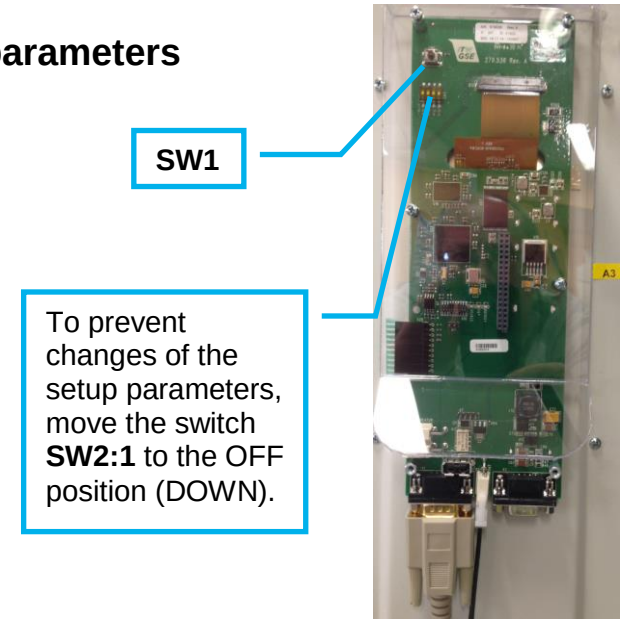
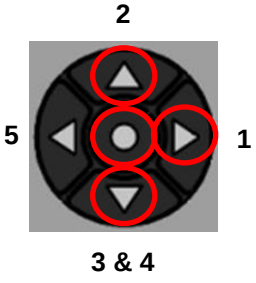


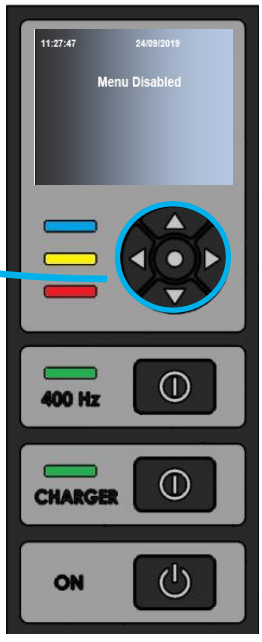
Fig. 7.1.1 - Display Board A3

Mobile units:
SW1 is not used on mobile units, so the key sequence below is used.

To enter a locked display, press and hold center until “Menu Disabled” is shown in the display, then push buttons in the sequence below.

1. Press arrow **“Right”**
2. Press arrow **“Up”**
3. Press arrow **“Down”**
4. Press arrow **“Down”**
5. Press and hold **“Center”**





7.2 Output Voltage

This setup submenu allows the output voltage to be adjusted between 19 V and 33 V using the UP and DOWN navigation buttons.
Please note that the standard voltage range for all commercial aircraft is 24 – 29.5 VDC.

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 Load Current Limit

It is possible to limit the maximum load current. At delivery the current limit is pre-set to 1600 A (400 A version) & 2400 A (600A version). When the converter works in current limit, this implies a decrease of the output voltage. Depending on the size of the load, disengagement's might occur due to under-voltage.

7.4 Output Voltage Compensation (Manual)

If long cables are used, the voltage drop becomes considerable during load situations. However, it is possible to increase the converter's output voltage proportionate to the load current. The adjustment is made while the converter is loaded and when the output cable has been mounted. With a load current above 50% of the nominal output current, the voltage at the plug is adjusted to the required value (larger load current gives a better result). At delivery, if the GPU is supplied without cables, the compensation is pre-set to 0.

To compensate for the voltage drop in the aircraft cable, the output voltage can be increased in proportion to the load current (Volt / 600 A).

1. Apply full load to the output connector.
2. Select compensation type "MANUAL" via Setup Mode.
3. Select "OUTPUT COMPENSATION".
4. Adjust the compensation using the vertical arrow buttons until the voltage at the aircraft connectors equals the no load value.

Note!
If the unit has more than 1 output all outputs are affected by the compensation value.

7.5 Output Voltage Compensation (Feedback)

The output compensation can be set to “Feedback” via the set-up menu. This enables the GPU to use the 28 VDC Interlock signal on pin F to monitor the plug voltage. The GPU automatically regulates the plug voltage to the set value of the output voltage, regardless of the load applied to the GPU.

Note!
An aircraft requires an input voltage of 24 – 29.5 VDC. The maximum voltage drop possible is 8 V since the highest voltage is limited to 32 V. With extremely long 28 VDC distribution cables, it might be necessary to use parallel output cables to stay within the required aircraft voltage.

7.6 Interlock Bypass

The F interlock is a personnel and equipment safety feature that is found in all commercial aircraft. This 28VDC signal will not present, before provides 28 VDC power to the aircraft. The 28 VDC for aircraft connector is feed back to the Interlock input of the ITW GSE 1400.

Enter 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.

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.

7.7 EF Interlock Delay

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.

Enter 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.

7.8 Aircraft Connector Insertion

Some aircraft power cables are equipped with a 90% switch in the connector. This device sends a 28 VDC signal to the unit when the connector is inserted at least 90% of the way into the aircraft power receptacle. Set this submenu value to Enable when such a cable is connected to the unit. The default value is set to Disable.

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

7.9 Cable Temperature

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

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

7.10 Real Time Clock Setup

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

Enter 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.

7.11 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.

Enter 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.

7.12 Ethernet Configuration

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

Enter 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.

7.13 Modbus Slave Address

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

Enter 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.

7.14 LED Brightness

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

Enter 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.

7.15 Unit of Measure

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

Enter 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.

7.16 Customer ID

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

Enter the Setup menu and then scroll up or down to the Customer ID submenu. Press the center ● button to enter the submenu and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Use the right arrow to advance to the next character. 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 Power Safe Mode

Use this submenu to select if the unit should go into Power Safe Mode (Enabled), the DC is then switched off every time the unit is stopped.

Enter the Setup menu and then scroll up or down to the Power Safe 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.

7.18 Battery Replaced

Use this submenu to reset the battery replacement timer after finishing the procedure described in Section 8.3.

Enter the Setup menu and then scroll up or down to the Battery Replacement 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 Language

This submenu is used to change the language that all of the display screens, messages, alarms and reports are displayed in. The unit comes with English, German, French, Russian, Danish, Spanish, Norwegian, Italian, Swedish, Portuguese, Polish, Czech, Turkish, Finnish, Dutch etc. already installed. The default is set to English.

Enter 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 always is 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 Lockout/Tagout procedure

Lockout/Tagout Procedure

ID: ITW GSE 1400
Doc. No.: 943005
Revision: -
Description: 28 VDC Ground Power Unit

4	Lockout Points	Note: This document is an ITW GSE standard procedure. Should local conditions and rules require additional lockout/tagout safety measures, it falls under the responsibility of the equipment owner to amend this procedure.

Lockout Application Process

1. Notify affected personnel. 2. Properly shut down unit. 3. Isolate all energy sources. 4. Apply lockout devices & tags. 5. Verify de-energization of all sources, according to EN 50110-1 (EU), NFPA 70E (US) and/or local electric safety standards.

Step	Energy source	Location	Method	Photo
	REMOTE PANEL	Right side	If the unit is in operation, push the STOP buttons, marked with ⏻ Verify that "Ready for Use" is displayed.	
	ELECTRICAL 400/480V	Mains/ Utility switch	Switch to the OFF position and lockout. (Mobile unit remove plug)	 (example)
	Open door	Front side	Use "Rittal" key to open door and to access breaker.	
	ELECTRICAL 400/480V	Electrical panel	Disconnect Q1 to the OFF position. Verify with a voltmeter (range: 500Vac)	

Lockout Removal Process

1. Ensure all tools and items have been removed. 2. Confirm all people are safely located. 3. Verify all controls are in neutral. 4. Remove lockout devices and reenergize the unit. 5. Notify affected personnel that servicing is completed.

8.2 Recommended Maintenance Schedule

8.2.1 Daily / upon use

	Maintenance Instruction for ITW GSE 1400 – 28 VDC unit **Daily / upon use** **This inspection does not in any way suspend local / airport rules and regulations**
01.	**Visual check of aircraft connector(s).** Depending on brand / 28 VDC type check: • Connector housing for damage / cracks and wear & tear. • Power Pins (+ & -) for damage and wear & tear. • Interlock Pin for damage and wear & tear. • Push buttons for correct function (if applicable). • LED / Lamps for correct indication (if applicable).
02.	**Visual check of output cable for damaged insulation & strain relief (if applicable).** • Check that the insulation is intact, and cable(s) do not show any sign of cracks / damage. • Check the strain relief for damage (if applicable).
03.	**Visual check of input cable and connector. (Mobile only)** • Check the input cable insulation is intact and cable do not show any sign of cracks / damage. • Check the input connector & pins for damage / cracks and wear & tear
04.	**Visual check of tires for wear and tear. (Mobile only)** • Check all 4 tires for damage / cracks and wear & tear

8.2.2 Quarterly

	Maintenance Instruction for ITW GSE 1400 – 28 VDC unit **Quarterly** **This inspection does not in any way suspend local / airport rules and regulations**
01.	**Check aircraft connector(s).** Depending on brand / 28 VDC type check: • Connector housing for damage / cracks and wear & tear. • Power Pins (+ & -) for damage and wear & tear. • Interlock Pin for damage and wear & tear. • Push buttons for correct function (if applicable). • LED / Lamps for correct indication (if applicable). • Aircraft Insertion Switch for correct function (if applicable). Note Load bank can be used to check the above
02.	**Check output cable for damaged insulation & strain relief (if applicable).** • Check the insulation is intact, and cable do not show any sign of cracks / damage. • Check output cable using a load bank. • Check the strain relief for damage and function (if applicable).
03.	**Check of air filters.** • Air inlet filters / Air Outlet mesh. • Wash or change as appropriate.
04.	**Check of input cable and connector. (Mobile only)** • Check the input cable insulation is intact and cable do not show any sign of cracks / damage. • Check the input connector & pins for damage / cracks and wear & tear
05.	**Check of tires for wear and tear. (Mobile only)** • Check all 4 tires for damage / cracks and wear & tear • Check correct air pressure (4.3 bar = 62 psi).

8.2.3 Yearly

	Maintenance Instruction for ITW GSE 1400 – 28 VDC unit **Yearly** **This inspection does not in any way suspend local / airport rules and regulations**
01.	**Check aircraft connector(s).** Depending on brand / 28 VDC type check: • Connector housing for damage / cracks and wear & tear. • Power Pins (+ & -) for damage and wear & tear. • Interlock Pin for damage and wear & tear. • Push buttons for correct function (if applicable). • LED / Lamps for correct indication (if applicable). • Aircraft Insertion Switch for correct function (if applicable). Note Load bank can be used to check the above
02.	**Check output cable for damaged insulation & strain relief (if applicable).** • Check the insulation is intact, and cable do not show any sign of cracks / damage. • Check output cable using a load bank. • Check the strain relief for damage and function.
03.	**Check of air filters.** • Air inlet filters / Air Outlet mesh. • Wash or change as appropriate.
04.	**Check of fans.** • Check that fans are running properly.
05.	**Check bolts & screws.** • Check internal bolt/screw and wire connections, tighten or replace if necessary.
06.	**Check PCB's.** • Visual inspection of components and printed circuit boards i.e. control, interface boards.

Continued on next page

Continued from previous page

07.	**Check output contactor.** • Check of the output contactor contact set and coil, clean or replace if necessary (if applicable). Inspect housing form burns / discoloration. Some output contactors may be sealed and contact set can not be inspected.
08.	**Check cabinet & rubber sealing.** • Check cabinet rubber sealing, repair or replace if necessary.
09.	**Check of input cable and connector. (Mobile only)** • Check the input cable insulation is intact and cable do not show any sign of cracks / damage. • Check the input connector & pins for damage / cracks and wear & tear
10.	**Check of tires for wear and tear. (Mobile only)** • Check all 4 tires for damage / cracks and wear & tear • Check correct air pressure (4.3 bar = 62 psi).

8.3 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/utility drop-outs. The expected life of the battery is approximately 7 years. However, a low battery voltage does not affect the internal safety system of the GPU that monitors the output voltage, among others. Thus aircraft connected to the GPU are not exposed to any danger. To avoid loss of data and Control Board lock up *, we recommend changing the battery after **5 years** of use.

Note!

A time stamp is stored in the ID chip (A6) upon production and after 5 years a warning occurs at the display, telling the user/operator to replace the Control Board battery.
It is strongly recommended to change the battery when this message is shown:

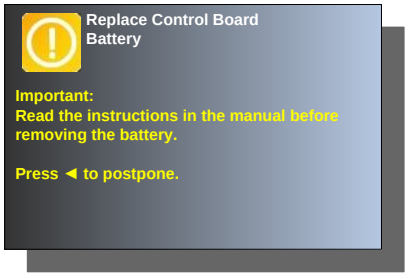


Fig. 8.3.1

To allow the user/operator to use the converter, it is possible to postpone the battery change, by pressing the ◄ (left arrow) push button. The warning message occurs 90 seconds after the unit is powered on or the output contactor(s) are opened (the unit is in Standby Mode). If this message is ignored for 6 months the controls will be locked out and the below failure message will be displayed.

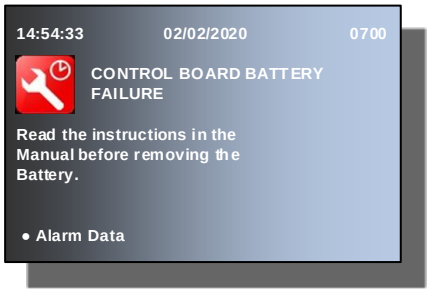


Fig. 8.3.2

The battery has to be changed before the unit can be operated again.

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

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

Important Notice!
Software revision H and forward:
Tamper Protection has been removed.
Only allowing the Control Board without power for 30 seconds does not apply any more. (The Control Board can stay without power for more than 30 seconds.)
After battery exchange, please remember to set Time & Date to correct values.

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

How to change the battery:

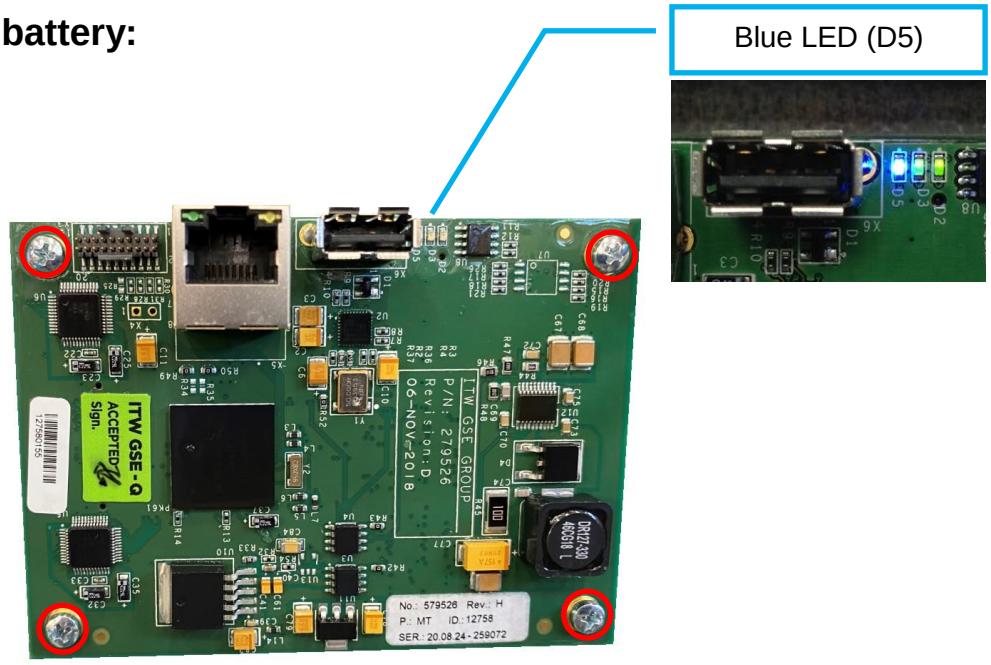


Fig. 8.3.3 - Control Board (front view)

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

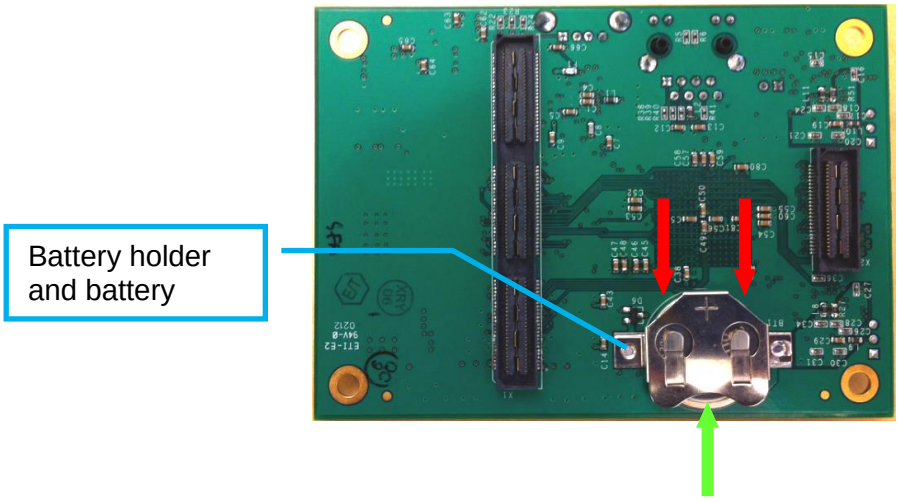


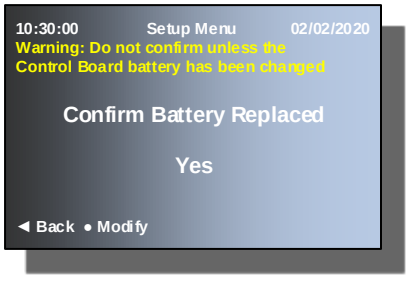
Fig. 8.3.4 - Control Board (rear view)

Remove the battery from the holder using a small insulated screwdriver to push out the battery, direction indicated by the two red arrows in figure 8.3.4 and insert the new battery in the direction of the green arrow in figure 8.3.4.

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

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

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



Switch off the unit again and wait 10 sec. before switching it back on.

* Important Note!

If the blue LED on the Control Board (location can be found on the Fig. 8.3.3) flashes with approximate 2 flashes per second and the display reports “Communication Error”, the firmware on the Control Board has been erased.
The Control Board must be sent to ITW GSE to be reloaded.

9.0 Troubleshooting & Repair

Allow only qualified personnel to 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/utility 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 Q1 (Circuit Breaker) and fuse F3 at the 28 V GPU Board A2 (corresponding LED D25). The following fuses are located on the 28 V GPU Board (A2):

Fuse #	Applicable for	Type	Rated voltage	Amp rating
F1 (D14)	Fan Fuse	ATO Blade Fuse	32 V	5 A
F2 (D15)	Interface Fuse	ATO Blade Fuse	32 V	10 A
F3 (D25)	Display Fuse	ATO Blade Fuse	32 V	2 A
F4 (D56)	I/O Fuse	ATO Blade Fuse	32 V	5 A

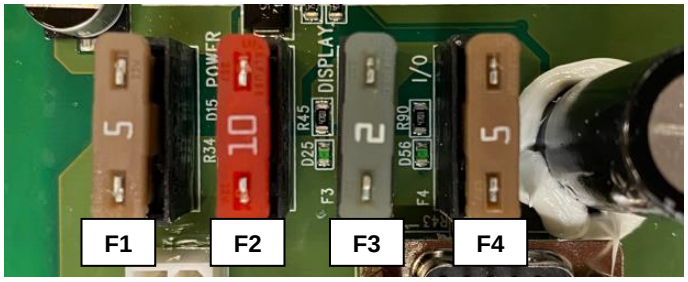


Fig. 9.0.1 - Fuses F1-F4 and LED indication (A2 - 28 V GPU Board)

If the displayed text does not provide sufficient information to solve the problem, Table 1 and Table 2 (Section 9.1) suggest corrective actions to be carried out for each error code. For each fuse there is a LED that indicates if the fuse is okay or not.
Additional error information regarding the error codes area can be derived from the error code according to the following directions:

Filter current:47xx

Phase code:
xx01 = Phase A
xx02 = Phase B
xx04 = Phase C

Examples: Error Code 4701 refers to “Filter current too high” at phase A.

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.

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	Call technician / Contact ITW GSE
202	WRONG SOFTWARE VERSION	Install correct software version	Install correct Software version / Contact ITW GSE
300	CONTROL VOLTAGE LOW	Control Voltage < 20V	Press start to reset
301	CONTROL VOLTAGE LOW	Control Voltage < 20V	
400	EMERGENCY STOP ACTIVATED		Release emergency stop and press start to reset
600	CONTROL BOARD ADC1 FAILURE		Press start to reset
700	CONTROL BOARD BATTERY FAILURE		
750	REAL-TIME CLOCK NOT SET	Please set to current time and date	
1000	SOFTSTART ERROR	DC Voltage < 400V	
1100	DC VOLTAGE TOO LOW	DC Voltage < 300V - 30ms	
1200	DC VOLTAGE TOO HIGH		
1201	DC VOLTAGE TOO HIGH	DC Voltage > 800V – 30 s	
1202	DC VOLTAGE TOO HIGH	DC Voltage > 850V - 3ms	
1300	DC CAPACITOR SHARING ERROR	DC Voltage > 850V	
1400	DC RIPPLE TOO HIGH	DC Ripple > 20V – 3min	
1500	INVERTER TEMP TOO HIGH	IGBT 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	
4000	OVERLOAD: > 100% - 60 s		
4700+code	FILTER CURRENT TOO HIGH	Phase X	
4800	SHORT CIRCUIT AT OUTPUT		
5000	TRANSFORMER TEMP TOO HIGH		
5100	RECTIFIER TEMP TOO HIGH		
6100	PLUG TEMPERATURE TOO HIGH		
6300	EF SIGNAL DROP OUT - OUTPUT	EF Signal Disappeared	
7000	OUTPUT VOLTAGE TOO HIGH	Voltage > 32V - 4s	
7100	OUTPUT VOLTAGE TOO HIGH	Voltage > 40V - 150ms	
7200	OUTPUT VOLTAGE TOO LOW	Voltage < 20V - 4s	
9000	END OF FACTORY TEST		

Error code	2nd. Corrective action	3rd. Corrective action	4th. Corrective action
0			
100			
200	Replace Control Board A1		
201			
202			
300	Check input voltage	Check Q1 & G1	
301	Check input voltage	Check Q1 & G1	
400	Check emergency stop	Check user EPO (A2:X3)	Replace Control Board A1
600	Check input voltage	Replace Control Board A1	
700	Replace battery		
750	Check / Set to current time and date		
1000	Check input voltage	Check DC softstart charging voltage > 400V	Replace Control Board A1 Replace 28 V GPU Board A2
1100	Check input voltage	Check DC Voltage at R99 & R101	Replace Control Board A1 Replace 28 V GPU Board A2
1200			
1201	Check input voltage	Replace Control Board A1	Replace 28 V GPU Board A2
1202	Check input voltage	Replace Control Board A1	Replace 28 V GPU Board A2
1300	Check R99/R101 (TP7 – TP8 – TP9) Check DC capacitors C77 / C81 /C82 / C87 / C88 / C89	Replace Control Board A1	Replace 28 V GPU Board A2
1400	Check input voltage	Check U16 & DC capacitors C77 / C81 /C82 / C87 / C88 / C89	Replace Control Board A1 Replace 28 V GPU Board A2
1500	Check fuse F1	Check voltage between + & - at fan terminals (A2:X13)	Check dust filters Replace Control Board A1 Replace 28 V GPU Board A2
2000	Replace Control Board A1	Replace 28 V GPU Board A2	
2000+code	Replace Control Board A1	Replace 28 V GPU Board A2	
2000+code	Replace Control Board A1	Replace 28 V GPU Board A2	
4000	Remove overload and press start	Replace Control Board A1	Replace 28 V GPU Board A2
4700+code	Check diodes V1 – V6	Check output C1 capacitor bank	Replace Control Board A1 Replace 28 V GPU Board A2
4800	Disconnect load / Output cable	Replace Control Board A1	Replace 28 V GPU Board A2
5000	Let the unit cool down and reset	Check dust filters and fans	Check (short circuit sensor) replace sensor if necessary Replace Control Board A1 Replace 28 V GPU Board A2
5100	Let the unit cool down and reset	Check dust filters and fans	Check temperature sensor at rectifier heat sink.
6100	Remove load and let plug cool down	Check connector / Output cabling for any malfunction	Replace Control Board A1 Replace 28 V GPU Board A2
6300	Verify that output cable is correctly inserted	Check / Correct installation	Replace Control Board A1 Replace 28 V GPU Board A2
7000	Check output voltage setup value		
7100	Check output voltage setup value		
7200	Check output voltage setup value		
9000			

Note!

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

Please observe!

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

10.0 Illustrated Parts List

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

10.1 Components placement

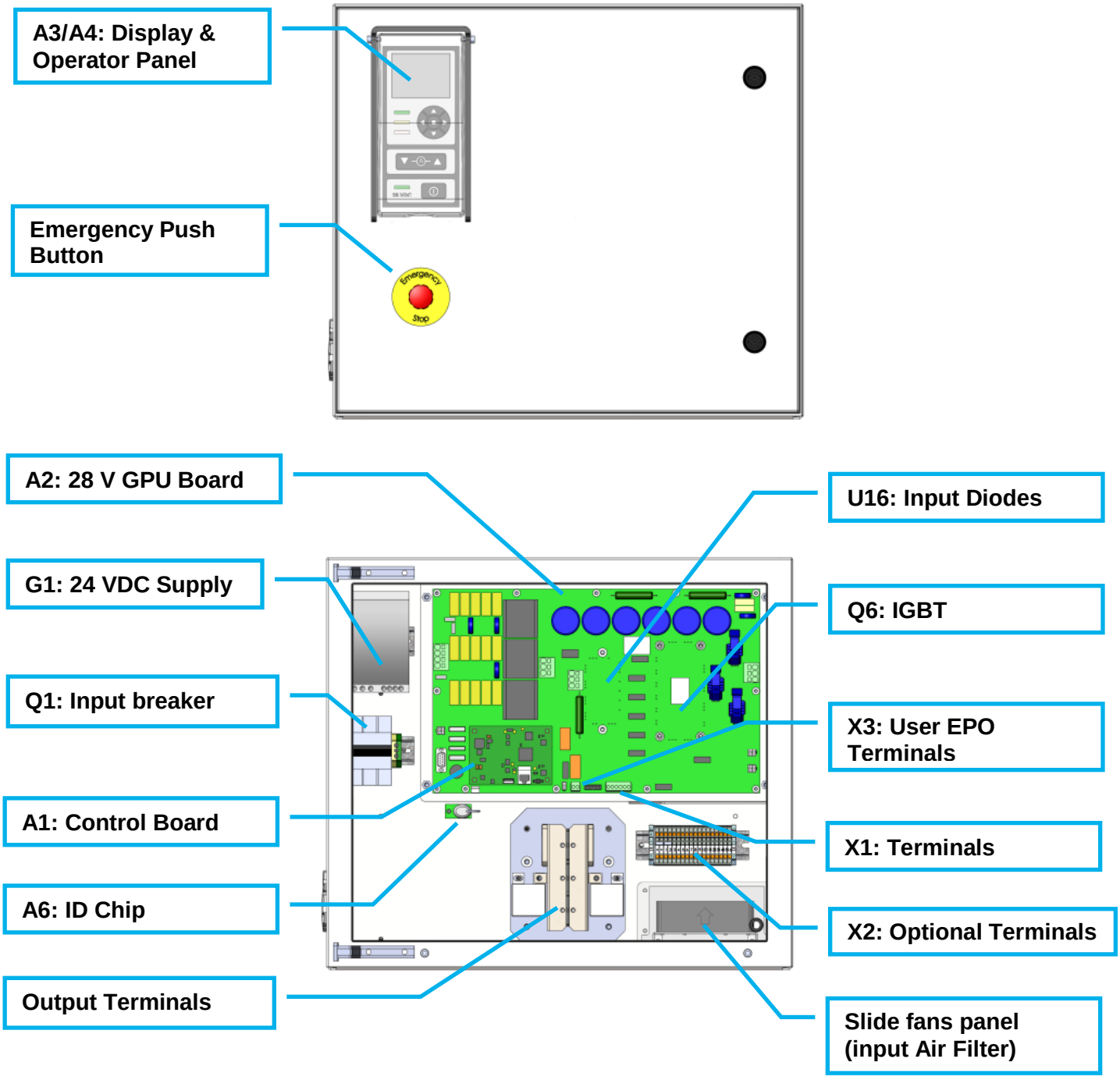


Figure: 10.1.1 - Front view outside and behind door

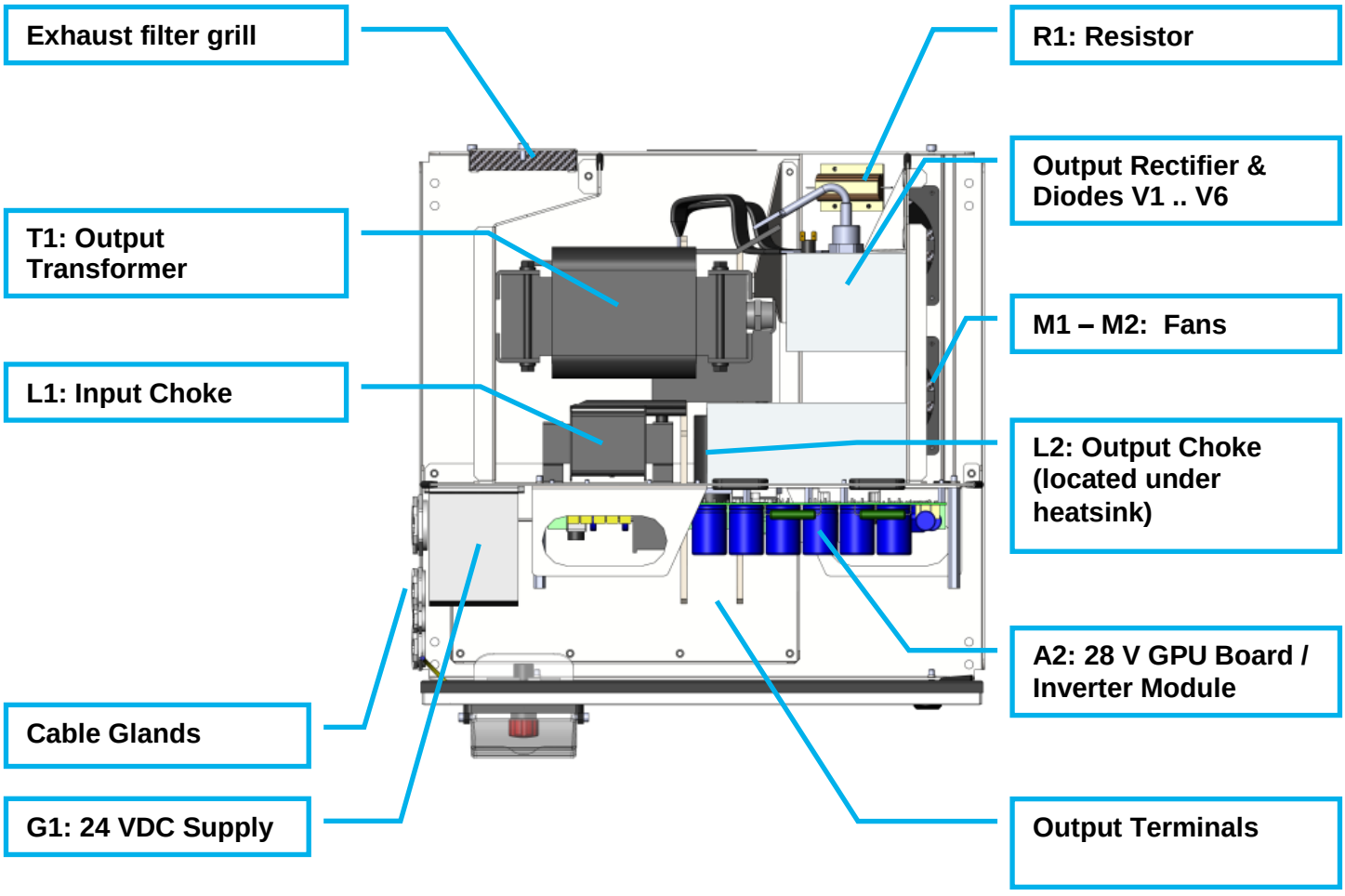


Figure 10.1.2 - Top view

10.2 Placement of labels (CE version)

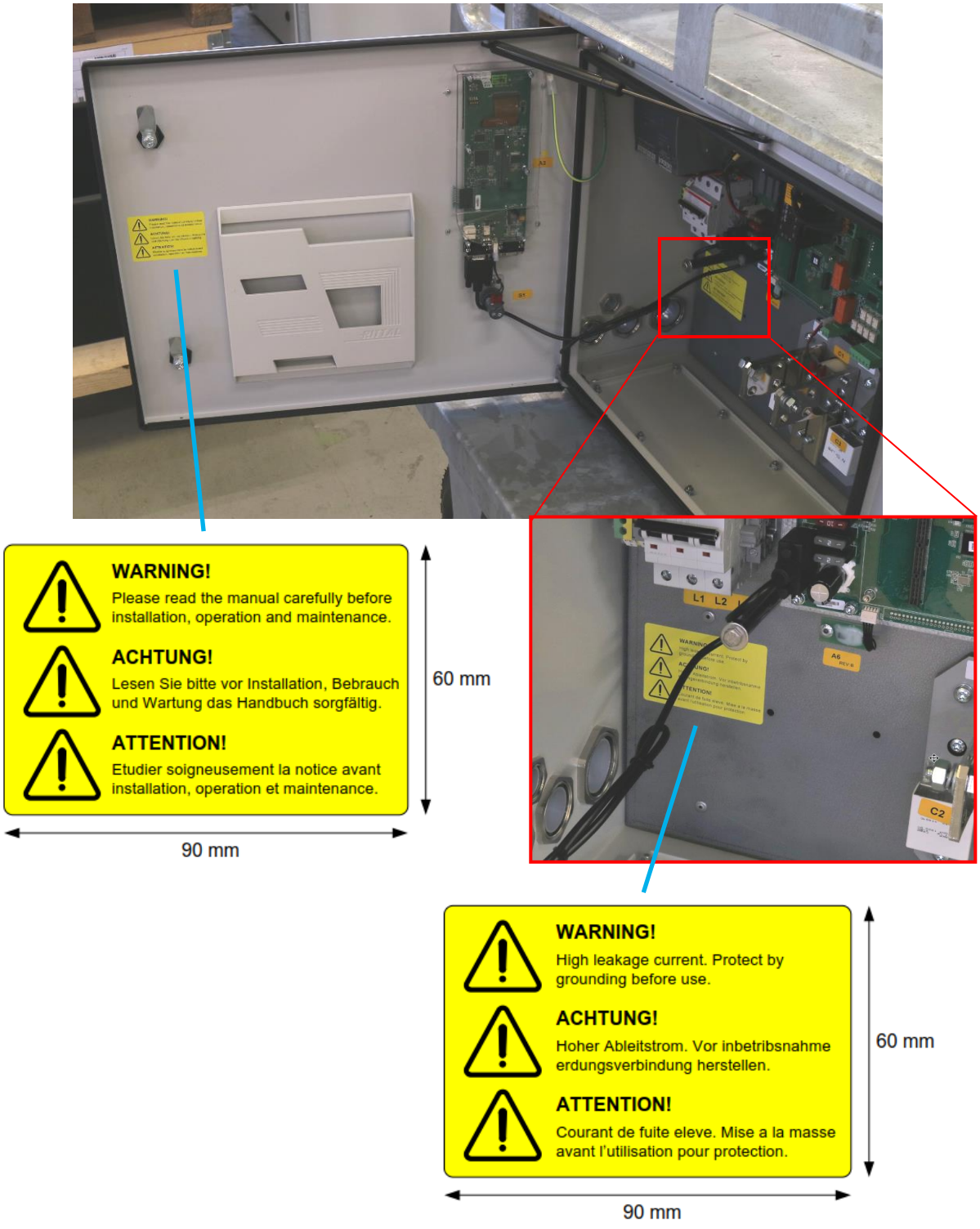


Figure 10.2.1 Inside front view (language may vary)

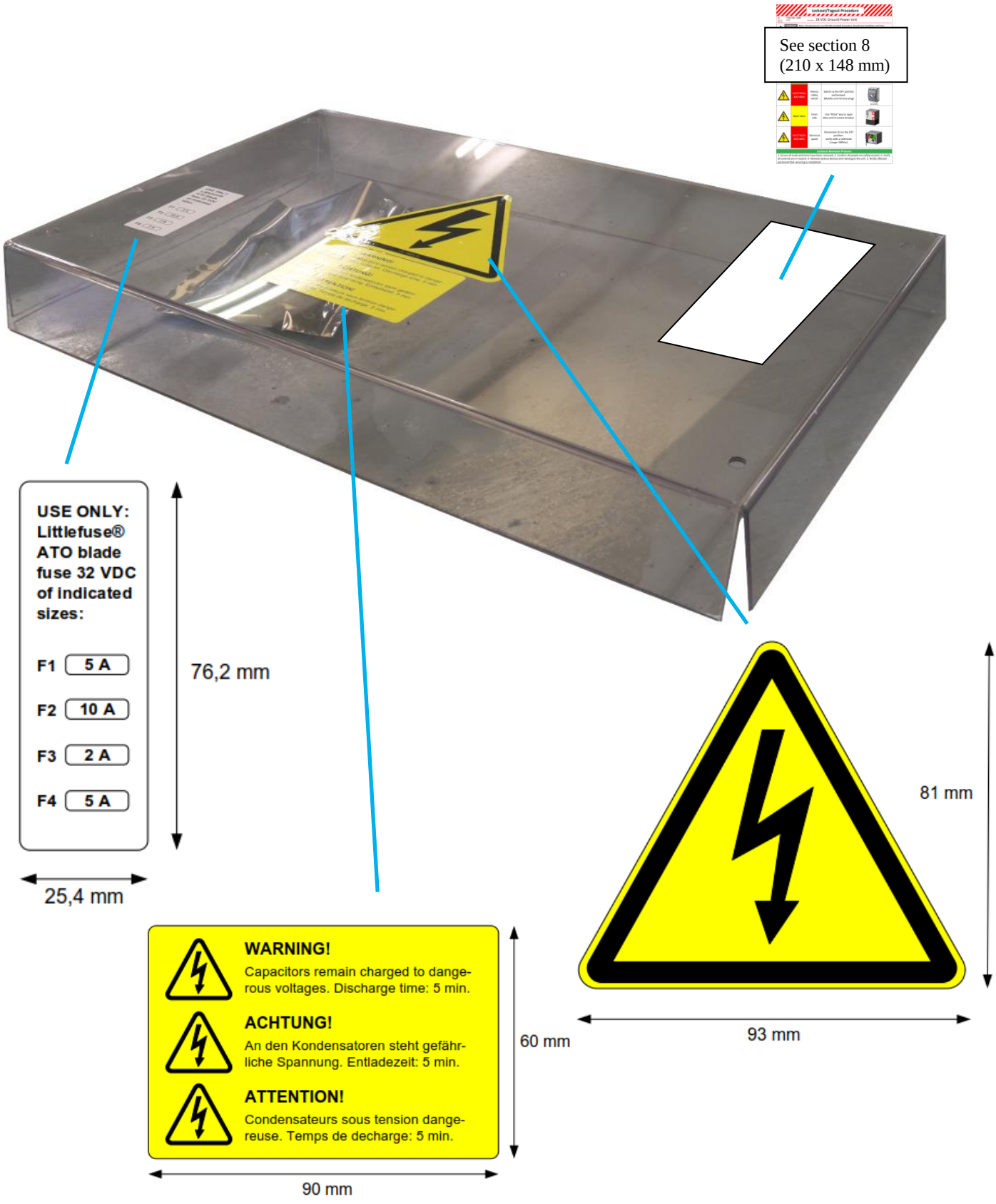


Figure 10.2.2 Cover view (language may vary)

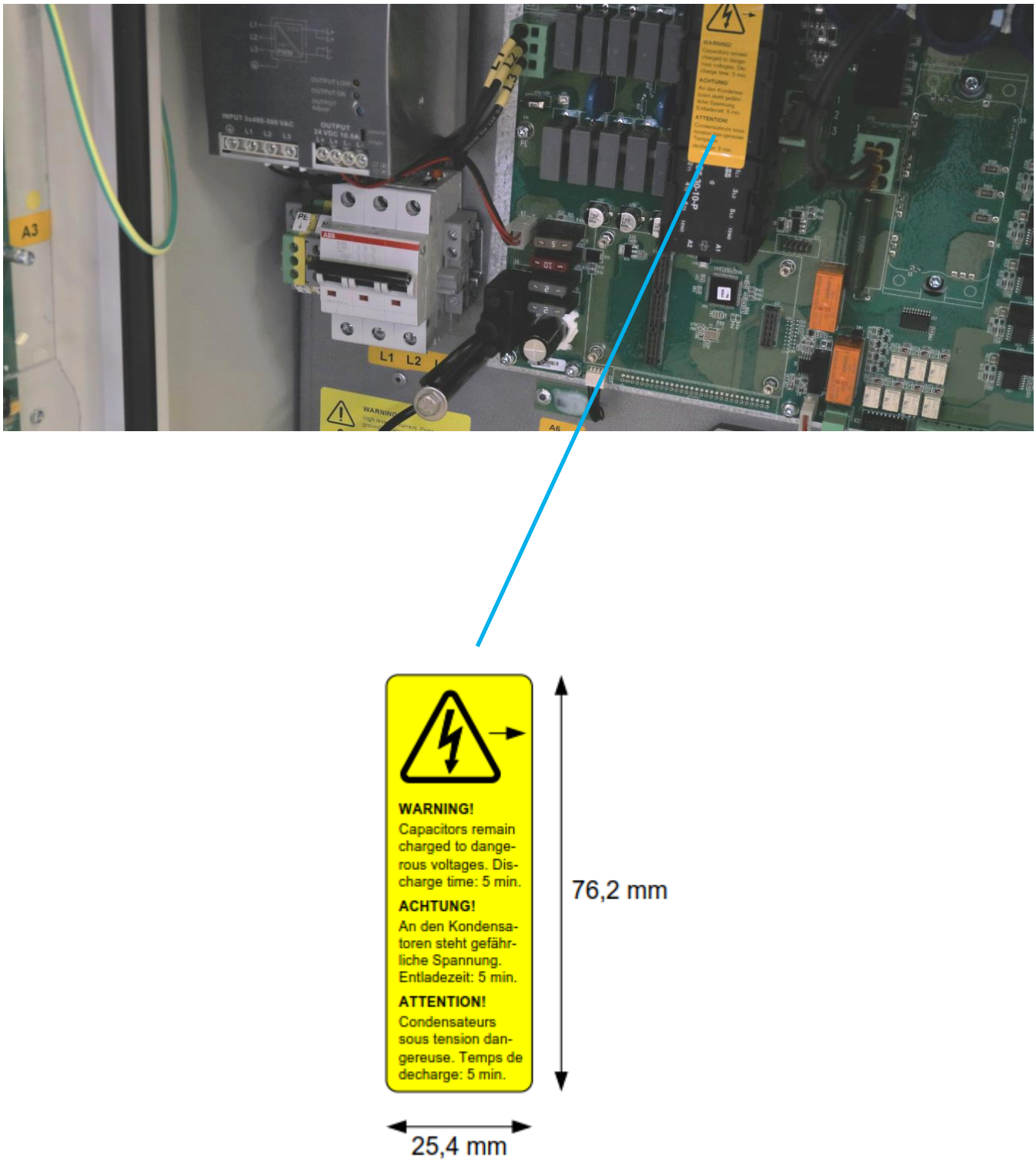


Figure 10.2.3 Power Module view (language may vary)

10.3 Placement of labels (UL version)

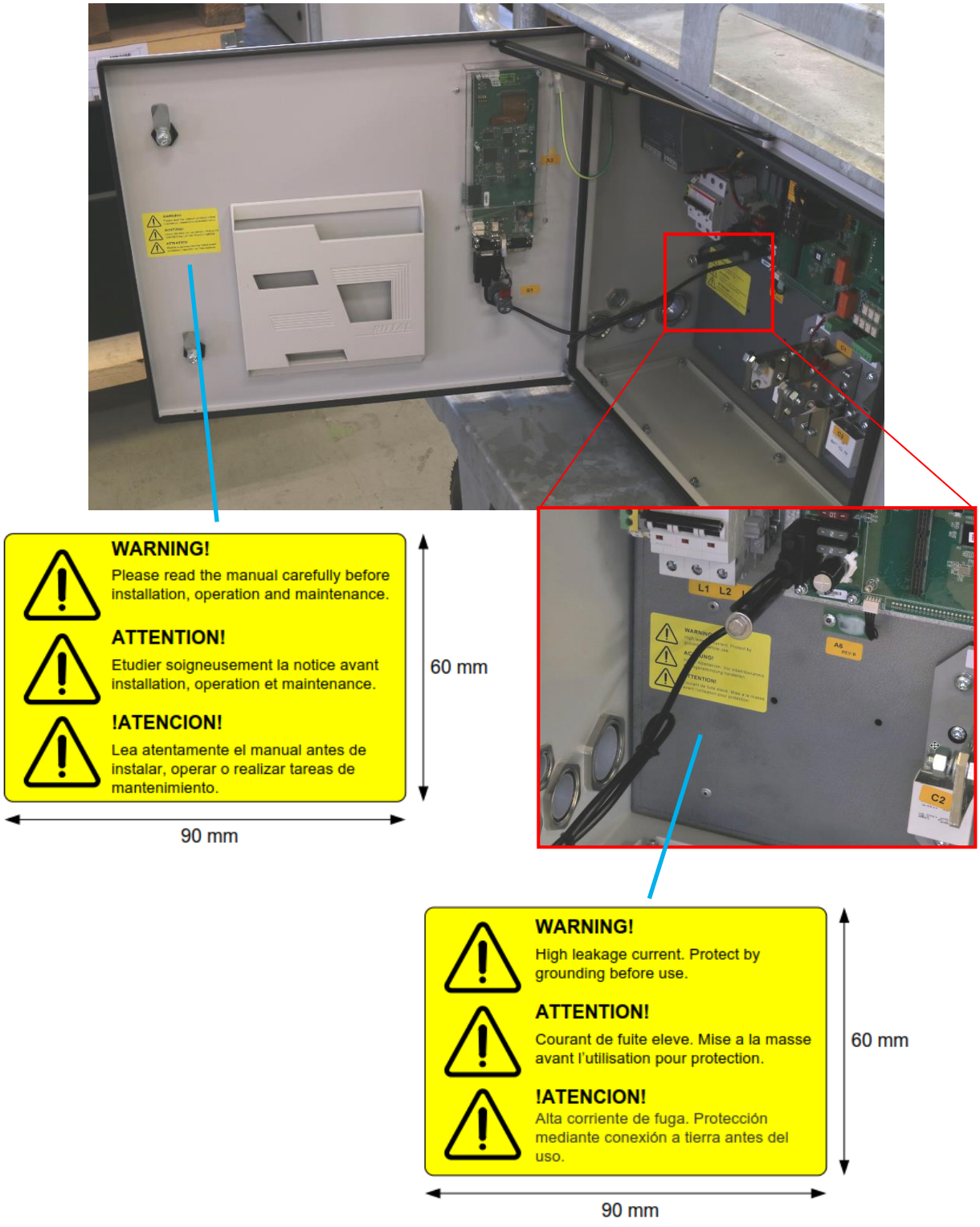


Figure 10.3.1 Inside front view (language may vary)

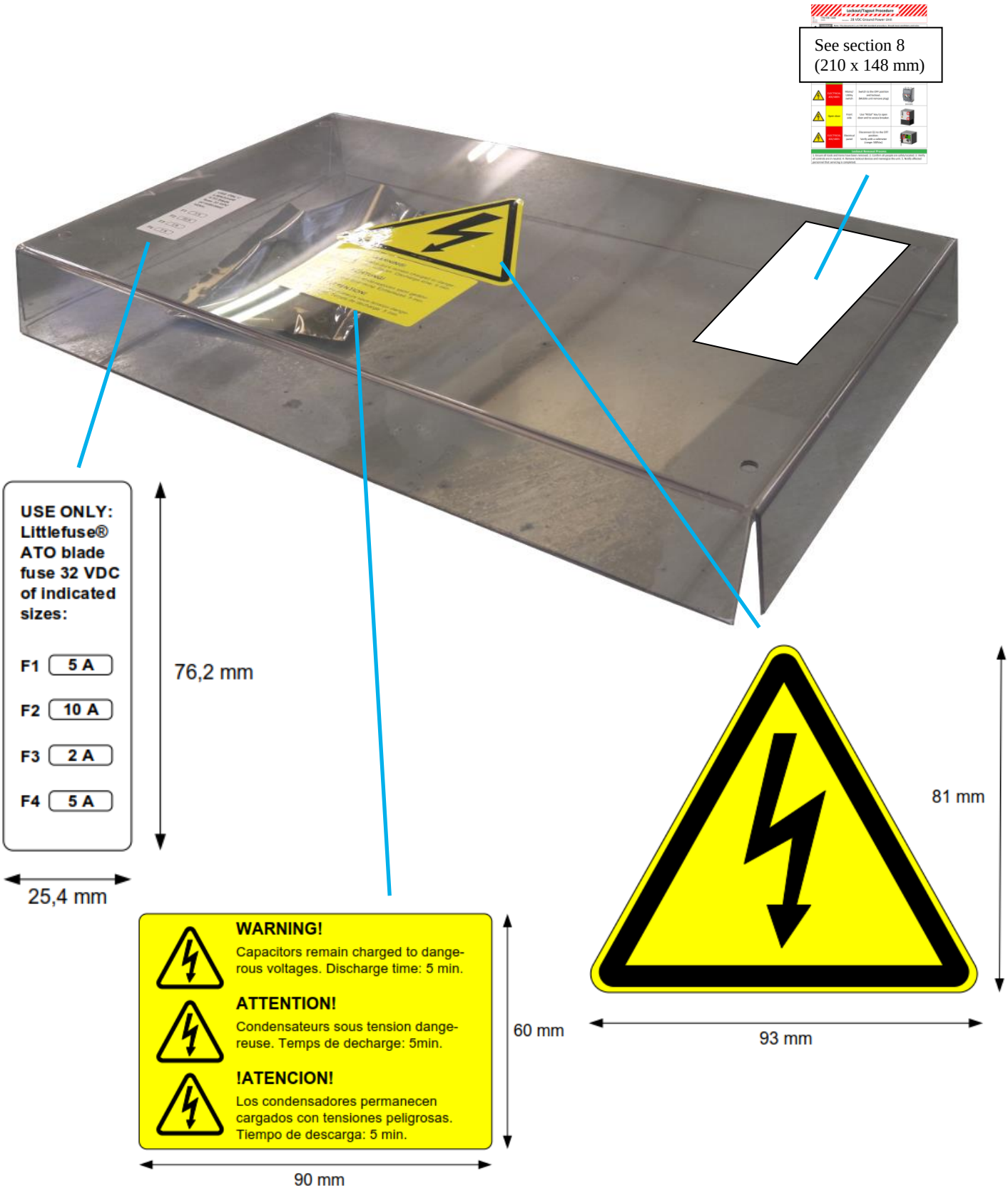


Figure 10.3.2 Cover view (language may vary)

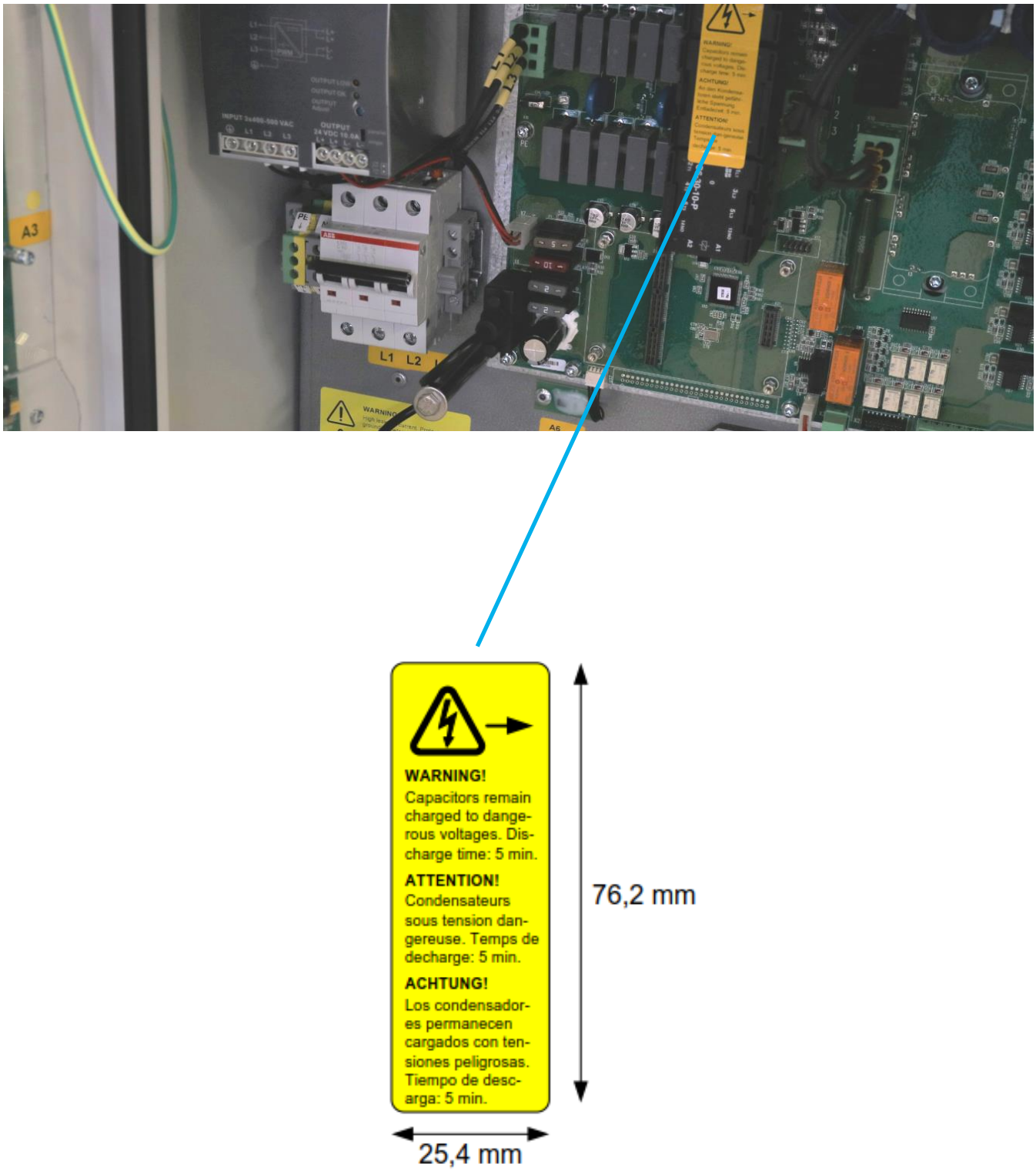
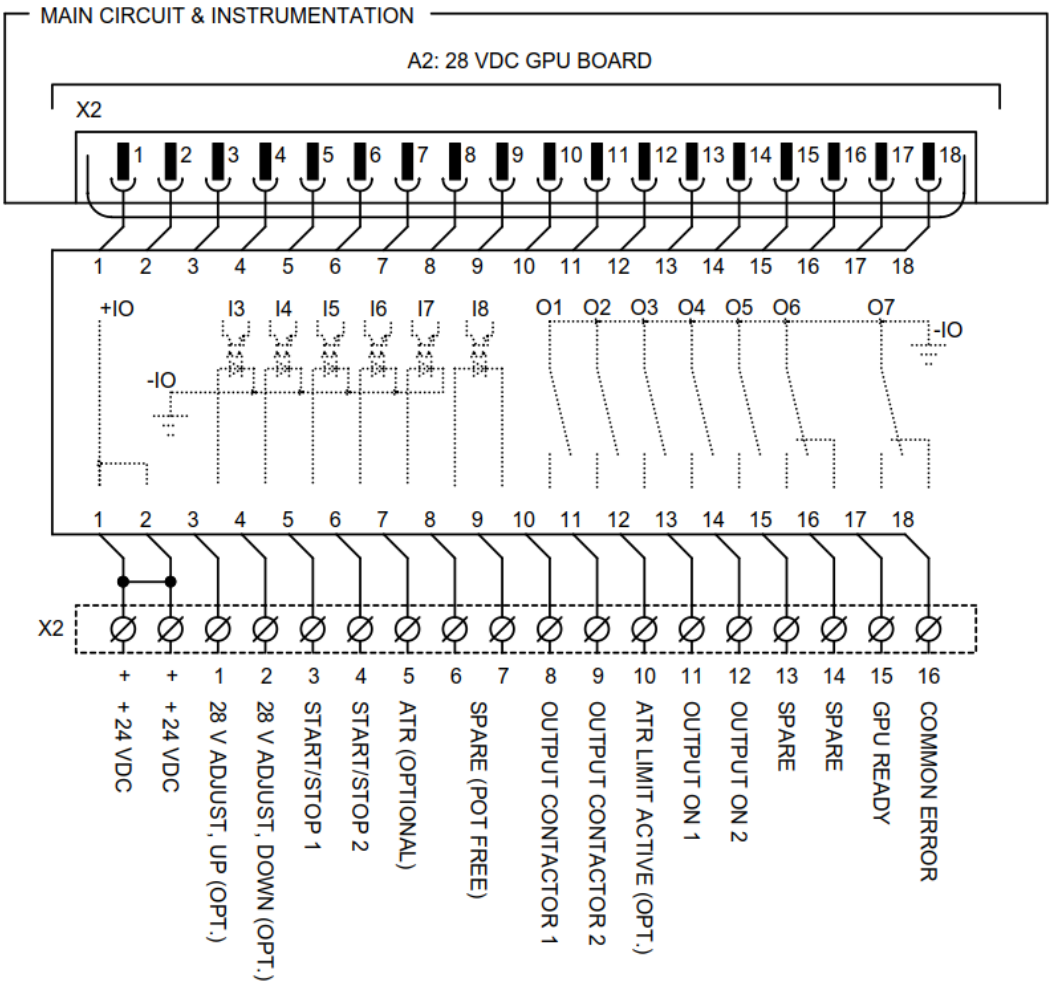


Figure 10.3.3 Power Module view (language may vary)

11.0 Options

543801 Additional Control Terminals (Diagram 443800)

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

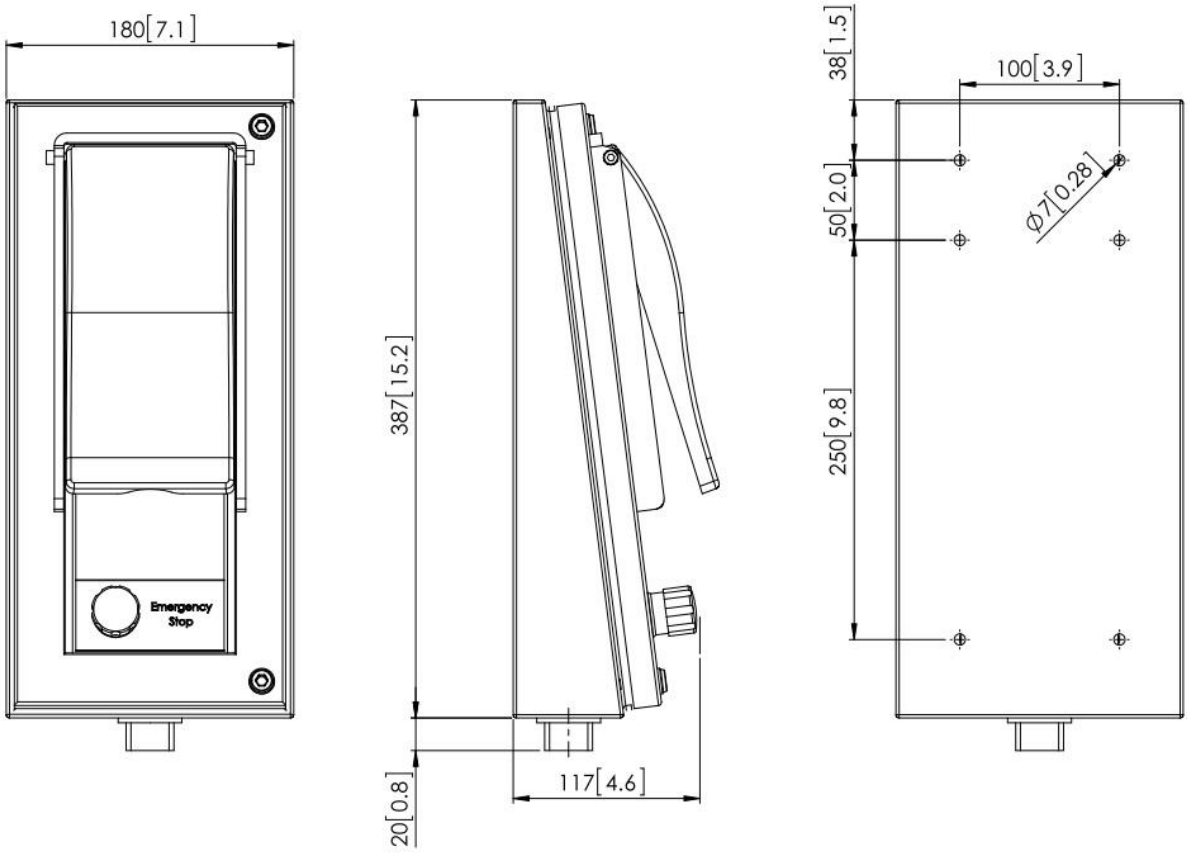


Note!

Remote I/O terminals (X2): 18 x 0.4 - 4 mm²

Input Logic high = 16 - 32 VDC
Output Contacts Vmax = 50 V AC/DC and Imax = 2 A

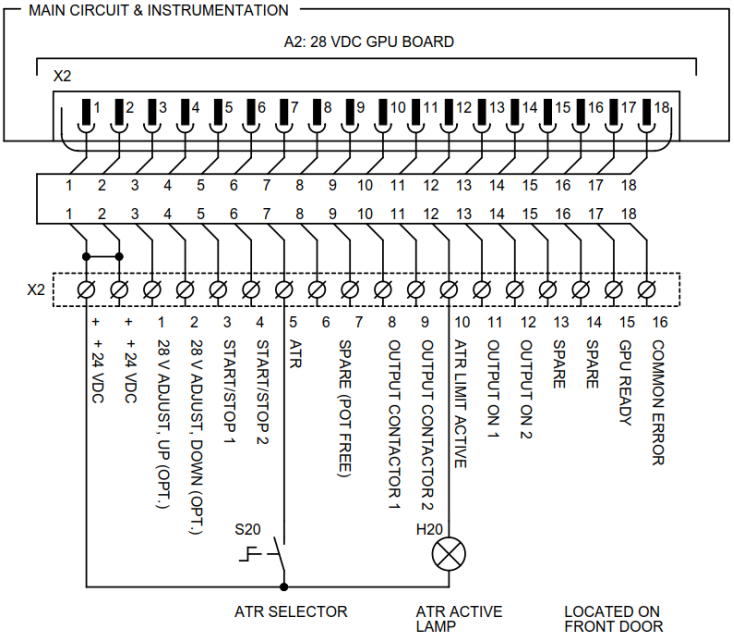
543802 Remote Control Box (Diagram 443400)



The control box is used for operation of the ground power unit, when the GPU is located away from the aircraft parking position / out of reach etc.

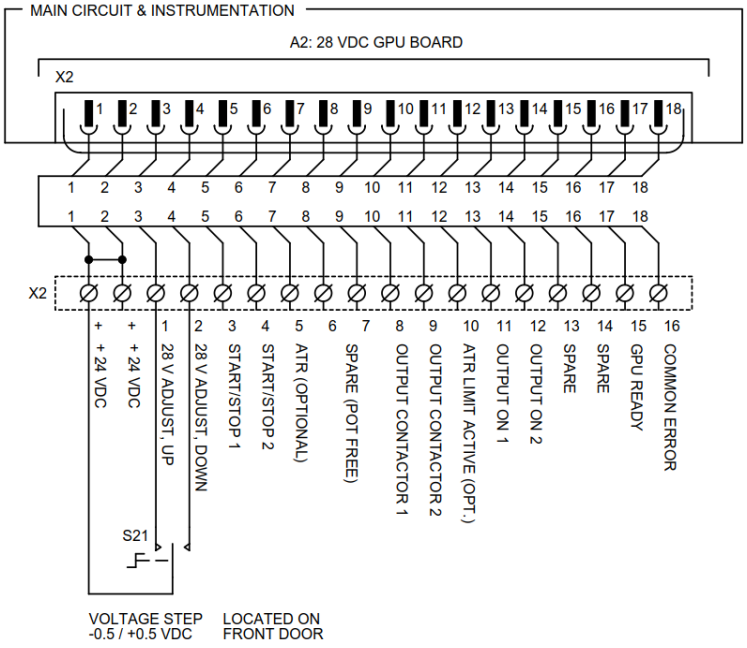
543805 ATR 1275 A Current Limit (Diagram 443800)

This option enables the user to set the current limit at 1275 A for the ATR aircraft, by switching the S20 switch to ATR selection.



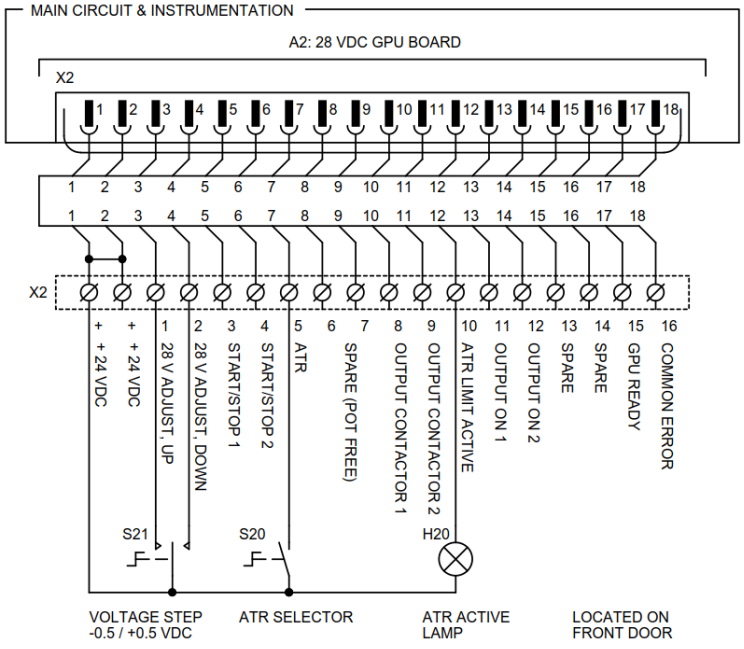
543806 28 VDC Voltage Adjust (Diagram 443800)

This option enables the user to step the output voltage either up / down in steps of 0.5 volt, by the means of S21 switch. This can be done during operation. As soon as the converter is switched off, the output voltage will return to the output voltage set-up value.



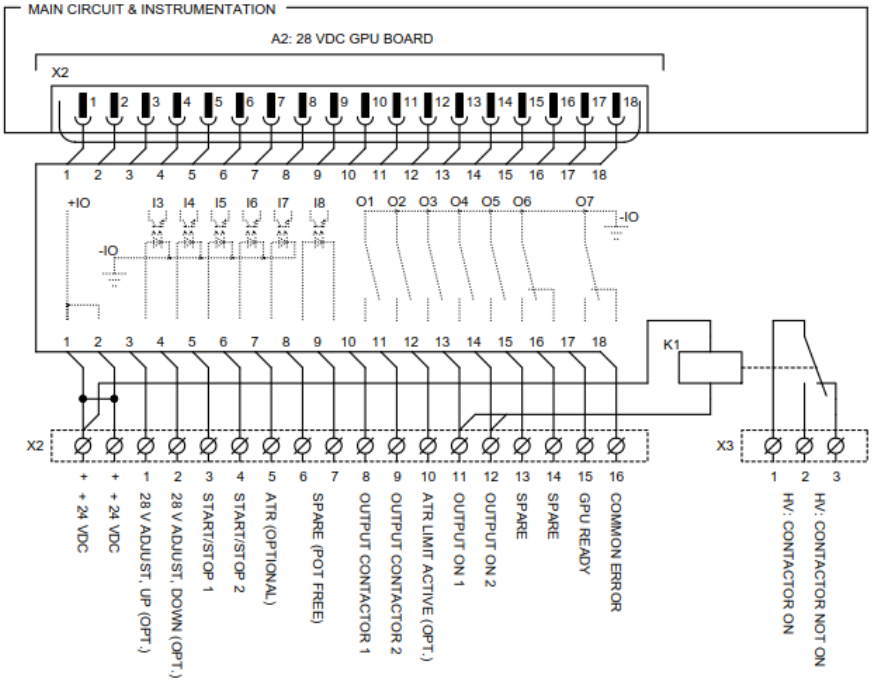
543807 ATR & 28 VDC Voltage Adjust (Diagram 443800)

This option combines the two options, ATR 1275 A current limit and the 28 VDC voltage adjust, as described at previous options.



543808 Additional Control Term. & HV Contactor On Relay (Diagram 443800)

This option add an isolated relay, that externally shows, if the GPU is turned ON.



543813 Lockable Door

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.