It's all about connections

Original User Manual
ITW GSE 7400 JetEx Battery Powered
(Single Leaf Battery Pack)

28VDC Ground Power Unit

Serial No.	
Type	3GWB-28/40I

IMPORTANT NOTE

Only qualified personnel may carry out Service/Troubleshooting/Maintenance/Repair of the ITW GSE 7400 JetEx GPU.

Refer to ITW GSE's website
https://itwgse.com/
or
contact ITW GSE
for further information.

IMPORTANT NOTE

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

Refer to Section 8.3
for further information.

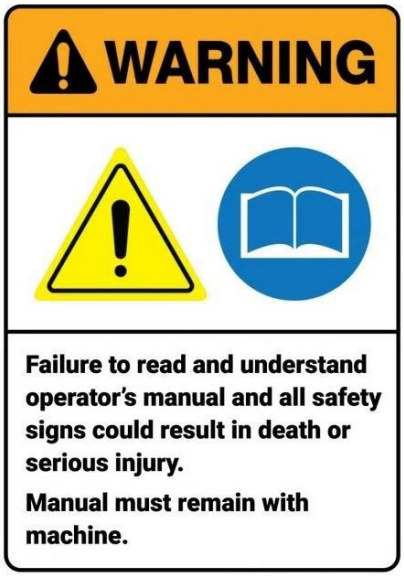
Diagrams and drawings are subject to change without prior notice.
Latest diagram versions can be found at www.itwgse.com

About this user manual

INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR ITW GSE 7400 JETEX GROUND POWER UNITS.

This manual provides information about the ITW GSE 7400 JetEx Ground Power Unit.
The manual covers the range of the 7400 JetEx 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	Electrostatic 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
SoC	State of Charge
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 Types and Ratings

Type	Rating	Capacity	Number of battery packs	Part number	Schematic	Charger voltage (Input Main/Utility Voltage)
3GWB-28/40I	600A	40 kWh	1	543500	443500	3 x 400/480 V (280-520 V)

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1.0 Declaration of Conformity

CE

EU Declaration of Conformity

ITW GSE ApS
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We declare under our sole responsibility that the following product type

Designation : 28 Vdc Mobile Ground Power Unit

Type : ITW GSE 7400 Series: 3GWB-28/40I

Description : Mobile ground power unit converting DC-Voltage supplied from Li-ion Batteries into a regulated 28VDC output intended for Ground Power supply of 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)
EN62040-1:2009	(LVD – Safety standard)
EN62619:2017	(Battery 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	19.02.2020	Soren R. Dahl
Place of issue	Date of issue	Soren R. Dahl, Director of R&D

799.340 Rev. A

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 fulfill 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 a  label.
- Keep all panels and covers securely in place.
- Only allow **qualified** people to 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, and repair/replace if necessary.

Moving Parts

- Keep away from fans. Running fans can cause injury to your hands.
- Only allow **qualified** people to remove covers for maintenance or troubleshooting.

Hot Parts

- Do not touch hot magnetics. Hot surfaces can course severe burns.
- Allow parts to cool off before performing maintenance.

KEEP THESE INSTRUCTIONS!

LEAF Battery (Main Battery)

- On-board battery packs that are sealed must not be opened and are maintenance free.
- Only use the same type of Leaf Batteries, and only ITW GSE or service engineers appointed by ITW GSE are allowed to change the batteries.
- Safety Data sheets on Lithium-ion battery modules can be obtained from ITW GSE on request.

AGM Battery (AUX Battery)

- On-board battery packs that are sealed must not be opened and are maintenance free.
- Only use the same type of AUX Batteries.

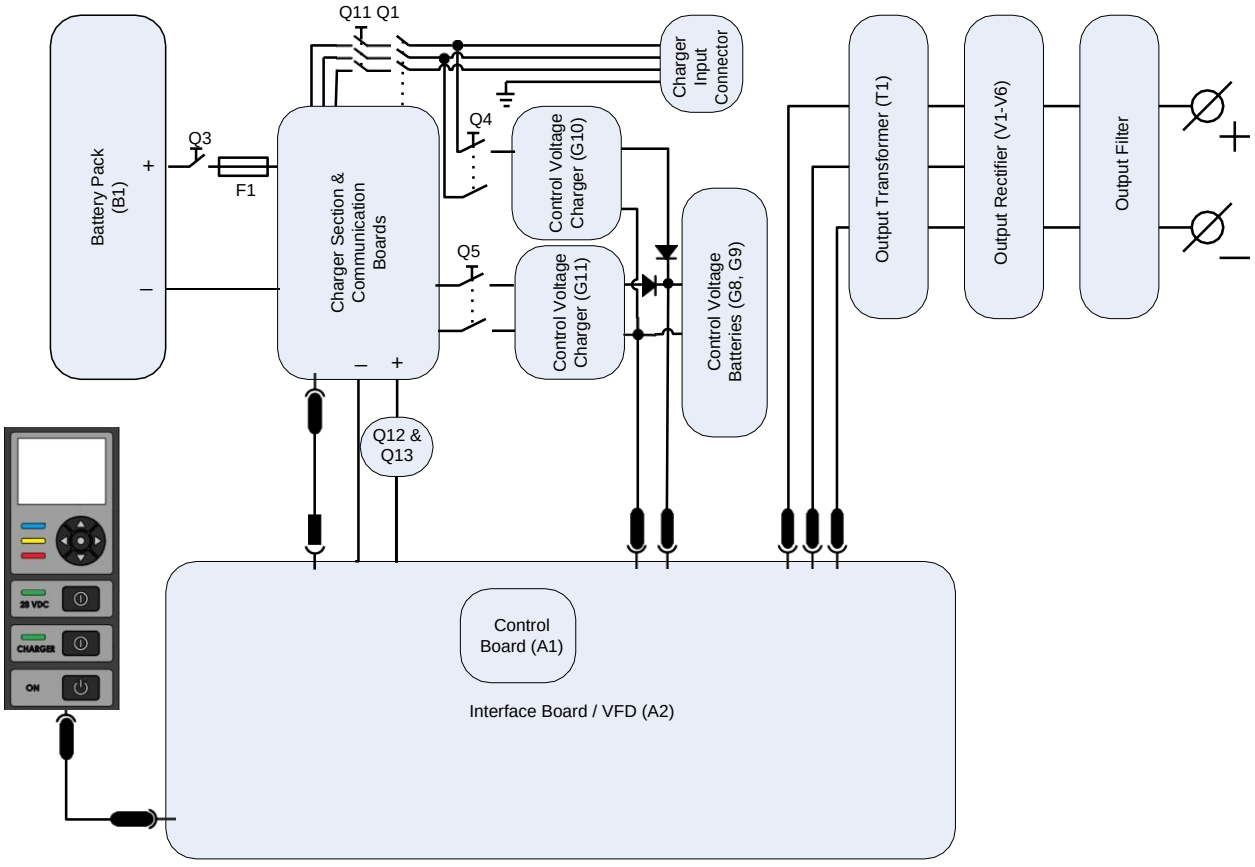
CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.

KEEP THESE INSTRUCTIONS

3.0 General Description

The ITW GSE 7400 JetEx is a compact Ground Power Unit that produces 28VDC for use in powering aircraft while they are on the ground. The output is powered by an internal rechargeable 40kWh battery pack. To create the regulated 28VDC that is required for the aircraft, a DC to DC converter lowers the nominal 400VDC of the battery to the specified power rating. In addition, an internal battery charger allows for simultaneous power to an aircraft while the battery is being charged by 50/60 Hz main/utility power.

The block diagram below shows basic operations of the 7400 JetEx. To provide the output voltage, the DC battery voltage is routed via Q12 and Q13 to an IGBT attached to the Interface Board (A2) that provides a PWM signal to the primary side of the output transformer, the output of which is then rectified and fed through an output filter to provide a clean 28VDC to the aircraft.



3.1 Basic Operations Block Diagram (Refer to schematic for details)

Main/Utility Input Contactor (Q1):
The input contactor disconnects all power to charger and is controlled by the unit.

Service Switch (Q3):
Disconnects the Battery Pack from the Unit.

Main Power MCB (Q5):
This MCB protects the unit controls and can be used to power down the unit.

Battery Charger MCB (Q11):
The charger input is protected by the MCB.

Battery Pack (B1):
The battery pack has a nominal voltage of 400 VDC and a capacity of 40 kWh. For intercommunication and supervision, an internal BMS system monitors the battery. They are linked together by the CAN bus via the communication board and fed back to the interface board.

Control Voltage Charger (G10, G8 & G9, Q4):
When connected to the 50/60 Hz supply, charger G11 charges batteries G8 and G9. This battery voltage is used as internal control voltage. The control voltage for the internal supply is fed through control voltage battery MCB Q4.

Control Voltage Charger (G11, G8 & G9, Q5):
If **NOT** connected to the 50/60 Hz supply, charger G10 charges batteries G8 and G9. This battery voltage is then used as internal control voltage. The control voltage for the internal supply is fed through control voltage battery MCB Q5.

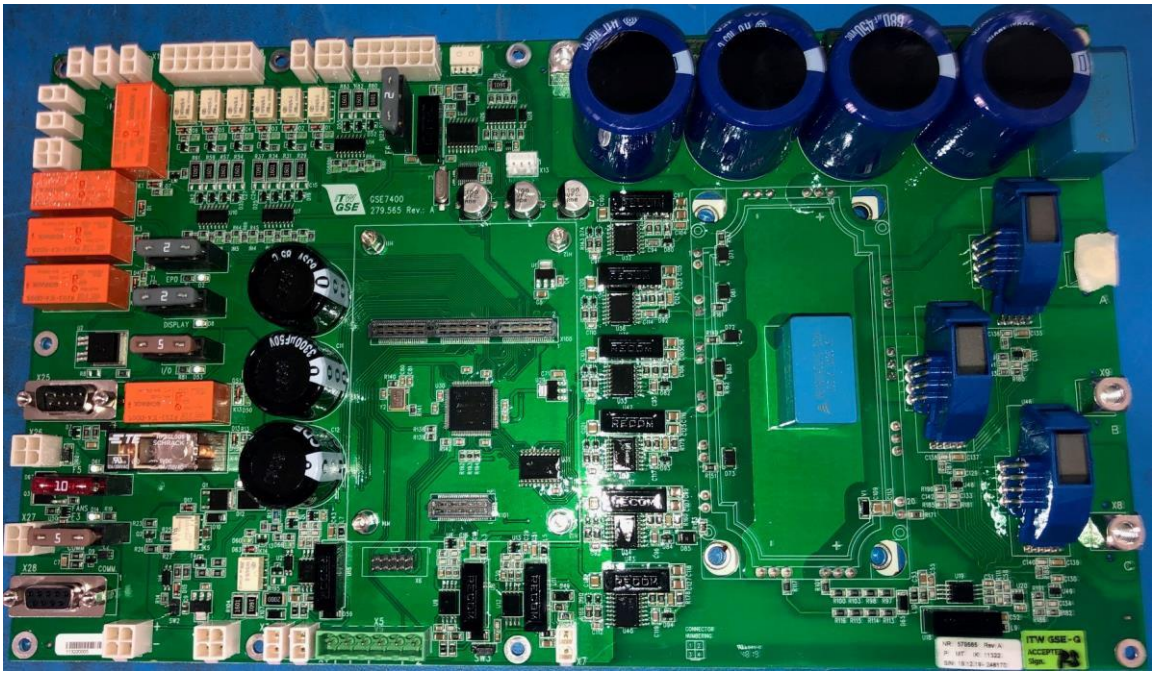
Main Power (Q12) and Pre-Charge (Q13) Contactors:
The battery pack power is switched as it goes into the interface board where the converter is located. Q13 has a resistor in series that slows the charge of the capacitors at the head of the converter, preventing a current spike to the battery when power is applied. This contactor is fired first until the capacitors are charged, then Q12 is closed for normal operation.

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 Rectifier (V1-V6):
Utilizing full wave rectification, six diodes take the three phase AC voltage from the Output transformer and rectify it to 28VDC.

DC Output Filter:
The LRC output filter takes the rectified voltage and ensures a consistent and stable DC voltage to the aircraft.

Interface Board / VFD (A2):
Interfaces between the control board and the rest of the ground power unit.



The interface module / VFD includes the following functions:

- Fuse (F1) 2A, EPO
- Fuse (F2) 2A, Display
- Fuse (F3) 5A, Communication Board
- Fuse (F4) 5A, I/O Power
- Fuse (F5) 10A, Fan Power
- Fuse (F6) 2A, GPS Power
- Control Battery Input (X1)
- Smoke Detector (X2)
- Grid Input Current (X3)
- Output to terminal X1 (X5)
- 28 VDC Feedback (X7)
- Converter Output C (X8)
- Converter Output B (X9)
- Converter Output A (X10)
- Battery Input – (X11)
- Battery Input + (X12)
- Connection for A6 EEPROM (X14)
- GPS Unit (X15)
- Output Transformer and Rectifier Temp Switches (X16)
- Grid Voltage Present Input (X17)
- Beacons Control (X18)
- Soft start (X19)
- External EPO input (X20)
- HVIL (X21)
- Mains Input contactor Coil Control (X22)
- Interface to the display board, CAN bus, 24 VDC, and EPO (X25)

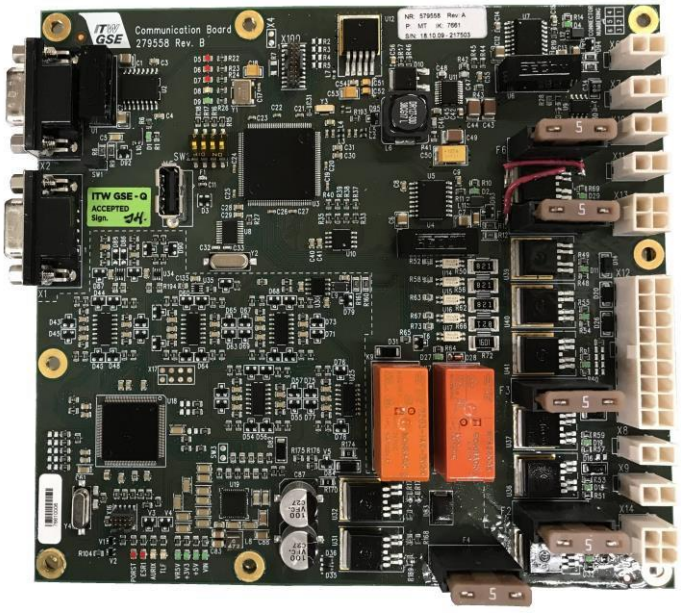
- Fan Control (X26)
- 24 VDC supply & EPO to Comm. Boards (X27)
- CANBUS to Comm. Boards (X28)

AUX Board (A5):
An additional interface board, with inputs for door sensors, beacons, siren, power supplies, control voltage batteries and more.

The AUX board includes the following functions:

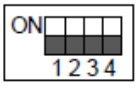
- Towbar sensor S4 (X4)
- +24 VDC input for Towbar magnet (X5)
- Grid Voltage Present (X6)
- Power Supplies G10 & G11 (X7)
- Batteries G8–G9 (X8)
- Control Voltage output to Interface Board A2 via MCB Q6 (X9)
- 24 VDC Aux Power & fused by F2 (2A) (X10)
- EPO Active Warning Signal (X11)
- Warning Beacon Input Signal (X12)
- Warning Beacon (X13)
- Warning Siren (X14)
- Towbar magnet (X15)

Communication Board (A12):
Used to interface between the control board and the battery pack/battery charger via the CAN bus.



The communication board includes the following functions:

- CAN bus (X1)
- EPO (X8, X10)
- CAN bus connection to charger G11 (X6)
- Control of battery contactor Q12 (X14)
- Leaf battery pack temperature sensor S6 (X7)
- CAN bus and signals to and from battery pack B1 (X12)
- 24 VDC to 12 VDC DC/DC converter G12 (X13)
- DIP switch for Board Setup (all off):

A12: 

Supply Module 10 A (G10):

Charges internal batteries G8 & G9 when mains/utility power is connected (factory-set to 28 V).
This module has a wide input range.
It is supplied directly from the input connector and pre-fused via the two-phase circuit breaker Q4.

Supply Module 10 A (G11):

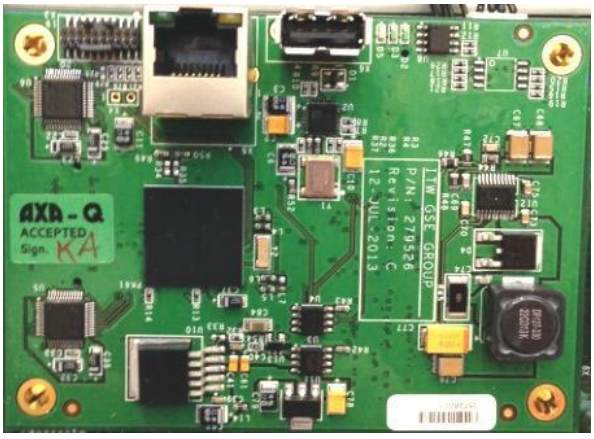
Charges internal batteries G8 & G9 when no mains/utility power is available, and the battery packs are enabled (factory-set to 28 V).
The module has a wide input range.
It is supplied directly from the Leaf batteries and is pre-fused via the two-phase circuit breaker Q5.

Charger Module (G1):

The Leaf battery pack (B1) is charged by a charger with a 15-kW capacity.
The charger has a wide AC input range.

Control Board (A1):

The control board is based on a microcontroller. Regulate, supervise, and diagnose possible external and internal faults as soon as the ground power unit is connected to the mains/utility power, and constantly during normal operation. The control board runs through a self-check program, which checks all the internal functions of the ground power unit. If an internal or external error is detected, the display shows the type of error. All immediate parameters related to a shutdown are stored in the ground power unit's memory. The control board has an on-board Ethernet RJ45 connector, used to communicate with the BMS and USB host Type A connection to retrieve data from the converter or to update the software.

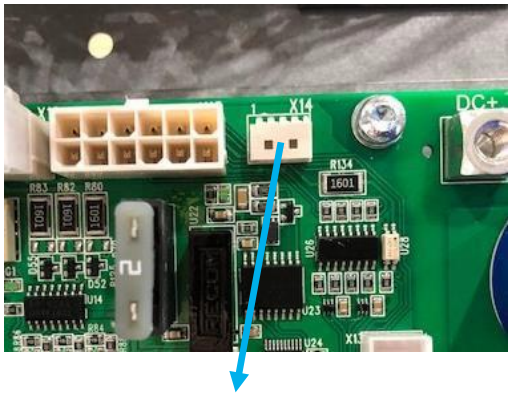


Display Board & Keyboard (A3/A4):

The display module serves as the interface for daily operation and is an integrated part of the unit. Furthermore, the display module includes a USB connection, used to download the black box and power logs, and for updating the display software.

ID Chip (A6):

The ID chip is connected to interface board A2 (X14) and is fixed behind the board.
It contains information on the GPU configuration and stores all setup values, black box and power log records.



Indicator Beacons – Unit Operation/Charging (H1) & Warning/Low Battery (H2):

The Indicator Beacons are located on top of the canopy of the unit. The colors can be modified as required. The standard configuration is as indicated below. The run beacon will flash when the unit is producing 28VDC or connected to the input grid. The warning/low battery beacon will flash when the Leaf Battery is below the minimum SoC to start parameter, when smoke is detected and when the EPO is activated.

H1 **H2**

Please refer to Sections 6.5 and 7.9 for low battery percentage indication setup.

3.1 Built-In Features/Protections

Over/Under DC Battery Voltage:
The DC voltage supervision monitors the battery's DC voltage. If the total battery DC level goes too low or too high, the unit trips to protect the battery pack and itself.

Over/Under Voltage during Output:
If the output voltage exceeds or falls below the levels in the table below, the unit automatically shuts down and opens the output contactor.

Output voltage V > 32.0V – 4 seconds
Output voltage V > 40.0V – 150ms
Output voltage V < 20.0V – 4 seconds

Overload:
If the output current exceeds the overload ratings in the table below, the unit shuts down to protect itself and the Leaf batteries:
Output Current 600A – 1200A, 120 seconds
Output Current 1200A – 1500A, 60 seconds
Output Current 1500A – 1900A, 30 seconds
Output Current 1900A – 2400A, 10 seconds
Output Current 2400A, Maximum

Internal High Temperature:
If for some reason the internal temperature of the rectifier module or output transformer rises above the factory-set temperature level, the unit shuts down, reporting either "*RECTIFIER TEMP TOO HIGH"* or "*TRANSFORMER TEMP TOO HIGH*"

Control Voltage Error:
If the control voltage supplied from G8 & G9 is <20 VDC,
the unit shuts down and reports "Control Voltage Too Low"

Interlock:
If the output cable is equipped with a 'split C' pin in the 28VDC plug, this function will not allow the output to be engaged if it is not connected to an aircraft.
To disable/bypass/activate this function, see Sections 6.5 and 7.6.

Aircraft Connector Insertion:
This feature verifies that the 90% switch in the 28VDC plug is activated.
If not activated, the respective outlet cannot be engaged.
To disable/activate this function, see Sections 6.5 and 7.7.

4.0 Transportation and Installation

4.1 Storage Before Installation

To guarantee optimal storage conditions prior to installation, we recommend that the ITW GSE 7400 is stored indoors. This protects the unit from rain and excessive humidity while it is unwrapped and not being used.
Only equipment in rainproof packing should be stored outside.
For storage conditions, please refer to Section 5.0.

4.2 Disposal of packaging material

The ITW GSE 7400 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 7400 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/ratings 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 no 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 7400consists of metal (steel plates), non-ferrous metals (copper and aluminum), fiberglass (canopy), Li-ion batteries (Leaf battery package), electronic components (PCBs, capacitors, fuse, 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 authorized by the national environmental agencies to carry out these activities.

4.4 Operating and Environmental Conditions after Commissioning

When the ITW GSE 7400 has been installed and commissioned, we strongly advise that the unit is always kept charged and ready to use.
For operating conditions, please refer to Section 5.1
For warranty conditions, please refer to section 5.2

4.5 Transportation

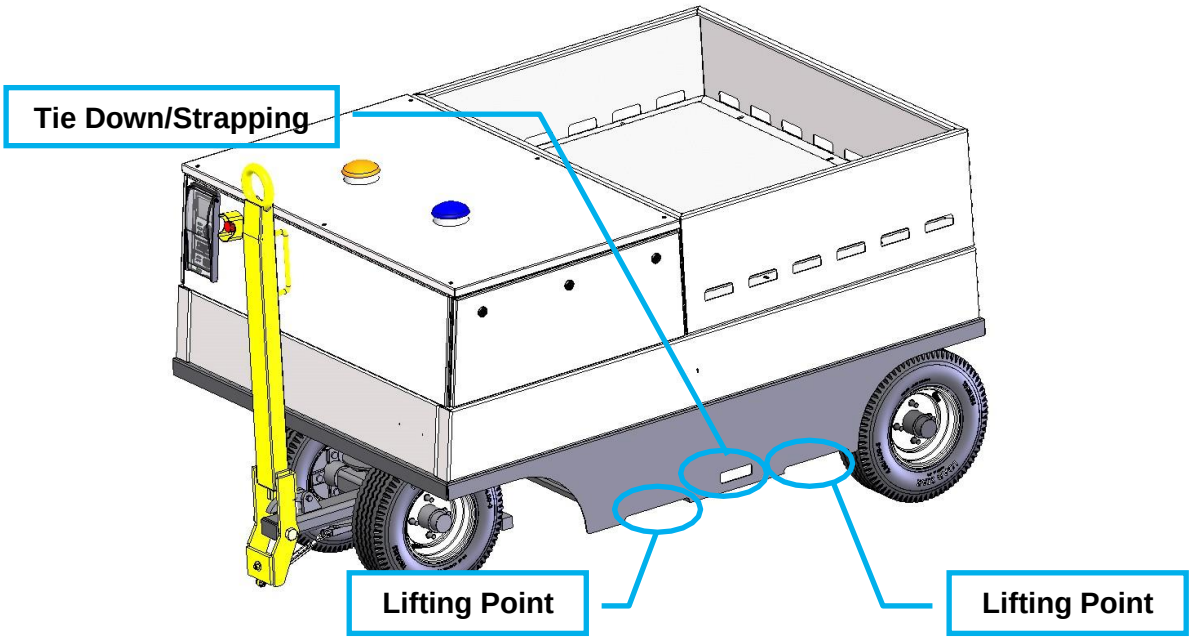


Fig. 4.5.1 Lifting points for Forklift, Truck, or Similar. Tie Down location

DO NOT strap over top of the unit for transportation

4.6 Preparation before use

Before the ITW GSE 7400 can be released for operation, the unit must be prepared.
The ITW GSE 7400 is delivered with the Main Power MCB (Q5) switched off.

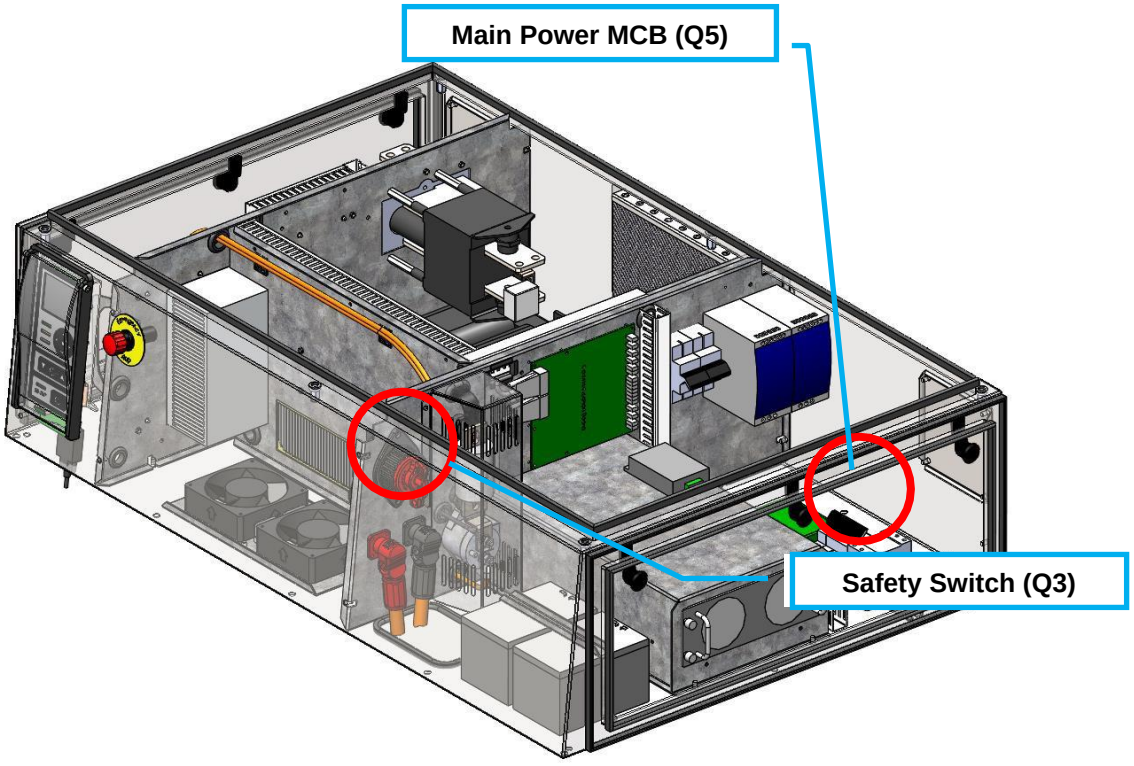


Fig. 4.6.1 Breaker Q5 / Safety Switch Q3

Q3 and Q5 can both be accessed behind the quick release side panel as shown in Figure 4.6.1.

1. Verify that the “Safety Switch Q3” is in the “ON” position; if not, switch it “ON”.
2. Switch “ON” the double pole Main Power breaker Q5.
3. The unit goes through initialization and, after 10-15 seconds, the unit is made ready for operation.

Note
The unit will automatically go into sleep mode if not used for 15 minutes.

4.7 Connection of Output Cable

Before connecting any cables to either the input or output, ensure that the ITW GSE 7400 is **switched off**.

Follow the Lockout/Tagout procedure in section 8.1 before performing ANY internal connections.

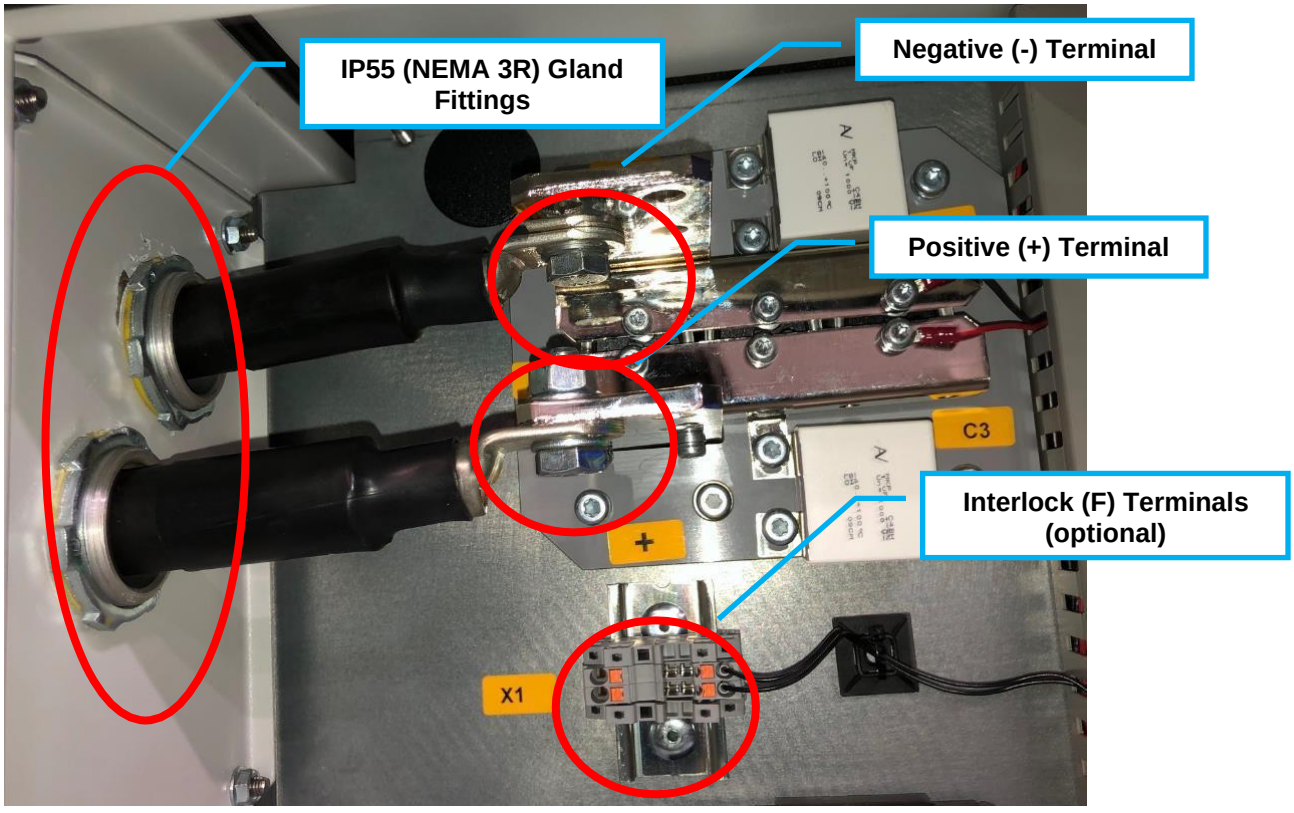


Fig. 12.2.1 Connection of cables

28 VDC Output terminals: 2 x 4 x ø11 (M10 bolt) 50Nm (444 in-lb)
Interlock terminals: 2 x 0.4 - 4 mm² (AWG21 – 11)

Note
Recommended output cable dimension to the aircraft is 2 x 120 mm² to minimize the voltage drop.

4.8 Mains/Utility Input

Before connecting any cables to either the input or output, ensure that the ITW GSE 7400 is **switched off**.

Follow the Lockout/Tagout procedure in section 8.1 before performing ANY internal connections.

For reasons of personal health and safety, the ITW GSE 7400 unit must always be protected by grounding the PE terminal ( ) during charging.
NOTE: The minimum ground wire size is 16 mm² / #6 AWG.
Consult local authorities to ensure this meets local requirements.
(Specifically, in accordance with *Canadian Electrical Code, Part 1* where applicable)

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

Outlet Size	16 A	32 A
Charging Line Current @ 3x 480V	16 A	32 A
Charging Line Current @ 3x 400V	16 A	32 A
Charging Line Current @ 1x 220V (L1, L3 & PE)	16 A	32 A

Note: Maximum grid power ampere (in steps of 1 A) can be set, according to the available mains/utility outlet, please refer to section 6.5.2 for further information.

Regardless of installation method, local regulations and legislation must be followed to ensure personal health and safety.

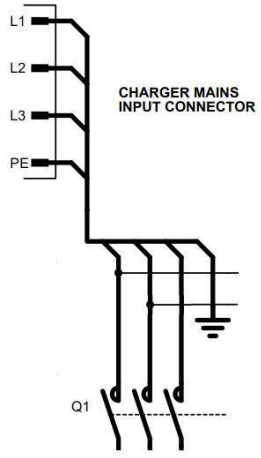


Fig. 4.7.2 Input (Charger) cable connections

50/60 Hz input terminals: 3 x M8 (3x ¼-20 by 1”) 6 Nm (53.1 in-lb.) (L1, L2, L3)
1 x M10 bolt 50 Nm (444 in-lb) (Ground/PE)

4.10 28VDC Interlock

The interlock safety system ensures that the output contactor stays engaged for as long as the aircraft connector is inserted into the aircraft receptacle. The 7400 connector provides 28 VDC back to itself on the F terminal.

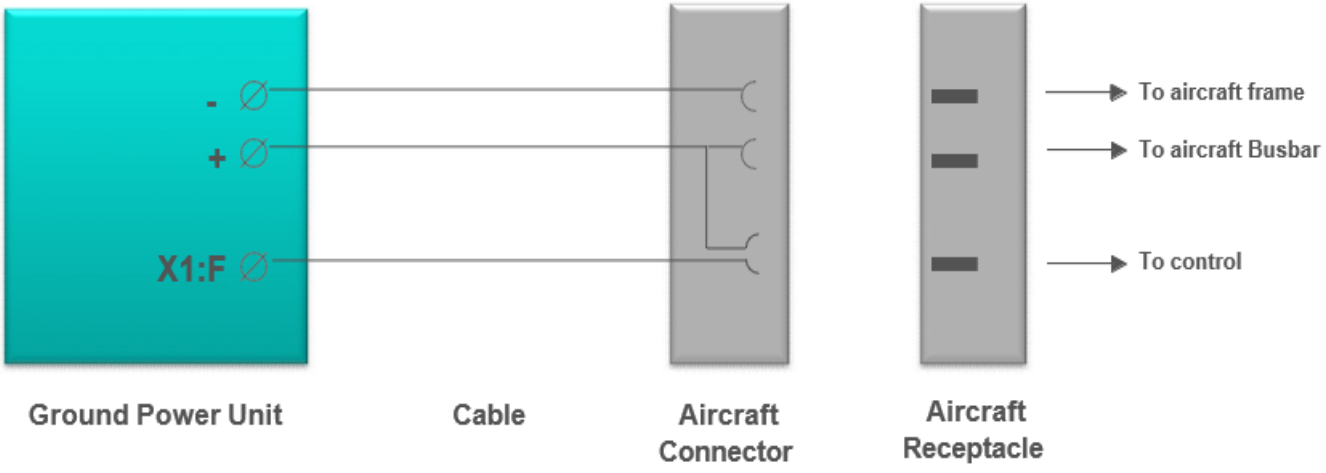
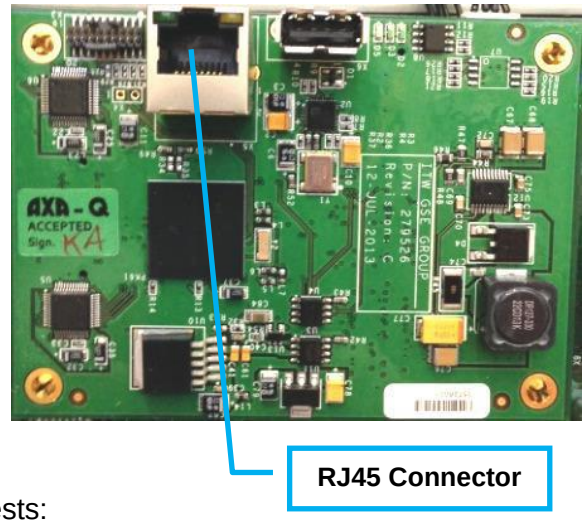


Fig. 4.10.1 Standard Wiring Diagram for Commercial Aircraft

4.12 TCP/IP On-Board Interface

The ITW GSE 7400 is equipped with a TCP/IP (RJ45) communication port for supervision and monitoring of the GPU by 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 ITW GSE 7400 is comprehensive and should meet most requirements.

Supported Modbus Function Codes

The ITW GSE 7400 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 on standby, and system fault.
- The GPU provides a comprehensive range of internal and external parameter measurements and information, e.g. voltages, currents, temperatures, time and date.
  - 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
Please refer to Section 6.3 and Sections 7.13 and 7.14 for communications setup.

5.0 Technical Specifications & Warranty

5.1 Technical specifications and information

Standards:

ISO 6858:2017(E)	Aircraft ground support electrical supplies – general requirements
BS 2G 219	General requirements for ground support electrical supplies for aircraft
SAE ARP 5015	Ground equipment – 28VDC ground power performance requirement
MIL-STD-704F	Aircraft electrical power characteristics
EN2282	Aerospace series characteristics of aircraft electrical supplies
EMC & Safety Standards	Please refer to the declaration of conformity, Chapter 1
EN 62619	Safety requirements for secondary lithium cells and batteries, for use in applications

Input:

Charging Time (Based on charging only):

Voltage/Phase	480VAC/3	480VAC/3	400VAC/3	400VAC/3	220VAC/1	220VAC/1
Outlet Size	16 A	32 A	16 A	32 A	16 A	32 A
Charging Time	<8h	<4h	<10h	<5h	<16h	<8h

Values based on 3 x 480 V and 20°C ambient.

Phase	ABC
Inrush current	None
Power interruption	20 ms

Note: The charger is rated at 15kW and will only pull the appropriate amount of current for the input voltage. When the charger is operated at 220VAC/1, it will derate to 5kW.

Low Voltage Charging: In order to charge at a low voltage, Phase B must not be connected to the input. Additionally, the voltage between A and C must be between 180 and 240VAC.

Output:

When set to 28VDC and a nominal load of 200A, the 7400JetEx can provide power to an aircraft for up to 7 hours.

Depending on ambient conditions and usage, the capacity can be expected to decrease by up to 30% over 10 years.

Specifications:

Output:

Voltage	: 28 VDC
Current	: 600 A continuously
Voltage regulation	: < 0.5%
Voltage ripple	: < 2%
Voltage transient recovery	: Complies with ISO 6858 / MIL-704E
Overload capability	:

Output Current 600A – 1200A, 120 seconds
Output Current 1200A – 1500A, 60 seconds
Output Current 1500A – 1900A, 30 seconds
Output Current 1900A – 2400A, 10 seconds
Output Current 2400A, Maximum

To protect the aircraft, the output voltage is decreased by 1 V per 300 A in the overload range (600-2400 A).

Setup:

Output voltage	: 22-31 V
Voltage compensation	: 0-3 V per 600 A
Current limit	: 300-2400 A in steps of 50/100/200/300 A*

*Steps depending on chosen value in the setup menu.

Protections:

Rectifier temperature too high (95°C)

Transformer temperature too high (180°C)

IGBT Temperature too high (200°C)

Short Circuit at output

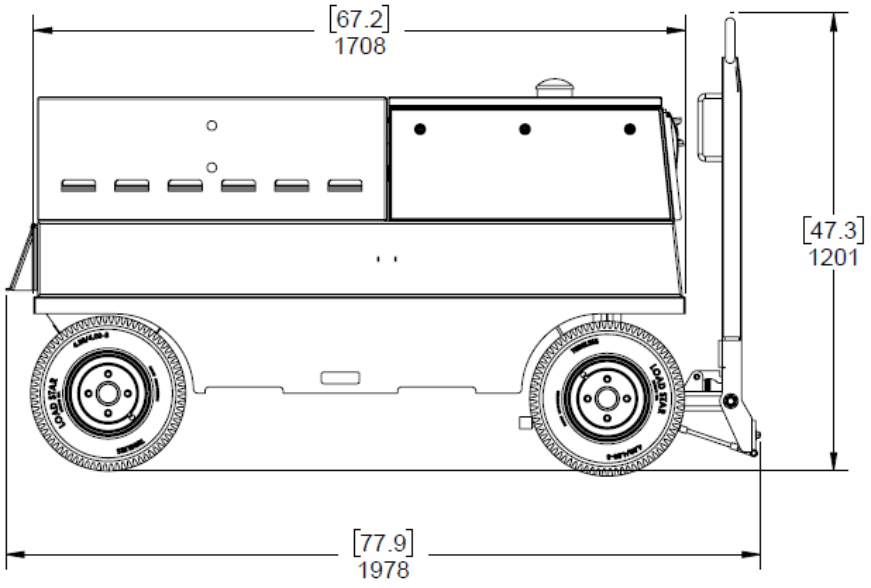
Over and under voltage at output in case:
U < 20 VDC for more than 4 seconds
U > 32 VDC for more than 4 seconds
U > 40 VDC for more than 150 ms

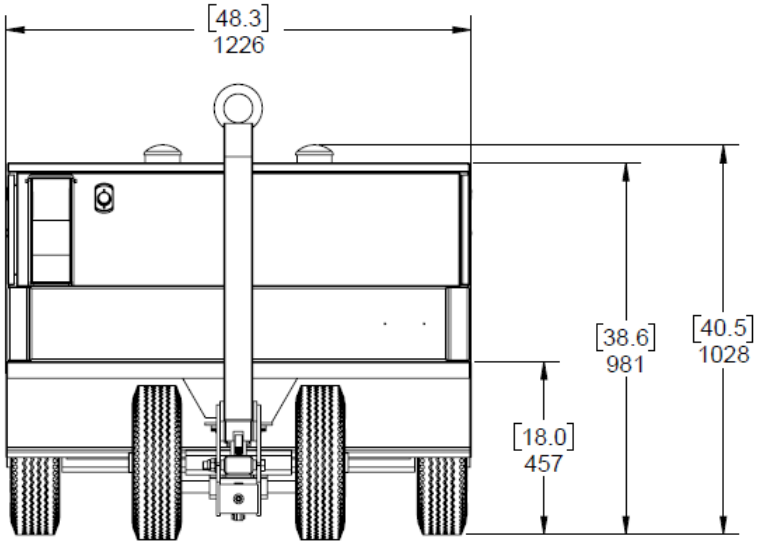
Battery over and under voltage

Control voltage error

Physical:

Dimensions (LxWxH):	1978 x 1226 x 1201 mm / 77.9 x 48.3 x 47.3 inches
Weight:	740 kg/1630 Lbs





Environmental:

Storage temperature	+10°C to +35°C / 50°F to 95°F & 20 to 70% RH
Operating temperature	-10°C to +45°C / 14°F to 113°F
Relative humidity	10-100% (noncondensing)
Noise level	<65 dB (A) @1m
Ingress protection	IP55 (NEMA 3R) Electronic Section

Miscellaneous:

Color	RAL 7035 standard, other colors on request
MTTR (converter/rectifier/charger)	Max. 20 minutes

5.2 7400 Battery Warranty Conditions

The ITW GSE 7400 battery is warranted for **5 years** against capacity loss below 72% of a new battery. The Lithium-ion batteries are designed to operate in avg. temperatures of 0°C (32F) to 35°C (95F).

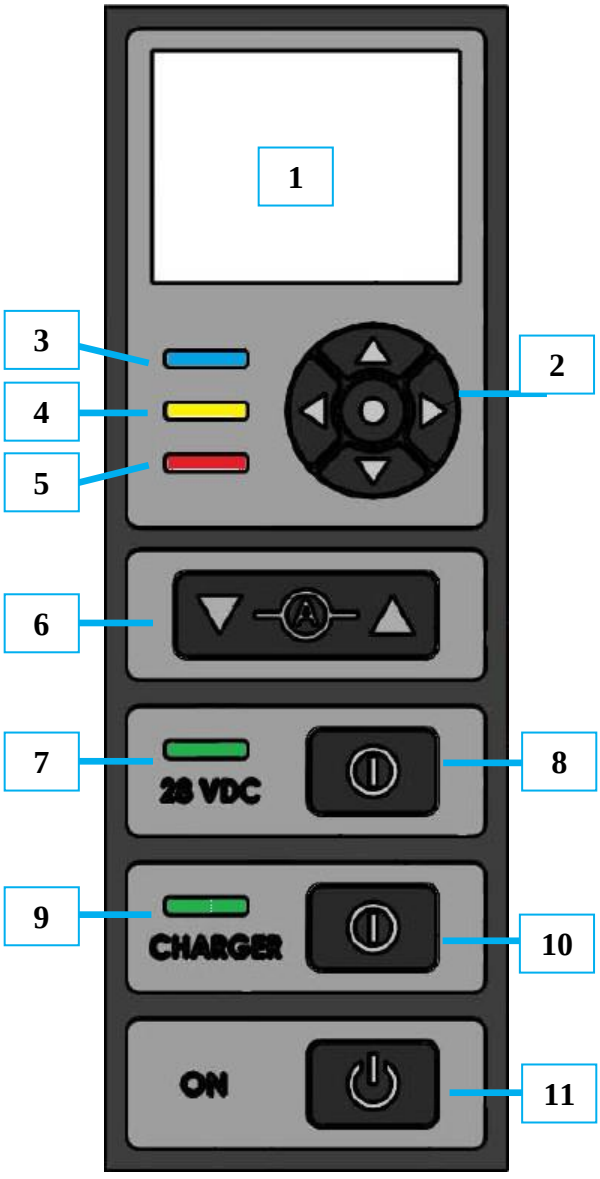
- As a condition of this warranty, you are responsible for properly using, maintaining and caring for your ITW GSE 7400.
- You are required to perform semiannual (½ Year) battery usage reports at intervals of 6 months, 12 months, 18 months, 24 months, 30 months, 36 months, 42 months, 48 months, 54 months and 60 months.
  These battery usage reports shall be performed by ITW GSE or any other certified partner/agent/distributor/person, which are appointed by ITW GSE.
- You are also required to provide consent to give ITW GSE access to data stored on ITW GSE 7400 systems for the purpose of ITW GSE 7400 diagnosis and repair. Failure to do so will likely result in denial of warranty coverage.
- To assist you in keeping appropriate maintenance records, the maintenance logbook can be retrieved from ITW GSE and be used along with supporting repair invoices, receipts and other such records.

This warranty does not cover damage or failures resulting from or caused by:

- Exposing the ITW GSE 7400 to ambient temperatures above 49°C (120F) for over 24 hours continuous.
- Storing the ITW GSE 7400 in temperatures below -25°C (-13F) for over seven days continuous.
- Leaving your ITW GSE 7400 for over 14 days where the lithium-ion battery reaches a zero or near zero state of charge.
- Physically damaging the lithium-ion battery or intentionally attempting to reduce the life of the lithium-ion battery.
- Exposing the lithium-ion battery to contact with a direct flame.
- Immersing any portion of the lithium-ion battery in water or fluid.
- Opening the lithium-ion battery enclosure or having it serviced by someone other than an ITW GSE certified technician.
- Consequential damage caused by the failure to repair an existing problem.

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

1 x 28 VDC output



1: LED Graphic Display
2: Navigation Keypad
3: Power ON "Blue" LED
4: Warning "Yellow" LED
5: Failure "Red" LED
6: Current Limit up/down
7: Output ON (28VDC) "Green" LED
8: Output (28VDC) ON/OFF
9: Charger "Green" LED
10: Charger ON/OFF
11. Power ON/OFF

6.1 Using the Display/Keypad

To enable 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. Depending on GPU status, the display shows operational data, warnings, or failure information in plain text, combined with a timestamp and a 4-digit code which, in combination with the manual, shows more detailed information on the reported message.

Note
Refer to previous pages for exact operator's keypad layout.

3 x LED Indicators

Blue LED:
As soon as the unit is woken up, this LED is illuminated.

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

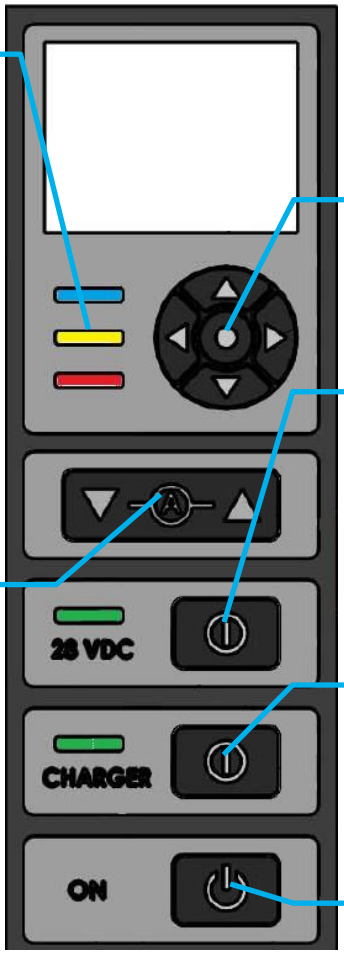
Red LED:
This LED is illuminated as soon as the unit shuts down due to a failure.

Current Limit Selection

▼ Press down arrow to decrement the current limit.

▲ Press up arrow to increment the current limit.

The size of the limit increments is selectable in the user menu.



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

Single push button for starting/stopping the unit.
The 28VDC LED turns **green** when the unit is supplying power at the output.
The push button also functions as a reset button.

Charger ON/OFF push button. Pressing this during charging enables the user to stop charging.

"Power On" push button

Fig. 6.1.1 Display/Operator Panel

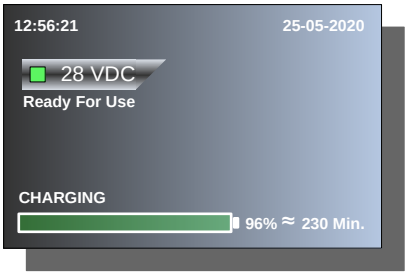
***A warning may appear during operation for the following issues:**

Cable Temperature Too High
EF Signal Dropout
Aircraft Connector Not Inserted

6.2 Charging the Unit

Connect the 50/60 Hz inlet plug to an appropriate mains/utility outlet. Depending on the configuration of the inlet charging cable and plug, it is possible to connect to a 32 A or less outlet*.
After connecting and switching on the mains/utility power, the charging starts automatically and is indicated with the "Green" charger LED.
When charging is completed or stopped by pressing the charger On/Off push button. Switch off the main/utility power and remove the input cable. The unit will go into sleep mode after 15 minutes.

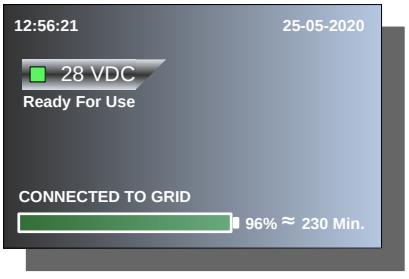
Default Screen Charging Display:



If, for some reason, the charging needs to be terminated before the batteries are fully charged:

- Press the Charger (On/Off)  button to stop charging.

This screen appears:



- Switch off mains/utility power and remove the supply cable from the outlet. Stow the inlet cable in the cable tray of the ITW GSE 7400 unit.

Or

- Press the Charger (On/Off)  button to continue charging.

Note

*See Section **7.10** to limit the charging current, to protect cable / pre-fuse. See Section **5.0** for approximate charging time.
Charging and supplying 28 VDC is possible simultaneously.

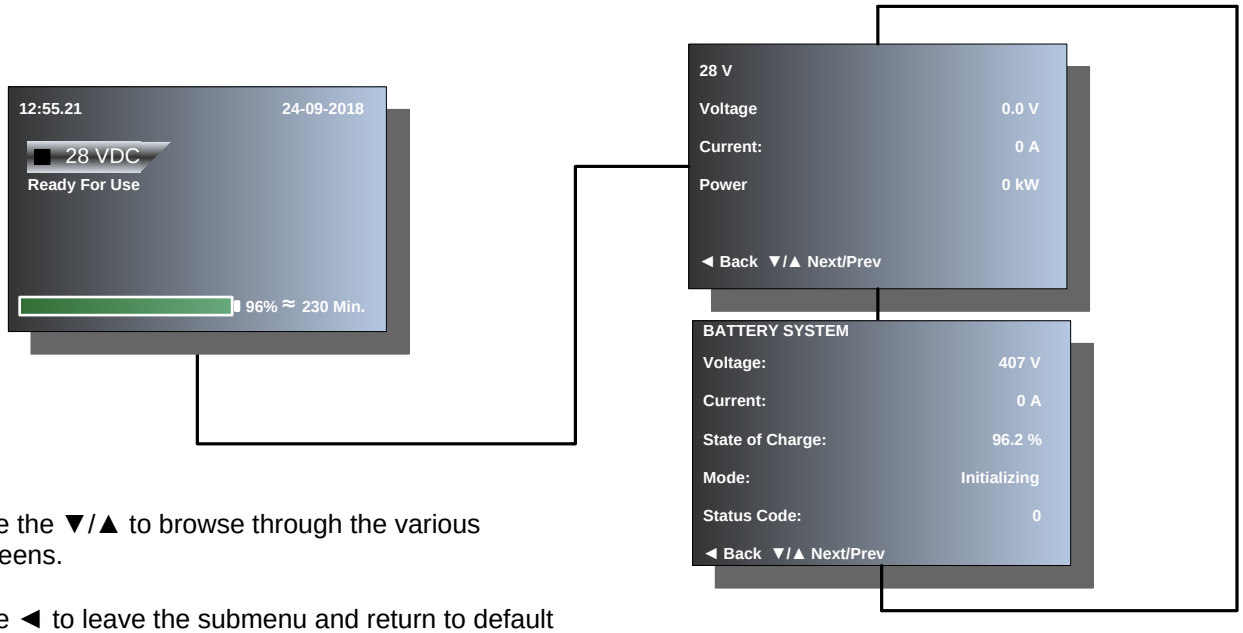
6.3 Operating the Unit

- Press the On/Off button to power up the GPU if it is not already under power.

- Insert the aircraft cable/plug into the aircraft. Make sure the plug is fully inserted until you feel a natural resistance. The plug may be equipped with a 90% switch/split "C" pin. If so, the unit will not function if the plug is not fully inserted.
- After initializing, press the corresponding to start the unit.
- The unit is now in operation and ready to supply the aircraft with power. Indicated with the green LED located next to the Start/Stop button.

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

Default Display Screen, Standby

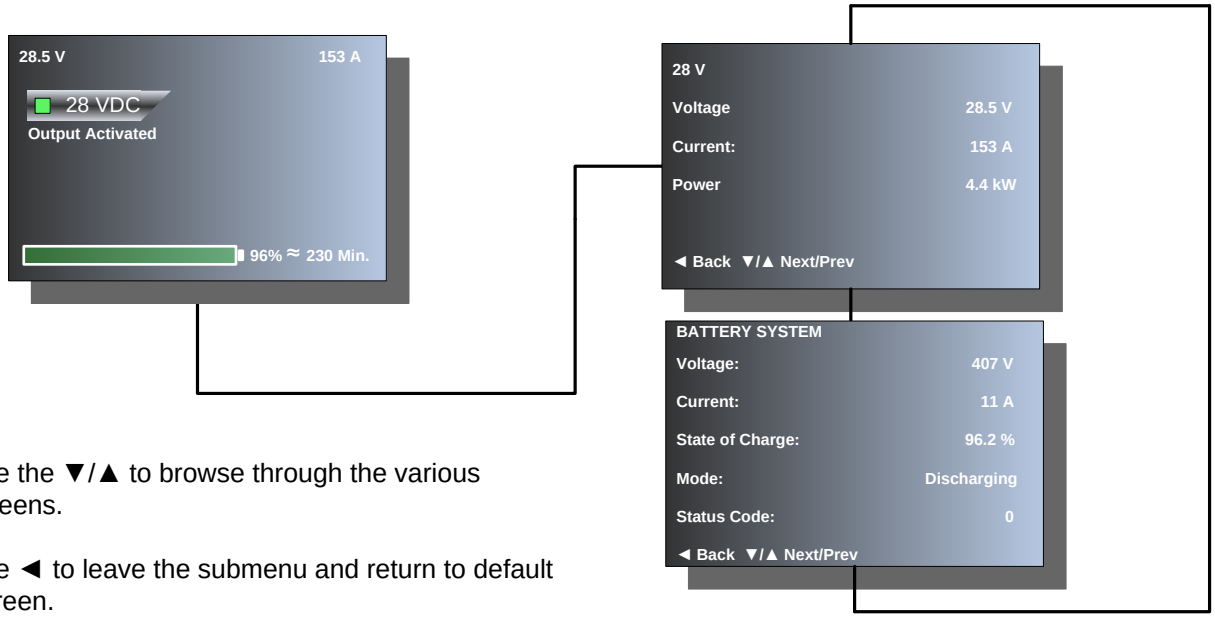


Use the ▼/▲ to browse through the various screens.

Use ◄ to leave the submenu and return to default screen.

Note
Parameters may vary depending on the unit mode (standby, operating, load profile, etc.).

Default Display Screen, Operating



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

Use ◄ to leave the submenu and return to default Screen.

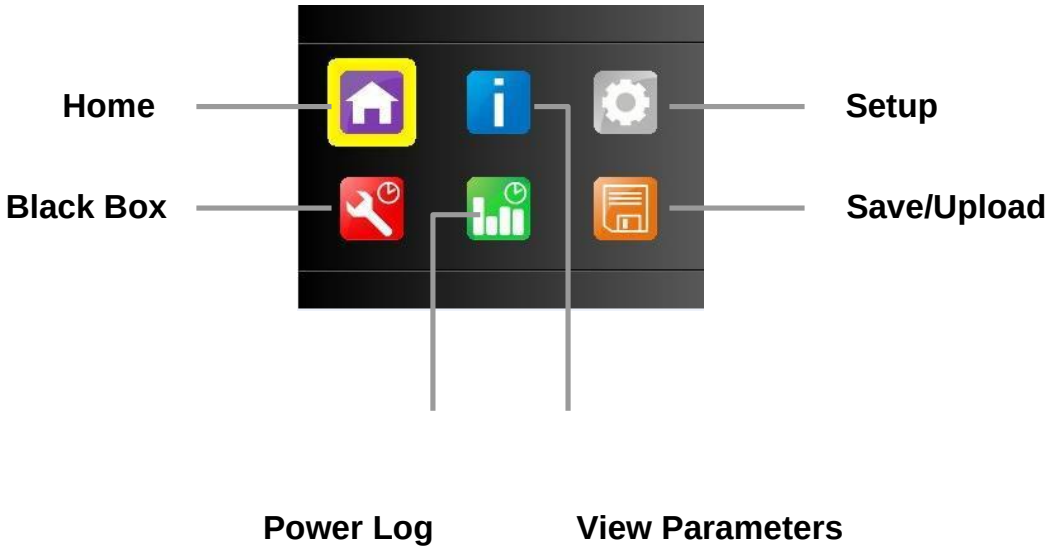
Note
Parameters may vary depending on the unit mode (standby, operating, load profile, etc.).

- After operation, press the Start/stop button  before removing the aircraft plug.
- Place aircraft cable in the cable compartment and close the door.
- The unit will automatically go back into sleep mode after 15 minutes.

Note
Please note that the Start/Stop  button also functions as a Reset button.

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

6.4 Basic Menu



The basic icon menu is shown above with the available submenus.

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

To select a submenu, simply use the navigation keys ◄▼▲► to highlight the icon and then press the ● to enter the submenu.

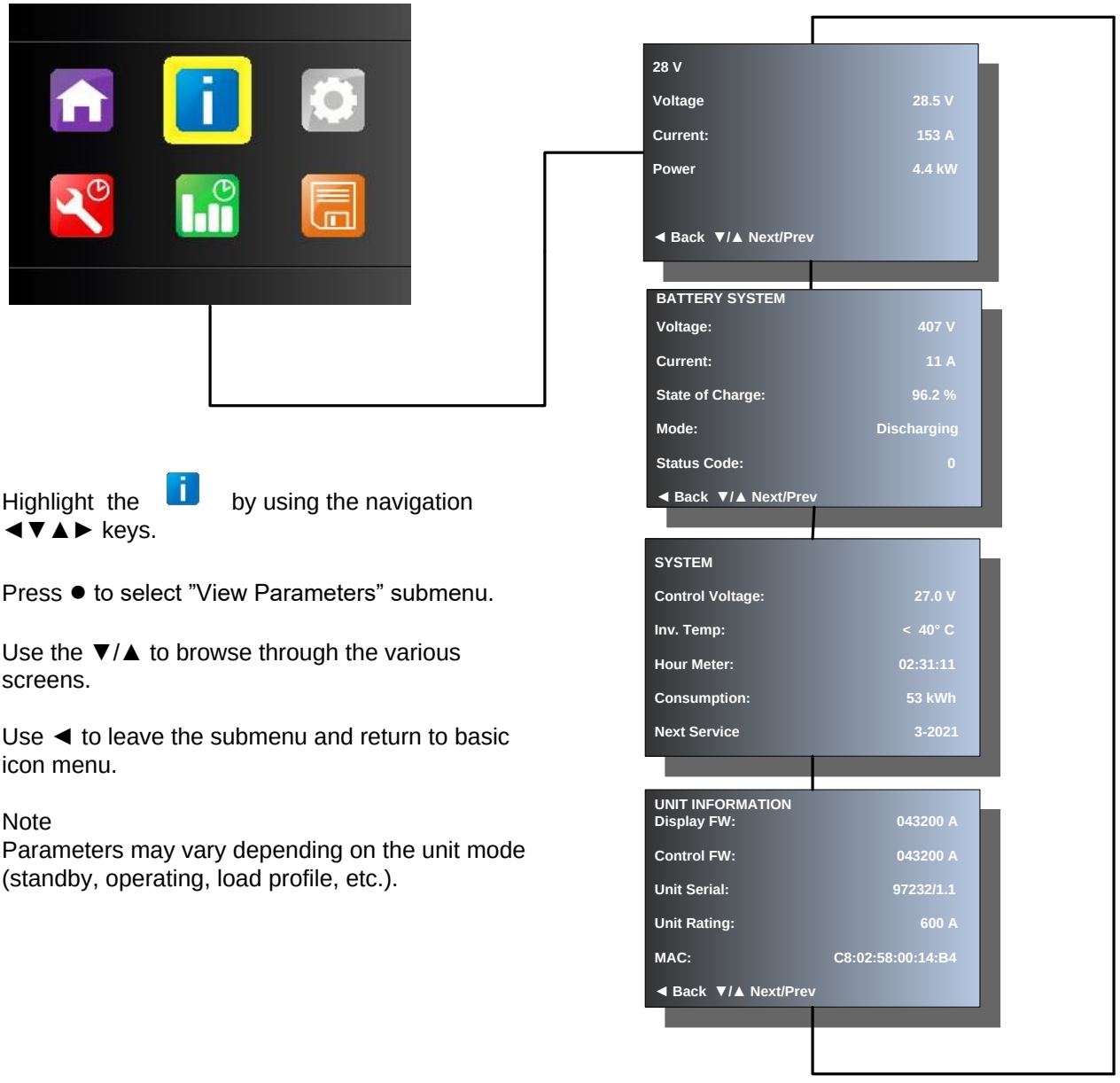
To leave the icon menu highlight the "Home" icon and press ●

Legend:

	Back to default screen
	View current converter parameters
	Setup menu for changing converter parameters
	Black box with last 100 failures/errors
	Power log with last 100 operations
	Save black box/power log records, or update software

*Detailed instructions on updating the software can be found in the document 699.135, which can be obtained from ITW GSE on request.

6.4.1 Parameters – Menu Structure



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

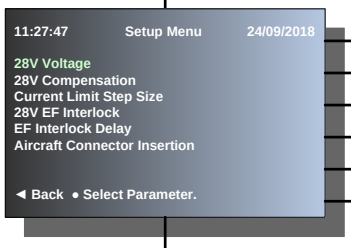
Press ● to select "View Parameters" submenu.

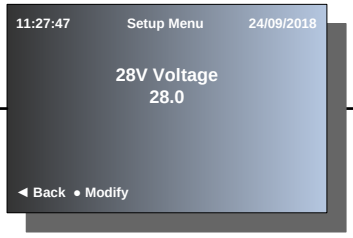
Use the ▼/▲ to browse through the various screens.

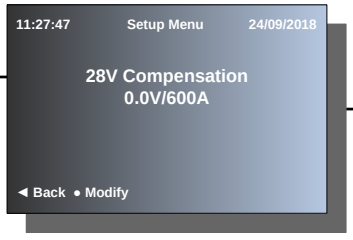
Use ◄ to leave the submenu and return to basic icon menu.

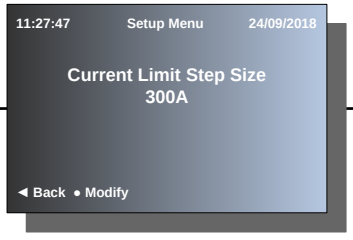
Note
Parameters may vary depending on the unit mode (standby, operating, load profile, etc.).

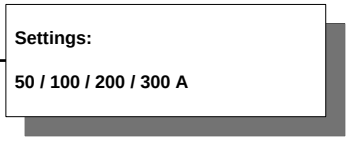
6.4.2 Setup – Menu Structure

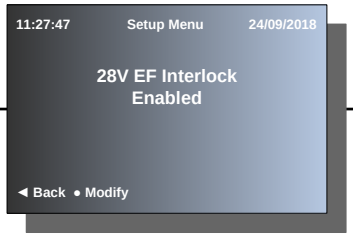


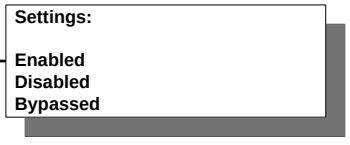


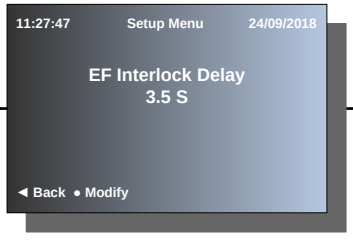


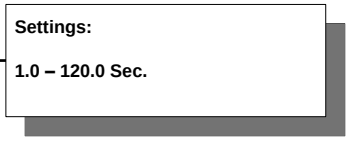


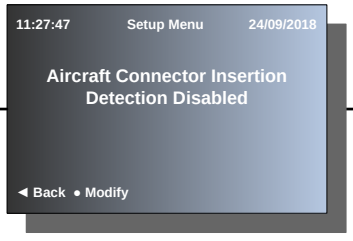


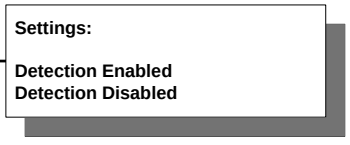












Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "Setup" submenu.

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

Press ● to select the parameter you want to change.

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

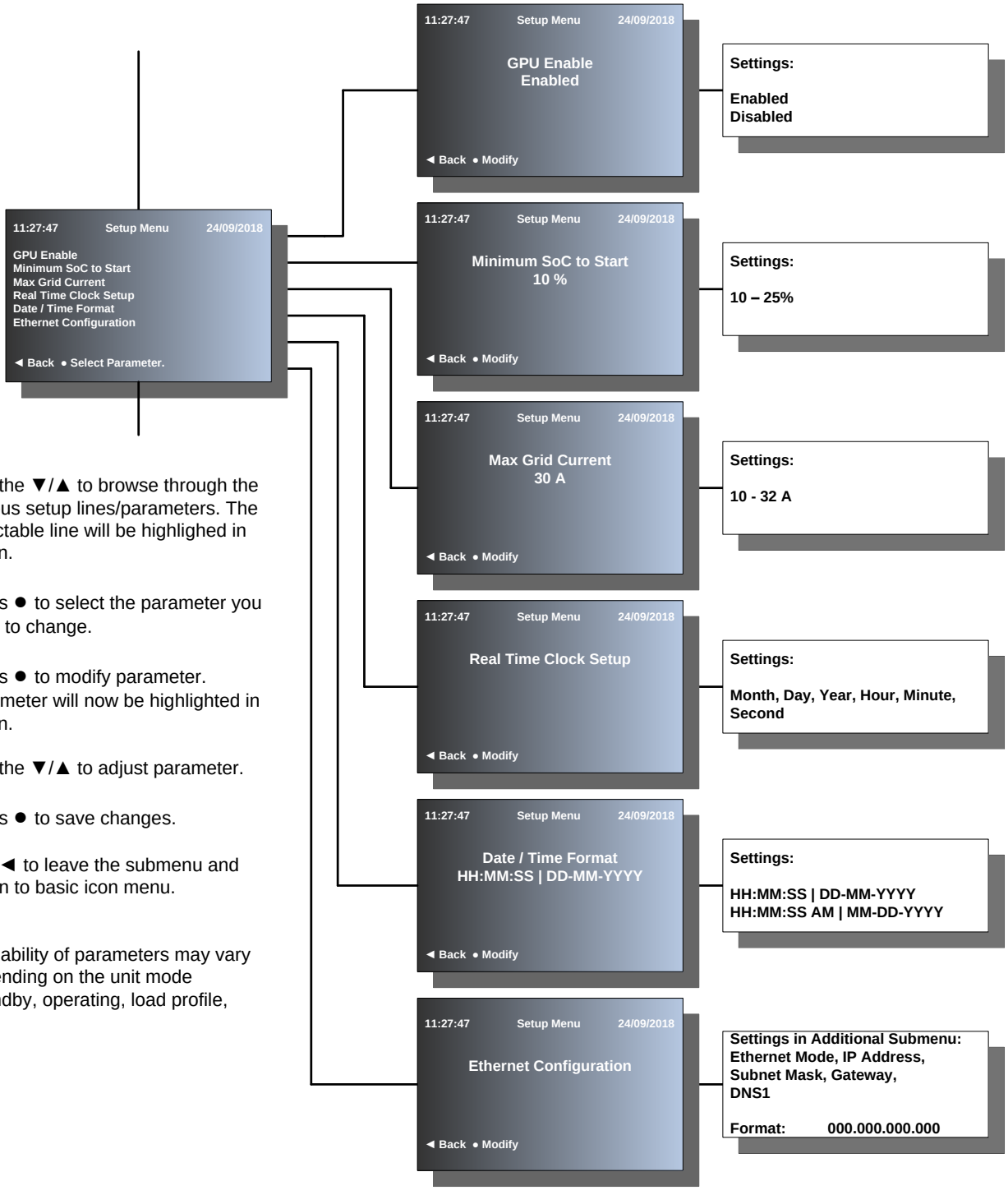
Use the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the submenu and return to basic icon menu.

Note
Availability of parameters may vary depending on the unit mode (standby, operating, load profile, etc.)

Setup – Menu Structure (Continued)



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

Press ● to select the parameter you want to change.

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

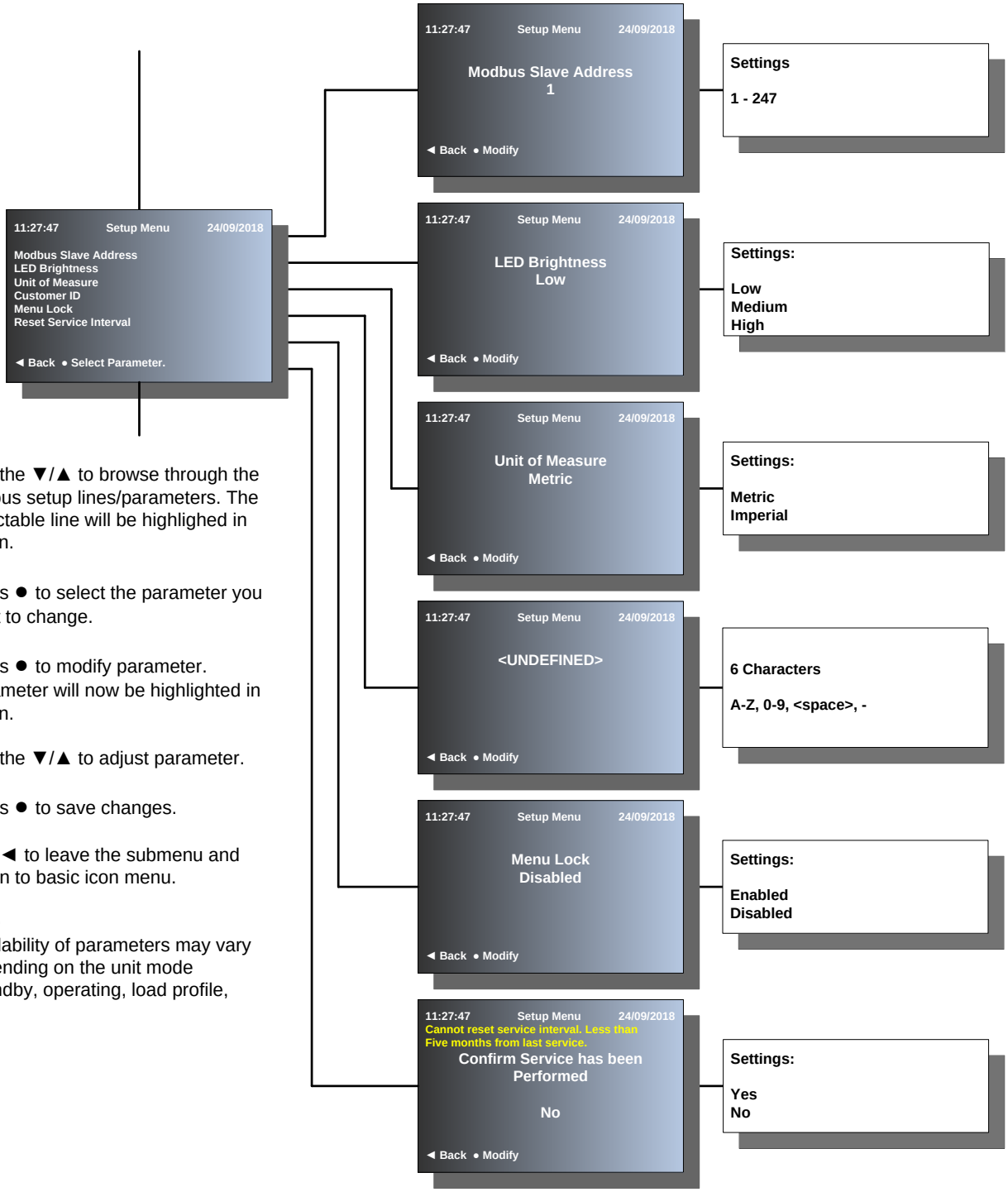
Use the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the submenu and return to basic icon menu.

Note
Availability of parameters may vary depending on the unit mode (standby, operating, load profile, etc.)

Setup – Menu Structure (Continued)



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

Press ● to select the parameter you want to change.

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

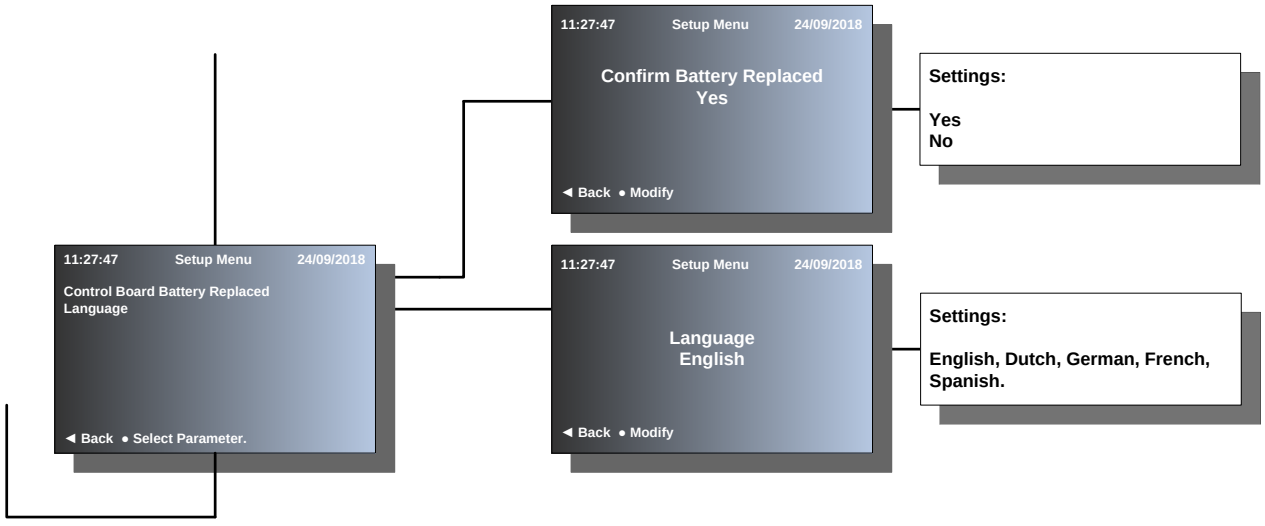
Use the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the submenu and return to basic icon menu.

Note
Availability of parameters may vary depending on the unit mode (standby, operating, load profile, etc.)

Setup – Menu Structure (Continued)



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

Press ● to select the parameter you want to change.

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

Use the ▼/▲ to adjust parameter.

Press ● to save changes.

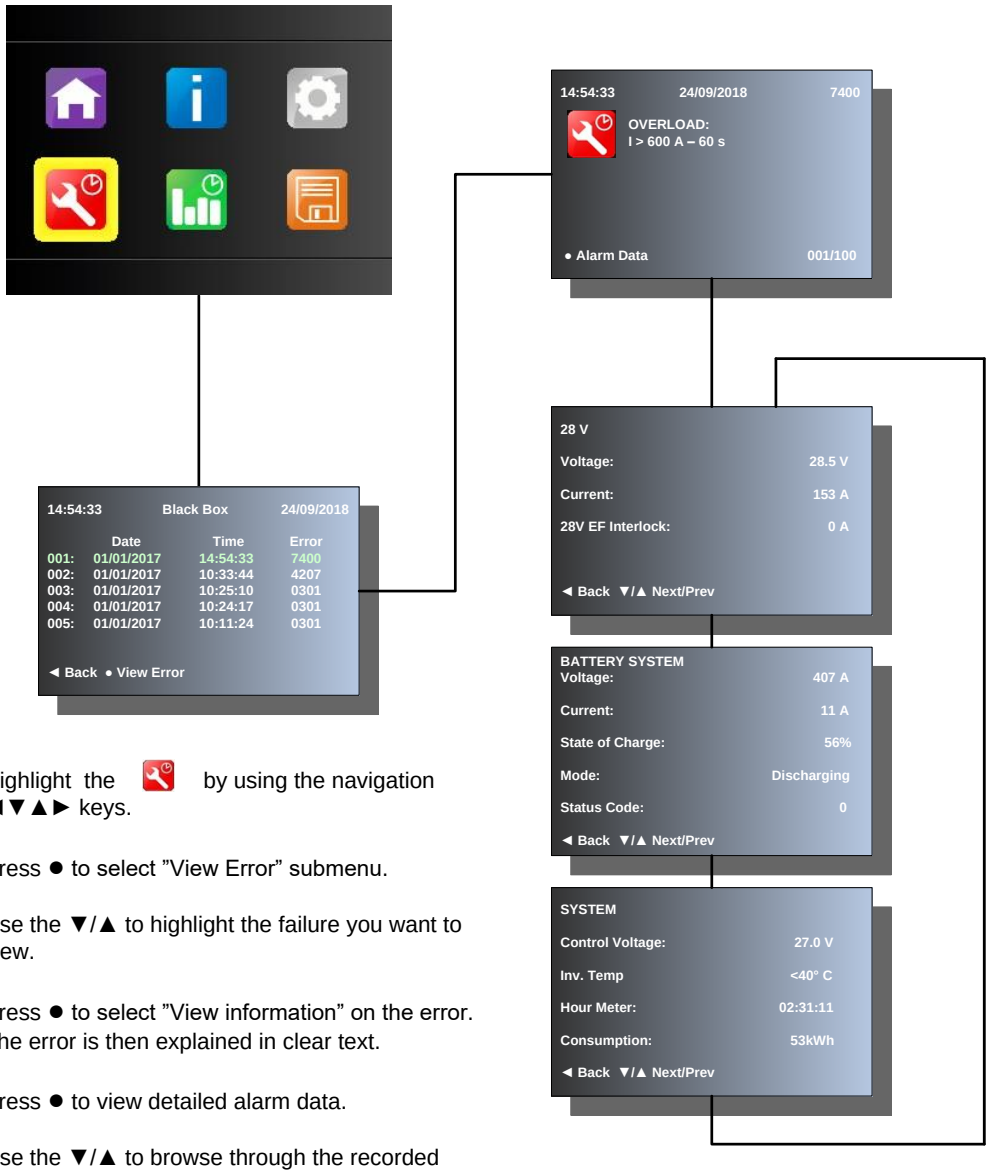
Use ◄ to leave the submenu and return to basic icon menu.

Note
Availability of parameters may vary depending on the unit mode (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.

6.4.3 Black Box – Menu Structure



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

Press ● to select "View Error" submenu.

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 submenu.

Use ◄ to leave the submenu and return to basic icon menu.

Note
The black box contains 100 recordings. When the limit is reached, the oldest failure is deleted.

6.4.4 Power Log – Menu Structure

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

Press ● to select "Power Log" submenu.

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

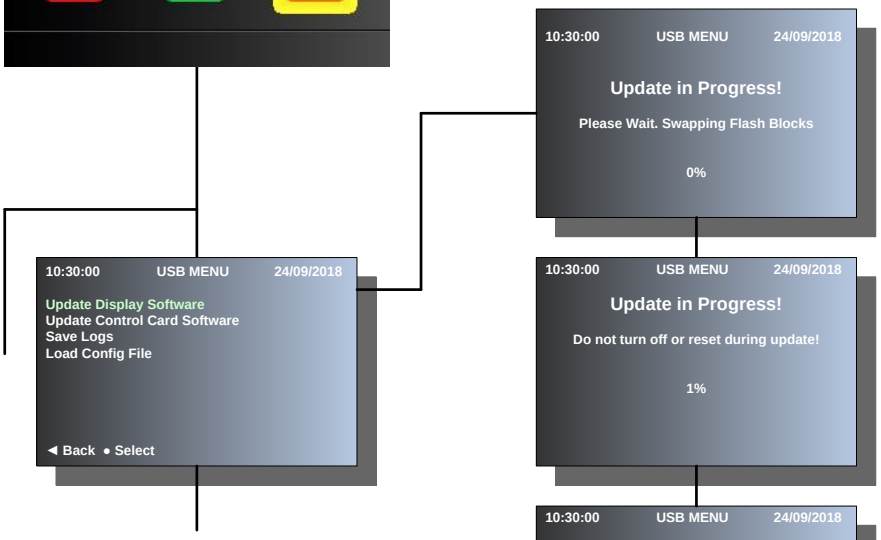
Use the ▼/▲ to browse to the next recorded event.

Use ◄ to leave the submenu.

Use ◄ to leave the submenu and return to basic icon menu.

Note
The power log contains 100 recordings. When limit is reached, the oldest log is deleted.

6.4.5 Update Software / Save Logs – Menu structure



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

Press ● to select "USB Menu" submenu.

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

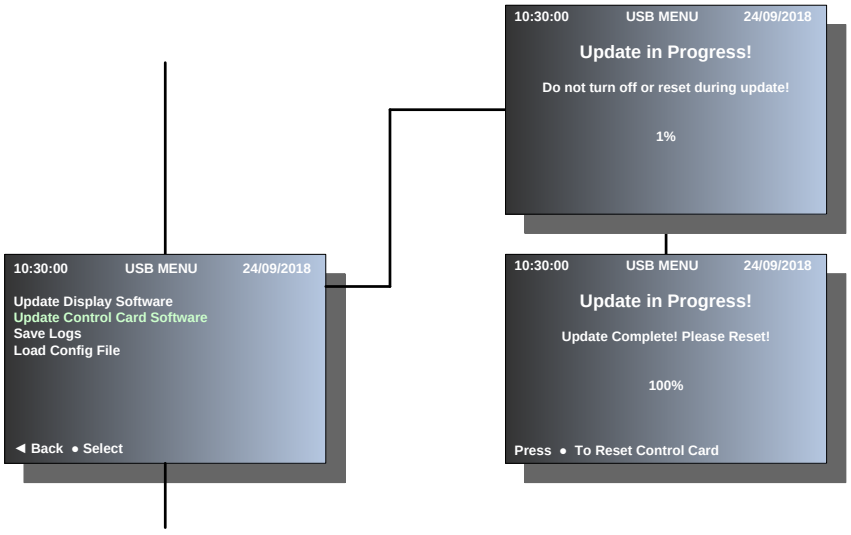
Press ● to select function and update firmware.

The firmware is now being uploaded to the display card. The upload percentage will count from 0% to 100% and "Update Complete! Please Reset" will be displayed when the update is complete.

To reset the unit, press the button ●

USB Connection Display

Update Software/Save Logs – Menu structure (Continued)



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

Press ● to select "USB Menu" submenu.

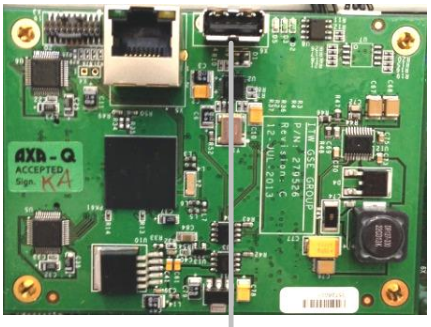
Use the ▼/▲ to highlight the function "Update Control Card software".

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

Press ● to select function and update firmware.

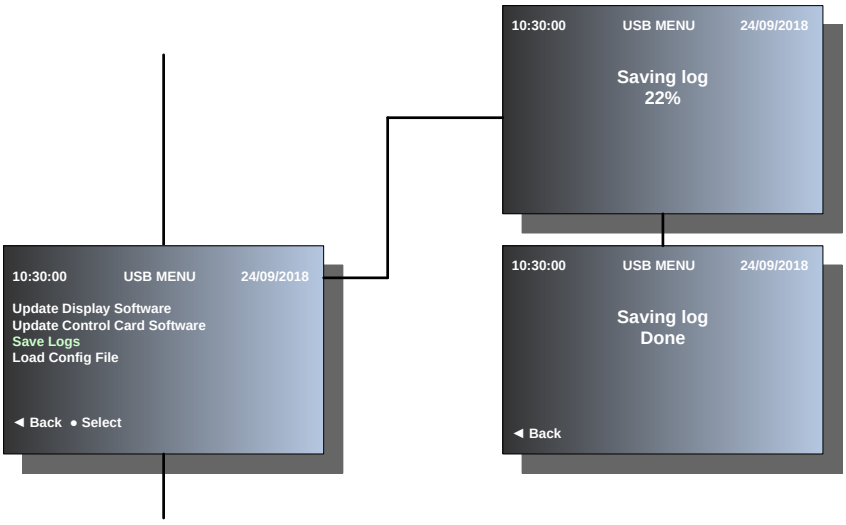
The firmware is now being uploaded to the control card.The upload percentage will count from 0% to 100% and "Update Complete! Please reset" will be displayed when the update is complete.

To reset the unit, press the button ●



USB Connection Control Card

Update Software/Save Logs – Menu Structure (Continued)



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

Press ● to select "USB Menu" submenu.

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.

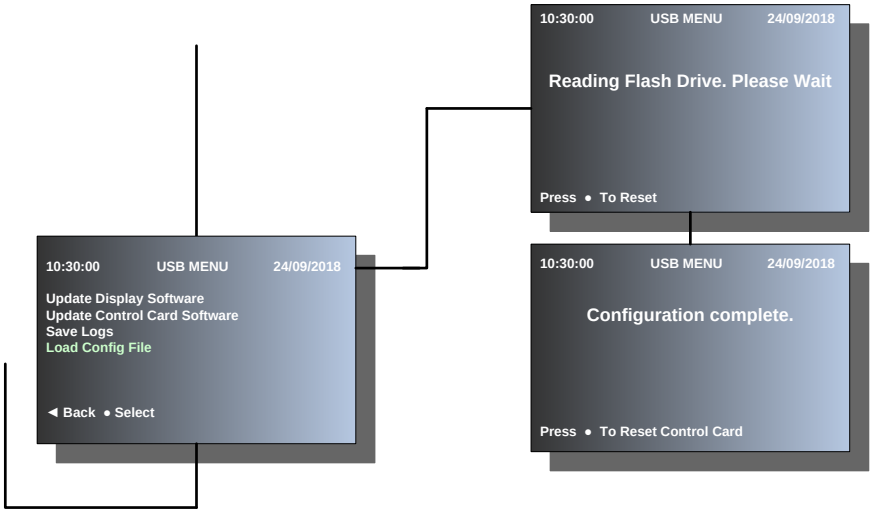
The logs are now saved to the USB stick. The log save percentage will count from 0% to 100% and "Done" will be displayed when saving is complete.

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

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

USB Connection Display

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



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

Press ● to select "USB Menu" submenu.

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 display (located on back of front door).

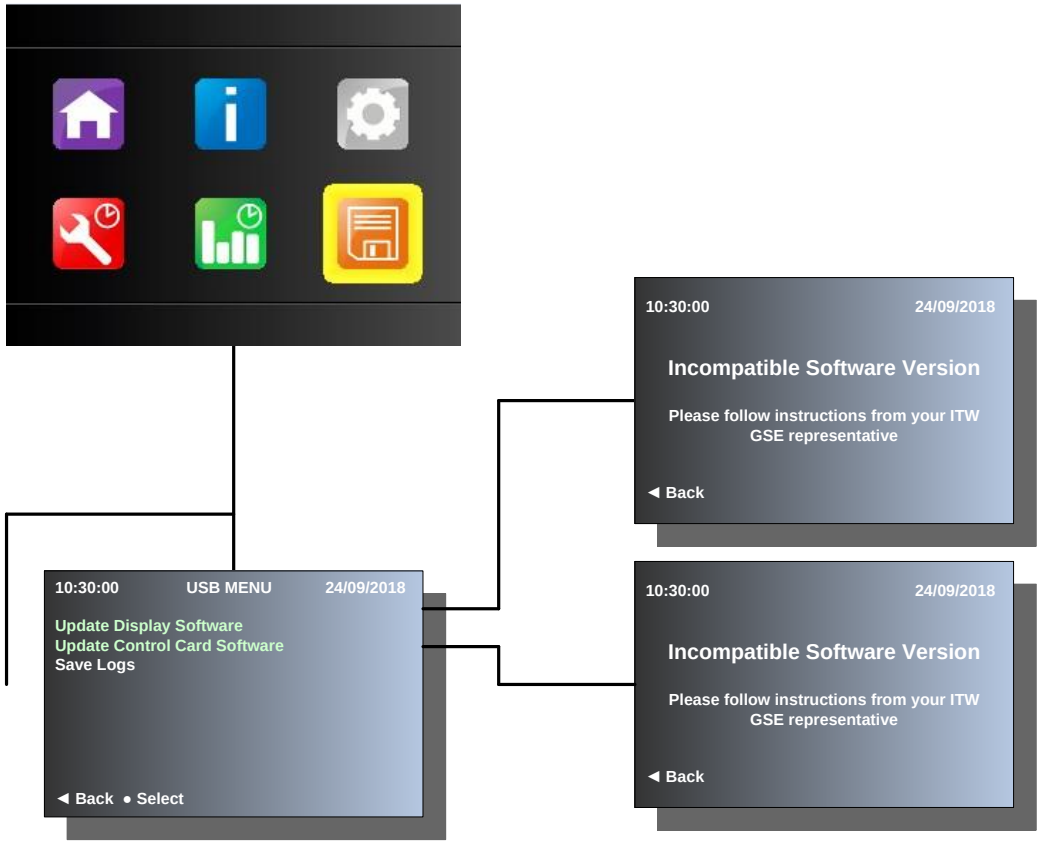
Press ● to select function.

The new unit configuration will now be uploaded from the USB stick and "Configuration complete" will be displayed when the upload is complete.

Press ● to reset control card.

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

6.4.6 Incompatible Software Version



If you try to install incompatible Software (for the display board or control card) the error **"**Incompatible Software Version**"** will be displayed.

Before changing software versions, consult ITW GSE. Alternatively, if you intend to proceed because you have already contacted or received the software files from ITW GSE, use the guidelines below to update the software:

1. Press ▼and▲ simultaneously for 5 seconds. The software will start automatically and will be updated.
2. Repeat Step 1 to update the other board or card.

6.5 Default Factory Settings

28V Voltage (VDC):	28.0
28V Compensation (V):	0.0 (Set if GPU supplied with cable)
Current Limit Step Size (A):	100
28V EF Interlock:	Bypassed (active if GPU supplied with split "C" cable)
Aircraft Connector Insertion:	Disabled (Enabled if supplied with cable with 90% switch)
GPU Enable:	Enabled
Real Time Clock Setup:	Actual (manufacturer's location)
Min. Charge to Start:	20%
Max. Grid Current:	Depends on supplied cable/plug (10-32 A in steps of 1A)
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 (USA)
Language:	English

7.0 Setup Lock/Output Mode/Compensation

7.1 Preventing Changes to Setup Parameters

To avoid unintentional modification of the setup parameters, it is possible to block access to setup mode by means of a DIP switch located on display board A3.

Note
If the DIP switch is set to blocked, pressing SW1 allows the user to enter the setup menu for 10 seconds. When the time has elapsed, the menu will be locked again.

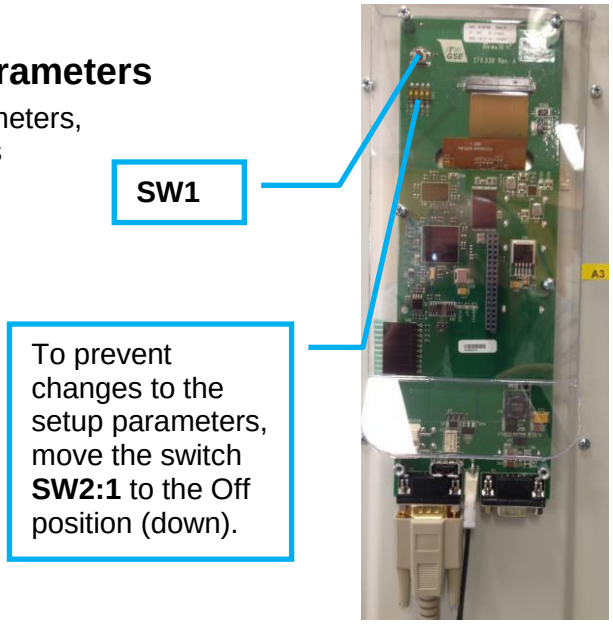
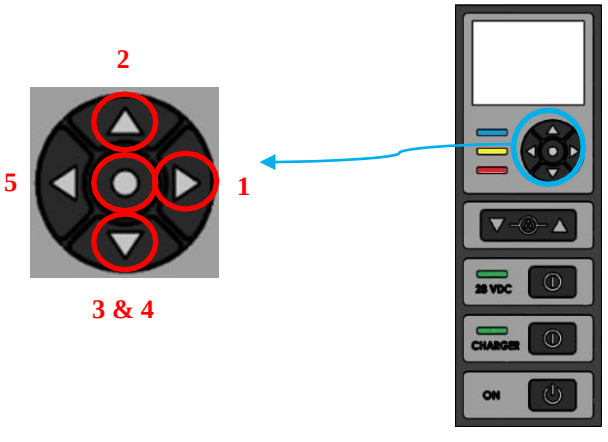


Fig. 7.1.1 Display Board A3

Note
The display is placed very close to the inverter module and not easy to reach. A combination of push button commands is used instead. To enter a locked display without pressing the SW1, simply push the 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"**



Now you can enter the menu similarly to pushing the SW1 button.

7.2 28V Voltage

This setup submenu allows the output voltage to be adjusted between 19.0 VAC and 33.0 VAC using the up and down navigation buttons.

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.

7.3 28V Compensation

This is the traditional method of cable compensation. The output voltage is increased in proportion to the load current (voltage / 600 A).
The compensation can be set from 0.0 to 3.0 V

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.

7.5 Current Limit Step Size

This submenu is used to set the current step size, by pressing the current increase / decrease push button on the Standby menu screen. The step size can be set to 50 / 100 / 200 / 300 A

Enter the Setup menu, and then scroll up or down to the Current Limit Step Size 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 28V EF Interlock (Split C)

This submenu is used to set the appearance of the GPU for the 28 VDC interlock signal. The signal can be set to either Enabled / Disabled / Bypassed.

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

7.7 Aircraft Connector Insertion

Some aircraft power cables are equipped with a micro-switch or split “F” pin in the connector. This device sends a 28 VDC signal to the unit when the connector is inserted at least 90% of the way into the aircraft power receptacle. Set this submenu value to Enable when such 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.

7.8 GPU Enable

This set of submenus allows the user to set whether GPU Enable is active or not. If set to “Enabled” the GPU looks for a high input signal on X28:I13, which will enable the GPU to be used. If set to “Disabled”, the GPU does not look for any signal and can be used immediately.

Enter 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.

7.9 Minimum SoC (State of Charge) to Start

This set of submenus allows the user to adjust the minimum battery capacity percentage value at which the user can start the unit.

Enter the Setup menu, and then scroll up or down to the Minimum SoC to Start 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 Max Grid Current

This set of submenus allows the user to adjust the Maximum Grid current, depending on the current available for charging the ITW GSE 7400 GPU and the installed charger cable/plug.

Enter the Setup menu, and then scroll up or down to the Max Grid Current 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 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.

7.12 Date/Time Format

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

7.13 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.

7.14 Modbus Slave Address

If the unit is 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.

7.15 LED Brightness

The unit status LEDs 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.

7.16 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.

7.17 Customer ID

This submenu allows the user to assign a name to the unit for reporting purposes when black box 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.

7.18 Reset Service Interval

This setup submenu allows the maintenance personnel to reset the service interval when service has been performed on the unit.

Enter the Setup menu, and then scroll up or down to the Reset Service Interval 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 Battery Replaced (Control Board)

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.

7.20 Language

This submenu is used to change the language that all display screens, messages, alarms, and reports are displayed in. The unit comes with English, German, Dutch, French, Spanish already installed. The default setting is 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 ensure the unit is always ready for use, it must be maintained on a regular basis.

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

8.1 Lockout/Tagout procedure

Lockout/Tagout Procedure

ID: ITW GSE 7400 Description: 28VDC Battery Ground Power Unit

5	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.

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	Input cable	Disconnect input cable	
	ELECTRICAL 400V	Electrical cabinet, charger side	Switch Q6 to the OFF position and lockout.	
	ELECTRICAL 400V	Electrical cabinet, charger side	Switch Q3 to the OFF position and lockout.	
	DC capacitors	Electrical panel, power module	Wait for 10 min. to discharge.	

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 7400 Daily / upon use **This inspection does not in any way suspend local / airport rules and regulations**	
01.	**Visual check of aircraft connector(s).**
	Check: Connector housing for damage / cracks and wear & tear. Connector Pins 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(s) for damaged insulation.**
	The insulation is intact, and cable(s) do not show any sign of cracks / damage.
03.	**Visual check of input charging cable and connector.**
	Check that the input cable insulation is intact, and cable(s) 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 and check brake.**
	Check all 4 tires for damage / cracks and wear & tear Check the brake to ensure that it locks the unit in position.
05.	**Visual check of all reflectors / beacons / siren.**
	Check reflectors for damage / function Check beacons for damage / function Check siren for damage / function

8.2.2 Quarterly

Maintenance Instruction for ITW GSE 7400 Quarterly **This inspection does not in any way suspend local / airport rules and regulations**	
01.	**Check aircraft connector(s).** Check: Connector housing for damage / cracks and wear & tear. Connector Pins 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 banks can be used to check the above
02.	**Check output cable(s) for damaged insulation.** The insulation is intact, and cable(s) do not show any sign of cracks / damage. Check output cable(s) using a load bank
03.	**Check input charging cable and connector.** Check the input cable insulation is intact, and cable(s) do not show any sign of cracks / damage. Check the input connector & pins for damage / cracks and wear & tear Check charging function, by connecting to 50/60 Hz grid
04.	**Check tires for wear and tear.** Check all 4 tires for damage / cracks and wear & tear Check for correct air pressure (6.8 bar = 99 psi).
05.	**Check all reflectors / beacons / siren.** Check reflectors for damage / function Check beacons for damage / function Check siren for damage / function

8.2.3 Semiannual (1/2 year) battery maintenance log

For software revisions not containing the menu screens, where you are able to read out the Histrorical Average Temperature / Average Discharge Power.

A USB can be used to download the parameters and then be viewed on a computer.
Downloading parameters please refer to section 6.4.5
Parameters downloaded can be viewed in ITW GSE Service Tool, which can be obtained from ITW GSE Web-Page or sent to you on request.

Please use additional document 675.405 to perform the semiannual battery log.

8.2.4 Yearly

Maintenance Instruction for ITW GSE 7400 Yearly **This inspection does not in any way suspend local / airport rules and regulations**	
01.	**Check aircraft connector(s).** Check: Connector housing for damage / cracks and wear & tear Connector Pins 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) Verify the output voltage at aircraft connector(s) with and without load Verify proper operation of the output contactor contact sets (max. 0.5 V voltage drop) and coil. Note Load bank can be used to check the above
02.	**Check output cable(s) for damaged insulation.** The insulation is intact, and cable(s) do not show any sign of cracks / damage Check output cable(s) using a load bank
03.	**Check input charging cable and connector.** Check the input cable insulation is intact, and cable(s) do not show any sign of cracks / damage Check the input connector & pins for damage / cracks and wear & tear Check charging function by connecting to 50/60 Hz grid
04.	**Check of tires for wear and tear.** Check all 4 tires for damage / cracks and wear & tear Check correct air pressure (6.8 bar = 99 psi).
05.	**Check all reflectors / beacons / siren.** Check reflectors for damage / function Check beacons for damage / function Check siren for damage / function

06.	**Check all fans**
	Check that Cooling fans are running properly
07.	**Check rubber seals**
	Check that all rubber seals are intact around the top panel, side doors.
08.	**Check bolts / screws / wires**
	Check internal bolts/screws and wire connections
09.	**Visual inspection of PCB's**
	Visual inspection of all PCB's such as Control Board, Interface Board, AUX board, etc.

8.3 Battery Backup & Replacement

Situated on the back of the control board is a coin-type lithium battery, which ensures that firmware, setup data, etc. are not lost during grid power dropouts. The expected life of the battery is approximately 7 years. Note that low battery voltage does not affect the internal safety system of the GPU that monitors the output voltage etc., so that 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.

Note

A timestamp is stored in the ID chip (A6) during production. After 5 years, a warning appears on the display telling the user/operator to replace the control board battery.
It is strongly recommended that the battery is replaced when this message is shown:

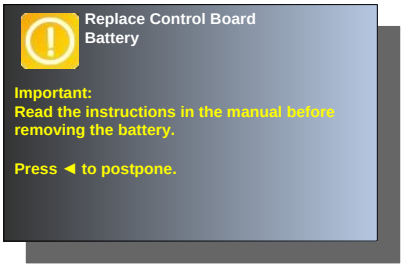


Fig. 8.3.1

To allow the user/operator to use the converter, the battery replacement can be postponed by pressing the ◄ (left arrow) push button.
The warning message appears 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 following failure message will be displayed.

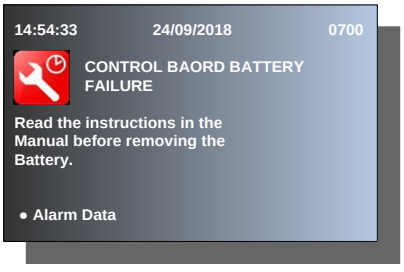


Fig. 8.3.2

The battery must be replaced before the unit can be operated again.

To ensure a high level of reliability of the backup battery, the only battery type that can be used on the control board is the Panasonic BR-2032.

Before removing the control board, and to avoid any static discharge to the control board during the replacement of the battery, please take ESD (electrostatic discharge) precautions.

How to Replace the Battery:

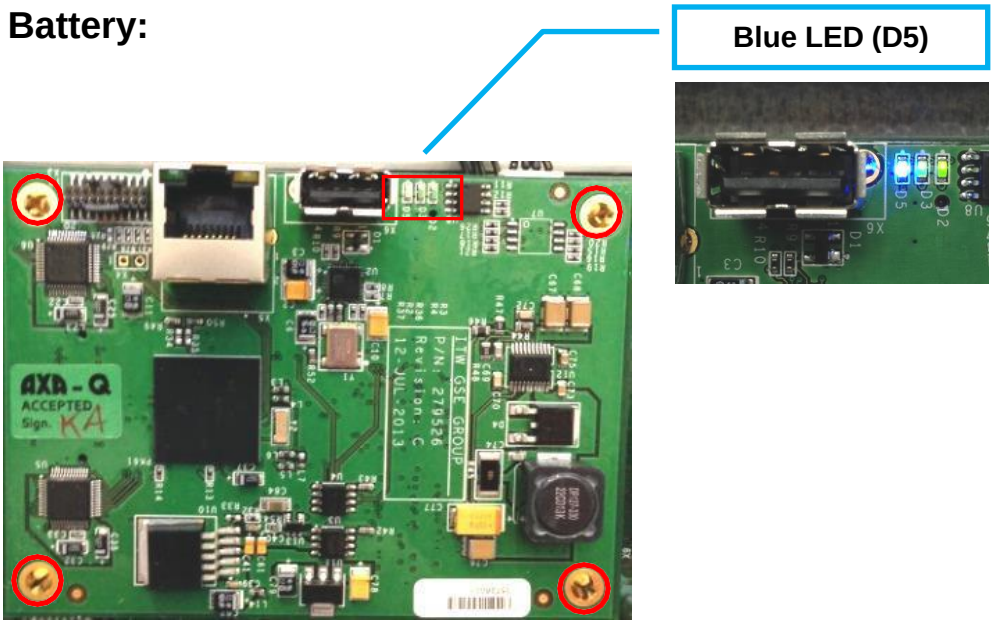


Fig. 8.3.3 Control Board (Front View)

To replace the battery, **switch off** the unit by means of Q1. Remove the control board from the 4 posts marked with a ○ in Figure 8.3.3. Place the PCB on an insulated surface, with the back side facing up.

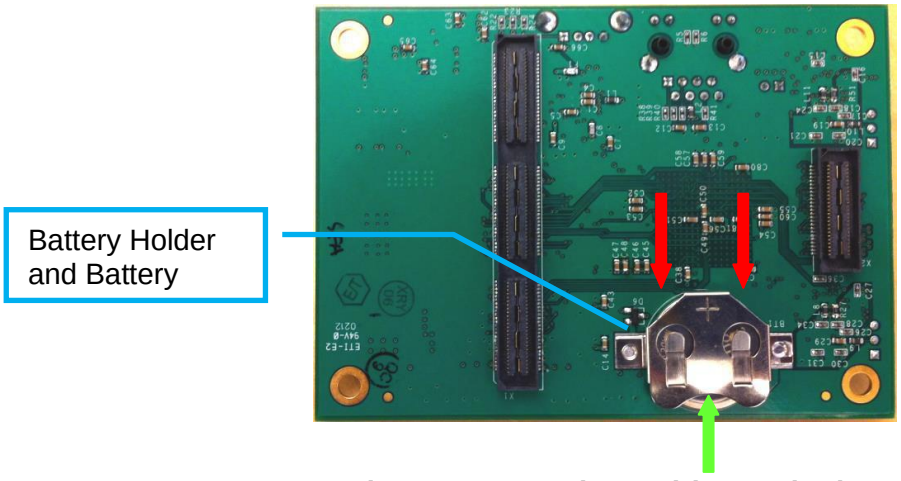


Fig. 8.3.4 Control Board (Rear View)

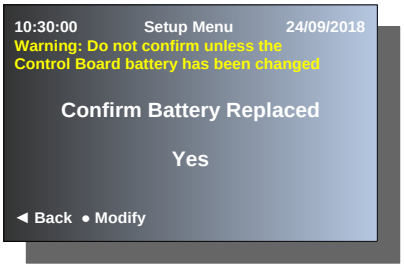
Before removing the battery from the holder, make sure that the replacement battery is within reach, as the **control board must not be without battery power for more than 30 seconds**. Otherwise, all firmware and setup data will be erased.*

Remove the battery from the holder using a small **insulated** screwdriver to push out the battery. The direction is indicated by the two red arrows in Figure 8.3.4. Insert the new battery in the direction of the single green arrow in Figure 8.3.4.

Mount the control board on the interface board again by gently pressing the PCB onto its rest on the interface board. Ensure that all four corners are fully pressed onto the interface board.

Switch the unit on via the input switch Q1 and close the door. The unit will go through an initialization test, and then enter standby mode.

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



*Important Note

If the blue LED on the control board (located in Fig. 8.3.3) flashes approximately twice 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 **Safety-Certified** personnel to remove covers for troubleshooting and repair. Please be aware that the DC capacitors can remain charged with a dangerous voltage **up to 10 minutes** after the battery power has been disconnected.

9.1 PCB Fuses & Battery Fuses

Usually the display text provides sufficient information to get the ground power unit into operation again. If the display is blank, please check Q6 (MCB) and fuses F1 on interface board A2.

The following fuses are located on the interface board A2:

Fuse #	Applies to	Type	Rated Voltage	Amp Rating
F1	EPO fuse	ATO Blade Fuse	32 V	2 A
F2	Display fuse	ATO Blade Fuse	32 V	2 A
F3	Comm Board	ATO Blade Fuse	32 V	5 A
F4	IO Fuse	ATO Blade Fuse	32 V	5 A
F5	Fans Fuse	ATO Blade Fuse	32 V	10 A
F6	GPS unit fuse	ATO Blade Fuse	32 V	2 A

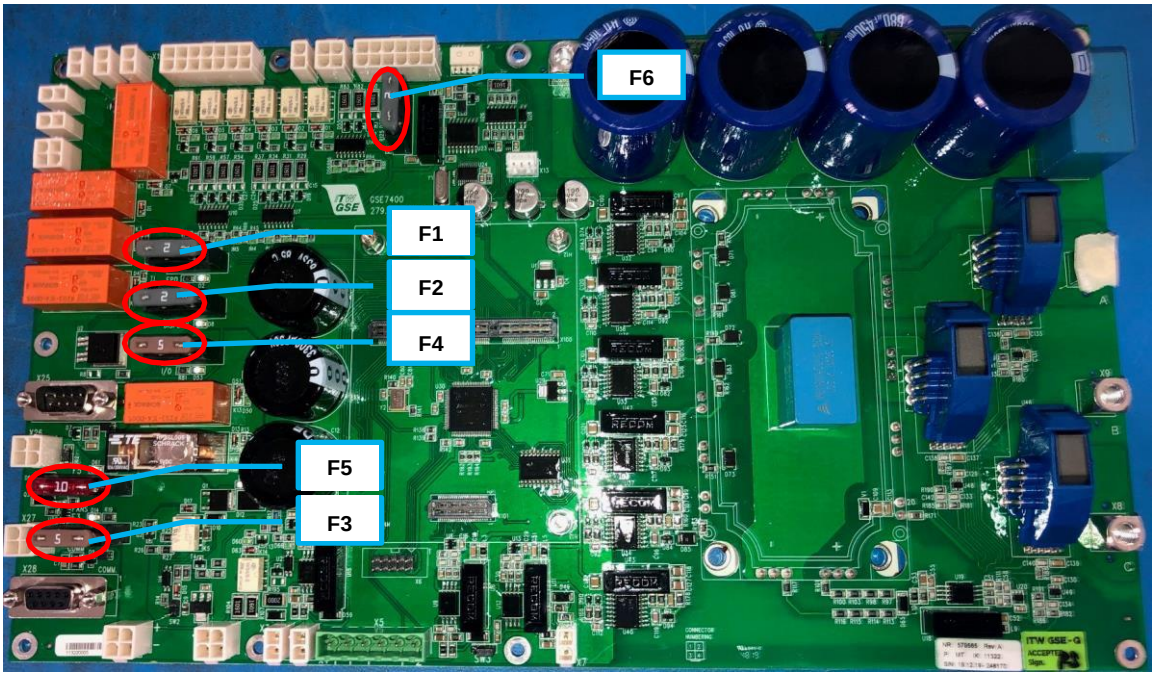


Fig. 9.1.1 Fuses F1–F7 (A2 Interface Board)

If the displayed text does not provide sufficient information to solve the problem, Tables 1, 2, and 3 (Section 9.1) suggest corrective actions to be carried out for each error code.

The following fuses are located on the Communication Board A12:

Fuse #	Applies to	Type	Rated Voltage	Amp Rating
F2	Charger - Ignition	ATO Blade Fuse	32 V	5 A
F3	Ignition	ATO Blade Fuse	32 V	5 A
F4	Relay Control	ATO Blade Fuse	32 V	5 A
F5	Leaf Pack Comm.	ATO Blade Fuse	32 V	5 A
F6	5V Power Supply	ATO Blade Fuse	32 V	5 A

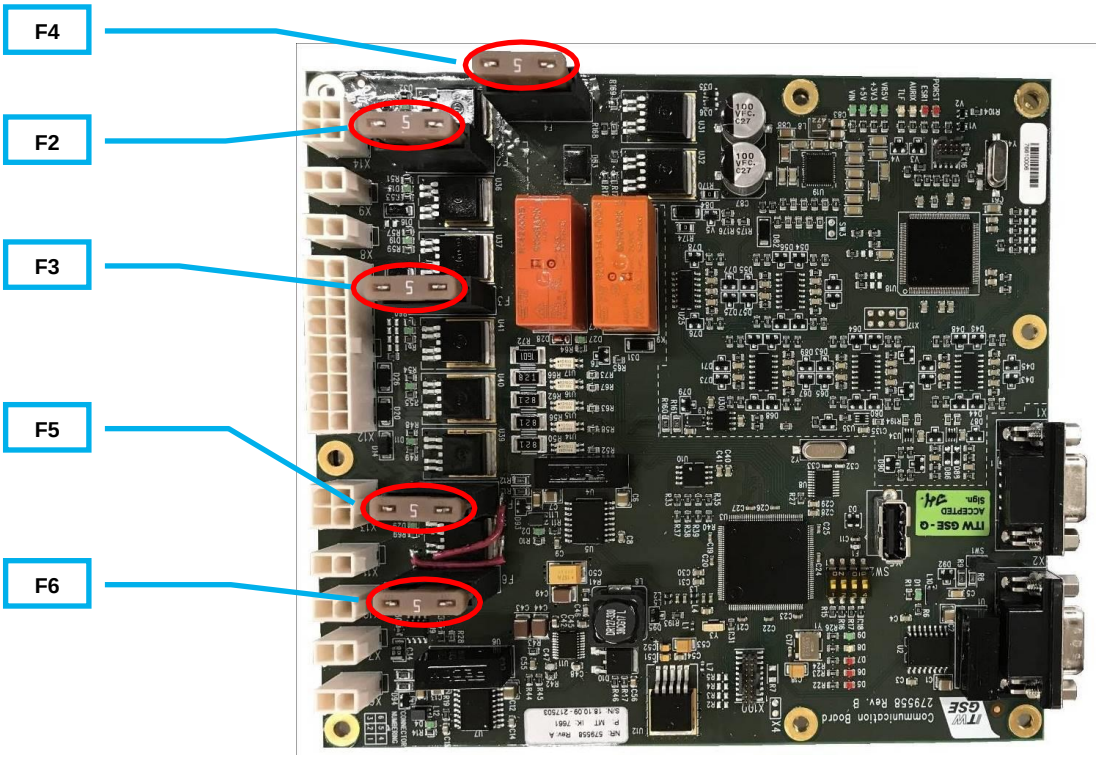


Fig. 9.1.2 Fuses F2–F6 (A12…A42 Communication Boards)

The following fuses are located on the AUX Board A5:

Fuse #	Applies to	Type	Rated Voltage	Amp Rating
F1	24 V Supply	ATO Blade Fuse	32 V	2 A
F2	24 V AUX Output	ATO Blade Fuse	32 V	2 A

Fig. 9.1.3 Fuses F1 & F2 (A5 AUX Board)

Fuse #	Applies to	Type	Rated Voltage	Amp Rating
F1	External Battery Fuses	Bussmann (FWP)	750 V	150 A

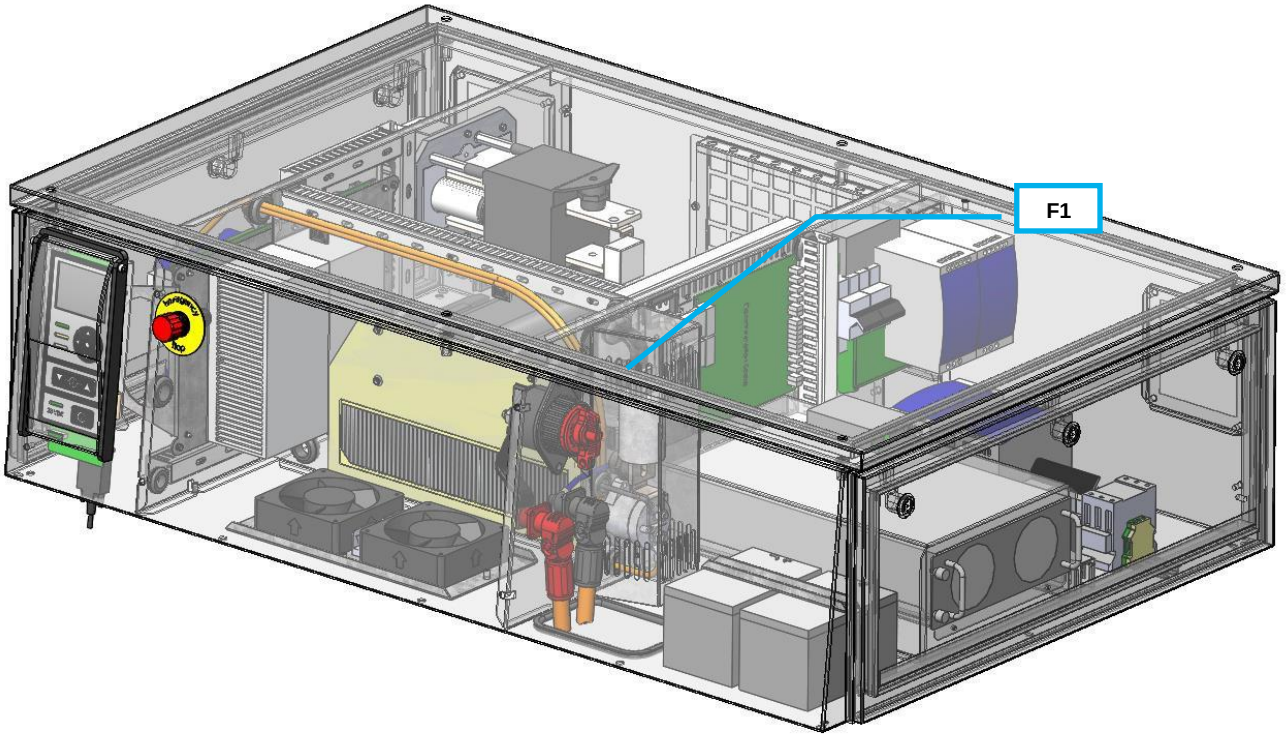


Fig. 9.1.4 Battery Fuses (Located behind cover in Charger section)

9.2 Fault Guidance / Error Codes

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

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

Error Code	Error Text on Display	Help Text	First Corrective Action
100	LOGGING UNSUCCESSFUL		Press start to reset
200	CONTROL BOARD FAILURE	Watchdog Timeout	
201	CONTROL BOARD FAILURE	CRITICAL: Memory Error	Verify ID chip inserted
202	WRONG SOFTWARE VERSION		Install correct software version
210	ID CHIP ERROR		Verify ID chip inserted
250	UPDATE FAILED		Please retry operation
300	CONTROL VOLTAGE LOW	Control Voltage <20V (Running)	Press start to reset
301	CONTROL VOLTAGE LOW	Control Voltage <20V (Standby)	
400	EMERGENCY STOP ACTIVATED		Release emergency stop and press start to reset
600	CONTROL BOARD ADC2 FAILURE		Press start to reset
700	CONTROL BOARD BATTERY FAILURE		
750	REAL-TIME CLOCK NOT SET	Please set to current time and date	Set time and date
1000	SOFTSTART ERROR		Press start to reset
1100	DC VOLTAGE TOO LOW	DC Voltage <300V – 30ms	
1201	DC VOLTAGE TOO HIGH	DC Voltage >420V – 30s	
1202	DC VOLTAGE TOO HIGH	DC Voltage >430V – 2.5ms	
1500	DC RIPPLE TOO HIGH	DC Ripple >20V – 3 minutes	
1600	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	
4700+code	FILTER CURRENT TOO HIGH	Phase X	
5000	TRANSFORMER TEMP TOO HIGH		
6100	PLUG TEMPERATURE TOO HIGH		
6300	EF SIGNAL DROP OUT – 28 VDC	EF Signal Disappeared at 28 VDC	
7000	OUTPUT VOLTAGE TOO HIGH	Voltage > 32 V – 4 sec.	Press start to reset
7100	OUTPUT VOLTAGE TOO HIGH	Voltage > 40 V – 150 ms	
7200	OUTPUT VOLTAGE TOO LOW	Voltage < 20 V – 4 sec.	
7300	SHORT CIRCUIT AT 28 V OUTPUT		Remove short circuit and press start to reset
7400	28 V OUTPUT CURRENT TOO HIGH		Remove load and press start to reset
7500	RECTIFIER TEMP TO HIGH		Press start to reset
8000	BATTERY VOLTAGE TOO LOW	Battery Level must be greater than % setup value in menu to start	Charge unit
8050	BATTERY VOLTAGE TOO LOW		Charge unit
8200	BATTERY CONTACTOR OPEN		Press start to reset
8300	DC CONTACTOR OPEN		Press start to reset
8350	SAFETY BREAKER OPEN	Close breaker	
8400	NO PACKS ACTIVE		
8500	NO PACKS CHARGING		
8600	BATTERY OVERLOAD		
8700+code	BATTERY OVER VOLTAGE		
8800	DC ELECTRIC SYSTEM FAULT		
8900	SMOKE DETECTED		Press start to reset
9000	END OF FACTORY TEST		Press start to reset

Table Continues on next page

Error Code	Second Corrective Action	Third Corrective Action	Fourth Corrective Action
100			
200	Replace control board A1		
201	Contact ITW GSE		
202	Contact ITW GSE		
210	Contact ITW GSE		
250	Contact ITW GSE		
300	Check input voltage at S10	Check Q4 & G10	
301	Check input voltage at S10	Check Q4 & G10	
400	Check emergency stop	Check user EPO (A2:X14)	Replace control board A1
500	Check input voltage	Replace control board A1	
700	Replace control board battery		
750	Check/set to current time and date		
1000	Check battery voltage	Check DC soft start charging voltage >400 V	Replace interface board A2 Replace capacitor module A5 Replace control board A1
1100	Check battery voltage	Replace control board A1	Replace interface board A2
1201	Check battery voltage	Replace control board A1	Replace Interface Board A2
1202	Check battery voltage	Replace control board A1	Replace Interface Board A2
1450	Check battery voltage	Check equal voltage across V1–V6	Replace control board A1 Replace interface board A2
1500	Check setup value	Check DC ripple	Replace control board A1 Replace interface board A2
1600	Checks fans are running	Check air-ducting for restrictions	Replace control board A1 Replace interface board A2
2000 - 2024	Replace inverter module	Replace control board A1	Replace interface board A2
4700+code	Check output filter capacitors	Check output transformer T1	Replace control board A1 Replace interface board A2
5000	Let the unit cool down and press start to reset	Check fans / air-ducting for restrictions	Check normally closed sensor/replace sensor TH if necessary Replace control board A1 Replace interface board A2
6100	Remove load and allow plug to cool down	Check connector/output cabling for any malfunction	Replace control board A1 Replace interface board A2
6300	Verify that output cable is correctly inserted	Check/correct installation	Replace control board A1 Replace interface board A2
7000	Check setup value		
7100	Check setup value		
7200	Check setup value		
7300	Check output cable		
7400	Check output cable		
7500	Check T1 at diode busbar	Check diode V11…V41	Contact ITW GSE
8000	Check status of correct charging	Replace control board A1	Replace Comm. Board A12
8050	Check status of correct charging	Replace control board A1	Replace Comm. Board A12
8300	Check Can-Bus cabling from battery to Comm. Boards	Contact ITW GSE	
8301	Check Can-Bus cabling from battery to Comm. Boards	Contact ITW GSE	
8302	Check Can-Bus cabling from battery to Comm. Boards	Contact ITW GSE	
8350	Check fuse F3	Check Q1 / Q2 and DC voltage at PM1	Replace control board A1
8500	Check MCB Q11 & Q1	Check Can-Bus cabling from battery to Comm. Board	Contact ITW GSE
8600	Check status of batteries via display	Contact ITW GSE	
8700	Check battery voltage	Contact ITW GSE	
8800	Contact ITW GSE		
8900	Press start to reset	Contact ITW GSE	

Communication Board error/warning codes

All codes from 10…60 may be added 256,512 and 1024

Code		
10	Watchdog Reset	Watchdog was triggered
11	Watchdog Init	Could not successfully initialize watchdog
20	Init	Comm. Board did not initialize within time limit
21	Init Address	Detected another Comm. Board with identical board address
25	Failsafe	The failsafe monitor was triggered
30	Battery CAN	Error on Leaf battery CAN bus.
31	Battery Init	Leaf battery did not initialize within time limit.
32	Battery Fail	Leaf battery LB_FAIL or LB_STATUS process A.
33	Battery Allow Contacts	Leaf battery does not allow contactors to be engaged.
34	Battery Interlock	Leaf battery interlock failure.
35	Battery System Voltage	Over discharge or overcharge protection.
36	Battery Main Relay Off Request	LB_STATUS process. A triggered main relay off.
37	Battery Isolation	Leaf battery isolation voltage failure.
38	Battery Discharge Current	Discharge current too high.
39	Battery ALU response	Leaf battery did not respond correctly to ALU safety question.
40	Charger CAN	Charger CAN bus failure.
41	Charger Fail	Charger reports error.
42	Charger Voltage High	Charger voltage too high.
50	Control Board CAN	Control board CAN bus failure.
60	Safety Controller	Safety controller error.
128 + code	1: Ignition	Relay/contactor in wrong state
	2: Charge - Ignition	
	4: Failsafe	
	8: DC contactor (external)	
	16: Leaf battery DC Plus	
	32: Leaf battery DC minus	
	64: Leaf battery Soft start	

Examples:

Code 572 is read thus:

572 – 512 = 60 (60) which leaves you with the error code 60

60 = Safety controller error

Code 131 is read thus:

131-128 = 3 (1 + 2) which leaves you with the error codes 1 & 2

1 = Failure of Ignition relay

2 = Charge – Ignition relay

Note

Before replacing any PCBs or the inverter module, check the corresponding connections and wiring.

Caution

To prevent PCB damage from electrostatic discharge, wear an ESD wrist strap during service or replacement.

10.0 Illustrated Parts List

Please refer to www.itwgse.com for a recommended list of spare parts. Diagrams and drawings of the unit can also be found on this website.

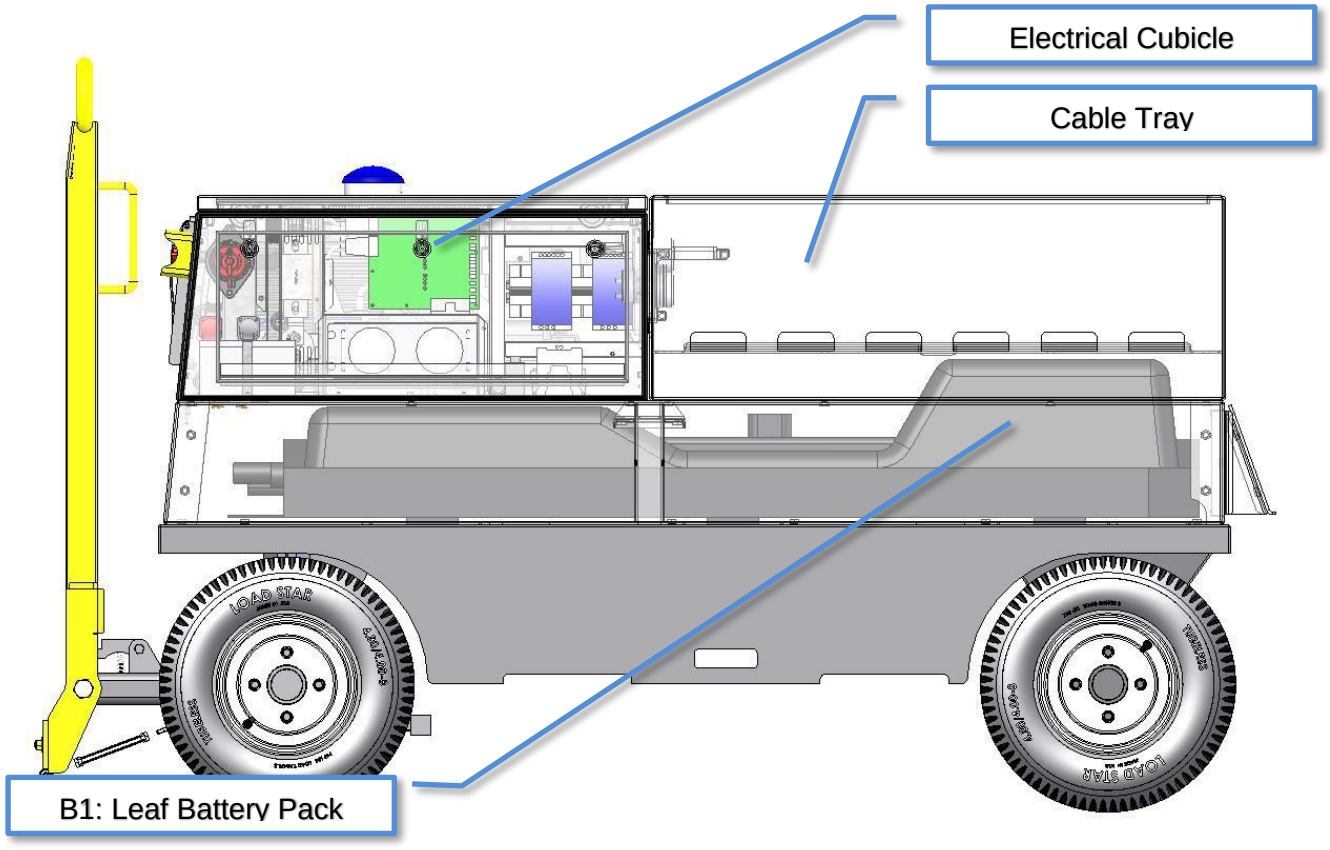


Fig. 10.1.1 Side View

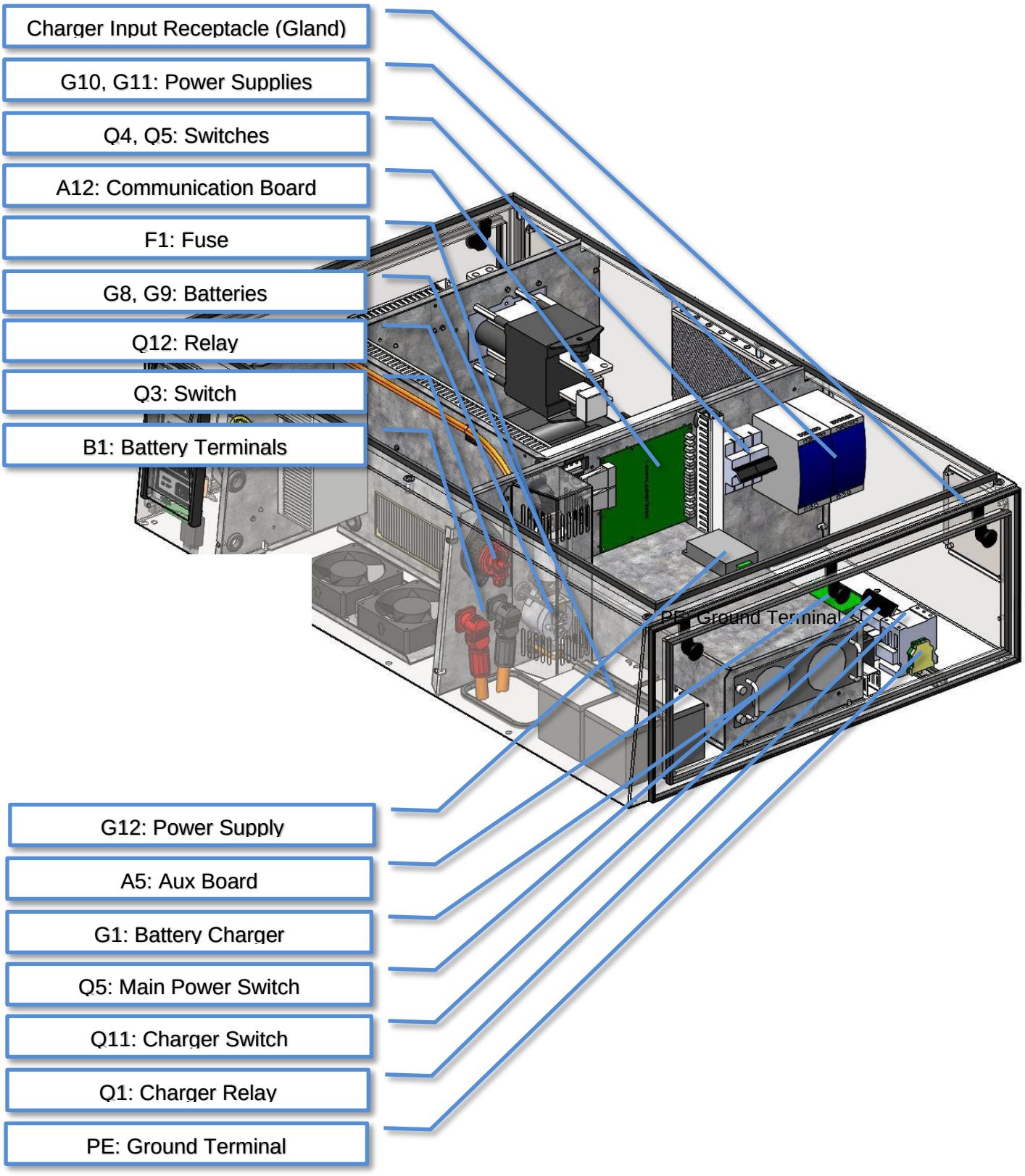


Fig. 10.1.2 Electrical Cubicle (Charger Section)

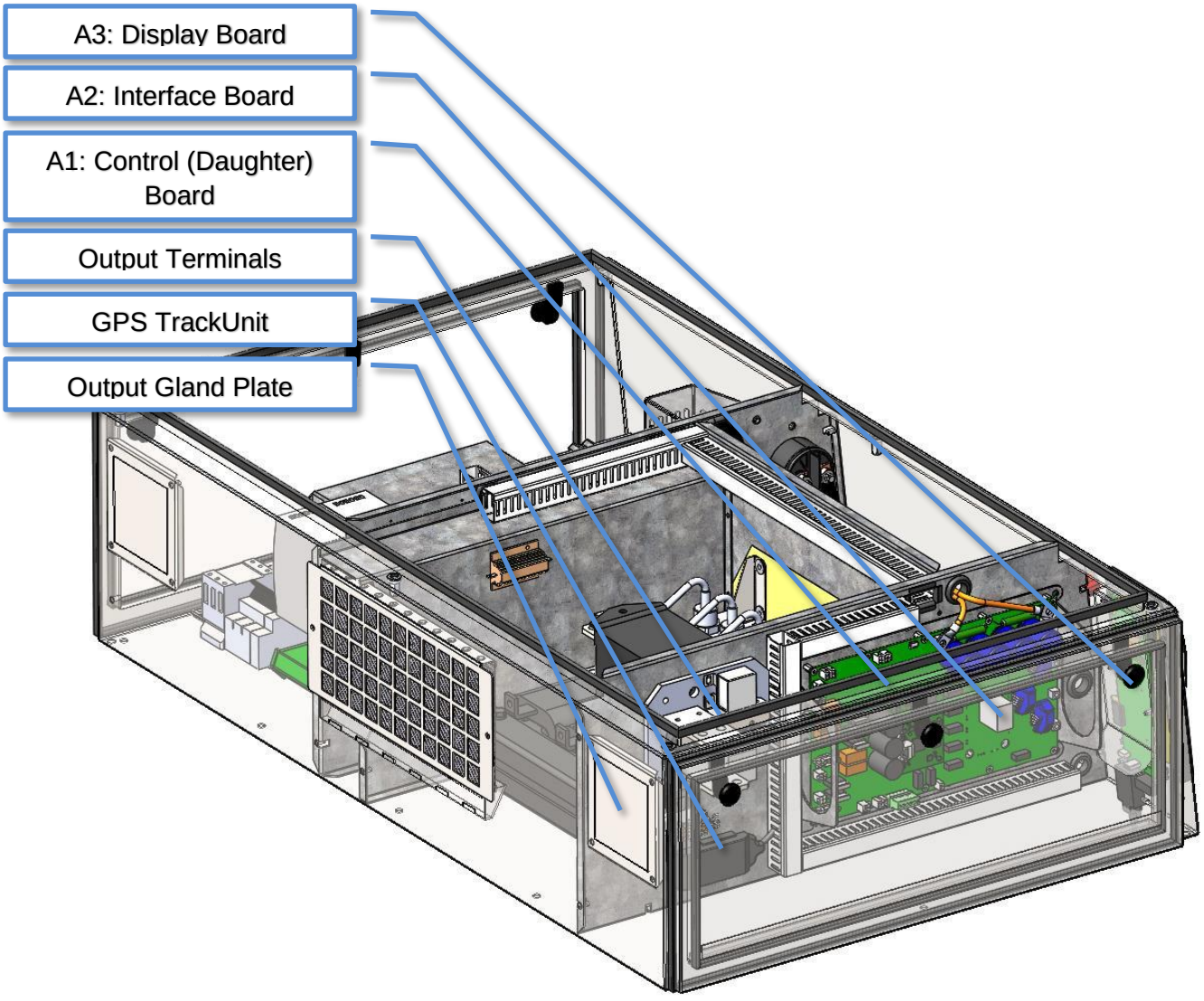


Fig. 10.1.3 Electrical Cubicle (Controls/Output Section)

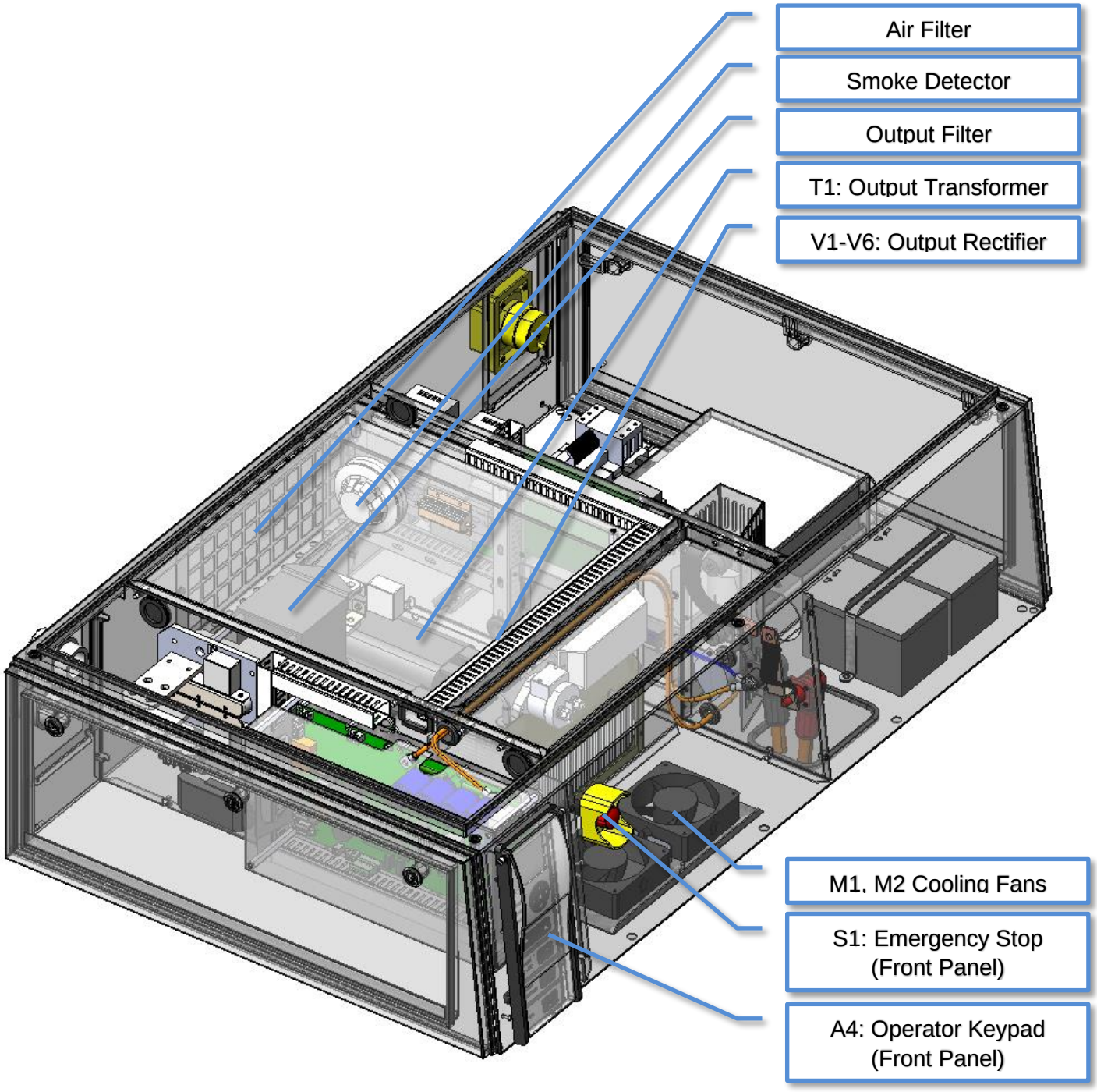


Fig. 10.1.4 Electrical Cubicle (Center Section)

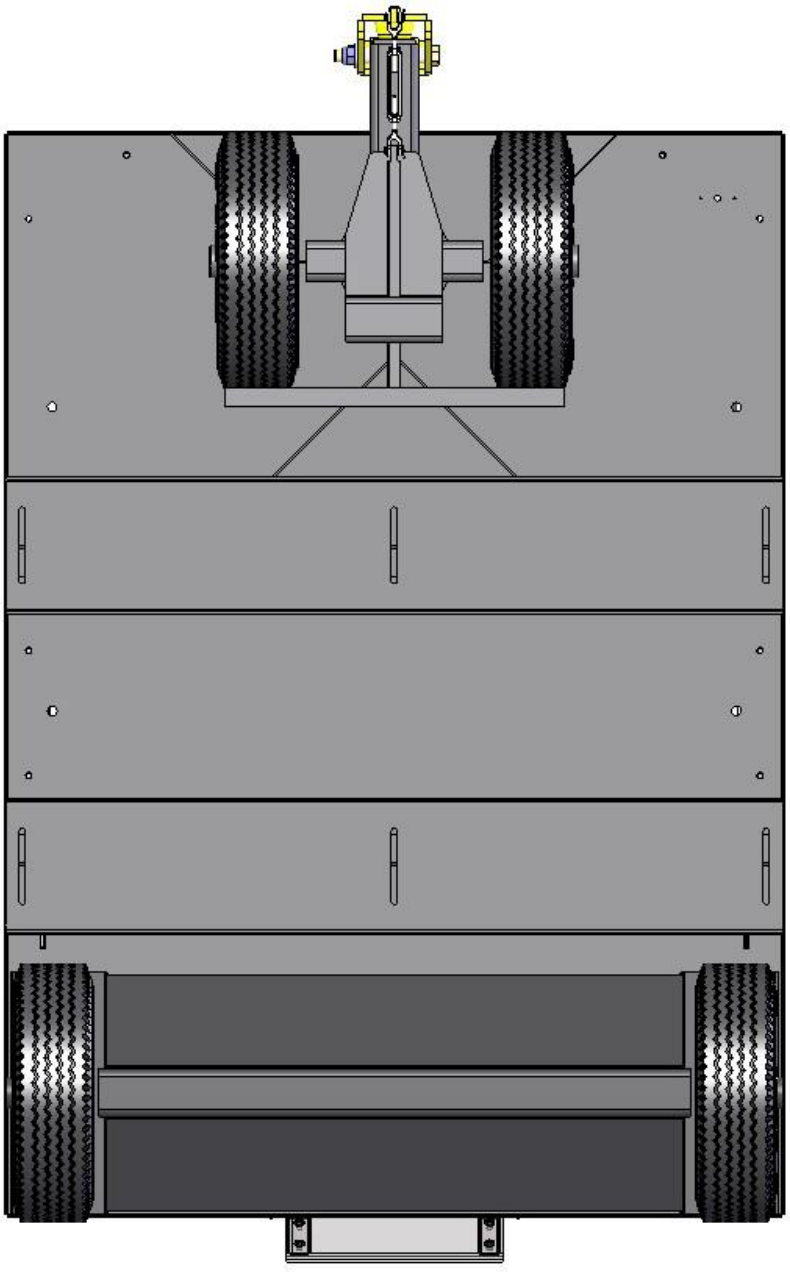


Fig. 10.1.5 Bottom View

11.0 Options

-No options at this time.-