



# Manual

## Hobart 2200 Compact 400 Hz Power Supply System

**Serial Number**

**Type**

3GSF -200/ 43-N

**Year of Manufacture**

Manufacturer

**Hobart Ground Power**

# Manual HOBART 2200

7,5 – 15 kVA

## Table of Contents

---

### Table of Contents

Safety Instructions.....	5
1. How to read this manual.....	5
2. Installation safety instructions.....	5
3. Operator safety instructions.....	5
4. Maintenance safety instructions.....	5
A. General Description.....	6
B. Preparation, Adjustment and Maintenance.....	8
B.1 Storage Before Installation.....	8
B.2 Operational and Environmental Conditions after commissioning.....	8
B.3 Connection of Cables.....	8
B.3.1 Input.....	8
B.3.2 Output.....	9
B.3.3 Interlock Safety System.....	9
B.3.4 Remote Control (Optional).....	10
B.4 Setup of Parameters.....	10
B.4.1 Language.....	11
B.4.2 Output Voltage Phase-Neutral.....	11
B.4.3 Output Voltage Compensation.....	11
B.4.4 Delay from Contactor OFF to Standby.....	12
B.4.5 Date and Hour.....	12
B.4.6 Setup of Interlock By-pass.....	12
B.4.7 Setup of Fan By-pass.....	12
B.4.8 Setup of Serial Protocol.....	12
B.4.9 Setup of Serial Port.....	12
B.4.10 Setup of JBUS Slave Address.....	13
B.4.11 Setup of Error Log, Power Log, Black Box.....	13
B.4.12 Setup of Counters.....	13
B.5 Maintenance.....	14
C. Instruction for Use.....	15
C.1 Input Breaker.....	15
C.2 Emergency Stop.....	15
C.3 Control Panel.....	16
C.3.1 Mains/Lamp Test (Lamp test is optional).....	16

# Manual HOBART 2200

7,5 – 15 kVA

## Table of Contents

---

C.3.2	Common Error .....	16
C.3.3	Start/Reset .....	16
C.3.3.1	Converter in Standby Mode: .....	16
C.3.3.2	Converter in 400 Hz Available:.....	17
C.3.4	Stop .....	17
C.4	Display / Keyboard Interface .....	18
C.4.1	Basic Information.....	18
C.4.2	How to Use Display / Keyboard .....	19
C.4.3	Signification of the LED Signals .....	19
C.4.4	Parameter Updating.....	19
C.4.5	Parameters Measuring Range.....	19
C.4.6	Adjusting Display Contrast (LED Display only).....	20
C.4.7	Display Modes .....	20
C.4.7.1	Default Mode .....	20
C.4.7.2	View Mode .....	22
C.4.7.3	Alarm Mode .....	24
C.4.7.4	Black Box Mode .....	26
C.4.7.4.1	Possibilities in Black Box Mode 1 .....	26
C.4.7.4.2	Black Box Mode 2, Viewing of Registered Parameters.....	27
C.4.7.5	Power Log Mode .....	29
C.4.7.5.1	Possibilities in Power Log Mode.....	29
C.4.7.6	Setup Mode .....	30
C.4.8	Confirmation Procedure.....	34
D.	Functional Description of Power Part.....	36
D.1	Input Breaker.....	36
D.2	Input Filter.....	36
D.3	12-pulse Transformer/ DC/AC Module .....	37
D.4	Isolation Transformer.....	38
D.5	Output Filter.....	38
D.6	Output contactor(s) .....	38
E.	Functional Description of Electronic Part.....	40
E.1	Facilities .....	40
E.2	Composition of Processor Module and Interfaces .....	41
E.2.1	Processor Module.....	42
E.2.2	Aux. Module .....	42

# Manual HOBART 2200

7,5 – 15 kVA

## Table of Contents

---

E.2.3	Display / Keyboard Module .....	43
E.2.4	Relay Module(s).....	43
E.2.5	Thyristor / Gate Drive .....	43
E.2.6	Output Feed Module .....	44
E.2.7	Voltage Feed Module (Component A14).....	44
F.	Error Diagnostics .....	45
F.1	Error Numbering / Grouping.....	46
F.2	Display Readings / Causes / Suggestions .....	46
F.2.1	Error Log Initialisation or Malfunctioning .....	47
F.2.1.1	Error Code 0000 - 0099 .....	47
F.2.1.2	Error Code 0100 - 0199 .....	47
F.2.2	Internal DC Supply (Control Voltage).....	48
F.2.2.1	Error Code 0200 - 0299 .....	48
F.2.3	Internal Communication Errors .....	49
F.2.3.1	Error Code 0400 - 0699 .....	49
F.2.4	AC Input Voltage Error.....	50
F.2.4.1	Error Code 0700 - 0899 .....	50
F.2.4.2	Error Code 0900 - 0999 .....	51
F.2.4.3	Error Code 1000 - 1099 .....	51
F.2.4.4	Error Code 1100 - 1399 .....	52
F.2.4.5	Error Code 1400 - 1499 .....	54
F.2.5	DC Voltage Error (Power).....	54
F.2.5.1	Error Code 1500 - 1599 .....	54
F.2.5.2	Error Code 1600 - 1699 .....	55
F.2.5.3	Error Code 1700 - 1799 .....	56
F.2.6	Errors Reported by DC/AC Modules.....	56
F.2.6.1	Error Code 2000 - 2099 .....	56
F.2.6.2	Error Code 2100 - 2199 .....	57
F.2.7	Output Voltage Error .....	58
F.2.7.1	Error Code 3000 - 3199 .....	58
F.2.7.2	Error Code 3500 - 3799 .....	59
F.2.8	Output Current Error.....	59
F.2.8.1	Error Code 4000 - 4499 .....	59
F.2.8.2	Error Code 4500 - 4599 .....	62
F.2.8.3	Error Code 4600 - 4699 .....	62

# Manual HOBART 2200

7,5 – 15 kVA

## Table of Contents

---

F.2.8.4	Error Code 4700 - 4799 .....	63
F.2.8.5	Error Code 4800 - 4899 .....	64
F.2.9	Undefined Error Codes .....	65
F.2.9.1	Error Code 1800-1999, 2200-2999 .....	65
	Error Code 3200-3499, 3800-3999 .....	65
	Error Code 4900-4999 .....	65
F.2.9.2	Error Code 5600 - 9999 .....	66
F.3	Listing of DC/AC Modules.....	67
F.4	Errors Related to Possible Options (refer to Section H).....	67
F.4.1	Over Temperature in Optional Transformer .....	67
F.4.1.1	Error Code 5500 - 5599 .....	67
G.	Technical Specifications .....	69
G.1	Standards.....	69
G.2	Electrical Specifications.....	69
G.2.1	Input .....	69
G.2.2	Output .....	69
G.3	Efficiency .....	70
G.4	Set-up .....	70
G.5	Protections.....	70
G.6	Physical .....	71
G.7	Environmental .....	71
G.8	Life etc. ....	71
H.	Options / Deviations.....	72
H.1	Standard Options.....	72
H.1.1	573923 Additional Output Contactor 7.5 - 15 kVA Units.....	73
H.1.2	573945 Additional Base Module (Add on Module) .....	73
H.1.3	573945 Input Auto Transformer with Tappings (Add on Module).....	73
H.2	Non Standard Options .....	73
I.	Annexes.....	75
	Electrical-diagrams .....	75
	Sketches & Drawings .....	75
	Fax formula – fault guidance .....	75

## **Safety Instructions**

### **1. How to read this manual**

To avoid hazards the following safety instruction must be followed to ensure personnel's health and safety during installation, daily operation and during maintenance interventions.

The HOBART 2200 can be delivered with several optional features. Therefore, kindly refer to Chapter H for information about the configuration of this particular equipment before installing, operating or performing maintenance of the equipment.

### **2. Installation safety instructions**

Prior to the installation of this equipment, you should read chapter A, B and G in addition to chapter H. Special attention must be given to chapter B and G which describe the requirements for the building installation, the interlock safety system, short circuit protection and minimum cable dimensions to get the maximum performance of the equipment.

For safety reasons the interlock cables must be connected in accordance with the diagram B-1. If the interlock cables are not correctly mounted, this may cause hazard to operators, as the output plug would then be left with voltage on, when the start push button has been pushed. After installation of interlock cables, output cable(s) and plug(s), the phase sequence and the function of the interlock system must be thoroughly checked prior to connection of any aircraft.

### **3. Operator safety instructions**

After the study of chapter H, you should read chapter A and C which give you an overall introduction of how to operate the equipment.

If the equipment is plugable at the input by means of an industrial plug and in case that you are not sure that the building installation complies with the requirements of the equipment to be connected, we refer to the installation safety instruction.

### **4. Maintenance safety instructions**

Service personnel should study the complete manual carefully. It is important not only to be confident with the equipment, but also to be aware of local health and safety rules applicable where the equipment is installed.

# Manual HOBART 2200

7,5 – 15 kVA

## General Description

### A. General Description

Figure A-1 on which the following description is based shows the basic design principle. A detailed description of the power part is found in chapter D whereas the electronic part is described in chapter E.

The block diagram shows the power part and electronic part. The power modules and the power switch gear make up the power part, whereas the electronic modules make up the electronic part.

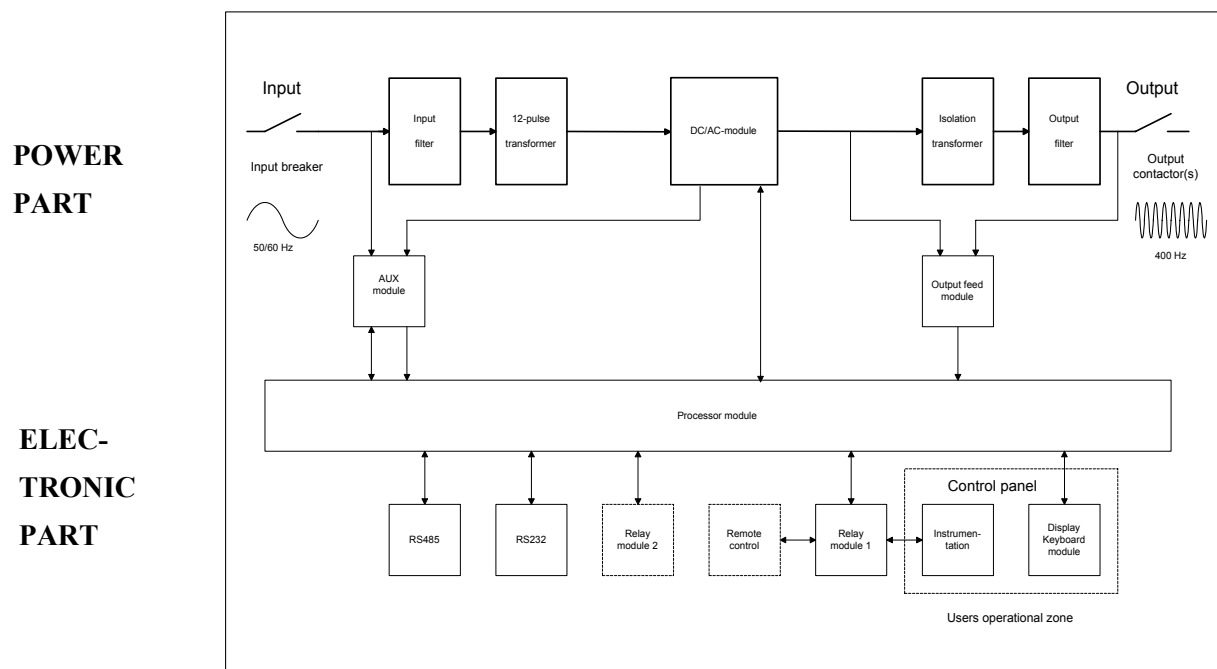


Figure A-1: Diagram, design principle

The input filter protects the converter from mains transients. After the filtering, the three phases of the mains are transformed into six phases which are then rectified in a non-regulated 12-pulse full bridge rectifier. The combination of the 12 pulse rectifier, the related transformer and the input filter ensures that harmonic feed back into the mains is reduced to a minimum (i.e. no mains pollution/distortion).

An additional benefit provided by the 12 pulse rectifier is the soft start facility which limits the inrush currents at the input to a value inferior to the converter's nominal current.

# Manual HOBART 2200

7,5 – 15 kVA

## General Description

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The filtered DC-voltage supplies the inverter which generates a 3-phase 400 Hz system with a regulated amplitude and a low harmonic content. The inverter technology is based on a **Space Vector Pulse Width Modulation** (SV-PWM) concept which is an advanced type of the PWM technology. The SV-PWM system provides the converter with extremely fast dynamic properties and a low distortion. The harmonic content of the output voltage is further reduced by means of an output filter resulting in a total distortion of less than 3%.

The isolation transformer secures galvanic separation between the mains and the 400 Hz outlet.

The processor module is based on a micro-controller and a digital signal processor (DSP) which together regulate, supervise and diagnose eventual external and internal faults. As soon as the converter is connected to the mains, and constantly during normal operation, the processor module runs through a self-check programme which checks all internal functions. 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 converter's memory whereas up to 1000 error situations can be stored.



## **B. Preparation, Adjustment and Maintenance**

### **B.1 Storage Before Installation**

To secure optimal storage conditions prior to installation, it is recommended that the converter is stored inside to protect it from rain and excessive humidity while it is left without power on.

Only equipment in seaworthy packing can be stored outside.

### **B.2 Operational and Environmental Conditions after commissioning**

When the converter has been installed and commissioned, we advice that the input is always kept with input power on to provide optimal conditions for the electronic components and to avoid humidity in form of condensed water from reaching vital parts.

If for some reason the converter has been without input voltage for a period, a visual inspection should be carried out. In case that humidity is discovered on any internal parts, the parts have to dry out before input voltage is again applied.

### **B.3 Connection of Cables**

#### **B.3.1 Input**

The converter should be pre-fused according to the table below

<b>Size in kVA</b>	<b>Line Current</b>	<b>Max. pre-fuse</b>
7.5	9.5A ± 15%	16 A
15	19A ± 15%	32 A

The three phases of the mains supply and the earth connection are connected to the terminals labelled: L1, L2, L3 and PE. As the phase sequence is of importance for the converter's function, the phase sequence is cleared by means of the built-in auto test (is made by connection of the mains). If the phase sequence is wrong, this is shown at the display. If wrong, the correction is made by changing the two phases.

# Manual HOBART 2200

7,5 – 15 kVA

Preparation, Adjustment and Maintenance

Power Rating in kVA	Input cable requirements Supply cords made of rubber cables		Output cable requirements Rubber cables	
	HOBART Part No.	Dimensions	HOBART Part No.	Dimensions
7,5 kVA	KB 8017	4 x 6 mm <sup>2</sup>	KB 4010	4 x 10 mm <sup>2</sup> *
15 kVA	KB 4004	4 x 10 mm <sup>2</sup>	KB 4010	4 x 10 mm <sup>2</sup> *

\* includes 2 x 2,5 mm<sup>2</sup> pilot cable, part no. KB 4016

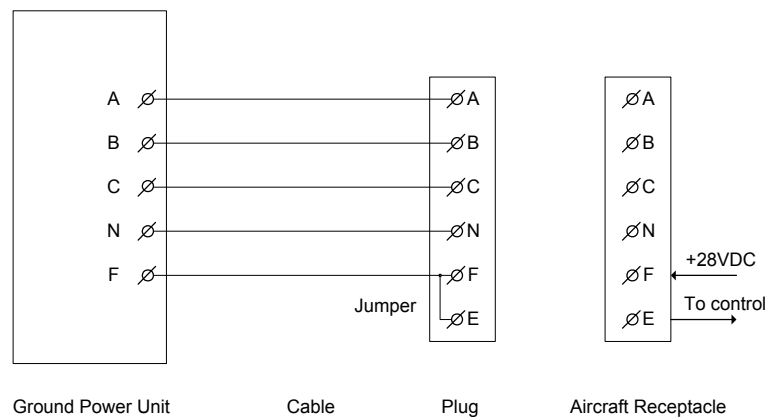
## B.3.2 Output

The supply cables to the aircraft or to an eventual distribution box are connected to the terminals labelled A, B, C and N.

## B.3.3 Interlock Safety System

To secure personnel's health and safety, the converter is equipped with an interlock system.

The system ensures that the output contactor only stays engaged as long as the plug is inserted in the aircraft receptacle. E.g. as long as the aircraft provide 28 VDC with respect to 400 Hz neutral to terminal F. Standard wiring between converter and plug is shown in fig. B-1.



**Fig. B-1: Standard wiring diagram, Civil aircraft**

For service, maintenance and test purposes, the interlock system can be by-passed via the display/keyboard set-up. To secure personnel's health and safety, the unit automatically returns into normal mode once it receives 28 VDC at terminal F. E.g. when the converter is connected to an aircraft.

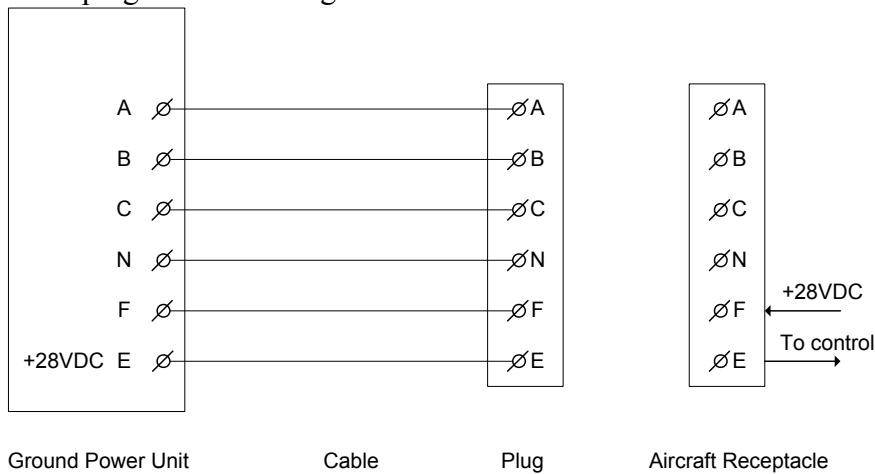
**From the factory, the interlock system in GPUs delivered without cables and plugs is by-passed (via display/keyboard).**

**Manual HOBART 2200**  
7,5 – 15 kVA  
Preparation, Adjustment and Maintenance

---

**Interlock system for military aircraft (optional):**

When used in connection with military aircraft, the converter normally has to provide 28 VDC with respect to 400 Hz neutral to ensure a proper interlock function. Standard wiring between converter and plug is shown in fig. B-2.



**Fig. B-2: Standard wiring diagram, Military aircraft**

**B.3.4 Remote Control (Optional)**

The converter's remote control cables are connected by means of the remote control terminals labelled in accordance with the diagram enclosed under chapter I. Cables shielded at both ends must be applied as remote control cables.

**B.4 Setup of Parameters**

It is possible to set and to adjust the following parameters by means of the converter's display and keyboard. The procedure is described in chapter C.4.

**Manual HOBART 2200**  
7,5 – 15 kVA  
Preparation, Adjustment and Maintenance

---

### **B.4.1 Language**

The display texts are provided in 3 languages as a standard. It is possible to switch between the languages by means of the dip switch S1 situated on the back of the display. The table shows how to select language.

<b>Language / Position</b>	<b>S1 - 1</b>	<b>S1 - 2</b>	<b>S1 - 3</b>	<b>S1 - 4</b>
Language 1	OFF	OFF	X	X
Language 1	ON	ON	X	X
Language 2	OFF	ON	X	X
Language 3	ON	OFF	X	X

X = position is random

### **B.4.2 Output Voltage Phase-Neutral**

At delivery, the converter is set to nominal output voltage. This level can be adjusted, if required, i.e. due to voltage drop in the supply cable. The adjustment range is nominal voltage  $\pm$  15%. **PLEASE NOTICE!** If the voltage level falls outside the converter's operation range under adjustment, the converter disengages and reports under- or overvoltage. The nominal voltage as well as the levels for under- and overvoltage are shown in chapter G.

### **B.4.3 Output Voltage Compensation**

If long supply 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 cables have been mounted. With a load current above 20% of the nominal output current, the voltage at the output plug is adjusted to the required value (larger load current gives a better result). At delivery, the compensation is pre-set to 0. The maximum compensation is 9V.

**If only one outlet is available**, only set up 1 is in use.

**If two outlets are available**, each output has its own set up (1 and 2). In case both outlets are in use at the same time, the compensation will be set to half of the mean value of the two set up values.

# Manual HOBART 2200

## 7,5 – 15 kVA

### Preparation, Adjustment and Maintenance

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#### **B.4.4 Delay from Contactor OFF to Standby**

If the converter's output contactor(s) is (are) not engaged, the converter automatically passes into standby mode after elapse of a pre-set period. This delay can be set to values between 5 and 900 seconds. At delivery, the time delay is set to 150 seconds.

#### **B.4.5 Date and Hour**

The converter has a built-in real time clock showing the date and the hour. At delivery, the clock is set to actual hour (European time). The clock does not adjust itself at changes from summer time to winter time and vice versa. It is possible to set year, month, day, hour, minutes and seconds.

#### **B.4.6 Setup of Interlock By-pass**

The interlock safety system can be by-passed by setting the set-up value to 1. For further information regarding the interlock system kindly refer to B.3.3

#### **B.4.7 Setup of Fan By-pass**

From the factory, the by-pass value is set to 0 which means that the ventilator is temperature controlled. To by-pass the temperature control for instance for repair and test purposes, the value is set to 1 whereafter the ventilators will be constantly running.

#### **B.4.8 Setup of Serial Protocol**

There are two protocols available. If the value is set to 1, the Siemens 3964R protocol is chosen. If the value is set to 2, the JBUS protocol is chosen. For further information about the protocols please contact HOBART.

#### **B.4.9 Setup of Serial Port**

It is possible to select an RS232 port and an RS422/485 port. If the value is set to 1, the RS232 port is selected. With the value set to 2, the RS422/485 protocol is selected.

#### **B.4.10 Setup of JBUS Slave Address**

If the JBUS protocol is selected, the slave address can be set up. The slave address can be set to values between 1 and 247. At delivery, the address is set to 1.

#### **B.4.11 Setup of Error Log, Power Log, Black Box**

From the factory the by-pass value is set to 0. If for some reason it is necessary to clear the memory log after installation the by-pass value is set to 1. After the reset, the by-pass value is automatically set to 0.

#### **B.4.12 Setup of Counters**

The hour counter and the consumed power counter is reset, when the value is set to 1 (used to clear the counter memory after installation). The value is automatically set to 0 after reset.

**Manual HOBART 2200**  
7,5 – 15 kVA  
Preparation, Adjustment and Maintenance

---

## **B.5 Maintenance**

At least once a year it is recommended to

1. Check airfilters - Wash or change as appropriate.

**We recommend, however, to check the airfilters once a month**

2. Check that all fans are running properly.
3. Check bolt/screw and wire connections.
4. Check vibration dampers.
5. Visual inspection of all components.
6. Visual inspection of PCB's - control unit / gate drive.
7. Control of the contactors' contact sets and coil.
8. Control of output voltage.
9. Check of external cables and plugs.

Especially for outside mounted models, we recommend to

10. Check rubber sealings.

Especially for mobile-converters:

11. Check tyres for wear and tear
12. Check that the air pressure is correct (76 psi).

**We recommend, however, to check the tyre pressure on a more frequent basis.**

Battery back-up:

Situated on the processor board, a lithium battery assures that set-up data etc. is not lost during mains dropouts. The expected life of the battery is approx. 10 years. However, a low battery voltage does not affect the internal safety system of the GPU that monitors the output voltage, among other things. Thus aircraft connected to the GPU are not exposed to any danger. To avoid loss of data we recommend you to replace the battery after 8-9 years of use.

## C. Instruction for Use

The converter is equipped with the following operation keys and indications:

- Input breaker
- Emergency stop
- Display and keyboard
- Control panel with
  - Mains voltage indication
  - Fault indication
  - Start / Reset push-button and indication for each output contactor
  - Stop push-button for each output contactor

Possible options:

- Push button for lamp test (in common with indication of mains voltage)

### C.1 Input Breaker

When activated it connects the converter to the mains. Upon engagement, the converter runs through a check programme which tests the converter's internal and external conditions. If no faults or irregularities are detected, the converter passes into standby mode.

### C.2 Emergency Stop

The converter can be immediately stopped by activation of the emergency stop.

**Please notice!** The emergency stop must be released, before it is possible to restart the converter.

As long as the emergency stop is activated, this is shown at the display.



# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

## C.3 Control Panel

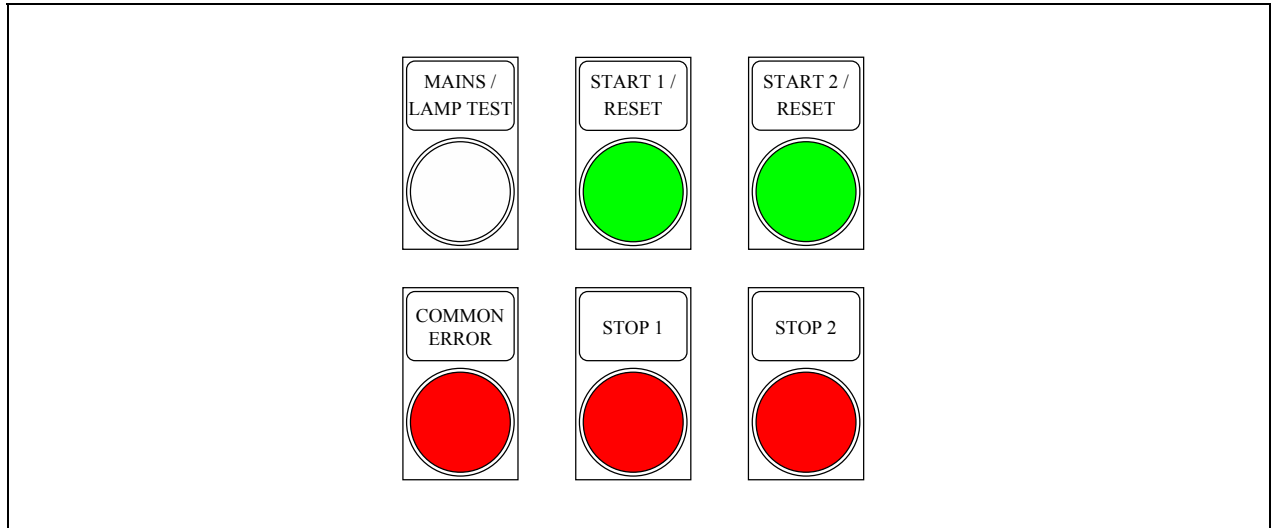


Figure C-1: Control panel

### C.3.1 Mains/Lamp Test (Lamp test is optional)

The mains lamp is lit, as soon as the converter is connected to the mains, and the input breaker is activated. A push-button for lamp test can be built in. If built in, the activation of the button lights all workable buttons at the control panel and keeps them lit until the button is released.

### C.3.2 Common Error

This lamp is lit in case of a fault in the converter or of its external conditions. The converter passes into alarm mode, and the fault is displayed (for further information see chapter F). The lamp is lit as long as the fault has not been corrected.

### C.3.3 Start/Reset

#### C.3.3.1 Converter in Standby Mode:

A push at the Start/Reset button resets the converter which then performs an auto-test of internal and external parameters. If the test programme is performed without detection of any errors, the corresponding output contactor is engaged (Start/Reset button), and the converter automatically passes from standby into 400 Hz available mode. The Start/Reset button is lit, meaning that 400 Hz is available at the output. The output contactor is activated for 1 second no matter whether the interlock signal is present or not. If the interlock signal disappears, the converter passes into standby mode after the elapse of the delay to standby. Missing interlock signal is shown at the display.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## **C.3.3.2 Converter in 400 Hz Available:**

The converter is in 400 Hz available when at least one of the output contactors is engaged. A push at Start/Reset engages the output contactor of the corresponding outlet and the button is lit, indicating that the output contactor is engaged. The converter supplies 400 Hz at the output, until the output contactor is disengaged. If both interlock signals disappear, the converter passes into stand-by mode after the elapse of the delay to standby.

## **C.3.4 Stop**

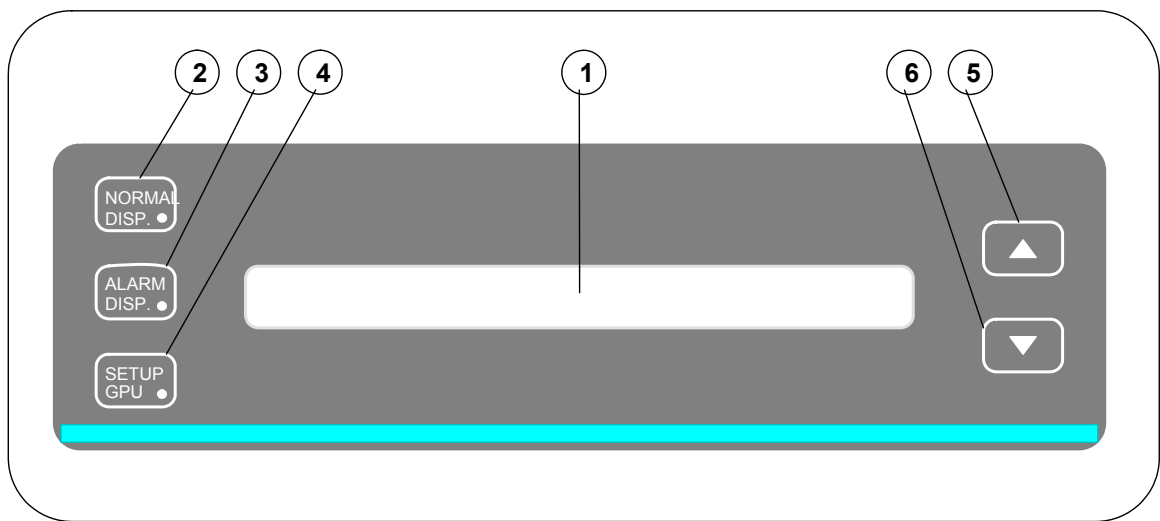
A push at the stop button disengages the corresponding output contactor. At disengagement of both output contactors, the converter immediately passes into standby mode.

## C.4 Display / Keyboard Interface

### C.4.1 Basic Information

From the display/keyboard it is possible to:

- view different internal and external parameters.
- change GPU settings.
- browse through the GPU memory.
- adjust the display contrast.



Definitions:

1. Display text area, 2 lines of 40 characters per line.
2. Key and LED : NORMAL DISP.
3. Key and LED : ALARM DISP.
4. Key and LED : SET-UP GPU.
5. Key : ARROW UP.
6. Key : ARROW DOWN.

**Figure C-2: Display/keyboard**

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## C.4.2 How to Use Display / Keyboard

The display/keyboard reacts in 2 different ways on a key press.

1. If switching between display modes or selecting a new picture, the display reacts on a key press, when the key is released. In these cases, the LED NORMAL DISP. flashes (2 Hz) in order to show that the key press is registered, and that the display is working. The flashing stops when the desired text appears on the display.
2. If adjusting GPU-settings or display-contrast the value keeps changing, as long as one of the ARROW keys is hold down.

The keyboard is read 4 times per second. Therefore a key press must last longer than 1/4 of a second to make sure that the key press is registered.

## C.4.3 Signification of the LED Signals

As already mentioned in section C.4.2, the LED NORMAL DISP flashes from the display has registered a key press till the instruction has been carried out. Additionally, the LED's are lit as shown below:

<b><u>Display mode:</u></b>	<b><u>LED lit:</u></b>
Default mode	NORMAL DISP.
View mode	NORMAL DISP.
Alarm mode	ALARM DISP.
Black box mode	ALARM DISP. & NORMAL DISP.
Power log mode	ALARM DISP. & SETUP GPU
Setup mode 1	SETUP GPU (constant light)
Setup mode 2	SETUP GPU (flashing light)

## C.4.4 Parameter Updating

The time from a key press to the new picture shows, and the time between updating of the parameter values, depend on the number of parameters in the picture. Normally this time will be less than 1 second. However, this is not applicable when adjusting setup parameters, where the update time is very short.

## C.4.5 Parameters Measuring Range

If the value of a parameter, in a selected display picture, is below the measuring range, the display will show the parameter as:

< xxx

where xxx shows the lowest value of the measuring range.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## C.4.6 Adjusting Display Contrast (LED Display only)

If the light conditions or the viewers position makes it difficult to read the display, the display-contrast can be adjusted by means of the keys NORMAL DISP. and ARROW UP/ ARROW DOWN. Contrast adjusting can be made in any display mode.

Start by pressing NORMAL DISP and keep it down. Press ARROW UP or ARROW DOWN until the display contrast is satisfactory. Release NORMAL DISP as the last key. If not, the display changes according to last pressed ARROW key.

## C.4.7 Display Modes

There are 6 basic display modes:

- Default mode (display shows actual converter status)
- View mode (viewing parameters)
- Alarm mode (browsing through error log)
- Black box mode (browsing through errors and thereto related parameters)
- Power log mode (browsing through logged operation information)
- Setup mode (viewing or changing settings)

The user can switch freely between the different display modes.

### C.4.7.1 Default Mode

#### Possibilities in Default mode

In Default mode, the displayed picture is one of the following 5 pictures or an ALARM picture, depending on the status of the converter.

STAND BY	year-mo-da	ho.mi
SYSTEM READY FOR USE		

OR

SYSTEM IN OPERATION	year-mo-da	ho.mi
xxx / xxx V	xxx A	xxx.x Hz

OR

INTERLOCK SIGNAL MISSING
VERIFY PLUG POSITION OR CHECK CABLING

OR

EMERGENCY STOP ACTIVATED
SYSTEM STOPPED

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

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OR

CONTROL UNIT IS WORKING PLEASE WAIT
--

OR ALARM PICTURE, according to Alarm mode

In case of built-in options such as magnetic card readers or 90% switches integrated in the plug, additional display default pictures may occur.

Switching to other modes from Default mode

<b><u>Switch to:</u></b>	<b><u>By pressing key:</u></b>
View mode	NORMAL DISP. or ARROW UP or ARROW DOWN
Alarm mode	ALARM DISP.
Black box mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU

Switching to Default mode from other modes

<b><u>Switch from:</u></b>	<b><u>By pressing key:</u></b>
View mode	NORMAL DISP
Alarm mode	NORMAL DISP. twice first key press gives View mode, the second Default mode
Black box mode	NORMAL DISP. twice first key press gives View mode, the second Default mode
Power log mode	NORMAL DISP. twice first key press gives View mode, the second Default mode
Setup mode	NORMAL DISP.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## C.4.7.2 View Mode

### Possibilities in View mode

When from one of the other display modes View mode is selected, the first picture shown is:

INPUT VOLTAGE : PHASE-PHASE	[V]	
L1-L2= xxx	L2-L3= xxx	L3-L1= xxx

By pressing and releasing ARROW UP or ARROW DOWN, the user can browse through the following pictures, including the above shown picture.

ARROW UP : Order as shown below  
ARROW DOWN : Reverse order of below

INPUT FREQUENCY	[Hz]
xxx.x	

VOLTAGE AT DC CAPACITOR BANK	[V]
xxx	

OUTPUT VOLTAGE : PHASE-NEUTRAL	[V]		
A = xxx.x	B = xxx.x	C = xxx.x	Avg = xxx.x

OUTPUT VOLTAGE : PHASE-PHASE	[V]		
AB = xxx	BC = xxx	CA = xxx	Avg = xxx

OUTPUT CURRENT	[A]
Avg = xxx.x	

ACTIVE OUTPUT POWER	[kW]
$\Sigma$ = xxx.x	

APPARENT OUTPUT POWER	[kVA]
$\Sigma$ = xxx.x	

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

OUTPUT FREQUENCY	[Hz]
	xxx.x

MODULE TEMPERATURE	[°C]
DC / AC = xxx	

TOTAL TIME	[hhhhh.mm.ss]
OUTPUT AVAILABLE	xxxxx.xx.xx

TOTAL ENERGY CONSUMPTION, OUTPUT	[MWh]
	xxxxx.xxx

Switching to other modes from View mode

<b><u>Switch to:</u></b>	<b><u>By pressing key:</u></b>
Default mode	NORMAL DISP
Alarm mode	ALARM DISP.
Black box mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU

The display remains in View mode until another mode is selected from the keyboard, unless the converter is reset/restarted from alarm status.

Switching to View mode from other modes

<b><u>Switch from:</u></b>	<b><u>By pressing key:</u></b>
Default mode	NORMAL DISP
Alarm mode	NORMAL DISP.
Black box mode	NORMAL DISP.
Power log mode	NORMAL DISP.
Setup mode	NORMAL DISP. twice

first key press gives Default mode, second key press View mode



# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

## C.4.7.3 Alarm Mode

### Possibilities in Alarm mode

In Alarm mode the user can browse through the logged errors. When entering Alarm mode the latest/youngest logged error is displayed.

By pressing and releasing one of the keys ARROW UP or ARROW DOWN, browsing is done in the order:

ARROW UP : Younger towards older

ARROW DOWN : Older towards younger

By pressing and releasing key ALARM DISP. the display returns to the youngest logged alarm.

The maximum number of loggings is 1000. If this number should be reached, the oldest error logging disappears, when a new error is logged, according to chapter F.

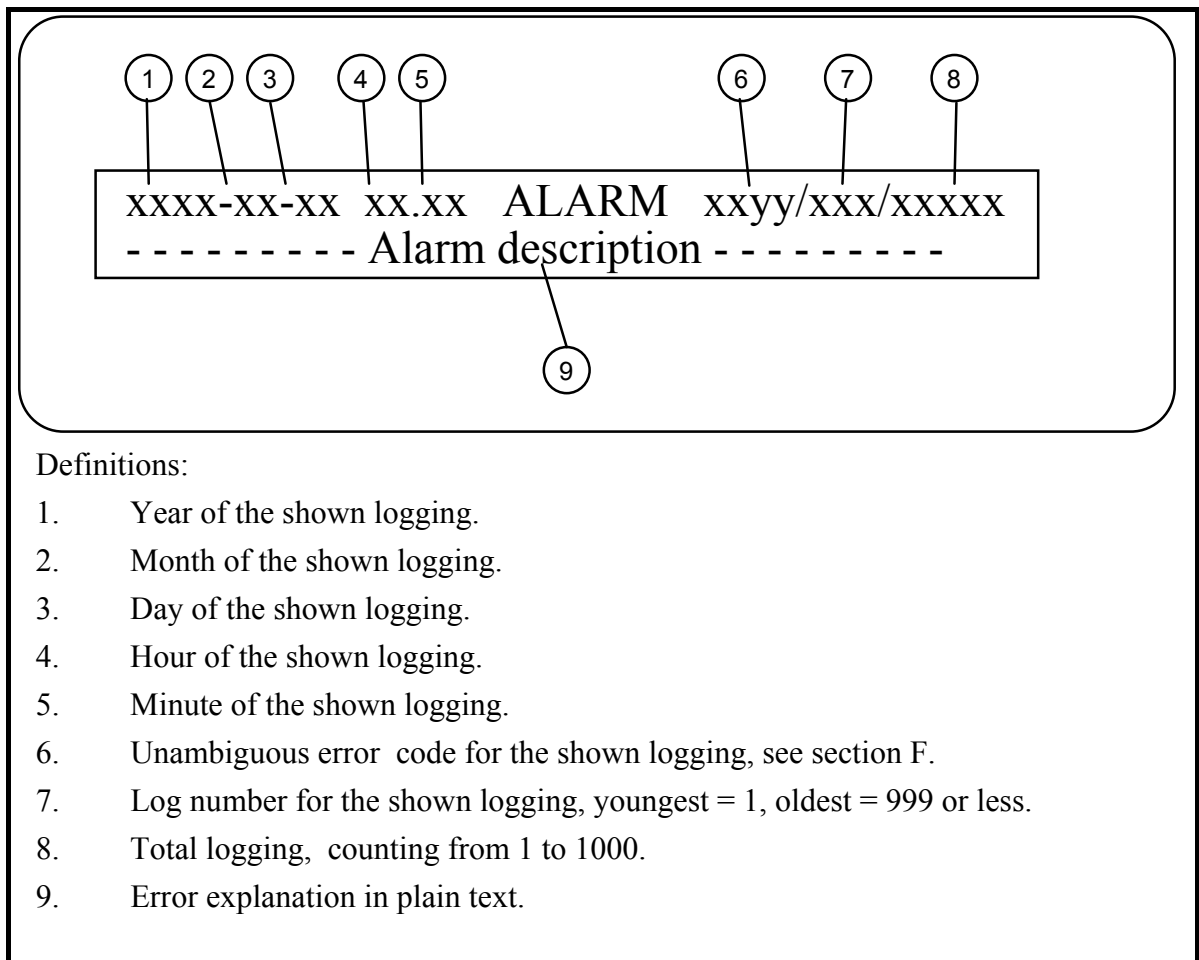


Figure C-3: Alarm display

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

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The displayed text in Alarm mode complies with figure C-3. The top line of the display contains logging data such as date and time, unambiguous error code and numbers concerning the actual and all logging. The bottom line contains an explanation in clear language of the alarm/error in question.

As long as the fault has not been corrected, the display keeps switching between one of the following messages and the one shown in figure C-3, depending of the nature of the error.

INTERNAL ERROR PRESS RESET OR CALL TECHNICIAN
--

EXTERNAL ERROR PRESS RESET OR CALL TECHNICIAN
--

For detailed information on the various display pictures and their signification in Alarm mode, see chapter F.

Switching to other modes from Alarm mode

<b><u>Switch to:</u></b>	<b><u>By pressing key:</u></b>
View mode	NORMAL DISP
Black box mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU
Alarm mode	ALARM DISP. (youngest logging)
Default mode	NORMAL DISP. twice first key press gives View mode, the second Default mode.

Switching to Alarm mode from other modes

<b><u>Switch from:</u></b>	<b><u>By pressing key:</u></b>
Default mode	ALARM DISP.
View mode	ALARM DISP.
Black box mode	NORMAL DISP This gives View mode, then press ALARM DISP.
Power log mode	ALARM DISP.
Setup mode	ALARM DISP.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

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If Alarm mode is selected from another display mode, and the converter is not in alarm status, the display returns to Default mode, after elapse of 1 minute without any key press.

If the converter is in alarm status, the display shows the youngest logged alarm (Log Number 1) after this time out.

## **C.4.7.4 Black Box Mode**

Black box mode consists of 2 modes.

**Mode 1:** Viewing/browsing through the last 50 logged errors and thereto related parameters

**Mode 2:** Viewing of chosen input / output parameters for the last 50 logged errors

When entering Black box mode from another display mode, the display passes into Black box mode 1.

### **C.4.7.4.1 Possibilities in Black Box Mode 1**

In Black box mode 1, the user can browse through the last 50 logged errors and thereto related parameters just as he can browse through different alarms in Alarm mode. When changing to Black box mode, the display shows the last occurring error logged by the converter.

By pushing ARROW UP or ARROW DOWN it is possible to browse in the following order:

ARROW UP            From latest towards previously logged errors

ARROW DOWN        From older towards recent logged errors

If the operator wants to have a closer look at the recorded input / output parameters in relation to a given logged error, this is done by pushing and releasing ALARM DISP. In the way, the display passes into Black box mode 2.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## C.4.7.4.2 Black Box Mode 2, Viewing of Registered Parameters

In Black box mode 2, the first picture shown is:

INPUT VOLTAGE : PHASE - PHASE	[V]	
L1-L2= xxx	L2-L3=xxx	L3-L1 = xxx

By pushing ARROW UP or ARROW DOWN, the operator can browse through the following pictures incl. the above shown.

ARROW UP            Order as shown below

ARROW DOWN        Reverse order

INPUT FREQUENCY	[Hz]
xxx.x	

VOLTAGE AT DC CAPACITOR BANK	[V]	
Delta = xxx	Instant = xxx	Avg = xxx

OUTPUT CURRENT	[A]
Avg= xxx.x	

INVERTER CURRENT	[A]	
A = xxx.x	B = xxx.x	C = xxx.x

OUTPUT VOLTAGE: PHASE-NEUTRAL	[V]	
A = xxx.x	B = xxx.x	C = xxx.x

MODULE TEMPERATURE	[°C]
DC/AC = xxx	

INTERNAL DC-VOLTAGES	[V]		
-5V = xx.x	12V = xx.x	17V = xx.x	30V = xx.x

SETUP VALUES		
VOLT = xxx	COMP = xxx.x	AMP = xxx

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

By pushing and releasing ALARM DISP. the display reverts to Black box mode 1, where it shows the error logged prior to the change into Black box mode 2.

The converter can memorise up to 50 logged errors with their related parameters. If this number is reached, the oldest error is deleted when a new is logged.

Switching to other modes from Black box mode

<b><u>Switch to:</u></b>	<b><u>By pressing key:</u></b>
View mode	NORMAL DISP
Alarm mode	NORMAL DISP. (gives View mode). ALARM DISP:
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU
Default mode	NORMAL DISP. twice first key press gives View mode, the second Default mode.

Switching to Black box mode from other modes

<b><u>Switch from:</u></b>	<b><u>By pressing key:</u></b>
Default mode	ALARM DISP. and ARROW UP
View mode	ALARM DISP. and ARROW UP
Alarm mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW UP
Setup mode	ALARM DISP. and ARROW UP

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

## C.4.7.5 Power Log Mode

### C.4.7.5.1 Possibilities in Power Log Mode

In Power log mode, the user can browse through previously recorded operations. When changing to Power log mode, the display shows the last operation recorded by the converter.

By pushing ARROW UP or ARROW DOWN it is possible to browse in the following order:

ARROW UP            From latest recorded towards previously recorded operations.

ARROW DOWN        From older towards recent recorded operations.

By simultaneous push and release of ALARM DISP. and ARROW DOWN, the display returns to the last recorded operation.

The converter can store up to 50 recorded operations. If this number should be reached, the oldest recording is deleted when a new is recorded.

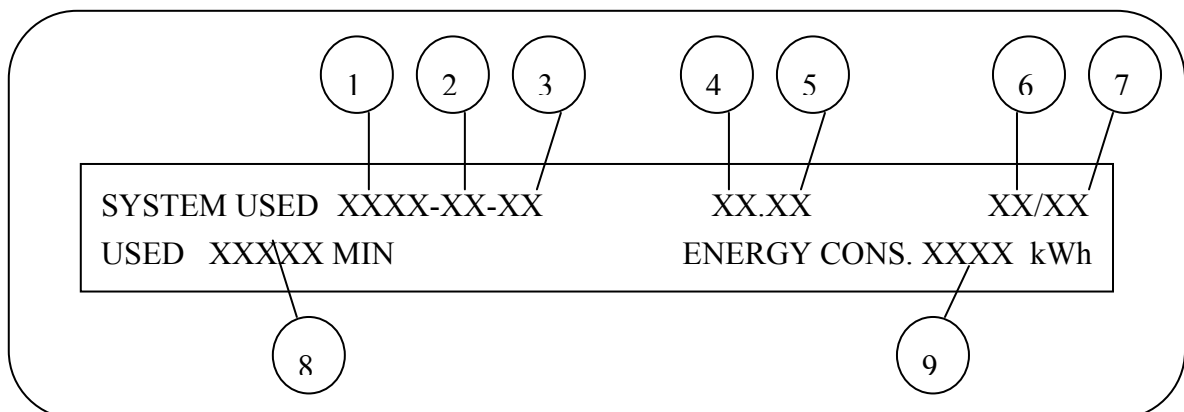


Figure C-4: Power log display

Definitions:

1. Year of the shown logging.
2. Month of the shown logging.
3. Day of the shown logging.
4. Hour of the shown logging.
5. Minute of the shown logging.
6. Log number for the shown logging, youngest = 1, oldest = 50 or less.
7. Total logging, counting from 1 to 50.
8. Total time consumption for the shown logging.
9. Total energy consumption for the shown logging.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

The text shown in Power log mode is in accordance with figure C-4. First line contains logging data such as date, hour, log number code for the actual operation and for previous loggings. The bottom line contains time and energy consumption as well as customer number (if available).

Switching to other modes from Power Log mode

**Switch to:**

View mode

Black box mode

Setup mode

Alarm mode

Default mode

**By pressing key:**

NORMAL DISP

ALARM DISP. and ARROW UP

SETUP GPU

ALARM DISP. (youngest logging)

NORMAL DISP. twice

first key press gives View mode, the second Default mode.

Switching to Power log mode from other modes

**Switch from:**

Default mode

View mode

Black box mode

Alarm mode

Setup mode

**By pressing key:**

ALARM DISP. and ARROW DOWN

ALARM DISP. and ARROW DOWN

ALARM DISP. and ARROW DOWN

ALARM DISP. and ARROW DOWN

ALARM DISP. and ARROW DOWN

## C.4.7.6 Setup Mode

Setup mode consists of 2 modes:

**Mode 1:** Viewing/Selecting setup parameter.

**Mode 2:** Adjusting setup parameter.

When entering Setup mode from another display mode, the display is in Setup mode 1.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## Setup mode 1, select parameter to adjust

When in Setup mode 1:

Select wanted parameter, among the following in forward or reverse order, by activating key

ARROW UP or ARROW DOWN.

OUTPUT VOLTAGE PHASE NEUTRAL	[V]
SETUP :	VALUE = xxx.x

OUTPUT VOLTAGE COMPENSATION 1	[V/100A]
SETUP :	VALUE = xxx.x

OUTPUT VOLTAGE COMPENSATION 2	[V/100A]
SETUP :	VALUE = xxx.x

DELAY FROM CONTACTOR OFF TO STAND BY	
SETUP :	SECONDS = xxxx

REAL TIME CLOCK SETUP	
SETUP :	YEAR = xx

REAL TIME CLOCK SETUP	
SETUP :	MONTH = xx

REAL TIME CLOCK SETUP	
SETUP :	DAY = xx

REAL TIME CLOCK SETUP	
SETUP :	HOUR = xx

REAL TIME CLOCK SETUP	
SETUP :	MINUTE = xx



# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

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REAL TIME CLOCK SETUP

SETUP : SECOND = xx

INTERLOCK BY-PASS

1=BY-PASS

SETUP : VALUE = xx

FAN CONSTANTLY ON

1= CONSTANTLY ON

SETUP : VALUE = xx

SERIAL PROTOCOL:

1=3964R

2=JBUS

SETUP : VALUE = xx

SERIAL PORT:

1=RS232

2=RS422/485

SETUP : VALUE = xx

JBUS SLAVE ADDRESS:

SETUP : VALUE = xxx

RESET ERROR/BLACKBOX/POWER LOG

1=RESET

SETUP : VALUE = xx

RESET HOUR COUNTER

1=RESET

SETUP : VALUE = xx

Additional setup parameters might occur on an optional basis.

When the wanted parameter is found, press and release key SETUP GPU to select this parameter for adjusting. To avoid undesired adjustments, the Confirmation procedure (section C.4.8) has to be carried out. If this is successfully done, the display passes into Setup mode 2.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

---

## Setup mode 2: adjustment of parameter

Setup mode 2 is only possible after successful confirmation of parameter selection in Setup mode 1. The displayed picture is identical to that in Setup mode 1, but it is now possible to adjust the value of the selected parameter.

## When in Setup mode 2:

Adjust parameter by pressing key ARROW UP or ARROW DOWN.

By a constant pressure the key will increase the adjustment speed. When satisfied with the parameter choice, press SETUP GPU. Once again the confirmation procedure has to be carried out, in order to store the new setup value.

If the confirmation is successful the below text will be displayed for 20 seconds or until activation of another key. Afterwards the display returns to Setup mode part 1, displaying the same parameter.

SETUP CONFIRMED  
NEW SETUP ACTIVATED

If a parameter (for example output voltage) is adjusted, while the converter is supplying 400 Hz at the output, the converter follows the commands from the display/keyboard. If setup confirmation is not successful, the converter returns to the old setup value.

As for the reset parameters (logs and counters) the value automatically returns back to 0 after confirmation.

After expiration of 1 minute without any key press, the display automatically returns to default mode. Previous parameter adjustments will be regarded as "not confirmed" and the parameter value remains as before entering setup mode.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

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## C.4.8 Confirmation Procedure

1. Switch S2 at PCB Display interface (A5 - see main diagram) must be in top position, if not the text:

CONFIRMATION SWITCH IN WRONG POSITION  
CORRECT POSITION TO CONTINUE

is displayed for 20 seconds or until key activation. In this case, the confirmation is not successful.

2. If the conditions in 1 are met, the displayed text is:

CONFIRM SETUP  
TO CONTINUE

To confirm the setup: Move switch S2 from top position to bottom position and back again to top position. If this is done within 30 seconds, the confirmation is successful, otherwise it is not. If the confirmation is successful, the display reacts as described in Setup mode 1 or 2.

If the confirmation is **not** successfully done, the text:

SETUP NOT CONFIRMED. NEW SETUP IGNORED  
OLD SETUP REACTIVATED

is displayed for 20 seconds or until key activation.

# Manual HOBART 2200

7,5 – 15 kVA

Instruction for Use

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Switching to other modes from Setup mode

<b><u>Switch to:</u></b>	<b><u>By pressing key:</u></b>
Default mode	NORMAL DISP.
Alarm mode	ALARM DISP.
Black box mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW DOWN
View mode	NORMAL DISP. twice first key press gives Default mode, second key press View mode.

The display automatically returns to Default mode, when 1 minute has elapsed without any key press.

Switching to Setup mode from other modes

<b><u>Switch from:</u></b>	<b><u>By pressing key:</u></b>
Default mode	SETUP GPU
View mode	SETUP GPU
Black box mode	SETUP GPU
Power log mode	SETUP GPU
Alarm mode	SETUP GPU

Selecting Setup mode from other modes always results in Setup mode 1.

## **D. Functional Description of Power Part**

### **D.1 Input Breaker**

The converter is equipped with an input breaker. The input breaker disconnects all power supply to the converter except for the input breaker terminals that are closest to the mains. Upon engagement, the converter passes into standby mode.

### **D.2 Input Filter**

The purpose of the filter is to reduce the EMC back into the mains to such a level that surrounding equipment is not disturbed. At the same time, the filter prevents mains transients from reaching vital parts in the converter.

The filter consists of an RFI-filter (X- and Y capacitors) and a series-choke. The purpose of the RFI filter is to limit the high frequency emission, whereas the series-choke prevents deformations and voltage reinjections back into the mains during the commutation between two diodes.

The distortion of the supply voltage depends on:

- The actual consumption of the connected GPU
- The impedance of the mains ( $R_k$  and  $X_k$ )
- The distortion caused by other users

### D.3 12-pulse Transformer/ DC/AC Module

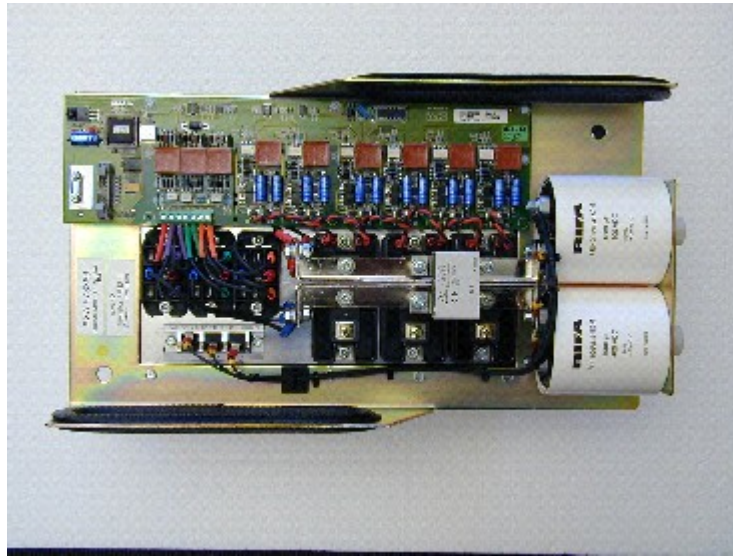


Fig. D-3 : DC/AC module

The 12-pulse transformer transforms the three phases of the mains into six phases. The six phases are rectified in a 12-pulse semi-conductor full bridge. The rectifier is made up of six diodes and six thyristors which are placed on the DC/AC module. The combination of the 12-pulse rectifier, the 12-pulse transformer and the input filter choke means that there is hardly no harmonic feed back into the mains (i.e. no mains pollution/distortion).

The 12-pulse rectifier also provides a soft start by gradually increasing the firing angle of the thyristors. In this way, the inrush current caused by the low-pass filter's capacitor is limited to a value inferior to the converter's nominal current. During operation, the thyristors are fully turned on and the rectifier bridge is acting as an un-regulated 6-phase rectifier bridge.

The 12-pulse rectifier system is characterised by an almost sinusoidal line current and a power factor better than 0,96. This means less stress on the main supply network and distribution transformers.

The DC Filter smoothes the pulsating DC voltage from the 12-pulse rectifier to a level which does not cause any significant voltage modulation at the output.

# Manual HOBART 2200

## 7,5 – 15 kVA

### Functional Description of Power Part

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At ohmic inductive load, the filter's capacitor battery supplies the reactive part of the current which means that the converter's apparent output power (kVA) might be bigger than the consumed power.

Based on the un-regulated DC voltage, the converter's inverter part generates a 400 Hz voltage with adjustable amplitude.

The amplitude adjustment of the voltage's fundamental is made by application of Space Vector Pulse Width Modulation. This gives the converter very good dynamic properties in case of load or mains variations.

IGBT-transistors are used as switches. The transistors' restricted voltage is 1200 V and their rated current is 100A. Apart from this, the transistors can handle the currents that occur in case of a short circuit at the output or a malfunction in the converter.

Short circuits are detected by means of current sensors measuring the inverter current thus securing a quick stop. Each module is equipped with a gate-drive that generates the necessary firing signals for the transistors.

#### **D.4 Isolation Transformer**

The output transformer secures galvanic separation between in- and output. It also transforms the voltages from the AC modules into the required 3 x 200/ 115V aircraft voltage. The filter choke for the output AC-filter is an integrated part of the transformer.

#### **D.5 Output Filter**

The output AC filter reduces the content of harmonics resulting in an output voltage with a total distortion of less than 3%.

Beside the filter choke (integrated in the transformer) and the capacitor bank, the AC-filter consists of a RFI-filter that reduces the high frequency emission from the converter.

#### **D.6 Output contactor(s)**

The converter is equipped with one output contactor per outlet. The contactor is engaged at start up of the corresponding output, and it is disengaged, when the stop button is applied. If the converter does not receive the aircraft's interlock voltage after 1 second, the contactor disengages. In case of repair/service, the converter's interlock system can be by-passed.

Manual HOBART 2200  
7,5 – 15 kVA  
Functional Description of Power Part

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## **E. Functional Description of Electronic Part**

By means of interface components, the processor module takes care of controlling-, supervision- and regulating tasks in the converter. The processor module is based on a micro-controller and a digital signal processor making it possible

- to implement complex mathematical relations (PWM systems), to achieve better performance.
- to monitor, store and recall a great number of parameters and information, to give the best possible service, for example in case of operation problems.
- to be flexible in relation to I/O signals.

### **E.1 Facilities**

The processor module provides the following facilities:

#### Communication with the operator via display

- Showing of the converter's electrical and thermal parameters
- Adjustment of the converter's parameters (output voltage, current limit, date etc.)
- Showing of error messages in a clear language and in related code form as well as input and output parameters of the time when the error occurred.
- Showing of customer information (customer number, power and time consumption).

#### Safety

- Check of the power components' function
- Monitoring of internal and external parameters.

#### Error logging / Investigation

- Date (year, month, day), time (hour, minute, second) and error code is logged in case of errors.
- Up to 1000 errors are available for recalling/investigation.
- As for the last 50 errors, chosen input and output parameters recorded at the moment where the fault occurred can be recalled / investigated.
- Battery backup - capacity for 10 years without external supply.

# Manual HOBART 2200 Compact

7,5 - 15 kVA

## Functional Description of Electronic Part

### Customer registration

- Date (year, month, day), time (hour, minute, second), customer number, power consumption and duration are recorded.
- The last 50 operations can be recalled / examined.

### Programming of the converter's electrical and functional characteristics

- Possibility of customer modification (lamp test, fuse indicators, potential free contacts)
- Expansion possibility (i.e. implementation of RS232 and or RS485 interface for computer reading)
- Precise regulation of the output voltage.

## E.2 Composition of Processor Module and Interfaces

Fig. E-2 shows the composition of the processor module as well as the relation between the processor module and the interfaces. The processor module and the interfaces are built-up in modules with only few single core connectors thus leading to easy service and repair. The interface modules provide galvanic isolation, transformation and over current protection between the processor module and the power part.

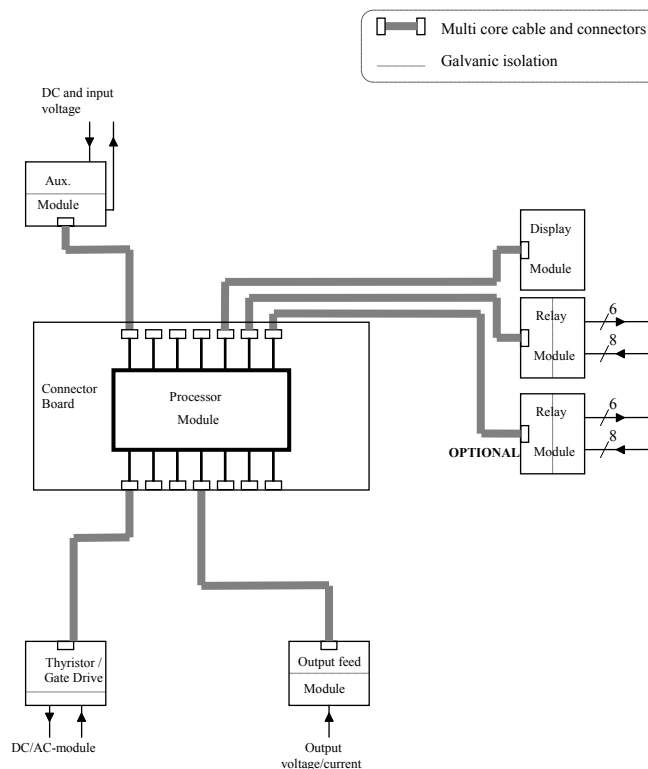


Figure E-1: Processor module and interfaces

# Manual HOBART 2200 Compact

7,5 - 15 kVA

## Functional Description of Electronic Part

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All interface modules are connected to the processor module by means of shielded multi-core cables. The cable connections are provided with mechanical lock.

The primary functions of the above mentioned components are briefly described in the following.

### E.2.1 Processor Module



- DC-DC conversion to internal supply voltages  $\pm 5$ , 12 and 17 VDC.
- Micro-controllers, performing I/O control, parameter monitoring and external communication by means of the display.
- Digital Signal Processors (DSP) performing regulation of output voltages, measurements of voltages, currents and calculations of RMS-values, meanvalues and power consumption.

### E.2.2 Aux. Module



- Transient protection of the converter's internal power supply (supply of processor module and interface)
- Overcurrent protection of the converter's internal power supply
- Isolated AC-DC supply to the processor module.
- Isolated AC-AC supply to relay module.
- Interface / drivers for operation of output contactors and / or input breakers (MCCBs)
- Interface for fans.
- Isolated DC conversion (DC watchdog). Makes it possible for the processor module to monitor the DC voltage and to give warning signal / to shut down the converter.
- Storage of energy to supply the processor module with voltage during mains failure of duration up to 40 ms.

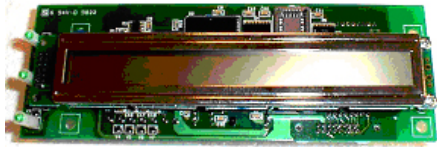
# Manual HOBART 2200 Compact

7,5 - 15 kVA

## Functional Description of Electronic Part

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### E.2.3 Display / Keyboard Module



- Alpha-numeric display showing converter status.
- Reading of parameters / data chosen by the consumer / operator (voltages, currents, output power, temperature, date, time, hour counter etc.)
- Setup of parameters via keyboard.
- Unambiguous error description in clear language / investigation of error logging's.

### E.2.4 Relay Module(s)



- 8 isolated input channels.
- 6 potential free output channels.

Depending on the requirements, some channels may be used for operation of the converter. Otherwise all I/O channels can be programmed according to customer requirements. **As an option**, an additional relay module identical with the above can be integrated.

### E.2.5 Thyristor / Gate Drive



Thyristor/ Gate drive

- Isolated thyristor-driver circuit
- Isolated IGBT-driver circuit.
- Dead time generators.
- Monitoring of supply voltage.
- Protection, fast IGBT-turn off in case of over currents, voltage errors or other errors reported by the actual module or by other modules in the converter.
- Supervision of heat sink temperature.

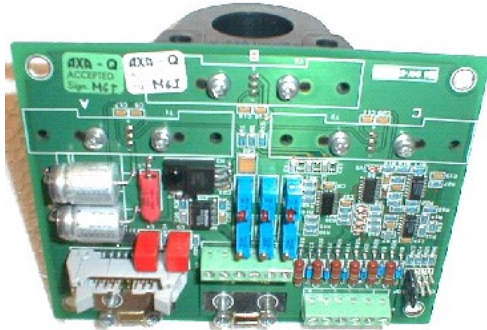
# Manual HOBART 2200 Compact

7,5 - 15 kVA

## Functional Description of Electronic Part

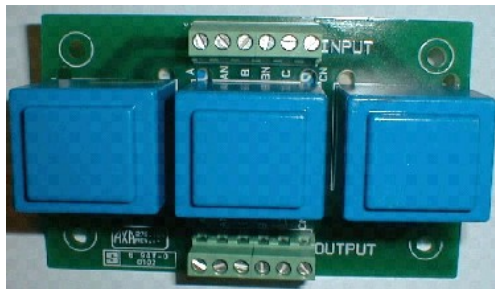
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### E.2.6 Output Feed Module



- Isolating transformer for voltage feedback of output voltage
- AC current sensors.
- Resistors for termination of additional current transformers at output.
- Current stop.

### E.2.7 Voltage Feed Module (Component A14)



- Galvanic Isolation of voltage feed back from
- Output Adjustment of voltage feed back

## F. Error Diagnostics

### Overall Comments

As described for the display in alarm mode (section C.4.7.3), the display provides extensive information in case of a failure in the converter or at its in- and output conditions.

In case of an error/alarm, the latest logged error information is automatically shown at the display. If for some reason, this is not the case, call up the latest logged error.

In most cases, the displayed text or the error code (and section F.2) provide the necessary information for correction of the error.

Before trying anything else it is recommended to perform at least one reset/restart of the converter, because:

- If the error was caused by an abnormality or related to external conditions, it is most likely not permanent.
- If the found/logged error has caused an internal damage, this damage is the problem to relate to or to correct. Such a damage is found by the extensive check routine, carried out during reset.

If the error persists after a reset and it therefore is necessary to check and repair the converter, kindly notice:

- that the capacitors remain charged to dangerous voltages. The discharge time is 5 minutes.
- that modules including Printed Circuit Boards with active components are sensitive to ESD.

*In case that you need to contact HOBART in connection with any fault guidance, please inform us of the serial number of the GPU. The serial number can be found at the rating plate which is placed on front of the GPU.*

### Data Control Cables

Theoretically, most failures in the GPU could be caused by bad connections and cable failures. Hence, for your convenience all control cables are equipped with the same 16-pole click-in connection at both ends. This means that they are compatible. Therefore you may use any control cable to verify if the cable should be the reason of the failure.

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

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## Failure Correction at Control Panel, Remote Control & Relay Module

If the fuses F1 or F2 on the relay module are blown, no interlock signal is returned. This error is probably related to a short circuit in the surge suppressors V1 and V2 which should therefore be checked. If a short circuit is detected: Remove the short-circuit and restart the converter.

In case of an over voltage the converter's safety terminals the so-called thermi traps will be short-circuited. Therefore, if any internal fuses on the relay module are blown, the related terminals should be checked.

## Defective Push Buttons

Push the defective push button and check that the corresponding LED on the relay module (component A6 see main circuit) is lit. If this is not the case, check that the main LED **H15** is lit; otherwise change fuse F3.

If the corresponding LED is lit and if the GPU does not react when the push button is activated, the relay board is defective and must be replaced.

## F.1 Error Numbering / Grouping

The error codes are organised in groups. Each group contains up to 100 numbers and the error code consists of 4 digits.

xyyy	= 4 digit error code		
xx	= group number	:	type of error
yy	= location number	:	location of error

(see figure C-3)

Group numbers starts at 00 and ends at 99

NB. Not all 100 location numbers within a group are necessarily used.

## F.2 Display Readings / Causes / Suggestions

If the displayed error explanation does not provide sufficient information to get the converter into operation, the error code (figure C-3) and this section provide detailed information about the cause of the error and it also suggests corrective actions.

For all possible error codes, the following is described:

- Possible causes
- Test-, measuring-, repair- or replacement suggestions

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

For convenience all examples of display alarm pictures in this section show the same date, time, log number and number of total loggings. The display alarm picture used is:

1998-08-20	08.00	ALARM	xxyy/001/0056
Text description of error			

**How to read:** On august 20 th 1998 at 8 am an error was logged. The error code is xxyy (group number xx, location number yy), this logging is the latest logging, number 001 out of 56 loggings in total.

### F.2.1 Error Log Initialisation or Malfunctioning

#### F.2.1.1 Error Code 0000 - 0099

##### Display alarm picture:

1998-08-20	08.00	ALARM	00yy/001/0056
NO ERRORS LOGGED YET			

##### Possible error causes:

This logging was done during a reset of the error log memory and is not considered as an error. It is overwritten when the error log memory is full (1000 errors).

##### Additional information on location numbers (yy) :

Only 00 used.

##### Recommended corrective actions :

None.

#### F.2.1.2 Error Code 0100 - 0199

##### Display alarm picture:

1998-08-20	08.00	ALARM	01yy/001/0056
LOGGING WAS NOT COMPLETED SUCCESSFULLY			

##### Possible error causes:

Logging of a detected error was interrupted due to disappearing internal supply voltage.  
Original error number lost.



# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### **Additional information on location numbers (yy) :**

Only 00 used.

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- If often occurring, replace Aux. module (Component A5 on main diagram; see also photo layout under section I)
- If often occurring, replace processor module (Component A9 on main diagram; see also photo layout under section I)

## **F.2.2 Internal DC Supply (Control Voltage)**

### **F.2.2.1 Error Code 0200 - 0299**

#### **Display alarm picture:**

1998-08-20	08.00	ALARM	02yy/001/0056
INTERNAL DC SUPPLY VOLTAGE ERROR			

#### **Possible error causes:**

One or more of the internal DC voltages (-5V, 12V, 17V or 30V) are too low.

Defective components at Aux. module or processor module.

Input voltage low.

### **Additional information on location numbers (yy) :**

01 : -5V only	08 : 30V only
02 : 12V only	09 : -5V and 30V
03 : -5V and 12V	10 : 12V and 30V
04 : 17V only	11 : -5V, 12V and 30V
05 : -5V and 17V	12 : 17V and 30V
06 : 12V and 17V	13 : -5V, 17V and 30V
07 : -5V, 12V and 17V	14 : 12V, 17V and 30V
	15 : -5V, 12V, 17V and 30V

### **Recommended corrective actions :**

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace Aux. module (Component A5 on main diagram; see also photo layout under section I)
- Replace processor module (Component A9 on main diagram; see also photo layout under section I)

### F.2.3 Internal Communication Errors

#### F.2.3.1 Error Code 0400 - 0699

##### Display alarm picture:

2001-08-20	08.00	ALARM	04yy/001/0056
DSP FAILURE – AC SOFTSTART NOT RUNNING			

2001-08-20	08.00	ALARM	05yy/001/0056
DSP FAILURE – INVERTER NOT RUNNING			

2001-08-20	08.00	ALARM	06yy/001/0056
INPUT VOLTAGE – PHASE SEQUENCE NOT FOUND			

##### Possible error causes:

Defective components in processor module.

##### Additional information on location numbers (yy) :

Only 00 in use.

##### Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace processor module (Component A9)
- Replace Aux. Module (Component A5)

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## F.2.4 AC Input Voltage Error

### F.2.4.1 Error Code 0700 - 0899

#### Display Alarm picture:

1998-08-20	08.00	ALARM	07yy/001/0056
INPUT VOLTAGE - FREQUENCY TOO HIGH			

1998-08-20	08.00	ALARM	08yy/001/0056
INPUT VOLTAGE - FREQUENCY TOO LOW			

#### Possible error causes:

- Input supply frequency above 65Hz or below 45Hz.
- Defective components in processor module.
- Defective Aux. module.
- Low input voltage.

#### Additional information on location numbers (yy) :

Only 00 used.

#### Recommended corrective actions :

In all cases measure/check input voltage, phase sequence and that all 3 phases are present.

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Check fuses F7-F9 at Aux. module (Component A5)
- Replace processor module (Component A9)
- Replace Aux. module (Component A5)

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## F.2.4.2 Error Code 0900 - 0999

### Display alarm picture:

1998-08-20	08.00	ALARM	09yy/001/0056
INPUT VOLTAGE - PHASE SEQUENCE WRONG			

### Possible error causes:

- Wrong phase sequence, input voltage.
- Input voltage low.
- Defective components in processor module.
- Defective Aux. module.

### Additional information on location numbers (yy) :

Only 00 used.

### Recommended corrective actions :

In all cases measure/check input voltage, phase sequence and that all 3 phases are present.

- Try to restart the converter.
- If the error persists after a reset, try in the following order:
- Replace processor module (Component A9 on main diagram; see also photo layout under section I)
- Replace Aux. module (Component A5 on main diagram; see also photo layout under section I)

## F.2.4.3 Error Code 1000 - 1099

### Display alarm picture:

1998-08-20	08.00	ALARM	10yy/001/0056
INPUT VOLTAGE TOO HIGH			

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### **Possible error causes:**

Input voltage has passed upper limit (see Specifications chapter G) for more than 20ms.

Temporary overvoltage.

Defective Aux. module.

Defective components in processor module.

### **Additional information on location numbers (yy) :**

Over voltage measured at:

01	corresponding to	L1-L2
02	-	L2-L3
03	-	L1-L2 and L2-L3
04	-	L3-L1
05	-	L1-L2 and L3-L1
06	-	L2-L3 and L3-L1
07	-	L1-L2 and L2-L3 and L3-L1

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Measure the input voltage, correct if not within limits and reset the converter.
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

#### **F.2.4.4 Error Code 1100 - 1399**

### **Display Alarm picture:**

1998-08-20	08.00	ALARM	11yy/001/0056
INPUT VOLTAGE TOO LOW			

1998-08-20	08.00	ALARM	12yy/001/0056
INPUT PHASE LOW / FUSE BLOWN			

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

1998-08-20	08.00	ALARM	13yy/001/0056
INPUT VOLTAGE TOO LOW			

### **Possible error causes:**

Input voltage has been below the lower limit (according to Specifications chapter G) for more than 20ms.

Temporary undervoltage or defective input fuse at Aux. module (Component A5).

Missing phase.

Defective Aux. module.

Defective processor module.

### **Additional information on location numbers (yy) :**

11yy Most likely defective components:

01 corresponding to L1-L2

02 - L2-L3

04 - L3-L1

12yy Most likely defective fuse at Aux. module (Component A5, see main diagram and photo layout) or missing phase

01 corresponding to Fuse 9 or phase L1

02 - Fuse 7 or phase L2

04 - Fuse 8 or phase L3

13yy

07 corresponding to Low voltage on all 3 phases (only logged in black box)

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Measure input voltage, correct if not within limits and reset the converter.
- Check fuses at Aux. module (Component A5), replace if necessary.
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## F.2.4.5 Error Code 1400 - 1499

### Display Alarm picture:

2001-08-20	08.00	ALARM	14yy/001/0056
RECTIFIER SOFT START FAILURE			

### Possible error causes:

Temporary undervoltage / missing phase  
Defective processor module.

### Additional information on location numbers (yy) :

Only 00 is used

### Recommended corrective actions :

- Try to restart the converter.
- If the error persists after a reset, try in the following order:
- Check fuses at Aux. module (Component A5), replace if necessary.
  - Replace processor module (Component A9)

## F.2.5 DC Voltage Error (Power)

### F.2.5.1 Error Code 1500 - 1599

### Display alarm picture:

1998-08-20	08.00	ALARM	15yy/001/0056
DC VOLTAGE < 350 V			

### Possible error causes:

The total voltage at DC capacitor bank has been below 350V for 30ms or more.  
Rectifier is not working.  
Defective capacitors (C1).  
Defective Aux. module.  
Defective components in processor module.

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### **Additional information on location numbers (yy) :**

01	:	350V > DC voltage $\geq$ 325V
02	:	325V > DC voltage $\geq$ 300V
03	:	300V > DC voltage $\geq$ 260V
04	:	260V > DC voltage

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Exchange the DC/AC module(s)
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

### **F.2.5.2 Error Code 1600 - 1699**

#### **Display alarm picture:**

2001-08-20	08.00	ALARM	16yy/001/0056
DC VOLTAGE > 850 V			

#### **Possible error causes:**

The total voltage at DC capacitor bank has been above 850V for 2ms or more. Eventually caused by energy flow towards converter during a No Break Power Transfer failure situation.

Defective Aux. module.

Defective components in processor module.

### **Additional information on location numbers (yy) :**

01	:	850V < DC voltage $\leq$ 865V
02	:	865V < DC voltage $\leq$ 880V
03	:	880V < DC voltage $\leq$ 895V
04	:	895V < DC voltage



# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

### **F.2.5.3 Error Code 1700 - 1799**

#### **Display alarm picture:**

1998-08-20	08.00	ALARM	17yy/001/0056
DC CAPACITOR SHARING ERROR			

#### **Possible error causes:**

The difference between the voltages of the DC capacitor battery's 2 parts has been more than 50 V for 30ms or more.

Defective capacitor.

Defective sharing resistor.

Defective Aux. module.

Defective components in processor module.

#### **Additional information on location numbers (yy) :**

Only 01 used

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace DC/AC module(s)
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

## **F.2.6 Errors Reported by DC/AC Modules**

### **F.2.6.1 Error Code 2000 - 2099**

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## **Display alarm picture:**

1998-08-20	08.00	ALARM	20yy/001/0056
HIGH TEMPERATURE DC/AC - MODULE			

## **Possible error causes:**

- Overtemperature at DC/AC module.
- Fans not running or limited airflow.
- Defective DC/AC module.
- Defective components in processor module.

## **Additional information on location numbers (yy) :**

Only 01 is used.

## **Recommended corrective actions :**

- Check airflow / airfilter.
- Check that fans are running properly; By-pass the fan as described in B.5 & C.4.7.

*NB: Remember to reset the set-up value (back to 0)*

If the fans are not running properly

- Check the supply voltage to the fans
- Replace Aux. module (Component A5)
- Wait for DC/AC module(s) to cool down.
- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace DC/AC module
- Replace processor module (Component A9)

## **F.2.6.2 Error Code 2100 - 2199**

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## **Display alarm picture:**

1998-08-20	08.00	ALARM	21yy/001/0056
GATE VOLTAGE ERROR DC/AC-MODULE			

## **Possible error causes:**

Gate drive voltage has been temporarily or is permanently below limit, eventually caused by an earlier overcurrent.

Defective DC/AC module.

Defective components in processor module.

## **Additional information on location numbers (yy) :**

Only 01 is used.

## **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace DC/AC module
- Replace processor module (Component A9)

## **F.2.7 Output Voltage Error**

### **F.2.7.1 Error Code 3000 - 3199**

## **Display alarm picture:**

1998-08-20	08.00	ALARM	30yy/001/0056
OUTPUT OVERVOLTAGE 1: U > 128V - 250ms			

1998-08-20	08.00	ALARM	31yy/001/0056
OUTPUT OVERVOLTAGE 2: U > 140V - 15ms			

## **Possible error causes:**

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

The output voltage (Phase-Neutral) at the converter's output terminals has exceeded the displayed limit. Most likely due to

Defective output feed module.

Defective voltage feed back module.

Defective components in processor module.

### **Additional information on location numbers (yy) :**

Overvoltage at Phase:		
01	corresponding to	A only
02	-	B only
03	-	A and B
04	-	C only
05	-	A and C
06	-	B and C
07	-	A and B and C

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Check that set-up value is within limits. If not correct.
- Replace output feed module (Component A8).
- Replace the voltage feed-back module (Component A14)
- Replace processor module (Component A9)

### **F.2.7.2 Error Code 3500 - 3799**

#### **Display alarm picture:**

1998-08-20	08.00	ALARM	35yy/001/0056
OUTPUT UNDERVOLTAGE 1: U < 100V - 300ms			

1998-08-20	08.00	ALARM	36yy/001/0056
OUTPUT UNDERVOLTAGE 2: U < 90V - 50ms			

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

1998-08-20	08.00	ALARM	37yy/001/0056
OUTPUT UNDERVOLTAGE 3: $U < 70V - 10ms$			

### **Possible error causes:**

The output voltage (Phase-Neutral) at the converter's output terminals was below the displayed limit. Most likely due to an abrupt drop out of the mains supply combined with a heavy overload. If this is not the case, the error may be due to

Defective output feed module.

Defective voltage feed-back module

Defective components in processor module.

Defective output filter.

### **Additional information on location numbers (yy) :**

Undervoltage at Phase:		
01	corresponding to	A only
02	-	B only
03	-	A and B
04	-	C only
05	-	A and C
06	-	B and C
07	-	A and B and C

## **F.2.8 Output Current Error**

### **F.2.8.1 Error Code 4000 - 4499**

#### **Display alarm picture:**

2001-08-20	08.00	ALARM	40yy/001/0056
OVERLOAD 1: $100\% < I \leq 120\% - 600s$			

2001-08-20	08.00	ALARM	41yy/001/0056
OVERLOAD 2: $120\% < I \leq 150\% - 30s$			

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

2001-08-20	08.00	ALARM	42yy/001/0056
OVERLOAD 3: $150\% < I \leq 170\%$ - 5s			

2001-08-20	08.00	ALARM	43yy/001/0056
OVERLOAD 4: $170\% < I \leq 200\%$ - 1s			

2001-08-20	08.00	ALARM	44yy/001/0056
OVERLOAD 5: $I > 200\%$			

### **Possible error causes:**

- Output current has been in the displayed range for the displayed time.
- Defective 400 Hz distribution installation.
- Defective output feed module.
- Defective components in processor module.

### **Additional information on location numbers (yy) :**

Overload at Phase:		
01	corresponding to	A only
02	-	B only
03	-	A and B
04	-	C only
05	-	A and C
06	-	B and C
07	-	A and B and C

### **Recommended corrective actions :**

- Remove overload and try to restart the converter.
- If the same error message keeps occurring, and there is no overload situation, the error is within the converter.
- Replace output feed module (Component A8).
- Replace processor module (Component A9)

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## F.2.8.2 Error Code 4500 - 4599

### Display alarm picture:

2001-08-20	08.00	ALARM	45yy/001/0056
SHORT CIRCUIT AT OUTPUT			

### Possible error causes:

DC/AC module current has exceeded the limit, most likely due to a short circuit in the output installation.

Eventually overcurrent due to a failure at a No Break Power Transfer.

Defective output feed module.

Defective DC/AC module.

Defective components in processor module.

Internal 12V DC supply voltage is too low.

### Additional information on location numbers (yy) :

Ref.: DC/AC module table (See section F.3)

In special situations a gate voltage error (21yy) can occur simultaneously. If so, this error will also be displayed as an overcurrent, but it will be correctly reported by the LED (H1) situated on the respective DC/AC module.

### Recommended corrective actions :

- Investigate for and remove short circuit.
- Try to restart the converter.

If the error persists after a reset, try to remove the distribution / load (alternatively the voltage to the output contactor) and restart the converter

If this solves the problem, the error is not within the converter. Examine and repair the 400 Hz distribution / load.

If the problem is still not solved, try in the following order:

- Exchange the output feed module (Component A8)
- Exchange the DC/AC module(s)
- Exchange the processor module (Component A9).

## F.2.8.3 Error Code 4600 - 4699

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## **Display alarm picture:**

2001-08-20	08.00	ALARM	46yy/001/0056
TRANSFORMER / FILTER CURRENT TOO LOW			

## **Possible error causes:**

- DC/AC module current was too low during the 400 Hz softstart.
- Defective capacitor in output filter.
- Defective output feed module.
- Defective DC/AC module.
- Defective components in processor module.

## **Additional information on location numbers (yy) :**

Ref.: DC/AC module table (See section F.3)

## **Recommended corrective actions :**

- Try to restart the converter.  
If the error persists after a reset call HOBART for further instructions or try in the following order:
- Replace defective capacitors in the output filter (Component C2-C4)
- Replace output feed module (Component A8)
- Replace DC/AC module(s)
- Replace processor module (Component A9)

### **F.2.8.4 Error Code 4700 - 4799**

## **Display alarm picture:**

2001-08-20	08.00	ALARM	47yy/001/0056
TRANSFORMER / FILTER CURRENT TOO HIGH			

## **Possible error causes:**



# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

DC/AC module current has exceeded the limit during the last part of the 400 Hz softstart, most likely due to short circuit in transformer-/filter-section or missing feed back voltage from the 400 Hz output.

Defective DC/AC module.

Defective output feed module

Defective voltage feed back module

Defective components in processor module.

Internal 12V DC supply voltage is too low.

### **Additional information on location numbers (yy) :**

Ref.: DC/AC module table (See section F.3)

In special situations a gate voltage error (21yy) can occur simultaneously. If so, this error will also be displayed as an overcurrent, but it will be correctly reported by the LED (H1) situated on the respective DC/AC module.

### **Recommended corrective actions :**

- Try to restart the converter.  
If the error persists after a reset, call HOBART, for further instructions or try in the following order:
- Replace DC/AC module(s)
- Replace output feed module (Component A8)
- Replace voltage feed-back module (Component A14)
- Replace processor module (Component A9)
- Replace / check output filter.
- Replace / check output transformer.

#### **F.2.8.5 Error Code 4800 - 4899**

### **Display alarm picture:**

2001-08-20	08.00	ALARM	48yy/001/0056
TRANSFORMER TEMPERATURE TOO HIGH			

### **Possible error causes:**

Too high temperature in the output transformer

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# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

The fans are not running properly or the air flow is reduced

Defective thermal sensor

Defective components at AUX module

Defective components at processor module

### **Additional information on location numbers (vv) :**

The display shows all relevant information

### **Recommended corrective actions :**

- Verify the airflow / air filter
- Verify that the fans are running properly. By-pass the fans as described in B.5 and C.4.7.

*NB. Remember to re-set the set-up value (back to 0)*

- Let the transformer cool down and verify the thermal sensor by short-circuiting the inlet of the AUX module (Component A5)
- Replace the AUX module
- Replace processor module (Component A9)

## **F.2.9 Undefined Error Codes**

### **F.2.9.1 Error Code 1800-1999, 2200-2999**

**Error Code 3200-3499, 3800-3999**

**Error Code 4900-4999**

### **Display alarm picture:**

Example:

2001-08-20	08.00	ALARM	03yy/001/0056
Not a defined number 3200-3499			

### **Possible error causes:**

Defects in processor module or display module.

Temporary or permanent disturbance of communication.

### **Additional information on location numbers (vv) :**

None

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace processor module (Component A9)
- Replace display module (Component A10)
- If failure reoccurs call HOBART.

### **F.2.9.2 Error Code 5600 - 9999**

#### **Display alarm picture:**

2001-08-20	08.00	ALARM	xxyy/001/0056
2001-08-20	08.00	ALARM	xxyy/001/0056

#### **Possible error causes:**

The displayed error code exceeds the limit of definitions caused by either: Defects in processor module or display module, or temporary or permanent disturbance of communication.

#### **Additional information on location numbers (yy) :**

None.

### **Recommended corrective actions :**

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace processor module (Component A9)
- Replace display module (Component A10)
- If failure reoccurs call HOBART.

# Manual HOBART 2200

7,5 – 15 kVA

Technical Specifications

---

## F.3 Listing of DC/AC Modules

The below table shows the relation between the location number (the two last digits in the error code) and the malfunctioning “leg” / “legs” in the DC/AC module. The table is valid for the following group numbers:

45yy, 46yy, 47yy

--yy	DC/AC-module leg
01	1
02	2
03	1,2
04	3
05	1,3
06	2,3
07	1,2,3

## F.4 Errors Related to Possible Options (refer to Section H)

### F.4.1 Over Temperature in Optional Transformer

#### F.4.1.1 Error Code 5500 - 5599

##### Display alarm picture:

2001-08-20	08.00	ALARM	55yy/001/0056
ADAPTATION TRANSFORMER OVERHEATED			

##### Possible error causes:

- Too high temperature in the adaptation transformer
- The fans are not running properly or the air flow is reduced
- Defective thermal sensor
- Defective components at AUX module
- Defective components at processor module

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### **Additional information on location numbers (yy) :**

The display shows all relevant information

### **Recommended corrective actions :**

- Verify the airflow / air filter
- Verify that the fans are running properly. By-pass the fans as described in B.5 and C.4.7.

*NB. Remember to re-set the set-up value (back to 0)*

- Let the transformer cool down and verify the thermal sensor by short-circuiting the inlet of the AUX module (Component A5)
- Replace the AUX module
- Replace processor module (Component A9)

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

---

### G. Technical Specifications

#### G.1 Standards

DFS 400	Specification for 400 Hz aircraft power supply.
ISO 6858	Aircraft ground support electrical supplies- General requirements
BS 2G 219	General requirements for ground support electrical supplies for aircraft
MIL-704E	Aircraft electric power characteristics.
EN 50091-1	General and safety requirements
EN 61000-6-4	Electromagnetic compatibility, Generic emission standard (EN 50081-2)
EN 61000-6-2	Electromagnetic compatibility, Generic immunity standard (EN 50082-2)
SAE ARP 5015	Ground equipment – 400 Hz ground power performance requirement
EN2282	Aerospace series characteristics of aircraft electrical supplies

#### G.2 Electrical Specifications

##### G.2.1 Input

Voltage	3 x 400V $\pm$ 15% or according. to customers spec.
Frequency	50 / 60 Hz $\pm$ 5 %
Rectification	12-pulse
Line Current	9.5 A $\pm$ 15% (7,5 kVA); 19 A (15 kVA)
Max. pre-fusing	16 A (7,5 kVA); 32 A (15 kVA)
Line Current Distortion	< 10% (15 kVA); < 15% (7,5 kVA)
Power Factor	> 0.96 at 100% load
Inrush current	None, soft start
Power interruption	Up to 20 ms

##### G.2.2 Output

Power	7.5 - 15 kVA, $\cos \varphi = 0.8$
Voltage	3 x 200/115 V.
Power factor	0,7 lagging to 0,95 leading.
Voltage regulation	< 0,5% for balanced load < 3% for 30% unbalanced load
Voltage transient recovery	$\Delta U < 8\%$ and recovery time < 10 ms at 100% load change
Total harmonic content	< 2% at linear load (typically < 1.5%) < 2% at non-linear load according to ISO 1540
Crest factor	1.414 $\pm$ 3%
Voltage modulation	< 1.1%
Phase angle symmetry	120° $\pm$ 1° for balanced load , 120° $\pm$ 2° for 30% unbalanced load
Frequency	400 Hz $\pm$ 0,1%
Overload	20% for 600 seconds 50% for 30 seconds 70% for 5 seconds 100% for 1 second

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

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### G.3 Efficiency

Overall efficiency	> 0,90 at 7,5 kVA load, 0,93 at 15 kVA load
Stand-by losses	< 50 W
No load losses	< 1 kW

### G.4 Set-up

Output voltage	100-128 V
Voltage compensation	0-9 V
Delay to stand-by	0-15 min.
Time	Year, month, day, hour, minute and seconds
Interlock	Bypass on/off
Fan	Test on / off
Error log / Power log	Reset
Timer (hour counter)	Reset

### G.5 Protections

No Break Power Transfer  
Input over-and under voltage  
Input overload  
Internal high temperature  
Internal voltage error  
Output over-and under voltage (according to DFS 400)  
Overload at output  
Short circuit at output  
Generative loads.

# Manual HOBART 2200

7,5 – 15 kVA

## Technical Specifications

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### G.6 Physical

Fixed model	200 kgs
Mobile model	275 kgs

For dimensions, please refer to layout drawing enclosed under section I

### G.7 Environmental

Operating temperature	-40 °C to +50 °C
Relative humidity	10-95% (10-100% optional)
Noise level	< 65 dB (A) at 1 m, typically 60 dB(A)
Standard protection	IP55 (Electronic Part)

### G.8 Life etc.

Operational life	Min 25 years
Mean time between failures (MTBF):	
• Converter	Min 100.000 hours
• Ventilation system	Min. 25.000 hours
Mean time to repair (MTTR)	Max. 20 min.



# Manual HOBART 2200

7,5 – 15 kVA

Options / Deviations

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## H. Options / Deviations

### H.1 Standard Options

This converter is equipped with the following standard options:

H.1.1	573923	Additional Output Contactor 7.5 - 15 kVA Units .....	76	<input type="checkbox"/>
H.1.2	573944	Additional Base Module (Add on Module).....	76	<input type="checkbox"/>
H.1.3	573945	Input Transformer with Tappings (Add on Module).....	76	<input type="checkbox"/>
H.2 Additional Options .....			77	

# Manual HOBART 2200

7,5 – 15 kVA

Options / Deviations

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## H.1.1 573923 Additional Output Contactor 7.5 - 15 kVA Units

Diagram no.: 473923 7,5 - 15 kVA

HOBART 2200 Ground Power Units with ratings from 7.5 – 90 kVA are as standard equipped with one output contactor. All models are, however, prepared for an additional output contactor. Each contactor can transfer the nominal current of the GPU.

In case of more than two outlets, an external distribution board is required.



## H.1.2 573945 Additional Base Module (Add on Module)

Additional base module, which extends the height of the GPU by 195 mm. Standard colour is RAL 7043 (dark grey) which corresponds to the colour of the frame.

## H.1.3 573945 Input Auto Transformer with Tappings (Add on Module)

Diagram no.: 473945

Transformer, which enables connection of the GPU to the following mains voltages:

- 3 x 208 VAC (recommended pre-fuse: 50 A)
- 3 x 220 VAC (recommended pre-fuse: 50 A)
- 3 x 230 VAC (recommended pre-fuse: 50 A)
- 3 x 240 VAC (recommended pre-fuse: 50 A)
- 3 x 440 VAC (recommended pre-fuse: 25 A)
- 3 x 460 VAC (recommended pre-fuse: 25 A)
- 3 x 480 VAC (recommended pre-fuse: 25 A)
- 3 x 600 VAC (recommended pre-fuse: 20 A)

## H.2 Non Standard Options

# Manual HOBART 2200

7,5 – 15 kVA

Options / Deviations

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This converter is not equipped with any additional options.

# Manual HOBART 2200

7,5 – 15 kVA

## Recommended Spare Parts

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### I. Annexes

#### Electrical-diagrams

	Drawing no.:
Electrical main-diagram and instrumentation	473179H <input type="checkbox"/>
Options – cf. section H	
Additional Output Contactor	473923H <input type="checkbox"/>
Input Transformer with Tappings	473945H <input type="checkbox"/>

#### Sketches & Drawings

Component Layout drawing	2 pages
Outline drawings	Drawing no.:
Fixed model	173075H <input type="checkbox"/>
Mobile model	143071H <input type="checkbox"/>

**Fax formula – fault guidance**

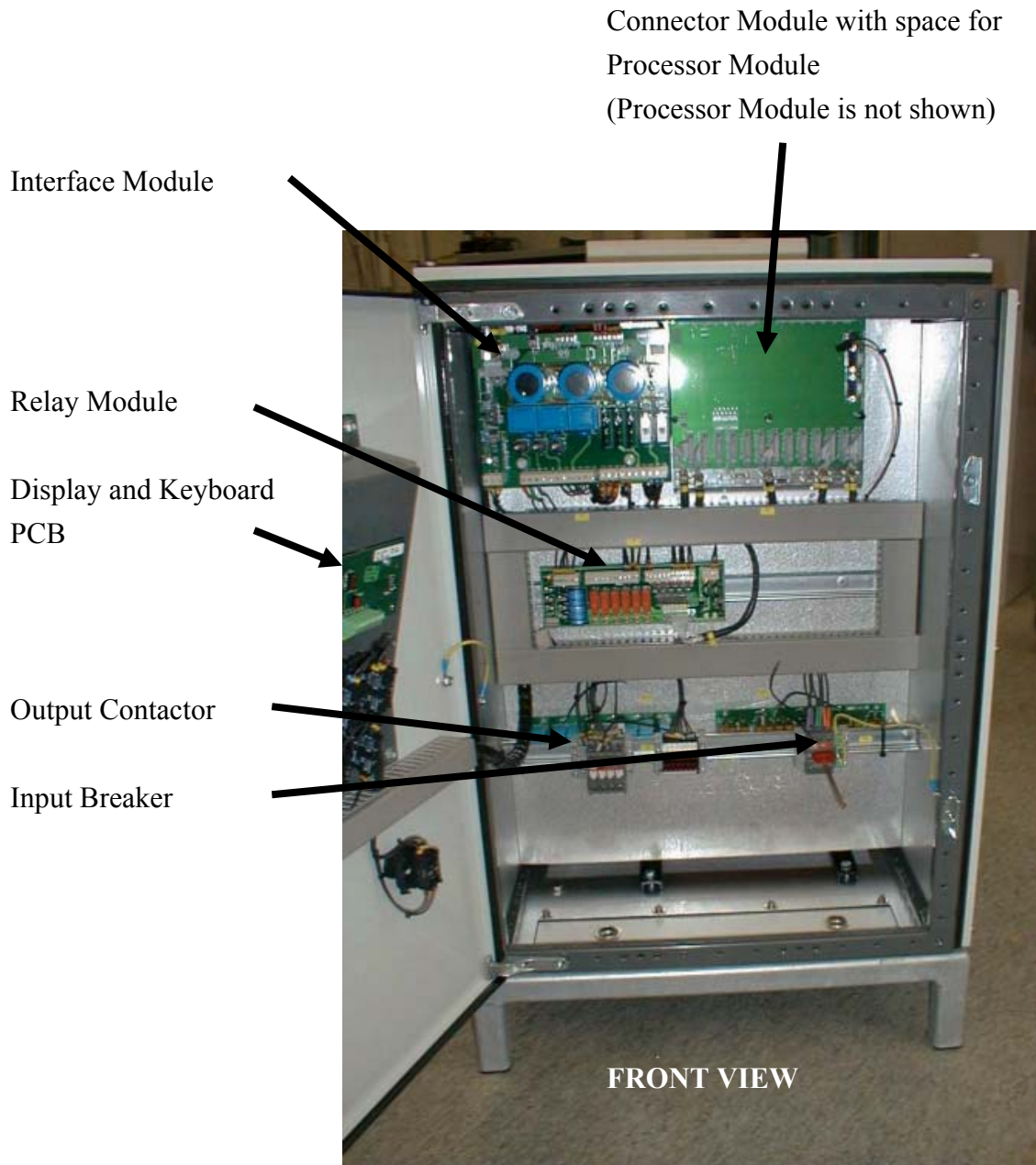
**List of recommended spare parts 573424** 3 pages

# Manual HOBART 2200

7,5 – 15 kVA

## Layout of Components

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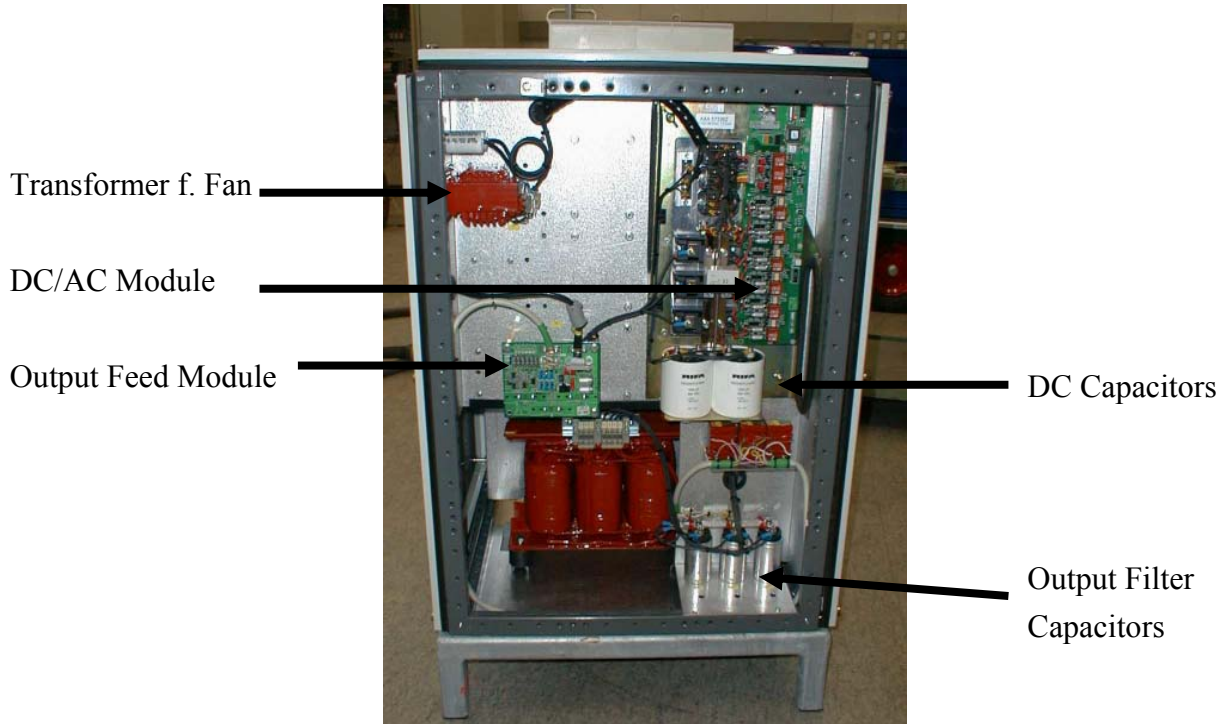


# Manual HOBART 2200

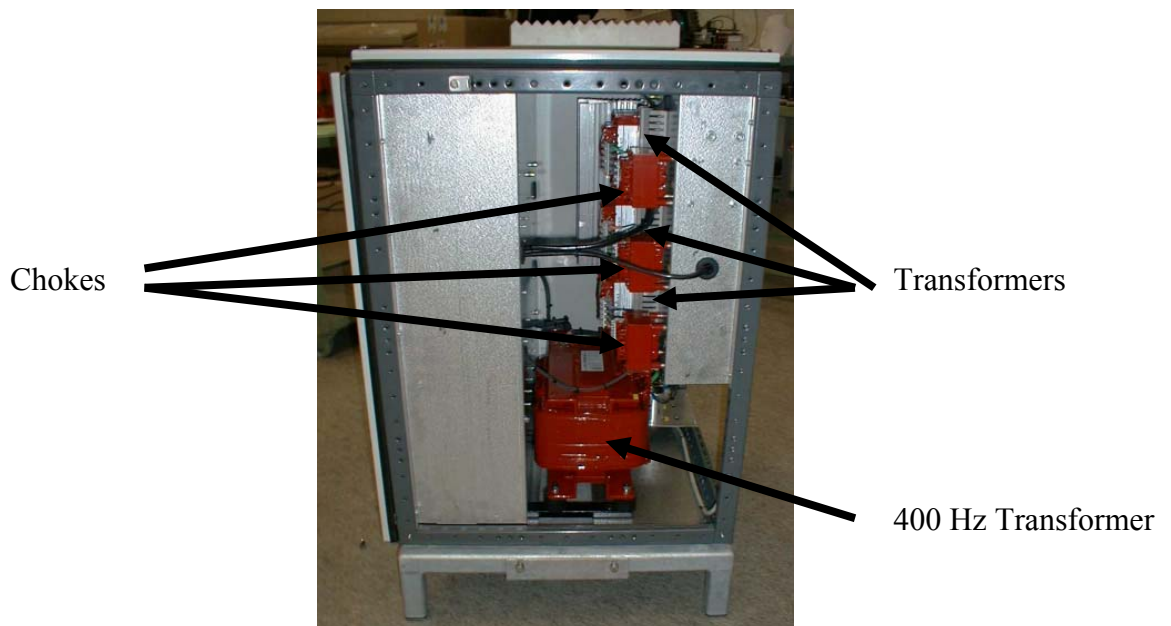
7,5 – 15 kVA

## Layout of Components

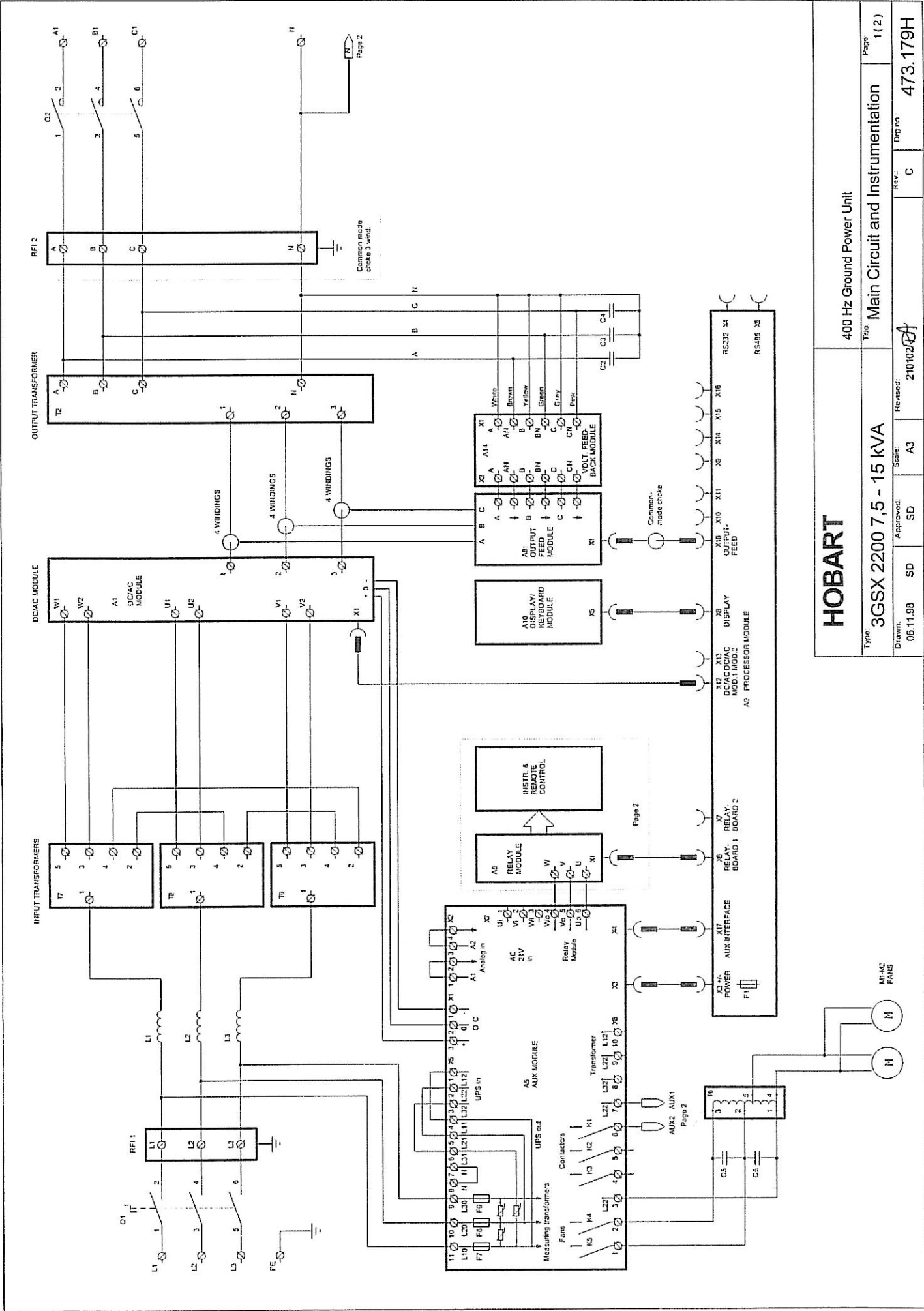
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**REAR VIEW**



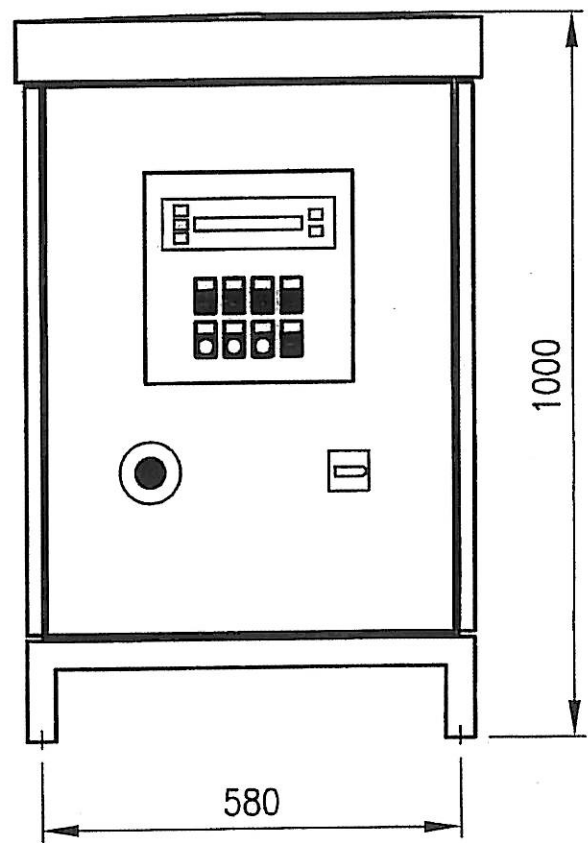
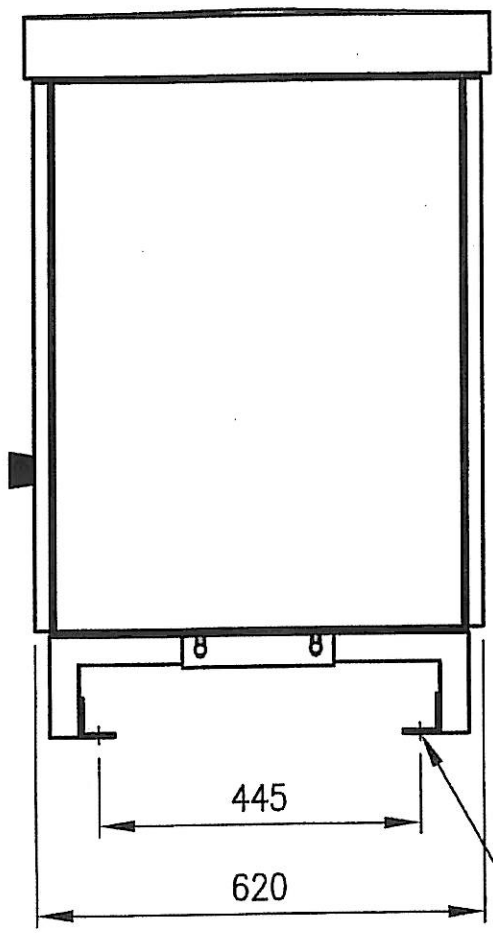
**SIDE VIEW**



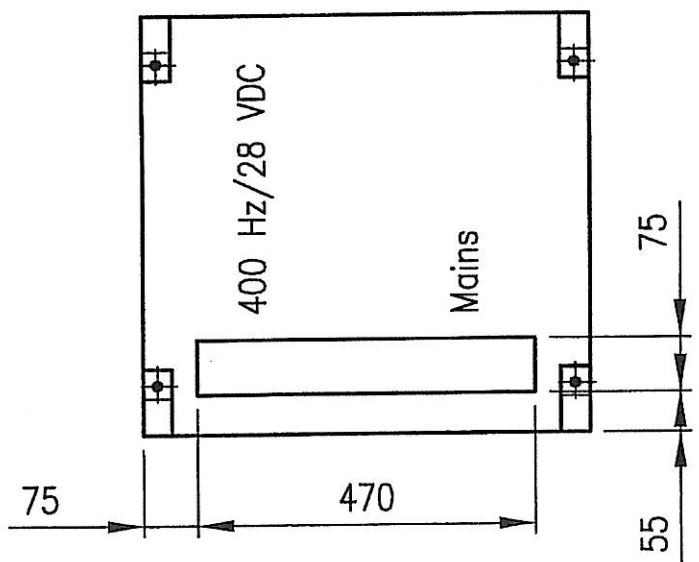
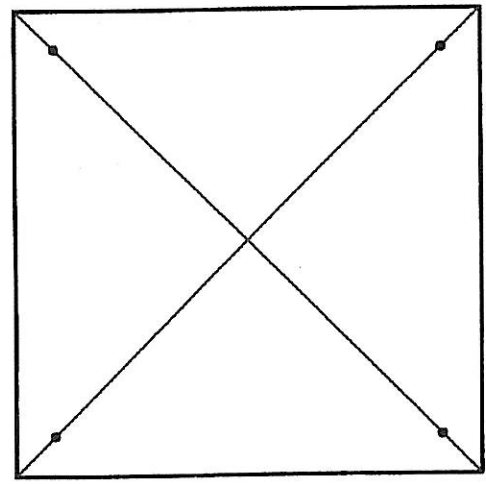
<b>HOBART</b>		400 Hz Ground Power Unit	
		Type: 3GSX 2200 7.5 - 15 kVA	Title: Main Circuit and Instrumentation
Drawn: 06.11.98	Approved: SD	Scale: A3	Rev: C
		Revised: 210102	Page: 1(2)
			Draw no: 473.179H





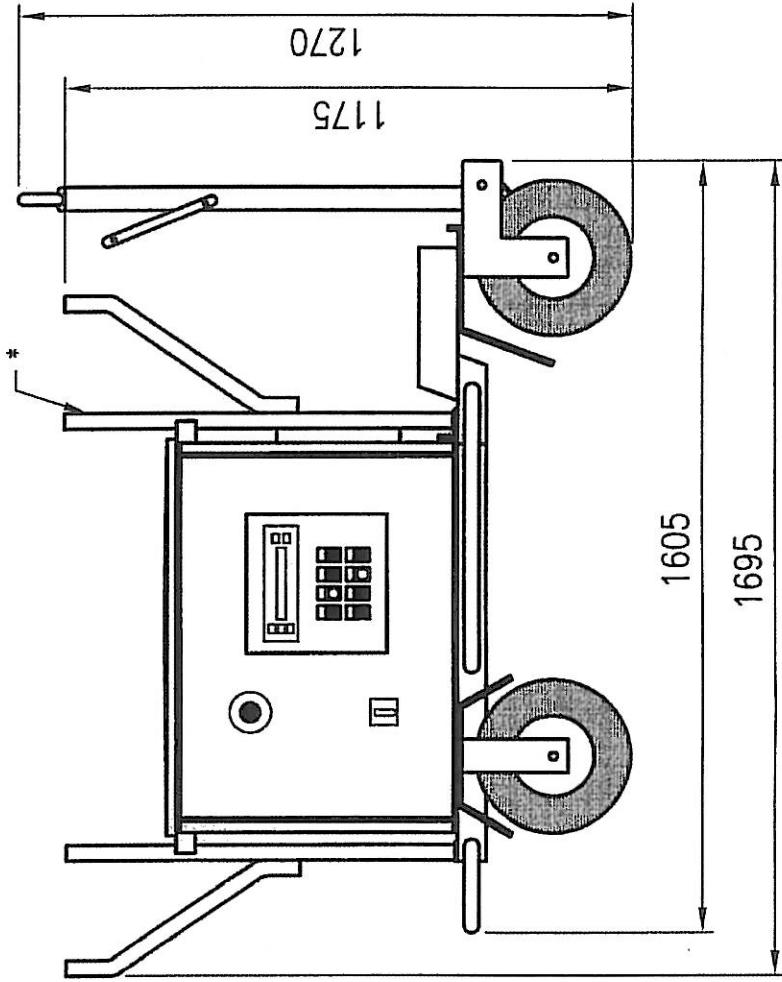
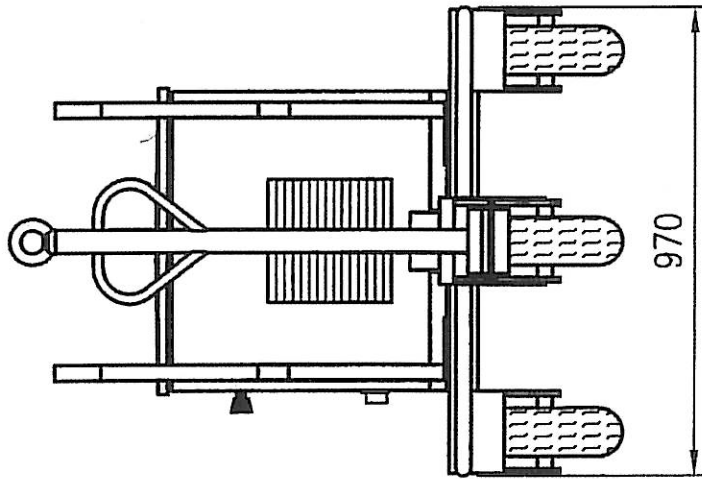


Foundation plan



(front)

		Fixed configuration 7.5 - 15 kVA / 28 VDC GPU		Page: 1/1
Type:  Mini		Outline Drawing		
Drawn: 220998 RH	Approved: SD	Scale: (A4) 1:10	Revised: 030699/SD, 290803/EA	Rev.: B
				Drg.no.: 173.075



\* : Optional

<b>HOBART</b> I N D U S T R I A L P O W E R S		Mobile configuration 7.5 - 15 kVA / 28 VDC GPU		Page: 1/1
Type: <b>HOBART</b> Mini GROUND POWER		Outline Drawing		
Drawn: 150699 UV	Approved: SD	Scale: (A4) 1:15	Revised: 271099/SD, 290803/RA	Rev.: B
			Drg.no.:	143.071