Operation & Service Manual

400 Hz 20-120 kVA Ground Power Unit

Models: *(see below)*

11B6648-1000/1010	**11B6649-1000/1010**	**11B6650-1000/1010**	**11B6652-1000/1010**	**11B6663-1000/1010**
11B6656-1000/1020	**11B6657-1000/1020**	**11B6658-1000/1020**	**11B6660-1000/1020**	**11B6664-1000/1020**
11C6648-1000/1010	**11C6649-1000/1010**	**11C6650-1000/1010**	**11C6652-1000/1010**	**11C6663-1000/1010**
11C6656-1000/1020	**11C6657-1000/1020**	**11C6658-1000/1020**	**11C6660-1000/1020**	**11C6664-1000/1020**

CE

02/2006 - Rev. 02

Includes Illustrated Parts Lists

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REVISION	DATE	TEXT AFFECTED
OR	08/2004	Original Release
01	12/2004	Added Version B of all models
02	02/2006	Added Parts List and Illustrations

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1.0 INTRODUCTION

When aircraft are parked at airport terminal stands with their engines shut down they require a reliable and controlled supply of 400Hz power at 200V to be supplied from an external source. This power is used to support the aircraft on-board electrical systems while the aircraft remains at the terminal.

Since normal airport power supplies are only available at 50 or 60Hz it is necessary to provide a frequency converter to convert the supply to 400Hz. Frequency conversion can take place local to the aircraft stand, or in a centralised location from which the power can be distributed to a number of stands. This latter configuration is known as a fixed ground power system (FGP).

In a centralised system one or more frequency converters feed power at a higher transmission voltage, for example 960V or 575V, via a distribution switchboard to one or more ring circuits. A star circuit configuration is also possible. Each ring circuit feeds a number of aircraft stands via Gate Boxes or Cubicles, at which the supply is transformed down to 200V. The individual aircraft are plugged in at the Gate boxes or Cubicles.

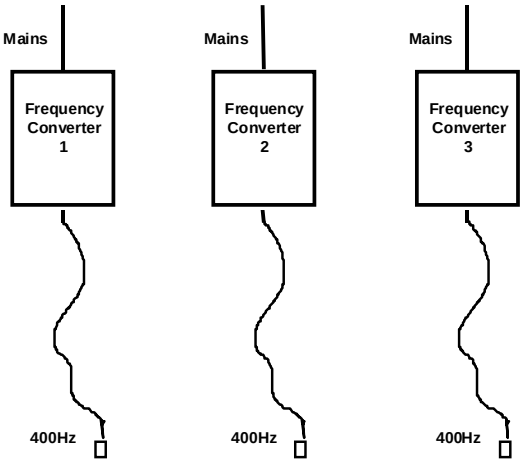

Figure 1
400 Hz Overview Decentralized System

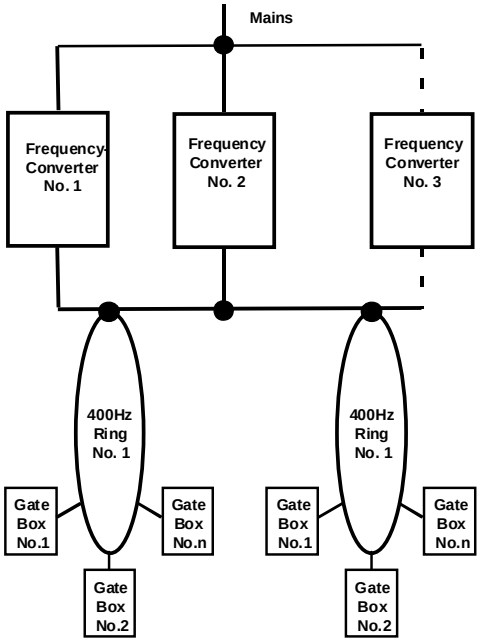

Figure 2
400 Hz Overview Centralized System

Tronair offers two different types of cabinet for the 400 Hz Ground Power Unit (GPU) power range. The 20kVA and 40kVA cabinet is very compact, low noise construction, specially designed for use in workshops, hangars etc.

For the higher power rating 60 to 90 kVA a compact cabinet is available. This cabinet is designed for universal use (on trailer, indoor and outdoor, under passenger boarding bridge).

1.0 Introduction continued on following page.

1.0 INTRODUCTION *(continued)*

Figure 3
Compact Cabinet (20/40 kVA)

Figure 4
Compact Cabinet (60 to 90 kVA)

The last cabinet type is low profile and specially designed to be used under passenger boarding bridges or on trailers.

This manual describes the frequency converter type 400 Hz GPU. If you follow these instructions you will be able to handle the equipment with confidence and utilize all its advantages.

NOTE
1. Naturally an operating manual cannot cover every conceivable installation, operating, maintenance or servicing situation. Should problems arise, or if the data in this manual is not sufficiently detailed, please contact your local Tronair representative who will be pleased to give further assistance.
2. If the equipment is installed for use as an aircraft ground power system, please pay particular attention to Section 4.10 which summarizes the special features of this type of application.

2.0 SAFETY NOTES

The frequency converter APOJET S is a piece of electrical equipment which carries voltages and currents that are hazardous to personnel. The following advice must therefore be observed at all times:

1. Installation, operation and maintenance of this equipment must only be carried out as per the instructions in this manual.
2. The equipment is to be handled only by well-trained and authorised personnel.
3. Take suitable measures to ensure that only trained operating and maintenance personnel have access to the interior of the system; the doors should be kept locked and the keys retained by authorised persons.
4. The installation of the system, service and maintenance must be carried out by electrical specialist staff.
5. The relevant regulations of the local electricity supply undertaking, and other safety instructions should be observed.
6. All personnel who have to work on the equipment should be familiar with first-aid procedures relating to electrical accidents.
7. Even when the equipment is switched off, a few internal parts remain “live” whilst they are connected to the incoming supply.
8. Work on the equipment must only take place with the unit switched off and isolated. A warning notice should attach at the disconnection point or points to prevent unintentional switch-on.
   Do not switch on
   Work in progress at
   Place
   Removal of this warning sign only by
9. Built-in capacitors can remain charged, even when the complete system is “dead”. They should be suitably discharged by trained personnel before contact is made with the connections.
10. Fuses must not be rewired or shorted out and rewired fuses must not be used. When replacing fuses, only the same or lower current ratings and the same types (slow-blow, quick-acting, very quick-acting) should be used.
11. The system environment should be kept as clean as possible and metallic or other electrically-conducting dust particles in particular must be prevented from being sucked in through the air inlet.
12. The warning and hazard notices inside the equipment must be observed.

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11C6657-1000/1020	**11C6658-1000/1020**	**11C6660-1000/1020**	**11C6664-1000/1020**

2.0 SAFETY NOTES *(continued)*

Explanation of the warning symbols used in these operating instructions are as follows:

WARNING appears alongside all instructions which must be followed exactly in order to eliminate personal injury and corruption/destruction of data.

IMPORTANT appears alongside all instructions which bust be followed in order to eliminate damage to equipment and/or malfunctions.

NOTE Indicates important information or advice, which must be followed during installation, operation, service or maintenance.

3.0 TECHNICAL DATA

TYPE	**20 kVA**	**40 kVA**	**60 kVA**	**90 kVA**	**120 kVA**
Input Data					
Nominal Voltage 3 hp	400 V ± 10% or 480 V ± 10%				
Nominal Frequency	50 Hz or 60 Hz ± 5%				
Input Power Factor	> cos φ 0.96				
Input Current At 400 V 60 Hz 480 V 60 Hz	 22 A 18 A	 44 A 36 A	 87 A 72 A	 130 A 108 A	 153 A 128 A
Output Data					
Output Power (cos φ 0.8)	20 kVA	40 kVA	60 kVA	90 kVA	120 kVA
Nominal Voltage 3 hp	200/115 V				
Nominal Current	58 A	116 A	173 A	260 A	346 A
Voltage Adjustment Range Waveform	+ 12%/- 5% Sinusoidal				
Distortion Factor (Linear Load)	± 3%				
Voltage Characteristics					
- Static	± 1%				
- Dynamic					
(100% Load Step)	MIL-Std. 704, Fig. 5				
Recovery Time	< 200 ms				
Voltage Symmetry					
- With Balanced Load	± 1%				
- With 100% Unbalanced Load	± 3%				
Phase Angle	120˚ ± 1.5˚				
Output Frequency	400 Hz ± 0.1%				
Crest Factor	1.8				
Overload Capability	20% Overload for 10 min 50% Overload for 30 sec				
General Data					
Total Efficiency	>90%	>90%	>92%	>92%	>92%
Maximum Losses	2.5 kW	4 kW	5.1 kW	8 kW	10.7 kW
Audible Noise	<65 dB(A)	<65 dB(A	<70 dB(A)	<70 dB(A)	<70 dB(A
Temperature Range	+32˚ to 131˚ F (0˚ to 55˚ C)				
Humidity	Max 90%				

3.0 Technical data continued on following page.

3.0 TECHNICAL DATA *(continued)*

TYPE	20 kVA	40 kVA	60 kVA	90 kVA	120 kVA
Dimensions – Stationary Version					
Width mm/in depth mm/in Height mm/in	750/29.5 800/31.5 1400/55.1	750/29.5 800/31.5 1400/55.1	1900/74.8 900/35.4 1160/45.7	1900/74.8 900/35.4 1160/45.7	1900/74.8 900/35.4 1160/45.7
Weight kg/lb	510/1124	552/1217	725/1598	815/1797	865/1903
Dimensions – Mobile Version					
Width mm/in depth mm/in Height mm/in	NA NA NA	NA NA NA	3101/122.1 1326/52.2 1420/55.9	3101/122.1 1326/52.2 1420/55.9	3101/122.1 1326/52.2 1420/55.9
Weight kg/lb	na	na	985/2172	1075/2370	1387/3058
Floor Loading					
Stationary Version kg/m^2	850	920	543	610	787
Paint Finish	RAL 7032				
Protection Type	IP54				

4.0 SYSTEM DESCRIPTION

4.1 INTRODUCTION

Tronair frequency converter type 400 Hz GPU accepts a mains input supply of 50Hz to 60Hz, 380V to 480V and converts the power to 400Hz at 200V. It is capable of supplying a maximum from 20 kVA up to 90 kVA at 0.8pf, depending from the size of the unit.

The incoming supply is rectified to DC then inverted back to AC at 400Hz under micro-processor control. The inverter output is transformed to 200V, and delivered to the load via an output contactor.

Every stage of the converter operation is monitored and controlled for correct operation and performance by high speed digital micro-processors operating in conjunction with analogue circuits (for the inverter control). Control circuits, together with the appropriate software, ensure that the converter output is maintained within the stated frequency and voltage limits whatever the fluctuations to load and/or input supply.

Should a malfunction occur a battery-backed Event Memory maintains a comprehensive record of the last 1200 operational events, which can be re-called via a mimic display panel in correct chronological order with date and clock time.

There is a Control Panel on the front of the Apojet cubicle which contains the mimic display with multi-aspect LED (light emitting diodes) indications, an 80-character LC (liquid crystal) display, on/off buttons, up and down buttons and enable and shift buttons.

The Control Panel gives the user a comprehensive status indication of the frequency converter. The LEDs on the mimic display show the status of each logical section of the converter, displaying green, yellow or red, and flashing or steady state to show various normal, available, warning and abnormal states of the converter. The push buttons allow the user to switch the unit on and off, and to switch the output on and off.

Input and output frequency, voltage and current for each phase are displayed on the LC Display by a single press of the “up” or “down” push buttons.

Access to the system set-ups can be gained via the LC Display using the ‘up’ and ‘down’ buttons below the display. The Event Memory can also be interrogated from this Control Panel which permits fault investigation to be carried out from the Control Panel.

The system software in the Controller board (described later) can be accessed via a laptop PC using an in-built On-line Monitoring facility.

Remote Indications for the Customer’s own use are available via a set of programmable relays. Volt-free contacts, ‘normally-open‘ and ‘normally-closed’ can be programmed for each alarm or operating condition. Additionally an RS485 interface is incorporated into the system giving the facility for more specialised remote monitoring, if required. Remote control and central monitoring are optional and described in 6.9

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4.0 SYSTEM DESCRIPTION *(continued)*

4.2 PERFORMANCE UNDER UNUSUAL CONDITIONS

Overload - The inverter can deliver 150% of its rated power for 30 seconds and 120% of its rated power for 10 minutes. At higher overloads the output current is limited. The frequency converter is switched off if the output voltage falls below the permissible tolerance.

Short-Circuit On The Load Busbar - In principle, a short-circuit occurring on the output side is handled similar to an overload, except that the output voltage is very low. The output power will be limited as described above at overload. The inverter itself has short circuit protection.

Mains Fault - If the mains supply is outside permissible tolerances, it is not possible to start the system, in which case all LEDs on the mimic display are switched off. If the frequency converter is running and the mains supply goes out of the permissible tolerances, the converter will switch off within 50ms.

Output Fault - The frequency converter monitors the output voltage and frequency continuously. If either exceeds the permissible tolerances the unit is switched off.

Over-Temperature - In the event of fan failure, the system continues to run normally until the over-temperature protection cuts in. An over-temperature warning is generated first and the system is switched off shortly afterwards when the maximum permissible temperature is reached.

Operation From A Diesel Genset - it is necessary to take into account the rectifier feedback when designing the genset configuration.

4.3 SYSTEM CONTROL

System control consists of one System Controller Board, several transducer cards, one Operator Display Controller and one optional Customer Interface Card. Depending on the use to which the system will be put, it may contain further optional boards. The individual controller boards are interconnected with serial interfaces and additional wires. Figure 5 shows the individual components connected via serial interface.

The System *Controller Board* handles the master system control function. Control commands from the Control Panel CP are transmitted to this controller, evaluated and converted into the appropriate actions. Current operating parameters (measured values etc.) are also evaluated by the System Controller Board and sent back to the CP, to displays them via the LC Display.

The following measure values are not only displayed, but are also monitored for deviations from the specification:

- Input under & over-voltage
- Input phase rotation
- DC link under & over-voltage
- Output under & over-voltage
- Output phase rotation
- Output overload
- Over-temperature
- Optional: Neutral voltage monitor
  Broken neutral monitor

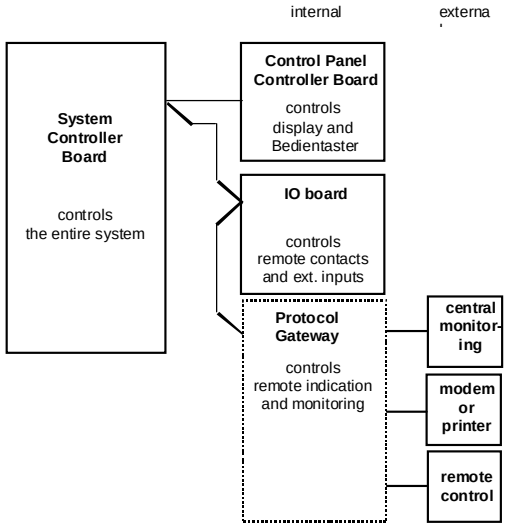

Figure 5
400 Hz System Control

4.3 System control continued on following page.

4.3 SYSTEM CONTROL *(continued)*

All decisions regarding Centralised Control of the system are taken in the software logic of the System Controller Board, as are matters relating to *load dependency* operations, and communications to and from other frequency converters in a group.

The *System Control Board* also controls the regulation of a frequency converter output voltage and current. It is also responsible for decisions on *power sharing* within a group of converters.

The *CP controller* is responsible for holding and displaying operational signals in the mimic diagram or recorded in a memory as events in correct chronological order with date and clock time. They can be retrieved to the LC Display or via the serial interface as required.

For remote indication, potential-free contacts (change-over type), which can be programmed on the Control Panel for operational and fault signals as required, are available on the Customer Interface Card (IO-board).

4.4 SAFETY AND PROTECTION

The design philosophy for the 400 Hz GPU is that it will endeavour to protect itself at all times. Self-protection is incorporated in both the hardware and software designs. Where situations arise that could either cause damage to the converter, or endanger the output load, the general rule is to disconnect and/or shutdown.

For safety of personnel, an Emergency Stop button is fitted local to the Control Panel on the front of the converter cubicle.

For maintenance and testing purposes there is an AUTOMATIC / MANUAL / MAINTENANCE switch. This switch also prevents the converter output contactor from closing when the unit is under maintenance, to protect the output load busbar or aircraft.

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4.5 DETAILED DESCRIPTION POWER CIRCUITS

4.5.1 Mains Supply

The frequency converter is designed to accept a 3-phase mains supply of 4-wire 400V or 480V ±10% at 50 or 60Hz ±5%. There is a filter at the input to the converter which limits the electrical emissions (RFI) back to the mains, thereby ensuring that the equipment meets the European EMC directives. Secondary supplies to feed control circuits & anti-condensation heater, switched via Q100, are also connected at the frequency converter input before the input circuit breaker. This ensures that even when the unit is shutdown, the control and monitoring circuits remain operational, as does the anti-condensation heater.

NOTE This means that some circuits remain live even when the frequency converter is shutdown.

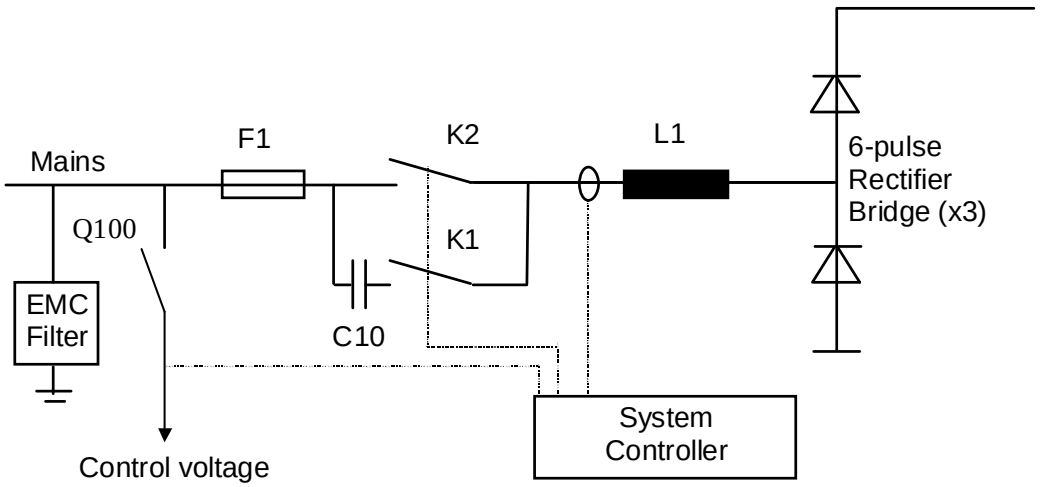

Figure 6
Input Circuit and Rectifier

4.5.1 Mains Supply *(continued)*

Incoming mains are monitored via the System Controller for phase loss, incorrect phase rotation, under & over-voltage, under & over-current and under & over-frequency.

Input semiconductor fuse F1 with a fault rating of 200kA provides short-circuit and overload protection. Input contactor K2 is used to switch the set on and off. Contactor K1 and capacitor C10 are used for current-limiting pre-charging of the intermediate DC circuit, thereby achieving a power 'walk in'.

The final 'input' stage is a choke L1, which prevents the voltage distortion created in the rectifier bridges from reflecting back onto the mains supply.

The rectifier bridge is an uncontrolled three-phase bridge with three double diode modules. It produces a DC voltage from the mains voltage. The set is always switched on with a soft-start via C10/K1. Only then is K2 switched on.

The System Controller monitors and operates contactors K1 and K2 and thereby the loading of the DC circuit ('walk in').

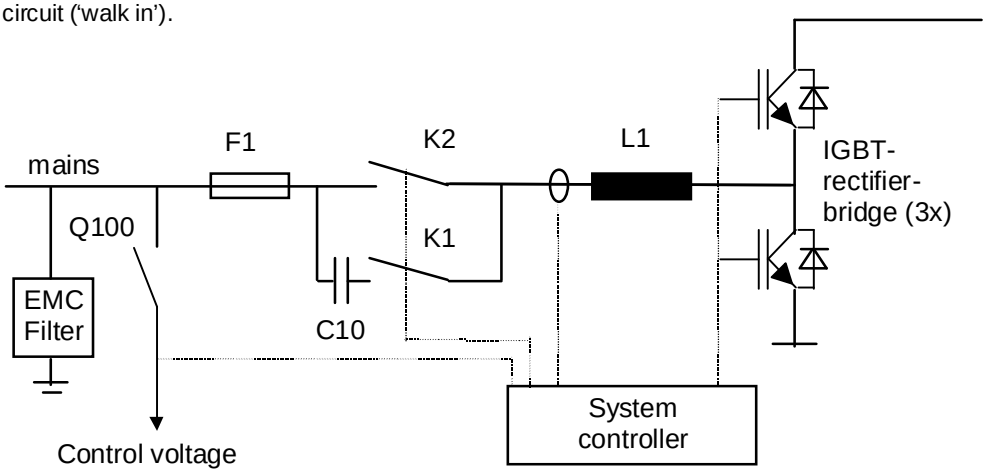

Figure 7
Input Circuit with Pulsed Rectifier (Option)

In the case of the IGBT rectifier, choke L1 releases DC power level during those parts of the mains cycle when instantaneous demand exceeds the mains power. This special circuit, in combination with appropriate control of the transistors ensures a sinusoidal input power demand, thereby minimising distortion back on the mains supply.

The System Controller monitors mains power and rectifier power, controls contactors K1 and K2, monitors pre-charging of GS circuit and controls Rectifier bridge (optionally). Measurements of the input circuit are processed by the System Controller and transmitted to the Control Panel display.

4.5.1 Mains supply continued on following page.

4.5 DETAILED DESCRIPTION POWER CIRCUITS (continued)

4.5.2 Inverter Description

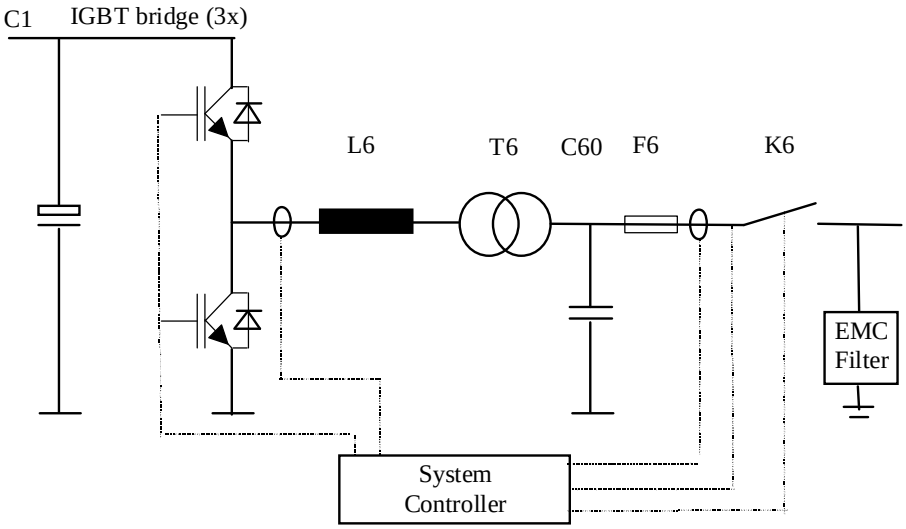

Figure 8
Inverter

Figure 8 shows the basic construction of the inverter. The main components of the inverter operate as follows:

- Capacitor C1 smoothes the voltage and effectively blocks out ripples and glitches.
- The Inverter Bridge A006 is a fully-controlled IGBT transistorised inverter bridge which converts the DC voltage into an AC voltage.
- L6 /C60 output filter network removes the upper harmonics of the 400Hz wave leaving just the fundamental - effectively turning the modulated wave output from the inverter into a clean sinusoidal wave.
- Output transformer T6 converts the AC voltage of the inverter output to 200V AC. The transformer is double-wound and provides galvanic isolation between the load and frequency converter (and therefore the mains supply).
- Output contactor K6 is used to connect and disconnect the load.
- The EMC filter at the output of the converter limits the electrical emissions (RF) to the load busbar, thereby ensuring that the equipment meets the European EMC directives.
- System Controller Board A100 controls and monitors the operation of the inverter and ensures that the output voltage and frequency remain stable, irrespective of the loading. Transformer input and output voltages, transformer output current, and the inverter output voltage are measured and evaluated for this purpose.
- The inverter output voltage can be adjusted via the adjustment menu on Control Panel display.
- The System Controller operates the output contactor K6 and monitors the output voltage, output current and output fuse F6.

4.0 SYSTEM DESCRIPTION *(continued)*

4.6 CONTROL AND MONITORING

4.6.1 Power Supplies For Controls & Monitoring

All the electronic cards within the converter receive their power via a transformer from a DC Power Supply Board designated *A211.*

4.6.2 Internal System Control

Figure 9 shows the connection plan of the control boards within the frequency converter. Control Panel, System Controller, Customer Connection board (optional) are connected via an internal CAN-Bus. Each board has its own micro-processor which controls specifically relevant functions.
There is one main logic board with two high-speed digital micro-processors and software, controlling the operation of the frequency converter for the rectifier and the inverter.

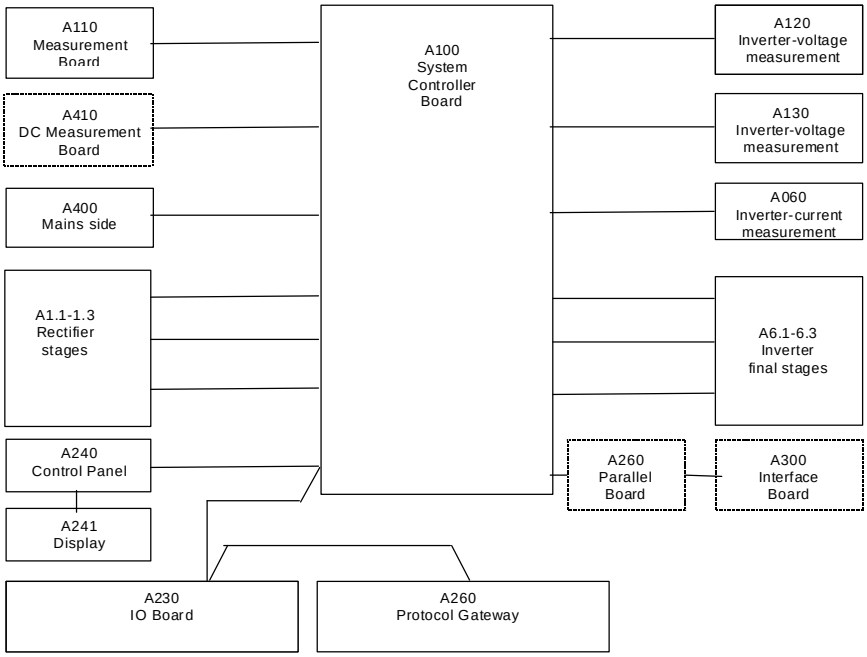

Figure 9
Internal Controls

System Controller Board *A100* has the function of system control (5.3). It controls the IGBT power stages for rectifier (optional) and handles all the main switching operations for the frequency converter, control of the rectifier, and '*load dependency'* decisions when the converter is operating in parallel with other converters. It also controls the contactors and the Inverter. The board measures and monitors the input and output voltage, current and frequency. For that it communicates via a CAN-BUS interface with other converters. The rectifier power stage is switched at high frequency in order to ensure a sinusoidal input power demand. It communicates with IO Board *A230* and the Protocol Gateway, which is built in as an option, via a CAN serial interface.

Inverter Controller is used for controlling the 400Hz inverter in sub assembly A006, and handles power sharing decisions (via a high speed digital interface) when the converter is operating in parallel with other converters in a group.

4.6 Control and monitoring continued on following page.

4.6.2 Internal System Control *(continued)*

Regulation and control electronics consist of a combination of analogue and digital circuits which work together and complement each other. All control functions where fast processing is important are executed directly in analogue technology. Master control functions where precision is particularly important or where complex calculations are required are carried out digitally in the micro-processor. This provides for instantaneous control.

The output voltage of each phase of the system is continuously compared to a synthetically-generated sinusoidal signal. In the event of deviations from the ideal waveform, immediate corrections are made to the inverter firing rate/duration via the Inverter Driver Board. This ensures the inverter's excellent control characteristics which always maintain the output voltage within the required tolerance range, even with sudden changes in load. This facility is particularly important in the case of non-linear loads, such as switched-mode power supplies. Here periodic, very high peak currents occur, which can only be controlled by a high-performance instantaneous-value controller.

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The reference sinusoidal signals are generated by the micro-processor, while the system output deviation and the PID (Proportional Integrated Differential) control algorithms are formed by a fast analogue arithmetic circuit. Clock pulses are then generated in a two-state controller which has the advantage of immediately applying the full manipulated variable to the inverter only when this is necessary. Thus optimum control is obtained over the output wave shape thereby guaranteeing the quality of the system output. A clock frequency controller maintains the average clock frequency at a constant value.

A current control circuit operating in parallel with the voltage control loop consists of an analogue, fast peak current limiter and a true rms. current regulator, incorporated in the micro-processor.

One feature to note is a magnetisation current regulator which ensures that the output transformer never goes into saturation when switching inductive loads or in the event of a short-circuit at the output.

Finally, a differential-current characteristic ensures that the inverter can run in parallel with other inverters with equal rating.

Control Panel A240 (CP) contains the controls necessary for the Operator Interface.
Control commands from the Control Panel of the *CP Controller* are transmitted to the System *Controller Board*, evaluated and converted into appropriate actions.

Measured values are evaluated by the System *Controller Board* and the *Inverter Controller Board* and sent back to the *CP Controller*, which in turn converts them and displays them.

Operational signals are displayed by the *CP Controller* on the mimic diagram or recorded in a memory (the Event Memory) as events in correct chronological order with date and clock time. They can be retrieved to the *LC Display* or via the serial interface as required.

For remote indication, six potential-free contacts (change-over type), which can be programmed on the Control Panel for operational and fault signals as required, are available on the IO board A230 (Customer Interface Card).

Customer Interface Card A230 (optional) carries the required interfaces for remote control and remote indications. Six free programmable contacts are available on this card which can be programmed via the Control Panel.

Protocol Gateway A260 (optional) contains the interfaces to plug in a remote control or the central monitoring.

4.6 CONTROL AND MONITORING *(continued)*

4.6.3 Frequency Converter Operation

As soon as mains incoming power is applied to the control logic the micro-processors commence operating and the internal digital interface (CAN) becomes active. Initially their only function is a 'watchdog operation' checking for faults within the converter and monitoring the incoming supply for voltage and frequency deviations. Any faults or deviations detected are reported back to the System Controller Board (the A100) via the digital interface, which in turn passes the information on to the Event Monitor via the CP Controller board. This latter board will also ensure the red Warning LED is lit if there is an outstanding "unaccepted" alarm in the Event Monitor.

If the converter is switched on using the AJ "I" and "Enable" keys simultaneously, then K1 closes first and then the power-limited pre-charging of DC circuit starts via C10. When a predetermined power level is reached, K2 will switch on and K1 switch off again. Only the converter transistors are controlled (with 'chopped rectifier') and the DC voltage will be regulated for use.

Now the inverter can be started by pressing key AJ "I" and "Enable". The transistor power stages are controlled, so that there will be a linear increasing output voltage. When the output voltage reaches the rated value, it is possible to switch on contactor K6 by pushing key AJ "I" and "Enable". Chapter 7 "Operating instructions" gives a detailed description of the operation sequence.

When operating converters in parallel, the inverter also starts as before, but the output voltage and frequency will be brought into line with the serial-transmitted reference value of the machines already running. Contactor K6 can then be closed. The load distribution is effected in a similar manner. Each converter transmits its own load values to the other converters. The actual total value will be divided by the sum of working converters and used as new rated value for each converter. According this value the output voltage will be regulated and with it a new load distribution will be achieved.

4.7 AGPS OPERATION

Using The Converter As An Aircraft Ground Power Supply:
The control technology of all 400 Hz GPU systems is designed so that they also meet the special requirements when employed as aircraft ground power supplies (AGPS). Certain external conditions have to be met in order to activate the necessary control and monitoring functions. These are described below.

4.7.1 EF-Interlock

In AGPS systems, the output should only be able to be connected or remain connected if the associated output connector is plugged into the aircraft and a 28-volt DC signal (E-F interlock) is sent back by the aircraft.

The controller is designed so that, in principle, the output can only be switched on if a "connector plugged in" check-back signal is generated. For this, either a microswitch, which signals the connection, must be incorporated in the aircraft connector, or a link must be inserted in the user interface card at the AGPS. In the case of converters having two output contactors, microswitches should be provided as a matter of principle. As a standard the links are already connected. With additional hardware, the use of split F-contacts instead of microswitches is also possible.

A relay connected to the E-F line evaluates the 28V signal from the aircraft. If the check-back signal does not appear five seconds after the output contactor is switched on, the output is disconnected again and a corresponding message appears on the LC Display. In the case of two output contactors, evaluation is carried out separately for each output.

4.7 AGPS operation continued on following page.

4.7 AGPS OPERATION *(continued)*

4.7.2 Switching The Converter On And Off

1. All converters can be fitted with remote control as standard. It should be noted that for reasons of space, for example, external “start” and “stop” buttons may not be available on the Control Panel at the aircraft connector. These functions may then be carried out by other buttons, as described below.
2. If an external “output on” push button is pressed, first the converter is started up if it was not already in operation. In this case, the push button must be pressed again after the converter has started in order to switch the output on.
3. Where a Cable Reeler is used, the push buttons for dispensing and retracting the cable can also be used for controlling the converter. The converter is started when the “cable out” button is pressed for the first time. The output contactor will only close if the aircraft connector had been inserted in the meantime, and a corresponding 28V check-back signal present. Likewise, the converter output is switched off when the “cable in” button is pressed.
4. In the above-mentioned cases, the converter is switched off automatically 15 minutes after the output or last output was switched off.
5. The following applies to converters with two outputs:
6. The output contactors are controlled separately by means of external push buttons. If the output is connected by means of the “output on” button on the Control Panel of the AGPS, only that output contactor for which there is a corresponding checkback signal from the aircraft connector is engaged. After this, the push button must be pressed again to switch on the second output. All outputs are always switched off if the “output off” push button on the Control Panel of the AGPS is operated.

4.8 VOLTAGE REGULATION MODE

4.8.1 General

The frequency converter supplies a load which requires a supply voltage with very little deviation. (Normally 115 volts P-N +/- 1% or 1.1 V). If a very long cable is used between the converter and the aircraft (load), a voltage drop will be created which might be greater than the acceptable voltage tolerance of the aircraft. If this happens, it is no longer possible for many units on the market to provide an acceptable voltage supply to the aircraft especially under all load conditions.

To overcome this problem, two possibilities are available:

1. The cable between the converter and the load could be designed in such a way that the voltage drop will be decreased so that the supply voltage is within tolerance range. The amount of copper wires and/or size can be increased or parallel cables can be used. However there comes a point where the size of copper wires required could become to heavy or costly, or if the length of run is to great, that increasing the amount or wire size will still not be enough to keep the tolerance within the voltage range, for all load conditions.
2. The converter must incorporate a LDC (Line Drop Compensation) system that can provide active compensation so as to automatically compensate for the voltage drop.

With very long cable runs, parallel cables will increase the wire investment costs dramatically and if flexible aircraft cables are also used, then parallel cabling might not be possible or practical.

To ensure that the proper voltage is delivered to the aircraft plug under all load conditions, there must be a means of measuring the voltage at the aircraft plug, and sending those voltage signals back to the converter, so they can be analyzed and responded to. This requires that signal wires be run between the plug and the converter unit, where again cost and practicality must be considered. In many cases where voltage sensing wires are not available, the active voltage drop compensation provided by I-Boost is the only practical method available to overcome this voltage drop problem.

4.8.1 General *(continued)*

The frequency converters have two different kinds of voltage drop compensation available as a standard feature. One is a remote voltage sensing and regulation system which uses control wires connected to the three phase and neutral pins from the plug. The plug sends it's voltage signals to the unit's voltage compensator controller, which compares them with the voltage readings just prior to the output contactor of the unit and then automatically adjusts the output voltage accordingly, to overcome the voltage drop created by the output cables. The second is the I-Boost compensation. The I-Boost senses the current flow just prior to the output contactor of the units and automatically adjusts the output voltage throughout the full output kVA and power factor rated range to accommodate the wire characteristics installed. First an initial installation set up procedure (setting in the software of the unit) has to be done. (Note: there are limitations as to type of wire and length that can be compensated for). This I-Boost system uses software and current transformers to provide the voltage drop compensation automatically.

4.8.2 I-Boost Compensation AC

With the I-Boost, the output voltage of unit will be modified by a compensation value, which depends on the output current. If the output current increases, the output voltage will be increased as well. In this case no additional control wires for the feedback of the voltage at the load point are necessary. The compensation factor depends on the current, the type and length of the cable and (especially with 400Hz systems) on the power factor of the load current.

In order for the I-Boost to work correctly, the compensation factor has to be adjusted initially and whenever the cable construction or length changes. There are two ways of doing the adjustment. The first requires resistive and reactive load banks, the second way uses the measured reference values shown in the table below.

Adjustment of the unit using measurements:
Two measurements are necessary to adjust the I-Boost. The first measurement is done with a resistive load only. The second measurement is done with the nominal (full) load at a 0.8 power factor.

1. Measurement with resistive load (e.g. 72kW)
   - Disable the remote sensing and the compensation at the setup menu (see 7.0).
   - Connect the resistive load and measure the voltage at the plug while the converter supplies the nominal output voltage (all three phases P-N or P-P).
   - Calculate the difference between the average measured voltage and the nominal voltage (for each phase separately). Enter the value (rounded to the nearest whole digit) into the Setup-Menu "Compensation" – "Active Power".
   - With the load disabled, enable the compensation mode and repeat the measurement.
   - Add any additional difference to the adjusted value in the "Compensation" – "Active Power" entry

   If it is not possible to make the measurement at nominal load, the correct value for the adjustment can be calculated using the following formula:
   Example: Nominal active power - 72kW; actual active power - 60kW, measured difference values are: for example if L1=4.5V
   1. The calculation of the value for the adjustment is: 4.5V x 72kW/60kW=5.4V
   2. The value for the adjustment is: 5V
   3. Repeat the steps before for phase 2 and 3

4.8.2 I-Boost compensation AC continued on following page.

4.8.2 I-Boost Compensation AC *(continued)*

2. Measurement with nominal (full) load (e.g. 90kVA)
   - Connect the nominal load and measure the voltage at the load point (plug) while the converter supplies the nominal output voltage (all three phases P-N or P-P).
   - Calculate the difference between the measured voltage and the nominal voltage (for each phase separately). Enter the difference (rounded to the nearest whole digit) into the Setup-Menu “Compensation” “Reactive power”
   - Repeat the measurement.
   - Add the additional difference value to the adjusted value in the Setup-Menu “Compensation“ „Reactive power“
   - Store the adjusted values using the Setup menu (see 7.0)

If it is not possible to make the measurement at nominal load, the correct value for the adjustment can be calculated using the following formula:
Example: Nominal reactive power - 90kVA; used reactive power - 72kVA, measured difference values are: for example if L1=3.8V

1. The calculation of the value for the adjustment is: 3.8V x 90kVA/72kVA=4.75V
2. The value for the adjustment is: 5V
3. Repeat the steps before for phase 2 and 3

Now the unit is adjusted for this type and length of cable. The adjustment has to be made again, if a different type and/or length of cable is used.

Adjustment Of The Unit Due To Correction Factors
As described above, two different factors are necessary to adjust the I-Boost. The factors depend on the length and the type of the cable and on the load current. The following table shows the correction factors for different types of cables. Use the formula below to calculate the correct adjustment values.

Type Of Cable	**Active Power (mV/A m)**			**Reactive Power (mV/A m)**		
	L1	**L2**	**L3**	**L1**	**L2**	**L3**
Baude SemoflexAir 400 7x35mm2+6x3x1mm2	0.6	0.6	0.6	0.6	0.6	0.6
BIW 180 0129						
BIW 180 0225						

The correct adjustment value is calculated in the following way: Multiply the correction factor for the type of cable, the nominal (full load) current and the length of the cable then divide the result by 1000 to get the adjustment value.

Example: The cable type is Baude SemoflexAir, the length is 27m, and the nominal current is 260A

The calculation of the value is:
1. Calculation for the adjustment: 0.6mV/Am x 260A x 27m/1000 = 4.2V
2. Value to be adjusted for Active Power is: 4V
3. So far the values are different for the different phases repeat the step for each single phase

Calculation of the value for Reactive Power adjustment:
1. Calculation for the adjustment: 0.6mV/Am x 260A x 27m/1000 = 4.2V
2. Value to be adjusted for Reactive Power is: 4V
3. So far the values are different for the different phases repeat the step for each single phase

4.0 SYSTEM DESCRIPTION *(continued)*

4.9 CONTROL PANEL

There is a local Control Panel on the cubicle door of the 400 Hz GPU (Figure 11) which contains a mimic display with multi-aspect light emitting diode (LED) indications, an 80-character liquid crystal (LC) display, on/off buttons, reset and lamp test buttons, and a visual load display.

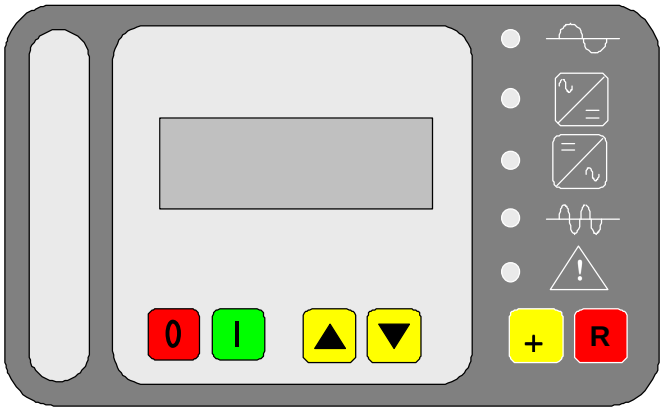


Figure 11
Control Panel

4.9.1 Mimic Display

The Mimic Display on the Control Panel gives the user a quick and comprehensive status indication of the frequency converter. Each of the following main functions of the frequency converter has an LED associated with it on the mimic diagram:

- Mains Input
- Rectifier
- Inverter
- Output
- Attention

The LEDs on the mimic display are multi-aspect, capable of displaying Red, Green or Yellow. They are also bi-functional, able to display as steady state or flashing. By means of permutation it is possible to display healthy state, non-operational, abnormal and fault conditions on the mimic for each main function within the converter:

Green flashing..... Starting phase
Green steady state ..... Running or switched on
Yellow flashing ..... Warning
Yellow steady state..... Available or ready
Red flashing ..... Hardware fault (fuse, contactor, etc.)
Red steady state..... Abnormal condition (eg mains fault, overload, etc)

The philosophy for the Red indicating LED is for fault conditions which are recoverable by push button action (such as overload) are displayed as a Red Steady light. Faults requiring engineer's attention (such as Fuse Failure) are displayed as a Red Flashing light.

4.9.2 Operator Controls

Push buttons "On" and "0ff", together with "Enable" control the converter. The arrow push buttons are controls for the LC Display. The "Reset" push button is for resetting of the failure indications.

4.9.3 Liquid Crystal Display (LCD)

The LC Display has a number of different functions. Using the yellow "Arrow up" and "Arrow down" push buttons it is possible to display different values (input and output frequency, voltage and current for each phase, for example). By using the "Arrow up" push button, together with the "Enable" the Event Memory can be interrogated. If the "Arrow down" and the "Enable" push buttons are pressed simultaneously, a Setup Menu appears on display. Various menu items can be selected to program certain functions.

4.9.4 Lamp Test

A lamp and LED indicator test can be executed by pressing the yellow "Shift" and "Reset" buttons.

4.9 Control panel continued on following page.

4.9 CONTROL PANEL *(continued)*

4.9.5 Emergency Stop

In an emergency, to immediately render the system “dead”, the red button below the Control Panel must be pressed.

IMPORTANT Bear in mind, however, that the mains infeed is still “live”. The converter can only be isolated by using suitable external means such as padlocking the supply breakers off on the incoming distribution board.

4.10 OVERVIEW OF 400 HZ GPU COMPONENTS

The modules and components of the individual sizes of the 400 Hz GPU are shown in the outline drawings in this section. The sizes and arrangement of the modules and components shown vary slightly according to the power rating and version of the 400 Hz GPU sets.

Abbreviations and the names of the modules are listed in the following table.

Abbreviation	Description of Component
A 001	Rectifier (uncontrolled)
A 6.1	Inverter half bridge Phase 1
A 6.2	Inverter half bridge Phase 2
A 6.3	Inverter half bridge Phase 3
A 10	Current transformer interface Input
A 60	Primary current transformer interface Transf. T6
A 100	System controller board
A 101	28V Relays (E/F interlocking, output 1, GPUs only)
A 103	
A 104	N-core monitor
A 110	Mains measured data acquisition of System Controller
A 120	Output measured data acquisition of System Controller
A 211	Power Supply
A 230	Customer interface card
A 250	Parallel interface board (parallel units only)
A 260	Protocoll Gateway (option)
A 410	DC measurement board
C 10	Pre-charge current limiting capacitor
C 11	Filtercapacitor input (chopped rectifier only)
C 12	Filtercapacitor input (chopped rectifier only)
C 13	Filtercapacitor input (chopped rectifier only)
E 001	Heater (outdoor version only)
E 002	Heater (outdoor version only)
F 001	Input semiconductor fuse (Option for S 20 - S 40)
F 002	Earth leakage relays (42V Relays; option)
F 006	Output semi-conductor fuse
K 001	Contactor for pre-charging of DC circuit
K 002	Input contactor
K 006	Output contactor output 1
K 012	Fan contactor (AJS 90 – 180 only)
L 001	Commutation choke
M 060	Cooling fan 1
M 061	Cooling fan 2

4.10 OVERVIEW OF 400 HZ GPU COMPONENTS *(continued)*

Abbreviation	Description of Component
Q 100	Protective circuit-breaker control voltage
Q 110	Protective circuit-breaker heaters (optional)
S 007	Operating mode switch (parallel units only)
T 006	Isolated 3 phase output transformer
T 011	LEM Current transformer input circuit
T 012	LEM Current transformer input circuit
T 013	LEM Current transformer input circuit
T 061	LEM current transformer primary side T6 Phase L1
T 062	LEM current transformer primary side T6 Phase L2
T 063	LEM current transformer primary side T6 Phase L3
T 064	Current transformer output 1 total phase A
T 065	Current transformer output 1 total phase B
T 066	Current transformer output 1 total phase C
T 211	Control voltage transformer
X 010	Mounting plug
X 011	Mounting plug

4.10.1 Overview 400 Hz GPU 20kVA, 40kVA

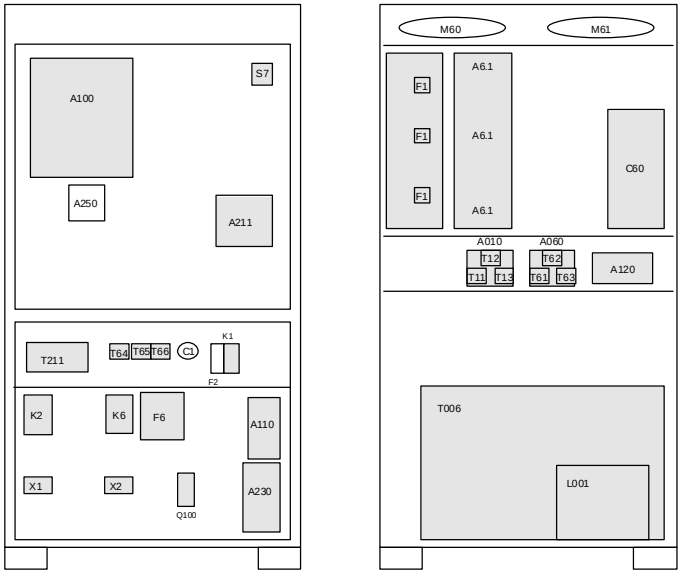


Figure 12
Position of components on both mounting plates and at rear

4.10 Overview of 400 HZ GPU components continued on following page

4.10 OVERVIEW OF 400 HZ GPU COMPONENTS *(continued)*

4.10.2 Overview 400 Hz GPU 60kVA

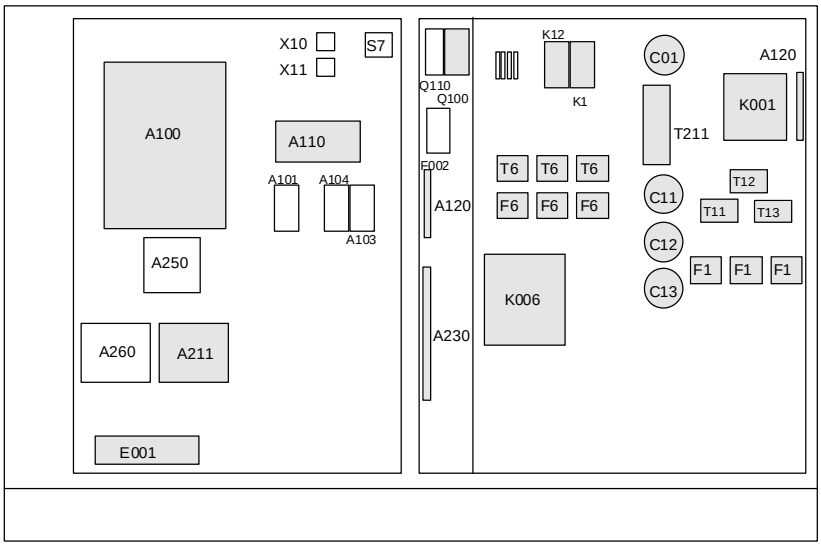


Figure 13
Position of components on both mounting plates

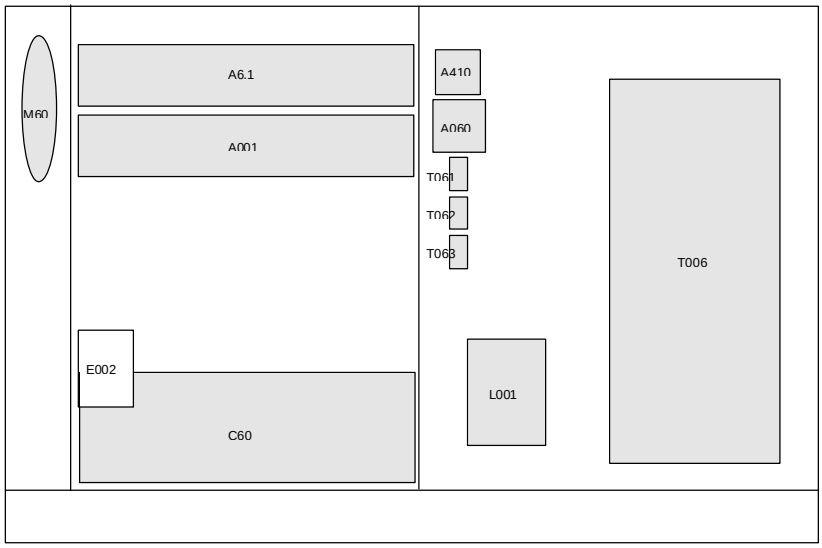


Figure 14
Position of components at rear of mounting plates

4.10 OVERVIEW OF 400 HZ GPU COMPONENTS *(continued)*

4.10.3 Overview 400 Hz GPU 90kVA

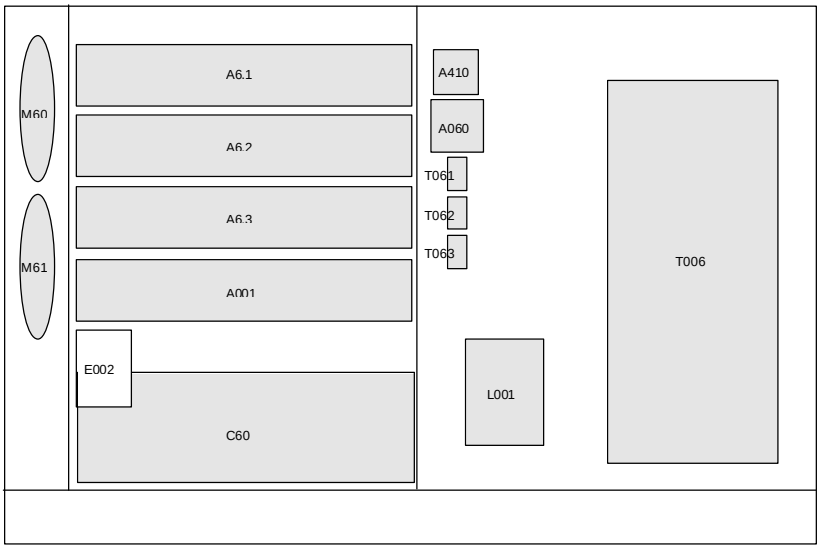


Figure 16
Position of components at rear of mounting plates

5.0 INSTALLATION AND CONNECTIONS

5.1 GOODS INSPECTION

Before leaving the factory, the correct mechanical and electrical state of the 400 Hz GPU is checked in a final inspection. As soon as the equipment has arrived check whether any freight damage has occurred and if necessary, bring this to the attention of the freight operator. **In no circumstances put a damaged 400 Hz GPU into service** without consulting your Tronairr representative first.

5.2 HANDLING

The frequency converter can be moved by means of a forklift or pallet lift truck.

IMPORTANT Moving by crane should only be used in exceptional circumstances using load-spreading rails above the unit.

Please pay attention to following handling advises:

- The equipment only has to transport upright
- The equipment must not be tilted or turned over
- Always avoid sharp impacts.
- Where possible leave the equipment in its original packing when moving it, this provides the best possible protection against damage.
- Moving the equipment on double grounds, it could be necessary to use load dispatcher plates, to distribute the load of the equipment and to avoid damage to the double ground.

5.0 Installation and connections continued on following page.

5.0 INSTALLATION AND CONNECTIONS *(continued)*

5.3 PROTECTION

During installation, erection and cabling it is absolutely essential that the equipment is protected from ingress of water, concrete or metal particles, and dust etc. Protection of the equipment is particularly important when other trades and building works are taking place in the same vicinity. All inlets and parts of the equipment not being worked upon should be covered at the least with heavy-duty polythene, and preferential with more substantial packing.

It is also important to ensure that people working overhead do not stand on the equipment or use it as a convenient platform for other works.

On completion of any works requiring the opening of the equipment doors or panels or removal of cover plates or gland plates, the unit should be thoroughly vacuumed out and re-packed or protected. Tronair accepts no liability for any damage to equipment caused by physical mal-treatment or by ingress of foreign material.

5.4 STORAGE

If it is necessary to store the converter for any length of time then it should be stored in a dry, well-ventilated room that is free of aggressive materials. Where possible, the original packing should not be removed during storage.

IMPORTANT In no circumstances must the frequency converter be stacked, or stored outside.

5.5 CHOICE OF INSTALLATION SITE

The 400 Hz GPU designed for mounting against a wall, i.e. access for operation and maintenance is only required from the front. The following criteria should be observed when selecting the installation site:

5.5.1 Floor Loading Capacity

The weight of the equipment is distributed over a relatively small area; special care must therefore be taken to ensure that the floor loading capacity is adequate. The exact value can be obtained from the Technical Data (see 4.0). If necessary, the supporting surface can be reinforced by interposing a suitable steel plate. Please consult your architect, the clerk of works or Tronair representative if you require assistance.

5.5 CHOICE OF INSTALLATION SITE *(continued)*

5.5.2 Space Requirements

As already stated, the 400 Hz GPU can be installed with the rear side against a wall. About 80 cm clearance should be left in front of the unit to provide unimpeded access to the cubicle. Local or general safety regulations, e.g. escape routes as per VDE 100, part 729, should also be observed.

In no circumstances must the air inlet and the air outlet be covered or obstructed.

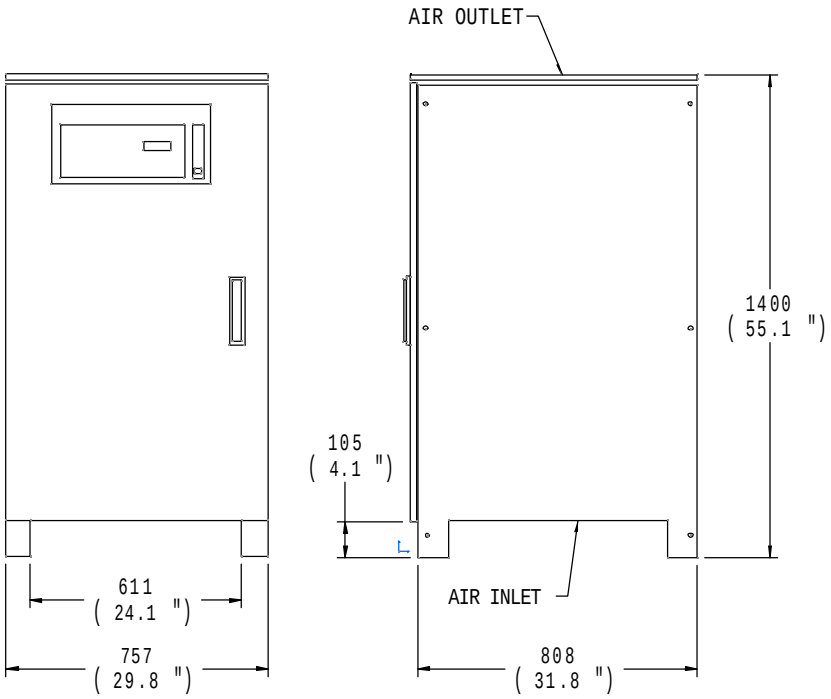


Figure 17
Dimensions and Space Requirements – 400 Hz GPU 20kVA, 40kVA (Stationary Version)

5.5.2 Space requirements continued on following page

400 Hz 20-120 kVA Ground Power Unit
Models:

11B6648-1000/1010	**11B6649-1000/1010**	**11B6650-1000/1010**	**11B6652-1000/1010**
11B6663-1000/1010	**11B6656-1000/1020**	**11B6657-1000/1020**	**11B6658-1000/1020**
11B6660-1000/1020	**11B6664-1000/1020**	**11C6648-1000/1010**	**11C6649-1000/1010**
11C6650-1000/1010	**11C6652-1000/1010**	**11C6663-1000/1010**	**11C6656-1000/1020**
11C6657-1000/1020	**11C6658-1000/1020**	**11C6660-1000/1020**	**11C6664-1000/1020**

5.5.2 Space Requirements *(continued)*

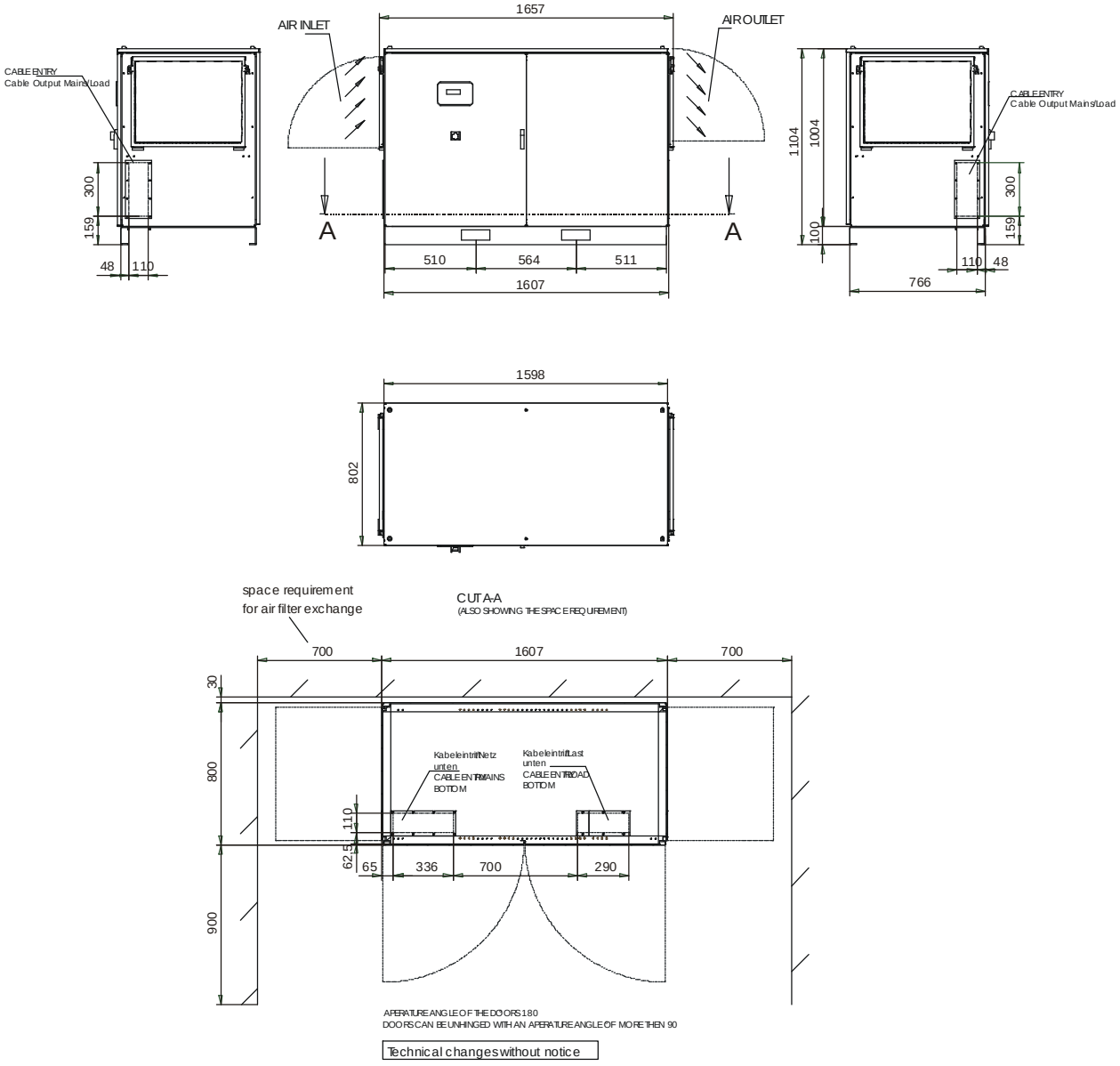


Figure 18
Dimensions and Space Requirements – 400 Hz GPU 60kVA - 90kVA (Stationary Version)

5.5.2 Space Requirements *(continued)*

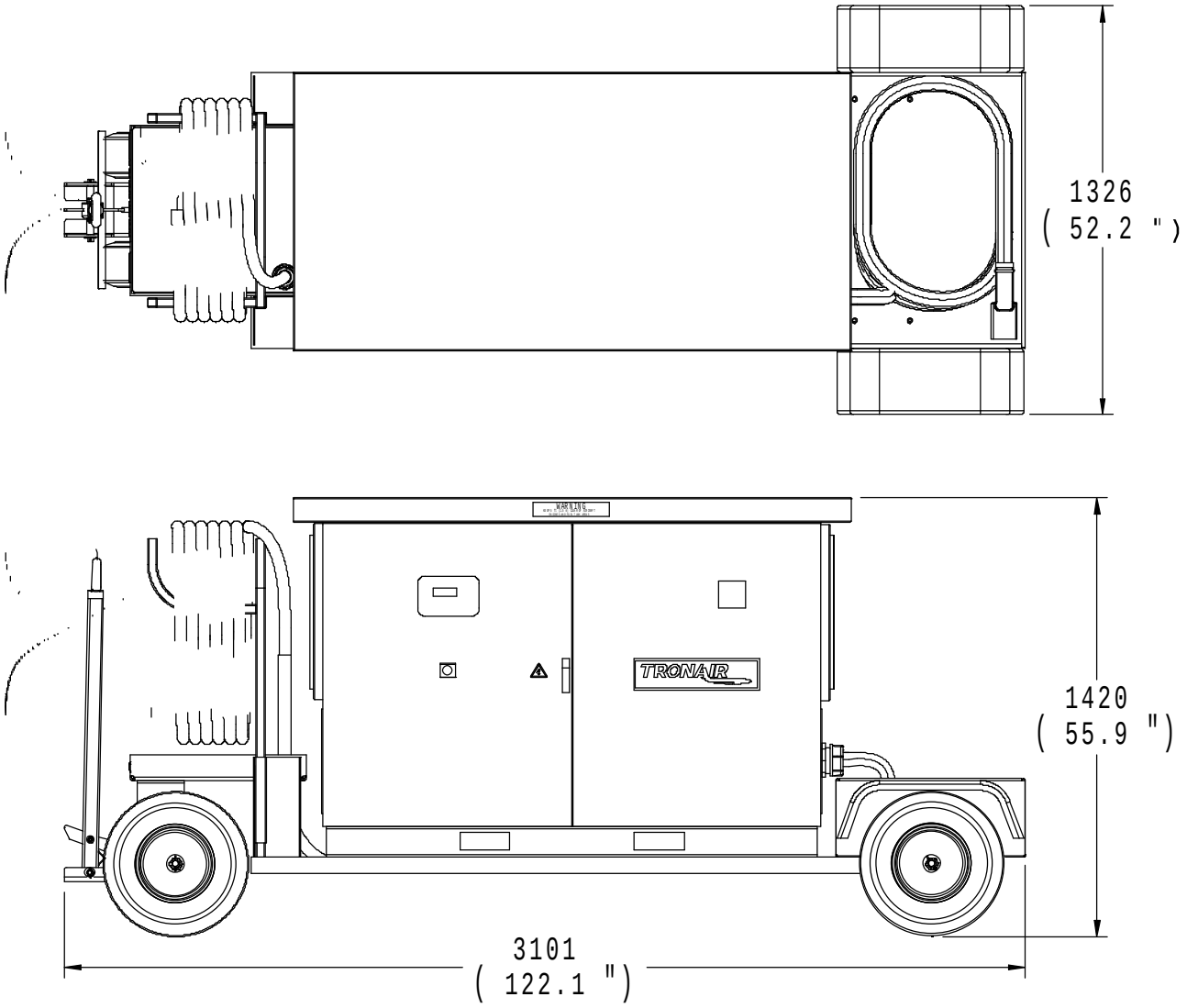


Figure 19
Dimensions and Space Requirements – 400 Hz GPU 60kVA - 90kVA
(Mobile Version)

5.5 Choice of installation site continued on following page.

5.5 CHOICE OF INSTALLATION SITE *(continued)*

5.5.3 Altitude, Temperature & Humidity

The 400 Hz GPU is designed for an installation altitude of up to 1000 metres above mean sea level, an ambient temperature of 0 to 40 ^{o}C and a relative humidity of up to 90%. The optimum temperature is around 20 ^{o}C. Please ensure that any existing air-conditioning plant meets these conditions and is also able to remove the unit's dissipated heat. Details are shown in the Technical Data (Chapter 4). The cooling air must always be free of aggressive agents. You should consult your Tronair representative if planning an installation above 1000 metres.

5.5.4 Ground Anchors

It is not normally necessary to bolt the converter to the floor. If, however, this is a contractual requirement, then four bolting points are provided. These are located in the base of the cabinet at each corner.

Method of fixing is as shown in Figure 20, using Liebig retaining bolts size M12, A4 (not supplied).

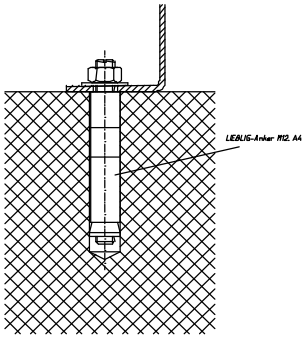


Figure 20
Retaining Bolt

5.6 ELECTRICAL CONNECTIONS (POWER)

5.6.1 Cable entry

The input and output cables are connected in the lower part of the cubicle. The cables can be brought up to the cubicle from the left or from the right and led in through the bottom or through the right-hand end panel of the cubicle (90kVA only). Please refer to table below for the cable sizes which must conform to DIN VDE 298.

Always ensure that the phases of the three-phase input connections are correct (clockwise rotating field), since incorrect connections could cause damage to the equipment. Cables must be properly glanded via screwed glands fitted with strain-relief device and sealing ring. Attention should be paid to the gland plate, which must be non-ferrous if single core cables are to be used.

5.6.2 Cable Sizing

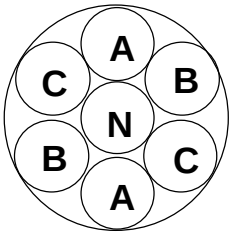
Cables should be sized in accordance with the ***rating of the next protective device upstream***, taking into account temperature, volt-drop and installation method factors, as per the appropriate standard for the site. In general, Tronair recommend that the volt-drop for both input and output power cables should not exceed 1.5%, and that the connecting cables should be as short as possible (less than 15 metres is recommended). Tronair should be consulted if these requirements cannot be met.

When specifying the cable lengths allow for about 0.5 metres inside the cubicle. The following table shows the recommended cable types:

Equipment Type	Input Cable	Output Cable
20kVA	1 x NYY 4 x 10 RE/10	1 x NYY 4x16RE /16
40kVA	1 x NYY 4 x 25 RE/16	1 x NYY 7 x 25
60kVA	1 x NYY 4 x 35 RM/25	1 x NYY 7 x 35
90kVA	1 x NYY 4 x 70 RM/35	2 x NYY 7 x 35

5.6.2 Cable Sizing *(continued)*

Where possible only a cable of balanced construction should be used on the 400Hz output to avoid voltage distortions. Generally this means a maximum core size of 35mm² in a 7-core cable formation but there are some occasions when a 70mm² core area is acceptable.. Please consult your Tronair representative regarding particular applications.



7x35 mm² 400Hz Low-Loss Cable

A = Phase A (L1)
B = Phase B (L2)
C = Phase C (L3)
N = Neutral N400

Figure 21
400Hz Low Loss Cable

5.6.3 Mains Fuses

To meet Health & Safety requirements, lockable isolating fused-switches must always be installed for the mains infeed. The fuses should be of type GL.
Please consult your Tronair representative regarding use of circuit breakers for the mains infeed.

Equipment Type	Fuse
20kVA	50 A
40kVA	80 A
60kVA	125 A
90kVA	160 A

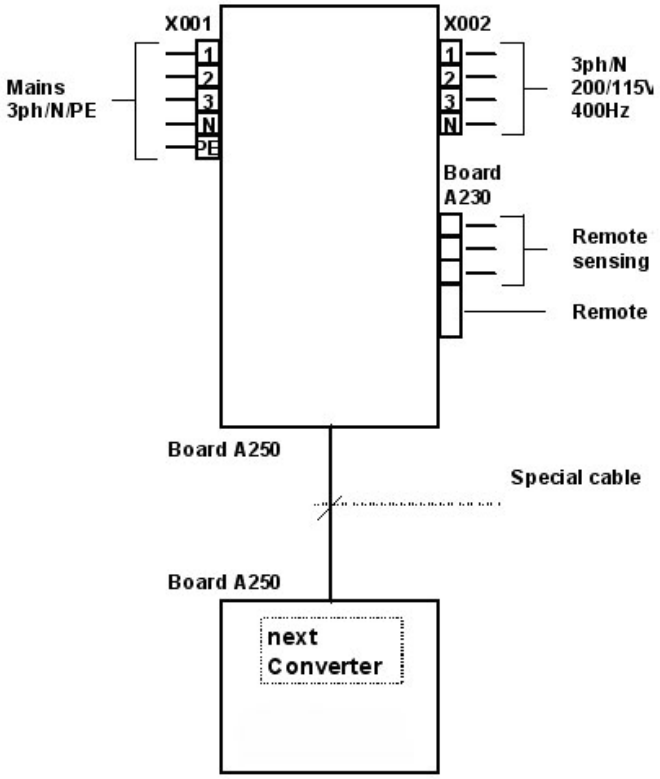
5.6.4 Connections

Power:

- 3 phase Mains Supply + PE
- 3 phase 400Hz output + Neutral

Controls:
Connections to the converter may include most of the following, depending on the configuration of the system

- External Voltage Monitoring
- Parallel Controls between converters
- Central Control Functions
- Remote Indications
- Emergency Stop circuit



5.6.4 Connections continued on following page.

5.6.4 Connections *(continued)*

The terminal arrangement will depend on the size and the configuration of the 400 Hz GPU. The following drawings show the various configurations.

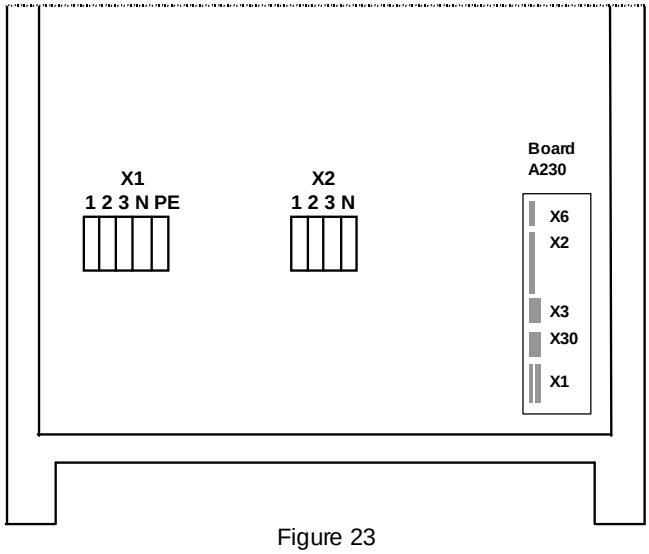


Figure 23
Terminal Arrangement 400 Hz GPU 20kVA, 40kVA

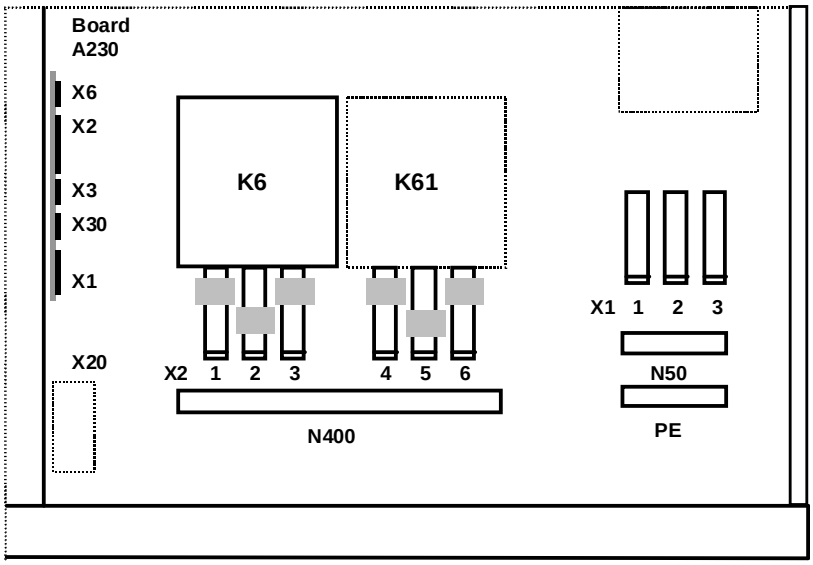


Figure 24
Terminal Arrangement 400 Hz GPU 60kVA - 940kVA

5.6.4 Connections *(continued)*

Terminal	No. Of Terminal	Function	Short Name
X1	1	Mains input	L1
	2	Mains input	L2
	3	Mains input	L3
	N50	Mains neutral	N50
X2	1	Load output 1	L1 (A1)
	2	Load output 1	L2 (B1)
	3	Load output 1	L3 (C1)
	N400	Load neutral	N400

Additional terminals at the IO board A230

Terminal	No. Of Terminal	Function
X1		External control, monitoring
X2		Remote indications
X30		Parallel operation, RCP, CCP

5.7 CUSTOMER INTERFACE CARD A 230 (OPTION)

Terminal strips X1/X2/X30 on the Customer Interface Board can be used by the customer to match the equipment to his own electronic installation, such as emergency stop circuit, remote control signals and so on.

5.7.1 Terminal Strip X1

Terminal strip X1 is used for external emergency stop, remote control and additional special signals.

Emergency stop circuit
The emergency stop circuit is initially only fitted internally. If an external emergency stop contact is to be added, then the links between EPO_{int} X1.1 and EPO_{ext} X1.2 should be removed and replaced by a normally-closed contact from the external emergency stop button.

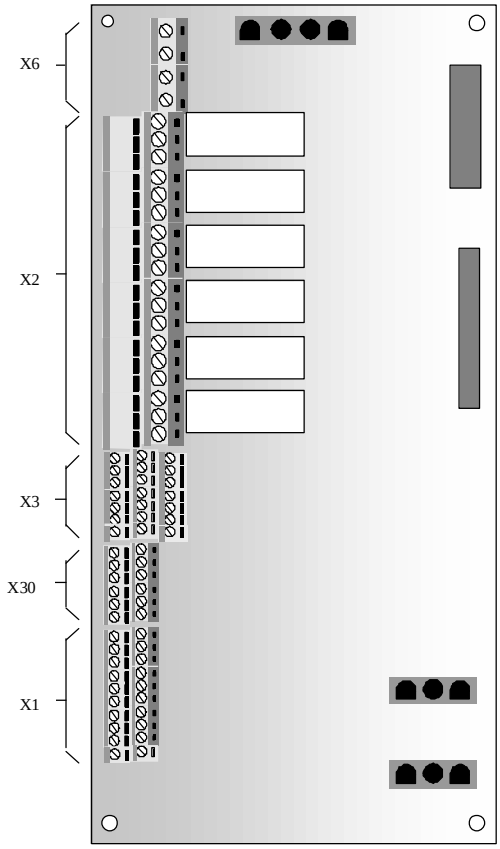


Figure 25
Customer Interface Board

5.7.1 Terminal strip X1 continued on following page.

5.7.1 Terminal Strip X1 *(continued)*

Remote control functions / Terminal Strip X1

The "AJon, AJoff, Output 1 on and Output 1 off, Output 2 on, Output 2 off" remote control functions and additional special signals can be controlled from a potential-free contact as well as from an external 24-V signal. The current loading is 13 mA.

These inputs are connected to the controller of the customer interface card, which transmit the signal states serially to the system controller. Each signal group has an own earthing. When using an external 24 V DC voltage, this must therefore also be connected to the external earth. Otherwise, when using an internal 24 DC voltage, this external earth connection has to be connected with the internal earth.

These earth connections (links) are already installed ex works and have to be removed if it is necessary.

The table below shows the remote control functions when potential-free contacts are used. However, if 24 V DC is used, then the GND should be connected to earth.

Note that there is only one choice: either to have all remote control signals as a potential-free contacts or to have all remote control signals using customer's own 24 V DC voltage. See Figures 26 and 27.

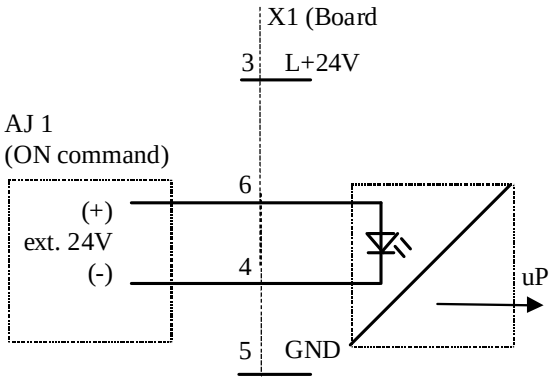


Figure 26
Start Command Via External 24V DC Signal

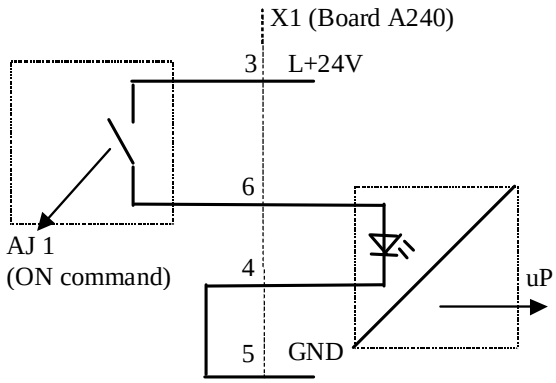


Figure 26
Start Command Via External Potential-Free Contact

1. Signal Group

Connection	**Function**	**Potential-free contacts** (only if link is made between GND X1.4 and DGND.1 X1.5)	**Ext. 24V DC** Negative potential at DGND.1 X1.5 Positive potential at:
X1.6 AJ_{on}	Starts the converter	From X1.3 to X1.6	X1.6
X1.7 AJ_{off}	Switches off the converter	From X1.3 to X1.7	X1.7
X1.8 OUTPUT1 1	Switches on Output 1	From X1.3 to X1.8	X1.8
X1.9 OUTPUT1 0	Switches off Output 1	From X1.3 to X1.9	X1.9

5.7.1 Terminal Strip X1 *(continued)*

2. Signal Group

Connection	**Function**	**Potential-free Contacts** (only if link is made between GND X1.19 and DGND.2 X1.18)	**Ext. 24V DC** Negative potential at DGND.2 X1.20 Positive potential at:
X1.12 Plugsw1	Indication aircraft plug 1 is inserted	From X1.20 to X1.12	X1.12
X1.14 Special 1	Special signal 1	From X1.20 to X1.14	X1.14
X1.15 Special 2	Special signal 2	From X1.20 to X1.15	X1.15
X1.16 Special 3	Special signal 3	From X1.20 to X1.16	X1.16
X1.17 Special 4	Special signal 4	From X1.20 to X1.17	X1.17

Remote Indications Terminal X30
The remote indications are also output via terminal strip X30. The external lamps require a voltage of 24V. The maximum possible current per output is 0.5 A.
The following messages are provided:

Connection	**Function**	**Terminal**
X30.1 LAJ ON	Converter is switched on	From X30.1 to X30.7
X30.2 LOUTP1 ON	Output 1 is switched on	From X30.2 to X30.7
X30.4 LGen Fail	General failure	From X30.4 to X30.7

Remote Voltage Sensing Terminal Strip X6
The 400 Hz GPU 20kVA – 90kVA are equipped with *remote voltage sensing* as required, to allow the converters to compensate for the voltage drop in the cable to the aircraft. To use the *remote voltage sensing* it is necessary to connect the feedback voltage (3ph + neutral) to terminals X6.1-4. The change-over to remote voltage sensing occurs automatically with feed backed voltage.

Connection	**Function**
X6.1 L1 (A)	Remote voltage phase L1
X6.2 L2 (B)	Remote voltage phase L2
X6.3 L3 (C)	Remote voltage phase L3
X6.4 N	Remote voltage neutral conductor N400

External Control Panel
An optional remote controller can be connected via terminals X30.40 – X30.44.

5.7 Customer interface card A 230 continued on following page.

5.7 CUSTOMER INTERFACE CARD A 230 (OPTION) *(continued)*

5.7.2 Terminal Strip X2

Six potential-free contacts are available on terminal strip X2. The maximum rating for the contacts at 250V AC is 8A.

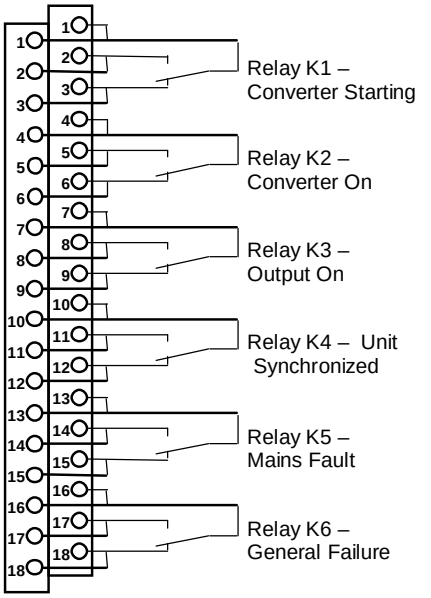


Figure 28
Contact Assignment Of Terminal Strip X2

5.8 EVENT RECORDER

5.8.1 Description of operation

The event recorder in the 400 Hz GPU indicates each change from logic 0 to logic 1. Changes in the opposite direction are not shown. Each event entry is also logged at the terminal interface of the CP. This record, however, only appears when the CP *on-line monitor* is inactive (the message ***Bye Bye*** must have been sent by the monitor. Monitor log-off occurs automatically after an interval of two minutes, or can be initiated by the "exit" command). Each event is shown on one line. The line starts with the event number, prefixed by an event code. This code has the following meaning:

Exxx an event has occurred without an acknowledgement

*xxx an event that must be acknowledged has occurred and has still not been acknowledged.

Rxxx an event that must be acknowledged has been acknowledged.

(xxx stands for a 3-digit decimal number)

The date and the time of occurrence follows, then the event text is output in the pre-selected language. All events still in the memory can also be shown on the LC Display.

Switching to the event recorder is made by means of the arrow push buttons. The end or the beginning of the event record is indicated by an arrow displayed in the first line. A "down" arrow means that the displayed event is the first event in the recorder. An "up" arrow indicates that the displayed event is the last event and therefore is also the most recent.

The events are output on several lines in the 400 Hz GPU LC Display, with 20 characters per line. The output starts with the time and date of the event, followed by the text in the chosen language, and is completed by the event number. This number is the serial text number in the text memory and is not the event number in the event memory. An "E" immediately in front of the number stands for an event not requiring acknowledgement, a " * " for events to be acknowledged but have yet not been reset, and an "R" for events that have been reset. Resetting is by means of the RESET push button on the CP. The display must show the event at this moment.

5.8 EVENT RECORDER *(continued)*

5.8.2 List of Event Recorder Entries

Event Number	Event
1	"K6 Contact Closed"
2	"K6 Contact Open"
3	"K61 Contact Closed"
4	"K61 Contact Opened"
6	"Fuse F6 Tripped"
7	"28v Output1 On"
8	"28v Output1 Off"
9	"K1 Contact Closed"
10	"K1 Contact Opened"
11	"K2 Contact Closed"
12	"K2 Contact Opened"
14	"Fuse F1 Tripped"
16	"Earth Fault"
17	"28v Output2 On"
18	"28v Output2 Off"
19	"400hz Neutral Failure"
20	"No 400hz Neutral Failure"
21	"Operation Mode Maintenance On"
22	"Operation Mode Maintenance Off"
23	"Operation Mode Automatic On
24	"Operation Mode Automatic Off"
29	"DC Measurement Board Connected"
30	"DC Measurement Board Disconnected"
31	"DC-Link Hw Voltage Ok"
32	"DC-Link Hw Voltage Failure"
33	"No Emergency Power Off"
34	"Emergency Power Off"
39	"Measurementboard2 Connected"
40	"Measurementboard2 Disconnected"
41	"Parallel Board Connected"
42	"Parallel Board Not Connected"
43	"Inverter Ok"
44	"Inverter Not Ok"
53	"No Hw Inverter Overcurrent"
54	"Hw Inverter Overcurrent"
59	"No Hw Rectifier Overcurrent"
60	"Hw Rectifier Overcurrent"
79	"Rectifier Ok"
80	"Rectifier Not Ok"
87	"PB 'Reset' Pressed"
97	"PB 'On' Pressed"
98	"PB 'Off' Pressed"
161	"Slave Processor Failure"
173	"Master Of Current Group"
174	"No Master Of Current Group"
175	"Converter In Parallel Mode"
176	"Converter Not In Parallel Mode"
187	"Converter Is Syncmaster"
188	"Converter Is Not Syncmaster"
189	"Mains Voltage Detected"
191	"Rectifier Is On"
192	"Rectifier Is Off"

5.8.2 List of event recorder entries continued on following page.

5.8.2 List of Event Recorder Entries *(continued)*

Event Number	Event
193	"Remote PB 'On' Pressed"
195	"Remote PB 'Off' Pressed"
197	"Remote PB 'On' Pressed"
199	"Remote PB 'Output1 On' Pressed"
201	"Remote PB 'Output1 Off' Pressed"
203	"Remote PB 'Output2 On' Pressed"
205	"Remote PB 'Output2 Off' Pressed"
207	"Aircraft Plug 1 Connected"
208	"Aircraft Plug1 Disconnected"
209	"Aircraft Plug2 Connected"
210	"Aircraft Plug2 Disconnected"
211	"Remote PB 'Output3 On' Pressed"
213	"Remote PB 'Output3 Off' Pressed"
215	"Aircraft Plug 3 Connected"
216	"Aircraft Plug 3 Disconnected"
289	"Close K6 Contact"
290	"Open K6 Contact"
291	"Close K61 Contact"
292	"Open K61 Contact"
293	"Close K61 Contact"
294	"Open K61 Contact"
297	"Close K1 Contact"
298	"Open K1 Contact"
299	"Close K2 Contact"
300	"Open K2 Contact"
309	"Rectifier Mode Enabled"
321	"Inverter Enabled"
341	"Inverter Not Synchron On Bus"
342	"Inverter Synchron On Bus"
405	"Same Active Power Regulation On"
425	"Phase Control Off"
426	"Phase Control On"
459	"Regulate On Remote Voltage"
460	"Regulate On Output Voltage"
461	"Converter On Bus"
462	"Converter Not On Bus"
464	"Rectifier On Command"
465	"GPU Is On Indication"
466	"No GPU Is On Indication"
467	"Output1 Is On Indication"
468	"No Output 1 Is On Indication"
469	"Output 2 Is On Indication"
470	"No Output 2 Is On Indication"
471	"General Failure Indication"
472	"No General Failure Indication"
473	Bridge Interlocking Indication"
474	"No Bridge Interlocking Indication"
475	"Output 3 Is On Indication"
476	"No Output3 Is On Indication"
593	"Converter On Pulse"
595	"Converter Off Pulse"
597	"Output On Pulse"
599	"Output Off Pulse"
601	"Output 2 On Pulse"
603	"Output 2 Off Pulse"

5.8.2 List of Event Recorder Entries *(continued)*

Event Number	Event
633	"Overload Output 1"
635	"Overload Output 2"
639	"Overload Inverter"
641	"Inverter On Command"
643	"Inverter Off Command"
655	"Converter In Parallel Mode"
656	"Converter Not In Parallel Mode"
667	"Output 3 On Pulse"
669	"Output 3 Off Pulse"
701	"Mains Failure"
702	"Failure Pre charging"
703	"Failure Operation Mode"
704	"Earthing Failure"
705	"Failure Dc Link Voltage"
706	"Board Connection Failure"
707	"Overload Failure"
708	"F1 Failure"
709	"F6 Failure"
710	"Failure Regulator Initialization"
711	"Failure Digital Resistor Setting"
712	"Temperature failure Inverter"
713	"Temperature failure Rectifier"
714	"K1 Failure"
715	"Overflow Failure DC Link Voltage"
716	"Setup Failure"
717	"Phase Rotation Failure Input"
718	"Phase Rotation Failure Output"
719	"Current Table Failure
720	“Failure Temperature”
721	"K1 Failure"
722	"K2 Failure"
723	"K6 Failure"
724	"K61 Failure"
725	"Output Voltage High"
726	"Output Voltage Low"
727	"Output Frequency High"
728	"Output Frequency Low"
729	"400hz Neutral Broken"
732	"Chopper Failure"
733	"Synchronisation Failure"
734	"Emergency Power Off"
735	"Temperature Failure Input Choke"
736	"Rectifier Failure"
737	"Inverter Failure"
740	"Remote Voltage Failure"
741	"Over Temperature Air Inlet"
818	"Parallel Mode On"
820	"Led Test"
821	"Remote Output Under Voltage"
823	"Remote Output Over Voltage"
825	"Remote Output Under Frequency"
827	"Remote Output Over Frequency"
835	"Mains Under Voltage"
837	"Mains Over Voltage"

5.8.2 List of event recorder entries continued on following page.

11B6648-1000/1010	**11B6649-1000/1010**	**11B6650-1000/1010**	**11B6652-1000/1010**
11B6663-1000/1010	**11B6656-1000/1020**	**11B6657-1000/1020**	**11B6658-1000/1020**
11B6660-1000/1020	**11B6664-1000/1020**	**11C6648-1000/1010**	**11C6649-1000/1010**
11C6650-1000/1010	**11C6652-1000/1010**	**11C6663-1000/1010**	**11C6656-1000/1020**
11C6657-1000/1020	**11C6658-1000/1020**	**11C6660-1000/1020**	**11C6664-1000/1020**

5.8.2 List of Event Recorder Entries *(continued)*

Event Number	Event
839	"Mains Under Frequency"
841	"Mains Over Frequency"
849	"Input Over Current"
851	"Output Under Voltage"
853	"Output Over Voltage"
859	"Output Over Current >100%"
861	"Output Over Current >120%"
863	"Output Over Current >150%"
865	"DC-Link Voltage < 460v"
867	"DC-Link Voltage < 305v"
869	"DC-Link Voltage < 600v"
871	"Inverter Over Temp 1"
872	No Inverter Over Temp 1"
873	"Inverter Over Temp 2"
874	"No Inverter Over Temp 2"
875	"Rectifier Over Temp 1"
876	"No Rectifier Over Temp 1"
877	"Rectifier Over Temp 2"
878	"No Rectifier Over Temp 2"
879	"Fast DC-Link Over Voltage >800v"
880	"No Fast DC-Link Over Voltage"
883	"Fast Dc-Link Under Voltage >555v"
884	"No Fast Dc-Link Under Voltage"
903	"Trafo Over Temp"
904	"Air In Over Temp"
905	"U Out Not Synchron To Bus"
906	"U Out Synchron To Bus"
907	"Input Choke Over Temp"
908	"Output Inductivity Over Temp"
909	"Inverter Current >200%"
910	"No Inverter Current >200%"
911	"Remote Output Undervoltage2"
912	"Remote Output Overvoltage2"
913	"Output 1 Current >100%"
914	"Output 1 Current >120%"
915	"Output 1 Current >150%"

6.0 OPERATING INSTRUCTIONS

6.1 GENERAL

This chapter describes how the 400 Hz GPU should be operated. After an introduction to the operator controls and indicators, the steps for switching the system on and off are given. A smooth sequence of operations is only achieved if the individual steps are carried out in the specific order. This chapter also explains the use of the LC Display and how to program the customer relays.

6.1.1 Control Panel

The Control Panel on the cubicle door contains a mimic display with LED indicators, an 80-character LC Display, the push buttons, and a load indicator.

The last event (button operation, switching process, fault) is shown on the display with date and time, while the LEDs in the mimic display indicate the current operating status of the unit. Specific switching functions are initiated; operating data is displayed and entered in succession in the event directory with the aid of the keyboard.

If an abnormal operating condition or fault occurs, the red “reset” button lights up. At the same time the LEDs on the mimic panel show the current operating status and the fault is indicated on the display.

6.1.2 Operator Controls

“Off” Push button
This key in combination with “Shift“ switches the set off (two handed control)

“On” Push button
This key in combination with “Shift“ switches the set on (two handed control)

“UP arrow” Push button
This key pages up through menus. In combination with “Shift“ it changes to a higher menu (main menu). In setup menus this function is called “Output“ function

“DOWN arrow” Push button
This key pages down through menus. In combination with “Shift“ it changes to a submenu. In setup menus this function is called “Input“ function

“Shift” or “Hand” Push button
This button confirms switching processes and, in combination with the arrow keys, switches to a new display (“Input“ or “Output“)

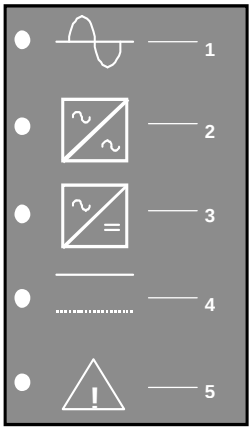
“Quit“ or ”RESET” Push button
This button displays an unacknowledged failure and cancels it if the button is pressed again.

difference between “long“ and “short“ pushes on the buttons and “Shift“ key pressed in combination. The following sequence is an example which should be followed:

When switching the set “on“ by pressing “Shift“ and “On“ simultaneously, it is important to press the “Shift“ key first, holding it in while pressing the “On“ button momentarily. The command will be entered when the buttons are released. In no circumstances should the “Shift“ button be released before the “On“ button. For all other functions which require the use of the “Shift“ button, operation is similar.

6.1 General continued on following page.

6.1 GENERAL *(continued)*



6.1.3 Mimic Panel Indicators

The following components are represented by light-emitting diodes (LED's):

1 Input
2 Static Switch
3 Transformer/Rectifier
4 DC Output
5 Warning (General failure)

The color of the LED's and whether they are steady or flashing provides information about the current operating status of the respective components:

Green flashing.....starting phase
Green steady..... running or switched on
Yellow flashing .....warning
Yellow steady .....available/ready
Red flashing..... fault
Red steady.....abnormal condition, e.g. mains fault, overload

6.1.4 Displays

With push buttons ▲ and ▼ It is possible to display various operating data.

With push buttons ▲ + ✋ or ▼ + ✋ It is possible to change to the

Event Monitor or into the setup menu. The following figure shows examples of display screens for converter type 400 Hz GPU.

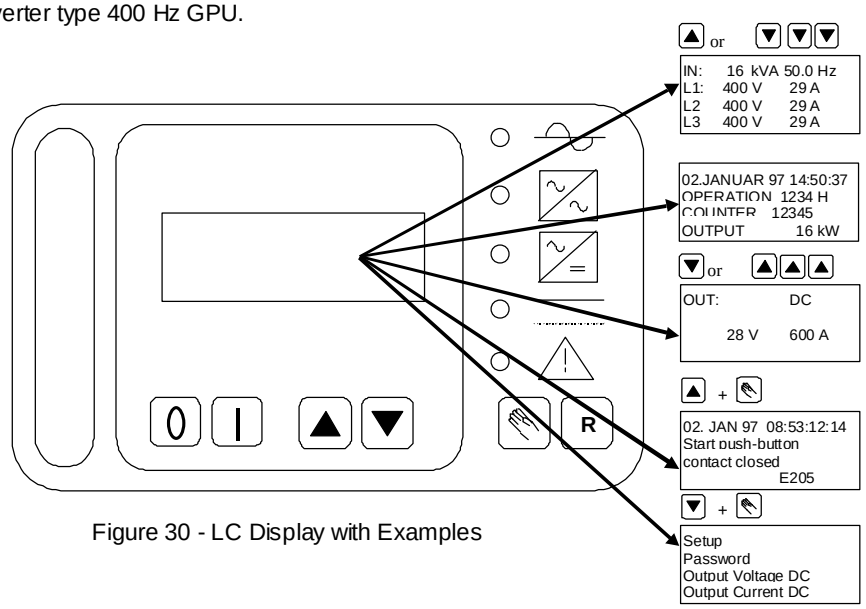


Figure 30 - LC Display with Examples

ATTENTION The Display OUT 1 and OUT 2 are only possible to get, if the unit is equipped with two output contactors.

6.0 OPERATING INSTRUCTIONS *(continued)*

6.2 COMMISSIONING

WARNING!

Before initial start-up, check the following:

1. **Is the equipment damaged? If yes, do not put into service without consulting your Tronair representative**
2. **Is the cabling properly installed? (Mains, output, remote control, etc. ?) Correct if necessary**

6.2.1 Tools Needed

The following tools will be needed in order to put the 28V DC GPU into operation:

- Multimeter
- Rotating field meter
- Various screwdrivers

6.2.2 Settings

A series of menus from which various customer-specific settings can be set up is available via the 400 Hz GPU display. The frequency converter has been set up according to the specification in the factory, and should not normally require any changes. In the event that changes are required (e.g. re-programming the volt-free customer alarm contacts) the set-up menu can be called up by pressing the arrow up and shift push buttons simultaneously (after switching on the mains supply). The Menus and Sub-menus are described later in this section.

6.2.3 Converter Commissioning

WARNING!

1. **Commissioning must only be carried out by trained personnel since work has to be done on components that may be "live"!**
2. **Power up the device only when requested to do so in the following text:**

ATTENTION 1. Commissioning tasks should be carried out if:

- The system is being put into service for the first time,
- Changes have been made, or
- Repairs were carried out.

2. Carry out the individual steps in the correct sequence:

1. Switch off circuit breaker Q100.
2. Switch on the power supply for the unit.
3. Check for clockwise rotating field of the mains supply to terminals X1.1/2/3.
4. Switch on circuit breaker Q100.
5. Carry out a lamp test by pressing the "Shift" and "Reset" push button simultaneously.
6. Check the settings in the display. If necessary, make changes and store these by means of the "setup" menu (see later in this section).
7. Acknowledge any faults shown on the display by means of the "Reset" push button.

6.0 Operating instructions continued on following page.

6.3 OPERATING THE SET

In the drawings to the right, LED's are shown thus:

- ○ off
- ◐ yellow
- ◑ yellow flashing
- ◬ green flashing
- ◉ green steady
- ● red steady
- ◎ red flashing

The below-mentioned event entries can be displayed by using the event display menu. In this display menu the various events will be shown in the way they occur, which means if a new event occurs it is displayed immediately. If the event display menu is not activated the various events will be stored in the event memory but not displayed.

To operate the unit depends on the operating mode. All single units operate in manual mode, in this case no operating mode switch is provided.

In case of parallel operation an operating mode switch S007 is provided. To operate the unit depends on the position of this switch.
To operate the set there are two or three (one optional) possibilities. They are available depending of the operating mode. At maintenance or manual mode the main control panel mounted at the front door of the switchboard or the remote control panel can be used. The method for operating the unit from the front control panel or the remote control panel is described below.

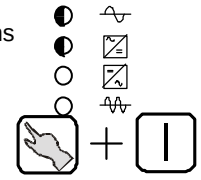
In automatic mode the "On" and "Off" button at the control panel and/or the remote control panel are out of function. In this case the external push buttons for "Central start" and "Central stop" are active.

The start up of the unit has to be finished (output contactor closed), before the outputs can be energized (in manual mode only)

6.3.1 Switching On In Manual Or Maintenance Mode

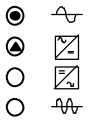
NOTE Before switching the set on for the first time after installation, check that the cabling has been correctly executed. It is absolutely imperative that the phase sequence of the AC connections is correct since incorrect connections can cause damage to the system.

1. Check that both yellow "Input" and "Rectifier" LEDs come on, i.e. that mains supply is available. Only then should the system be switched on.



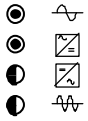
2. Press the "Shift" and "On" push buttons simultaneously. The following messages appear one after the other in the event display menu:
   "On push button contact closed"
   "K1 contact closed"

   The intermediate DC circuit is pre-charged. The following LEDs should be lit up on the mimic panel
   "Input"..... green
   "Rectifier"..... green flashing



   When pre-charging is completed, the following message appears:
   "K2 on"
   "K1 off"

   The following indicators light up:
   "Intermediate DC circuit"..... green
   "Inverter"..... yellow
   "Output"..... yellow



6.3 OPERATING THE SET *(continued)*

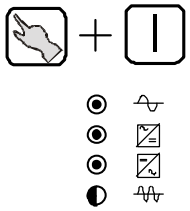
6.3.2 Switching the Output On

For the output contactor(s) two different operating modes are possible. By using the “Autostart” entry in the setup menu the output contactor is switched on automatically after the converter is live (Autostart active)

Alternatively the output contactor can be switched on by using the “On” push button a second time after the converter is live (Autostart not active).

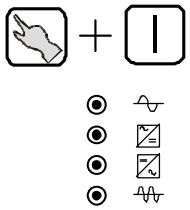
1. Press the “Shift” and “On” push buttons simultaneously. The following messages appear one after the other in display
   “On push button pressed”
   “Inverter on”

   The following LEDs should be lit up:
   “Inverter”..... green



2. Press “Shift” and “On” push buttons simultaneously. The following messages appear one after the other in the display:
   “Push button contact closed”
   “K6 contact closed”

   The following LEDs should be lit up:
   “Output” ..... green



6.3.3 Switching The Output Off

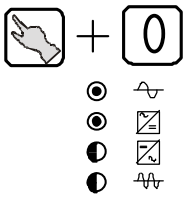
ATTENTION The load is no longer supplied if you carry out the following step.

NOTE For the output contactor(s) two different operating modes are possible. By using the “Autostart” entry in the setup menu the output contactor is switched on automatically after the converter is live and switched off together with the converter (Autostart active).

The output contactor can be switched on manually by using the “On” push button a second time after the converter is live to switch the contactor on or off by using the “Off” push button to switch the contactor off (Autostart not active).

1. Press the “Shift” and “Off” push buttons simultaneously. The following messages appear one after the other in display:
   “Off push button contact closed”
   “Inverter off”
   “K6 contact opened”

   LEDs “Output” and “Inverter” change color and display yellow.



WARNING!

Input and rectifier are still live.

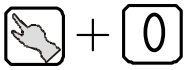
2. If you wish to reconnect the supply to the load, switch the output on as described in Section 7.3.1.

6.3 .3 Switching the output off continued on following page.

6.3 OPERATING THE SET *(continued)*

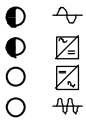
6.3.4 Switching The Set Off

Press the “Shift” and “Off” push buttons simultaneously. The following messages appear one after the other in display:



“Off push button contact closed“
“K2 contact opened”

The “Output” and “Inverter” LEDs go out and the “Input” and “Rectifier” LEDs change the colour and show steady yellow.

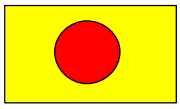


WARNING!

Even when switched off, a few components inside the set remain “live“. Only trained personnel should be allowed to work on set.

6.3.5 Emergency Stop

In an emergency, to immediately render the system “dead”, the red Emergency Stop push button beside the Control Panel must be pressed. Bear in mind, however, that the mains infeed is still “live”. It can only be isolated by using suitable external means.



6.3.6 LC Display Messages

The LC Display consists of four lines of 20 characters each. Operating data, the setup and the last 1200 events (operations, fault messages, etc.) are displayed on it with the aid of the two yellow arrow push buttons below the display panel.

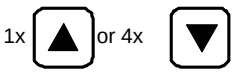
When the frequency converter is switched on, the following standard data appears on the display: More displays are called up by pushing the “UP arrow“ or “DOWN arrow“ key. With it the various

```
18.APR.2002 13:50:03
HOURS           1000H
INPUT      56kW/I0.99
OUTPUT     48kW/I0.80
```

displays are changed cyclical. Each display can be reached via two different combinations of push buttons, because the operator is free to choose the direction of change.

Starting at the basic adjustments, the following displays will be reached using the various combinations of push buttons described below.

1x "arrow up" or
4x "arrow down" push button

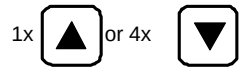


This push button calls up the input circuit data. Pressing the push buttons display the following:

```
IN:      56 kVA 50.0Hz
L1     400 V     81 A
L2     400 V     81 A
L3     400 V     81 A
```

6.3.6 LC Display Messages *(continued)*

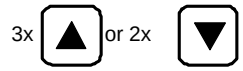
1x "arrow down" or
4x "arrow up" push button



This push button calls up the output circuit data. Pressing the push buttons displays the following output information:

```
INV:    90 kVA  400Hz
L1    115 V    260 A
L2    115 V    260 A
L3    115 V    260 A
```

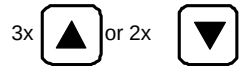
2x "arrow down" or
3x "arrow up" push button



This push button calls up the output data for output 1. It can only be displayed if the unit has two outlets. Pressing the push buttons displays the following output information:

```
OUT1:  58 kVA  400 Hz
L1    112 V    173 A
L2    112 V    173 A
L3    112 V    173 A
```

3x "arrow down" or
2x "arrow up" push button

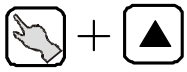


This push button calls up the output data for output 2. It can only be displayed if the unit has two outlets. Pressing the push buttons displays the following

```
OUT2:  58 kVA  400 Hz
L1    112 V    173 A
L2    112 V    173 A
L3    112 V    173 A
```

output information:

"Shift" + "arrow up" push buttons



These push buttons display one event from among the last 1200 which have occurred.

```
18.APR.2002 13:50:03
PB ‘ENABLE‘
PRESSED
                E0041
```

The “UP” arrow scrolls backwards in time

NOTE The first entry (event) of the event memory is reached by scrolling backwards, and a “DOWN” arrow then appears after the information shown.

6.3.6 LC display messages continued on the following page.

6.3.6 LC Display Messages *(continued)*

The "DOWN" push button scrolls in the opposite direction if the "UP" push button has previously been used.

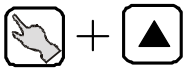
NOTE If the last entry (event) of the event memory is reached by scrolling in the opposite direction, an "UP" arrow appears after the information shown.

The individual lines of display show:
- Date and time of the occurrence of the event
- Description of the event
- Program number of the event and predetermined code, for example:
  - E = status message
  - * = fault message
  - R = fault message cancelled with "Reset" push button
  - A = time of acknowledgement of the fault message

NOTE Operating data called up with the "UP arrow" or "DOWN arrow" push buttons remain displayed for several minutes if no other push button is pressed. The display then switches back to the standard frequency converter parameters.

"Down" and "Up" arrow keys

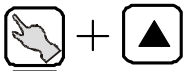
The main menu is called up by pressing the "Input" function keys ("Shift" and "arrow down" keys simultaneously).



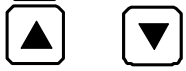
- Pressing the "Down" key scrolls downwards through the main menu.

- Pressing the "Up" key scrolls upwards through the main menu.

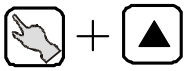
- A sub-menu is called up by pressing the "Input function" keys ("Shift" and "arrow down" keys simultaneously).



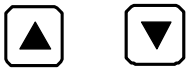
- Where figures or letters are to be entered in the input fields in the sub-menus, the desired entry is reached by scrolling with the "Up" and "Down" keys.



- Most sub-menus have several input fields. Press the "Input" function keys to go from one input field to the next one. An active input field in which entries can be made is indicated by the cursor.

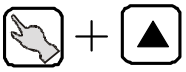


- With input fields allowing a choice between two items, for example, yes/no or on/off, you can toggle between the various options by means of the "Down" and "Up" keys.

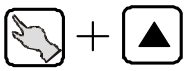


NOTE When the last input field is reached in a sub-menu, the cursor returns to the first input field when the "Input" key is next pressed.

- Pressing the "Output" function keys ("Shift" and "arrow up" keys simultaneously) quits the sub-menu and displays the main menu. The previous changes are accepted by the system at the same time.



- Pressing the "Output" key again quits the main menu and the standard display appears



The following sub-menus can be called up in the main menu:

Language	Output Voltage
Date/time	Compensation AC
Set-up	Password
Auto start	DSO Status
Contrast	Type

6.3.6 LC Display Messages *(continued)*

1. **Language**
   Set the language in which the display is to appear. Four languages are available: German, English, French, Italian and Spanish.
2. **Date/Time**
   Set the current date and time if required and then specify that the modified value should be accepted.
3. **Set-Up**
   This menu is required on completion of the settings for programming in the EEPROM. See number 14 below.
4. **Auto Start**
   In this menu the output on function of the output contactor and the 28V DC rectifier (automatic on or manual on) can be chosen.
5. **Contrast**
   This menu allows you to set the contrast of the display.
6. **Output Voltage**
   With this key the AC output voltage can be adjusted.
7. **Compensation AC**
   This menu allows you to set the output voltage compensation of the AC outlet.
8. **Password**
   A password must be entered in order to enter settings in the following menus. In this case please consult your Tronair representative.
9. **DSO Status**
   A digital storage oscilloscope (DSO) function is built into both the main and inverter controller board. The status of the DSOs can be checked with this menu (for servicing personnel only).
10. **Type**
    The type designation of the unit is set at the factory.
11. **Set-Up**
    Return to this menu on completion of the settings in order to program them into the BATTRAM.
    - Store new values: enter “yes” to store the settings.
    - Load old values: “yes” erases all new settings and returns to the last stored setting.

    The sub-menus have different ‘rights of access’, i.e. changes or entries cannot be made in all sub-menus. The right of access depends on passwords. Furthermore, the sub-menus can be divided into three groups:

    1. Sub-menus in which entries or changes can be made without entering a password:
       - Language
       - Date/time
       - Contrast
       - DSO status

NOTE Changes to the sub-menus are stored in the system’s BATTRAM by means of the “Set-up“ sub-menu. If a change is not stored it is lost when the frequency converter set is switched off. If the date is corrected for example, and the frequency converter is switched off and then on again, the date which appears is the one which was set prior to the correction.

2. Sub-menus in which entries or changes can be made with a “User Password”:
   - Set-up
   - Output voltage AC
   - Compensation AC

Entries and changes can be made in these sub-menus by entering the user password. The password programmed at the factory is “AJ“.

6.3.6 LC display messages continued on following page.

6.3.6 LC Display Messages *(continued)*

NOTE The "Set-up" menu is used to store changes which are to remain active after the frequency converter is switched off and on (see sub-menus without entering a password).

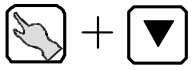
3. Sub-menus in which entries or changes can be made with the "Service Password":
   - Auto start
   - Type

These sub-menus are available only to Tronair service technicians by entering the service password. The operator can only view entries made in the sub-menus in the manner described above.

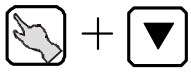
6.3.7 Selecting The Language

NOTE It is assumed in the following description that the standard data are displayed (date, mode, counter, output).

1. The main menu is called up by pressing the "Shift" and "arrow down" keys simultaneously. The cursor is already at the language entry.

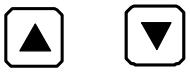


2. Call up the "Language" sub-menu by pressing the "Input" key.



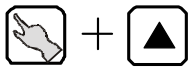
```
***   LANGUAGE   ***
-->   ENGLISH    <--
```

3. Select the desired language by pressing the "Up" or "Down" arrow keys.



NOTE The selected language appears on the display between the two arrows.

4. Confirm the selection and quit the sub-menu by pressing the "Output" function keys ("Shift" and "arrow up" keys simultaneously.

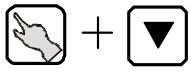


Depending on the configuration, two of the following languages are available:
Only German and English are available at this time

6.3.8 Setting The Date/Time

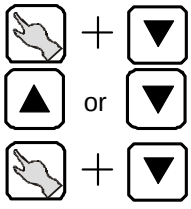
NOTE It is assumed in the following description that the standard data is displayed (date, mode, counter, output).

1. The main menu is called up by pressing the "Input" function keys. ("Shift" and "arrow down" keys simultaneously).



2. Call up the "Date/Time" sub-menu by pressing the "arrow down" and then the "Input" function to confirm

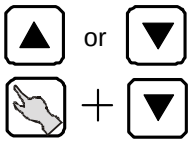
3. Set the day by pressing the "Up" or "Down" key, and accept with the "Input" function.



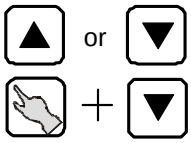

```
**** DATE/TIME  ****

18.APR.2002 13:51:10
SET DATE/TIME?   NO
```

6.3.8 Setting The Date/Time *(continued)*

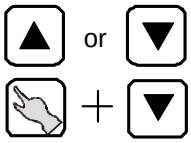
4. Set the month by pressing the “Up” or “Down” key, and accept with the “Input“ function.



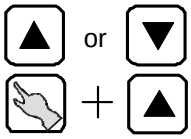
5. Set the year by pressing the “Up” or “Down” key, and accept with the “Input“ function.



6. Set the time (hours, minutes, seconds) by pressing the “Up” or “Down” key, and accept with the “Input“ function.

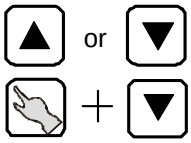


7. Confirm “Accept” with “Yes” by pressing the “Up” or “Down” key, and accept the entry with the “Output” function and quit the sub-menu.



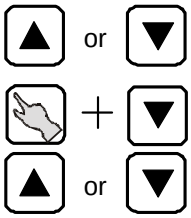
6.3.9 Setup

1. Call up the “set-up“ sub-menu by pressing the “arrow up“ or “arrow down“ key and then the “Input“ function to confirm.




```
****** SETUP  ******

SAVE NEW SETUP : NO
LOAD OLD SETUP : NO
```

2. Accept “store new“ with the “Up“ or “Down“ key if changes have to be saved in BATTRAM.



Confirm “Write Set-up“ by pressing any key or
change to the “load old“ input field with the “Input“ function and answer “yes“ with the “Up“ or “Down“ key if the changes are not to be made in the BATTRAM.

Confirm "Load Setup“ by pressing any key

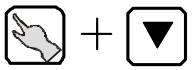
6.3 Operating the set continued on following page.

6.3 OPERATING THE SET *(CONTINUED)*

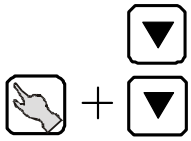
6.3.10 Auto Start

NOTE It is assumed in the following description that the standard data is displayed (date, mode, counter, output) and that the user password (AJ), which was programmed in the factory, has not changed.

1. The main menu is called up by pressing “Shift” and “arrow down” keys simultaneously.

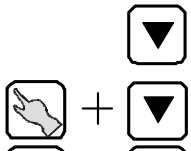


2. Select sub-menu “Auto start“ with “arrow down“ key and press “Input“ function to confirm.

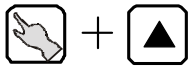


```
**** AUTOSTART   ****

AUTOSTART       :  OFF
```

3. Select auto start “on“ by pressing “arrow down“ key and confirm with “Input“ function.



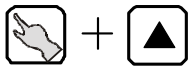
4. Press the “Output“ function twice to quit the sub-menu “Auto start“ and to go back to main menu.



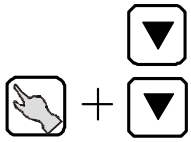
6.3.11 Setting Contrast

NOTE It is assumed in the following description that the standard data is displayed (date, mode, counter, output).

1. The main menu is called up by pressing “Shift” and “arrow down” keys simultaneously.

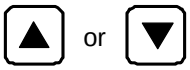


2. Call up the “Contrast” sub-menu by pressing the “arrow up” or “arrow down” and then the “Input” function.

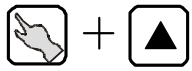


```
****  CONTRAST  ****

  CONTRAST:     96 %
```

3. Set the desired contrast for the LCD display with the “Up” or “Down” key.



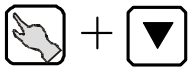
4. Quit the “Contrast” sub-menu and return to the main menu with the “Output“ function.



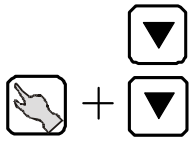
6.3 OPERATING THE SET *(CONTINUED)*

6.3.12 Output Voltage AC Adjustment

1. The main menu is called up by pressing “Shift“ and “arrow down“ simultaneously.

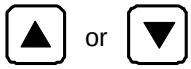


2. Call up the “Voltage“ sub-menu by pressing the “arrow down“ key and confirm with “Input“ function.

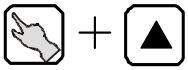


```
** OUTPUT VOLTAGE **

VOLTAGE :      200 V
```

3. Press the “up“ or “down“ arrow keys to raise or lower the voltage.



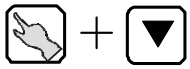
4. Quit the “Voltage“ sub-menu and return to the main menu with the “Output“ function. From this moment the new value for the output voltage will be used for voltage regulation.



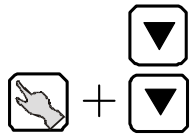
NOTE Output voltage adjustment range is ±5%. The full frequency converter regulation range of ±12% is only available when the Remote Sensing cables are connected.

6.3.13 Output Voltage AC Compensation Adjustment

1. The main menu is called up by pressing “shift” and “arrow down“ simultaneously.



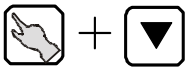
Call up the “Compensation AC L1“ sub-menu by pressing the “arrow down“ key and confirm with “Input“ function.



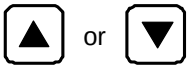
```
COMPENSATION AC L1
COMPENSATION     OFF
ACTIVE POWER:    8 V
REACTIVE POWER:  4 V
```

3. Press the “down“ arrow key enable (on) or disable (off) the compensation (will work for all three phases at the same time).

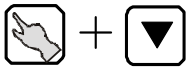
4. Call the “input” function to change over to the active power adjustment.



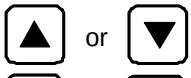
Press the “up“ or “down“ arrow keys to raise or lower the voltage for the active power adjustment.



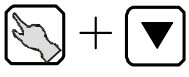
5. Call the “input” function to change over to the reactive power adjustment.



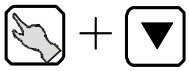
Press the “up“ or “down“ arrow keys to raise or lower the voltage for the reactive power adjustment.



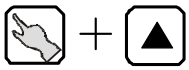
6. Call the “input” function to change over to the adjustments for phase L3. Repeat step 4 and 5.



7. Call the “input” function to change over to the adjustments for phase L2. Repeat step 4 and 5.



8. Quit the “Compensation“ sub-menu and return to the main menu with the “Output“ function. From this moment the new value for the voltage drop will be used for voltage compensation.



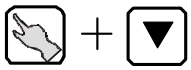
6.3 Operating the set continued on following page.

6.3 OPERATING THE SET *(CONTINUED)*

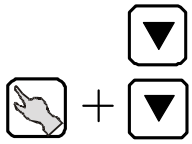
6.3.14 Password

NOTE It is assumed in the following description that the standard data is displayed (date, mode, counter, output) and that the user password (AJ), which was programmed in the factory, has not been changed.

1. The main menu is called up by pressing “Shift” and “arrow down” keys simultaneously.



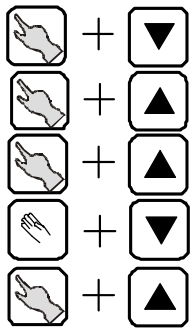
2. Call up the “Password” sub-menu by pressing the “arrow up” or “arrow down” and then the “Input” function.



```
***** PASSWORD *****

  PASSWORD: ########
```

3. Press the “Input“ function to enter the second character (J) of the password in the second input field.

4. Press the “Output“ function twice to quit the “Password” sub-menu and return to the main menu or



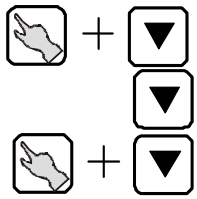
Press the “Output“ function once and press the “Input“ function once to enter the “Change password“ sub-menu.

Enter the new password as described above and press the “Output” function to return to the main menu.

6.3.15 DSO Status

1. The main menu is called up by pressing “Shift“ and “arrow down“ simultaneously.

2. Call up the “DSO Status“ sub-menu by pressing the “arrow down“ key and confirm with “Input“ function.



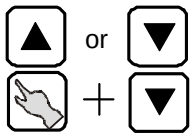
```
**** DSO STATUS ****

CONTROLLER :      -
```

If the DAC box was activated, the actual status is indicated (for service only)

6.3 OPERATING THE SET *(CONTINUED)*

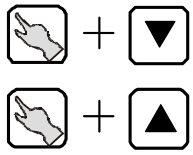
6.3.16 Type Menu

1. Call up the “Type“ sub-menu by pressing the “arrow up“ or “arrow down“ key and then the “Input“ function to confirm.




```
AJ-S  60kVA   3/3
 60Hz/400Hz-480V-C-C
REMOTE SENSING:  OFF
SERIAL NUM.: 300XXXX
```

2. If the unit is equipped with a remote sensing device, the remote sensing function could be enabled at the remote sensing entry. To enable the remote sensing go down to remote sensing by pressing the “Input“ function to confirm. Accept the adjustment by pressing the “Output” function.



7.0 TROUBLE SHOOTING

7.1 General

All malfunctions in the frequency converter are recorded by the system. The latest malfunction is shown in plain language on the display of the Control Panel. The red “Reset” lamp also lights up on the Control Panel. Depending on the type and severity of the malfunction, the load continues to be supplied if at all possible; otherwise the converter will shut down.

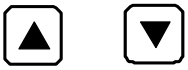
NOTE In the event of a fault, the system fault messages should be evaluated first in accordance with Section 6.8.2. If the cause of the fault is within the frequency converter and you cannot clear it with your own personnel, please contact your **Tronair Service representative at 419-866-6301 or 1-800-426-6301.**

It is very helpful for fault diagnosis if you can tell us the fault messages in the order in which they occurred.

7.2 Procedures in the event of malfunctions

Follow the steps below in case of malfunctions:

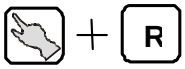
1. Since it is feasible that a series of abnormal events have led up to the present fault condition, use the “Up“ arrow key to call up previous events because it is quite possible for several faults to occur simultaneously or in succession.
2. Press the “UP arrow” button (if this is illuminated) to cancel the fault message.
3. If the “UP arrow ” button continues to be illuminated, press the “UP arrow” button again to display the next fault message.
4. Acknowledge the fault message by pressing the “UP arrow” button.
5. If further fault messages appear, continue as in points 3 and 4 above until no further fault message is displayed.
6. After all fault messages have been acknowledged, you can scroll through the event memory with the aid of the “Up“ and “Down“ arrow keys. In front of each malfunction event an “R” is displayed to indicate that the fault is cancelled.



NOTE The events or faults are displayed in the order in which they occur.

7.2.1 Lamp Test

A test sequence for all LEDs is started by pressing the yellow “Input” and “Output” push buttons simultaneously.



7.0 Trouble shooting continued on following page.

7.0 TROUBLE SHOOTING *(continued)*

7.3 Monitors & Fault Indication

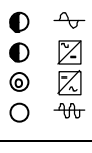
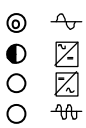
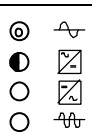
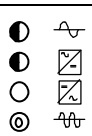
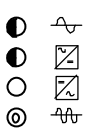
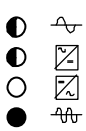
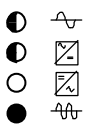
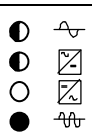
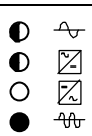
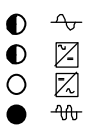
The following LED symbols are used to define the color / flashing status of the LED's on the Control Panel:

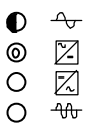
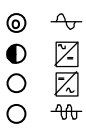
- ○ off
- ◐ yellow
- ◑ yellow flashing
- ◮ green flashing
- ◉ green
- ● red
- ◎ red flashing

Event numbers are prefixed with an * are events which require acknowledging using the pusbutton. Events prefixed with an E are events that do not require acknowledging.

7.3 Monitors & Fault Indication *(CONTINUED)*

Event Number	LED Status	Test or Inspection	Corrective Action
E393 – Overload Output	● ◐ ○ ○	1. Check the maximum load on the unit and make sure that it doesn't exceed 105% of the max amps of the unit	1. Lower the total load on the unit
*701 – Mains Failure	● ◐ ○ ○	1. Verify that the cabling hasn't been incorrectly installed, e.g. the rotating field is not correct 2. If the mains voltage or frequency exceeds the permissible tolerances during operation, the converter is switched off and the LED's light up as shown.	1. Rewire the input cables so that phasing is correct. 2. Monitor input power to verify that it is between 432 and 528 VAC and 57 Hz to 63 Hz. Correct any problems at the source.
*704 – Earthing Failure	◐ ◐ ○ ◎	1. Check for continuity in the neutral wire from the unit to each of the plugs. 2. Verify that the F2 (42Volt relay) is working. (Green LED on the relay is ON.) 3. Check for voltage between ground and neutral 400Hz without and with load current.	1. Replace any cable that has a broken neutral wire. 2. If the green LED is OFF, replace the fuse in the relay. (Under the black cap on the front of the relay.) 3. If the voltage exceeds 42 volts, something external to the unit is shorting to one of the neutral wires.
*707 – Overload Failure	◎ ◐ ○ ○	1. Check the active load of the unit	1. Lower the active load to the unit
*712 – Temperature Failure Inverter	◐ ◐ ◎ ○	1. Check for blocked air inlet 2. Verify that the unit has not been operating in an overload condition for an extended period of time.	1. Clean all air inlet and screens 2. Allow inverter to cool down and then operate it with less load.
*713 – Temperature Failure Rectifier	◐ ◎ ○ ○	1. Check for blocked air filters 2. Verify that the unit has not been operating in an overload condition for an extended period of time.	1. Clean all filters and screens 2. Allow rectifier to cool down and then operate it with less load.
*717 – Phase Rotation Failure Input	● ◐ ○ ○	1. Inspect input power cables for incorrect phase connection	1. Correct incorrect phase connections
*718 – Phase Rotation Failure Output	◐ ◐ ○ ●	1. Inspect output power cables for incorrect phase connection	1. Correct incorrect phase connections

Event Number	LED Status	Test or Inspection	Corrective Action
*720 – Failure Trafo Temperature		1. Check for blocked air filters 2. Verify that the unit has not been started too many times in a short period of time	1. Clean all filters and screens 2. Allow the unit to cool down and then start it
*721 – K1 Failure		1. Check the K1 coil 2. Check the K1 auxiliary contact and wiring	1. Replace the coil if it is defective 2. Fix the wiring or replace the auxiliary contact if needed
*722 – K2 Failure		1. Check the K2 coil 2. Check the K2 auxiliary contact and wiring	1. Replace the coil if it is defective 2. Fix the wiring or replace the auxiliary contact if needed
*723 – K6 Failure		1. Check the K6 coil 2. Check the K6 and auxiliary contacts and wiring	1. Replace the coil if it is defective 2. Fix the wiring or replace the auxiliary contacts if needed
*724 – K61 Failure		1. Check the K61 coil 2. Check the K61 auxiliary contact and wiring	1. Replace the coil if it is defective 2. Fix the wiring or replace the auxiliary contact if needed
*725– Output Voltage High		1. Check wiring for output voltage measurement at A120 2. Check for a faulty inverter	1. fix the wiring 2.
*726 – Output Voltage Low		1. Check for a faulty voltage regulator 2. Check for faulty inverter	1. Replace the A3 Excitation Device Generator/power supply
*727 – Output Frequency High		1. Verify input power frequency is within ± 5%	1. Regulate input power frequency to within ± 5%
*728 – Output Frequency Low		1. Verify input power frequency is within ± 5%	1. Regulate input power frequency to within ± 5%
*733 – Synchronisation Failure		1. Check parallel communication connection cable 2. Check the K7 coil and auxiliary contact and wiring	1. Replace communicaton connection cable if needed 2. Replace K7 relais and fix the wiring

Event Number	LED Status	Test or Inspection	Corrective Action
*735 – Temperature Failure Inputchoke		1. Check for blocked air filters 2. Verify that the unit has not been started too many times in a short period of time	1. Clean all filters and screens 2. Allow the unit to cool down and then start it
*741 – Overtemperature Air Inlet		1. Check for blocked air inlet 2. Is the outside temperature above 108 ° F	1. Clean all air inlet and screens 2. Provide extra cooling to the unit or wait until it cools down.
No LED's lit and the Control Panel display is Off		1. Verify input power is available 2. Check the Q1 input circuit breaker 3. Check Q100 circuit breakers	1. Restore input power to the unit 2. Reset Q1 or replace Q1 if it will not reset 3. Open Q1 and then reset tripped circuit breakers

8.0 MAINTENANCE AND SERVICE

8.1 Preventive maintenance

8.1.1 General

Because of their construction, Tronair converters require practically no maintenance. The few operations which are required should be carried out carefully since they contribute to the trouble-free operation and increased service life of the installation.

8.1.2 Cleanliness

Always ensure that the system environment is kept as free as possible of dust, metal, lubricants, etc. Check at regular intervals, preferably when re-lubricating the set, that all air inlets and outlets are free of dust and are not blocked by any obstructions, sheets of papers, etc. Air inlets should be sucked out from time to time.

In no circumstances use compressed air since this can force dust particles into the interior and cause malfunctions.

8.1.3 Voltage Check

To ensure that the set is delivering the correct voltage we recommend that this be checked at regular intervals. To do this, press the yellow "output" button. The output voltage appears in the LC Display.

8.1.4 Lamp Test

A lamp test should be carried out approximately once a month to make sure that the display LEDs are working. A test sequence for all LEDs is started by pressing the yellow "input" and "output" buttons simultaneously. Faulty LEDs should be replaced as soon as possible.

8.1.5 Filter Mat Replacement

For reliable operation it is important that the condition of the filter mats in the air inlet is checked at regular intervals and the mats replaced if necessary. Recommended inspection intervals are: every four weeks for indoor installations and every 14 days for outdoor installations

The filter mat is located on the air inlet side (left-hand side of cabinet). If a replacement is necessary, the mat holder has to be opened by using a tool or coin. At the outdoor version of the converter an outer cover has to be opened before you will get to the mat holder.

8.0 Maintenance and service continued on following page.

8.0 MAINTENANCE AND SERVICE *(continued)*

8.2 Service

Prior to delivery each converter is subjected to a thorough check which includes running at full load for a prolonged period, and the prescribed overload test. Faults should not normally occur during proper, careful handling. Faults cannot be entirely ruled out, however, if caused by transportation, unfavourable environment or operating conditions, or incorrect operation.

If a fault occurs and you are unable to rectify this yourself with the aid of the fault messages in the LC Display, please contact us at :

TRONAIR, Inc.
1740 Eber Road
Holland, Ohio 43528-9794 USA

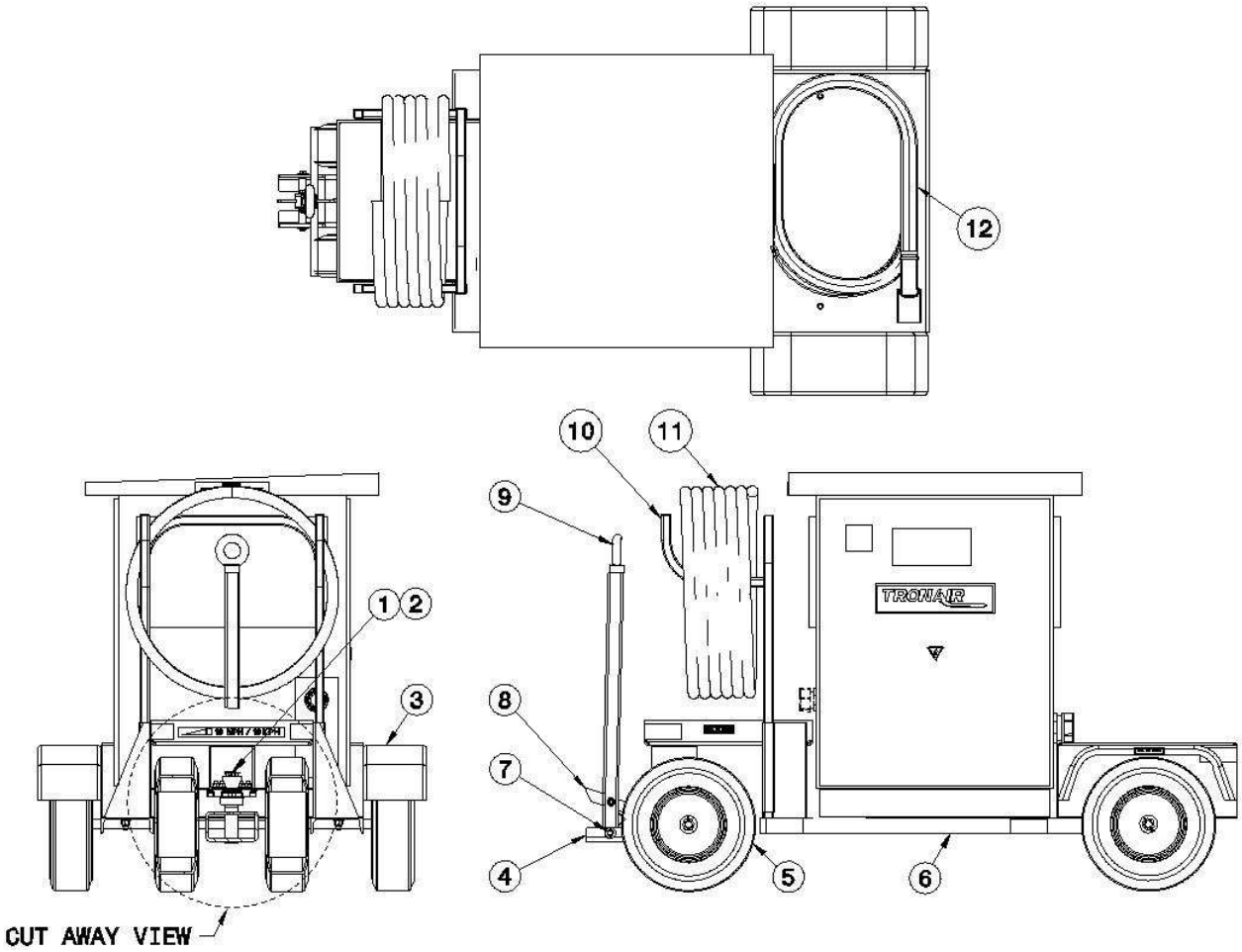
Telephone: (419) 866-6301 or 800-426-6301
Fax: (419) 867-0634
E-mail: sales@tronair.com
Website: www.tronair.com

With all enquiries please state the model number and serial number of the equipment. These are located on the front panel of the unit.

400 Hz 20-120 kVA Ground Power Unit
Models:

11B6648-1000/1010	**11B6649-1000/1010**	**11B6650-1000/1010**	**11B6652-1000/1010**
11B6663-1000/1010	**11B6656-1000/1020**	**11B6657-1000/1020**	**11B6658-1000/1020**
11B6660-1000/1020	**11B6664-1000/1020**	**11C6648-1000/1010**	**11C6649-1000/1010**
11C6650-1000/1010	**11C6652-1000/1010**	**11C6663-1000/1010**	**11C6656-1000/1020**
11C6657-1000/1020	**11C6658-1000/1020**	**11C6660-1000/1020**	**11C6664-1000/1020**

Parts List



ITEM	PART NUMBER	DESCRIPTION	QTY
1	H-1389	Hub, Idler	1
2	G-1230-01	Nut, Axle	1
3	S-1976-01	Fender	2
4	Z-6002-01	Weldment, Front Truck	1
5	U-1042	Assembly, Wheel	4
6	Z-6049-01	Trailer (20, 40, 60 KVA & 90 KVA from 02/2010)	1
	Z-6607-01	Trailer (120 KVA & 90 KVA to 01/2010)	1
7	R-2166	Pin, Towbar	1
8	J-3427	Lever	1
9	Z-6003-01	Weldment, Towbar	1
10	Z-6004-01	Weldment, Cable Hanger	1
11	EC-1171-01*0600	Cable, Power 50Ft (20 KVA)	1
	EC-1227-01*0600	Cable, Power 50Ft (40 KVA)	1
	EC-1227-03*0600	Cable, Power 60Ft (60 KVA)	1
	EC-1227-05*0720	Cable, Power 60Ft (90 KVA)	1
	EC-1227-07*0720	Cable, Power 60Ft (120 KVA)	1
12	EC-1887-30	Cable, Aircraft 30 ft (20, 40, 60 KVA)	1
	EC-1887-50	Cable, Aircraft 50 ft (20, 40, 60 KVA)	1
	EC-1887-100	Cable, Aircraft 100 ft (20, 40, 60 KVA)	1
	EC-1814-30	Cable, Aircraft 100 ft (90, 120)	1

9.0 CIRCUIT DIAGRAMS

9.1 Notes on the current path system

The system circuit diagrams hereafter have a series of numbers, the so-called current paths, at the top edge. They are numbered consecutively and make it easier to locate components, contacts, etc.

Each current path number consists of two digits separated by a full-stop. The first number is the consecutive sheet number, whilst the second digit (1 to 8) divides the individual sheets into columns.

The contact block of each relay or contact is specified under this component, which shows a further number to the right of the contact numbers. This number is the current path under which the respective contact can be found. Accordingly, each contact in the drawing has a figure in brackets which states the current path under which the coil of the relevant relay or contactor is located.

Similarly, other components or cable connecting points also have current path numbers in brackets in order to establish the relationship within the circuit diagrams.

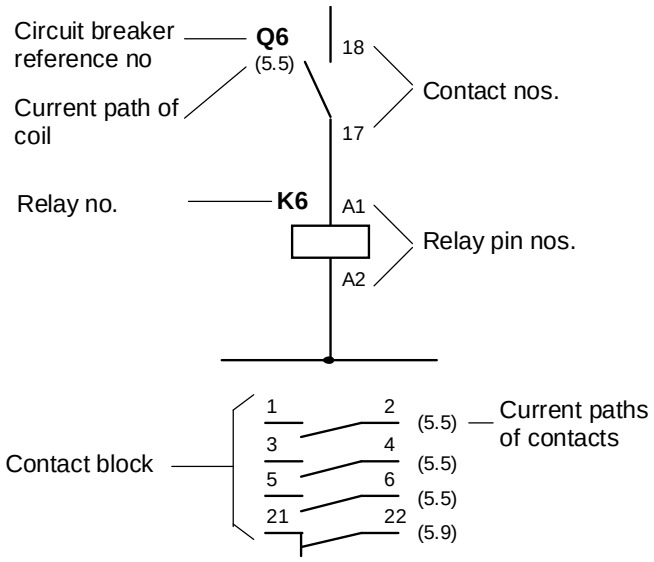


Figure 31
Current Path Example

9.1.1 Wiring Diagram Navigation

The following sample wiring diagram (43.8.099.0271 Sheet 23) offers detailed explanations of the various sections and the path designations used in Piller drawings.

TRONAIR

APPENDIX I

Declaration of Conformity

PILLER

EG-Konformitätserklärung
im Sinne der EG-Richtlinie

91.9.110.0057
01.02.2005

ELECTROMAGNETIC INTERFERENCE 89/336/EWG INCLUDING 91/362/EWG; 92/31/EWG; 93/69/EWG
LOW VOLTAGE 73/23/EWG

APPLICABLE PRODUCT:

28V DC GPU
GROUND POWER UNIT

THE DESIGN; DEVELOPMENT AND MANUFACTURE IS IN ACCORDANCE WITH THE ABOVE-MENTIONED EUROPEAN COMMUNITY GUIDELINES AND IS THE SOLE RESPONSIBILITY OF:

Piller Power Systems GmbH, PO BOX 1851, 37508 Osterode

THE FOLLOWING INTERNATIONAL/HARMONISED STANDARDS APPLY:

MIL-STD-704E
UL 1012
EN 55011
EN 60146 part 1-1
EN 61000-6-2

THE FOLLOWING NATIONAL STANDARDS; GUIDELINES AND SPECIFICATIONS APPLY:
DIN VDE 0100
DIN VDE 106, part 1 IEC 536
DIN VDE 0110 01/89
DIN VDE 0470 part 1
DIN VDE 0558 part 11
DIN IEC 721-2-1
DIN ISO 3746
BS 2G219: 1983

Osterode, 01.02.2005

Place, Date

HEAD OF
PC CONVERTER

HEAD OF
R&D PC CONVERTER