Industrial UPS 5-100kVA
3 Ph Input / 1Ph Output
Operating Manual

Operating Manual
JUD403105
INDEX

SECTION 1: JUD403105  INDEX AND SAFETY INSTRUCTIONS
SECTION 2: JUD403106  GENERAL SYSTEM DESCRIPTION
SECTION 3: JUD403107  INSTALLATION AND INITIAL START-UP
SECTION 4: JUD403108  OPERATING MODES
SECTION 5: JUD403109  OPERATING PANEL
SECTION 6: JUD403110  PCB DESCRIPTION
SECTION 7: JUD403111  TECHNICAL DATA
Safety Instructions

1.1 SAFETY INSTRUCTIONS

⚠️ The unit must be used as intended. Follow the instructions given in the operating manual.

⚠️ Dangerous voltages are present inside the unit.

⚠️ Installation and use of this equipment must comply to all national and local regulations and procedures.

⚠️ To prevent overheating do not obstruct the flow of air for ventilation openings to the unit.

⚠️ The components inside the unit are not repairable by the user. The user must not open the UPS cabinet or remove any protective covers from inside the UPS cabinet.

⚠️ This equipment must be installed and serviced by qualified personnel.

⚠️ To completely isolate the equipment, the input, output and battery (if preset) switches must be switched off the input supply and the battery supply (if present) must be isolated from the UPS and the output isolated from other modules if the unit is part of a multi-module system.

⚠️ Connect protective earth before power supply cables.

⚠️ All primary power switches installed downstream of the UPS must be labelled as follows: “Isolate UPS (Uninterruptible Power Supply) before working on this circuit”.

⚠️ Earth leakage protection: this device may have a high leakage current towards protective earthing. When setting the threshold of the earth leakage circuit breaker installed upstream from this equipment consider this amount of current and that due to the loads.


⚠️ This is a product for restricted sales distribution to informed partners. Installation restrictions or additional measures may be needed to prevent disturbances.
# General System Description

## Chapters

<table>
<thead>
<tr>
<th>1</th>
<th>UPS ASSEMBLY</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Features</td>
<td>2</td>
</tr>
<tr>
<td>1.2</td>
<td>UPS System Structure</td>
<td>2</td>
</tr>
<tr>
<td>1.3</td>
<td>Rectifier/Battery Charger</td>
<td>3</td>
</tr>
<tr>
<td>1.4</td>
<td>Battery (Accumulator)</td>
<td>3</td>
</tr>
<tr>
<td>1.5</td>
<td>Inverter</td>
<td>3</td>
</tr>
<tr>
<td>1.6</td>
<td>Static Switch Unit</td>
<td>4</td>
</tr>
<tr>
<td>1.7</td>
<td>Maintenance Bypass</td>
<td>5</td>
</tr>
<tr>
<td>1.8</td>
<td>Hot-Standby Systems</td>
<td>5</td>
</tr>
<tr>
<td>1.9</td>
<td>Parallel-Redundant Systems</td>
<td>6</td>
</tr>
<tr>
<td>1.10</td>
<td>Parallel Systems</td>
<td>6</td>
</tr>
</tbody>
</table>

## Pictures

| PIC. 1.1 | UPS Block-Diagram | 2 |
| PIC. 1.2 | Rectifier Block-Diagram | 3 |
| PIC. 1.3 | Inverter Block-Diagram | 3 |
| PIC. 1.4 | Static Switch Block-Diagram | 4 |
| PIC. 1.5 | Maintenance Bypass Block-Diagram | 5 |
1.1 Features

**UPS Function**

The uninterruptible power supply (UPS) is connected between the consumer’s critical equipment (the load) and supply mains. Its function is to guarantee a continuous and conditioned power supply to the load. Even in the case of a total blackout it will supply the load for a predetermined time (autonomy time). In addition, the UPS provides the following advantages in comparison with conventional supply systems (mains, motor generator sets, etc.):

- **Better Output Power Characteristics**
  The UPS output voltage control of frequency and amplitude guarantees consistent and stabilized output power. Mains voltage fluctuations and frequency changes that are usually present in electricity supply systems do not affect the UPS output voltage.

- **Uncoupling from Mains Distortion**
  By using double energy conversion from ac to dc and back to ac and using an isolation transformer in the inverter output, all mains distortions are filtered out. Therefore, all loads connected to the UPS system are protected against mains distortions that are usually present in industrial electricity supply systems. This is especially important for sensitive electronic devices, e.g. computer systems, control systems, medical equipment.

- **Complete Protection against Mains Failures**
  During long term or short term ac mains supply interruption, the UPS system guarantees continuous load supply by means of a battery. The battery is connected to the rectifier and the inverter of the UPS system. In normal operation the inverter (which feeds the load) is fed by the rectifier. In case of a mains failure, the connected battery automatically feeds the inverter. Thus the load is supplied without interruption. However, the load can only be supplied by the battery for a certain time (autonomy time). If longer autonomy times are required, we recommend the use of a Diesel Generator Set. In this case the battery autonomy time only has to be sufficient for the time span between mains failure and full operating capacity of the Diesel-Generator-Set.

1.2 UPS System Structure

The basic **E-2001** power supply unit is an ac/dc/ac converter; the block diagram Figure 1.1 illustrates six essential functional components:

- Rectifier/battery charger (6 pulse) (RECT.)
- Battery (BATT.)
- Inverter (INV.)
- Static inverter switch (SSI)
- Static bypass switch (SSB)
- Maintenance bypass (QIBY)

All components are located in a single housing. They are explained in detail on the following pages. The control electronics of the rectifier, inverter and static bypass section are completely independent of each other, i.e. a failure in any one section will not cause a failure in another section.
1.3 Rectifier/Battery Charger

In the standard configuration the charger is a three phase/6 pulse rectifier that converts ac voltage to dc voltage. An isolation transformer and a commutation choke is used at the input of the rectifier bridge. The dc output of the rectifier feeds the inverter and the battery. The battery is connected to the rectifier through a saturation choke which reduces ac ripple current to the battery, thus ensuring the maximum battery life-time.

The rectifier is designed to feed both the inverter at maximum load conditions and simultaneously the battery with maximum charging current. The rectifier’s recharge characteristic is of the I/U type. This means that the recharging current limitation is accomplished by reduction of the dc voltage according to a specified curve, thus assuring that the batteries will not be damaged by excessive charging current values. A 12-pulse rectifier is optional and requires the addition of a second rectifier bridge inside the UPS cabinet and a phase-shifting transformer in a separate cabinet.

1.4 Battery (Accumulator)

The battery supplies power in case of a short interruption or a total breakdown of the ac mains source. In case of a rectifier failure (no dc voltage output), the load will be fed by the battery.

⚠️ The battery is only capable of feeding the load for a certain time (autonomy time), depending on battery capacity and actual load.

The number of cells within the battery depends on the battery type and may also vary due to specific customer requirements.

1.5 Inverter

The inverter converts dc voltage supplied by the rectifier or battery to ac voltage of precisely stabilized amplitude and frequency that is suitable for power supply to most sophisticated electrical equipment.

The inverter output voltage is generated by sinusoidal pulse width modulation (PWM). The use of a high carrier frequency for the PWM and a dedicated ac filter circuit consisting of the transformer and capacitors, assure a very low distortion of the output voltage (THD<1% on linear loads).

The inverter control logic restricts the maximum output current to 150% of the nominal current in case of a short circuit. In case of overload (up to 125% of the nominal current), the output voltage is kept constant. For higher currents the output voltage is reduced. However, this will only occur if the static bypass is not available; otherwise the UPS will switch to bypass operation for currents higher than 125% of the nominal current.

The inverter IGBT transistors are fully protected from severe short circuits by means of a desaturation monitor or "electronic fuse".
1.6 Static Switch Unit

The block diagram illustrates the two static switch sections that use thyristors as switching elements. During normal UPS operation, SSI is closed and SSB is open, thus connecting the load to the inverter output.

During overload or inverter failure conditions, SSI is switched off and SSB is switched on, providing power supply from a backup source (mains, output of another UPS system, diesel generator set...). By always actuating both switches together for a short period, an uninterrupted power supply during the switching is ensured. This is an essential condition to reliably meet all power supply requirements for connected sensitive equipment.

The control for each static switch (SSB and SSI) is performed totally independently of each other, thus ensuring that a failure in one static switch does not affect the other.

Switching Conditions, Inverter - Bypass

The voltage and frequency of the bypass line have to be within set tolerance limits, and the inverters have to be synchronized with the bypass line.

Under inverter failure conditions:
- the UPS switches to bypass operation, for a single unit. (SSB switches ON, and SSI OFF)
- for hot-standby units, the load is commutated to the second inverter, and will switch to bypass only when no inverter is ready to take the load.

If the conditions above for the bypass line and synchronisation are not met:
- the inverter will continue to operate with reduced output voltage under overload conditions or
- the inverter will stop if an inverter failure occurs.

In this second case, the system will:
- commutate to a second standby inverter in the case of a hot-standby system or
- the UPS will commutate to the bypass supply with a very short interruption of 10msec if the supplies are not synchronised, for the case of a single UPS unit.

Under overload conditions, all UPS modules present will switch to the bypass supply, and remain in bypass until the overload is removed.
Switching Conditions, Bypass - Inverter

a) The UPS switches automatically back to inverter operation when inverter voltage and frequency are within tolerance limits, the overload has been removed and the inverter is synchronized with the bypass line (SSI switches ON and SSB OFF).

b) If the UPS unsuccessfully attempts five times within 3 minutes to switch to inverter operation, the UPS remains in bypass operation and signals an alarm.

After pressing the reset-button once to reset the audible alarm, it should be pressed a second time to automatically switch back to inverter operation.

c) If the UPS remains blocked on bypass operation and a mains failure occurs, the UPS will switch automatically to inverter operation if the inverter voltage and frequency are within tolerance and the inverter is synchronised to the mains.

1.7 Maintenance Bypass

The maintenance bypass function is to supply power directly to the connected load during UPS maintenance. The bypass consists essentially of one switch QIBY.

With **E-2001** series UPS systems, switching from different operating modes to maintenance bypass can be performed without interruption. With the maintenance bypass on, the UPS may be completely switched off, thus permitting maintenance work to be carried out safely (there will only voltage at the input and output terminals and their connections to the circuit breaker). In order to prevent erroneous switching of the maintenance bypass switch QIBY that could possibly cause parallel connection of the bypass line and the inverter line, QIBY is electronically interconnected with the static inverter switch SSI. Thus, during actuation of QIBY, switch SSB will be closed and switch SSI opened automatically, preventing parallel operation of the maintenance bypass network and inverter.

1.8 Hot-Standby Systems

A hot-standby UPS system basically consists of two (or more) single UPS units which operate independently of each other. Any one unit can be feeding the load at any time.

- All units are continuously in operation; but only one is supplying the load, at any one time.
- In case of a failure in the unit currently supplying the load, another unit is ready to takeover the load without an interruption on the output side. i.e. the load is still supplied with conditioned and stabilised power.
- The load is supplied by the static bypass, only if there is no inverter ready in the system to takeover the load.
1.9 Parallel-Redundant Systems

A parallel UPS system consists of 2 to 8 single UPS units connected in parallel, sharing the load current equally. Each unit has an individual static bypass, thus also ensuring the redundancy of the static bypasses in a redundant system, i.e. if one static bypass should fail, the bypass system will still be available.

There is no common electronic device for the parallel system. Each unit has its own parallel-operation electronics that controls all of its functions, thus ensuring perfect redundancy.

1.10 Parallel Systems

This is identical to the configuration in section 1.9 except that the rated load is normally equal to the rating of the UPS and there is therefore no redundant unit. UPS units of different kVA ratings may be connected in parallel in this configuration, proportionally sharing the load.

Note that the parallel configuration is identical to the parallel-redundant configuration if the load is reduced to a value such that the system minus one (or more) units is capable of supplying the reduced load. Therefore one (or more) units become redundant and the control is identical.
Installation and Initial Start-Up

Chapters

1 INSTALLATION 2

1.1 Mechanical Installation 2
1.1.1 Handling the UPS System 2
1.1.2 Room size for UPS 4
1.1.3 Mechanical Drawing of UPS 800mm width 5
1.1.4 Mechanical Drawing of UPS 1400mm width 6
1.1.5 Mechanical Drawing of UPS 1800mm width 7
1.1.6 Tables of UPS sizing 8
1.1.7 Terminals Drawings 9
1.1.7 Tables of the Terminal Type 9
1.2 Electrical Installation 11
1.3 Interconnection of control BUS cables between parallel units 11
1.4 Internal View 14
1.5 Components List 15

2 INITIAL START-UP 16

2.1 Start Up Procedure 16

3 ADDITIONAL START-UP PROCED. FOR MULTI-UNIT SYSTEMS 19

3.1 Start-Up Procedure for Hot -standby Systems 19
3.2 Start-Up Procedure for Parallel Systems 21

4 ORA - RELAY INTERFACE CARD 23

4.1 ORA pcb for the rectifier (12Vdc) 23
4.1.2 Position of dip-switches for common alarm 23
4.1.3 PCB configuration 23
4.2 ORA pcb for the inverter (24Vdc) 25
4.2.1 Position of dip-switches for common alarm 25
4.2.2 PCB configuration 25
4.3 ORA pcb for the static switch (12Vdc) 26
4.3.1 Position of dip-switches for common alarm 26
1 Installation

1 INSTALLATION

1.1 Mechanical Installation

**Equipment Delivery and Storage**

After delivery, check equipment for any damage that may have occurred during shipment. The shipper and you agency must be notified in writing about damages due to shipment, including a detailed description of visual defects. If you do not wish to install the equipment immediately, please observe the following storage recommendations:

- Store equipment in a vertical position in a well-conditioned room, protected against humidity. Do not store the equipment in close proximity to frequently used passageways and keep it away from movable parts.
- If the UPS system is already unpacked, please ensure storage in a clean environment protected from dust, away from heat sources.

**1.1.1 Handling the UPS System**

The UPS can be lifted and moved by means of a lifting truck or a fork lifter. Remove front side and rear side base sheets. The UPS can now be moved with a lifting fork.

*Caution: Secure equipment against being knocked over*

![Image of UPS system being moved by fork lifter](PIC_1.1-Moving_the_UPS_by_means_fork_lifter)
1 Installation

Handling the UPS System by means of rollers

The UPS can be lifted and moved by means of rollers. Lift the units so as to insert the rollers under the base. Lay the unit on the rollers and then move it.

Setting Up

The UPS system should be installed in a dry, clean and lockable room. Provisions have to be made to remove heat created by the system. Under all installation conditions, the unrestricted flow of cooling air must be assured.
1.1.2 Room size for UPS

When locating the UPS system make sure that ventilation and space requirements are met. There should be a 600mm clearance on the rear side of the UPS and 1000mm on the top of the UPS.

![Diagram of UPS Room Size](FIG. 1.4 - UPS Room Size)
1.1.3 Mechanical Drawing of UPS width 800mm
See the section 1.1.6 “Tables of UPS dimensions” to know the dimension of every UPS.
1.1.4 Mechanical Drawing of UPS width 1400mm
See the section 1.1.6 “Tables of UPS dimensions” to know the dimension of every UPS.

1= Base plant used for UPSs described on section 1.1.6
2= Base plant used only for 20kVA UPSs
1.1.5 Mechanical Drawing of UPS width 1800mm
See the section 1.1.6 "Tables of UPS dimensions" to know the dimension of every UPS.
## 1.1.6 Tables of UPS dimensions

### UPS 110Vdc/115Vac

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1 Installation

1.1.7 Terminals Drawings
See the section 1.1.8 “Tables of the Terminal Type” to know the Terminal Type used for every UPS.
1 Installation
# 1 Installation

## 1.1.7 Tables of the Terminal Type

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1.2 Electrical Installation

This equipment must be installed by qualified service personnel.

Switch off QIRP, QIRE, QIB, QIUG, QIBY circuit breakers to completely isolate the equipment.

Earth leakage protection: this device has a high leakage current towards protective earthing. The maximum earth leakage current is 300mA when setting the threshold of the earth leakage circuit breaker installed upstream from this equipment, consider this amount of current and that due to the loads.

High leakage current: it is essential to connect the protective earth before connecting the power supply.

All primary power switches installed remotely from the UPS area must be fitted with the following label: "Isolate uninterruptible power supply (UPS) before working on this circuit".

**General**

All electrical connections must be made in accordance with local standards and all input terminals must be protected by external fuse or circuit breakers.

Ensure clockwise connection of conductors L1, L2 and L3 at input terminals.

If possible, install battery cables separately from other power cables in order to avoid possible RF interference. Before wiring, open all system switches plus the battery switch.

---

![Diagram of electrical connections](image-url)
1 Installation

1.3 Interconnection of control BUS cables between parallel units

PIC. 1.5 - UPS connection diagram
1.5 Components List

1. SFP Panel
2. Inverter Bridge
3. DC Filter Capacitors (C1-N)
4. Rectifier Bridge A1 (HS1, PB1-3, F1-3, RE-FY12, VL1)
5. Circuit breaker QIRP, QIUG, QIBY, QIRE, QIB
6. Static Switch A4 (HS6, PTM, F11, VL6)
7. ORA cards
8. Input Isolation Transformer (TR)
9. Output Inverter Transformer
10. AC Filter Capacitors (CF1-n)
11. Battery inductance or blocking diode
12. Terminal board
13. Earth Bar
14. Control logic
2  INITIAL START-UP

2.1 Start Up Procedure

General

With the Start Up procedure the correct installation of the UPS according to previous chapter is checked. It must be carried out by specialized personnel.

Safety precautions according to the appropriate local safety standards must be applies. Should problems arise during the startup procedure call for service assistance.

Preparation

For carrying out the Start Up Procedure, 3½ digit voltmeter with 1% accuracy, an AC/DC clip-on ammeter, and a small screwdriver for potentiometers are needed.

The installation of the UPS must have been carried out according to the previous section.

- Check that the ventilation system of the UPS room is ready to operate.
- Check that all switches QIRP - QIRE - QIUG - QIBY - QIB are open and the load is off.

A: Rectifier Power Supply Check :

- Switch on the external mains supply to the UPS.
- Check that the supply voltage at terminals X1.1, X1.2, X1.3 is within ±10% of the UPS rated voltage.
- Close QIRP.

? Does the display on the CPHC16 - R Pcb for the rectifier give the indication “P” ?

yes : The phase rotation at the input is incorrect.

- Open QIRP, switch off the external mains supply and exchange any two of the cables at input terminals X1.1, X1.2, X1.3.
- Return to A.

no : The rectifier input voltage is OK and the rectifier will automatically start to operate.

- Wait until the Front Panel is illuminated.
- Push the button PB2 on the top of ICP Pcb the inverter will start and after approximately 10 sec the green led “INV. OK” will be lit permanently.
- Press the push button PB3 on the bottom of ICP Pcb after a few seconds the green led on the top of SS-1F Pcb will be permanently lit.
- On the SS-1F, measure the voltage at the inverter screw with respect to the neutral terminal.

? Does this voltage correspond to the desired voltage ?

no : Adjust the voltage to the desired value using P3 on the ICM Pcb.

NOTE : if the inverter output voltage is changed, the value at TP1 (adjusted with P1) on the ICP Pcb should be checked (6V correspond to nominal voltage).

yes : continue with B.

JUD403107
B: Inverter free-run frequency Check:

Insert a pin d = 2mm in the red test point SI in the ICP Pcb. The red led LD3 on the ICP Pcb must be lit permanently. The inverter frequency is now free-running without the internal oscillator.

- On SS-1F Pcb measure the inverter frequency on the inverter screw with respect to neutral.
- Check that the frequency is set at the required value (50/60 Hz ± 0,1 Hz). It can be adjusted with P1 on the ICM Pcb. Remove the pin from S1. The inverter now synchronises with the internal oscillator.

C: Battery Installation Check:

Make sure that the batteries have been installed according to the instructions for installation.

- Measure the battery voltage at the battery switch between XB+.1 and XB-.1 terminals.

? Does this voltage have positive polarity?

no:
- Open QIRP, wait for 5-10 minutes, and then reconnect the battery cables at the terminals which load to the switch where the wrong polarity was detected.
- Return to C.

yes:
- Check the voltage between the battery terminals. The value of this voltage should already be set according to the battery installed
  - Close the battery switch QIB.
  - The alarm “battery switch open”.

D: Bypass Power Supply Check:

Switch on the external supply for the bypass check that the bypass supply at terminals X4L.1, X4N.1 is within ±10% of the nominal input voltage.

- Close QIUG.
- Close QIRE.

? Are the status LEDS (green) for the bypass line on the operating panel continuously ON?

no:
- Check that the mains frequency is in tolerance.
  OK?

yes:
- Is the Pcb CPHC16-S for the bypass correctly functioning?
  The display should be rotating clockwise.

no:
- Call for service assistance.

yes:
- Check the input supply again check that it is in accordance with the UPS rating label.

no:
- The mains frequency must be within tolerance in order, for the bypass to be available

yes:
- Continue with E
2 Initial Start-Up

E: Synchronisation Check:

- Check that the green led LD1 on the ICM Pcb is lit permanently and there is no “S” indication on the bypass electronics.
- On the SS-1F Pcb’s, measure the voltage between the screw inverter (on the inverter SS-1F Pcb) and bypass (on the bypass SS-1F Pcb).

? Are the voltage <25Vac?

no:
- If the voltage is continuously fluctuating there is a synchronisation problem. Switch off QIRE and call for service assistance. If the voltage is slightly higher but relatively constant and the default values have been re-entered using the serial interface on the CPHC16-S Pcb, then the synchronisation may need to be readjusted. This can be easily confirmed by comparing the two sinewaves for a possible phase difference.

? Are the two waveforms phase-shifted?

yes:
- The synchronisation must be readjusted using the serial interface on the CPHC16-S Pcb and a portable computer.

no:
- The difference is probably due to distortion of the mains voltage (the inverter voltage is an almost perfect sinewaves). Continue with G.

yes:
- Continue with G.

F: Static Switch Commutation Check:

- Commutation to the bypass.
  Press the push button ON the CPHC16-S Pcb for the bypass. The SSB static switch will switch ON and SSI will switch OFF, as indicated ON the front panel and ON the SS-1F Pcb (for the bypass the green led will be lit permanently).
- Commutation to inverter.
  Press the push button PB3 at the bottom of the ICP Pcb. The static switch SSI will switch ON and SSB will switch OFF, as indicated ON the front panel and the inverter SS-1F Pcb (the green led will be permanently lit).
- Commutations to/from the bypass and inverter may also be performed using the “Test Menü” of the Smart Front Panel.

G: Date & Time Setting:

- Clear alarm memory.
  Enter the alarm memory, a stack of the last 100 alarms, by pressing F2 followed by F4 from the “4) Alarms” Menü. The entire alarms memory can be deleted by pressing F3 followed by the F1 key.
- Date and clock adjustment.
  Enter the ‘7) Test’ Menü (Password 8031) and select ‘7) Clock’ Menü then select each of the items (DD-MM-YYYY, hh:mm:ss) using cursors “<” & “>”. The values can be adjusted using the “up” or “down” keys. To store the adjustment, press the “ENTER” key.

END
- The start-up procedure for a stand-alone unit has been successfully completed now.
3 ADDITIONAL START-UP PROCED. FOR MULTI-UNIT SYSTEMS

3.1 Start-Up Procedure for Hot-standby Systems

Repeat the procedure of section 2 for the second unit in the system (with the first unit off).

Ensure that the interconnecting BUS cable is connected according to section 1.3.

- Switch off the inverter at the second unit with PB2 at the top of the ICP pcb. The unit will transfer to the bypass supply.
- Switch on QIRP of the first unit.
- Ensure that the QIUG switch of this unit is off.
- Switch on QIRE of the first unit.

After approx. 10 seconds the display will flash with a "U" indication and the SSB static bypass switch will be closed.

- Measure across the QIUG output switch from input to output of each phase.

? **Is this voltage less than 2V a.c?**

no The output power interconnections are incorrect and must be reconnected correctly. Switch off both units and the mains supply and recheck the connections. Return to J

yes Continue

- Close the QIUG of the first unit. The two static bypasses (SSB) are now connected in parallel.
- Close the battery switch of the first unit.
- Start the unit by pressing "START" on the front operating panel. When the inverter is synchronised, the unit will transfer the inverter to the output (SSI closes and both SSB switches switch off).
- Press "START" on the operating panel of the second unit. The inverter will start and become ready (check that the green LED LD6 on the ICP pcb is illuminated) but the SSI static switch will not close.
- Check the commutation of the inverters by pressing PB2 at the top of the ICP pcb on the unit currently with the SSI closed.
- Restart the inverters (with PB2 on ICP or with "START").
3 Additional Start-Up proced. for multi-unit systems

Enter the alarm memory, a stack of the last 100 alarms, by pressing F2 followed by F4 from the "4) Alarms" Menu. The entire alarms memory must be deleted by pressing F3 followed by the F1 key. Repeat for all the units.

**Date and clock adjustment**

Enter the "9) Test" Menu (PW 8031) and select "7) clock", then each item (DD-MM-YYYY, hh:mm:ss) can be selected with the cursor keys "<" and ">". The values can be adjusted using the "up" or "down" keys. To store the adjustment, press the "ENTER" key, otherwise the date and time remain unchanged.

Repeat for all the units.

**Note:** If an external output switch is added for each unit, it must include two auxiliary contacts connected as the QIUG auxiliary contacts are connected inside each unit. Open every external output switch after opening the relative internal QIUG and close it before closing QIUG.
3 Additional Start-Up proced. for multi-unit systems

3.2 Start-Up Procedure for Parallel Systems

Repeat the procedure of section 2 individually for all units in the system, with the other units off.

Note: If the BUS cables were connected before the start-up of each unit individually, it is possible that erroneous alarms are displayed or the EPO command is activated. This condition is not possible if the interconnecting cables are disconnected.

Connect the BUS cables according to section 1.3.

- Open QIRP, QIRE, QIB and QIUG of the last unit checked with the procedure in section 2.

Ensure that no load is connected to the system output.

Ensure that all QIUG switches are open.

Switch on the QIRE switches of all units. Wait until all units give a flashing "U" indication on the display of the CPHC16-S pcb.

Close QIRP of all the units and press RESET on all the units.

When the front operating panel is initialised on all units (after 3 beeps), close the battery switches of the respective units.

Close the QIUG of unit 1. At each unit in turn:
- Measure across the QIUG output switch of the next unit from input to output of each phase.

Is this voltage less than 2V.a.c?

- no
  The output power interconnections are incorrect and must be reconnected correctly. Switch off all units and the mains supply and recheck the connections.
  Return to K

- yes
  - Close the QIUG of this unit and proceed with the following unit until all QIUG are closed.
  - The static bypasses (SSB) will now be connected in parallel for all units.
  - Press the "START" push-button on any one unit. The inverter will start and when synchronised to the bypass supply, transfer to the system output and all static bypass switches (SSB) will open.
  - Press the "START" push-button on each successive unit in the system, each time checking that the SSI closes on the unit and that the system operates in parallel operation.
  - Commutations to the bypass/inverter supplies may be checked by pressing the pushbutton on the CPH16 -S pcb and PB3 at the bottom of the ICP pcb.
  - Apply a load to the UPS system and check for correct sharing of the load currents on each phase. If stand-alone units have been converted for parallel operation, the current sharing needs to be checked and is best performed with a load as close as possible to the nominal load. Measure the currents at the output of each module. If this current varies by more than ± 1% for this module, fine adjustment can be made with P1 on the IPR-1F pcb.
3 Additional Start-Up proced. for multi-unit systems

Clear alarm memory
Enter the alarm memory, a stack of the last 100 alarms, by pressing F2 followed by F4 from the "4) Alarms" Menu. The entire alarms memory must be deleted by pressing F3 followed by F1 key.
Repeat for all the units.

Date and clock adjustment
Enter the "9) Test" Menu (PW 8031) and select "7) clock", then each item (DD-MM-YYYY, hh:mm:ss) can be selected with the cursor keys "<" and ">". The values can be adjusted using the "up" or "down" keys. To store the adjustment, press the "ENTER" key, otherwise the date and time remain unchanged.
Repeat for all the units.

THE SYSTEM START-UP HAS NOW BEEN SUCCESSFULLY COMPLETED.

Note: If an external output switch is added for each unit, it must include two auxiliary contacts connected as the QIUG auxiliary contacts are connected inside each unit. Open every external output switch after opening the relative internal QIUG and close it before closing QIUG
4 ORA - Relay Interface Card

The ORA pcb is used for remote signalling of standard alarm conditions by means of voltage-free contacts.

4.1 ORA pcb for the rectifier (12Vdc)

<table>
<thead>
<tr>
<th>Relay</th>
<th>Alarm description</th>
<th>Terminals board M1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>RL1</td>
<td>Fuses failure</td>
<td>20</td>
</tr>
<tr>
<td>RL2</td>
<td>Mains OK</td>
<td>23</td>
</tr>
<tr>
<td>RL3</td>
<td>Overload</td>
<td>14</td>
</tr>
<tr>
<td>RL4</td>
<td>Rectifier failure</td>
<td>17</td>
</tr>
<tr>
<td>RL5</td>
<td>Not used</td>
<td>8</td>
</tr>
<tr>
<td>RL6</td>
<td>Not used</td>
<td>11</td>
</tr>
<tr>
<td>RL7</td>
<td>Not used</td>
<td>2</td>
</tr>
<tr>
<td>RL8</td>
<td>Boost charge</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: The position of the contacts is relative to the normal functioning of the UPS, the position of the contacts changes in case of an alarm.

4.1.2 Position of dip-switches for common alarm

<table>
<thead>
<tr>
<th>J1</th>
<th>J2</th>
<th>J3</th>
<th>J4</th>
<th>J5</th>
<th>J6</th>
<th>J7</th>
<th>J8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: The numeration of dip-switches is according to the numeration of the relay (e.g. J1 is the dip-switch connected to the contacts of the relay RL1).

4.1.3 PCB configuration

<table>
<thead>
<tr>
<th>PCB configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

X = CLOSED
4.1.4 ORA for the Rectifier - Jumper Setting

<table>
<thead>
<tr>
<th>Jumper Settings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>JP1</td>
<td>Closed</td>
</tr>
<tr>
<td>JP2</td>
<td>Closed</td>
</tr>
<tr>
<td>JP3</td>
<td>Closed</td>
</tr>
<tr>
<td>JP4</td>
<td>Closed</td>
</tr>
<tr>
<td>JP5</td>
<td>Closed</td>
</tr>
<tr>
<td>JP6</td>
<td>Closed</td>
</tr>
<tr>
<td>JP7</td>
<td>Closed</td>
</tr>
<tr>
<td>JP8</td>
<td>Closed</td>
</tr>
</tbody>
</table>
4.2 ORA pcb for the inverter (24Vdc)

<table>
<thead>
<tr>
<th>Relay</th>
<th>Alarm description</th>
<th>Terminals board M1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>RL1</td>
<td>Inverter OK</td>
<td>20</td>
</tr>
<tr>
<td>RL2</td>
<td>Inverter feeding</td>
<td>23</td>
</tr>
<tr>
<td>RL3</td>
<td>Overtemperature</td>
<td>14</td>
</tr>
<tr>
<td>RL4</td>
<td>Retransfer blocked (not to be used)</td>
<td>17</td>
</tr>
<tr>
<td>RL5</td>
<td>Overload</td>
<td>8</td>
</tr>
<tr>
<td>RL6</td>
<td>Not used</td>
<td>11</td>
</tr>
<tr>
<td>RL7</td>
<td>Synchronism OK (internal oscillator)</td>
<td>2</td>
</tr>
<tr>
<td>RL8</td>
<td>Battery discharging</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: The position of the contacts is relative to the normal functioning of the UPS, the position of the contacts changes in case of an alarm.

4.2.1 Position of dip-switches for common alarm

Position of dip-switches for common alarm

<table>
<thead>
<tr>
<th>J1</th>
<th>J2</th>
<th>J3</th>
<th>J4</th>
<th>J5</th>
<th>J6</th>
<th>J7</th>
<th>J8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: The numeration of dip-switches is according to the numeration of the relay (e.g. J1 is the dip-switch connected to the contacts of the relay RL1).

4.2.2 PCB configuration

<table>
<thead>
<tr>
<th>PCB configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
</tr>
<tr>
<td>1 2 3 4</td>
</tr>
<tr>
<td>5 6 7 8</td>
</tr>
<tr>
<td>X X X</td>
</tr>
</tbody>
</table>

X = CLOSED
4 ORA - Relay Interface Card

4.3 ORA pcb for the static switch (12Vdc)

<table>
<thead>
<tr>
<th>Relay</th>
<th>Alarm description</th>
<th>Terminals board M1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>RL1</td>
<td>Not used</td>
<td>20</td>
</tr>
<tr>
<td>RL2</td>
<td>Bypass available</td>
<td>23</td>
</tr>
<tr>
<td>RL3</td>
<td>Bypass line OK</td>
<td>14</td>
</tr>
<tr>
<td>RL4</td>
<td>Not used</td>
<td>17</td>
</tr>
<tr>
<td>RL5</td>
<td>Load on bypass supply</td>
<td>8</td>
</tr>
<tr>
<td>RL6</td>
<td>Synchronism OK (inverter-mains)</td>
<td>11</td>
</tr>
<tr>
<td>RL7</td>
<td>Not Used</td>
<td>2</td>
</tr>
<tr>
<td>RL8</td>
<td>Retransfer blocked</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: The position of the contacts is relative to the normal functioning of the UPS, the position of the contacts changes in case of an alarm.

4.3.1 Position of dip-switches for common alarm

<table>
<thead>
<tr>
<th>J1</th>
<th>J2</th>
<th>J3</th>
<th>J4</th>
<th>J5</th>
<th>J6</th>
<th>J7</th>
<th>J8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: The numeration of dip-switches is according to the numeration of the relay (e.g. J1 is the dip-switch connected to the contacts of the relay RL1).

4.3.2 PCB configuration

<table>
<thead>
<tr>
<th>PCB configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
</tr>
<tr>
<td>1 2 3 4 5 6 7 8</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

X = CLOSED
4.3.4 ORA pcb for the static switch (12Vdc)

<table>
<thead>
<tr>
<th>Jumper Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP1</td>
</tr>
<tr>
<td>JP2</td>
</tr>
<tr>
<td>JP3</td>
</tr>
<tr>
<td>JP4</td>
</tr>
<tr>
<td>JP5</td>
</tr>
<tr>
<td>JP6</td>
</tr>
<tr>
<td>JP7</td>
</tr>
<tr>
<td>JP8</td>
</tr>
</tbody>
</table>

**Diagram:**

- **IBYBP-1F**
- **RBPHC16**
- **CPU/SFP** (SFP Control Board)
- **ORA** (Inverter)
- **ORA** (Bypass)
- **ORA** (Rectifier)

**Connectors:**

- CN1
- CN3
- CN6
- CN7
- CN12
- M1
- M2
# Operating Modes

## Chapters

<table>
<thead>
<tr>
<th>1</th>
<th>OPERATING MODES</th>
<th>2</th>
<th>OPERATING INSTRUCTIONS</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>General</td>
<td>2</td>
<td>4.1</td>
<td>Switching On the UPS System</td>
</tr>
<tr>
<td>1.2</td>
<td>Normal Operation</td>
<td>3</td>
<td>4.2</td>
<td>Switching Off The UPS System</td>
</tr>
<tr>
<td>1.3</td>
<td>Battery Operation</td>
<td>3</td>
<td>4.3</td>
<td>Switching on Anyone Module within a System (Parallel and Hot-standby Systems)</td>
</tr>
<tr>
<td>1.4</td>
<td>Bypass Operation</td>
<td>3</td>
<td>4.4</td>
<td>Switching off Anyone Module within a System (Parallel and Hot-standby Systems)</td>
</tr>
<tr>
<td>1.5</td>
<td>Maintenance Bypass Operation</td>
<td>3</td>
<td>4.5</td>
<td>System Check</td>
</tr>
<tr>
<td>1.6</td>
<td>Battery Save</td>
<td>4</td>
<td>4.7</td>
<td>Reset Emergency Power off</td>
</tr>
<tr>
<td>1.7</td>
<td>Efficiency Optimiser</td>
<td>4</td>
<td>4.6</td>
<td>Emergency Power off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>OPERATING MODES HOT-STANDBY OPERATION</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Normal Operation</td>
<td>5</td>
</tr>
<tr>
<td>2.2</td>
<td>Operation with an Inverter Failure</td>
<td>5</td>
</tr>
<tr>
<td>2.3</td>
<td>Battery Operation</td>
<td>5</td>
</tr>
<tr>
<td>2.4</td>
<td>Bypass Operation</td>
<td>6</td>
</tr>
<tr>
<td>2.5</td>
<td>Maintenance Bypass Operation</td>
<td>6</td>
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<table>
<thead>
<tr>
<th>3</th>
<th>OPERATING MODES PARALLEL AND PARALLEL/REDUNDANT OPERATION</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Normal Operation</td>
<td>7</td>
</tr>
<tr>
<td>3.2</td>
<td>Partial Load Operation</td>
<td>7</td>
</tr>
<tr>
<td>3.3</td>
<td>Battery Operation</td>
<td>8</td>
</tr>
<tr>
<td>3.4</td>
<td>Operation with an Inverter Failure</td>
<td>8</td>
</tr>
<tr>
<td>3.5</td>
<td>Bypass Operation</td>
<td>9</td>
</tr>
<tr>
<td>3.6</td>
<td>Maintenance Bypass Operation</td>
<td>9</td>
</tr>
</tbody>
</table>
1 OPERATING MODES

1.1 General
The are four different operating modes of the standard stand-alone on-line UPS system (5 for hot-standby), ensuring uninterrupted power supply of the load under all conditions. Transitions between these operating modes are performed without interruption of the power supply to the load.

Safety concept
- in "Normal Operation" any failure, internal or external, will transfer the UPS system either to "battery operation", to "bypass operation" for a stand-alone UPS or to operation with an "Inverter failure" for hot-standby system.
- in "Battery Operation" or "Bypass Operation", with a stand-alone UPS system, an additional failure may interrupt the power supply to the load, depending on the kind of failure. In both operating modes the UPS signals a failure condition (audible and visual alarm) to indicate that any additional failure bears the risk of interrupting the power supply to the load. As additional security, a second UPS unit may be added and connected in parallel with the original unit, in a hot-standby configuration. Therefore, in the case of a failure of one inverter, the second inverter will take over the load. This system requires the occurrence of 3 or 4 simultaneous failures (the bypass can also be redundant) before the load is interrupted. Any number of units can be connected together in this way, the addition of each unit providing the addition of 1 or 2 additional security factors. The interconnection of the UPS in this way requires a special cable available from your local distributor.
- "Maintenance Bypass Operation" is used to supply the load directly from mains during maintenance or repair work.

⚠️ Warning: Even in case of a total blackout, the UPS will continue to supply power to the load, therefore all necessary precautions against direct and indirect accidental contact as specified in national and local safety standards must be followed.
1.2 Normal Operation

“Normal Operation” is the standard operating mode of the UPS
- Mains power is present.
- The rectifier converts ac power to dc power which charges the batteries and feeds the inverter.
- The inverter converts this dc power to ac power used to feed the connected load.

1.3 Battery Operation

The “Battery Operation” mode is activated by a mains failure or rectifier failure
- The rectifier supplies no power.
- The battery supplies the required dc power to the inverter.
- The inverter supplies ac power to the load as described above.
- Power will only be supplied to the load for a certain period of time depending on the battery capacity and the amount of load applied.

1.4 Bypass Operation

The “Bypass Operation” mode is activated by an inverter failure or an overload
- The rectifier supplies dc power only to the battery.
- The static inverter switch SSI opens automatically after the static bypass switch SSB is closed.
- The load is supplied directly from the mains through the static bypass line.

1.5 Maintenance Bypass Operation

The “Maintenance Bypass Operation” mode is used to supply the load directly from the mains during maintenance or repair work.
- In this mode, the individual functional components are completely separated from the load.
- Power for the load is supplied directly from mains through QIBY.
1.6 Battery Save

If the "Battery Save Operation" mode is set in the "Test Menù-Submenù 5 Alarms ON/OFF (see section Operating Panel), on a rectifier failure condition the load will be fed by the bypass line, if available. This allows to save the battery nominal runtime until a mains failure occurs.

1.7 Efficiency Optimiser

If the UPS off-line mode is selected in the "Test Menù - Submenù 4 Parameter setting - UPS Identiﬁcation (see section Operating Panel), the load is normally supplied directly from the mains through the static bypass line. The inverter will supply the load when mains failure occurs.
2 OPERATING MODES
HOT-STANDBY OPERATION

2.1 Normal Operation

"Normal Operation" is the standard operating mode of the hot-standby system.
- Mains power is present.
- The rectifiers of all units convert ac power to dc power which charges the batteries and feeds the inverters.
- The inverters convert this dc power to ac power.
- The inverter of one unit feeds the connected load.
- The inverter of the other unit(s) is working in standby mode, ready to takeover the load if there is a failure in the unit supplying the load.
- All units in the system are identical and operate completely independently of each other.

FIG. 3.1 - Normal Operation

2.2 Operation with an Inverter Failure

"Operation with an Inverter Failure" is the operating mode of the hot-standby system after a failure has occurred in one unit.
- Mains power is present.
- The static inverter switch of the failed unit opens automatically and the static inverter switch of another unit is closed.
- The rectifier of that unit converts ac power to dc power which charges the battery and feeds the inverter. The inverter then converts this dc power to ac power used to feed the connected load.
- The static bypasses within all units remain ready to supply the load in case of any additional failure(s) or overload.

FIG. 3.2 - Operation with an inverter failure

2.3 Battery Operation

The "Battery Operation" mode is activated by a mains failure or rectifier failure.
- The rectifiers of all units supply no power.
- The batteries of all units supply the required dc power to the inverter of each unit.
- The inverter of one unit continues to supply ac power to the load.
- The inverter(s) of the other unit(s) are operating in standby mode, ready to takeover the load, without interruption.
- If an additional failure in the first unit occurs, or when the battery of that unit is exhausted, the inverter of another unit will takeover the load, continuing in battery operation until the mains returns or the second battery is exhausted.

FIG. 3.3 - Battery Operation
## Operating Modes

### 2.4 Bypass Operation

The "Bypass Operation" mode is activated by an overload or by inverter failures in all units or by a manual commutation. 

- The rectifiers supply dc power only to the batteries.
- The SSI static inverter switch of the unit supplying the load opens automatically after the SSB static bypass switch is closed.
- The load is supplied directly from the mains through the static bypass.
- If the transition to "Bypass Operation" was caused by a temporary overload, the UPS system returns automatically to "Normal Operation", any inverter may takeover the load, when the load returns to within tolerance.

![FIG. 3.4 - Bypass Operation](image)

### 2.5 Maintenance Bypass Operation

"Maintenance Bypass Operation" is used to supply the load directly from the mains during maintenance or repair work.

- In this mode, the individual functional components of all units are completely separated from the load.
- Power for the load is supplied directly from the mains through the switch QIBY.

![FIG. 3.5 - Maintenance Bypass Operation](image)
3 OPERATING MODES PARALLEL AND PARALLEL/REDUNDANT OPERATION

3.1 Normal Operation

"Normal Operation" is the standard operating mode of the UPS if the system load is at its nominal value or the system is programmed in a way that all units remain on-line.

- Mains power is present
- The rectifiers convert a.c. power to d.c. power used to charge the batteries and feed the inverters
- The inverters convert this d.c. power to a.c. power used to feed the connected load
- All units are sharing the load current uniformly. This is accomplished by means of the optional parallel-operation-electronic pcb (IPR-1F).
- All units operate completely independently of each other, each unit supplying its respective share of the load.

3.2 Partial Load Operation

Single inverters that are not needed to supply the load can be switched off automatically, thus saving energy and increasing system efficiency.

- The load is supplied by the remaining inverters
- All rectifiers will continue to operate, charging also the batteries of the units whose inverters have been switched off
- The system can be easily programmed for the minimum number of units which must supply the load at any time.
- When the load is reduced, the units will individually decide which one is to switch off automatically.
- The system may be programmed so that there will always be one redundant unit on-line.
- If the load is again increased, or in the case of an inverter failure, the unit(s) which have been switched off will automatically switch on again to share the load.
- If the mains supply fails, all inverters will switch on and connect to the load in parallel operation in order to maximize the battery autonomy time,
3.3 Battery Operation

The "Battery Operation" mode is activated by a mains failure or rectifier failure:

- The rectifiers supply no power
- The batteries supply the required d.c. power to the inverters
- The inverters supply a.c. power to the load.
- Power will only be supplied to the load for a certain period of time depending on the battery capacity
- If there were stand-by units switched off at the time of the mains failure, all units will automatically switch ON in order to extend the battery autonomy time.

3.4 Operation with an Inverter Failure

This operating mode is activated by a failure in one or more inverters:

- As long as the load is not too great for the remaining units, the parallel system will stay in UPS (inverter) operation mode.
- The static inverter-switch(es) (SSI) of the defective unit(s) will open automatically, separating them from the load-busbar
- The rectifier(s) of the defective unit(s) will supply d.c. power to the battery (batteries) only if the respective rectifier is not defective.
### 3.5 Bypass Operation

The "Bypass Operation" mode is activated by a multiple inverter failure or overload:

- If the load is greater than 110% of the load capacity of all available inverters, the static bypasses of all individual units will connect the load with the mains directly.
- All inverter output switches (SSI) will open, inverters may continue to operate.
- The rectifiers continue to charge the batteries.
- If the load is reduced to 100% or less of the load capacity of all available inverters, the system switches automatically back to normal operation.
- All bypasses always switch on together.
- If a standby unit was off at the time of the inverter failure/overload, it will automatically switch ON and all units take-over the load.

![FIG. 4.5 - Bypass Operation](image)

### 3.6 Maintenance Bypass Operation

The "Maintenance Bypass Operation" mode is used to supply the load directly from mains during maintenance or repair work:

- During this mode, the individual functional components are completely separated from the load (e.g. for maintenance work).
- Power for the load will be supplied directly from mains through internal or external power switch(es) (QIBY).

**Note:** If the 3-position maintenance bypass cabinet MB3/2 is installed, the UPS system may be totally isolated from all supply by switching to the 3rd position "UPS ISOLATED". Again the load will be supplied through the maintenance bypass switch.

![FIG. 4.6 - Maintenance Bypass Operation](image)
4 OPERATING INSTRUCTIONS

4.1 Switching On the UPS System

Initial UPS Operating Mode:
The UPS is switched off, the load is not supplied, and all power switches are open.

Operating Steps:
• Switch on the external mains supply of the UPS.
• Open the UPS front door to gain access to the switches QIRP, QIRE, QIUG and QIBY.
• Close the QIRP switch.
The unit performs a self-test and the rectifier starts automatically.
• Wait until the Smart Front Panel is illuminated.
• Repeat for all units within the system (hot-standby systems).
The display(s) show:

• On the Smart Front Panel(s) press four times the "up" arrow, then the display(s) show:

• Press ENTER and then follow the instructions given on the displays of all units being switched on.
At the end of the "SYSTEM START-UP" procedure the display(s) must show:

NOTE: The sub-menu 6) "MODULE STARTUP" is enabled only for hot-standby operation and represents the startup procedure for each unit in the system.

Final UPS Operating Mode:
The UPS is now in "Normal Operation", all green status LEDs on the Smart Front Panel must be illuminated, the yellow ones must be off.
4.2 Switching Off The UPS System.

Initial Operating Mode:
The UPS is in any operating mode described in previous sections except "Maintenance Bypass Operation". All power switches except QIBY are closed, and the load is fed either through the inverter or the static bypass.

Operating Steps:
- From the Main Menu on the Smart Front Panel of all units in the system select “SYSTEM SHUTDOWN” using “up” or “down” keys (if you are in a Sub Menu press ESC key first) until the display(s) shows:

```
NORMAL OPERATION
7) SYSTEM SHUTDOWN
8) MODULE SHUTDOWN
```

- Press “ENTER” and then follow the instructions given on the display(s).

At the end of the “SYSTEM SHUTDOWN” the display(s) must show:

```
UPS MODULE OFF
7) SYSTEM SHUTDOWN
8) MODULE SHUTDOWN
```

NOTE: The sub-menu 8) "MODULE SHUTDOWN" is enabled only for hot-standby or parallel operation and represents the shutdown procedure for one of the units in the system.

After opening the QIRP switch(es) the control electronics is only powered by the DC capacitors: the display will fade out within a few minutes.

Final Operating Mode:
The UPS system is now in "Maintenance Bypass Operation". The single unit(s) are now completely de-energized. The load is supplied by the maintenance bypass(es) QIBY.

Warning! Although all power switches (except QIBY) are opened, there is still voltage at the inputs of the power switches QIRP, QIRE, QIBY and at the output of QIUG and QIBY.
4.3 Switching on Anyone Module within a System (Parallel and Hot-standby Systems).

Initial Operating Mode:
The UPS system is in "Partial load Operation" or "Operation with an Inverter Failure". Any unit that was switched off shall be switched on to share the load equally with the other units (parallel systems) or to become available as a stand-by unit (hot-standby systems).

Operating Steps:
- Open the front door of the unit to be switched on.
- Close the QIRP switch of this unit.

The unit performs a self-test and the rectifier starts automatically.

Wait until the operating panel is illuminated.

The display shows:

- Press the "up" arrow five times, then the display shows:

- Press ENTER and then follow the instructions given on the display.

At the end of the "MODULE START-UP" procedure the display must show:

Ensure that the switch S1 on the IPR-1F pcb (if present) is set to the AUTO position.
Final Operating Mode:

The UPS system is now in "Normal Operation", all green status LEDs on the Smart Front Panel must be illuminated and the yellow LEDs must be off. Should problems arise during the Module Start-Up, please follow the instructions in section: "Initial Start-up".
4.4 Switching off Anyone Module within a System (Parallel and Hot-Standby Systems)

Initial Operating Mode:
The UPS is in "Normal Operation" mode. All power switches except the QIBY are closed, and the load is fed through the inverters. One of the units is to be switched off, e.g. for maintenance work.

Operating Steps:
- Open the front door of the unit to be switched off and at the bottom of the IPR-1F pcb (if present), inside the unit, switch the microswitch S1 to the manual position, otherwise (when not present), continue.

- Select on the Smart Front Panel the Main Menu point 8 "MODULE SHUTDOWN") by pressing ESCAPE (if you are in a Sub Menu) and the "up" or "down" arrows several times, until the display shows:

- Press ENTER and then follow the instructions given on the display.
At the end of the "MODULE SHUTDOWN" procedure the display must show:

After opening the QIRP switch the control electronics is only powered by the DC capacitors: The display will fade out within a few minutes.
Final Operating Mode:
The UPS system is now in "Partial load operation", or "Operation with an Inverter Failure", (hot-standby systems). The load is supplied by the remaining unit(s).

Note: If any one module is to be left switched off for any extended period of time, the battery should remain on charge, i.e. the switches QIRP and QIB must remain closed.

Attention! Although all power switches of the unit are opened, there is still voltage at the inputs of the power switches QIRP, QIRE, QIBY and the output of QIUG and QIBY and at the respective terminals.
4.5 System Check

Either of the start-up procedures can be entered at any time. Entering a start-up procedure during normal operation will perform a check on the UPS module and any abnormal condition will be indicated on the display.

When the UPS status is normal the indications should be as follows:

- Rectifier check has been performed
- DC voltage check has been performed (This may read BOOST CHARGE if the rectifier is boost charging the battery).
- Inverter check has been performed
- UPS check has been completed
4.6 Emergency Power off
An emergency power off may be activated on the panel by pressing the EPO pushbuttons simultaneously. This action will switch off the UPS output, the inverter and the bypass, interrupting the supply to the load. If a shunt trip is installed in the battery circuit breaker and it is connected to terminals C3 and C4 of the UPS, the QIB breaker will trip.

4.7 Reset Emergency Power off
To reset Emergency Power off, press the "EPO Reset" push button and the rectifier is switched ON. To start the UPS again, see the Startup Procedure.
# Operating Panel

## Chapters

<table>
<thead>
<tr>
<th>1</th>
<th>GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GENERAL</td>
</tr>
</tbody>
</table>

## 2 SMART FRONT PANEL

| 2.0 | LED Indication | 3 |
| 2.1 | Main Menu Overview | 4 |
| 2.2 | SUB MENU 1: Voltage Measurement | 6 |
| 2.3 | SUB MENU 2: Current Measurement | 8 |
| 2.4 | SUB MENU 3: Frequency Measurement | 11 |
| 2.5 | SUB MENU 4: Alarm Messages | 12 |
| 2.6 | SUB MENU 5: Switching On the UPS System. | 17 |
| 2.7 | SUB MENU 6: Switching On anyone Module within a Multi-Unit System | 18 |
| 2.8 | SUB MENU 6: Switching Off the UPS System | 19 |
| 2.9 | SUB MENU 8: Switching Off Anyone Module within a Multi-Unit System | 20 |
| 2.10 | TEST MENU Overview | 21 |
| 2.11 | Connection to PC | 22 |
| 2.11.1 | CPNET Interface Card | 23 |
| 2.11.2 | Alarms | 23 |
| 2.11.3 | Metering | 23 |
| 2.12 | Remote Panel | 24 |
| 2.12.1 | Installation | 25 |
| 2.12.2 | Functions | 25 |

We reserve the right to modify the contents of this document without notice.
1 GENERAL

The Smart Front Panel (SFP) provides a power flow, UPS status indication remote monitoring features measurements and alarm messages.
2 SMART FRONT PANEL

2.0 LED Indication

The block diagram of the UPS, with integrated LEDs, allows a quick check of the UPS operating status.

LED 1 MAINS OK (RECTIFIER)
LED 2 RECTIFIER OK
LED 3 BATTERY CHARGING
LED 4 BATTERY DISCHARGING
LED 5 INVERTER OK
LED 6 INVERTER FEEDING LOAD
LED 7 LOAD IS SUPPLIED
LED 8 MAINS OK (BYPASS)
LED 9 BYPASS AVAILABLE
LED 10 BYPASS FEEDING LOAD
LED 11 COMMON ALARM
LED 12 MAINTENANCE BYPASS
LED 17 EPO
### 2.1 Main Menu Overview

In the MAIN MENU the first line of the display always shows the operating mode.
The second line of the display shows the sub menu that can be activated by pressing "ENTER".

**MAIN MENU**

- **Scrolling in the MAIN MENU**
- **Activating the SUB MENUS**

**SUB MENUS**

- **by pressing "up" or "down" arrows**
- **by pressing "ENTER"**

**NORMAL OPERATION**

- **1) VOLTAGES**
  - • SUB MENU 1: Voltage Measurement, see section 2.2

- **2) CURRENTS**
  - • SUB MENU 2: Current Measurement, see section 2.3 (This may read "CURRENTS/TEMP" if one of the optional temperature measurements is selected.)

- **3) FREQUENCY**
  - • SUB MENU 3: Frequency Measurement, see section 2.4

- **4) ALARMS**
  - • SUB MENU 4: Alarm Messages, see section 2.5

- **5) SYSTEM START-UP**
  - • SUB MENU 5: System Startup, see section 2.6
• SUB MENU 6: Module Startup, see section 2.7
  (Active for hot-standby systems only)

• SUB MENU 7: System Shutdown, see section 2.8
  (Sub Menu 6 for stand alone units)

• SUB MENU 8: Module Shutdown, see section 2.9
  (Active only for hot-standby units)

• SUB MENU 9: Adjustments, see section 2.10 (Sub Menu 7 for stand alone units)

Note: If the panel is not used, after 5 min. the display is automatically set to SUB MENU 2 and shows either the BATTERY AUTONOMY or the UPS OUTPUT POWER, depending on the system configuration.
2.2 SUB MENU 1: Voltage Measurement

All the values are given in Volts; several voltage measurements are available when one or more SFP/ACM or SFP/DCM optional boards are installed (up to 8 boards).

You can exit the SUB MENU at any time pressing ESC.

• XXX = Mean Inverter Output Voltage

• XXX = voltage L1-N,

• BBB = battery voltage

• XXX = voltage L1-L2, YYY = voltage L2-L3, ZZZ = voltage L3-L1

When one or more SFP/ACM or SFP/DCM optional boards are installed (up to 8 boards), additional AC and DC current measurements and temperature are available. The AC optional measurements can selected phase to phase or phase to neutral. Table 6.2 (see next page) gives an overview of the available optional measurements.
### Operating Panel

<table>
<thead>
<tr>
<th>AC</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectifier Input</td>
<td>Rectifier</td>
</tr>
<tr>
<td>UPS Input</td>
<td>Battery</td>
</tr>
<tr>
<td>Bypass Line</td>
<td>1 Battery Level</td>
</tr>
<tr>
<td>Auxiliary Line</td>
<td>2 Battery Level</td>
</tr>
<tr>
<td>Auxiliary Line 2</td>
<td>3 Battery Level</td>
</tr>
<tr>
<td>Maint. Bypass Line</td>
<td>4 Battery Level</td>
</tr>
<tr>
<td>Distribution (AC)</td>
<td>Distribution (DC)</td>
</tr>
<tr>
<td>Distribution 2 (AC)</td>
<td>Distribution2 (DC)</td>
</tr>
<tr>
<td></td>
<td>Battery Cabinet</td>
</tr>
<tr>
<td></td>
<td>Battery Cabinet 1</td>
</tr>
<tr>
<td></td>
<td>Battery Cabinet 2</td>
</tr>
<tr>
<td></td>
<td>Battery Cabinet 3</td>
</tr>
<tr>
<td></td>
<td>Ambient Temperature</td>
</tr>
<tr>
<td></td>
<td>UPS Internal</td>
</tr>
<tr>
<td></td>
<td>UPS Internal 1</td>
</tr>
<tr>
<td></td>
<td>UPS Internal 2</td>
</tr>
</tbody>
</table>

Tab 6.2 Optional measurements
2.3 SUB MENU 2: Current Measurement

In this sub menu the values of various UPS currents are shown. The Smart Front Panel also provides the calculation of important values as Thermal Image, Output Power, Output Current, Output Load, Battery Test Results and Battery Autonomy which are described below:

**BATTERY AUTONOMY** is an optional function which gives the user an approximate value for the available autonomy time under actual load conditions. If activated in Test Menu, the remaining autonomy time of the battery will be continually calculated, updated and displayed in this sub menu. Alarm threshold, battery autonomy at full load and battery capacity have to be set correctly in Test Menu.

The algorithm assumes that the batteries have their full capacity. The BATTERY AUTONOMY calculation can be activated and deactivated in Test Menu.

**THERMAL IMAGE** is an optional function (normally disabled) which is activated in case of an overload. On the basis of the actual overload, it calculates continually the length of time for which the UPS can withstand the overload without being damaged. When the value of ACTUAL OUTPUT reaches 100%, the inverter static switch will be switched off and the system will switch over to bypass. If the overload condition is removed before the UPS switches to bypass, the actual output is reduced at 1% steps every 20 seconds. THERMAL IMAGE can be enabled and disable in the Test Menu.

**OUTPUT POWER** is a simple calculation as follows:

\[
P_0 = V_{L1} \cdot I_{L1}
\]

**PERCENTAGE OUTPUT LOAD** of each phase:

\[
P_0 = \left(\frac{V_{L1} \cdot I_{L1}}{P_{\text{nom}(kVA)}}\right) \cdot 0.3
\]

You can exit the SUB MENU at any time by pressing ESCAPE.
You can exit the SUB MENU at any time pressing **ESC**

**NORMAL OPERATION**

2) **CURRENT**

**ENTER**

- XXXXXX = output power (VA) L1

**OUT PWR (VA) L1**

XXXXXX

**TOTAL OUT POWER (VA)**

PO XXXXX YYY%

**UPS OUTPUT CURRENT**

L1 XXX

**BATTERY TEST**

LAST RESULT PRESS F1

F1

- XXX = current L1
- Battery Test Results displayed for 5 seconds
- XXXX = \( V_{L1} \cdot I_{L1} \)
- YYY = output power % of rated power
Operating Panel

- DD MM AAAA hh mm ss = battery date and time

Battery Message:
- Battery never tested
- Battery test not performed
- Battery test failed
- Battery test aborted
- Battery test passed

- MMM = battery autonomy (min)

- ZZZ = percentage of calculated overload time already elapsed (only shown when activated in the test menu)

- XXX = percentage calculated: \((V_L \cdot I_L / P_{nom}(\text{kVA})) \cdot 0.3\)

- Optional measure (AC/DC and/or temperature)

When one or more SFP/ACM or SFP/DCM optional boards are installed (up to 8 boards), additional AC and DC current measurements and temperature become available. Table 6.2 (see previous page) gives an overview of the available optional measurements.
2.4 SUB MENU 3: Frequency Measurement

Several frequency measurements are available when one or more SFP/ACM card are installed, the table 6.2 shows the AC optional measurements.

You can exit the SUB MENU at any time pressing ESC.

- XXX = frequency in Hz, measured at the input of QIUG

- Optional measure
Operating Panel

2.5 SUB MENU 4: Alarm Messages

You can exit the SUB MENU at any time pressing **ESC**.

- If no alarm is present, the display shows:

- If alarms are activated, the display shows the first alarm message:

  - Pressing “up” at the indication of ALARM MESSAGE 1 will show the message FIRST ALARM for two seconds and then automatically return to the indication of ALARM MESSAGE 1.
  - Instead of “ALARM MESSAGE 1” the actual message is shown, e.g. BYPASS FEEDING LOAD. All **actual** alarm messages can be displayed subsequently by pressing “up” or “down” keys.

- Pressing “down” key at the indication of the last alarm the message LAST ALARM will be displayed for two seconds and then automatically returns to the indication of last alarm.
The memory is organised as First In First Out, storing new data in position one and shifting older data to the next position. If 100 events are stored, storage of a new event will always delete the oldest one, stored in position 100.

The last 100 alarm messages can be displayed by pressing F2 and F4 subsequently. Then the display shows:

- XXX: position-number of the alarm in the memory.
- CC: Alarm code see section alarm
- T: Indicates activation or deactivation of this alarm:
  - S = Start E = End
- DD-MM-YYYY HH:MM:SS: The date and time of the event.

- XXX+1 = Pressing once the "up" or down" arrow the position is increased or decreased by 1.

- XXX+10 = Pressing F4 key the symbol # appear and the position is increased or decreased by 10.

- Pressing F1+ENTER the description message corresponding to alarm code "CC" is shown.
Any individual alarm displayed may be deleted from the list by pressing F1 and then F3. Pressing F3 followed by F1 will delete the entire alarm list.

Scrolling through the various positions is achieved by pressing "up" or "down" keys.

- normally, pressing once increases or reduces the actual position by 1.
- this can be accelerated by pressing F4: the symbol “#” appears in the upper right corner of the display and the position is increased or decreased by 10 when “up” or “down” key is pressed.

- pressing F4 again disables the acceleration

You can leave this menu at any time simply pressing ESCAPE.

Alarms are also indicated in the main menu by a bell symbol on the right hand side of the first line of the display.

Pressing F1 or ENTER shows the actual alarm message to the respective alarm code for two seconds on the display. Then the previous message is automatically shown again.

Alarms

- **Inverter not Feeding (01)** The inverter is not supplying the load.
- **Inverter not synchr (02)** The inverter is not synchronised to the bypass supply.
- **Inverter Overload (03)** The Inverter is overloaded.
- **Rectifier Overload (04)** The rectifier is overloaded.
- **Overtemperature (05)** The inverter/rectifier components are operating at an excessive temperature. This can be due to extreme environmental conditions or a failure within the inverter or rectifier sections.
  
  If the bypass is available the UPS transfers immediately to the bypass supply (in the case of a hot-standby system, the second unit takes over the load). If the bypass or another inverter is not available then the UPS will continue to supply the load for a further 10 minutes before shutting down.

- **Inverter Failure (06)** The inverter is ON but the inverter voltage or inverter conditions are not in order.

- **Battery Discharging (07)** The mains or rectifier has failed and the batteries are discharging. This alarm is activated at a battery voltage of approx. 350Vdc.

- **Battery Switch Open (08)** The battery switch is open.

- **Bypass Feeding Load (09)** The load is being supplied by the bypass supply

- **Rectifier Failure (10)** The Rectifier mains is in order but a failure is present within the rectifier.
Fuses Blown (11)  The rectifier fuses are blown.

Mains Failure (12)  The mains is not present or not within the specified voltage and frequency tolerances.

Bypass not Available (13)  The bypass mains supply is OK but the bypass is not available to take the load if the inverter fails (the inverter is not synchronised or is blocked externally).

Output Switch Open (14)  The output switch is open.

Common Alarm (15)  Is the OR of all the alarms.

Auxiliary Alarm (16)  This alarm consists of a series of system alarms and includes the following:

- Oscillator failure
  A failure has occurred in the oscillator circuit or a loss of synchronism with another oscillator of another unit within the system.

- QIUG monitoring failure
  An error has occurred within the monitoring circuit of the output switch (disabled for single units).

- Static switch failure (SSI)
  A failure has occurred within the monitoring circuit of the inverter output static switch.

- Static switch failure (SSB)
  A failure has occurred within the monitoring circuit of the bypass static switch.

- Missing or incorrect bypass trip signal (hot-standby systems)
  An indifference has occurred within the bypass trip logic of this unit and the remainder of the system.

- System not redundant (parallel/redundant systems)
  If the inverter of the unit signalling this alarm fails, the system must transfer to the bypass supply.

- SSI-ON generator failure (parallel/redundant systems)
  A failure or loss of synchronism has occurred with the SSI ON pulse generator on IPR-1F pcb and may occur during start-up of a unit in a parallel system. To reset press "PB3" and then "PB2" on the ICP pcb.

To determine which of the alarm(s) are present refer to the section "PCB Description".
**Bypass System not Available (17)**  For systems with multiple static bypasses (hot-standby and parallel/redundant), if the bypass of this unit is available, but the bypass system is not available, the UPS system cannot transfer to the bypass supply, due to the fact that there may be insufficient bypasses available within the system.

**Paralleling Fault (18)**  The inverter has failed to regulate correctly in parallel operation with another inverter (parallel systems only).

**Retransfer blocked (19)**  The inverter has attempted unsuccessfully to take over the load at least 5 times within 3 minutes.

To reset, press "ENTER" when instructed.

**Note:** If the UPS is unattended and the alarm Retransfer blocked occurs, after 1-2 min, the UPS module will automatically reset and attempt a further 5 times to retransfer the load to the inverter.

This procedure will be repeated 3 times and if not successful, the UPS retransfer will remain blocked, the UPS must be reset manually by pressing ENTER.

Pressing ESCAPE will exit the routine and the UPS can only be re-transferred by using one of the START-UP routines.

**Boost Charge Failure (20)**

**Warning: Battery Low (21)**  The remaining battery capacity during discharge has been calculated to be less than programmed value for Autonomy Alarm threshold.

**Thermal Image (22)**  The calculated load for the unit is too large and the inverter static switch has switched off.

**Battery Test Failure (23)**  The battery test has failed: indicates a damaged battery.
2.6 SUB MENU 5: Switching On the UPS System.

- Press "ENTER" and then follow the instructions given on the display.

- You can exit the start-up procedure at any time by pressing "ESCAPE".

The start-up procedure is intelligent, i.e. every action of the user and the corresponding UPS status are monitored.

After carrying out all steps correctly, the UPS system is in normal operation - the load is supplied by the inverter, the static bypass system is available.
2.7 SUB MENU 6: Switching On Anyone Module within a Multi-Unit System (not activated for stand alone units).

Press "ENTER" and then follow the instructions given on the display.
You can exit the start-up procedure at any time by pressing "ESCAPE".

The start-up procedure is intelligent, i.e. every action of the user and the corresponding UPS status are monitored.

After carrying out all the steps correctly, the UPS module is in inverter operation - the load is supplied by the inverter, (or any one inverter in the case of a hot-standby system) the static bypass is available.
2.8 SUB MENU 6: Switching Off the UPS System.
(SUB MENU 7 for multi-unit systems)

• Press “ENTER” and then follow the instructions given on the display.
• You can exit the shutdown procedure at any time by pressing "ESCAPE".

The shutdown procedure is intelligent, i.e. every action of the user and the corresponding UPS status are monitored.

After carrying out all the steps correctly, the UPS is in service bypass operation. The UPS is now completely de-energised. The load is supplied by the QIBY maintenance bypass.

Attention! Although all power switches (except QIBY) are opened, there is still voltage at the input of the power switches QIRP, QIRE, QIBY and QIB and at the respective terminals.
2.9 SUB MENU 8: Switching Off any One Module within a Multi-Unit System (not activated for stand alone units).

- Press "ENTER" and then follow the instructions given on the display.
- You can exit the shutdown procedure at any time by pressing "ESCAPE".

The shutdown procedure is intelligent, i.e. every action of the user and the corresponding UPS status are monitored.

After carrying out all the steps correctly, the UPS module is switched off. The load is still supplied by the remaining units.

**Attention!** Although all power switches are opened, there is still voltage at the input of the power switches QIRP, QIRE, QIB, at the output of QIBY and QIUG and at the respective terminals.
2.10 TEST MENU OVERVIEW
The Test Menu is used to adjust the internal settings of Smart Front Panel

This MENU is protected by a password. After pressing "ENTER" the input of the password is requested.
The password is indicated in the service manual, it is accessible to service people only, since it allows modifications of important parameters of the unit.
2.11 Connection to PC

The UPS is connected to the PC via the RS232 interface. The respective connector is the male 9-pin sub-D J5 connector on the SFP/CPU pcb on the inside of the UPS front door. At the PC a serial port is used which can either be a male 9-pin sub-D connector or a male 25-pin sub-D connector.

The UPS can be monitored and controlled through the SEC protocol. In this case, software packages such as SMARTMON® from Systems Enhancement Corporation may be directly applied using a P.C.

The software runs on PCs with several Operating systems. The software allows:
- UPS monitoring
- Software shutdown
- Event logging
- Broadcasting
- Paging
- E-Mail (only for Windows 95)

The UPS can be connected to a LAN and monitored through a SNMP protocol.

An external Hardware interface is required to perform the protocol conversion from SEC protocol to SNMP protocol.

Cable Specification

For connecting the PC and UPS use twisted pair, 24 AWG shielded cable. Connect the shield to ground at the PC side.

![RS232 connection Cable](FIG. 3.1 - RS232 connection Cable)
2.11.1 CPNET Interface Card
The CPNET interface card is used for remote signalling of four standard alarm conditions by means of voltage-free contacts in programmable configurations.

The UPS can be monitored through a contact closed protocol.
The software runs on PCs with several Operating systems.
The software allows:
- UPS monitoring
- Software shutdown
- Event logging
- Modem communication

The UPS can be connected to a LAN and monitored through a SNMP protocol.
An external Hardware interface is required to perform the protocol conversion from contacts protocol to SNMP protocol.

2.11.2 Alarms
All the alarms available on the front panel are transmitted to an external monitoring PC.

2.11.3 Metering
With a connected PC, the following measurements can be realised (SNMP and service modes):

- Vout (UPS output voltage)
- Vinv (Inverter output voltage)
- Vbatt (Battery voltage)
- Iout (UPS output current)
- Pout% (UPS output in % of nom. kVA)
- Aut% (Battery autonomy in % of nom. autonomy)

There are also two optional board for additional measures.

- SFP/ACM 3 AC Voltages
  3 AC Currents
  1 Frequency

- SFP/DCM 4 DC Voltages
  3 DC Currents
  1 Temperature (with optional thermal probe)

The SFP can be connected to up to eight optional boards, either SFP/ACM or SFP/DCM, in a daisy - chain mode.
Each Optional measure can be adjusted on the front panel.
2.12 Remote Panel

The Remote Panel is used for remote monitoring of UPS systems for distances of up to 400m. It is connected by cable via a RS485 interface. It can be installed in a control room and provides the same user interface as the local operating panel. Only the E.P.O. function is not implemented.
Operating Panel

2.12.1 Installation
The UPS is connected to the remote panel via the RS485 interface. The respective connector is the female 9-pin sub-D J6 connector on the SFP/CPU pcb on the inside of the UPS front door. At the remote panel there is a male 9-pin sub-D connector.
The Remote Panel is mounted in a box (215x223x80mm).
The Remote Panel is supplied by an external power supply 220/230/240 V<sub>ac</sub>, 50 Hz (which must be connected to the output of the UPS).
The connection between the UPS and the Remote Panel is provided by a Keyboard 5-Wire Jack.
For the Remote Panel housing the same colour is used as for the UPS cabinets.

Cable Specification:
The Remote Panel is connected to the UPS by a shielded cable 4x0.5mm of max. 400m length with 9-pole sub-D connectors.
Connect the shield to ground at the PC side.

2.12.2 Functions

General
The Remote Panel provides the same LED indications as the operating panel. Alarms are indicated by flashing LEDs and an integrated buzzer. The alarms can be muted directly at the Remote Panel by pressing the "Alarm Reset" push-button.
The buzzer can be deactivated by setting switch 2 of DIP1 to the Off position. The inverter can be switched on from the remote panel but cannot be switched off.
Operating Manual

PCB Description

## Chapters

<table>
<thead>
<tr>
<th>1</th>
<th>UPS CONTROL LOGIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>UPS Control Logic</td>
</tr>
<tr>
<td>1.1</td>
<td>Legend of symbols used</td>
</tr>
<tr>
<td>1.2</td>
<td>Rectifier</td>
</tr>
<tr>
<td>1.3</td>
<td>Inverter</td>
</tr>
<tr>
<td>1.4</td>
<td>Bypass</td>
</tr>
</tbody>
</table>

## Figures

<table>
<thead>
<tr>
<th>FIG.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIG. 1.1</td>
<td>IF/PS - R front view</td>
</tr>
<tr>
<td>FIG. 1.1.1</td>
<td>IF/PS - R 12P front view</td>
</tr>
<tr>
<td>FIG. 1.2</td>
<td>CPHC16 - R front view</td>
</tr>
<tr>
<td>FIG. 1.3</td>
<td>ICP front view</td>
</tr>
<tr>
<td>FIG. 1.4</td>
<td>ICM front view</td>
</tr>
<tr>
<td>FIG. 1.5</td>
<td>IPS-500/I front view</td>
</tr>
<tr>
<td>FIG. 1.7</td>
<td>IF/PS - 1F front view</td>
</tr>
<tr>
<td>FIG. 1.8</td>
<td>CPHC16 - S front view</td>
</tr>
</tbody>
</table>

We reserve the right to modify the contents of this document without notice.
1 UPS CONTROL LOGIC

1.0 UPS Control Logic
The UPS control logics consists of one rack with 7-8 PCBs (depending on the system configuration). The various potentiometers, test point and LEDs are briefly labelled on the covers of the rack.
A more detailed explanation is given in this chapter.

1.1 Legend of symbols used

- LED (light emitting diode)
  - GREEN: normal condition
  - RED: alarm condition.
  - YELLOW: warning

- Potentiometer
  - For adjustment
    (only for qualified personnel)

- Test Point
  - Requires a pin 2mm for measurement.

- Test point/switch
  - Insertion of a 2mm Pin disables the described function

- Pushbutton
  - Performs a reset or switching operation

- Micro switch
  - Switch from manual to automatic mode
1.2 Rectifier

The rectifier control logic consists of two PCBs.

**IF/PS - R**  Rectifier electronic power supply
- input voltage sensing
- rectifier electronics power supply

**CPHC16 - R**  Rectifier control and regulation
- rectifier output voltage regulation
- rectifier output current limitation
- soft-start control
- battery charging current limitation
- generation of the thyristor firing pulses
- input voltage monitoring (phase rotation, mains failure)
- control for parallel rectifiers (with a common battery)
- 12-pulse rectifier control
- Second level current limitation for diesel-generators.
- Boost charging according to DIN 41773.
- Thermal compensation.

**IF/PS - R Front View**  FIG. 1.1 illustrates the LEDs of the IF/PS - R PCB which are accessible from the front.

- **PSPA**  • + 12V analog circuits power supply OK
- **PSPP**  • + 16V microprocessor power supply unregulated
- **PSPA1**  • + 12V interfaces power supply
FIG. 1.1.1 illustrates the LEDs of the IF/PS - R 12P (used in 12Pulse configurations)

- PSPA
  - + 12V analog circuits power supply OK
- PSPP
  - + 16V microprocessor power supply unregulated
- PSPA1
  - + 12V interfaces power supply
- + 15
  - + 15V auxiliary LEM power supply
- - 15
  - - 15V auxiliary LEM power supply
FIG. 1.2 illustrates the display, switches and connectors of the CPHC16 - R PCB which are accessible from the front.

- 7 segment display for diagnostics (see table below)

- Reset max. Vdc pushbutton: press when the character "4" is displayed or the central segment is blinking.
- Reset Boost Charge Alarm
- Reset after EPO (V2.1)

- RV1 Manual adjustment of the DC voltage (adjustment possible only with Dip 3 of dipswitch S1 in position OFF)

- RS232 connector (male)

<table>
<thead>
<tr>
<th>Priority</th>
<th>Indication</th>
<th>Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>EPROM failure</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Fuse blown</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>Mains not OK</td>
</tr>
<tr>
<td>4</td>
<td>P</td>
<td>Wrong phase rotation</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>Overtemperature</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>Overvoltage</td>
</tr>
<tr>
<td>7</td>
<td>Ø</td>
<td>Pulse release missing</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>Rectifier failure</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>Fan failure</td>
</tr>
<tr>
<td>10</td>
<td>L</td>
<td>Overload</td>
</tr>
<tr>
<td>--</td>
<td></td>
<td>Boost charge</td>
</tr>
</tbody>
</table>

In normal condition the display shows a red segment rotating clockwise. During the starting phase, a blinking central segment "-" is displayed. During parameter acquisition through the serial interface, the character "A" is displayed. If more than one alarm is present, only the one with the higher priority is displayed.

"-" (when blinking) Has left the boost charge due to a given time limit but the battery was not completely charged. Reset with "RESET max. Vdc" above.
1.3 Inverter
The inverter control logic consists of three PCBs

ICP Inverter control
• control for the inverter static switch (SSI)
• temperature monitoring
• inverter monitoring and protection
• hot-standby control
• quartz oscillator
• fan monitoring
• inverter electronic power supply monitor
• short circuit protection (can be disabled opening the jumper J12)

ICM Inverter regulation
• inverter output voltage regulation
• inverter output current limitation
• short-circuit protection
• inverter soft start control
• inverter-bypass synchronisation
• inverter-oscillator synchronisation
• synchronisation monitor:

IPS - 500/I Inverter electronic power supply
• inverter electronic power supply
• inverter input voltage monitoring
• generation of the battery-discharging alarm.
FIG. 1.3 illustrates the LEDs and switches of the ICP PCB which are accessible from the front.

- Push to switch the inverter ON/OFF
- Inv. electronic power supply in order: green LED is illuminated
- Defect in the internal quartz oscillator: red LED is illuminated
- RESET
- Inverter in order: green LED is illuminated
- Inv. voltage within tolerance (within +/- 10% of Vnom): green LED is illuminated
- Retransfer to inv. operation is blocked after 5 attempts within 3 minutes: red LED is illuminated
- Overtemperature within the inv. section: red LED is illuminated
- The inverter static switch has failed to switch ON/OFF: red LED is illuminated
- All conditions are in order for a retransfer of the load to the inv. (for hot-standby units, the inv. is ready in case of a failure to the on-line inv.): green LED is illuminated
- Short circuit protection: when short circuit remains for more than 5 '' and static bypass is not available, the inverter will be switched off - red LED is illuminated
- A failure within the monitoring of the output switch: red LED is illuminated
- Disable the quartz oscillator
- Disable inverter voltage monitoring
- Proportional to the inv. voltage. 6V = nominal inverter voltage
- Inv. voltage tolerance adjust for 6V at TP1 with nom. voltage
- Push to switch ON the inverter output static switch (SSI)
FIG. 1.4 illustrates the potentiometers, LEDs and test points of the ICM PCB which are accessible from the front.

- Frequency offset adjustment (when synchronisation is blocked at TP5)
- Current limitation adjustment primary 2. Adjust for 4Vdc at TP2
- Current limitation adjustment primary 1. Adjust for 4Vdc at TP1
- Inverter voltage adjustment
- Inverter voltage adjustment during test operation (jumpers JP9, close 2,3)
- Overload Primary 2: red LED is illuminated
- Overload Primary 1: red LED is illuminated
- Pulse release: green LED is illuminated
- Synchronisation OK: green LED is illuminated
- Test point: test voltage = 4Vdc at full load on primary 2
- Test point: test voltage = 4Vdc at full load on primary 1
- Test point: synchronisation block
- Test point: test voltage = 6Vdc at full load
Operating Manual

PCB Description

FIG. 1.5 illustrates the potentiometers, LEDs and test points of the IPS-500/I which are accessible from the front.

- Power ON: green LED is illuminated
- Power supply OK: green LED is illuminated
- Electronics supply voltage +12V
- Electronics ground
- Electronics supply voltage +26V
- Electronics supply voltage +24V
- Jumper for test operation (suppression of inverter input voltage monitoring signal)
- Power supply OK: green LED is illuminated
- Inv. input voltage in tolerance: green LED is illuminated otherwise blinking
- Adjustment of overvoltage monitoring threshold for the inverter input voltage.
- Adjustment of undervoltage monitoring threshold for the inverter input voltage.
1.4 Bypass

The bypass static switch control logic consists of two PCBs.

**IF/PS - 1F**  
Bypass monitoring and power supply  
- bypass electronic power supply  
- mains voltage sensing

**CPHC16 - S**  
Bypass control  
- switching control of the static bypass switch SSB  
- interface with the inverter or multiple inverters  
- mains frequency monitoring  
- mains voltage and phase rotation monitoring  
- generation of synchronisation signal  
- interface with multiple static bypasses  
- UPS output voltage monitoring  
- majority control for multiple static bypasses (hot standby systems)  
- synchronisation monitor: mains - UPS output
IF/PS - 1F Front View  FIG. 1.7 illustrates the LEDs of the IF/PS - 1F PCB which are accessible from the front

- PSPA  • +12V analog circuits power supply OK: green LED is illuminated
- PSPP  • +16V microprocessor power supply OK: green LED is illuminated
- PSPA1  • +12V interfaces power supply OK: green LED is illuminated
- +24 VBY  • +24V Power Supply for Static Bypass Driver: green LED is illuminated
### Operating Manual

**PCB Description**

FIG. 1.8 illustrates the display, switches and connectors of the CPHC16 - S PCB which are accessible from the front.

- **7 segment display for diagnostics (see table below)**
- **Manual transfer to bypass pushbutton**
- **Not used**
- **RS232 connector (male)**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Indication</th>
<th>Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>EPROM failure</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Bypass Fuses Blown or IRE open</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>Phase failure</td>
</tr>
<tr>
<td>5</td>
<td>b</td>
<td>Bypass square wave generation error</td>
</tr>
<tr>
<td>6</td>
<td>O</td>
<td>Output out of tolerance</td>
</tr>
<tr>
<td>7</td>
<td>L</td>
<td>Overload</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>Mains frequency out of tolerance</td>
</tr>
<tr>
<td>9</td>
<td>H</td>
<td>Mains voltage out of tolerance</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>Auxiliary power supply failure on the SS/FY PCB</td>
</tr>
<tr>
<td>11</td>
<td>b</td>
<td>Bypass blocked</td>
</tr>
<tr>
<td>12</td>
<td>S</td>
<td>Bypass not synchronised</td>
</tr>
<tr>
<td>13</td>
<td>d</td>
<td>SSB failure</td>
</tr>
<tr>
<td>14</td>
<td>E</td>
<td>Bypass system not available</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>Missing or false bypass trip signal</td>
</tr>
<tr>
<td>16</td>
<td>7</td>
<td>EPO activated</td>
</tr>
<tr>
<td>17</td>
<td>U</td>
<td>IUG open</td>
</tr>
<tr>
<td>18</td>
<td>ő</td>
<td>SSB on</td>
</tr>
</tbody>
</table>

In normal condition the display shows a red segment rotating clockwise. If more than one alarm present, only the one with the higher priority is displayed.
## Technical Data

### 1.1 Technical Data

<table>
<thead>
<tr>
<th>SIZE (kVA)</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Voltage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage Vcc</td>
<td>110 Vcc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output Current Rect. (A)</strong></td>
<td>48</td>
<td>96</td>
<td>140</td>
<td>192</td>
<td>280</td>
<td>383</td>
<td>479</td>
</tr>
<tr>
<td><strong>Input Current Rect. (A)</strong></td>
<td>11.3</td>
<td>22.7</td>
<td>33.2</td>
<td>45.6</td>
<td>66.3</td>
<td>90.6</td>
<td>113.4</td>
</tr>
<tr>
<td><strong>Input Power (kVA)</strong></td>
<td>7.85</td>
<td>15.7</td>
<td>23</td>
<td>31.4</td>
<td>45.9</td>
<td>62.7</td>
<td>78.5</td>
</tr>
<tr>
<td><strong>Efficiency (%)</strong></td>
<td>92</td>
<td>93</td>
<td>93</td>
<td>93</td>
<td>94</td>
<td>94</td>
<td>95</td>
</tr>
<tr>
<td><strong>Battery Capacity (Ah)</strong></td>
<td>37 / 50</td>
<td>75 / 100</td>
<td>125</td>
<td>150 / 200</td>
<td>250</td>
<td>400</td>
<td>400 / 500</td>
</tr>
<tr>
<td><strong>Battery Charger Current (A)</strong></td>
<td>7.5</td>
<td>15</td>
<td>22.5</td>
<td>30</td>
<td>45</td>
<td>60</td>
<td>75</td>
</tr>
</tbody>
</table>

### Inverter

| **Input Voltage (Vcc)** | 95 - 165 |
| **Output Voltage (Vac)** | 115 (110-120) or 230 (220-240) |
| **Nominal Output Voltage (A)** | 17 / 34 | 35 / 70 | 52 / 104 | 69 / 138 | 104 / 208 | 139 / 278 | 174 / 348 |

### Input Power (kW)

| 4.6 | 9.2 | 13.6 | 18.2 | 27.2 | 36 | 45 |

### Efficiency (%)

| 86 | 87 | 88 | 88 | 89 | 89 |

### Voltage Stability

1% static, 5% dynamic with reset to 1% in 40ms

### Total Harmonic Distortion (THD)

1.5% Linear Load, 5% Not Linear Load (CF=3:1)

### Overload

125% x 10^ (Pn), 150% 1’ (In)

### Total Efficiency

| 79 | 81 | 82 | 83 | 83 | 84 | 84 |

### Protection Degree

IP20

### Operating Temperature

0°C ± 40°C

### Storage Temperature

0°C ± 85°C

### Relative Humidity

≤ 95%

### Altitude

≤ 2000 m. above sea level

### Colour

RAL 7032

### Dimensions (mm)

<table>
<thead>
<tr>
<th>L</th>
<th>H</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400</td>
<td>1400</td>
<td>1400</td>
</tr>
<tr>
<td>1800</td>
<td>1800</td>
<td>1800</td>
</tr>
</tbody>
</table>

### Weight (Kg)

| 450 | 500 | 600 | 650 | 820 | 900 | 1000 |

Table 1.1 Technical Data
### Technical Data

<table>
<thead>
<tr>
<th>Operating Manual</th>
</tr>
</thead>
</table>

#### Table 1.2 Technical Data

<table>
<thead>
<tr>
<th></th>
<th>5</th>
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<th>20</th>
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<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SIZE (kVA)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vcc Voltage</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Power Rect. (A)</td>
<td>24</td>
<td>48</td>
<td>72</td>
<td>96</td>
<td>140</td>
<td>192</td>
<td>232</td>
<td>280</td>
<td>383</td>
<td>479</td>
</tr>
<tr>
<td>Input Power Rect. (A)</td>
<td>11.3</td>
<td>22.5</td>
<td>33.7</td>
<td>45.1</td>
<td>56.5</td>
<td>75.6</td>
<td>108.8</td>
<td>131.5</td>
<td>179.6</td>
<td>224.8</td>
</tr>
<tr>
<td>Input Power (kVA)</td>
<td>7.8</td>
<td>15.6</td>
<td>27.3</td>
<td>31.2</td>
<td>45.4</td>
<td>62.3</td>
<td>75.3</td>
<td>91</td>
<td>124.3</td>
<td>155.6</td>
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<tr>
<td>Efficiency (%)</td>
<td>92</td>
<td>93</td>
<td>93</td>
<td>93</td>
<td>94</td>
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<td>Battery</td>
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<tr>
<td>Battery Capacity (Ah) (autonomy 30 min)</td>
<td>25</td>
<td>37 / 50</td>
<td>75</td>
<td>75 / 100</td>
<td>125</td>
<td>150 / 200</td>
<td>200</td>
<td>250</td>
<td>400</td>
<td>400 / 500</td>
</tr>
<tr>
<td>Battery Charger Current (A)</td>
<td>3.75</td>
<td>7.5</td>
<td>11.25</td>
<td>15</td>
<td>22.5</td>
<td>30</td>
<td>37.5</td>
<td>45</td>
<td>60</td>
<td>75</td>
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</tbody>
</table>

### Inverter

- **Input Voltage (Vdc)**: 176 - 325
- **Output Voltage (Vac)**: 115 (110-120) or 230 (220-240)
- **Nominal Output Current (A) 230V/115V**: 17 / 34 | 35 / 70 | 52 / 104 | 69 / 138 | 104 / 208 | 130 / 260 | 174 / 348 | 208 / 416 | 278 / 556 | 348 / 696
- **Input Power (kW)**: 4.5 | 9 | 13.2 | 17.3 | 26.1 | 34.8 | 43.5 | 51.2 | 68.8 | 86
- **Efficiency (%)**: 88 | 89 | 91 | 92 | 92 | 92 | 92 | 93 | 93 | 93
- **Voltage Stability**: 1% static, 5% dynamic with reset to 1% in 40ms
- **Total Harmonic Distortion (THD)**: 1.5% linear load, 5% not linear load (CF=3:1)
- **Overload**: 125% x 10' (Po), 150% 1' (In)

### Inverter

- **Total efficiency**: 81 | 83 | 85 | 85 | 86 | 86 | 87 | 88 | 88 | 88
- **Protection Degree**: IP20
- **Operating Temperature**: 0°C ± 40°C
- **Storage Temperature**: 0°C ± 85°C
- **Relative Humidity**: ≤ 95%
- **Altitude**: ≤ 2000 m. above sea level
- **Colour**: RAL 7032

<table>
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<tr>
<th>Dimensions (mm)</th>
<th>L</th>
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<tr>
<td>1400</td>
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</table>

**Weight (Kg)**

- 450 | 500 | 600 | 650 | 750 | 830 | 920 | 1050 | 1140 | 1300

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**Warning!** * 1400 with 110Vca Output Voltage