Inverter Single-Phase Operating Manual
# IMB Inverter - Operating Manual

## Index

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SAFETY INSTRUCTION</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>GENERAL SYSTEM DESCRIPTION</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>Static Switches</td>
<td>3</td>
</tr>
<tr>
<td>2.2</td>
<td>Maintenance Bypass</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>INSTALLATION</td>
<td>5</td>
</tr>
<tr>
<td>3.1</td>
<td>Mechanical Installation</td>
<td>5</td>
</tr>
<tr>
<td>3.2</td>
<td>Electrical Installation</td>
<td>7</td>
</tr>
<tr>
<td>3.3</td>
<td>Interconnection of control BUS cables between parallel units</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>INITIAL START UP PROCEDURE</td>
<td>9</td>
</tr>
<tr>
<td>4.1</td>
<td>Standalone Unit Startup</td>
<td>9</td>
</tr>
<tr>
<td>4.2</td>
<td>Start-Up Procedure for Hot-standby Systems</td>
<td>13</td>
</tr>
<tr>
<td>4.3</td>
<td>Start-Up Procedure for Parallel Systems</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>USER PANEL</td>
<td>17</td>
</tr>
<tr>
<td>5.1</td>
<td>Main Menu Overview</td>
<td>18</td>
</tr>
<tr>
<td>5.2</td>
<td>SUB MENU 1: Voltage Measurement</td>
<td>19</td>
</tr>
<tr>
<td>5.3</td>
<td>SUB MENU 2: Current Measurement</td>
<td>20</td>
</tr>
<tr>
<td>5.4</td>
<td>SUB MENU 3: Frequency Measurement</td>
<td>21</td>
</tr>
<tr>
<td>5.5</td>
<td>SUB MENU 4: Alarm Messages</td>
<td>22</td>
</tr>
<tr>
<td>5.6</td>
<td>SUB MENU 5: Switching On the System</td>
<td>26</td>
</tr>
<tr>
<td>5.7</td>
<td>SUB MENU 6: Switching Off the Inverter System</td>
<td>27</td>
</tr>
<tr>
<td>5.8</td>
<td>TEST MENU Overview</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>INVERTER CONTROL LOGIC</td>
<td>29</td>
</tr>
<tr>
<td>6.0</td>
<td>Control Logic</td>
<td>29</td>
</tr>
<tr>
<td>6.1</td>
<td>Legend of symbols used</td>
<td>29</td>
</tr>
<tr>
<td>6.2</td>
<td>Inverter control logic</td>
<td>30</td>
</tr>
<tr>
<td>6.3</td>
<td>Bypass</td>
<td>35</td>
</tr>
<tr>
<td>7</td>
<td>TECHNICAL DATA</td>
<td>37</td>
</tr>
</tbody>
</table>
1 SAFETY INSTRUCTIONS

The unit must be used as intended. Follow the instructions given in the Operating Manual and in the attached wiring diagrams and test reports. In case of discrepancy between the Operating Manual and the wiring diagram, priority must be given to the wiring diagrams.

⚠️ 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 equipment cabinets or remove any protective covers from inside the cabinets.

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

⚠️ To completely isolate the equipment, the input, output and battery (if present) switches must be switched off.

⚠️ Connect protective earth before power supply cables.

⚠️ **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.

⚠️ **CE** This equipment complies to the essential requirements of European directives 89/336/EEC and 73/23/EEC.

⚠️ This is a product for restricted sales distribution to informed partners. Installation restrictions or additional measures may be needed to prevent disturbances.
2 GENERAL SYSTEM DESCRIPTION

The inverter converts dc voltage supplied by the rectifier or battery to ac voltage of a precisely stabilised 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, ensure a very low distortion of the output voltage (THD < 1% on linear loads).

The inverter is designed specifically for the application of today's loads i.e. The output harmonic distortion will be maintained at low levels due to a unique adaptive correction technique, even with the application of highly distorted 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 150% of the nominal current), the output voltage is maintained constant. For higher currents the output voltage is reduced, however, this will only occur if the bypass supply is not available. Otherwise the system will switch to bypass operation for currents higher than 110% (adjustable) of the nominal current.

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

2.1 Static Switches

The block diagram illustrates the two static switch sections that use thyristors as switching elements. During normal Inverter 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 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.
2.2 Maintenance Bypass

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

With IMB series inverter systems, switching from different operating modes to maintenance bypass can be performed without interruption. With the maintenance bypass on, the inverter system may be completely switched off, thus permitting maintenance work to be carried out safely (there will only be voltage at the input and output terminals and their connections to the circuit-breakers).

In order to prevent erroneous switching of the maintenance bypass switch IBY that could possibly cause parallel connection of the bypass line and the inverter line, IBY is electronically interconnected with the static inverter switch SSI. Thus, during actuation of IBY, switch SSB will be closed and switch SSI opened automatically, preventing parallel operation of the maintenance bypass network and the inverter.

As an option, an external wall-mounted no-break maintenance bypass switch (see FIG. 2.2) may be supplied. This switch provides simple one-step transfer to maintenance bypass (version 1) without the possibility of erroneous switching and without interruption to the load. For the version 2 type maintenance bypass, an additional position is provided in order to completely isolate the inverter with the one bypass switch. In this way, the inverter may be isolated totally from all supply by switching off the input supply to the inverter.
3 INSTALLATION

3.1 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 system is already unpacked, please ensure storage in a clean environment protected from dust, away from heat sources.

3.1.1 Handling the System

Handling the System by means fork lifter

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

Caution: Secure equipment against being knocked over

![Pic. 1.1 - Moving the SYSTEM by means fork lifter](image-url)
<table>
<thead>
<tr>
<th>Handling the System by means of rollers</th>
<th>The SYSTEM 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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting Up</td>
<td>The 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.</td>
</tr>
</tbody>
</table>
3.2 Electrical Installation

This equipment must be installed by qualified service personnel.

Switch off QIEI, QIRE, 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 SYSTEM area must be fitted with the following label: "Isolate the SYSTEM 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.

PIC. 1.5 - IMB connection diagram
3.3 Interconnection of control BUS cables between parallel units

Note: If the system configuration is hot-standby only one interconnection cable must be configured.
4 INITIAL START UP PROCEDURE

General
The Start Up procedure must be carried out by specialised personnel.
Safety precautions according to the appropriate local safety standards must be applied.
Should problems arise during the Start Up Procedure, call for service assistance.

Preparation
For carrying out the Start Up Procedure, a 3 1/2 digit voltmeter with 1% accuracy, an AC/DC clip-on ammeter and a small screwdriver for potentiometers are needed.
- Check that the ventilation system of the inverter room is ready to operate.
- Check that all switches QIEI, IRE, IUG, IBY are open and the load is off.

4.1 Standalone Unit Startup

A: Vdc Power Supply Check
- Switch on the external Vdc supply to the inverter.
- By means of a DC tester make sure Vdc voltage (coming from the battery or from the rectifier) is present on DC input terminals (+/-) with the correct polarity.
- By means of an AC tester make sure that mains voltage within the rated value is present on emergency line input terminals.
- Precharge the DC filter by pressing push button CPFC placed inside the equipment until relevant luminous signal lights, then close circuit breaker QIEI.
- Wait until the SFP/CPU inverter Panel is illuminated
- Go to the test menu on the operating panel:
  Enter the password 8031.Select the submenu “INV/RECT ON/OFF” and press F1.The inverter will start and after approximately 10s the green led “INV ok” will be permanently lit.
- Press the push-button PB3 on the bottom of ICP card: after few seconds the green led on SS-1F card will be lit.

B: Inverter Voltage Adjustment
- Measure the voltage at the Inverter output.

? Does this voltage correspond to the desired voltage?

no
- Adjust the voltage to the desired value using P2 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 corresponds to nominal voltage). Note also that for parallel systems, if the voltage is changed here, the current sharing will also be affected. Therefore, change voltage settings ONLY IF ABSOLUTELY NECESSARY. Small variations of the voltage will not affect system performance. The inverter is already pre-calibrated in the factory with nominal load.
C: Inverter free-run frequency check

- Insert a pin d=2mm in the red test point S1 on the ICP pcb.
  The red LED LD3 on the ICP pcb must be permanently lit.
  The inverter frequency is now free-running without the internal oscillator.
- Measure the frequency of inverter output.
- 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.

D: Bypass Power Supply Check

- Switch on the external supply for the bypass. Check that the bypass supply voltage at terminals is within ±10% of the nominal input voltage.
- Close IUG.
- Close IRE.

? Does the display on the CPHC16-S pcb for the bypass give the indication “P”?

yes
- Open IRE and exchange any two of the cables at the bypass input terminals.
- Return to D.

no
- 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 again the input supply. Check that it is in accordance with the inverter rating label.
  no: The mains frequency must be within tolerance in order for the bypass to be available
  yes: Continue with E.
E: Synchronisation Check

- Check that the green LED LD1 on the ICM pcb is permanently lit and there is no “S” indication on the bypass electronics.
- On the SS-1F pcb, measure the voltage between the screws Bypass and Inverter.

? Is the voltages < 25Vac?

no

- If the voltage is continuously fluctuating from 0 to 400V there is a synchronisation problem. Switch off IRE 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 p.c.b., then the synchronisation may need to be re-adjusted. 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 re-adjusted using the serial interface of the CPHC16 -S pcb and the PSRS232 and a portable computer.

no: The difference is probably due to distortion of the mains voltage (the inverter voltage is an almost perfect sinewave)

yes: Continue with F

no: Continue with F

F: Static Switch Commutation Check

- **Commutation to the Bypass**
  Press the pushbutton on the CPHC16 pcb for the bypass. The static switch SSB will switch on and SSI will switch off, as indicated on the front panel and on the SS-1F pcb (red LEDs).

- **Commutation to Inverter**
  Press the pushbutton 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 SS-1F pcb (green LEDs).

Commutations to/from bypass and inverter may also be performed using the Test Menu of the Smart Front Panel.
• 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 can be deleted by pressing F3 followed by the F1 key.

• Date and clock adjustment.
  Enter the “7) Test” menu (Password 8031) and select “7) Clock” menu 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.

  The start-up procedure for a stand-alone unit has been successfully completed now.
4.2 Start-Up Procedure for Hot -standby Systems

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

Ensure that the interconnecting BUS cable is connected according to section 3.3.

- 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 QIEI of the first unit (precharge procedure must be followed).
- 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.
- 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").

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 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.
THE SYSTEM IS NOW IN NORMAL OPERATION AND THE HOT-STANDBY START-UP HAS 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.
4.3 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 QIRE, QIEI and QIUG of the last unit checked with the procedure in section 2.

**K**
- 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 QIEI 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.
### 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.
5 USER PANEL

LED Indication

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

- LED 1 INVERTER OK
- LED 2 INVERTER FEEDING LOAD
- LED 3 LOAD IS SUPPLIED
- LED 4 MAINS OK (BYPASS)
- LED 5 BYPASS FEEDING LOAD
- LED 6 COMMON ALARM
- LED 7 MAINTENANCE BYPASS
- LED 8 EPO
5.1 Main Menu Overview

In the MAIN MENU the first line of the display always shows the operation mode of the Inverter. The second line of the display shows the sub menu that can be activated by pressing “ENTER”.

**MAIN MENU**
Scrolling in the MAIN MENU by pressing “up” or “down” arrows

**SUB MENUS**
Activating the SUB MENUS by pressing “ENTER”

- **SUB MENU 1**: Voltage Measurement, see section 5.2
- **SUB MENU 2**: Current Measurement, see section 5.3 (This may read “CURRENTS/TEMP” if one of the optional temperature measurements is selected.)
- **SUB MENU 3**: Frequency Measurement, see section 5.4
- **SUB MENU 4**: Alarm Messages, see section 5.5
- **SUB MENU 5**: System Startup, see section 5.6
- **SUB MENU 6**: System Shutdown, see section 5.7
- **SUB MENU 7**: Adjustments, see section 5.10 (password protected)

**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 Inverter OUTPUT POWER, depending on the system configuration.
5.2 SUB MENU 1: Voltage Measurement

All the values are given in Volts, if you want to adjust the measurements, consult the Service Manual.

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

- XXX = Inverter Output Voltage
- XXX = voltage L1-N
5.3 SUB MENU 2: Current Measurement

In this sub menu the values of various INVERTER currents are shown.

The Smart Front Panel also provides the calculation of important values as Thermal Image, Output Power, Output Current, Output Load, which are described below:

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 inverter 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 inverter 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:

\[ P_0 = V_L I_L \]

PERCENTAGE OUTPUT LOAD of each phase:

\[ P_0 = \frac{V_L I_L}{P_{nom}(kVA)} \]

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

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

- XXXXXXX = output power (VA)
- XXX = current L1
• **ZZZ** = percentage of calculated overload time already elapsed (only shown when activated in the test menu)

• **XXX** = percentage calculated

---

5.4 SUB MENU 3: Frequency Measurement

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

• **XXX** = frequency in Hz, measured at the input of IUG
5.5 SUB MENU 4: Alarm Messages

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

- If no alarm is activated, 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”.

- Pressing “down” at the indication of the last alarm the message LAST ALARM will be displayed for two seconds and then automatically return to the indication of last alarm.
Alarm Messages / Alarm Memory

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 arrow "up" or down" 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".

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

Overtemperature (04)  The inverter components are operating at an excessive temperature. This can be due to extreme environmental conditions or a failure within the inverter sections.

If the bypass is available the Inverter 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 Inverter will continue to supply the load for a further 10 minutes before shutting down.

Inverter Failure (05)  The inverter is ON but the inverter voltage or inverter conditions are not in order.

Bypass Feeding Load (06)  The load is being supplied by the bypass supply

Bypass not Available (08)  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 (09)  The output switch is open.

Common Alarm (10)  Is the OR of all the alarms.

Auxiliary Alarm (11)  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.

- IUG 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.

To determine which of the alarm(s) are present refer to the section “PCB Description”.
Retransfer blocked (12)  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 inverter is unattended and the alarm Retransfer blocked occurs, after 1-2 min, the inverter 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 inverter retransfer will remain blocked, the inverter must be reset manually by pressing ENTER.

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

Thermal Image (13)  The calculated load for the unit is too large and the inverter static switch has switched off.
5.6 SUB MENU 5: Switching On the 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 inverter status are monitored.

After carrying out all steps correctly, the system is in normal operation - the load is supplied by the inverter, the static bypass system is available.
5.7 SUB MENU 6: Switching Off the Inverter System.

- 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 inverter status are monitored.

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

Attention! Although all power switches (except IBY) are opened, there is still voltage at the inputs of the power switches QIEI, IRE and IBY and at the respective terminals.
5.8 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.
6 INVERTER CONTROL LOGIC

6.0 Control Logic

The Inverter Control logic is situated in the centre of the front part of the inverter. On the covers of the rack, the various potentiometers, test points and LEDs are briefly labelled. A more detailed explanation is given in this chapter.

6.1 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
6.2 Inverter control logic

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

**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/I - 500**

Inverter electronic power supply
- inverter electronic power supply
- inverter input voltage monitoring
- generation of the battery-discharging alarm

**IPR-1F**

Inverter control and regulation (parallel configuration)
- parallel regulation of up to 8 inverters
- system control for up to 8 inverters (together with ICP pcb)
- cold-standby control
- load monitoring
- redundancy monitoring
FIG. 1.3 illustrates the LEDs and switches of the ICP PCB which are accessible from the front.

- **PB2 Inv. ON / OFF**
  - Push to switch the inverter ON/OFF

- **LD1 PSP OK**
  - Inv. electronic power supply in order: green LED is illuminated

- **LD3 Osc. Failure**
  - Defect in the internal quartz oscillator: red LED is illuminated

- **PB1 Reset**
  - RESET

- **LD9 Inverter OK**
  - Inverter in order: green LED is illuminated

- **LD8 Inverter volts OK**
  - Inv. voltage within tolerance (within +/- 10% of Vnom): green LED is illuminated

- **LD2 Retr. blocked**
  - Retransfer to inv. operation is blocked after 5 attempts within 3 minutes: red LED is illuminated

- **LD4 Overtemperature**
  - Overtemperature within the inv. section: red LED is illuminated

- **LD5 SSI failure**
  - The inverter static switch has failed to switch ON/OFF: red LED is illuminated

- **LD6 Inverter ready**
  - 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

- **LD7 IUG failure**
  - A failure within the monitoring of the output switch: red LED is illuminated

- **S1 Osc. Block.**
  - Disable the quartz oscillator

- **S2 Inverter Monit. Block.**
  - Disable inverter voltage monitoring

- **TP1 INV. Volts Vnom=6V**
  - Proportional to the inv. voltage. 6V = nominal inverter voltage

- **P1 INV. Volts tol.adjust**
  - Inv. voltage tolerance adjust for 6V at TP1 with nom. voltage

- **PB3 SSI ON**
  - 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
FIG. 1.5 illustrates the potentiometers, LEDs and test points of the IPS-500 which are accessible from the front.

- Power ON: green LED is illuminated
- Power supply OK: green LED is illuminated
- Electronics supply voltage +12V
- 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.
- Parallel Operation On: This inverter is connected with another or more inverters to the output in parallel.

- Redundancy Not OK: Redundant units only. The load has increased or an inverter is off so that if this unit fails, the system must transfer to the bypass supply.

- Parallel Fault: A fault has occurred with the regulation of the inverter in parallel with another inverter.

- SSI pulse generator failure: A failure or loss of synchronism has occurred within the SSI ON pulse generator. To reset press PB3 and then PB1 on the ICP pcb.

- Reference current for parallel regulation 6Vrms = nominal current of the system (0.8 p.f.).

- Inverter output current for parallel regulation 6Vrms = nominal current of this unit (0.8 p.f.).

- Difference current for parallel regulation

- Output current of this unit. 8Vdc = nominal load current of this unit (0.8 p.f.)

- System output current. 8Vdc = nominal load current on the system (0.8 p.f.)

- Redundancy current. 8Vdc = nominal load current on the remainder of the system (without this unit, 0.8 p.f.)

- Power of this unit. 6Vdc = nominal load power on this unit

- Power of the system. 6Vdc = nominal load power on the system

- Output voltage

- Adjust for 6Vrms at TP1 with nominal load current (0.8 p.f.)

- Adjust for 6Vrms at TP2 with nominal load current (0.8 p.f.)

- Adjust for 8Vdc at TP4 with nominal load current (0.8 p.f.)

- Adjust for 8Vdc at TP5 with nominal load current (0.8 p.f.)

- Adjust for 6Vdc at TP7 with nominal load

- Adjust for 6Vdc at TP8 with nominal load

- Manual: manual switching on/off of the inverter permitted

- Auto: inverter will automatically switch on/off depending on the load applied and the internal programming of IPR-1F pcb.
6.3 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
FIG. 1.8 illustrates the display, switches and connectors of the CPHC16 - S PCB which are accessible from the front.

### DIAGNOSTICS

- **Bypass**
  - Manual transfer to bypass pushbutton
  - Not used

- **RS 232**
  - 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>E²PROM 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>4</td>
<td>P</td>
<td>Incorrect phase rotation</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Bypass square wave generation error</td>
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<tr>
<td>6</td>
<td>O</td>
<td>Output out of tolerance</td>
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<td>7</td>
<td>L</td>
<td>Overload</td>
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<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>
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<tr>
<td>11</td>
<td>b</td>
<td>Bypass blocked</td>
</tr>
<tr>
<td>12</td>
<td>S</td>
<td>Bypass not synchronised</td>
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<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>
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<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>--</td>
<td>SSB on</td>
</tr>
</tbody>
</table>

In normal condition the display shows a red segment rotating clockwise. If more than one alarm is present, only the one with the higher priority is displayed.
## 7 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>
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<tbody>
<tr>
<td>Voltage Vcc</td>
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<tr>
<td>Input Voltage (Vcc)</td>
<td>95 - 165</td>
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<tr>
<td>Output Voltage (Vca)</td>
<td>1Ph 115 (110-120) or 230 (220-240)</td>
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<tr>
<td>Nominal Output Voltage (A) 230V/115V</td>
<td>17 / 34</td>
<td>35 / 70</td>
<td>52 / 104</td>
<td>69 / 138</td>
<td>104 / 208</td>
<td>139 / 278</td>
<td>174 / 348</td>
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<tr>
<td>Input Power (kW)</td>
<td>4.6</td>
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<td>13.6</td>
<td>18.2</td>
<td>27.2</td>
<td>36</td>
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<td>87</td>
<td>88</td>
<td>88</td>
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<td>89</td>
<td>89</td>
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<td>Voltage Stability</td>
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<td></td>
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<tr>
<td>Total Harmonic Distortion (THD)</td>
<td>&lt;5% not Linear Load according to IEC62040-3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crest Factor</td>
<td>3:1 without power derating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload</td>
<td>125% x 10 min., 150% 1 min. Pn</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total Efficiency</td>
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<td>81</td>
<td>82</td>
<td>83</td>
<td>83</td>
<td>84</td>
<td>84</td>
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<tr>
<td>Protection Degree</td>
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<td></td>
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</tr>
<tr>
<td>Operating Temperature</td>
<td>0°C ± 40°C</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Storage Temperature</td>
<td>0°C ± 85°C</td>
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<td></td>
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<tr>
<td>Relative Humidity</td>
<td>≤ 95%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Altitude</td>
<td>1000 m. above sea level</td>
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<td></td>
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<td>Dimensions (mm)</td>
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<td>1400</td>
<td>1400</td>
<td>1800</td>
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<td></td>
<td>H 1800</td>
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<td>Weight (Kg)</td>
<td>450</td>
<td>500</td>
<td>600</td>
<td>650</td>
<td>820</td>
<td>900</td>
<td>1000</td>
</tr>
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</table>
## IMB Inverter - Operating Manual

### Inverter

<table>
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<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>
<th>60</th>
<th>80</th>
<th>100</th>
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<tbody>
<tr>
<td>Vcc Voltage</td>
<td>220Vcc</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Voltage (Vdc)</th>
<th>176 - 325</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage (Vac)</td>
<td>1Ph 115 (110-120) or 230 (220-240)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal Output Current (A)</th>
<th>17 / 34</th>
<th>35 / 70</th>
<th>52 / 104</th>
<th>69 / 138</th>
<th>104 / 208</th>
<th>130 / 260</th>
<th>174 / 348</th>
<th>208 / 416</th>
<th>278 / 556</th>
<th>348 / 696</th>
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</thead>
<tbody>
<tr>
<td>Input Power (kW)</td>
<td>4.5</td>
<td>9</td>
<td>13.2</td>
<td>17.3</td>
<td>26.1</td>
<td>34.8</td>
<td>43.5</td>
<td>51.2</td>
<td>68.8</td>
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<td>Efficiency (%)</td>
<td>88</td>
<td>89</td>
<td>91</td>
<td>92</td>
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<td>93</td>
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<tr>
<td>Voltage Stability</td>
<td>1% static, 5% dynamic with reset to 1% in 40ms</td>
<td></td>
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</table>

**Total Harmonic Distortion (THD)** < 5% with nonlinear load according to IEC612040-3

**Crest Factor**

3:1 without power derating

**Overload**

125% 10 min, 150% 1 min Pn

<table>
<thead>
<tr>
<th>Total efficiency</th>
<th>81</th>
<th>83</th>
<th>85</th>
<th>85</th>
<th>86</th>
<th>86</th>
<th>87</th>
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</table>

<table>
<thead>
<tr>
<th>Protection Degree</th>
<th>IP20</th>
</tr>
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</table>

**Operating Temperature**

0°C ± 40°C

**Storage Temperature**

0°C ± 85°C

**Relative Humidity**

≤ 95%

**Altitude**

1000 m above sea level

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
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</table>

<table>
<thead>
<tr>
<th>Weight (Kg)</th>
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<th>500</th>
<th>600</th>
<th>650</th>
<th>750</th>
<th>830</th>
<th>920</th>
<th>1050</th>
<th>1140</th>
<th>1300</th>
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</table>