MASTER 2.0

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Complete power plant controller with mains paralleling

Technical Documentation

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Date	Version	Comments	Par
Nov 12th 2008	A	Derived from MASTER 2.0 documentation. Starting point.	LB
Feb 19th 2008	B	Added menu references. Global revision by all the team	JFB/JAM
April 6th 2009	C	Update and revision.	JFB/JAM
02 Fev 2010	D	Ethernet connexion update. Wiring diagram update. SD Card modification. Breaker modification.	JFB

You can download this documentation and the different documentation relating to MASTER 2.0 on our web site: http://www.cretechnology.com/ .

Documentation list on web site:
A54 Z0 9 0020 x-EN is the Master 2.0 technical documentation (this manual). This documentation is generally used for product integration.
used as reference during the installation phase. It is generally called “HELP FILE”.
A53 Z0 9 0020 x-EN is the Complete variable list with labels, units and limits (see §14 below) in English, in PDF format. This documentation is generally used as reference during the integration phase.
A53 Z0 9 0020 x- is the Complete variable list with labels, units and limits (see §14 below) in all languages, in EXCEL WORKBOOK format. This documentation is generally used as reference during the installation phase. It is generally called “EXCEL FILE”.

NOTE:
Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Apply all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.
Contact your CRE distributor for course training.

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1 Overview

MASTER 2.0 is a power plant controller for gensets paralleled with one or several mains.
This product includes all necessary functions:

- Power plant management with several mains
- Three phase mains failure
- Electrical protection for power plants and mains
- Manual and automatic paralleling with mains (frequency, phase, voltage)
- KW power management with several modes:
  - No break change over with load transfer
  - Permanent paralleling in base load
  - Permanent paralleling in peak shaving mode
- Power factor control when paralleling with mains.

1.1 European Union Directive Compliance CE

The EMC Directive (89/336/EEC) deals with electromagnetic emissions and immunity. This product is tested by applying the standards, in whole or in part, which are documented in the following technical construction file:
CEM 2004/108/EC, which replaces directive CEM (89/336/EEC) relative to electromagnetic emissions as from July 20th 2009.
This product is developed to respect harmonized norms:
EN 55099:2009
EN 55099:2010
EN 55088:2008
2006/95/EC (replaced directive 73/23/EEC since January 16th 2007).
SAE J1939/71, /73, /31
Other norms:
EN 61326-1: 2006 (Industrial location)
EN 55011
EN 61000-3-2
EN 61000-3-3

NOTE: This is a Class A product. In a domestic environment it may produce radio interference. The user is required to take any necessary measures.

1.2 Environment

Temperature
Operating 0 to 55°C
Storage -30 to +70°C

Humidity 5 to 95%

Tropic proof circuits for normal operation in humid conditions.
Front panel: IP54 protection.
Back panel: IP20 protection.

Altitude 2000m

1.3 Characteristics

Size 248x197x57mm (9.76x7.76x2.24in)
Weight 1.9kg (4.2oz)

1.4 Panel cut-out:

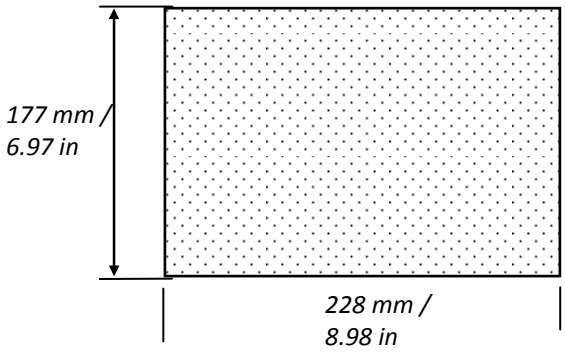


Figure 1 - Panel cut-out

Note: Cut-out must be cleaned and de-burred before mounting.

2 Description

2.1 Front panel

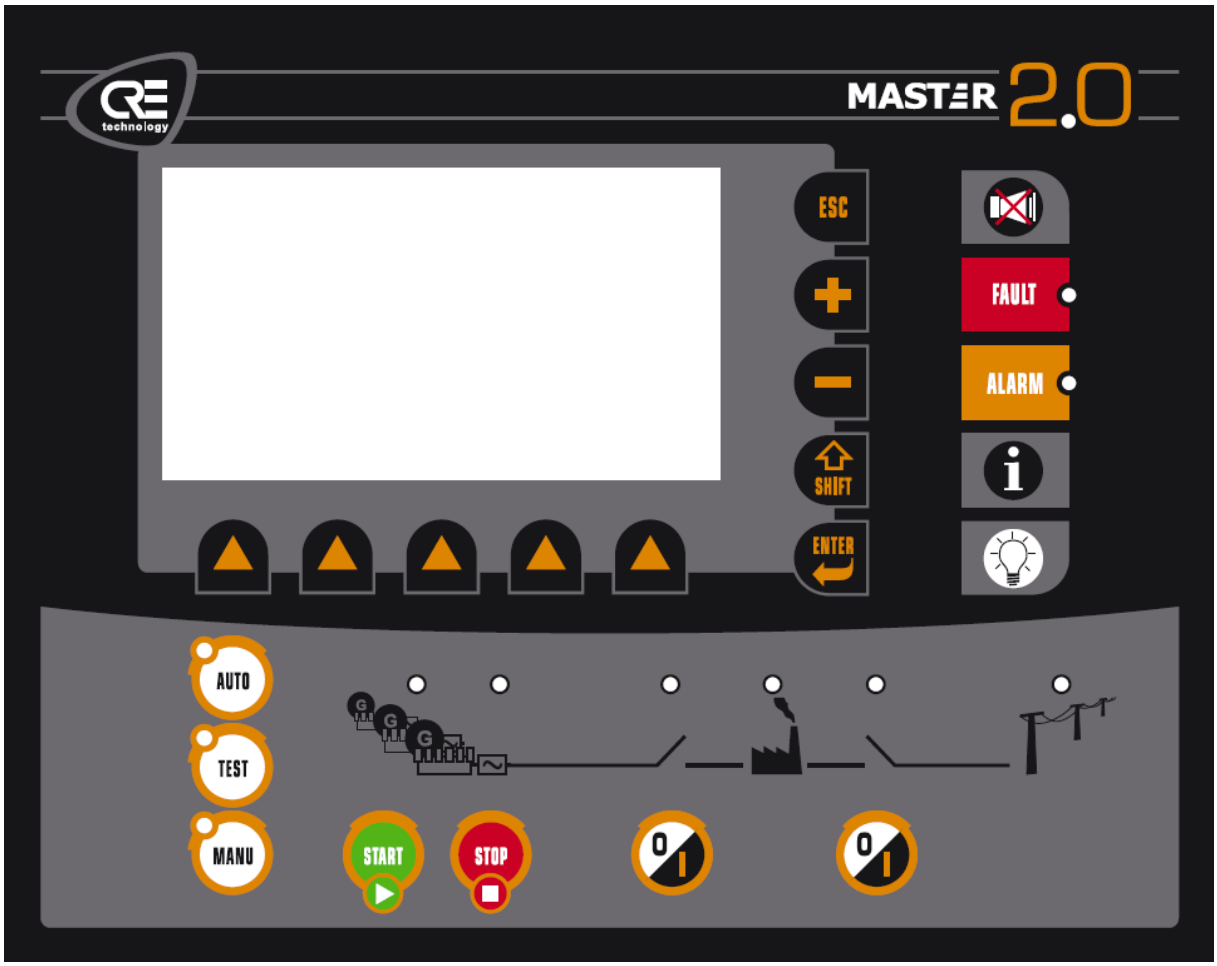


Table 1 - MASTER 2.0 Front Panel

The display panel allows setting up and monitoring of the MASTER 2.0 configuration and the power plant it controls. It provides a large LCD display and a keypad. See "User interface" chapter, page 20, for more details about the functions of LEDs & Keys.

LCD characteristics	Value	Unit
Viewing area	240x128	dots
	114x64 (4.49x2.52)	mm (in)
	30x16	Characters
Character size (small font)	2.7x3.6 (0.1x0.14)	mm (in)
(standard font)	3.6x3.6 (0.14x0.14)	mm (in)
(large font)	9.45x9.45 (0.37x0.37)	
Back light	60	cd/m²
LCD mode	STN	

Table 2 - LCD screen characteristics

2.1.1 Display panel

The five dedicated keys of the display panel allow direct access to special menus or functions. See the "User interface" section for more details about the functions of LEDs & Keys.

Table 3 - Display Panel keys

Key		Navigation mode	Input mode (during parameter modification)
Navigation bar		Scroll / select menus and parameters.	Change parameter value.
Enter		Enter a menu / switch to 'Input mode'	Validate parameter and return to 'Navigation mode'
Shift		Used with other keys only (+, -, i).	Not used.
+		Shortcut to special function. Increase frequency of plant in manual mode. Increase voltage when associated with Shift key in manual mode.	Increase parameter value. Choose next preset value.
-		Shortcut to special function. Decrease frequency of plant in manual mode. Decrease voltage when associated with Shift key in manual mode.	Decrease parameter value. Choose previous preset value.
Esc		Return to parent menu.	Discard parameter changes and return to 'Navigation mode'

2.1.2 Service panel

Key		Function
Buzzer		This key will stop the buzzer and turn the associated LED off. The associated red LED indicates the status of the buzzer output.
Fault		Direct access to the Fault menu. An associated red LED indicates the Fault status of the plant. Pressing this key will switch to the associated menu, showing active faults. Pressing a second time on the same key will switch back to the menu displayed beforehand.
Alarm		Direct access to the Alarm menu. An associated orange LED indicates the Alarm status of the plant. Pressing this key will switch to the associated menu, showing active alarms. Pressing a second time on the same key will switch back to the menu displayed beforehand.
Info		1. Direct access to global monitoring page (user configurable). 2. Save parameters in flash storage when pressed with SHIFT: this action is called “SHIFT-I” Pressing this key will switch to the associated menu, which is custom made and contains parameters the user wants to monitor easily. Pressing a second time on the same key will switch back to the menu displayed beforehand.
Bulb		LED test: pressing this key will turn on all MASTER 2.0 LEDs. It is a simple test to check the LEDs and the keypad.

Table 4 - Service Panel keys

2.1.3 Control panel

The control panel allows the user to pilot and control the generator. See "User interface" chapter, page 20, for more details about the functions of LEDs & Keys.

Key		Function
LED upper right	**2.0**	This LED is not associated to any key. It is illuminated when a key is pressed and switched off when all keys are released. This LED also stays on during a save parameters command (see SHIFT-I above).
Auto		Switches the system to automatic mode. The associated LED is ON when AUTO mode is activated.
Test		Switches the system to test mode. The associated LED is ON when TEST mode is activated.
Manu		Switches the system to manual mode. The associated LED is ON when MANU mode is activated.
Start		Starts the plant (only available in manual mode).
Stop		Stops the plant (only in manual mode).
O/I		Closes/opens the bus bar breaker (only in manual mode).
O/I		Closes/opens the mains breaker if available (only in manual mode).

Table 4 - Control Panel keys

2.1.4 Control panel LEDs

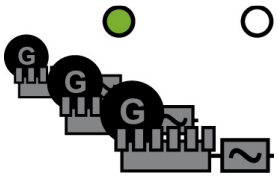
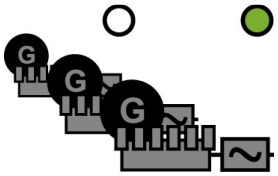
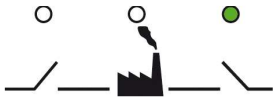
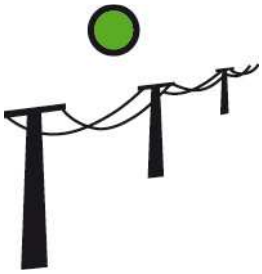
Led		Function
Plant		Shows green when plant is running.
Bus		Shows green when plant voltage is present at bus.
Bus bar breaker		Shows green when bus bar breaker is closed.
Mains breaker		Shows green when mains breaker is closed.
Mains / Bus voltage		Shows green when voltage is present at Mains/bus input

Table 5 - Control Panel LEDs

2.1.5 Upper Panel LED

The upper panel displays the status of the power supply. There is one green LED which acts as the dot in the 2.0 logo. This LED lights up when MASTER 2.0 is powered.

2.2 Rear panel - Connectors

2.2.1 Overview

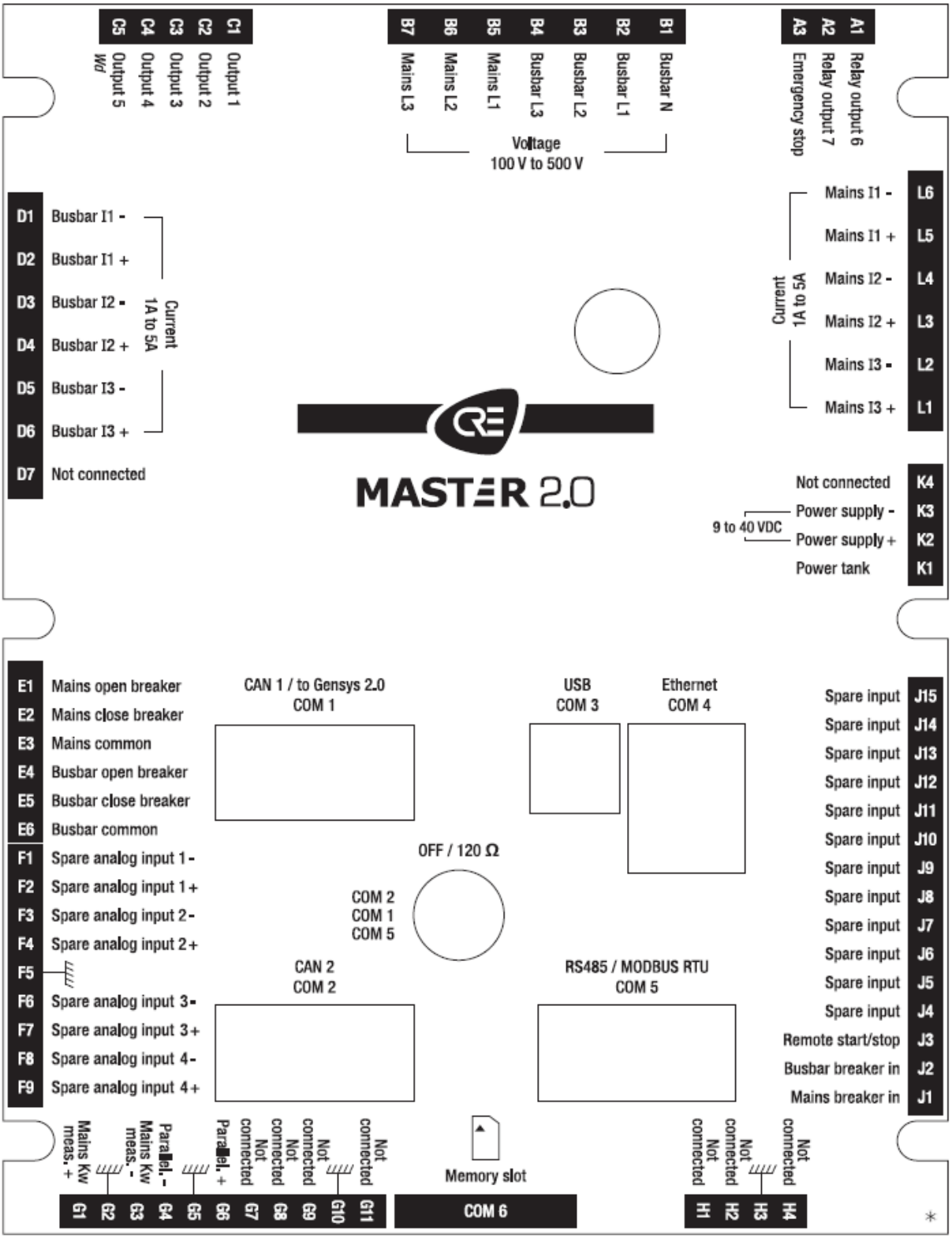


Figure 2 - Rear panel

2.2.2 Inputs/Outputs

Pin#	Description	Terminal capacity (mm² / AWG)	Comment
A1	Relay out Output 6	2.5 / 12	Configurable output. 16 Amps max @ 240V
A2	Relay out Output 7	2.5 / 12	
A3	Emergency stop	2.5 / 12	To battery positive, normally closed
B1	Busbar N	2.5 / 12	May not be connected: if not connected, MASTER 2.0 will calculate a virtual neutral voltage.
B2	Busbar L1	2.5 / 12	Power plant voltage measurement. 100 to 480 V-AC line to line. Frequency: 50 or 60 Hz. 100 mA / 600 V-AC fuses.
B3	Busbar L2	2.5 / 12	
B4	Busbar L3	2.5 / 12	
B5	Mains L1	2.5 / 12	Mains voltage measurement. 100 to 480 V-AC line to line. Frequency: 50 or 60 Hz. 100 mA / 600 V-AC fuses.
B6	Mains L2	2.5 / 12	
B7	Mains L3	2.5 / 12	
C1 to C5	Output 1 to 5	2.5 / 12	350 mA. Over current protected. Reactive load. Each output can be configured with a specific function or program with equations. C5 can also be used as a watchdog output (configurable)
D1	Busbar I1-	2.5 / 12	Power plant current measurement 0 to 5 Amps. Maximum rating: 15 Amps during 10s. 1 W max. consumption. External current transformer is normally used.
D2	Busbar I1+	2.5 / 12	
D3	Busbar I2-	2.5 / 12	
D4	Busbar I2+	2.5 / 12	
D5	Busbar I3-	2.5 / 12	
D6	Busbar I3+	2.5 / 12	
D7	Not connected	2.5 / 12	
E1	Mains open breaker	2.5 / 12	Two configurable relays with one in common, one for closing, and one for opening. 240 V AC, 5 Amps. Isolated contact.
E2	Mains close breaker	2.5 / 12	
E3	Mains common	2.5 / 12	
E4	Busbar open breaker	2.5 / 12	Two configurable relays with one in common, one for closing, and one for opening. 240 V AC, 5 Amps. Isolated contact.
E5	Busbar close breaker	2.5 / 12	
E6	Busbar common	2.5 / 12	
F1	Spare analog input 1-	2.5 / 12 (shielded)	0 to 10 kOhms resistive sensors with programmable gain.

F2	Spare analog input 1+	2.5 / 12 (shielded)	
F3	Spare analog input 2-	2.5 / 12 (shielded)	0 to 10 kOhms resistive sensors with programmable gain.
F4	Spare analog input 2+	2.5 / 12 (shielded)	
F5	Shield	2.5 / 12 (shielded)	Must be used to protect resistive measurement from external perturbations.
F6	Spare analog input 3-	2.5 / 12 (shielded)	0 to 400 Ohms resistive sensors.
F7	Spare analog input 3+	2.5 / 12 (shielded)	
F8	Spare analog input 4-	2.5 / 12 (shielded)	0 to 400 Ohms resistive sensors.
F9	Spare analog input 4+	2.5 / 12 (shielded)	
G1	±20 mA +	2.5 / 12 (shielded)	±10 V (20 kOhms input) or ±20 mAmps (50 Ohms input). Used as Mains power measurements.
G2	Shield	2.5 / 12	
G3	±20 mA -	2.5 / 12 (shielded)	
G4	Parallel. -	2.5 / 12 (shielded)	5V (10KOhms) Load sharing and power set level (kW only). Compatibility with traditional analog load shares lines (often called Parallel Lines). Compatibility with Wheatstone bridge. Only used with old ILS Isolated.
G5	Shield	2.5 / 12	
G6	Parallel. +	2.5 / 12 (shielded)	
G7	Not connected	2.5 / 12	Analogue load control output (power plant without CANbus communication)
G8	Not connected	2.5 / 12	
G9	Speed out	2.5 / 12	
G10	Shield	2.5 / 12	
G11	Speed ref	2.5 / 12	
H1	Not connected	2.5 / 12	
H2	Not connected	2.5 / 12	
H3	Shield	2.5 / 12	
H4	Not connected	2.5 / 12	
J1	Mains breaker in	2.5 / 12	Digital input with 10 kOhms pull-up. Dedicated input for mains breaker feedback. Accepts NO or NC contact to 0V. Not isolated.
J2	Busbar breaker in	2.5 / 12	Digital input with 10 kOhms pull-up. Dedicated input for bus bar breaker feedback. Accepts NO or NC contact to 0V. Not isolated.

<table>
<tr><td>J3</td><td>Remote start/stop</td><td>2.5 / 12</td><td>Digital input with 10 kOhms pull-up.
Dedicated input for remote start/stop request in Auto mode.
Accepts NO or NC contact to 0V.
Not isolated.</td></tr>
<tr><td>J4 to J15</td><td>Spare Input</td><td>2.5 / 12</td><td>Digital inputs with 10 kOhms pull-up.
10 inputs can be configured with a specific function or be programmed with PLC equations.
Accepts NO or NC contact to 0V.
Not isolated.</td></tr>
<tr><td>K1</td><td>Power Tank</td><td>2.5 / 12</td><td>Used for 12V power supply backup during crank time. An externally supplied capacitor can be externally connected between ground and this line to have a better tolerance upon power failure.</td></tr>
<tr><td>K2</td><td>Power supply +</td><td>2.5 / 12</td><td rowspan="2">9 to 40 V, 10 Watt consumption (without actuator).
Polarity inversion protection.
Note:
The "Power supply -" must be wired between all the modules using 4 mm² wires. See "state of the art" rules wiring diagram.
5 Amp / 40 VDC fuse recommended.</td></tr>
<tr><td>K3</td><td>Power supply -</td><td>2.5 / 12</td></tr>
<tr><td>K4</td><td>Not connected</td><td>2.5 / 12</td><td></td></tr>
<tr><td>L1</td><td>Mains I3+</td><td>2.5 / 12</td><td rowspan="6">Bus/Mains current measurement.
1 to 5 Amps. Maximum rating: 15 Amps during 10s.
1 VA consumption.
External current transformer is normally used.</td></tr>
<tr><td>L2</td><td>Mains I3-</td><td>2.5 / 12</td></tr>
<tr><td>L3</td><td>Mains I2+</td><td>2.5 / 12</td></tr>
<tr><td>L4</td><td>Mains I2-</td><td>2.5 / 12</td></tr>
<tr><td>L5</td><td>Mains I1+</td><td>2.5 / 12</td></tr>
<tr><td>L6</td><td>Mains I1-</td><td>2.5 / 12</td></tr>
<tr><td>COM1</td><td>CAN1 inter MASTER 2.0/ GENSYS 2.0</td><td>Male DB9 (shielded)</td><td>125 kbauds
Standard CAN© bus.
Uses a proprietary protocol to communicate with other MASTER 2.0 and GENSYS 2.0 units (kW, kVAR, dead bus management) for data sharing.
Isolated.
<table>
<tr><td>SHIELD</td><td>SHIELD</td></tr>
<tr><td>PIN 1</td><td>NC</td></tr>
<tr><td>PIN 2</td><td>CAN-L</td></tr>
<tr><td>PIN 3</td><td>GROUND-1</td></tr>
<tr><td>PIN 4</td><td>NC</td></tr>
<tr><td>PIN 5</td><td>GROUND-2</td></tr>
<tr><td>PIN 6</td><td>GROUND-1</td></tr>
<tr><td>PIN 7</td><td>CAN-H</td></tr>
<tr><td>PIN 8</td><td>NC</td></tr>
<tr><td>PIN 9</td><td>NC</td></tr>
</table></td></tr>
</table>

<table>
<tr>
<td>COM2</td>
<td>CAN2 options
CANOPEN</td>
<td>Male DB9
(shielded)</td>
<td>125 kbauds
Standard CAN© CANOPEN©.
Used to communicate with remote I/O (WAGO) (see remote I/O chapter).
<table>
<tr><td>SHIELD</td><td>SHIELD</td></tr>
<tr><td>PIN 1</td><td>NC</td></tr>
<tr><td>PIN 2</td><td>CAN-L</td></tr>
<tr><td>PIN 3</td><td>GROUND-1</td></tr>
<tr><td>PIN 4</td><td>NC</td></tr>
<tr><td>PIN 5</td><td>GROUND-2</td></tr>
<tr><td>PIN 6</td><td>GROUND-1</td></tr>
<tr><td>PIN 7</td><td>CAN-H</td></tr>
<tr><td>PIN 8</td><td>NC</td></tr>
<tr><td>PIN 9</td><td>NC</td></tr>
</table>
</td>
</tr>
<tr>
<td>COM3</td>
<td>USB</td>
<td>USB
Type B
High Quality</td>
<td>Type B standard USB connector.
CRE use only.</td>
</tr>
<tr>
<td>COM4</td>
<td>Ethernet</td>
<td>RJ45 CAT5</td>
<td>Standard RJ45 ETHERNET connector.
Isolated. Uses TCP/IP protocol to communicate with external world.
<table>
<tr><td>PIN 1</td><td>Tx pair</td></tr>
<tr><td>PIN 2</td><td>Tx pair</td></tr>
<tr><td>PIN 3</td><td>Rx pair</td></tr>
<tr><td>PIN 4</td><td>NC</td></tr>
<tr><td>PIN 5</td><td>NC</td></tr>
<tr><td>PIN 6</td><td>Rx pair</td></tr>
<tr><td>PIN 7</td><td>NC</td></tr>
<tr><td>PIN 8</td><td>NC</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr>
<td>COM5</td>
<td>RS485
MODBUS RTU</td>
<td>Male DB9
(shielded)</td>
<td>4800, 9600 or 19200 bps.
Used to communicate with SCADA.
MODBUS RTU slave. Read (04 and 03) and write (06) functions.
2 wires mode. Use twisted pair with shield and GROUND.
Isolated.
<table>
<tr><td>SHIELD</td><td>SHIELD</td></tr>
<tr><td>PIN 1</td><td>NC</td></tr>
<tr><td>PIN 2</td><td>NC</td></tr>
<tr><td>PIN 3</td><td>GROUND</td></tr>
<tr><td>PIN 4</td><td>GROUND</td></tr>
<tr><td>PIN 5</td><td>B</td></tr>
<tr><td>PIN 6</td><td>A</td></tr>
<tr><td>PIN 7</td><td>NC</td></tr>
<tr><td>PIN 8</td><td>NC</td></tr>
<tr><td>PIN 9</td><td>GROUND</td></tr>
</table>
</td>
</tr>
<tr>
<td>COM6</td>
<td>Memory slot</td>
<td>SD</td>
<td>Memory slot used for extensions</td>
</tr>
</table>

Table 6 - Inputs/Outputs description

3 User interface

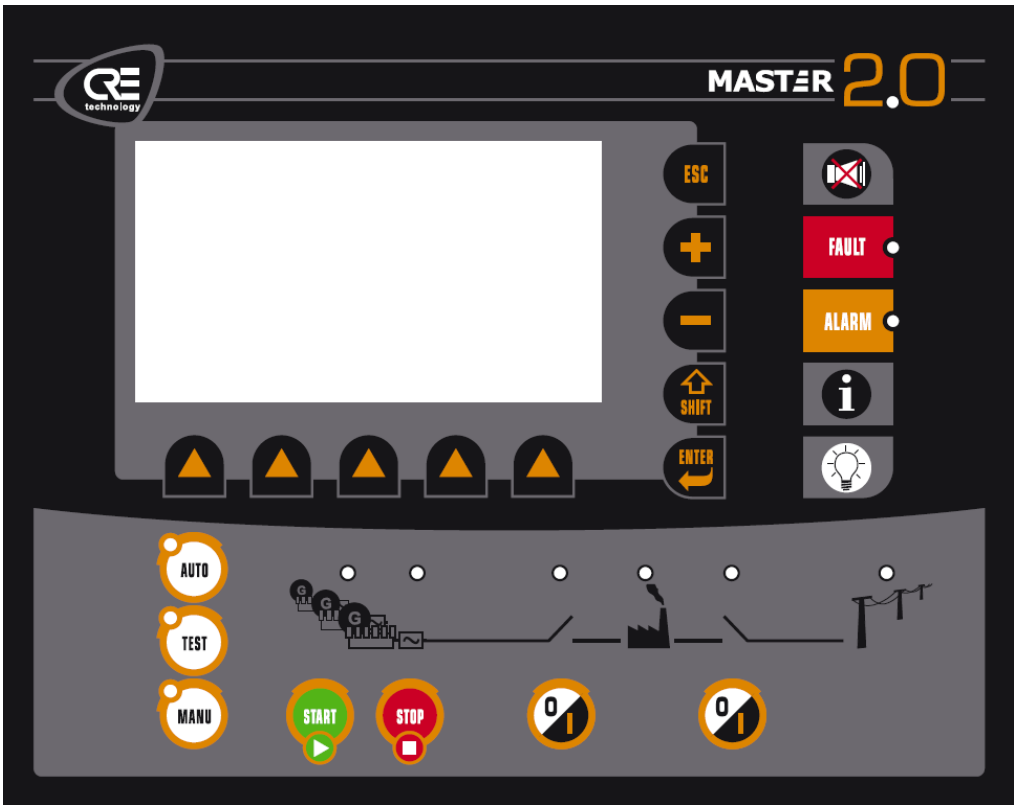


Figure 3 - User interface

The user interface can be controlled through two different ways:
-Directly on local browser using front panel LCD screen and keyboard.
-Remotely through an internet browser running on a PC.
In both cases, the accessed menus are the same. Only the user interface, LOCAL or PC, changes.
On power up, MASTER 2.0 displays a WELCOME SCREEN during a short time, then switches to plant status (if EMERGENCY STOP is not connected):

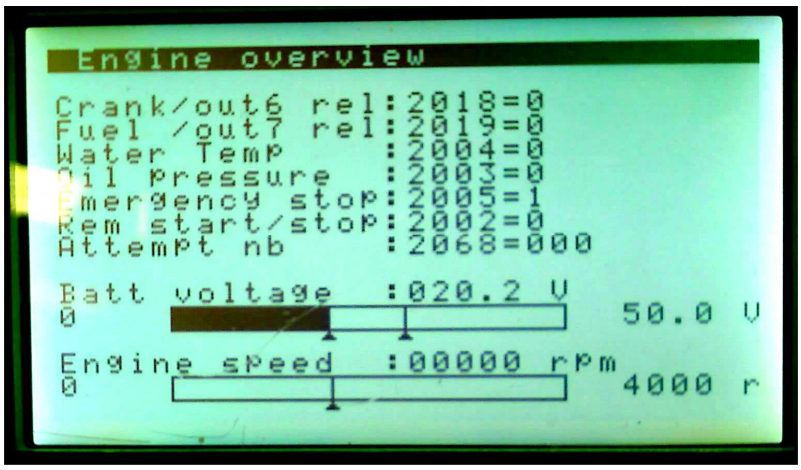


Figure 4 - Plant status screen

3.1.1 Security levels and passwords

To manage menu access, the MASTER 2.0 has different security levels which are password protected. These levels are explained in the next table.
Four levels of authorization exist in the MASTER 2.0. The four levels are:

Level	Default password	Authorization	Accessible menu
-1	G59 – Meter preset (options) This is a special function access (see §10.5 for details)		
0	No password entered, just press [ENTER] key.	This level is not password protected.	Only DISPLAY menu
1	1 (just the digit "ONE").	User level, parameters settings & Commissioning. Level used to change PLC level 1 equations and parameters.	All menus
2	Only known to CRE and distributors.	Distributor level, PLC programming level 2. Level used to change PLC level 2 equations and parameters.	All menus
3	Only known to CRE.	Manufacturing level reserved for CRE only	

Table 7 - Authorization levels and passwords

The password for your level and lower can be changed in the system menu (see chapter 14.6.2).
When the password page is shown on the LCD display, the user must first press on the **[ENTER]** key (as for other parameters) to switch to the 'Password page'.

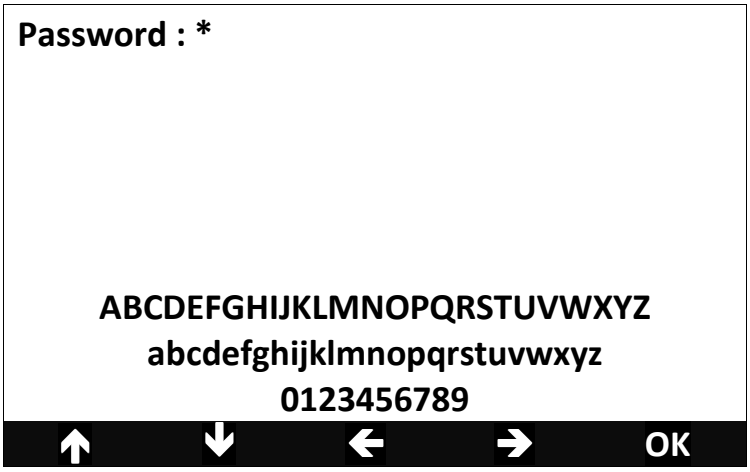


Figure 5 - Password input mode display

Three lines of characters (upper case and lower case letters and '0' to '9' characters) will appear along with 5 icons above the contextual keys.
The first four contextual keys allow the user to move the cursor up, down left or right onto the desired character. The last key (OK icon) will validate the selected character and write it in the password line (a * will appear).
When all characters are entered, another press on the **[ENTER]** key will validate the password. If it is correct, the main menu will appear on the LCD display. Otherwise, the password page will be displayed again.

You can now enter: **[ESC] [ENTER]** and type in the level 1 password as described above so as to access the top level menu.
The first level menu contains three entries:

- -Display
- -Configuration
- -System

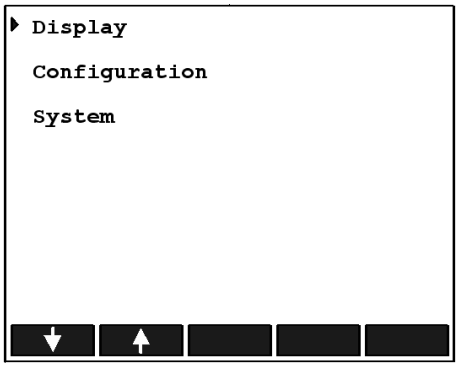


Figure 6 - Main menu

A full description of all MENU levels and items is given in chapter ***14***

3.2 Local navigation

The 5 icons above the contextual keys will change in appearance depending on the type of parameter to modify (chosen list, label, numerical value, password...). They are referred to as the “navigation bar”, or soft keys.
The user can navigate through the different menus with this navigation bar and the **[ESC] [ENTER]** keys.
The navigation bar has 5 contextual keys (soft keys). Depending on the menu displayed, different icons may appear above these keys, allowing the user to scroll up/down the pages or to select a link to a new menu or parameter.
When the user selects a parameter and presses the **[ENTER]** key, the display switches to ‘Input mode’.
When in ‘Input mode’, the **[ESC]** key will discard the parameter changes and return to the ‘Navigation mode’.
The **[ENTER]** key will confirm the parameter changes and return to the ‘Navigation mode’.
The browser displays a white pointer in front of each link or parameter of a menu. A black pointer will indicate the active link or parameter. Figure 7- Browser link description shows these two pointers:

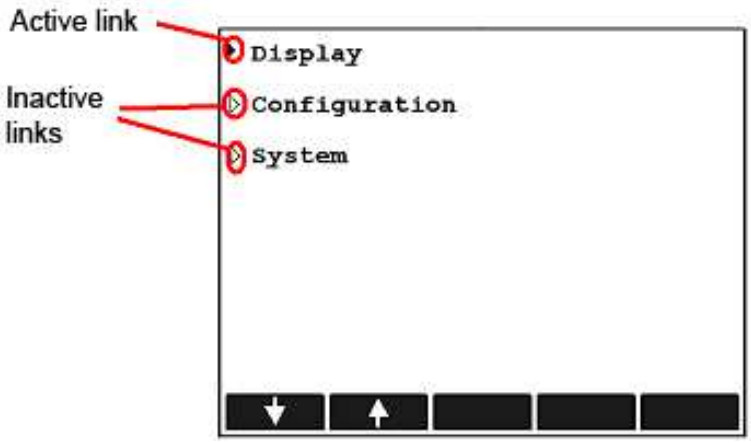


Figure 7- Browser link description

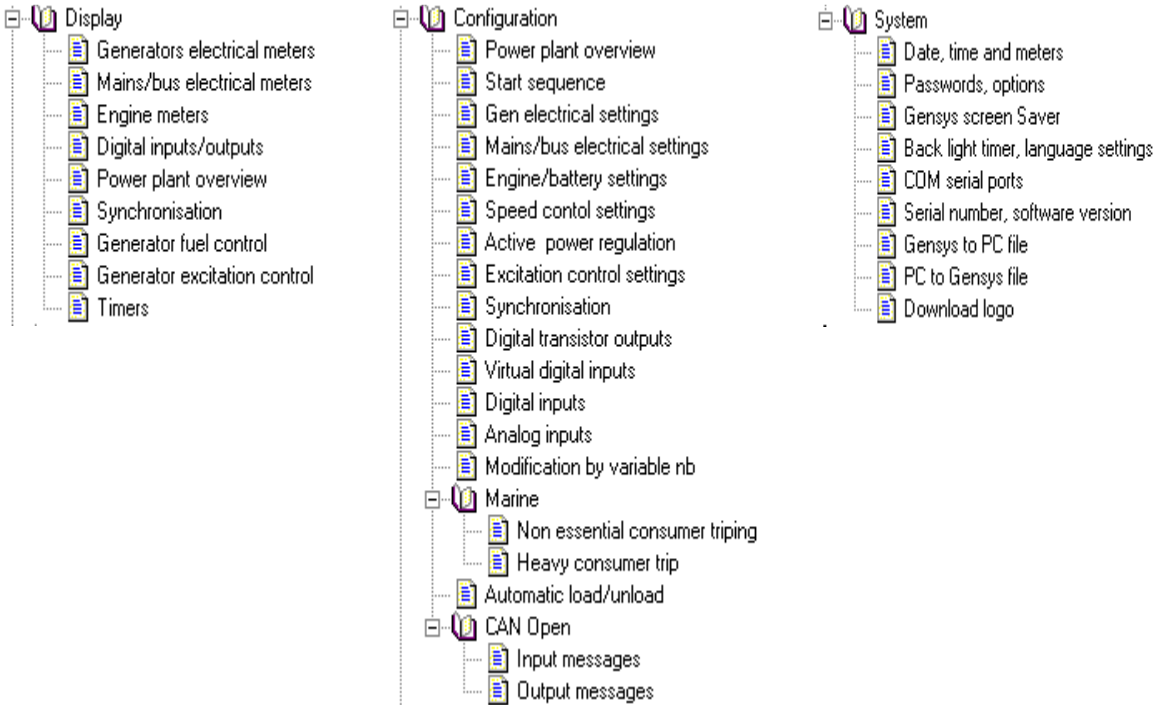


Figure 8 - Tree menus

3.2.1 Input Mode

To change a parameter, first select it with the contextual keys and then press **[ENTER]** to switch to 'Input mode'. New icons will appear above the contextual keys, depending on the kind of parameter selected.

Label modification:	
Digital value modification:	
Option modification:	

Figure 9 - Contextual keys for Input Mode

When the new parameter value is set press **[ENTER]** to store and confirm the new value.

3.2.2 Save parameters configuration

All MASTER 2.0 parameters used in configuration are stored in a FLASH memory. When a parameter is changed by the user, the new value is stored in a RAM memory. The new value will be effective as soon as it is entered, but it will be lost if the MASTER 2.0 power supply is cut or too low. To save the new parameters to the FLASH memory, you must use "SHIFT-I": the user must press both **[SHIFT]** + **[i]** keys together. This will start the backup sequence and store all parameters in the FLASH memory. Now, the new parameters will be effective even after a power supply failure. During this sequence (a few seconds) an orange led on the upper right of the unit will light up to indicate that information is being stored.

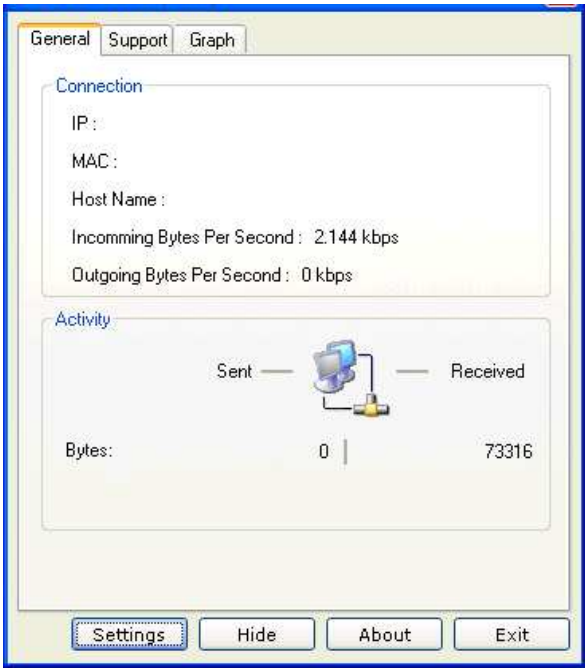
NOTE:
Due to the large number of parameters, the back-up procedure may take a few seconds. It is thus essential to save parameters when the motor is stopped. To save all parameters, the user must press on both **[SHIFT]** + **[i]** keys at the same time on the MASTER 2.0 front panel. Otherwise, the new parameters will be lost when shutting down the MASTER 2.0.
NEVER SHUT DOWN DURING STORAGE SEQUENCE (ORANGE LED ILLUMINATED)

3.3 Remote control using a PC (Ethernet connexion)

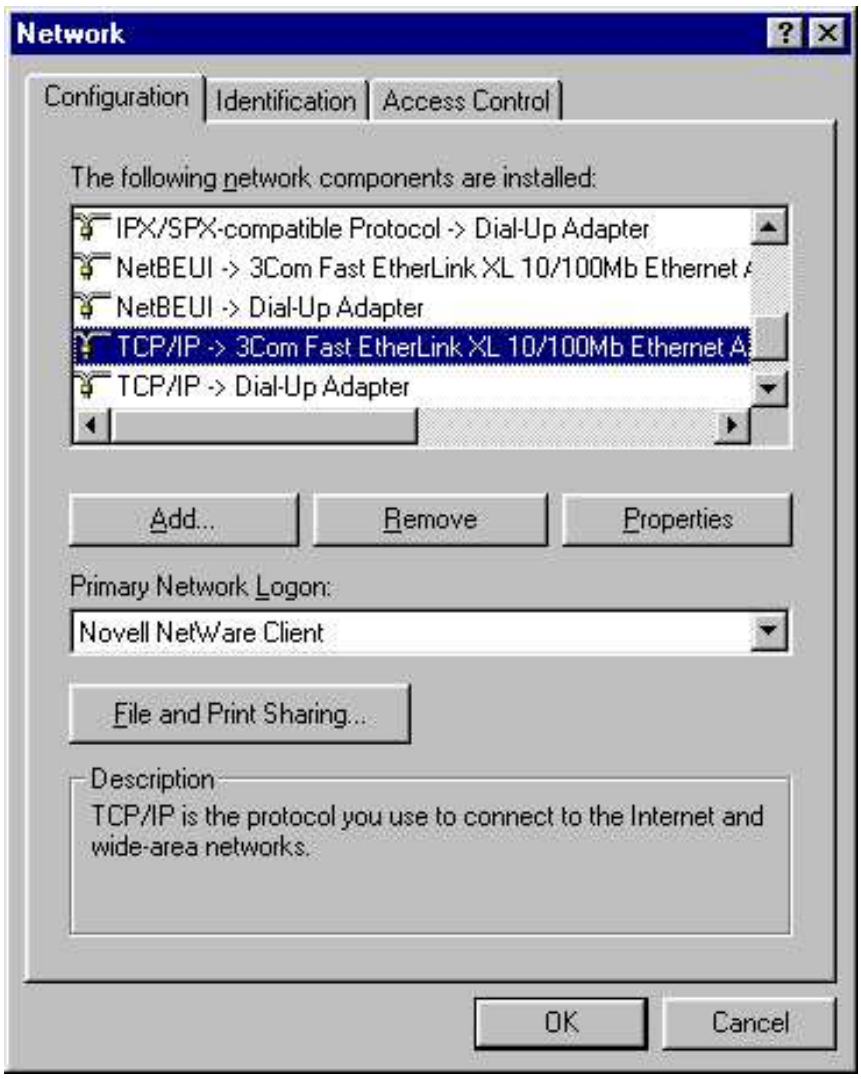
3.3.1 Setting up the Ethernet connexion

With Windows XP:

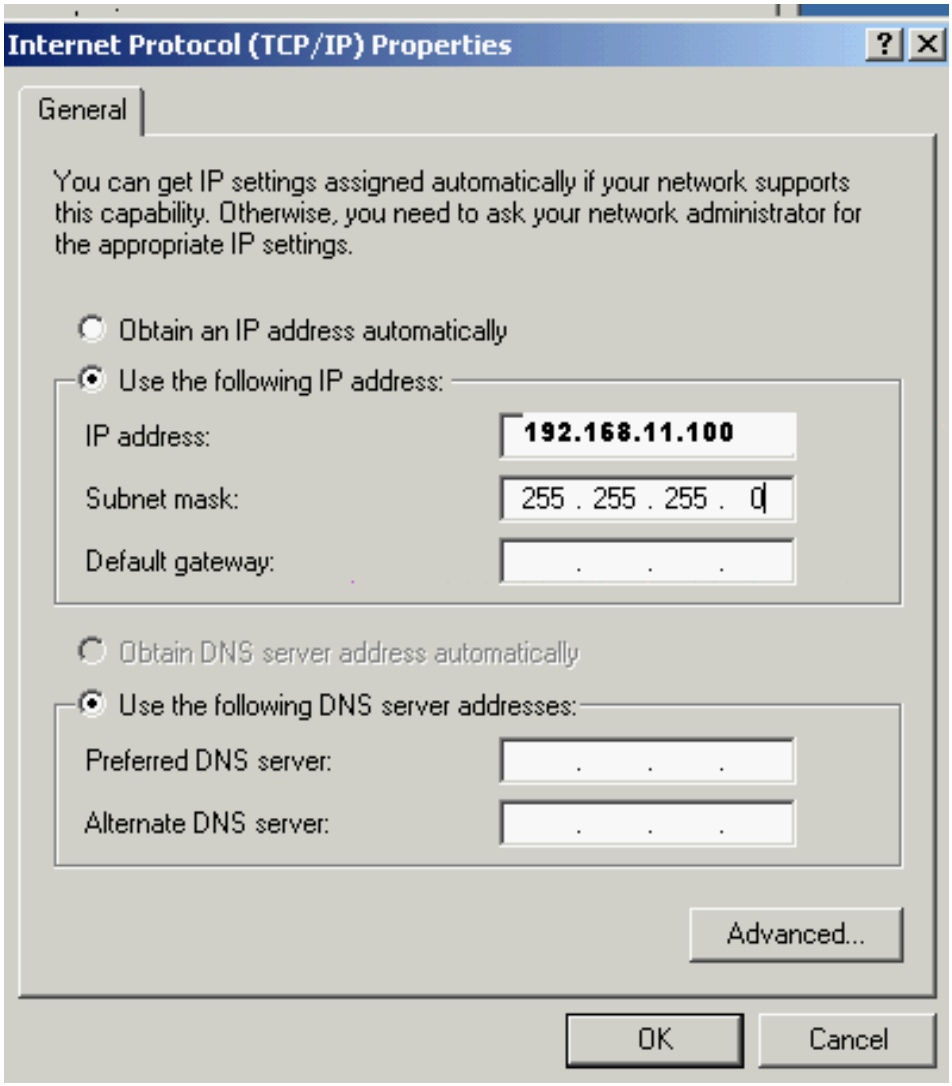
- Open the control panel
- Click on network connexions
- Click on local network



- Click on « Settings »



- Select « Ethernet (TCP/IP) »
- Properties



- Enter the addresses as shown above (192.168.11.100) and (255.255.255.0)
- Click on OK
- Close the networking windows

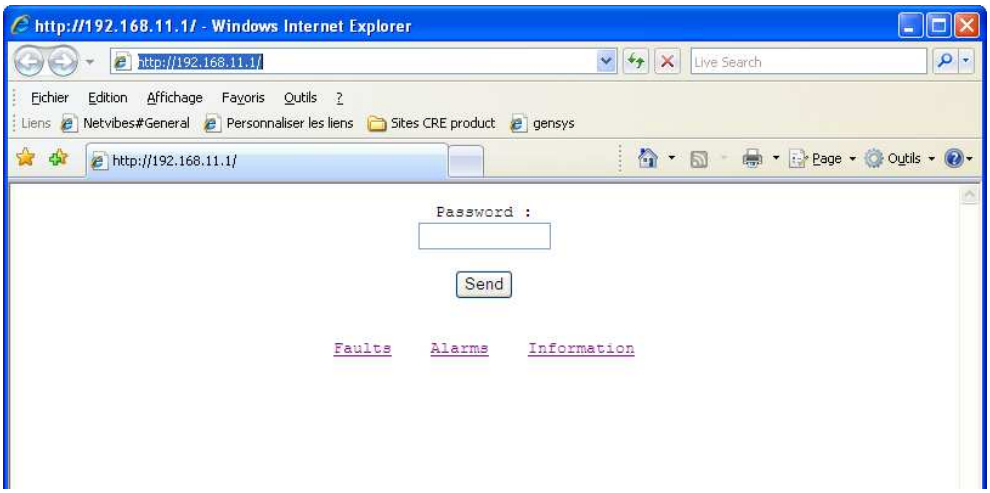
3.3.2 ETHERNET connexion

- Link GENSYS2 to the PC with an Ethernet **cross over cable**.
- Start internet explorer
- In the "Address" area, type in the MASTER2.0 URL: http://MASTER2.0

Warning: the hosts file must be present in the “C:\WINDOWS\system32\drivers\etc” file and must contain a line such as:
« 192.168.11.1 MASTER2.0 »
When trying to change the host file with Windows Vista, you may come across a warning message like those shown below:
Warning message 1
Access to C:\Windows\System32\drivers\etc\ hosts was denied
Warning message 2
Cannot create the C:\Windows\System32\drivers\etc\hosts file.
Check that the file's name and location are correct.
This problem may occur even if you are the system administrator. To solve this problem, follow these steps:
1. Click on start

, click on All Programs, **Accessories**, right click on notepad, and then **Run as administrator**.

If you are prompted for an administrator password or for a confirmation, type the password, or click **Allow**.
2. Open the **Hosts** file, make the necessary changes, and then click **Save** on the **Edit** menu.



Note: Parameter E4042 allows the user to set the connexion time in minutes. Once this time is passed, the password will be asked for again.

3.3.3 Viewing web pages with the MASTER2.0 server

Once the TCP/IP connexion has been established with the MASTER2.0, you can view the MASTER2.0 menus with any browser such as Firefox or Internet Explorer.
Start the browser (Internet explorer, Firefox …).
The password page of the MASTER2.0 should appear. Enter your password.
You can now access the MASTER2.0 menus.
To close the connection, double-click on the connection icon in the status bar of Windows. In the Connected to MASTER2.0 dialog box, click Disconnect. Close your web browser.

The integral web server allows GENSYS2.0 to be set up very quickly and efficiently.
The various menus can be accessed via a web browser such as Firefox or Internet Explorer. However, it is recommended that you disconnect the PC from the unit while the engine is running.
Before connecting the MASTER2.0 to your PC, your PC must be configured as described in the next chapter.

The next figure shows a typical MASTER2.0 menu as accessed from a PC Web browser.

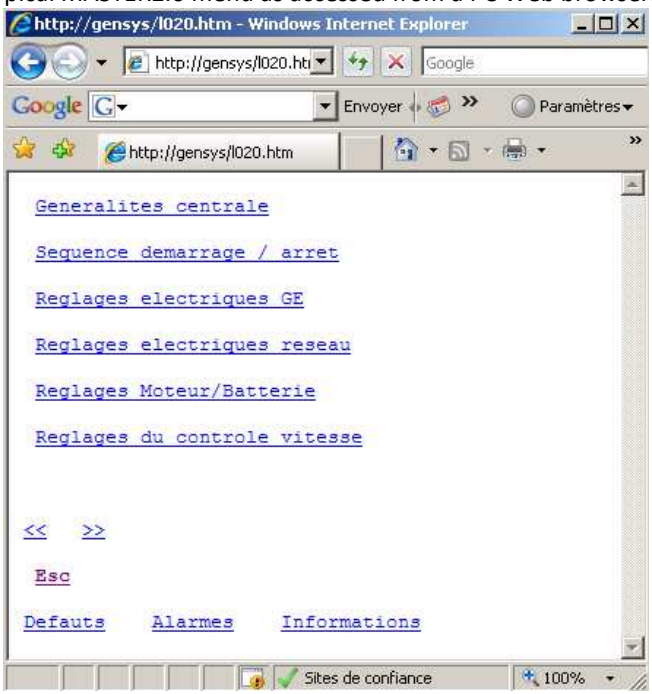


Figure 10 – Typical menu

In this page, the user can choose from among 6 submenus (Genset electrical meters for example). It is also possible to scroll through the other pages of the menu with the << and >> links. The ESC link acts in the same way as the MASTER2.0 ESC key: it will display the parent menu.
The last 3 links are identical to the Fault / Alarm / Information keys on the MASTER2.0 front panel.

The next figure shows a typical configuration page. The user can change 5 different parameters (in this case, two numerical values and three option lists) and send them to the MASTER2.0 using the [Save] button. Clicking on the [Save] button changes the parameter immediately.
The modified parameter is held in volatile memory, and will be lost on power down unless the backup parameter is used, **[SHIFT]** + **[i]**. If backup is used, the parameter is written in flash memory and will be used for the start up.

3.3.4 Remark concerning the Ethernet connexion

- If you change the IP address, you must also modify the Windows HOSTS file to be able to connect to "http://gensys/" at its designated IP address. Otherwise, you will have to use "http://123.123.123.1/" in your browser if this is the IP address which the unit has been given.
- *Java Applets also use "GENSYS" rather than an IP address; this won't work if the HOSTS file doesn't match the IP address of the unit.
- If your PC is already connected to your business network and only has one Ethernet port, CRE markets a USB-Ethernet adaptor which will allow you to stay connected to your network while being connected to the GENSYS2.0. The adaptor's reference is A53W2.

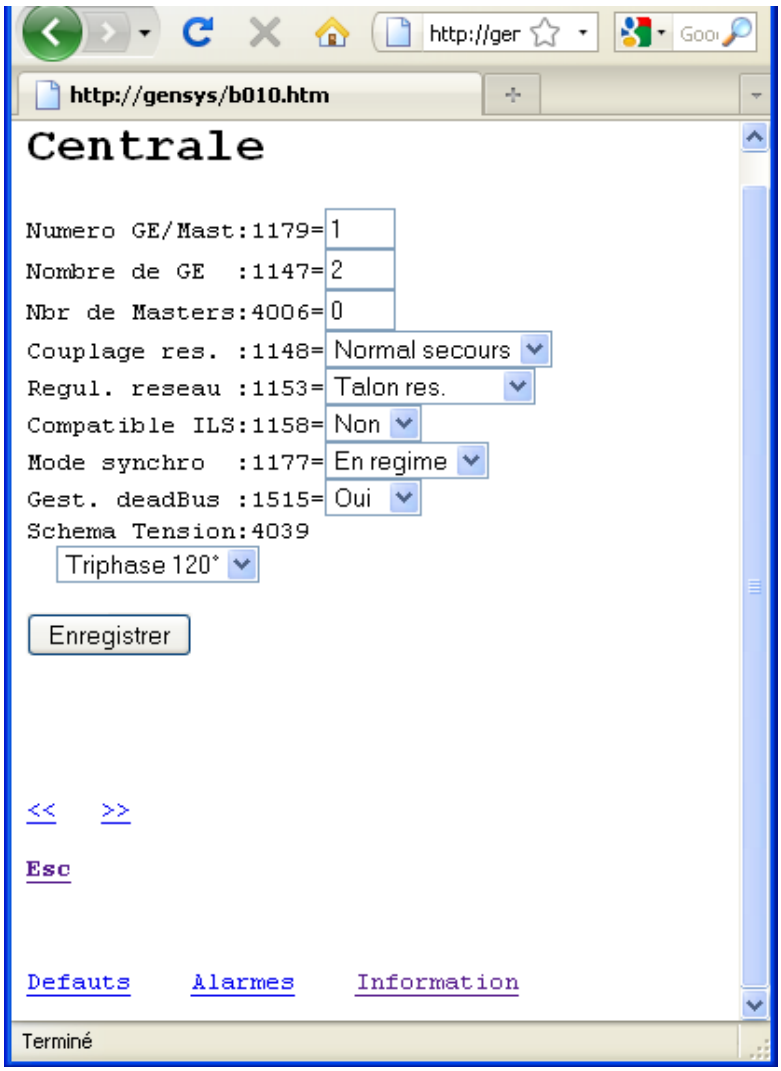


Figure 11 – Page de configuration type

3.3.5 Downloading a text file

When you are linked to the PC, a text file can be transferred between the MASTER2.0 and the PC. This allows the following actions:
Upload new parameters to the MASTER2.0.
Upload new source equations to the MASTER2.0.
Download parameters from the MASTER2.0 (safeguard).
Download new source equations from the MASTER2.0 (safeguard).

The data that can be transferred depends on your access level. For more information concerning text files please refer to chapter 12.3.

4 Operating modes

With the MASTER 2.0 unit, three main operating modes and one special mode allow you to control your power plant.
Modes are:
-Manual
-Automatic
-Test Mode

The special mode is:
-Semi-automatic. This mode must be enabled when parameter E1614 =1 is enabled.

4.1 Manual mode

Warning:

The manual mode we are talking about here is for a complete power plant. Each GENSYS 2.0 on the plant must remain in automatic mode if it is to be controlled by the MASTER 2.0. A GENSYS 2.0 in manual mode will never be controlled by a MASTER 2.0.

In Manual mode, you can:
Start plant with the Start button
Stop plant with the Stop button
Close / open circuit breakers of plant and mains
Increase / decrease the frequency of all coupled gensets with the + / - keys.
Increase / decrease the voltage of all coupled gensets with the Shift + / Shift – keys.
Increase / decrease the power of all coupled gensets with the + / - keys, when the plant is coupled to the mains.
Increase / decrease reactive power of all coupled gensets with the Shift + / Shift- keys, when the plant is coupled to the mains.
Each genset must be in active / reactive load sharing mode. GENSYS 2.0 being in automatic mode, starts and stops are made normally, with timers set on each GENSYS 2.0, including the stop sequence.

4.2 Auto mode

All standard auto modes will be explained later. Globally, these are the main ways of operating:

Constant plant power:

In this mode, the power plant provides constant power. The mains power varies according to the load.

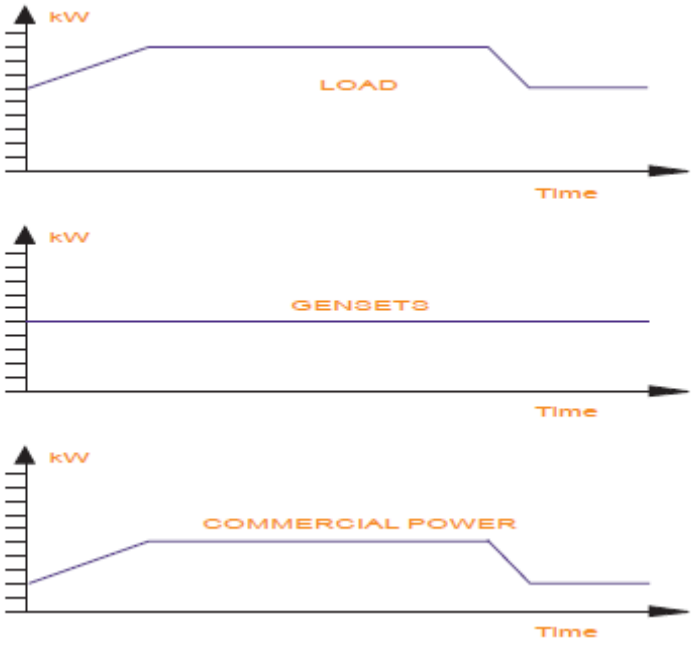


Figure 12 - Constant plant power

Constant mains power:

In this mode, the mains power (imported or exported) remains constant. The plant power varies according to the load.

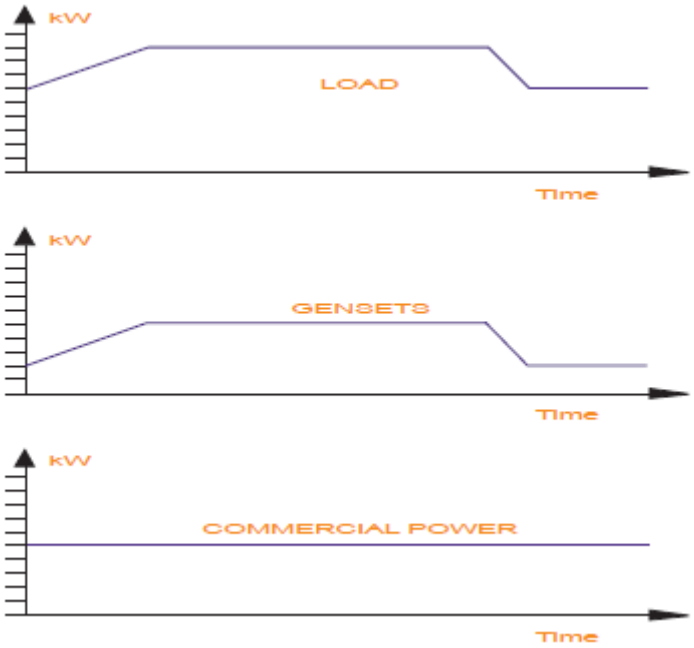


Figure 13 - Constant mains power

Power plants with several mains powers:

Negotiation between MASTER 2.0 units is done via the CAN© bus and determines which mains are used.

No-break change-over with load transfer:

When remote start is on, the plant starts, synchronizes and parallels with the mains, then takes a load via a ramp. When the mains have no more load, MASTER 2.0 opens the mains breaker. When the remote start is off, the mains take the load in the same way as the plant did previously. If the plant started because of mains failures, when the mains return, the plant stops in the same way as previously (synchronization, download ramp, opens breaker and stops).

4.3 Test mode

This mode tests the Auto mode. When you press the **[Test]** key, the engine starts as if there was a remote start, and MASTER 2.0 will carry out the standard Auto mode sequence. To exit "TEST MODE", push the **[AUTO]** key.

4.4 Semi auto mode

This mode is similar to the auto mode. It differs in that the step from one state to another is trigged by pressing a key. The next figure shows the transition from one state to another.
The semi auto mode is activated via an option.

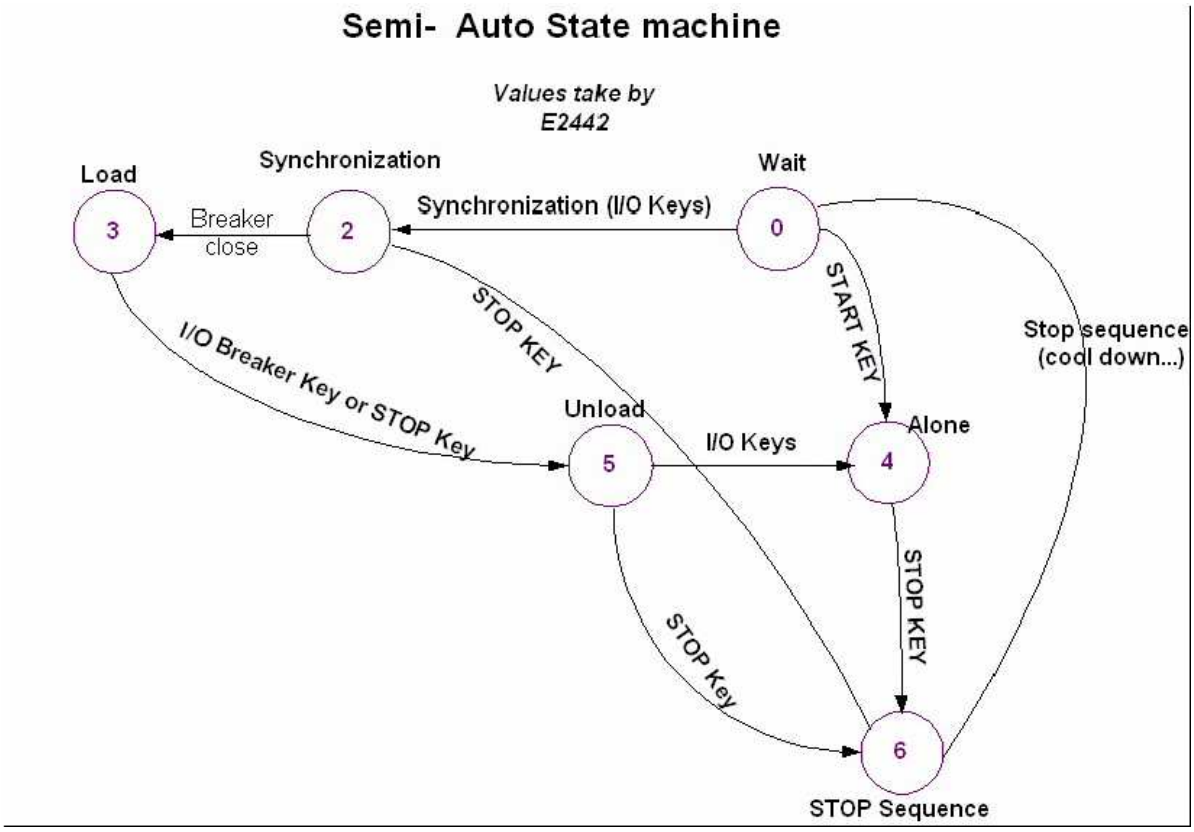


Figure 14 – State Machine

5 Predefined configurations

5.1 Change-over mode

In automatic mode, upon loss of external power or external request, this configuration will manage:
-The starting of the plant and the switch to change over mode.
-When the mains return, or if an external boot appears, the return to Normal mode.
-Shut down.

Variable number	Variable label	Variable value
1179	Mast/Gen. number	1 to n
1147	Nb of gen.	1 to 14
4006	Nb of MASTER 2.0	1
1148	Mains parallel	Change over
1153	Mains regul	X
1158	ILS compatible	NO
1177	Synchro mode	Dynamic
1515	Deadbus manag.	X
1258	Load/Unl. mode	Inhibited
1846	Break Ma Fault	Mains
1461	Fault start	YES

Table 8 - Change over mode

Note: The "network management" is systematically enabled on MASTER 2.0.

5.2 Power plant control with mains

In this configuration, in addition to the change over mode which is always available in case of mains failure, MASTER 2.0 will also manage the paralleling of the plant to the mains upon its return (no break return to mains) or upon an external start / stop request

Variable number	Variable label	Variable value
1179	Gen/Mast. number	1 to n
1147	Nb of gen.	1 to 14
4006	Nb of MASTER 2.0	1
1148	Mains parallel	Change over
1153	Mains regul	Peak shaving, base mode
1158	ILS compatible	NO
1177	Synchro mode	Dynamic
1515	Deadbus manag.	X
1258	Load/Unl. mode	Inhibited
1846	Break Ma Fault	Mains
1461	Fault start	YES

Table 9 - Power plant control with mains

You can choose between permanent paralleling and no break Change Over. It is also possible to choose between peak shaving and production (base load) modes.
In the case of mains failure, it is possible to prohibit the start (E1841) and choose to open the bus bar breaker rather than the mains breaker (E1846).

1/ No Break CO (No break change over)

When remote start is on, the plant starts, synchronizes and parallels with the mains, then takes the load (ramps up). Once the mains are unloaded, MASTER 2.0 opens the mains breaker. When remote start is off, the mains takes the load in the same way as the plant did previously. If the plant started for a mains failure, when mains power returns the MASTER 2.0 synchronizes the load transfer (ramps down), opens the breaker and then stops the plant.

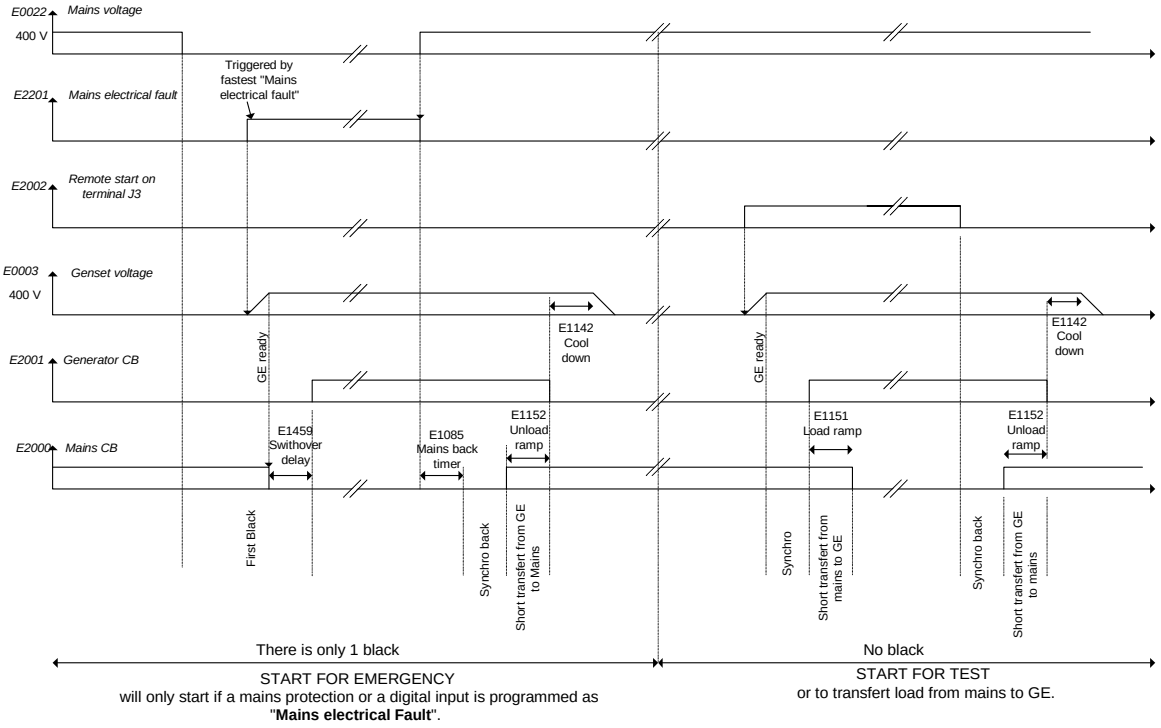


Figure 15 - Typical sequence in No Break CO mode

Ramp configurations are available in the Configuration / active Power regulation menu.
The paralleling time depends on the load, the ramp time and the high and low thresholds.

2/ Permanent mode

When remote start is on, MASTER 2.0 starts the plant, synchronizes and parallels with the mains, then ramps up load until it reaches its set point. In base load mode (E1153), the plant has a constant load and the mains take the utility load variations. If the utility load is less than the plant set point, mains are in reverse power. In peak shaving mode (E1153), the mains have a constant load and the plant takes the utility load variations.

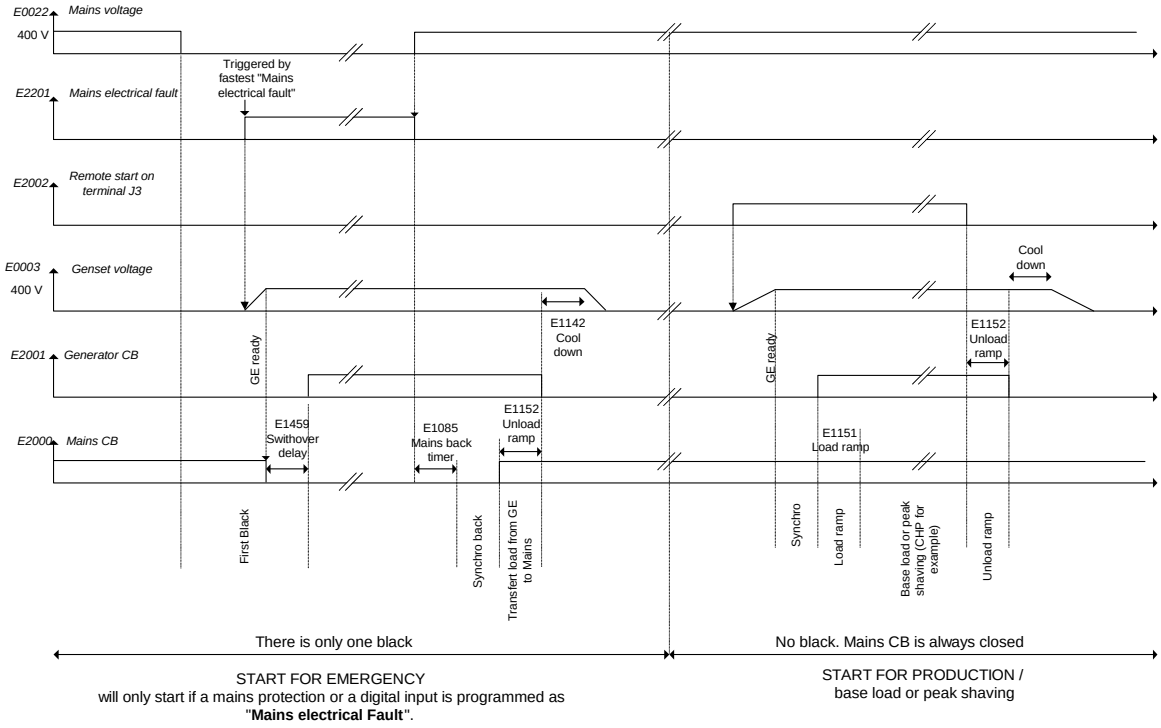


Figure 16 - Typical sequence in permanent mode

5.3 Power plant control with several mains

The multi-mains function is an extension of the modes described above. Each mains is managed independently by a MASTER 2.0. Depending on events and configuration, one MASTER 2.0 will take control of the central power role.
A system of election between MASTER 2.0 modules is set up to choose which one should launch its sequences. The rules are as follows:

-A MASTER 2.0 in Manual mode is still active and may control the voltage / frequency even if a MASTER 2.0 in automatic mode was elected as being the central unit.
-A MASTER 2.0 configured in AMF mode does not participate in the election and triggers a standard sequence without worrying about the others since they control neither the frequency nor the voltage of the gensets.
-When a sequence is initiated, it must be completed before a new election of a MASTER 2.0 is started.
-The election order depends on the configuration of the connection to the mains: first No break C/O, then C/O, then the number assigned to each MASTER 2.0 (E1179), the highest number having priority.
-Each MASTER 2.0 is configured as if it were unique in terms of what is desired from each mains. Compared with a simple mains configuration as above, the only changes are the number of MASTER 2.0 units (E4006) and the number of gensets (E1179) to be entered in each MASTER 2.0 unit.

Important: The number of GENSYS 2.0 and MASTER 2.0 units is limited to 15 in all. There can therefore be no more than 10 GENSYS 2.0 units if there are 5 MASTER 2.0 units, for example.

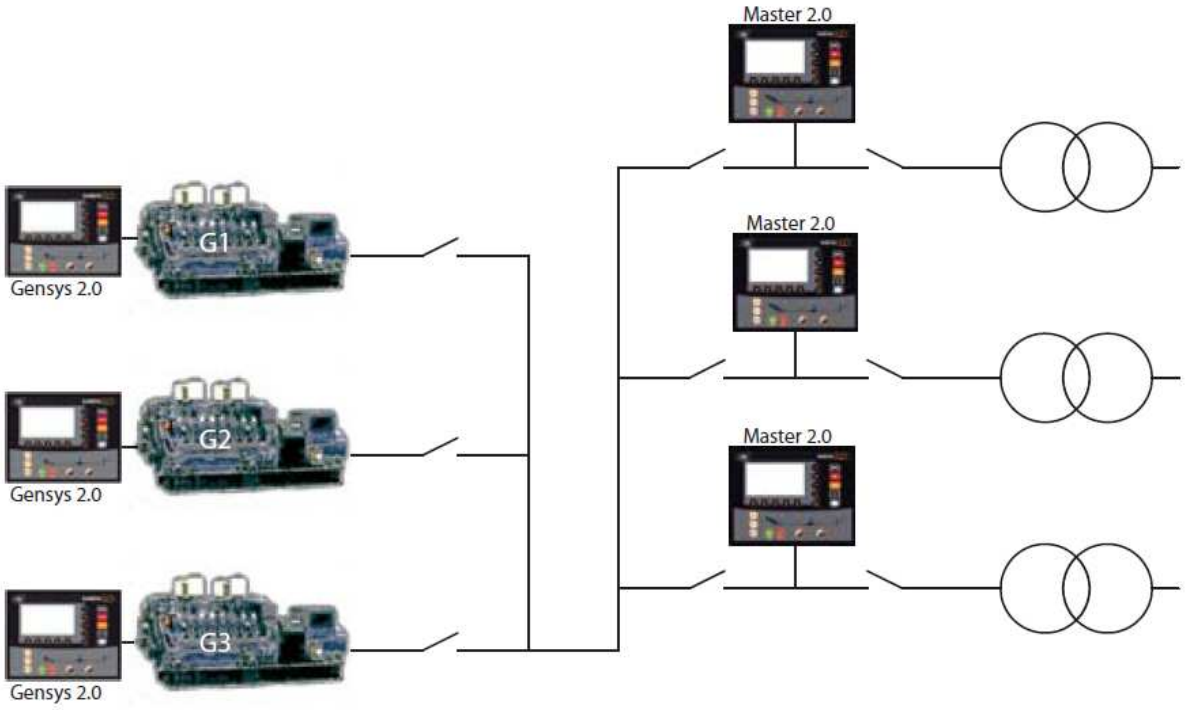


Figure 17 - Paralleling with several mains

This application is the standard application for MASTER 2.0 with GENSYS 2.0.

In this configuration, base load or peak shaving regulation can be selected.

Variable number	Variable label	Variable value
1179	Mast/Gen. number	1 to n
1147	Nb of gen.	n (>=2)
4006	Nb of Masters	n mains
1148	Mains parallel	No ch.over
1153	Mains regul	X
1158	ILS compatible	Yes
1177	Synchro mode	Dynamic
1515	Deadbus manag.	Yes
1258	Load/Unl. mode	X
1020	MA kW <-> 20mA	18000
1021	MA 0kW setting	0
1461	Ext kW measure	+/- 10V

Table 10 - Paralleling with several mains

To allow Power Factor regulation, the "Mains breaker in" (J1) information to MASTER 2.0 must be wired. Power Factor regulation is not an option.

5.4 Power plant paralleling with MASTER 2.0 and parallel line modules

The active power and the timing of the plant can be controlled by analogue parallel lines. The MASTER 2.0 is compatible with Unigen units and older generation analogue systems such as Woodward/Barber Colman (ILS PowRcon ...).

Restrictions:
Multi-mains option is only available with several MASTER 2.0 modules.
Reactive power / voltage equalization is not managed.
When paralleling with the mains, each Unigen switches to power factor regulation once it is paralleled.
A FUEL output must be linked to each Remote start input.
Starter modules must be present.
The report of faults / alarms / operation modes is not available.

Setup:

Adjust ESG offset or trim speed pot
The output (G9-G11) is used, the main objective being to bias the speed/fuel rack for synchronizing, Load sharing, ramping Load on and off. This output only alters the Power (KW) it can be set by parameters E 1077 ESG Offset and E1076 ESG Amplitude (span).
The base settings are generally well suited to control standard parallel line modules (+/- 3V for 100%).

You can adjust the values of these parameters as follows to allow the Master to control a plant within a range of +/- 3 Hz of its nominal frequency.

- The ESG offset adjustment (E1077) is settable between -10V and +10V, and it's added to the external speed reference (G11).
- Start the plant, set rated speed. Stop plant.
- Connect the control wire.
- Start the plant. If required adjust MASTER 2.0 output voltage a small amount (E1077) thus adjusting the offset to get back to rated. Check the maximum range of speed in manual mode with + and – (E2058 must be at +/- 7000 for these extreme values): this range must be close to +/- 3 Hz.
- Adjust amplitude (gain) E1076 if necessary.

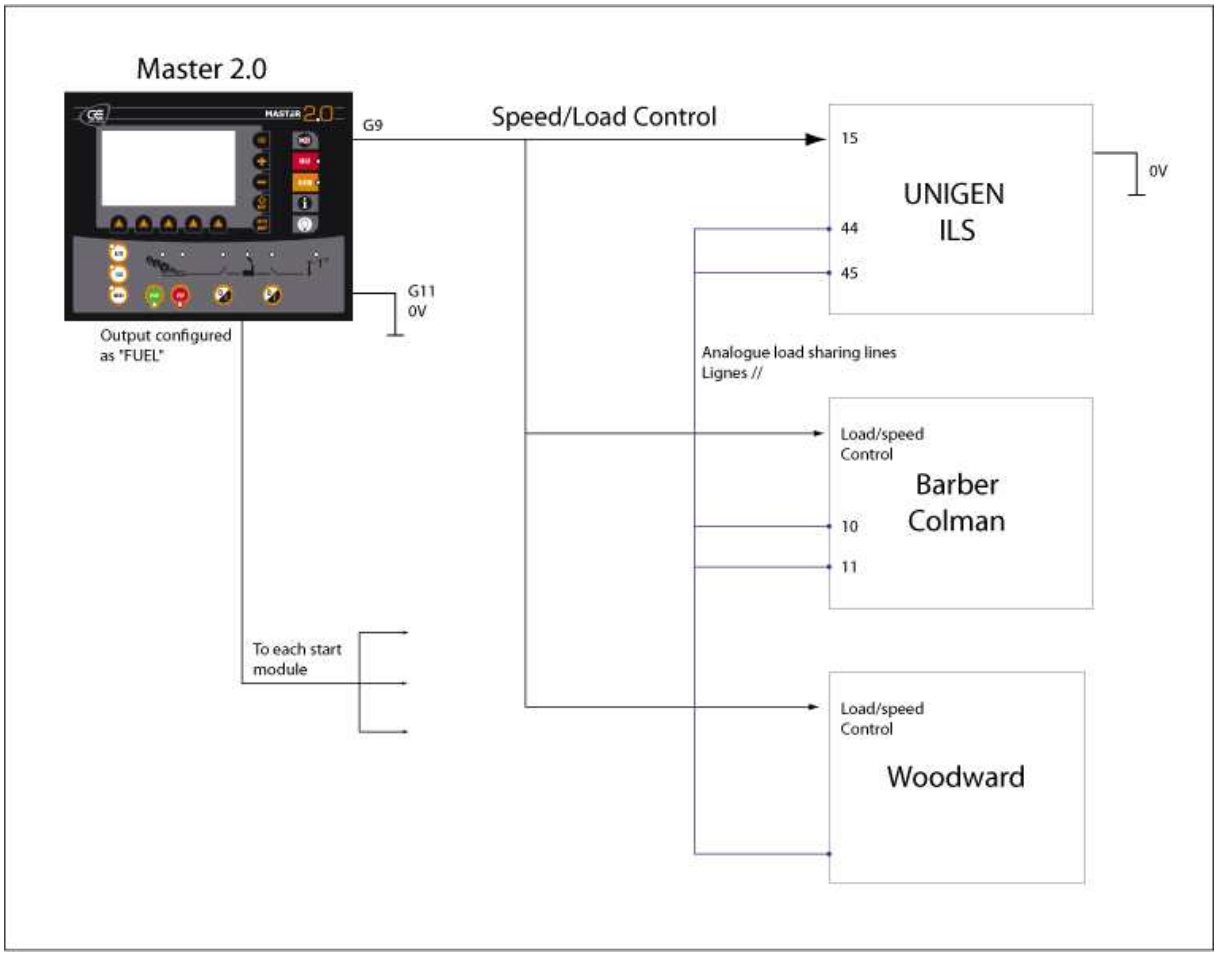


Figure 18 – Load sharing with MASTER 2.0 and parallel line modules

Variable number	Variable label	Variable value
1179	Mast/Gen. number	1 to n
1147	Nb of gen.	n (>=2)
4006	Nb of Masters	1
1076	Speed/load offset	0% for 0V reference
1077	Speed load output	To obtain +/- 3Hz
1148	Mains parallel	No break change over / permanent
1153	Mains regul	Peak shaving / Base Load
1158	ILS compatible	NO
1177	Synchro mode	Dynamic
1515	Deadbus manag.	X
1258	Load/Unl. mode	Inhibited
1846	Break Ma Fault	Mains
1461	Fault start	YES

Table 11 - MASTER 2.0 with parallel line modules

When MASTER 2.0 is in ILS compatible mode, active power sharing is via the parallel lines. You can choose between permanent and NO break Change Over modes. In permanent mode, it is also possible to choose

between peak shaving and production (base load) modes. In the case of mains failure, it is possible to prohibit the start (E1841) and choose to open the bus bar breaker rather than the mains breaker (E1846).

5.5 Multiple generators with static paralleling

In this mode, the GENSYS 2.0 modules take care of static paralleling. The MASTER 2.0 only sends a start request.

This mode is useful when you urgently need to start a full plant with multiple generators. The generators will be ready to take load in the shortest possible time.

This mode is also very useful when your installation includes high voltage transformers. Starting generators which are paralleled together gives a progressive magnetisation without peaks (no transient short-circuit).

NOTE: As long as there is a voltage on the bus bar, the dynamic paralleling mode will be used even if static paralleling is configured. The static paralleling mode is only usable if all of the power generators are stopped and bus bars are dead.

6 Installing and commissioning a MASTER 2.0 application

6.1 Power plant startup

6.1.1 Conditions

To be considered as operational after startup, the power plant must meet **ALL** the following conditions:

Number of gensets OK (set with variable E4000)
Available power (KW) OK (set with variables E4001, 4002, 4003)
Voltage OK

The power plant can be forced to be operational with variable E2515 (EXT GE OK)

6.1.2 Load shedding

If the start conditions mentioned previously are not met, Master 2.0 can take care of load shedding for 5 starts.
To this to be active, the measurement of E4001 must be other than 0. (At least one minimum KW condition).
In this instance, each start will be linked to a load threshold (E4001 to E4005) which will be shed after the E4048 delay.
The breaker feedbacks will be linked to digital inputs defined by "Unload brk" 1 to 5 (variables E5005 to E5009).
To control load shedding, digital outputs must be set for "Unload" 1 to 5 (variables E5000 to E5004).

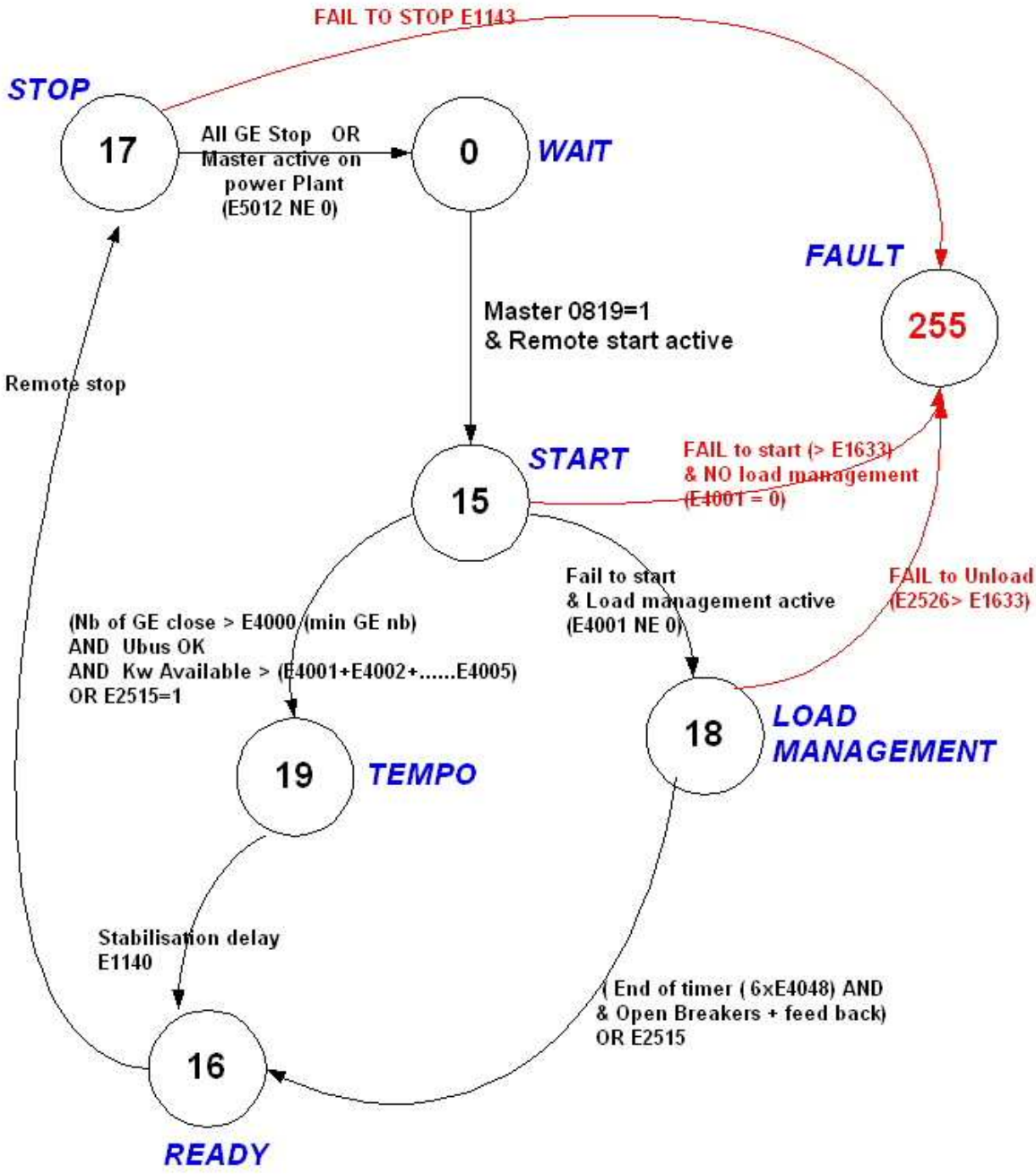
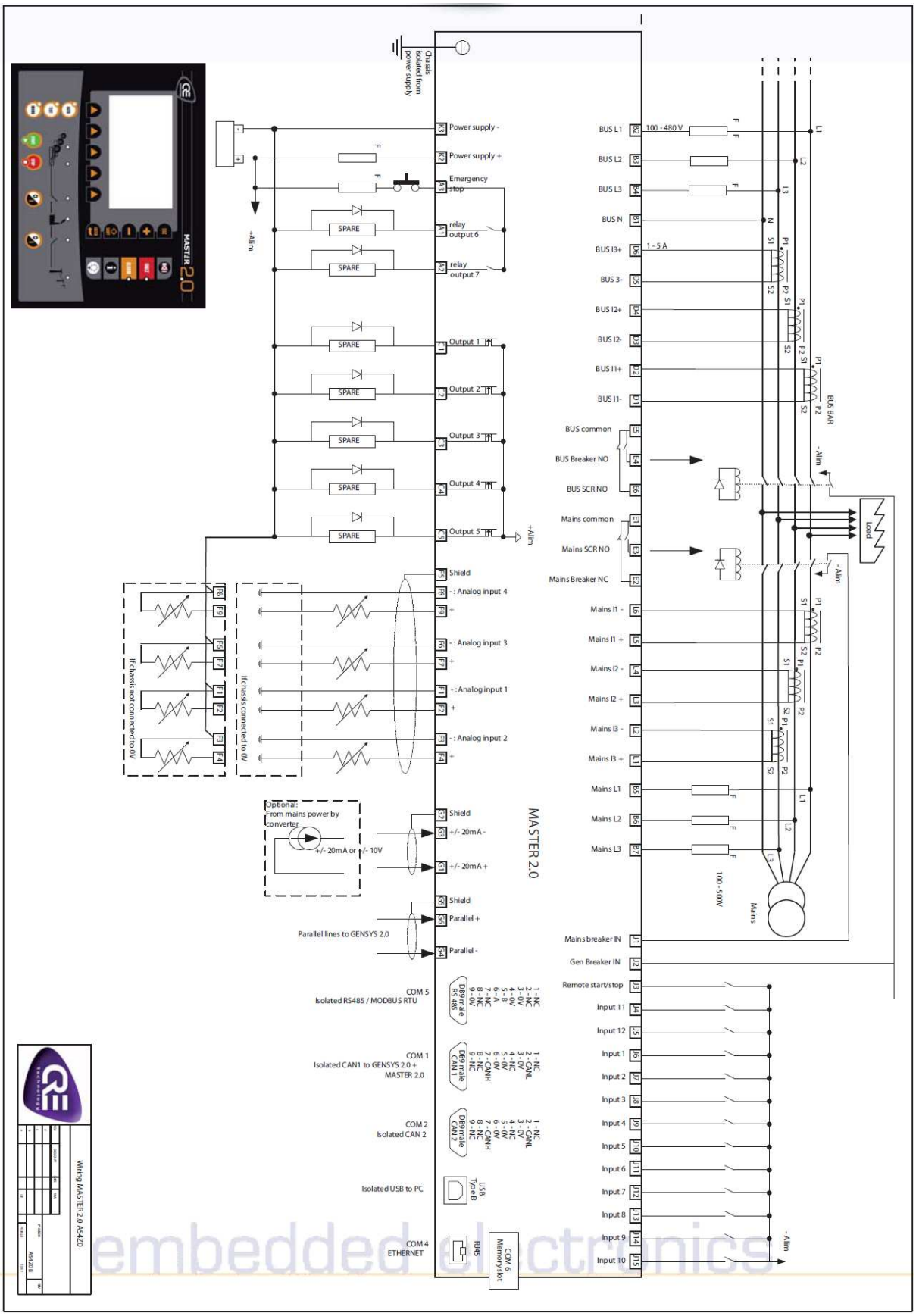


Figure 19 - MASTER 2.0 States

6.2 Wiring diagram



6.2.1 Installation instructions:

The MASTER 2.0 module has been designed for front panel mounting.
Indoor or outdoor installation is possible as long as the following requirements are met:

-The chosen cabinet must meet the standard safety rules of the workplace.
-The chosen cabinet must be closed during normal use to prevent the user from coming into contact with power cables.
-Only the front panel must be accessible during normal use.
-In accordance with the Bureau VERITAS marine agreement, the module must not be installed in areas which are exposed to the weather.

6.2.2 Mounting:

To secure the MASTER 2.0 onto the panel, use the special kit provided with the module. The kit contains 4 screws, 2 brackets and 1 mounting tool.

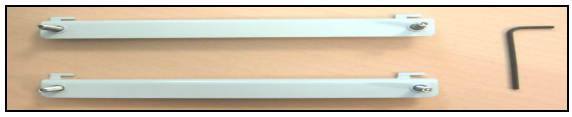


Figure 20 - Mounting kit

Remove the connectors.
Pass the module through the panel cut-out. Ensure that the gasket is properly positioned on the panel and that it is flat.
On the rear side of the module, insert the first bracket into the two holes on the upper edge of the module and push it to the left.

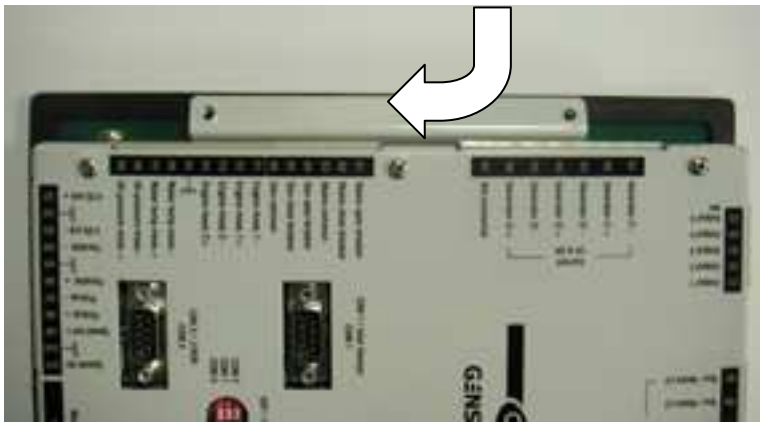


Figure 21 - Mounting brackets on MASTER 2.0

Use the tool which is provided to screw the bracket gently onto the panel (just to hold the module in place).
Insert the second bracket into the two holes on the lower edge of the module and push it to the right.
Use the tool to screw the bracket gently onto the panel.
Tighten brackets gradually until the module is firmly secured.
Plug in the connectors.

6.2.3 Earth grounding:

Earth grounding of the MASTER 2.0 should be made with two M5 screws & fan washers. Use a short 4mm² cable to connect the unit to earth (see below).

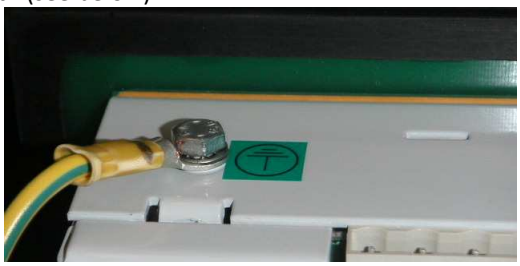


Figure 22 - Earth grounding

6.2.4 Wiring guidelines:

The power cables must be kept separate from the communication cables. The communication cables can be installed in the same conduit as the low level DC I/O lines (under 10 volts).

If power and communication cables have to cross, they should do so at right angles.

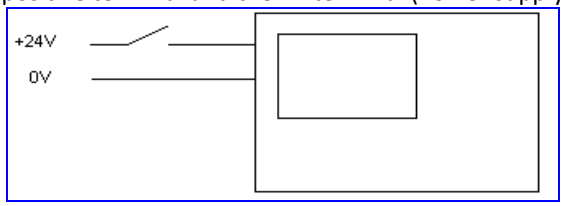
Correct grounding is essential to minimise noise from electromagnetic interference (EMI) and is a safety measure in electrical installations. To avoid EMI, shield communication and ground cables appropriately.

If several MASTER 2.0 units are used, each of the 0V power supplies (pin K3) must be connected to each other with 10mm² cable (minimum).

	**CAUTION:** Please read the following recommendations to avoid any hardware damage on the MASTER 2.0 CANBUS Driver (not isolated).

1/ Power supply circuit breaker

Terminal K3 (0V) should never be disconnected. The battery circuit should only be opened using a breaker placed between the battery's positive terminal and the K2 terminal (Power supply +).



Note: *If the K3 (0V) terminal is disconnected and the bus bar voltage is applied to the MASTER 2.0, there is the risk of getting AC voltage on the CANBUS terminals.*

2/ Interconnection of all battery negatives

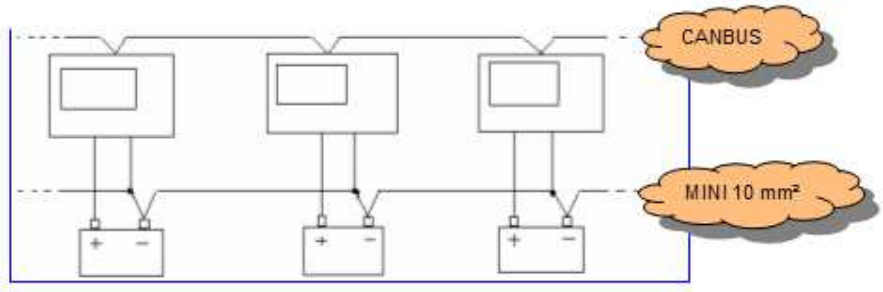


Figure 23 - Interconnection of all battery negatives

6.2.5 Vibrations:

In case of excessive vibrations, the module must be mounted on suitable anti-vibration mountings.

6.2.6 Real time clock battery:

If the battery is disconnected, remove the rear panel and connect a 3V battery to the ST1 jumper (+battery: ST1 up; -battery: ST1 down).
Battery maintenance must be provided separately from the MASTER 2.0 unit.

6.3 Before commissioning (before going on site)

Schematics check

How?

Be sure you have the latest power plant schematics.
Why?

To be sure the wires will be present on site (Can bus connector, shielded wires...).
What?

0 Volt wiring
Shields
CAN Bus
GENSYS 2.0

Check the list of inputs /outputs

How?

Check if the required function is present in the list of preset functions.
If in any doubt check with distributor.
Why?

-To evaluate if an input/output needs an extra equation.
-To evaluate quote / development time.
-To evaluate necessary password clearance: Level 1 (consumer), Level 2 (Distributor), or Level 3 (CRE Technology only).

6.4 During commissioning

Start with safe conditions

How?

Disconnect the MASTER 2.0 connector labelled as “E” (controls breakers).
Check important MASTER 2.0 parameters.
Ask the technician who wired the power plant to lock the bus bar breaker open.
Why?

So as to be sure not to cause a false paralleling during commissioning.

Download the text file from the MASTER 2.0.

How?

With a PC and Internet explorer.
Why?

To store all parameters before starting the commissioning.
How?

As described in this manual.
Always use a text file corresponding to the current firmware version.
Never use an old text file coming from a previous version.

Check speed detection.

How?

Press on the **[MANU]** key.
Access the information menu.
Press and hold the start button for 5 sec.
While the plant turns over, check that MASTER 2.0 RPM shows close to 200RPM.
Why?

To be sure that the MASTER 2.0 will release the start signal at the correct speed (around 400RPM).
To have over speed protection.

Start the plant, check speed detection.

How?

In **[Manu]** mode, press and hold **[Start]** button for 10s.
Adjust the speed to 1500 RPM. This is given as example. May be set at 1800 RPM for 60Hz applications, or other values depending on the installation.
In the information menu check that Frequency= 50.00 when RPM=1500RPM.
Press **[Stop]** to stop the plant.

Check the minimum protections before carrying out any other tests:

Over speed
Over voltage
Emergency stop
How?

Short-circuit the sensors.
For over speed and over voltage, set the thresholds to 101%.

Check the control of the dead bus breaker

How?

Be sure there is no critical load connected to bus bar
Plug the "E" connector into MASTER 2.0
Start the plant in manual mode by pressing **[Manu] [Start]**
Press the bus bar breaker **[0/I]** key.
Check the breaker settings.
The breaker should close (control OK) and the MASTER 2.0 front face led should light up (feedback position OK).
Press the bus bar breaker **[0/I]** Key.
The breaker should open and the led should go out.

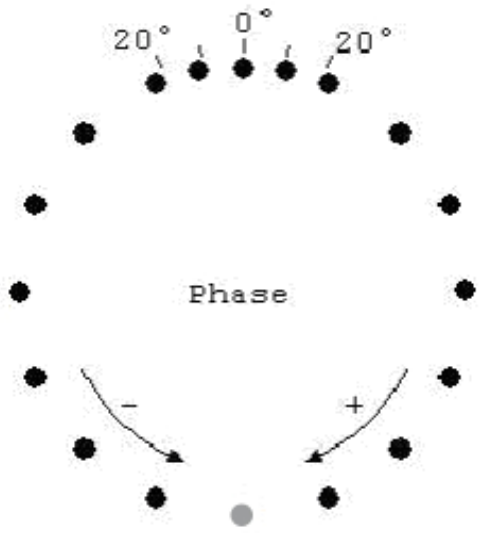
Check mains / bus ref L1, L2 & L3

How?

In **[Manual]** mode, press and hold **[Start]** button for 10s.
Close the bus bar breaker by pushing the **[0/I]** Key.
Enter Synchronisation menu to check that phase difference is 0°.

Check synchronization

How?



Unplug connector “E”
Check Voltage on bus bar
Set the parameter “Fail to synchronize” at 500s.
[Start] the plant in **[Auto]** mode.
Check that you are now in synchronization mode using the information screen key **[i]**.
Adjust the phase and frequency PID.
Frequency sweep is important over the 49-51Hz range.
PID phase is important around the synchronization point.
When the difference between phases is stable and near to 0°, measure the voltages (L1 L2 and L3) directly on the circuit breaker between mains and bus bar.
When you are sure there is no wiring problem, stop the plant.
Set the “Fail to synchronize” parameter according to the consumer's request.
Connect the “E” connector.
Start in automatic mode.
The plant must be paralleled in less than 10s.

Synchronization test

Go to **[Manu]** mode.
Use the **[+]** key to increase frequency to 51Hz.
Go back to **[Auto]** mode.
Check that the correction is OK on the synchroscope.

Load sharing / kW regulation

For this application, check the stability of KW and kVAR regulation.
After the mains breaker closes, check load ramp (P=CsteGPID) configuration in the “Active Power Regulation” menu.
If the plant goes into reverse power or stays at low load during the ramp time (E1151) increase P=CsteGain in the “Active Power Regulation” menu.
At the end of the ramp time, the MASTER 2.0 will swap to “Kw Sharing Gain”.
You can now set your load sharing gain and check the settings which depend on load impact (test with load bench, for example).

7 Dedicated I/O lines

Inputs/outputs are associated with functions. Some I/Os are dedicated; others are programmable using configuration parameters.

7.1 Breaker relay control

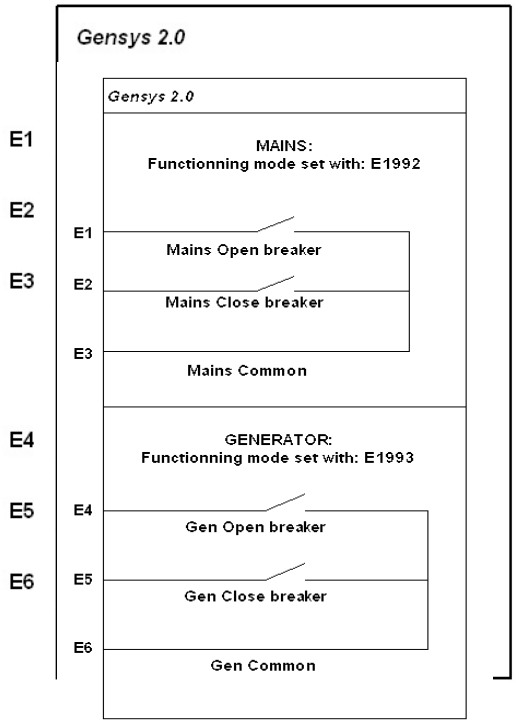
MASTER2.0 is equipped with 4 NO relays (at rest) for breaker control.

- 2 relays to control the generator breaker (backup), one for opening (E4) and one for closing (E5).
- 2 relays to control the mains breaker (Normal), one for opening (E1) and one for closing (E2).

These outputs allow you to control various types of breaker. This chapter explains the available setups and their associated variables.

Variables	
E2000	Digital input for Normal breaker return
E2001	Digital input for Backup breaker return
E2016	Normal breaker control
E2017	Backup breaker control
E1149	Delay before breaker opening/closure failure
E1992	Choice of Normal (Genset) breaker relay work mode
E1993	Choice of Backup (Mains) breaker relay work mode
E1994	Time before undervoltage trip coil control contact closure
E1995	Time before a new closure request is authorized
E1893	Trip coil min. pulse length.

Note:
Breaker control can be viewed by showing variables E2016/2017 (Backup/Normal breaker relay) and E2000/2001 (breaker status info). Whatever the setup chosen, any opening or closure of the relays by the MASTER2.0 is shown by the values of E2016 and E2017 changing (1=closure, 2=opening).
When the breaker gives the correct feedback, the MASTER2.0 LED display lights up and variables E2000 (Normal) or E2001 (Backup) switch to 1.
The delay for a breaker to close before a failure is detected is 5 seconds as standard *(Configuration/Enhanced configuration/Modification by variable n°/1149).*



Working modes:
The *Configuration/Enhanced configuration/ gen/mains breaker setup* menu allows you to chose the working mode of these relays via the variables E1992 for the mains (Normal) and E1993 for the genset (Backup).

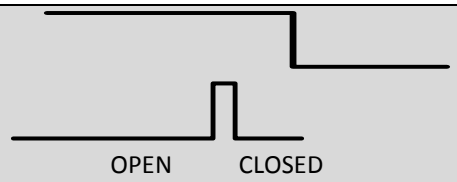
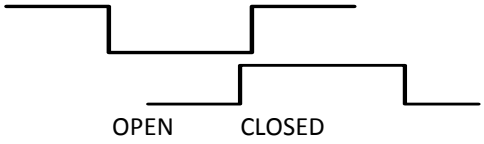
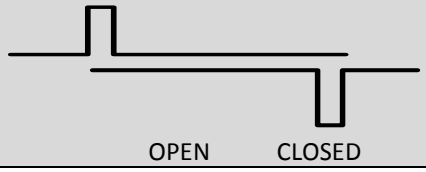
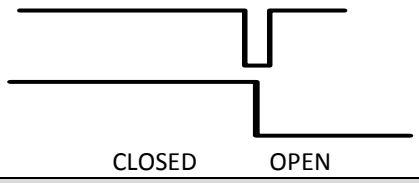
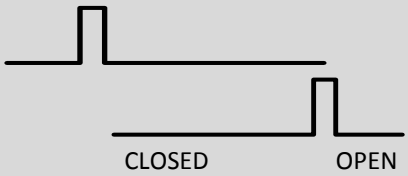
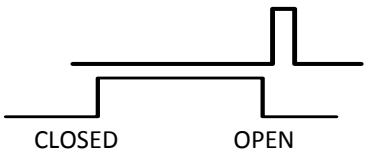
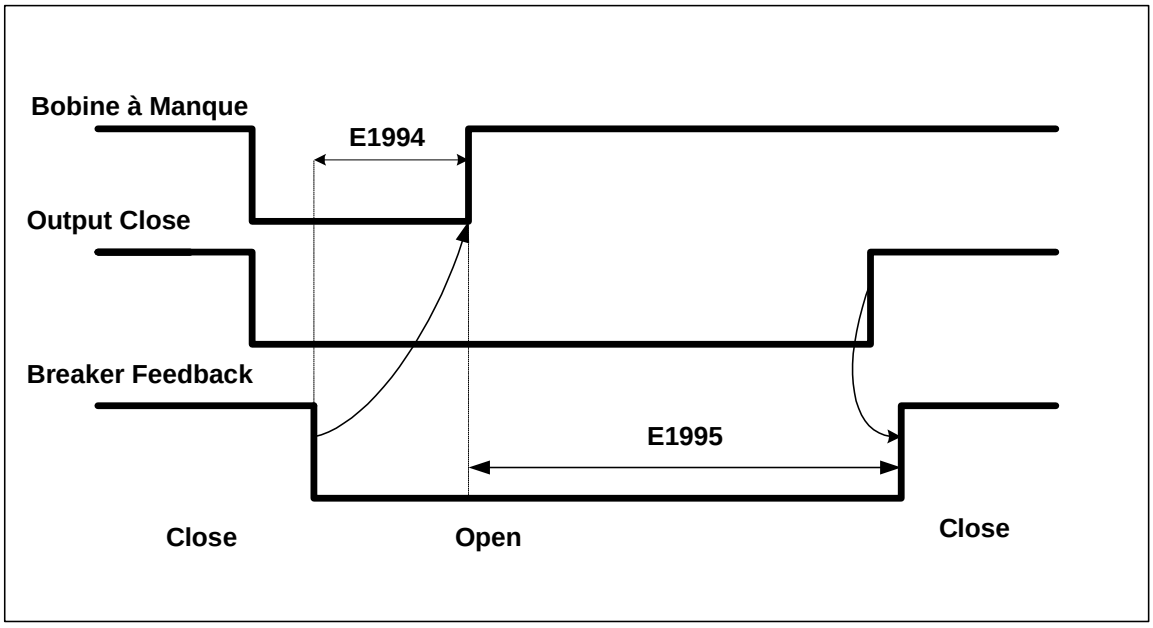
E1992 (Normal) or E1993 (Backup)	Relay output	Chronogram
0	continuous contact opening *E1 (normal) / E4 (Backup)* pulse closure (positive) *E2 (normal) / E5 (Backup)*	
1 (same as GENSYS 1.0)	continuous contact opening *E1 (normal) / E4 (Backup)* continuous contact closure *E2 (normal) / E5 (Backup)*	
2	opening for trip coil *E1 (normal) / E4 (Backup)* pulse closure *E2 (normal) / E5 (Backup)*	
3	opening for trip coil *E1 (normal) / E4 (Backup)* continuous contact closure *E2 (normal) / E5 (Backup)*	
4	pulse opening *E1 (normal) / E4 (Backup)* pulse closure *E2 (normal) / E5 (Backup)*	
5	pulse opening *E1 (normal) / E4 (Backup)* continuous contact closure *E2 (normal) / E5 (Backup)*	

Table 12 - Breaker control configuration

For control using a pulse or an undervoltage trip coil, the necessary parameters are:

E1893: length of pulse.
E1994: Undervoltage trip coil delay. This sets the time between the opening of the breaker and the closing of the undervoltage trip coil control contact.
E1995: Undervoltage trip coil pause time. Sets the time between the closing of the undervoltage trip coil control contact (E1 or E4) and another breaker close request by the other contact (E2 or E5). This must be longer than the breaker reset time.
These values can be modified in the *Configuration/Enhanced configuration/ Modification by variable n°* menu.



WARNING: Never switch from one mode to another when the plant is in use. An unwanted breaker state modification may occur.

To close the generator breaker the following conditions have to be met:

Voltage must be between 70% (parameter E1432) and 130% (parameter E1433) of the nominal voltage (parameter E1107 or E1108).
Speed must be between 70% (parameter E1434) and 130% (parameter E1435) of the nominal speed (parameter E1080 or E1081).

8 Spare I/O lines

8.1 Digital inputs

There are twelve configurable inputs, J4 to J15, all on the same pin-out.
The following parameters can be set:
-Label: can be modified with parameters file.
-Validity: can be modified using configuration menu or equations.
-Direction: can be modified using configuration menu or equations.
-Delay: can be modified using configuration menu or equations.
-Function: can be modified using configuration menu or equations.

To modify a parameter through the menu, go to the configuration menu: “Enhanced configuration”/“Digital transistors output”. Choose the digital input to modify using the **[<<]** and **[>>]** soft keys to change page (2 inputs per page), and **[↑]** and **[↓]** to choose the parameter. The description of the function is given on the next line, and can be modified with the **[+]** and **[-]** keys.

Do not forget to use **[SHIFT]** + **[i]** to save modified values.

	Non delayed input	Delayed input	Delay value	Validity	Polarity
Input J4	E2800	E2804	E1998	E4035	E1456
Input J5	E2801	E2805	E1999	E4036	E1457
Input J6	E2788	E2806	E1277	E1287	E1297
Input J7	E2789	E2807	E1278	E1288	E1298
Input J8	E2790	E2808	E1279	E1289	E1299
Input J9	E2791	E2809	E1280	E1290	E1300
Input J10	E2792	E2810	E1281	E1291	E1301
Input J11	E2793	E2811	E1282	E1292	E1302
Input J12	E2794	E2812	E1283	E1293	E1303
Input J13	E2795	E2813	E1284	E1294	E1304
Input J14	E2796	E2814	E1285	E1295	E1305
Input J15	E2797	E2815	E1286	E1296	E1306

Table 13 - Input parameters

8.1.1 Configurable input label

This is the name you give to the input. The name will be displayed in the info, alarm, and fault screens if so programmed. You can change the label using the menu, or you can download a text parameter file via the Internet connection.

8.1.2 Validity

Validity input variable numbers can be set as:

Num	Label	Function
2329	Never	Never active: should be selected if you do not use the input.
2330	Always	Always active: input will be monitored as long as MASTER 2.0 has power.
2331	Post-Start	Input will be monitored at the end of the "safety on timer" [E1514] (*)
	Stabilized	Input will be monitored when plant is ready for use (E2057 = 6).
2332	Spare scenario	Input will be monitored as defined in equations.

Table 14 - Input validity domain

(*) Safety ON time configuration is accessible via "Enhanced configuration/Start / stop sequence" menu, on the "Timers" page. Parameter is configured in E2192, and counter value is in E1514.

8.1.3 Direction

Direction input variable numbers: (E1456, E1457, and E1297 to 1306)
For each of the ten inputs, two options are available:

Num	Label	Function
0	Norm open	Should be selected in normal cases unless the input is used for protection.
1	Norm close	Normally closed; should be selected if the input is normally connected to 0V and is opened when active

Table 15 - Input direction domain

8.1.4 Delay

Delay variable numbers: (E1277 to 1286)
For each input, delay can be defined in 0.100 ms steps between 0 and 6553 s.

8.1.5 Input functions

Function input variable numbers (E1267 to 1286) can be set as indicated in the following table.

Value	Function	Description
0	Unused	Should be selected if you do not use the input.
1	Used by equations	If the effect of the input activation is not listed below, choose "used by equations"
2224	Manual water preheat request	Not used with MASTER 2.0.
2225	Manual oil prelube request	Not used with MASTER 2.0.
2226	Manual preglow request	Not used with MASTER 2.0.
2205	Fault reset request	If an external reset is wired to the input, choose fault reset request. This will have the same effect as pressing the reset key on the MASTER 2.0 front panel on Fault and Alarm displays.
2227	Manual start request	To be selected if a remote start command is to be installed.
2228	Manual stop request	To be selected if a remote stop command is to be installed - different from emergency stop.
2233	Manual +f request	To be selected if a remote frequency increasing command is to be installed.
2234	Manual -f request	To be selected if a remote frequency decreasing command is to be installed.

Value	Function	Description
2235	Manual +U request	To be selected if a remote voltage increasing command is to be installed.
2236	Manual -U request	To be selected if a remote voltage decreasing command is to be installed.
2231	Fuel high level	Not used with MASTER 2.0.
2230	Fuel low level	Not used with MASTER 2.0.
2244	Coolant high level	Not used with MASTER 2.0.
2243	Coolant low level	Not used with MASTER 2.0.
2247	Oil high level	Not used with MASTER 2.0.
2246	Oil low level	Not used with MASTER 2.0.
2197	Securities inhibition	Will inhibit all protections. These alarms and faults remain listed in the faults and alarm logging.
2198	No cranking	Not used with MASTER 2.0.
2210	Ext. secu.(Hard shut down)	If external protections are installed, for immediate stop of the engine. See recommendations in "Directions" paragraph.
2209	Ext. fault(Soft shut down)	If external protections are installed, for immediate opening of Genset breaker and stopping of the engine after cooling down timer has expired. See recommendations in "Directions" paragraph.
2208	External alarm	If external protections are installed, to report an alarm. See recommendations in "Directions" paragraph.
2217	Generator(s) electrical fault	If external protections are installed, protection will open bus bar breaker and try to synchronize again. See recommendations in "Directions" paragraph.
2218	Mains electrical fault	If external protections are installed, protection will open mains breaker and try to synchronize again. See recommendations in "Directions" paragraph.
2681	Non essential trip alarm	Remote non essential load.
2736	Help + Fault (Soft shut down)	Not used with MASTER 2.0.
2737	Help + Gen Electrical Fault	Not used with MASTER 2.0.
2655	Remote stop horn	To be selected to stop the external Horn. Useful if one output is set as "Horn". to be used in conjunction with digital outputs
2336	Gen. breaker Close manual	To be selected if manual remote close button for bus bar breaker is programmed.
2337	Gen. breaker Open manual	To be selected if manual remote open button for bus bar breaker is programmed.
2338	Mains breaker Close manual	To be selected if manual remote close button for mains breaker is programmed.
2339	Mains breaker Open manual	To be selected if manual remote open button for mains breaker is programmed.
2001	Generator breaker Aux	To be selected if a different input for the bus bar breaker position is required.
2000	Mains breaker Aux	To be selected if a different input for the mains breaker is required.
2002	Remote start	To be selected if a different input for remote start is required.

Value	Function	Description
2003	Oil pressure fault	Not used with MASTER 2.0.
2004	Water temperature fault	Not used with MASTER 2.0.
2241	Priority generator	Not used with MASTER 2.0.
2257	Synchronization forced	Will force MASTER 2.0 to synchronize the output with the governing system. AVR will act so as to synchronize the plant. The “Power mode” (E2088) is forced to Synchronization (1).
2258	Fixed kW forced	Will force MASTER 2.0 to give constant power delivery. The output governing system will maintain a fixed power output from the plant. The “Power mode” (E2088) is forced to Fixed kW (4).
2259	kVAR sharing forced	The output to AVR will share reactive load with other gensets, using the inter MASTER 2.0 CAN bus. (E.g. to be used in manual mode). The “AVR cont. mode” (E2090) is forced to kVAR sharing (5).
2656	Voltage Droop forced	Not used with MASTER 2.0.
2260	No manu mode	Will inhibit the "Manu" key on the MASTER 2.0 front panel. MASTER 2.0 will never be in Manu mode even if you press the MASTER 2.0 "Manu" key.
2261	External manu mode request	Will put MASTER 2.0 into Manual mode. Will have the same effect as the MASTER 2.0 "Manu" key.
2661	Running with breaker open	Allows the plant to run in Auto mode without paralleling or closing its breaker.
2279	Select speed 2	Will select the second speed set point.
2280	Select volt 2	Will select the second voltage set point.
2281	Select KW 2	Will select the second power output set point.
2513	Select Pnom 2	Will select the second nominal power (active and reactive).
2273	Preheating	Not used with MASTER 2.0.
2252	Manu fuel fill	Not used with MASTER 2.0.
2253	Manu coolt fill	Not used with MASTER 2.0.
2254	Manu oil fill	Not used with MASTER 2.0.
2766	Heavy consumer request	Not used with MASTER 2.0..
5005	Unload brk1 in	Generator breaker n°1 feedback upon startup if the nominal power<E4001. Controlled by E5000.
5006	Unload brk2 in	Generator breaker n°1 feedback upon startup if the nominal power<E4002. Controlled by E5001.
5007	Unload brk3 in	Generator breaker n°1 feedback upon startup if the nominal power<E4003. Controlled by E5002.
5008	Unload brk4 in	Generator breaker n°1 feedback upon startup if the nominal power<E4004. Controlled by E5003.
5009	Unload brk5 in	Generator breaker n°1 feedback upon startup if the nominal power<E4005. Controlled by E5004.

Table 16 - Input functions

8.1.6 Dedicated inputs

In the menu list, each input is named after its pin number on the wiring of MASTER 2.0. Polarity can be normally open or normally closed. Program this according to the wiring you will have on site.

As a reminder:

J1 is the Mains breaker state.
J2 is the Bus bar breaker state.
J3 is the remote start input.
[E2000, E2001, E2002]

8.2 Digital outputs

Output1 to Output5 are wired on the C connector. These outputs are electronically protected, but not isolated.

Outputs 1 to 5 (E1260, E1261, E1262, E1262, E1264): function and polarity can be defined.

8.2.1 Output configurable functions

Value	Function	Description
0	Unused	To be selected if output is not wired.
1	Used by equations	To be selected if output is used by equations.
2083	Water preheat	Not used with MASTER 2.0.
2084	Pre-lubrication	Not used with MASTER 2.0.
2085	Pre glow	Not used with MASTER 2.0
2018	Crank	Not used with MASTER 2.0
2019	Fuel	Not used with MASTER 2.0
2211	Excitation	Can be used to activate an external AVR in a static synchronizing configuration [see Configuration -> power plant overview] Will activate an external excitation relay when engine state [E2057] is: engine ready [5]; generator ready [6]; wait after stop request [7]; cool down [8]. In the case of dynamic paralleling [E1177 = 0], the output will also be activated in the start [2], warm up [3], and nominal speed [4] states.
2212	Fuel (energize to stop)	Not used with MASTER 2.0.
2016	Generator breaker order	Can be used to open or close bus bar breaker. The outputs configured with this function will have exactly the same behaviour as the outputs for the bus bar breaker [E4 to E6].
2017	Mains breaker order	Can be used to open or close the mains breaker. The outputs configured with this function will have exactly the same behaviour as the outputs for the Mains breaker [E1 to E3].
2202	Alarms summary	Fault summary: will activate an output when there is at least one “alarm” triggered by MASTER 2.0.
2204	Securities summary	Fault summary: will activate an output when there is at least one “Security” triggered by MASTER 2.0.
2203	Faults summary	Fault summary: will activate an output when there is at least one “fault” triggered by MASTER 2.0.
2200	Gen. elec faults summary	Fault summary: will activate an output when there is at least one “generator elec. fault” triggered by MASTER 2.0.

Value	Function	Description
2201	Mains elec. faults summary	Output will be activated whenever a protection triggers a mains electrical fault.
2724	Trip out 1	Not used with MASTER 2.0.
2725	Trip out 2	Not used with MASTER 2.0.
2726	Trip out 3	Not used with MASTER 2.0.
2727	Trip out 4	Not used with MASTER 2.0.
2728	Trip out 5	Not used with MASTER 2.0.
2774	Trip out direct	Not used with MASTER 2.0.
2213	Smoke limiter	Not used with MASTER 2.0.
2214	Warm up	Not used with MASTER 2.0.
2206	Horn	Can be used for external horn or flashing light relay; output will activate whenever a protection triggers. The output will have the same behaviour as the MASTER 2.0 front face LED. It will be activated when a generator electrical fault [E2200], mains electrical fault [E2201], alarm [E2202], fault [E2203] or security [E2204] triggers, and while the MASTER 2.0 horn button is pressed.
2215	Air fans	Not used with MASTER 2.0.
2219	Generator breaker Close	Can be used to close bus bar breaker [100 ms pulse]
2221	Generator breaker Open	Can be used to open bus bar breaker
2220	Mains breaker Close	Can be used to close mains breaker.
2222	Mains breaker Open	Can be used to open mains breaker.
		Generates a 100ms pulse on the output, when Generator/Mains breaker [E2016/E2017] wants to close/open
2229	Fuel filling	Not used with MASTER 2.0.
2242	Coolant filling	Not used with MASTER 2.0.
	Oil filling [2245]	Not used with MASTER 2.0.
2341	+f	
2342	-f	
2343	+U	
2344	-U	The behaviour will change according to the mode. In Manual mode, if you program the +f function, the output will be activated when you press the MASTER 2.0 F1 key or if there is a “Manual +f request” [E2233]. Likewise for the other functions; -f activates with F2 key or “Manual –f request [E2234]; -f activates with F1+SHIFT keys or “Manual +U request [E2235]; -f activates with F2+SHIFT keys or “Manual –U request [E2236].
2223	Damper	Not used with MASTER 2.0.
2232	Light test	This will activate the output whenever the light test key is pressed on the front panel of MASTER 2.0, or an input programmed for light test is active

Value	Function	Description
2331	Generator ready	Output will be active when start sequence is completed and voltage is present at the bus bar. In Auto mode, the output will be activated when the engine state [E2057] is “Gen ready” [6]. In Manual mode the output will be activated when the speed [E0033] is positive.
2240	Generator stopped	Output will be active when plant is at rest. In Auto mode, the output will be activated when the engine state [E2057] is “Waiting” [0]. In Manual mode the output will be activated when there is no speed [E0033].
2262	**[+]** key	
2263	Shift & **[+]** keys	
2264	**[-]** key	
2265	Shift & **[-]** keys	These key are useful in Manu mode to control the speed and the voltage.
2056	Manu mode	Output will be active when MASTER 2.0 is in manual mode.
2267	Starter 2	Not used with MASTER 2.0.
2268	Starter 3	Not used with MASTER 2.0.
2269	Ana1 threshold	Output will be active when the measurement of analogue input 1 is under the set value; it will not de-activate until measurement is over [set value + hysteresis value]. To be programmed and used with the following parameters: “Ana1 threshold” [E1175], “Ana1 hysteresis” [E1176].
2270	Ana2 threshold	Output will be active when the measurement of analogue input 2 is over the set value; it will not de-activate until measurement is under [set value minus hysteresis value]. To be programmed and used with the following parameters, “Ana2 thresh” [E1426], “Ana2 hyst.” [E1427]
2271	Ana3 threshold	Output will be active when the measurement of analogue input 3 [1st spare measure] is over or under the set value; it will not de-activate until measurement is under or over [set value +/- hysteresis value]. To choose the direction of the protection, see Configuration -> engine/battery settings [SS measure 1 min or max thresh.]. To be programmed and used with the following parameters: “Meas 1 thresh.” [E1428], “Meas 1 hyst.” [E1429].
2272	Ana4 threshold	Output will be active when the measurement of analogue input 4 [2nd spare measure] is over or under the set value; it will not de-activate until measurement is under or over [set value +/- hysteresis value]. To choose the direction of the protection, see Configuration -> engine/battery settings [SS measure 2 min or max thresh.]. To be programmed and used with the following parameters: “Meas 2 thresh.” [E1430] and “Meas 2 hyst.” [E1431].
2525	Available in Auto	Will activate when the plant has completed its start sequence in auto mode - can be used for external logic. The output will be activated when MASTER 2.0 is in Auto mode and the power state [E2071] is not in fault [40, 100 or 255].
2767	Heavy consumer authorization	Not used with MASTER 2.0.
5000	Unload brker 1	Order output to close generator breaker n°1 upon start if the nominal power<E4001

Value	Function	Description
5001	Unload brker 2	Order output to close generator breaker n°1 upon start if the nominal power<E4002
5002	Unload brker 3	Order output to close generator breaker n°1 upon start if the nominal power<E4003
5003	Unload brker 4	Order output to close generator breaker n°1 upon start if the nominal power<E4004
5004	Unload brker 5	Order output to close generator breaker n°1 upon start if the nominal power<E4005

8.2.2 Polarity

For each of the five outputs, two options are possible:
NE: normally energized; the output will de-energize when required, according to its function.
ND: normally de-energized; the output will energize when required.

8.3 Analogue inputs

8.3.1 Configuration of analogue inputs

Spare Analogue measurements can be named, and the unit to be displayed chosen among the following:
No unit, V, kV, mA, A, kA, Hz, kW, kWh, kVAR, kVARh, rpm, %, Bar, mBar, kPa, PSI, °, °C, °F, L, Gal, s, h, days, Hz/s, m3/h, L/h, Gal/h.
You can then choose the degree of accuracy (number of digits after decimal point):

- 1
- 0.1
- 0.01
- 0.001

8.3.2 Calibration of analogue inputs

1/ 0-400 Ohms sensors

Please enter the pressure or temperature read by your sensors according to the resistance shown in the table.
Pressure calibration points are [E1188 to E1198], which correspond to 0 to 400 Ohms
Temperature calibration points are [E1199 to E1209], which correspond to 0 to 400 Ohms.

Ohm	VDO 5b	VDO 10b	VDO 25b	AC 10b	Veglia 8b	Veglia 12b	Dat 10b
0	-345	-487	-2 120	-260	8 442	12663	12142
40	834	1 585	3 777	4 316	6 922	10387	8962
80	2 014	3 945	9 674	8 892	5 402	8111	6102
120	3 193	6 245	15 571	13 468	3 882	5835	3562
160	4 372	9 050	21 469	18 044	2 362	3559	1342
200	5 552	12 220	27 366	20 000	842	1283	-558
240	6 731	20 000	30 000	20 000	-678	-993	0
280	7 911	20 000	30 000	20 000	0	0	0
320	9 090	20 000	30 000	20 000	0	0	0
360	10 270	20 000	30 000	20 000	0	0	0
400	11 449	20 000	30 000	20 000	0	0	0

Table 17: Analogue pressure calibration points

Ohm	VDO 120°	VDO 150°	Veglia	Datcon L	Datcon H	AC
0	145	1000	1000	1000	0	1000
40	96	119	140	104	40	104
80	74	94	118	78	80	78
120	63	80	105	63	120	63
160	55	70	96	52	160	52
200	49	62	89	43	200	43
240	44	56	83	36	240	36
280	40	51	78	31	280	31
320	37	46	74	26	320	26
360	34	42	70	21	360	21
400	32	38	67	17	400	17

Table 18: Analogue Temp calibration points:

2/ Engine measurements 1 and 2

Spare 1 engine measure calibration points are [E1210 to E1220].
Spare 1 engine measure impedance points are [E1188 to E1198].
Spare 2 engine measure calibration points are [E1232 to E1242].
Spare 2 engine measure impedance points are [E1199 to E1209].

For each of the spare sensors, this table shows the given value (left side) for each of ten sampled resistive values in ohms (right side). Intermediate values are obtained with linear approximation.
E. g.: min = 3000, max =6000, gives the values corresponding to 3000, 3300, 3600, 3900, 4200, 4500, 4800,..., 5700, 6000 Ohms. These can be used in equations or displayed.

8.3.3 Use spare analogue input as digital input

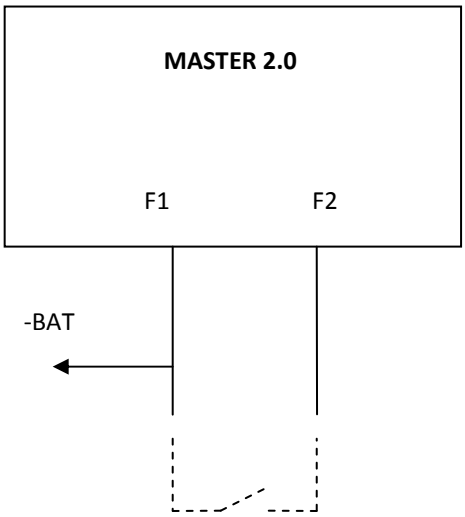
If necessary, it is possible to use an analogue input as a digital input.

1/ Purpose

Use spare analogue input (spare 1 and 2, connections F1-F2 and F3-F4) as digital input.

2/ Configuration

Spare analogue input calibration table should be set as shown below to mimic digital input.



3/ Parameters

Calibration table for a normally closed input:

```
V1210   0       N       Spare1 calib1   -32768  +32767
V1211   1       N       Spare1 calib2   -32768  +32767
V1212   1       N       Spare1 calib3   -32768  +32767
V1213   1       N       Spare1 calib4   -32768  +32767
V1214   1       N       Spare1 calib5   -32768  +32767
V1215   1       N       Spare1 calib6   -32768  +32767
V1216   1       N       Spare1 calib7   -32768  +32767
V1217   1       N       Spare1 calib8   -32768  +32767
V1218   1       N       Spare1 calib9   -32768  +32767
V1219   1       N       Spare1 calib10  -32768  +32767
V1220   1       N       Spare1 calib11  -32768  +32767

V1221   0       N       Spare1 res1     +00000  +10000
V1222   1000    N       Spare1 res2     +00000  +65535
V1223   2000    N       Spare1 res3     +00000  +65535
V1224   3000    N       Spare1 res4     +00000  +65535
V1225   4000    N       Spare1 res5     +00000  +65535
V1226   5000    N       Spare1 res6     +00000  +65535
V1227   6000    N       Spare1 res7     +00000  +65535
V1228   7000    N       Spare1 res8     +00000  +65535
V1229   8000    N       Spare1 res9     +00000  +65535
V1230   9000    N       Spare1 res10    +00000  +65535
V1231   10000   N       Spare1 res11    +00000  +10000
```

For « Normally closed » or « normally opened » inputs wiring will be similar, only the software requires modification.

Then enter these equations to switch to virtual input:

```
@*********************************;
@analog input to DI/spare 1 ;
@*********************************;
@E0031 analog input spare 1;
@E2283 virtual input 1 ;
@*********************************;
E2283:= E0031 ;


Calibration table is similar for a normally opened input; you need only change the
equations:
@*********************************;
@ Analog input in numeric/spare 1 ;
@*********************************;
@E0031 analog input spare 1;
@E2283 virtual input 1;
@*********************************;
E2283:= !E0031 ;
```

9 Protections

Protections are triggered by different events (digital inputs, and logic sequences). They take action to protect a process, engine or alternator.
When configured, they can take the actions listed hereunder.

9.1 Disable

This gives no effect.

9.2 Power plant electrical fault

This action triggers a “Plant electrical fault”. Protection will open bus bar breaker and try to synchronise again. Number of attempts can be configured.

9.3 Mains electrical fault

This action triggers a “Mains electrical fault”. Protection will open mains breaker and try to synchronize again. Number of attempts can be configured.

9.4 Alarm

This action triggers an “Alarm”.

9.5 Fault (Soft Shut down)

This action triggers a “Soft shutdown”. Bus bar breaker will open allowing the plant to cool down off load for the duration of the cool down timer. The plant is then stopped.

9.6 Security (Hard Shutdown)

This action triggers a “Hard shutdown”. Bus bar breaker will open and the plant will be stopped immediately without cooling down.

9.7 Help + Fault (Soft Shut down)

Not used in MASTER 2.0.

9.8 Help + Gen. Electrical fault

Not used in MASTER 2.0.

10 Additional functions

10.1 Operator controlled return to mains

10.1.1 Explanation

Normal operation: In the case of mains failure, the plant starts and takes the load. When the mains voltage returns, the plant resynchronizes with the mains and automatically gives back the load.
The “Operator controlled return to mains” special function (set with the parameter E1620 = 1) allows the operator to control the moment the plant will return the load to the mains.
The MASTER 2.0 waits for E2584 = 1 (Virtual input 40) before re-synchronizing the plant to the mains.

10.1.2 How to set this function

The E1620 variable must be set to 1.
The Virtual Input 40 must be set as “used by equations” (E1699=1)
This virtual input can be associated to:
-a digital input: Ex: E2584= E2006;
-a CANopen deported digital input: Ex: E2584= E0158;
-an equation result: E2584= (E2440 GT 1000) AND (E2006 EQ 1)

10.1.3 Summary

E1620 = 1.
E2584 = Virtual Input 40 to allow the plant to return the load to the mains.
E1699 = 1: (E2584 (VI 40) is "used by equations")

10.1.4 Parameters used

E1620	Inhibition of Variable 13= Operator return to Mains (+ E2584)
E2584	Virtual input Spare 40
E1699	Virtual Input 40 associated function.

10.2 Mains & Plant electrical fault options

Mains electrical fault management
Parameters (default value in bold):

E1846: Open breaker: selects the breaker that will be opened upon a "Mains electrical fault". Choose between the "**Mains**" breaker or the "Bus bar" breaker or "both".
E1841: Fault start: allows the plant to start upon a "Mains electrical fault". You can select "**Yes**" to start the plant or "No".
E1840: Start delay (**0.0**): is the delay between the "Mains electrical fault" and the plant starting. It will delay a digital or virtual input. In the case of an internal detection, this delay bypasses the delay of the protection.
E1842: No load delay (**60.0**): is the time for which the plant runs without load when the bus bar breaker is opened. If the delay is 0, the plant will never stop.

10.2.1 Default configuration

Diagram of behaviour in change over and mains paralleling modes.

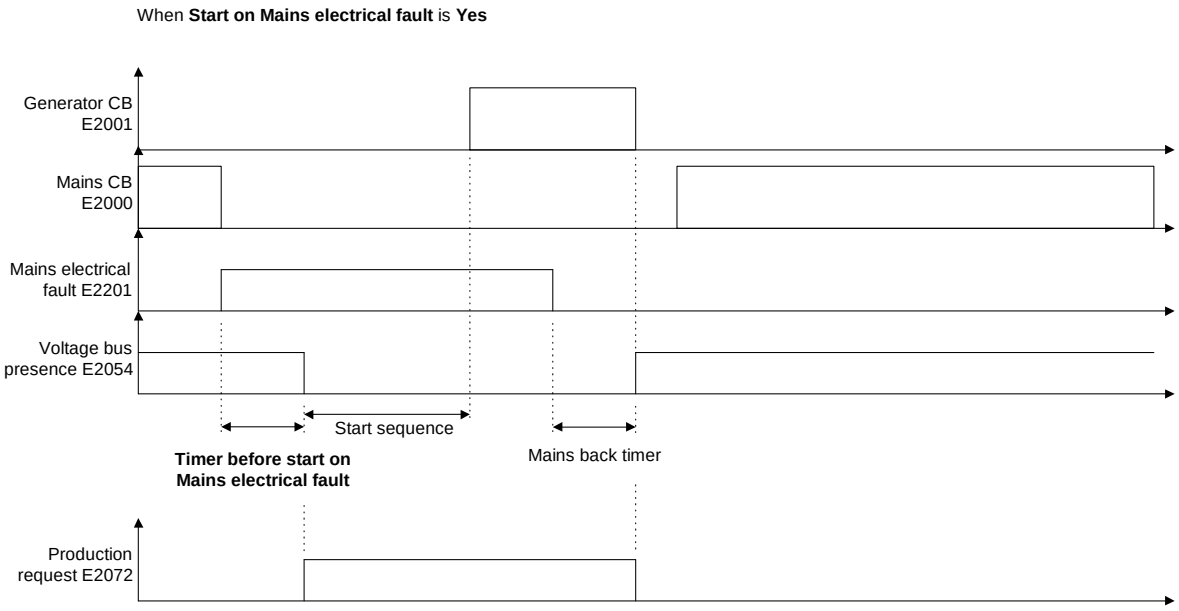


Figure 24 - Change over with one digital input programmed as "Mains electrical fault"

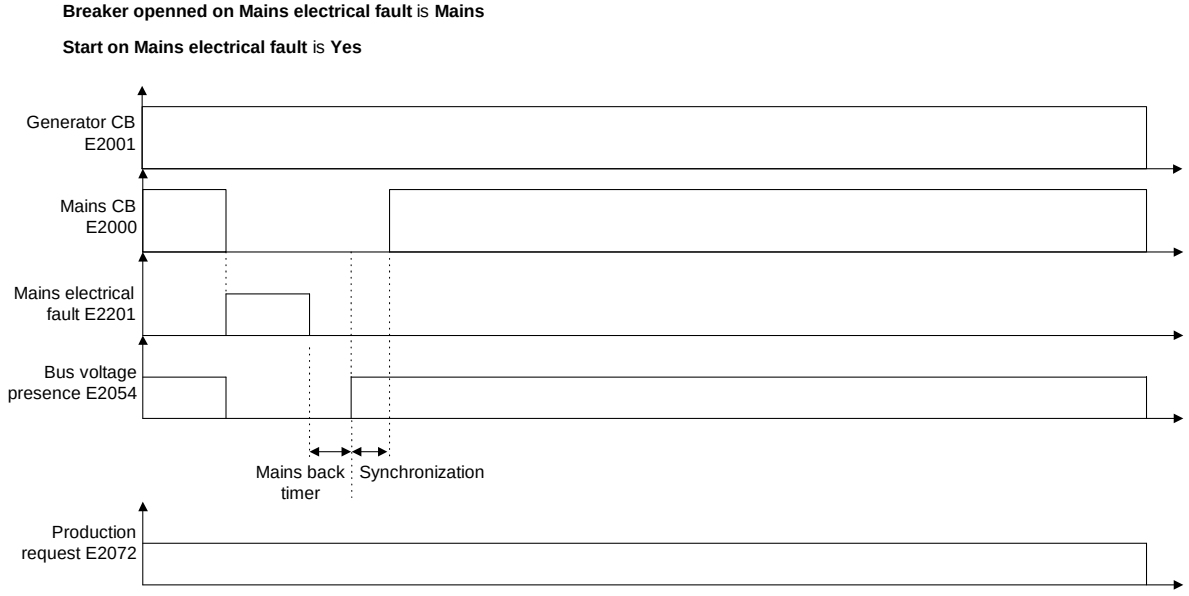


Figure 25 - Permanent mains paralleling with one digital input programmed as "Mains electrical fault"

10.2.2 Start on fault and open plant on fault

This parameter is useful in permanent mains paralleling mode with "open bus bar breaker on mains failure". It can be used if the plants' nominal power is not high enough to take the load in island mode.
In this case, the plant will provide power, but if there is a mains failure the plant will not take the load alone, and opens its breaker.
In case the setup of the unit does not generate a plant start upon mains failure, it will run with no load and stop after a preset time (E1842).

Breaker openned on Mains electrical fault is **Generator**

Start on Mains electrical fault is **No**

Remote start is always On

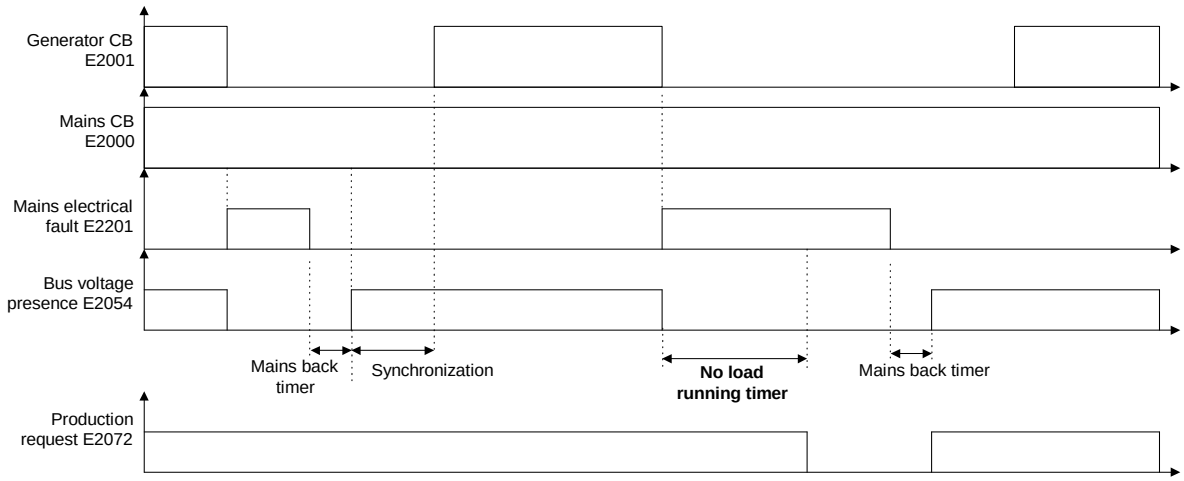


Figure 26 - Permanent mains paralleling with one digital input programmed as "Mains electrical fault"

Breaker openned on Mains electrical fault is **Generator**

Start on Mains electrical fault is **Yes**

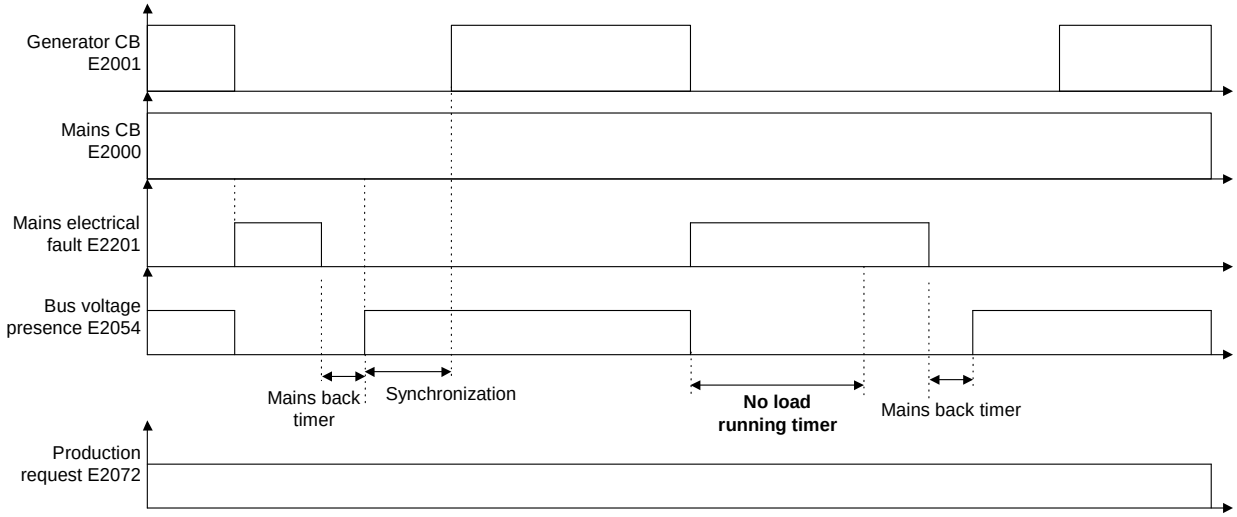


Figure 27 - Permanent mains paralleling with one input as "Mains electrical fault"

NOTE:
Never use “No start on fault” in conjunction with "open mains on fault" in permanent mode or no break change over mode.
Always use “No start on fault” when "bus bar breaker" or "both breakers" to open is selected.

10.3 Plant electrical fault

Parameters (default value in bold):
E1843: TM re-synch. (**30.0**): the delay before the plant tries to re-synchronize with the Mains after a "Plant electrical fault".
E1844: Nb re-synch. (**3**): number of attempts to re-synchronize.
In the case of a plant electrical fault, the bus bar breaker is opened and the MASTER 2.0 is in state 40. After the

E1265 timer, if the fault is still present, there is a hard shutdown. Otherwise MASTER 2.0 will try to re-synchronize.

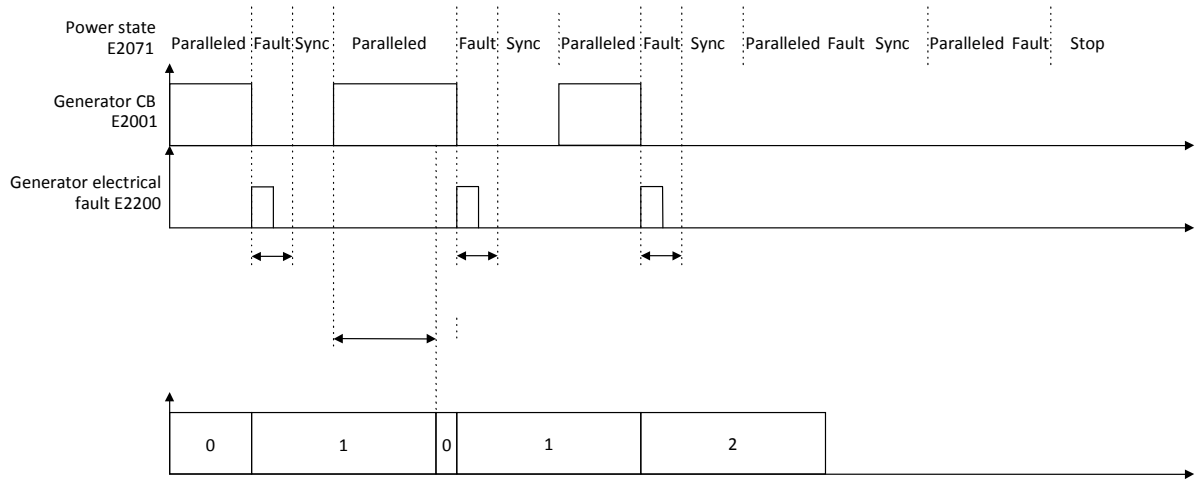


Figure 28 - Permanent mains paralleling and generator electrical fault

10.4 Remote start upon external pulse

To set the MASTER 2.0 to start upon an external pulse input, 2 solutions can be used:
-Use a relay
-Set an external input

10.4.1 Setting external input

This variable E2514 (Virtual Start) must be maintained at « 1 » after the first rising edge and go to 0 after the second rising edge.

Example is for the J15 input:

```
@ WARNING: if section empty or missing, existing equations will be lost;
PROG 1
BLOC

    @@@@ PULSE ON REMOTE START FROM EXTERNAL  @@@@;
    @ E2585 = Value of the E2815 with one cycle less to detect a pulse;
    @ ( E2815 EQ 1) AND (E2585 EQ 0) Detection of a top pulse;
    @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@;



    E2585:= E2815;
    E2514:=((E2514 OR ((E2815 EQ 1) AND (E2585 EQ 0))) AND ((E2514 AND ((E2815 EQ
1) AND (E2585 EQ 0))) EQ 0))



BEND
.
```

Do not forget to set the input. MASTER 2.0 must be informed that J15 (in this example) is used by a custom equation:

```
V1276   1       N       DIJ15 function   +00000   +02999
```

Here the variable E2585 detects a rising edge on E2815.
The cycle or the variable E2815 goes from 0 to 1. The variable E2585 stays at 0 a cycle longer in order to see E2815 =1 and detect the rising edge.
You can also detect the falling edge by changing the equation:

```
 (E2815 EQ 1) AND (E2585 EQ 0) to (E2815 EQ 0) AND (E2585 EQ 1).
```

10.5 Level -1 (G59 & counters)

The end user can access limited parameters without using the level 1 password.
To activate the level 1 password menu, you have to connect in level 2, enter the “System” menu, and then go to “level-1 password menu”.
Then set 1610 to the menu you want (None, G59 or Meter Pres).
Press **[ENTER]**
Don’t forget to save the settings on the MASTER 2.0 by pressing **[SHIFT]** + **[i]**
In this menu, you can also change the custom password. The default password is “CustMenu”.
Now, you can only access the specific menu and its parameters by inserting the custom password in the password menu.

10.5.1 Specific applications

1/ Meters preset

With this option you can set all the counters, and not only reset them.
Don’t forget to save the settings on the MASTER 2.0 **[SHIFT]** + **[i].**

2/ G59 option

G59 is a protection norm widely used in the UK.
You can set and lock the following protections:
Mains Under / Over frequency
Mains Under / Over voltage
Vector surge
ROCOF (df/dt)
When the protections are locked, thresholds, timers and controls are also locked.
You can also change the custom password to an official application.
Don’t forget to save the settings on the MASTER 2.0 **[SHIFT]** + **[i]**

10.6 Scada

MASTER 2.0 communication uses industrial standards. This product is versatile, and can be used with Modbus, for example to be controlled by a SCADA system.
CRE Technology offers different solutions for such applications (remote display, remote control, event and alarm management …). Contact us for more information.

10.7 How to set a GPID

10.7.1 Principle

A GPID allows the control of any system in a simple way. Figure 32 shows a typical GPID.

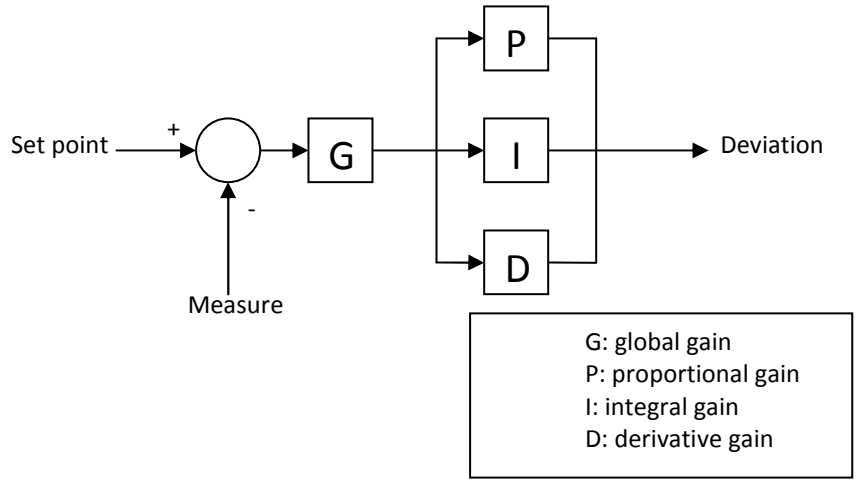


Figure 29 - Typical GPID controller

The G parameter acts as sensitivity adjustment for the other parameters.
The P parameter adjusts the rise time (time needed for the system to reach its set point for the first time). By increasing P, the rise time will decrease. However, overshoot will increase and may also render the system unstable (fast hunting). Using only the P factor will always leave a difference between the set point and the actual value (this difference is also called droop).
The I parameter reduces the difference between the set point and the actual value. By increasing I, the rise time will decrease. However, overshoot will increase and may also render the system unstable (slow hunting).
The D parameter increases the stability and minimizes the overshoot phenomena. By increasing D, overshoot will decrease but the system may still be unstable, particularly if the measured signal is disturbed (sensor signal not filtered).

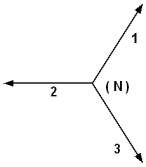
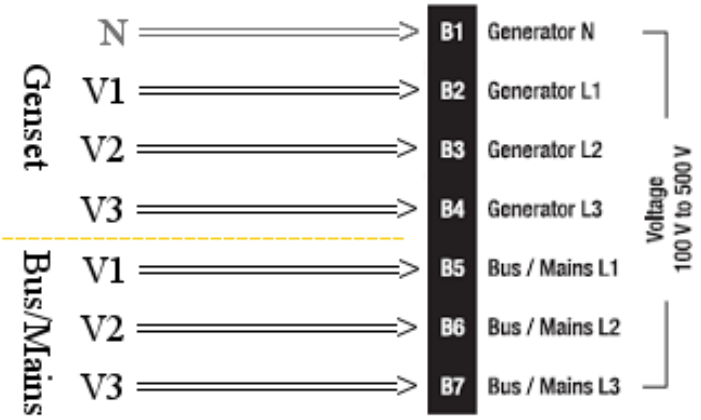
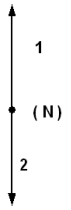
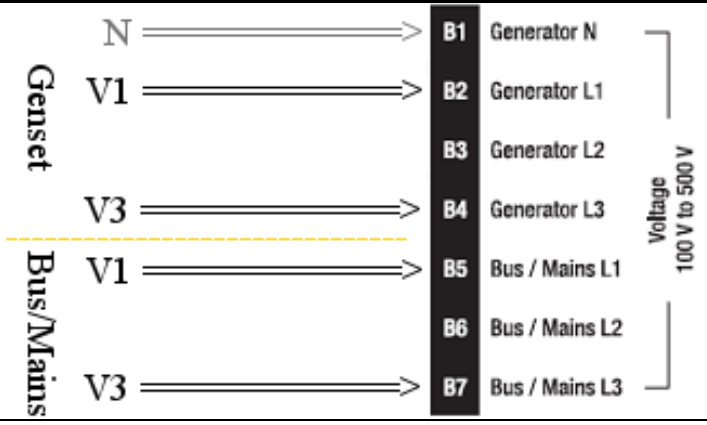
10.7.2 Empirical setting method

First set G to 50%.
Set the parameters P, I and D to zero.
Increase the value of P until the system becomes unstable. From this position, decrease the value of P to 60% of the previous value.
Set I in the same way.
Increase D if the system is unstable upon fast load variation.
If stability cannot be achieved, restart the settings and reduce (system unstable) or increase (system too slow) G.

10.8 120° three phase and 180° two phase systems

Parameter E4039 allows you to select the system to be used in the *Configuration/Basic configuration/Genset* menu.

System used	E4039
Three phase 120°	0 *(default value)*
Two phase 180°	1

SYSTEM	PARAM.	CONNEXIONS
3 phase 120°  **3 phase + Neutre**	**E4039 = 0**	
SYSTEM	**PARAM.**	**CONNEXIONS**
2 phase 180°  **2 phase 180°+ Neutre**	**E4039= 1**	

11 Text file & PLC

11.1 Introduction

The core system of the MASTER 2.0 is based on a list of predefined variables.
These variables can be used in a programming language called CRE language. This language uses simple keywords in an ASCII text file. This text file is downloaded from MASTER 2.0 (details in §**Erreur ! Source du renvoi introuvable.**). It is stored as a binary program for use with flash memory. A copy of the source file is also stored on MASTER 2.0 for documentation and readability purposes. This copy can be retrieved at any time to be modified or transferred to another MASTER 2.0.
These equations can be used to add a logic equation and/or conditional function if your application requires non standard functions. It is also possible to change the predefined behaviour with custom applications.
The PLC provided has a loop time of 100ms, and a special code can be defined to run the first time only (INIT).
This chapter provides all resources for PLC programming.
A text file can be transferred to or from the MASTER 2.0 to set or retrieve the whole setup of the MASTER 2.0.

The text file allows you to:
-Set the value of every parameter.
-Change the units of analogue inputs (example: V, mbar, PSI,).
-Change the accuracy when displaying analogue values (example: 24V or 24.0V).
-Change the labels of some custom inputs and the screensaver.
-Transfer custom equations to the embedded PLC.

11.2 Variable naming

The file named “A53 Z0 9 0030x.xls” gives an explanation of each variable.
The variable number always uses the same format, the letter **“E”** followed by 4 digits:
EXYYY
The first digit, **“X”,** is the type of variable:
0 and 5: Measurement or real time value (Ex: Voltage phase 1, CAN Bus Fault …)
1 and 4: Parameter to be stored in non-volatile memory (Ex: Genset number, Nominal power …)
2 and 3: General purpose variable (Ex: Alarms, PLC variables …)

The next 3 digits **“YYY”** give the number of the variable.
All the parameters (Variable from 1000 to 1999 and from 4000 to 4999) of the MASTER 2.0 are stored in a non-volatile FLASH memory within the module. It is possible to download or upload these parameters with a computer, thus allowing the user to save, modify and reuse these parameters later.
All these values are stored in a text file. The following chapter describes the layout of the file.
The file can be exchanged between a PC and MASTER 2.0, as described in §**Erreur ! Source du renvoi introuvable.**

11.3 Text file description

The text file is made up of 5 parts:
-Parameter definitions
-Label definitions
-Unit definitions
-Custom PLC Initialization definitions
-Custom PLC Equation definitions

11.3.1 Parameter definition block

The starting point of this block is designated by a "{PARAMETERS}" statement.
Each parameter (1xxx or 4xxx variable) can be found as an input in this block. The structure of the input is as follows:

The variable parameter number preceded by the letter V	(Ex: V1006)
The value	(Ex: 320)
R/W attribute (for MODBUS and PLC equations)	(Ex: Y)

The label (only for clarification) (Ex: Gen Nominal KW)
The minimal value (only for clarification) (Ex: +00000)
The maximal value (only for clarification) (Ex: +65535)
Ex:

```
{PARAMETERS}
V1006    320 Y    Gen nominal kW   +00000   +65535
V1007    1.00N    Gen PT ratio     +00000   +65535
```

In the example above, Genset (plant) nominal power is set to 320kW. The ***Y*** attribute shows that this value can be changed by MODBUS or custom PLC equations (for de-rating purposes for example) whereas the ***N*** attribute in the second line sets Generator PT ratio as "read only" for MODBUS and PLC equations.
It is possible to modify the values directly in the text file before uploading it into the MASTER 2.0. The user must be sure that the modified value is within the minimum / maximum range. Failure to do so will lead to an error message during uploading (***Compilation result: VARIABLE***).
It is also possible to write an incomplete parameter block (not all parameters are displayed in the list). When uploaded, such a file will only modify the parameters which have been entered, the others remain unchanged. This procedure can be used to upload an old text file into a newer MASTER 2.0 or to activate special features independently.

11.3.2 Label definition block

The beginning of this block is shown by a "{LABELS}" statement.
This block is used to define custom labels.
Only the spare analogue inputs, the digital inputs, the virtual digital inputs, the maintenance cycle, and the lines in the Logo Page can have an input in this block. The table below shows the correspondence between the LABEL number and its associated value:

Analogue inputs		Spare input		Cycle label		Virtual input			
L0029	AI spare 1	L2657	User meter 1	L1442	Cycle 1 (h)	L2283	Virtual in 1	L2565	Virtual in 21
L0030	AI spare 2	L2659	User meter 2	L1443	Cycle 2 (h)	L2284	Virtual in 2	L2566	Virtual in 22
L0031	AI spare 3	L2804	Spare Input J4	L1444	Cycle 3 (h)	L2285	Virtual in 3	L2567	Virtual in 23
L0032	AI spare 4	L2805	Spare Input J5	L1445	Cycle 4 (h)	L2286	Virtual in 4	L2568	Virtual in 24
		L2806	Spare Input J6	L1446	Cycle 5 (h)	L2287	Virtual in 5	L2569	Virtual in 25
		L2807	Spare Input J7	L1447	Cycle 1 (d)	L2288	Virtual in 6	L2570	Virtual in 26
		L2808	Spare Input J8	L1448	Cycle 2 (d)	L2289	Virtual in 7	L2571	Virtual in 27
		L2809	Spare Input J9	L1449	Cycle 3 (d)	L2290	Virtual in 8	L2572	Virtual in 28
		L2810	Spare InputJ10	L1450	Cycle 4 (d)	L2291	Virtual in 9	L2573	Virtual in 29
		L2811	Spare InputJ11	L1451	Cycle 5 (d)	L2292	Virtual in 10	L2574	Virtual in 30
		L2812	Spare InputJ12			L2293	Virtual in 11	L2575	Virtual in 31
		L2813	Spare InputJ13			L2294	Virtual in 12	L2576	Virtual in 32
		L2814	Spare InputJ14			L2295	Virtual in 13	L2577	Virtual in 33
		L2815	Spare InputJ15			L2296	Virtual in 14	L2578	Virtual in 34
						L2297	Virtual in 15	L2579	Virtual in 35
						L2298	Virtual in 16	L2580	Virtual in 36
						L2299	Virtual in 17	L2581	Virtual in 37
						L2300	Virtual in 18	L2582	Virtual in 38
						L2301	Virtual in 19	L2583	Virtual in 39
						L2302	Virtual in 20	L2584	Virtual in 40

Table 19- Label definition bloc

Page logo label	
T0249	MASTER 2.0
T0250	CRE product
T0251	Genset Paralleling
T0252	www.cretechnology.com

Table 20 - Custom logo labels

Each line of this block contains 2 elements:
-The variable number of the text, preceded by the letter L for label, and T for page logo.
Ex: L1130
-The text itself.

Labels are 14 characters long while Texts are 28 characters long maximum.
Ex: Sample Label
Supported characters include [a..z], [A..Z], [0..9] and the following graphical characters:
<space> ! # $ ( ) * + / : ; < = > [ ] ^ _ . -
All other characters are considered as insecure, and their use is prohibited. Their use can result in a bad display.

Ex:

```
{LABELS}
L1130    Sample label
```

Note: The label is language sensitive, i.e. a text file uploaded with PC language set to French will modify only the French labels. The English or Italian labels will remain unchanged. For the same reason, a text file uploaded with PC language set to French will display only French labels.

You must switch to the desired language before uploading/downloading a text file. Change the language (menu System/ "Back light timer / Languages"/"Local language") before changing the desired label.

11.3.3 Units and accuracy definition block

The beginning of this block is shown by a "{UNITS}" statement.
This block defines what kind of units and accuracy will be associated with each analogue value input (MASTER 2.0 analogue inputs, virtual inputs, and CANopen analogue inputs).
You only need to define the unit of the analogue input itself. All associated parameters (thresholds for instance) will automatically be modified in accordance. This includes native analogue inputs, extension CANopen analogue inputs, and virtual inputs.
The table below lists the different units supported by MASTER 2.0.
Only the 4 analogue inputs have an entry in this bloc (see file named Z090030.xls for variable number).
The structure of a unit/accuracy definition consists of the variable number preceded by a letter (U for Unit, A for Accuracy definition) and followed by a code as shown in the examples below.

The input is as follows:

```
{UNITS}
U0029    01
U2584    00
A0029    0000032768
```

The tables below give you the list of codes which correspond to the supported units and accuracies. In the examples above, input E2584 has no specific unit while input E0029 will be displayed in Volts (Unit code 01) and with 2 decimal digits (Accuracy code 32768).

Code	Unit	Code	Unit	Code	Unit	Code	Unit	Code	Unit
Electrical		**Power**		**Pressure**		**Volume**		**Time**	
00	" "	07	kW	13	Bar	20	L	24	s
01	V	08	kWh	14	mBar	21	m3	25	h
02	kV	09	kVAR	15	kPa	22	mm3	26	days
03	mA	10	kVARh	16	PSI	23	Gal	**Time related**	
04	A	**Rotating speed**		**Temperature**				27	Hz/s
05	kA	11	rpm	17	°			28	m3/h
Frequency		**Percent**		18	°C			29	L/h
06	Hz	12	%	19	°F			30	Gal/h

Code	Accuracy
00000	1
16384	0.1
32768	0.01
49152	0.001

Table 21 - Valid units and accuracy codes

Code Variable number	Default unit code	Default accuracy code	Description	Label
Native analogue inputs				
0029	14	00000	Analogue measure of analogue 1 (0-10kOhm)	AI spare 1
0030	18	00000	Analogue measure of analogue 2 (0-10kOhm)	AI spare 2
0031	00	00000	Analogue measure of analogue 3 (0-10kOhm)	AI spare 3
0032	00	00000	Analogue measure of analogue 4 (0-10kOhm)	AI spare 4
Analogue inputs for CANopen & CANopen extensions				
0285	00	16384	analogue input 1	Analog in 01
0286	00	16384	analogue input 2	Analog in 02
0287	00	16384	analogue input 3	Analog in 03
0288	00	16384	analogue input 4	Analog in 04
0289	00	16384	analogue input 5	Analog in 05
0290	00	16384	analogue input 6	Analog in 06
0291	00	16384	analogue input 7	Analog in 07
0292	00	16384	analogue input 8	Analog in 08
0293	00	16384	analogue input 9	Analog in 09
0294	00	16384	analogue input 10	Analog in 10
0295	00	16384	analogue input 11	Analog in

Code Variable number	Default unit code	Default accuracy code	Description	Label
				11
0296	00	16384	analogue input 12	Analog in 12
0297	00	16384	analogue input 13	Analog in 13
0298	00	16384	analogue input 14	Analog in 14
0299	00	16384	analogue input 15	Analog in 15
0300	00	16384	analogue input 16	Analog in 16
0301	00	16384	analogue input 17	Analog in 17
0302	00	16384	analogue input 18	Analog in 18
0303	00	16384	analogue input 19	Analog in 19
0304	00	16384	analogue input 20	Analog in 20
0305	00	16384	analogue input 21	Analog in 21
0306	00	16384	analogue input 22	Analog in 22
0307	00	16384	analogue input 23	Analog in 23
0308	00	16384	analogue input 24	Analog in 24
0309	00	16384	analogue input 25	Analog in 25
0310	00	16384	analogue input 26	Analog in 26
0311	00	16384	analogue input 27	Analog in 27
0312	00	16384	analogue input 28	Analog in 28
0313	00	16384	analogue input 29	Analog in 29
0314	00	16384	analogue input 30	Analog in 30
0315	00	16384	analogue input 31	Analog in 31
0316	00	16384	analogue input 32	Analog in 32
0317	00	16384	analogue input 33	Analog in

Code Variable number	Default unit code	Default accuracy code	Description	Label
				33
0318	00	16384	analogue input 34	Analog in 34
0319	00	16384	analogue input 35	Analog in 35
0320	00	16384	analogue input 36	Analog in 36
0321	00	16384	analogue input 37	Analog in 37
0322	00	16384	analogue input 38	Analog in 38
0323	00	16384	analogue input 39	Analog in 39
0324	00	16384	analogue input 40	Analog in 40
0325	00	16384	analogue input 41	Analog in 41
0326	00	16384	analogue input 42	Analog in 42
0327	00	16384	analogue input 43	Analog in 43
0328	00	16384	analogue input 44	Analog in 44
Virtual inputs (first block)				
2283	00	00000	Virtual input Spare 1	Virtual in 01
2284	00	00000	Virtual input Spare 2	Virtual in 02
2285	00	00000	Virtual input Spare 3	Virtual in 03
2286	00	00000	Virtual input Spare 4	Virtual in 04
2287	00	00000	Virtual input Spare 5	Virtual in 05
2288	00	00000	Virtual input Spare 6	Virtual in 06
2289	00	00000	Virtual input Spare 7	Virtual in 07
2290	00	00000	Virtual input Spare 8	Virtual in 08
2291	00	00000	Virtual input Spare 9	Virtual in 09
2292	00	00000	Virtual input Spare 10	Virtual in 10

Code Variable number	Default unit code	Default accuracy code	Description	Label
2293	00	00000	Virtual input Spare 11	Virtual in 11
2294	00	00000	Virtual input Spare 12	Virtual in 12
2295	00	00000	Virtual input Spare 13	Virtual in 13
2296	00	00000	Virtual input Spare 14	Virtual in 14
2297	00	00000	Virtual input Spare 15	Virtual in 15
2298	00	00000	Virtual input Spare 16	Virtual in 16
2299	00	00000	Virtual input Spare 17	Virtual in 17
2300	00	00000	Virtual input Spare 18	Virtual in 18
2301	00	00000	Virtual input Spare 19	Virtual in 19
2302	00	00000	Virtual input Spare 20	Virtual in 20
Virtual inputs (second block)				
2565	00	00000	Virtual input Spare 21	Virtual in 21
2566	00	00000	Virtual input Spare 22	Virtual in 22
2567	00	00000	Virtual input Spare 23	Virtual in 23
2568	00	00000	Virtual input Spare 24	Virtual in 24
2569	00	00000	Virtual input Spare 25	Virtual in 25
2570	00	00000	Virtual input Spare 26	Virtual in 26
2571	00	00000	Virtual input Spare 27	Virtual in 27
2572	00	00000	Virtual input Spare 28	Virtual in 28
2573	00	00000	Virtual input Spare 29	Virtual in 29
2574	00	00000	Virtual input Spare 30	Virtual in 30
2575	00	00000	Virtual input Spare 31	Virtual in 31
2576	00	00000	Virtual input Spare 32	Virtual in

Code Variable number	Default unit code	Default accuracy code	Description	Label
				32
2577	00	00000	Virtual input Spare 33	Virtual in 33
2578	00	00000	Virtual input Spare 34	Virtual in 34
2579	00	00000	Virtual input Spare 35	Virtual in 35
2580	00	00000	Virtual input Spare 36	Virtual in 36
2581	00	00000	Virtual input Spare 37	Virtual in 37
2582	00	00000	Virtual input Spare 38	Virtual in 38
2583	00	00000	Virtual input Spare 39	Virtual in 39
2584	00	00000	Virtual input Spare 40	Virtual in 40

Table 22 - Variables with customizable unit/accuracy values

11.3.4 Initialization definition blocks

The beginning of these blocks is shown by the statements "{INIT1}" or "{INIT2}" depending on the level of access (1st or 2nd level password).
A user connected in level 0 (no password) cannot read equations from, or transfer equations to, the MASTER 2.0.
A user connected in level 2 will get access to INIT1 and INIT2 blocks.
A user connected in level 1 will only get access to the INIT1 block.
INIT equations are only run by the PLC when the power supply of the module is turned ON. They won't be run again until power supply is turned OFF and then ON again. The purpose of these blocks is to provide custom equations to the user. They are run during the power up stage.
INIT blocks are typically used to set the initialization values of outputs, timers or counters associated to custom equations or custom parameters.
For further details on the programming language see chapter 11.4 " PLC programming language".

11.3.5 Equation definition blocks

The beginning of this these blocks is shown by the statements "{EQUATIONS L1}", "{EQUATIONS L2}", depending on the level of access (1st level password or 2nd level password).
A user connected in level 0 (no password) cannot read equations from or transfer equations to the MASTER 2.0.
A user connected in level 2 will get access to ***EQUATIONS L1*** and ***EQUATIONS L2*** blocks.
A user connected in level 1 will only get access to ***EQUATIONS L1*** block.

The purpose of these blocks is to provide custom equations to the user which are run cyclically. These equations are run every 100ms (PLC cycle time).
Non standard equations can be entered here to handle user defined features like thresholds, Input/Output expansions, PID controls …
For further details on the programming language see chapter 11.4 " PLC programming language".

11.3.6 End of file

Every text file must end with the "{END OF FILE}" statement.
MASTER 2.0 will not try to read data following that statement, so you can place your own comments here.

Note: It is strongly recommended not to add too many comments after the" End of File" statement because the size of the file must not exceed 126Kbytes.

	NOTE: This file is a text ONLY file. Do not use word processors (like Microsoft© Word) to edit this file: it would include layout information and corrupt the file. Use text editors only (Notepad for example). The file should not exceed 126Kbytes. If you try to transmit a bigger file to a MASTER 2.0, it will be rejected.

	Warning: Power control and protections are disabled while the MASTER 2.0 is processing a file. When you download or upload a file, you have to disconnect all connectors, except power supply. You must be in manual mode, with engine stopped.

11.4 PLC programming language

It is strongly advised that you follow training before using custom PLC equations on a power plant. Contact your local dealer for details on training sessions.
The PLC equations use a simple language with a small number of commands. The code is intrinsically linear, each equation being executed one after the other (without any loop). Level 1 equations are executed first, followed by level 2 equations. This way, level 2 equation results can overwrite any conflicting level 1 equation.
The "INIT" part is only executed upon start-up, and the "PROG" part is executed every 100 ms.
All the MASTER 2.0 variables can be used in the equations in the way defined below:
-E0xxx and E5xxx are read only as measurements/inputs. They can't be changed by equations.
-E1xxx and E4xxx parameters can be read by equations. If allowed, they can also be modified using MODBUS or equations downloaded via the text file (see {PARAMETERS} section of the text file chapter).
E2xxx parameters are PLC outputs. They can be read and written by custom equations.

Note:

-Variables E1xxx/E4xxx are parameters stored in FLASH (non volatile memory). In level 2 and above, the user can allow the parameters to be written by PLC equations or via MODBUS.

-Be very careful when modifying a parameter through equations, as unexpected behaviour (due to an error in your equations for example) may damage your plant.

-It is advisable to include tests in the equations to verify that the engine is stopped prior to changing a parameter. Otherwise, make modifications in the "INIT" block if possible. These parameter modifications will not be saved in FLASH memory, i.e. parameters will be reset to their previous value if power supply is turned OFF and then ON again, unless the user saves them manually.

-Use document A53 Z0 9 0030 to get a complete list of all MASTER 2.0 variables.

-Variables E2xxx/E5xxx are outputs from the PLC, they can be read and written by PLC equations without restrictions.

The table below gives a list of all available instructions that can be used in custom PLC equations:

Instruction family	PLC instruction	Definition
Program	**PROG** **INIT** **.**	Starting point of PLC equations Starting point of INIT equations End of equations
Blocs	**BLOC** **BEND**	Starting and ending points of a block of equations
Logical operators	**AND** **OR** **XOR**	Logical operation used on a whole variable (i.e. these are not bit to bit operators)
Unary operators	**!**	Bit to bit complement
	-	Sign change
	>	Right shift
	<	Left shift
	$	Hexadecimal value
Arithmetical operators	**+**	Addition
	-	Subtraction
	*****	Multiplication
	/	Division
	INC	Increment
	DEC	Decrement
Bit operators	**^**	Rotation right
	|	Access one bit
	#	Bits mask
Affectation	**:=**	Affectation
Comparison operators	**EQ**	Equal
	NE	Not Equal
	GT	Greater Than
	LT	Less Than
	GE	Greater or Equal
	LE	Less or Equal
Array	**[...]**	Array element
Tests	**TEST** **THEN** **ELIF** **ELSE TEND**	
Comments	**@**	

Table 23 – Available instructions

Instructions are separated by a semicolon (**;**) except before reserved words BEND, ELIF, ELSE and TEND. INIT and PROG blocks are terminated by a dot (**.**).
Each instruction is terminated by a semicolon (;) except before reserved words (BEND, ELIF, ELSE, TEND).

11.5 Variables

11.5.1 Variable type and size

The PLC equations only use 16 bit signed integer values. This means that all variables and data should be between -32768 and +32767. This is an important point to keep in mind when comparing values or doing calculations. For example, 20000*10 will produce a calculation overflow. For the same reason, variables displayed with decimal digits are treated in the equations as if the decimal point wasn't there. For example, a power supply voltage of "24.5 V" will be treated as "245" in the equations.
Be careful when entering values which have digits after the decimal point. If you have one digit after the dot, you have to multiply the number by 10. If you have two digits, multiply by 100.

For instance, the battery voltage measure (variable E0041), is from 0.0 to 6553.5, so you have one digit after the dot. If you want to compare the battery voltage to 25.0 volts, you have to write:
TEST E0041 GT 250 THEN...

To know the number of digits after the dot, look in the “A53 Z0 9 0030-x.xls” file. In the 'Mini' / 'Maxi' columns, the number of digits after dot appears.

11.5.2 Locked variables versus dynamic variables

The PLC works with two complete sets of variables. The first set is a snapshot of the values before the execution of the equations, the second set of variables is the result of the different equations already executed. Before execution of the very first equation, the second set is an exact copy of the first set of variables. It is then altered by the results of the custom equations.
Access to these two sets of variables is differentiated by the way you refer to a variable:
Eyyyy means that you want to use the value of variable YYYY before any equation was executed.
Xyyyy means that you want the actual value of variable YYYY, which has been modified by previous equations.

Note that as the first set is a picture of the variables before execution of the equations, it can be viewed as “read only”. This means that when you write the following equation:
E2680 := 320;

The value “320” will be attributed to variable 2680 in the second set of variables as well.

There are two ways of accessing the 2xxx variables for reading. With E2xxx you access the value locked at the start of program loop. With X2xxx you access the very last value modified by the program executed previously. It is strongly recommended that you use the E2xxx Eyyyy syntax. X2xxxyyyy can only be used for special purpose and only by advanced, "High MASTER 2.0 Knowledge" users.

11.6 Syntax examples

Test examples:

```
TEST condition THEN instruction TEND;
```

```
TEST condition THEN BLOC instruction; instruction;…;instruction BEND TEND;
```

```
TEST condition THEN BLOC instruction; instruction;…;instruction BEND
ELIF condition THEN BLOC instruction; instruction;…;instruction BEND
ELIF condition THEN BLOC instruction; instruction;…;instruction BEND
ELSE BLOC instruction; instruction;…;instruction BEND
TEND;
```

Calculation / instruction examples:

```
E2680:=(E2000+E2001+E2002+E2003)/4;
E2000:=2; E2680[E2000+1]:=10;
E2680:=(E0030 GT 1450) AND ((E0030 GT 1500) OR E2680);
```

Condition examples:

```
TEST E2050 EQ 1 THEN ...
TEST E0030 GT 1500 THEN ...
TEST (!E2046) AND E2055 AND ((E2071 EQ 14) OR (E2071 EQ 15)) EQ 1 THEN …
```

The following example is a small text file that could be sent to a MASTER 2.0 using a level 2 password. In this example, the following variables are used:
-E0160 is the value of CANopen digital input 1 from an extension module.
-E1710 is a user parameter. It will be used as the period of a counter.

-E1711 is another user parameter used as the “duty ratio” of the counter.
-E2440 is a user variable used as a counter in this example.
-E2441 and E2442 are two user variables.

```
{INIT L2}
INIT 2
BLOC
    E2440 := E1710;
    E2441 := 0;
    E2442 := 1
BEND
.

{EQUATIONS L2(every 100ms)}
PROG 2
BLOC
    @ E2440 is used as a counter that decreases from parameter E1710 down to 0;
    TEST E2440 GT 0 THEN
        DEC E2440
    ELSE
        E2440 := E1710
    TEND;
    @ Set the values of E2441 and E2442 depending on digital input 1 (E0160) and
the counter E2440;
    TEST E0160 AND (E2440 LT E1711) EQ 1 THEN
        BLOC
            E2441 := 1;
            E2442 := 0
        BEND
    ELSE
        BLOC
            E2441 := 0;
            E2442 := 1
        BEND
    TEND
BEND
.
{END OF FILE}
```

The INIT block initializes counter E2440 to the value set by the user in parameter E1710. Variable E2441 is set to zero, and variable E2442 is set to one. These initializations are done when the MASTER 2.0 powers up.
The PROG block is executed once every 100ms. In this block, if variable E2440 is not zero, it is decreased by one. Otherwise, it is re-set to the value of parameter E1710. Then we check if CANopen digital input 1 is set to one and counter E2440 is lower than the value set in user parameter E1711. If this is the case, E2441 is set to one and E2442 is set to zero. Otherwise, E2441 is set to zero and E2442 is set to one.
For example if E1710 is set to 100 and E1711 is set to 20, E2441 can be seen as a PWM with a cycle time of 10s (100*100ms) and a duty ratio of 20% when CANopen digital input is set to one. Here, E2442 is simply the complement of E2441.

12 Communication

12.1 CAN bus good practices

This chapter explains and describes good practices used to ensure a good reliable CAN communication. This advice is true for all CAN bus connections and should be applied to all MASTER 2.0 units on the inter MASTER 2.0 bus, and for second CAN communication port (COM1 and COM2).

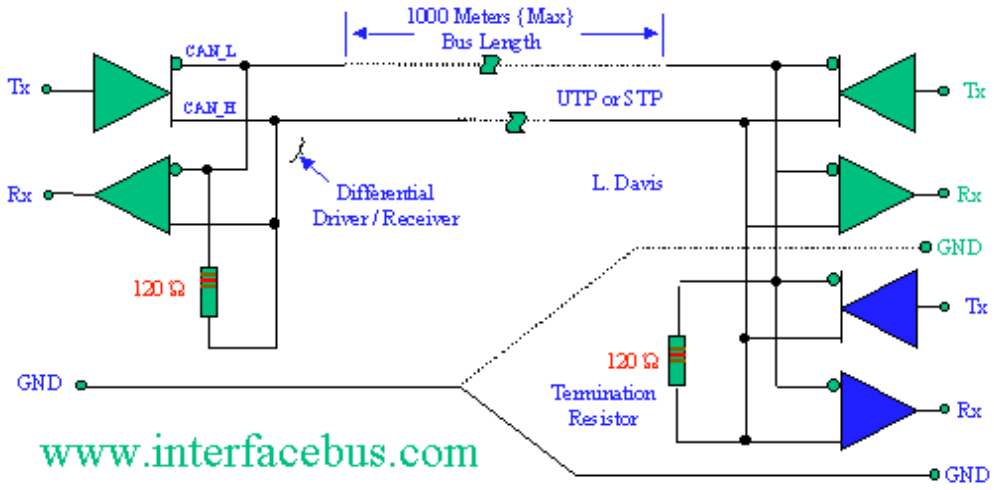


Figure 30 – CAN bus wiring

Here is the standard pin out of a DB9 CAN connector compared with a MASTER 2.0 implementation:

	MASTER 2.0	Standard
SHIELD	GROUND	
PIN 1	NC	Cable Drain
PIN 2	CAN-L	CAN-L
PIN 3	GROUND-1	CAN GND
PIN 4	NC	free
PIN 5	GROUND-2	+24V POWER
PIN 6	GROUND-1	free
PIN 7	CAN-H	CAN-H
PIN 8	NC	free
PIN 9	NC	0V POWER

Table 24 – DB9 pin out

Note: GROUND-1 and GROUND-2 are each protected with a 47 ohm resistor.

CAN-BUS cable:

The CAN bus-BUS cable must be able to carry the CAN signals (CAN-L and CAN-H). These 2 signal wires should be a 120 Ohm twisted pair (Ex: Belden's 3105A, 3082A-3087A (www.belden.com), LAPP CABLE Unitronic bus DeviceNet or CAN (www.lappcable.com) or equivalent).
The CAN bus-BUS cable must be shielded, and must have a drain wire connected to the cable shield. This drain connects to pin 1 of each connector. The connector housing must be connected to the cable shield, and metallic shells should be used if possible.
For better results, a common GROUND should be used for all connected devices (this can be verified easily with an ohmmeter, for example).
The total length of the cable must not exceed 250m for a CAN communication speed of 250kb/s. This length may decrease with lower quality cables.

The CAN bus must be linear (no star connections) and both ends of the bus must be connected to 120 Ohm termination resistors. MASTER 2.0 includes 120 Ohm termination resistors on COM1 and COM2. These termination resistors can be connected to the CAN bus via DIP switches at the rear of the module. Only the MASTER 2.0 located at an end of a CAN bus should have its termination resistor activated.

	Warning: Never plug or unplug CAN-BUS bus connectors with power on. This may cause internal damage or cause internal CAN -BUS transceivers to burn.

12.2 COM1: Inter MASTER 2.0 / GENSYS 2.0 CAN bus

This CAN bus is a communication bus between different MASTER 2.0 and GENSYS 2.0 units of the same power plant. It allows MASTER 2.0 units to synchronize with each other, manage dead bus connections, share active and reactive load, send data from one module to the other … This CAN bus uses a CRE proprietary protocol.

The figure below shows the connections between each MASTER 2.0 unit. The Termination Resistors are integrated inside MASTER 2.0 and can be activated with a switch located at the rear of the module (under the plug marked “OFF / 120Ω”). COM port is marked on the rear. You need to extract the plug to change the switch. The termination resistor is connected to the CAN bus when the switch is pushed toward the “120 Ohm” side. When the switch is towards ON, resistor is active on bus. When switch is pushed to the other side, the resistor is not active on the bus.

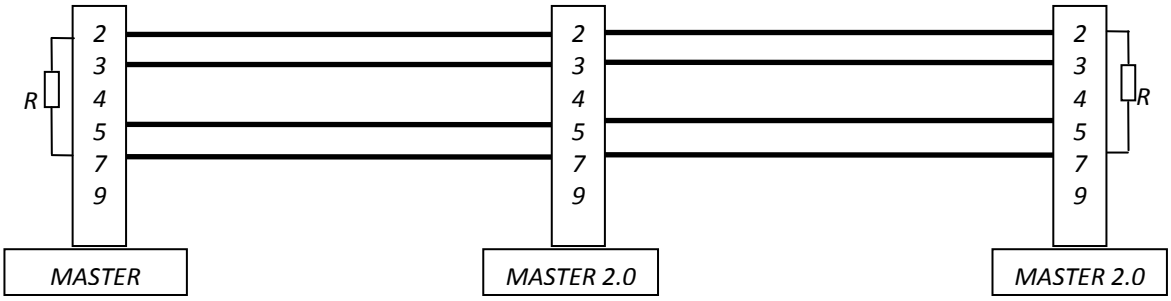


Figure 31 - CAN Bus wiring

Terminals 2 and 7: 1 twisted pair cable.
Terminals 3 and 5: 1 twisted pair cable.
R: 120 Ohms termination resistor (included inside MASTER 2.0)

You can also use CRE accessories as shown below in figures 46 and 47 to connect several MASTER 2.0 units together. Contact your local distributor to help you choose accessories that fit your needs.

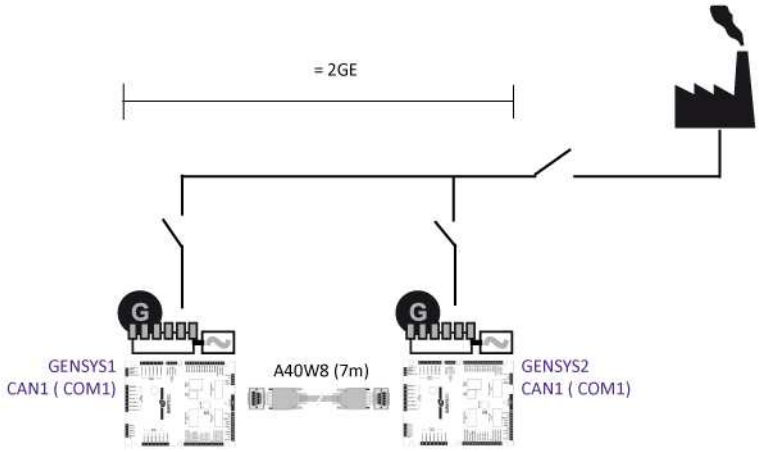


Figure 32 - MASTER 2.0 ⇔ GENSYS 2.0

Note: The 120 Ω termination resistors must be activated using the micro switch on the rear of the units.

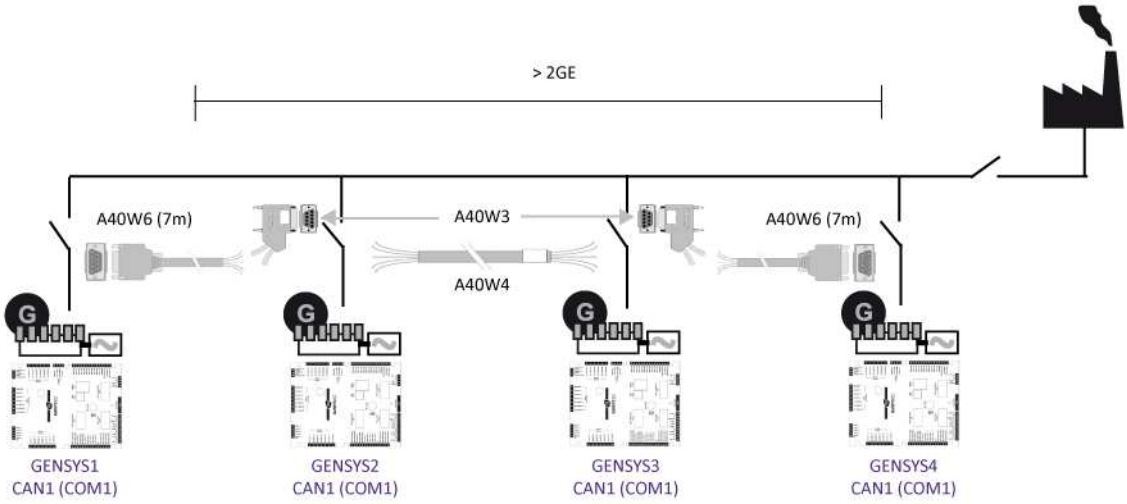


Figure 33 - MASTER 2.0 ⇔ GENSYS 2.0 ⇔ GENSYS 2.0 ⇔ …

Note: The 120 Ω termination resistors must be activated using the micro switch on the rear of the units.

12.2.1 CAN bus fault

CAN bus communication is monitored by MASTER 2.0 modules and compared to the MASTER 2.0 parameters. MASTER 2.0 continuously transmits data on the COM1 CAN bus so each MASTER 2.0 can always know how many MASTER 2.0 units are connected to the CAN bus and are switched on. The number of MASTER 2.0 units should always be equal to the number of mains configured on the power plant settings of the MASTER 2.0 (parameter E1147).
In case of discrepancy between parameter E1147 and the number of MASTER 2.0 units seen on the CAN bus, a CAN bus error is shown. This can also be the case if:
-Two or more MASTER 2.0 units share the same number (parameter E1179).
-Termination resistors are not used correctly.
-CAN bus cable is not properly connected

This CAN error can only be RESET when the correct number of MASTER 2.0 modules can be seen on the CAN bus.
As with every error managed by MASTER 2.0, the consequence of this error can be set up with parameter E1259.

E1259 = 0: no action
E1259 = 1: power plant electrical fault
E1259 = 2: mains electrical fault
E1259 = 3: alarm
E1259 = 4: soft shut down
E1259 = 5: hard shut down
E1259 = 6: droop mode; generate an alarm (default setting)
This fault only affects the working of a power plant with several MASTER 2.0 units (E1147 > 1).

If a remote start occurs on a MASTER 2.0 set up to manage Deadbus situations (E1515 = 0) and a CAN bus fault has already been triggered, MASTER 2.0 will start the plant and close its breaker. If there is a voltage on the mains, MASTER 2.0 will synchronize the plant before connecting to the mains.

If the plant is paralleled to the Mains when a CAN bus fault occurs, and error control variable E1259 is set to 6 (Droop mode + Alarm), speed control will be switched to droop and volt control will be switched to power

factor regulation. If the mains are not connected, both speed and voltage droop is applied. With generators paralleled and the “bus CAN fault control” variable (E1259) set to 6, the generators with GENSYS 2.0 are in speed droop and power factor regulation when paralleled with the mains. When not paralleled with mains they are in speed and voltage droop regulation.

Note: If you need to disconnect a MASTER 2.0 from the inter MASTER 2.0 CAN bus, you must change the number of mains (parameter E1147) on all other MASTER 2.0 units of the power plant.

When the power plant is set to load/unload mode (Parameter E1258 set to "Hours run" or "Digital in"), all generators will start using droop mode if a CAN bus error occurs.

12.2.2 Broadcasting data between multiple MASTER 2.0 or GENSYS 2.0 units

It is possible to send up to 10 digital variables and 2 analogue variables from one MASTER 2.0 unit to all other MASTER 2.0 and GENSYS 2.0 units connected to the same inter MASTER 2.0 CAN bus (COM 1).
It is necessary to use a PC to create “Broadcast Data by Inter MASTER 2.0 CAN bus” equations. Variables sent to other MASTER 2.0 units are described in the table below:

NOTE: When you assign a variable to broadcast data (ex: E2752:=...) remove the “E” from in front of the variable name: this is the number of the variable you assign, not the variable itself.

Example to send digital input or analogue input to each MASTER 2.0:

2752:=2002

BEND

Variables which are sent via "Broadcast Data by Inter MASTER 2.0 CAN bus":

Variable number	Description
E2752	1st digital variable sent over CAN bus COM1VarDigCAN01
E2753	2nd digital variable sent over CAN bus COM1VarDigCAN02
E2754	3rd digital variable sent over CAN bus COM1VarDigCAN03
E2755	4th digital variable sent over CAN bus COM1VarDigCAN04
E2756	5th digital variable sent over CAN bus COM1VarDigCAN05
E2757	6th digital variable sent over CAN bus COM1VarDigCAN06
E2758	7th digital variable sent over CAN bus COM1VarDigCAN07
E2759	8th digital variable sent over CAN bus COM1VarDigCAN08
E2760	9th digital variable sent over CAN bus COM1VarDigCAN09
E2761	10th digital variable sent over CAN bus COM1VarDigCAN10
E2762	1st analogue variable sent over CAN bus COM1VarAnaCAN01
E2763	2nd analogue variable sent over CAN bus COM1VarAnaCAN02

Table 25 - Broadcast variables sent over inter MASTER 2.0 CAN bus

You can select what should be sent on the CAN bus by using custom PLC equations. These equations contain the number of the variable/parameter to be sent:
E27xx:= YYYY;
With E27xx being one of the broadcast variables and YYYY being the number of the variable you want to send to the other MASTER 2.0.
In the equation below, the broadcast variable E2752 is used to send the value of variable E2002 to all the other MASTER 2.0 units connected on CAN bus COM1:
E2752:=2002;

Broadcast variables received from other MASTER 2.0 are listed in the table below:

Variable number	Description
E0536 to E0545	1st to 10th Can bus extension digital input variables received from 1 to 10 – GE01
E0546 to E0547	1st and 2nd Can bus extension analogue variables received from GE01input 1 to 2 – GE1
E0552 to E0561	1st to 10th digital variables received from GE02Can bus extension digital inputs 1 to 10 – GE2
E0562 to E0563	1st and 2nd analogue variables received from GE02Can bus extension analogue inputs 1 to 2 – GE2
E0568 to E0577	1st to 10th digital variables received from GE03Can bus extension digital inputs 1 to 10 – GE3
E0578 to E0579	1st and 2nd analogue variables received from GE03Can bus extension analogue inputs 1 to 2 – GE3
E0584 to E0593	1st to 10th digital variables received from GE04Can bus extension digital inputs 1 to 10 – GE4
E0594 to E0595	1st and 2nd analogue variables received from GE04Can bus extension analogue inputs 1 to 2 – GE4
E0600 to E0609	1st to 10th digital variables received from GE05Can bus extension digital inputs 1 to 10 – GE5
E0610 to E0610	1st and 2nd analogue variables received from GE05Can bus extension analogue inputs 1 to 2 – GE5
E0616 to E0625	1st to 10th digital variables received from GE06Can bus extension digital inputs 1 to 10 – GE6
E0626 to E0627	1st and 2nd analogue variables received from GE06Can bus extension analogue inputs 1 to 2 – GE6
E0632 to E0641	1st to 10th digital variables received from GE07Can bus extension digital inputs 1 to 10 – GE7
E0642 to E0643	1st and 2nd analogue variables received from GE07Can bus extension analogue inputs 1 to 2 – GE7
E0648 to E0657	1st to 10th digital variables received from GE08Can bus extension digital inputs 1 to 10 – GE8
E0658 to E0659	1st and 2nd analogue variables received from GE08Can bus extension analogue inputs 1 to 2 – GE8
E0664 to E0673	1st to 10th digital variables received from GE09Can bus extension digital inputs 1 to 10 – GE9
E0674 to E0675	1st and 2nd analogue variables received from GE09Can bus extension analogue inputs 1 to 2 – GE9
E0680 to E0689	1st to 10th digital variables received from GE10Can bus extension digital inputs 1 to 10 – GE10
E0690 to E0691	1st and 2nd analogue variables received from GE10Can bus extension analogue inputs 1 to 2 – GE10
E0696 to E0705	1st to 10th digital variables received from GE11Can bus extension digital inputs 1 to 10 – GE11
E0706 to E0707	1st and 2nd analogue variables received from GE11Can bus extension analogue inputs 1 to 2 – GE11
E0712 to E0721	1st to 10th digital variables received from GE12Can bus extension digital inputs 1 to 10 – GE12
E0722 to E0723	1st and 2nd analogue variables received from GE12Can bus extension analogue inputs 1 to 2 – GE12
E0728 to E0737	1st to 10th digital variables received from GE13Can bus extension digital inputs 1 to 10 – GE13
E0738 to E0739	1st and 2nd analogue variables received from GE13Can bus extension analogue inputs 1 to 2 – GE13
E0744 to E0753	1st to 10th digital variables received from GE14Can bus extension digital inputs 1 to 10 – GE14
E0754 to E0755	1st and 2nd analogue variables received from GE14Can bus extension analogue inputs 1 to 2 – GE14

Table 26 – Broadcast variables received by BROADCAST DATA from inter MASTER 2.0 CAN bus

1/ Example 1: broadcast analogue and digital data

In this example, two MASTER 2.0 units are connected together using CAN bus COM1. In this configuration there will be one MASTER 2.0 (MASTER 2.0 #1) which sends variables and the other MASTER 2.0 (MASTER 2.0 #2) which receive variables. Both of them will send two broadcast variables on CAN bus COM1, one being digital input J6, the other one being analogue value E0033 (engine speed).
Each of the two values will be usable by both MASTER units. One will be a digital value (input J6) and the other will be an analogue value.

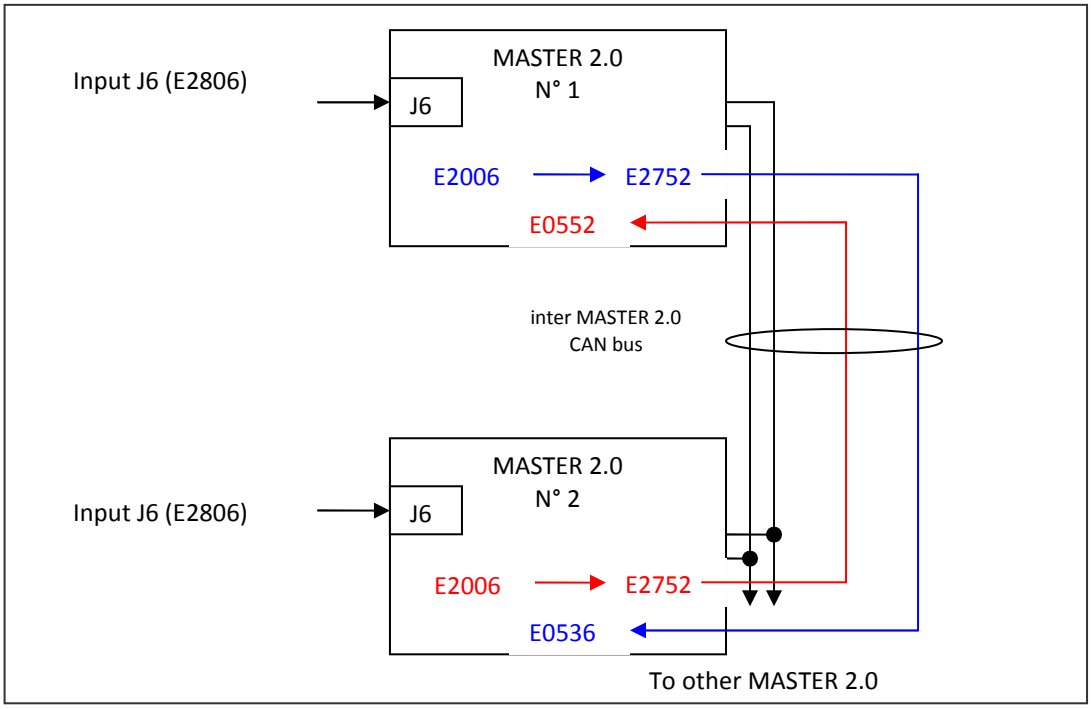


Figure 34 - Connecting J6 to broadcast variables

To send value from MASTER 2.0 #1 to MASTER 2.0 #2, write this equation:

BLOC

@Example to send digital and/or analogue input variables to the other MASTER 2.0;

E2752:=2806;

E2762:=33

BEND

Digital input J6 from MASTER 2.0 number 1 is sent on the CAN bus using the 1st digital broadcast variable E2752, so it will be stored on variable E0536 of MASTER 2.0 number 2.
Variable E0033 from MASTER 2.0 number 1 is sent on the CAN bus using the 1st analogue broadcast variable E2762, so it will be stored on variable E0546 of MASTER 2.0 number 2. On MASTER 2.0 #2, these values can be read if the following variables are used:

E0536 which is the value of the MASTER 2.0 #1 J6 input (E2806).
E0546 which is the value of the MASTER 2.0 #1 E0033 input.

The same equations should be written on MASTER 2.0 number 2:

BLOC

@ Example to send digital and / or analogue variables to other MASTER 2.0 units;

E2752:=2806;

E2762:=33

BEND

Digital input J6 from MASTER 2.0 number 2 is sent on the CAN bus using the 1st digital broadcast variable E2752, so it will be stored on variable E0552 of MASTER 2.0 number 1.
Variable E0033 from MASTER 2.0 number 2 is sent on the CAN bus using the 1st analogue broadcast variable E2762, so it will be stored on variable E0562 of MASTER 2.0 number 1.
On MASTER 2.0 #1, these values can be read if the following variables are used:
E0552 which is the value of the MASTER 2.0 #2 J6 input (E2806).
E0562 which is the value of the MASTER 2.0 #2 input (E0033).

2/ Example 2: application example

In this example, which uses 3 MASTER 2.0 units, a remote start signal connected to the J2 digital input (E2002) of one MASTER 2.0 is broadcast to the other MASTER 2.0 units of the power plant. Thus, only one remote start signal is needed.

Equation written on MASTER 2.0 #1:

@Remote start input is only connected to MASTER 2.0 #1 and is sent to the other units via CAN bus (COM1);example to send digital input to the other MASTER 2.0 units;

E2752:=2002

BEND

Equation written in all other MASTER 2.0 units of the power plant:

@example to receive remote start digital input from MASTER 2.0 #1;

E2514:=E0536

BEND

The broadcast data is received in variable E0536 on all other MASTER 2.0 units and then copied to variable E2514 (equation above).

Important: Even if CAN bus inhibition is activated between MASTER 2.0 units (see below), broadcast data is always sent and received on the inter MASTER 2.0 CAN bus (COM1).

12.2.3 CAN bus inhibition

COM1 CAN bus is mainly used by MASTER 2.0 modules to send power management data to each other. CAN bus inhibition is used to prevent one MASTER 2.0 from taking into account data coming from one or more MASTER 2.0 units. This is especially useful when tie breakers are used to change the configuration of the power plant (for example from a 6 generator power plant to two power plants with 3 generators each).
Variables E2691 to E2704 are used to decide with which modules the MASTER 2.0 should communicate power management data.

Variable	Description
E2691	Ignore power management data from GE01
E2692	Ignore power management data from GE02
E2693	Ignore power management data from GE03
E2694	Ignore power management data from GE04
E2695	Ignore power management data from GE05
E2696	Ignore power management data from GE06
E2697	Ignore power management data from GE07
E2698	Ignore power management data from GE08
E2699	Ignore power management data from GE09
E2700	Ignore power management data from GE10
E2701	Ignore power management data from GE11
E2702	Ignore power management data from GE12
E2703	Ignore power management data from GE13
E2704	Ignore power management data from GE14

Table 27 - CAN bus inhibition variables

If one of these variables is set to one, power management data from the corresponding MASTER 2.0 will not be taken into account.

Note that broadcast data is not influenced by the value of these inhibition variables, so it is still possible to send and receive broadcast values between “inhibited” MASTER 2.0.

1/ How to set theses functions:

Special variables can be used to inhibit CAN bus variable use.

Each MASTER 2.0 is able to ignore (inhibit) all the others, depending to the state of the inhibition can variable. Note that this does not affect “BROADCAST DATA”, but only plant related functions.

The following table describes these variables.
To take effect (inhibition active), the variable must be set at 1.

Remark: In the MASTER 2.0, control of inhibition is often associated with feedback from the Tie breaker.

Variable	Genset inhibited
E2691	Inhibition variable for GE 1 on CAN bus
E2692	Inhibition variable for GE 2 on CAN bus
E2693	Inhibition variable for GE 3 on CAN bus
E2694	Inhibition variable for GE 4 on CAN bus
E2695	Inhibition variable for GE 5 on CAN bus
E2696	Inhibition variable for GE 6 on CAN bus
E2697	Inhibition variable for GE 7 on CAN bus
E2698	Inhibition variable for GE 8 on CAN bus
E2699	Inhibition variable for GE 9 on CAN bus
E2700	Inhibition variable for GE 10 on CAN bus
E2701	Inhibition variable for GE 11 on CAN bus
E2702	Inhibition variable for GE 12 on CAN bus
E2703	Inhibition variable for GE 13 on CAN bus
E2704	Inhibition variable for GE 14 on CAN bus
E2705	Inhibition variable for GE 15 on CAN bus
E2706	Inhibition variable for GE 16 on CAN bus

Table 28 - CAN bus inhibition parameters

12.3 COM2: Remote input/output module

The COM2 Communication port is a standard CAN port.

Industrial CANopen extension modules can be used to increase the number of digital/analogue inputs and outputs of MASTER 2.0. This is CAN bus hardware using CANopen protocol and application support to transfer data between nodes.

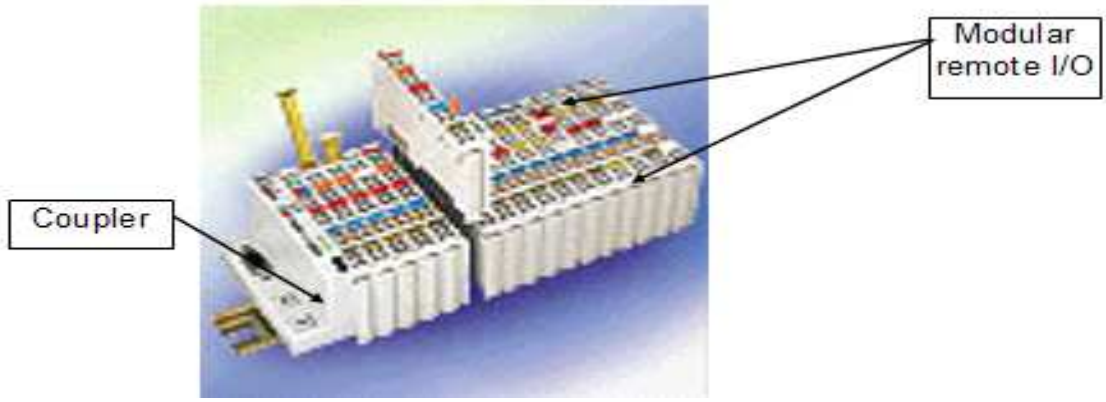


Figure 35 - Modular remote CANopen I/O extension module

The refresh rate of these CANopen inputs and outputs is 100ms.
Wiring of the CAN bus on COM2 should be as described in chapter 12.1, "CAN bus good practices". Also refer to the CANopen extension module's user manual for correct wiring on the CANopen module side.

Modular remote I/O can also be added to MASTER 2.0 using the CANOPEN© protocol and DB9 connector.
For the remote I/O wiring see the figure below.

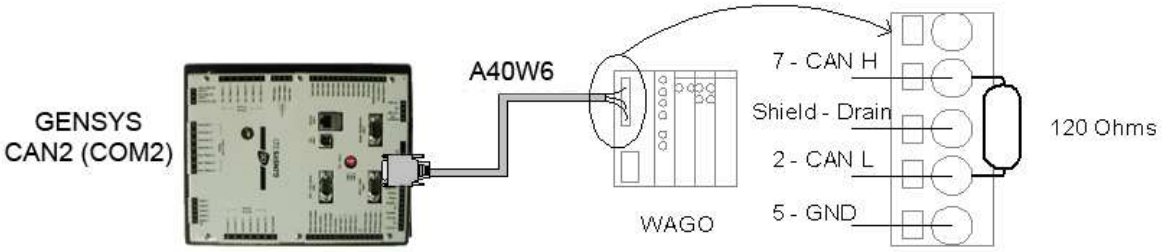


Figure 36 - CANopen coupler wiring

CAN L must be connected to pin 2 of the DB9.
CAN H must be connected to pin 7 of the DB9.
CAN GND must be connected to pin 5 of the DB9.
Drain must be connected to the shield of the DB9.
MASTER 2.0 can be connected with up to 3 couplers.
Each coupler can have up to 32 remote I/O terminals.
An end resistor of 120 Ω must be connected to each end of the cable between CANH and CANL. This resistor exists inside MASTER 2.0 and can be activated with a switch accessible from the rear of the unit and located under the plug marked “OFF / 120Ω”. COM port is marked on the rear. You need to extract the plug to change the switch. When the switch is towards ON, resistor is active on bus. When switched the other way, the resistor is not active on the bus.

Contact your local dealer for a list of recommended CANopen extension modules. To obtain a list of compatible modules, consult your local dealer.

1/ System configuration

CANopen communication uses CANopen messages that can be set up in the “Enhanced configuration/CANopen” menu. MASTER 2.0 can handle a total of 13 input messages and 19 output messages. Three parameters must be set for each message to be used. Each message is determined by:
-The ID of the CANopen extension module (most modules use DIP switches to set their ID).
-The type of data contained in the message (analogue or digital).
-The Number of input/output channels in the message.

Note: A CANopen message can handle a maximum of 4 analogue values or 64 digital values.

The total number of CANopen inputs/outputs available is:
- 44 analogues inputs.
- 128 digitaux inputs.
- 32 analogues outputs.
- 64 digital outputs.

To ensure proper communication between MASTER 2.0 and CANopen extension modules, the following rules should be followed:
For a given CANopen module, always group the maximum number of data of the same type in one message. For example, it is better to set up one message with 50 digital inputs than 2 messages with 25 digital inputs each.

Always group messages to/from one CANopen module. For example, do not use output messages 1 and 3 with CANopen module number 1 and message 2 with CANopen module number 2. It is preferable to use messages 1 and 2 with module number 1 and message 3 with module number 2.

CANopen inputs and outputs can be accessed using MASTER 2.0 variables as described below:

MASTER 2.0 variable numbers	Description
E0157 to E0284	CANopen digital inputs 1 to 128
E0285 to E0328	CANopen analogue inputs 1 to 44
E2368 to E2431	CANopen digital outputs 1 to 64
E2432 to E2439	CANopen analogue outputs 1 to 8
E2682 to E2689	CANopen analogue outputs 9 to 16
E2708 to E2723	CANopen analogue outputs 17 to 32

Table 29 - CANopen input and output variables

The lower variable number is associated to the lower message number configured. The following example will help you understand the relationship between MASTER 2.0 CANopen variables and physical CANopen I/Os.

CANopen mapping example:

In this example, 3 CANopen modules are connected to CAN bus COM2 of MASTER 2.0. All these modules offer different kinds of input.

Note: When configuring inputs or outputs, programming must be done first for analogue I/O, and then for digital I/O.

Note: Always group all the messages by coupler.

For example, don't use message 1 for coupler 8, message 2 for coupler 7 and message 3 for coupler 8. Use message 1 for coupler 7 and message 2 and 3 for coupler 8.

2/ Read / write I/O

With the Info screen (view by pressing the info key **[i]**), you can view the remote I/O:
-Digital inputs from 0157 to 0284
-Analogue inputs from 0285 to 0328
-Digital outputs from 2368 to 2431
-Analogue outputs from 2432 to 2439

To have the right variable associated to an input / output, follow this rule: the lower variable number is associated to the lower message number and the I/O nearest to the coupler.

CANopen module	Physical I/Os available in the module Configuration	Messages as set in MASTER 2.0 CANopen inputs menu	Associated Variable number
Coupler Id 1	First module: 2 '0-20mA' analogue inputs 0-20 mAmp	Msg 1: ID = 1 ; type = Analog ; nb of Input inputs = 4	0285
			0286
	Second module: 2 PT100 analogue inputs PT100		0287
			0288
	Third module: 2 digital inputs	Msg 2: ID = 1 ; type = Digital ; nb of Input inputs = 2	0157
			0158
Coupler Id 2	First module: 2 thermocouple analogue inputs	Msg 4: ID = 2 ; type = Analog ; nb of Input inputs = 2	0291
			0292

	Second module: 4 digital inputs	Msg 5: ID = 2 ; type = Digital ; nb of inputs = 4	0159
			0160
			0161
			0162
Coupler Id 3	1 module with analogue inputs	Msg 3: ID = 3 ; type = Analog ; nb of Input inputs = 2	0289
			0290

Table 30 - CANopen configuration example

12.4 COM3: USB to PC

This communication has been described in a previous chapter. This is a standard USB communication port that can be used for:
-MASTER 2.0 flash memory programming
-Manufacturing process calibration
-Manufacturing quality control
-On site Firmware update (with special utility).

12.5 COM4: ETHERNET

See the "Remote control using a PC (Ethernet connexion)" chapter.

Ethernet is used to connect MASTER 2.0 with Internet and the PC application. Supported protocols include TCP/IP and MODBUS TCP. Please consult CRE Technology for availability.
Ethernet interface hardware conforms to the definition in IEEE802.3 and is intended to be used with the following cables:

Connection to HUB: use patch cable CAT5 (1:1).
Connection to PC: use cross over cable CAT5.

Pin out of the Ethernet connector and standard colours of the cable internal wires are given in the table below:

Designation	Pin	Name	EIA/TIA-T 568 A standard	EIA/TIA- 568 B standard
Transmit data positive	1	Tx+	white/green	white/orange
Transmit data negative	2	Tx-	Green	orange
Receive data positive	3	Rx+	white/orange	white/green
	4			
	5			
Receive data negative	6	Rx-	Orange	green
	7			
	8			
Protection	SHIELD			

Table 31 - ETHERNET connection

12.6 COM5: MODBUS RTU on serial port RS485

All MASTER 2.0 internal variables (Measurements, parameters, PLC outputs…) can be monitored remotely through an RS486 communication bus using a MODBUS RTU protocol, MASTER 2.0 being a MODBUS slave. It is also possible to enter parameters into the MASTER 2.0. All digital and analogue input/output values and all other parameters which appear in the MASTER 2.0 menus can be obtained by the serial port RS485, DB9 male COM4. If allowed, variables (2xxx) and parameters (1xxx) can be written via MODBUS.

Warning:
Be careful when modifying a parameter while the engine is running as unexpected behaviour while functioning may damage your generator. It is always advised to change parameters when generator is stopped.

Note that factory settings are set to READ ONLY for most parameters. Writing access is on a 'per parameter' basis using a configuration text file sent by PC to the MASTER 2.0. Please refer to chapter 11 for more details on this Read/Write attribute.

MODBUS supported functions are:
-03 Read holding registers.
-04 Read input registers.
-06 Preset single register.
-16 Preset multiple registers.

Note that MODBUS register addresses have an offset of +1 compared to variable numbers. This means that you should use address 1 (one) in a MODBUS request to get the value of MASTER 2.0 variable E0000.

MODBUS settings can be found in the "System/Serial communication ports" menu, where you can set:
-MODBUS slave address E1634 (valid MODBUS slave address is in the range 1…247).
-Communication speed (4800, 9600, 19200 bauds).

Note that MASTER 2.0 doesn't support broadcast requests (i.e. requests sent with ID address set to zero).

Other serial port parameters are:
-8 data bits
-No parity bit
-1 stop bits

COM5 pin out is as follows:

Pin number	Description
5	B signal
6	A signal
3, 4, 9	GROUND
1, 2, 7, 8	Not connected

Table 32 - COM5 pin out

Wiring on the serial port can be achieved using 2 wires (plus GROUND and SHIELD) in point to point mode (1 master and 1 slave) or in multi-drop mode (1 master and several slaves).
The following figure shows the wiring between the MASTER 2.0 and an RS485 modem.

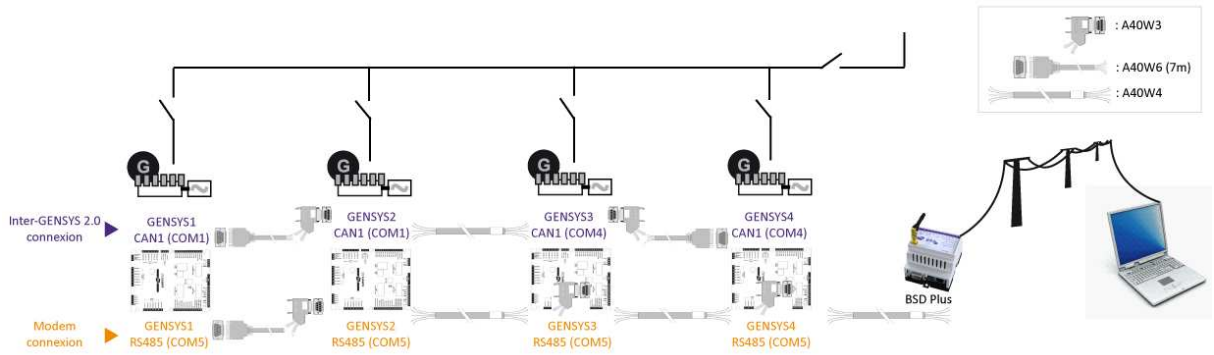


Figure 37 - MASTER 2.0 ⇔ MASTER 2.0 ⇔MASTER 2.0 ⇔ … (MODBUS)

MODBUS RTU is supported by MASTER 2.0 when within the following fields:
Communication speed: 4800, 9600 and 19200 (pre-setting: 4800).
Number of bits by character: 8
Number of parity bits: 0
Number of stop bits: 1
RTU address: 1 to 254 (addresses 0 and 255 are reserved). This can be modified by variable 1634, which is only accessible in the "Modification by variable nb" menu.

Supported functions:

04 Analogue reading
03 Register reading
16 Preset multiple registers

The RTU address of the variables is the same as their number plus 1, converted into hexadecimal. For example, variable 2000 (Mains break in) has for RTU address 07D1h (2001). See the Z090030.xls file to locate the variable number.

Example: Here are two MODBUS RTU frames (request from a remote device and answer from MASTER 2.0). In this case MASTER 2.0 slave address is 5, and the request is to read variables E0000, E0001 and E0002. The result is a function 04 request starting at address 1 (variable E000) and ending at address 3 (variable E0002).

MODBUS Request:

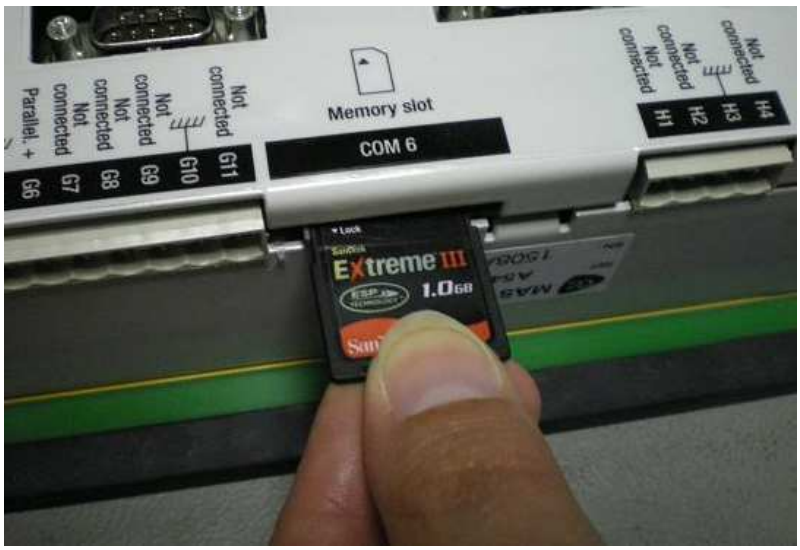
Fields	Value (hex)
Slave address	05
Function	04
MSB start address	00
LSB start address	01
MSB number of registers	00
LSB number of registers	03
CRC16	--

MASTER 2.0 answer Response:

Field	Value (hex)
Slave address	05
Function	04
Number of bytes	06 (3 registers * 2 bytes per register)
1st byte (MSB of 1st reg.)	xx
2nd byte (LSB of 1st reg.)	xx
3rd byte (MSB of 2nd reg.)	xx
4th byte (LSB of 2nd reg.)	xx
5th byte (MSB of 3rd reg.)	xx
6th byte (LSB of 3rd reg.)	xx
CRC16	--

12.7 COM6: Memory PORT

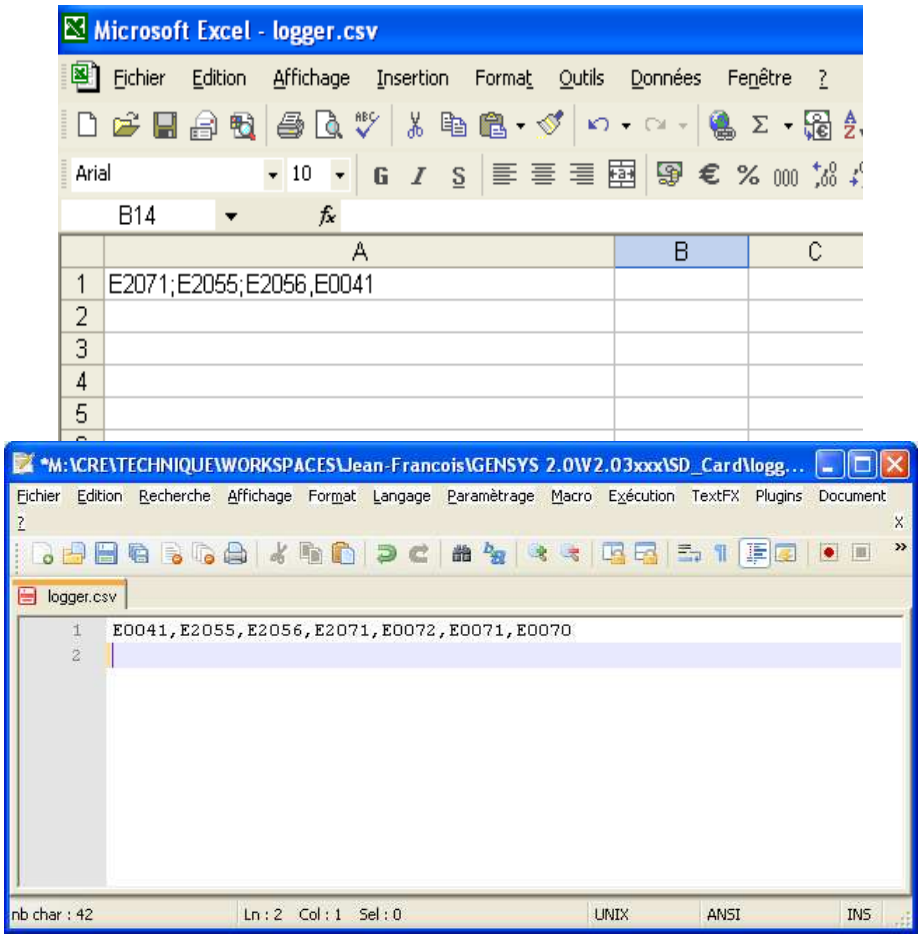
MASTER 2.0 is equipped with a SD card slot. This is used to save MASTER 2.0 information on a regular basis using flash memory.



Memory cards must be FAT16 format and no larger than 2Go. High capacity SDHC cards and FAT32 format are not compatible.

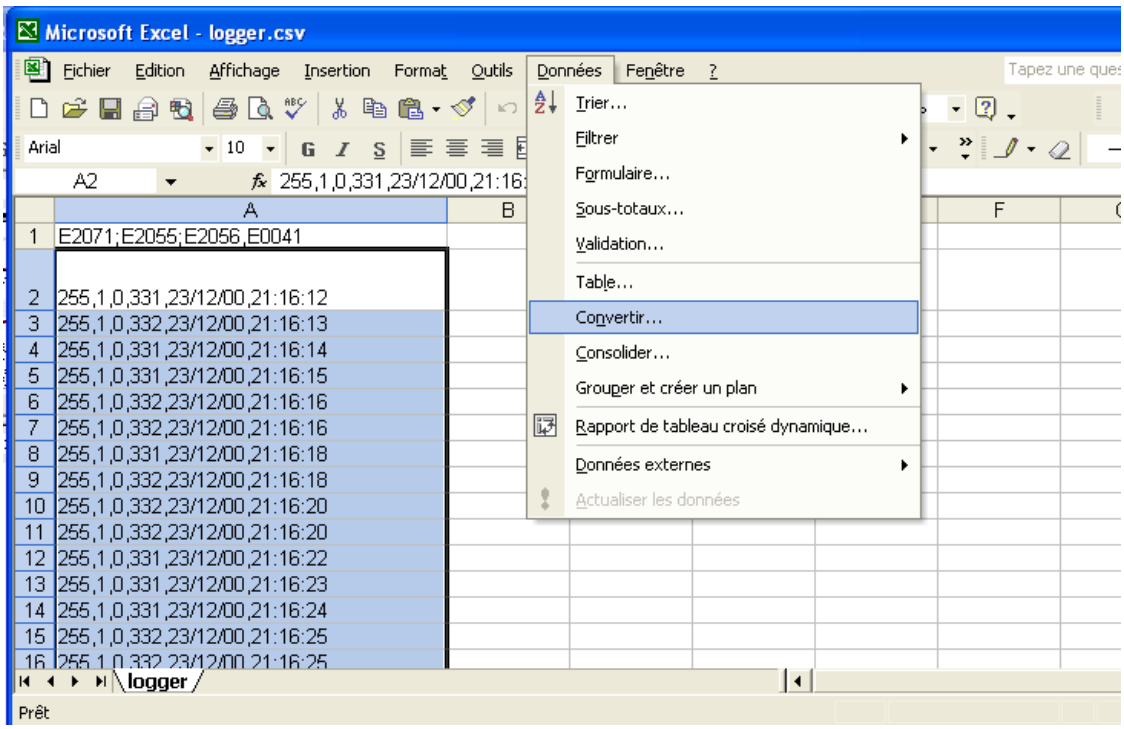
Backup using SD Cards:

The SD card must contain a file named **logger.csv**. CSV (*Comma separated value*) is a computer file format which shows tables in the form of values separated by commas or semi-colons.
This file can be created using Microsoft Excel or the notepad: open the notepad, then write the names of the variables you wish to save (max 25) using the Exxxx format. Separate each variable with a comma and save the file as logger.csv :

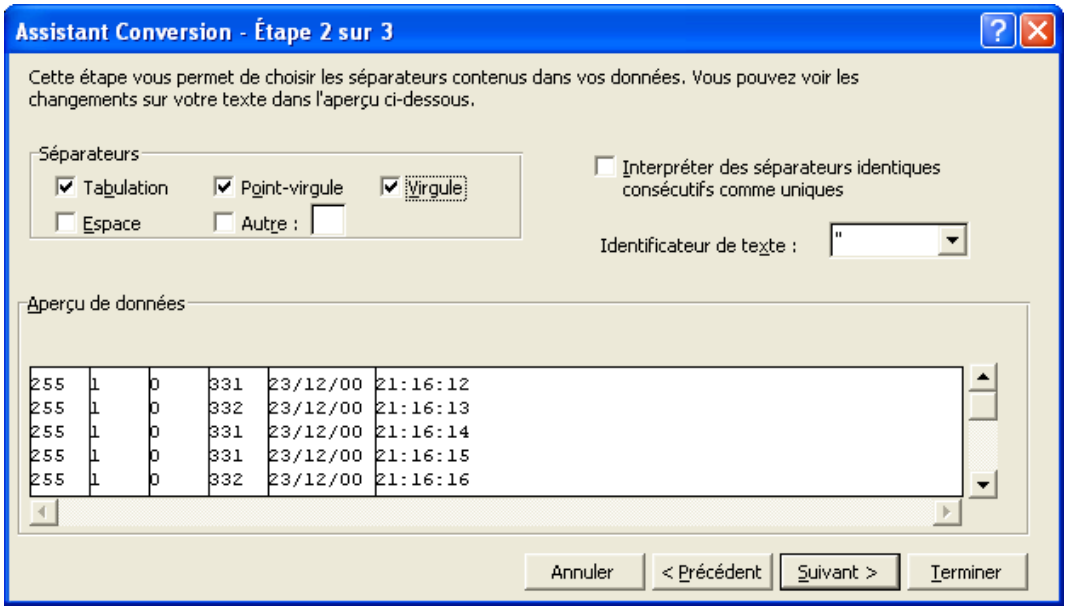


Variable E4041 allows you to choose the recording time in seconds. As soon as the SD card is inserted into the MASTER 2.0, the recording will start every E4041 seconds.
Every E4041 seconds, all the variables entered in the first line of the logger.csv file will be saved to the file.
To avoid damaging information, only remove the SD card when the LED at the top right of the display (see below) is turned off.

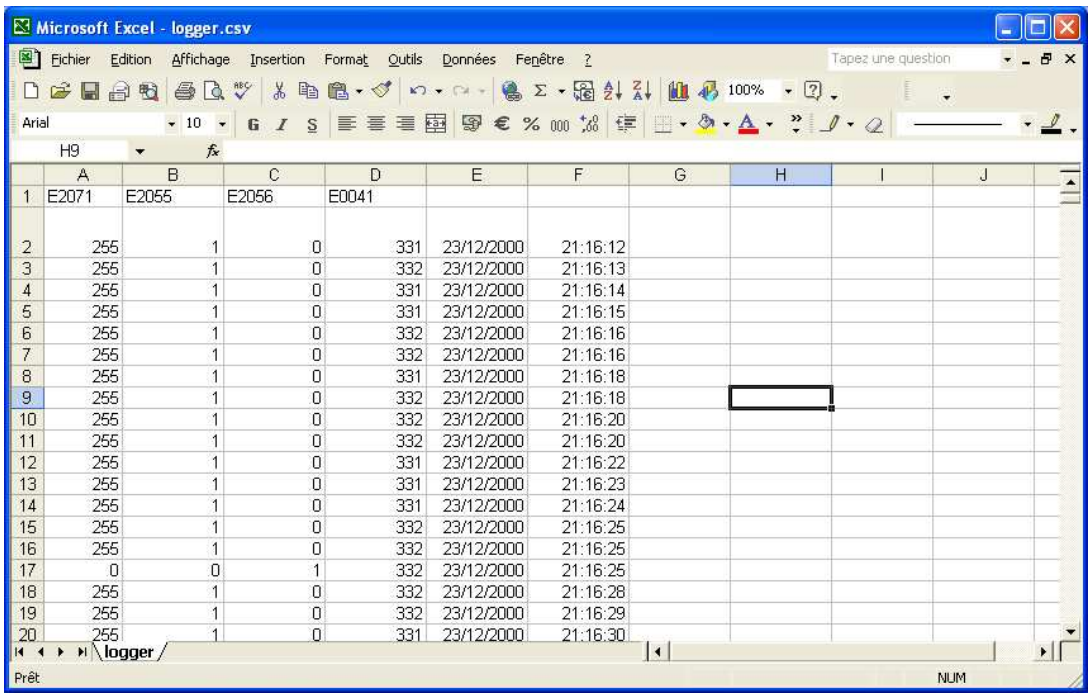
To view the archive, open the logger.csv file using Excel. Each line of recording is date marked.



- Select the first column (A) with saved values.
- Click on "Data", then "convert".
- Select "limited".
- Select Table, Comma and Semicolon. Click "Next".



The variables, values, dates and times are now laid out in columns.



Microsoft Excel - logger.csv

Fichier Edition Affichage Insertion Format Outils Données Fenêtre ?

Tapez une question

Arial 10

H9

	A	B	C	D	E	F	G	H	I	J
1	E2071	E2055	E2056	E0041						
2	255	1	0	331	23/12/2000	21:16:12				
3	255	1	0	332	23/12/2000	21:16:13				
4	255	1	0	331	23/12/2000	21:16:14				
5	255	1	0	331	23/12/2000	21:16:15				
6	255	1	0	332	23/12/2000	21:16:16				
7	255	1	0	332	23/12/2000	21:16:16				
8	255	1	0	331	23/12/2000	21:16:18				
9	255	1	0	332	23/12/2000	21:16:18				
10	255	1	0	332	23/12/2000	21:16:20				
11	255	1	0	332	23/12/2000	21:16:20				
12	255	1	0	331	23/12/2000	21:16:22				
13	255	1	0	331	23/12/2000	21:16:23				
14	255	1	0	331	23/12/2000	21:16:24				
15	255	1	0	332	23/12/2000	21:16:25				
16	255	1	0	332	23/12/2000	21:16:25				
17	0	0	1	332	23/12/2000	21:16:25				
18	255	1	0	332	23/12/2000	21:16:28				
19	255	1	0	332	23/12/2000	21:16:29				
20	255	1	0	331	23/12/2000	21:16:30				

logger

Prêt NUM

13 Troubleshooting

During starting, MASTER 2.0 displays unavailable:

Unavailable shows that the power plant is currently unavailable.
See chapter 6.1.1

MASTER 2.0 is powered and LED blinks:

Calibration lost, the MASTER 2.0 must be returned to CRE Technology to be re-calibrated.

MASTER 2.0 displays a "MASTER CAN Bus" fault:

If the flaw appears during parameter backup, check the connection between MASTER 2.0 units.
Check the number of the set and number of sets is correct, this is in Power plant overview menu.
Check the connection between MASTER 2.0.

MASTER 2.0 displays "breaker failure":

Check that control switch is in manual mode.
Check that J2 (breaker feedback) is activated. If this entry did not have time to activate, you can increase the E1149 variable delay.
This fault can occur if the opening of the circuit breaker has not been controlled by the MASTER 2.0. See if another module is able to control the circuit breaker.

When you power up the MASTER 2.0, the display does not work:

Check the bootstrap button on the back of MASTER 2.0 is off. Remove the power and change the position of the bootstrap.
If there is no change, the module is defective and needs to be returned to CRE Technology.

If fault occurs while testing speed or voltage:

Check the connection of 0V.

14 Menu overview

14.1 Menu introduction

Menu is entered when [ESC] key is pressed, and once password has been verified. The password will define which menu will be accessible:
Level 0: will give access to display menu only.
Level 1: will give access to all menus and level 1 equation.
Level 2: will give access to all menus and level 2 equations.

3 main menus are available:
Display will give information about the power plant, bus-bar or mains, and will display real time information and parameters status.
Configuration is only accessible if you have entered a level 1 or 2 password. You will be able to program MASTER 2.0 according to the needs of your plant.
System is only accessible if you have entered a level 1 or 2 password. The system menu will let you change parameters that are not related to the plant, but rather to the MASTER 2.0 system.

14.2 DISPLAY Menu

This menu gives access to the following information:

Note: In MASTER 2.0 menus, the Power Plant is referred to as "Generator".

14.2.1 Generator electrical meter

Power plant meters displayed in real time. Scrolling through this menu, you will display the following values:
Phase to neutral voltage for each phase [E0000, E0001, E0002]
Phase to phase voltage for each phase [E0003, E0004, E0005]
Current for each phase [E0006, E0007, E0008]
Active power for each phase [E0009, E0010, E0011]
Reactive power for each phase [E0012, E0013, E0014]
Power factor for each phase [E0015, E0016, E0017]
Average active and reactive power, frequency and power factor [E0018, E0019, E0020, E0021]
Active and reactive energy meters [E0025, E0026 / E0125, E0126]

The "**Global view**" screen will display all parameters listed above on a single screen. This is particularly useful in pre-commissioning phase.

14.2.2 Generator global view

Global view

V1=	0 V	U31=	0 V	I1=	0 A
V2=	0 V	U23=	0 V	I2=	0 A
V3=	0 V	U12=	0 V	I3=	0 A
P1=	0 kW	Q1=	0 kVAR	cosφ1=	1.00I
P2=	0 kW	Q2=	0 kVAR	cosφ2=	1.00I
P3=	0 kW	Q3=	0 kVAR	cosφ3=	1.00I
P=	0 kW	F=	0.00 Hz		
Q=	0 kVAR	cos(φ)=	0.00I		

Figure 38 – Generator global view

1/ Generator phase to neutral voltages

This screen displays the three phase to neutral voltage measurements.

2/ Generator phase to phase voltages

This screen displays the three phase to phase voltage measurements.

3/ Generator currents

This screen displays the three current measurements.

4/ Generator kW

This screen displays the three kW measurements.

5/ Generator kVAR

This screen displays the three kVAR measurements.

6/ Generator PF

This screen displays the three power factor measurements.

7/ All Generator parameters

This screen displays all electrical parameters measurements.

8/ KW meter & kVAR meter

This screen displays KWh and kVARh calculation.

14.2.3 Mains / Bus bar electrical meters

These meters are displayed in real time. Scrolling through this menu, you will display the following values:
Phase to neutral voltage for each phase [E0793, E0794, E0795]
Phase to phase voltage for each phase [E0796, E0797, E0798]
Current for each phase [E0799, E0800, E0801]
Active power for each phase [E0802, E0803, E0804]
Reactive power for each phase [E0805, E0806, E0807]
Power factor for each phase [E0808, E0809, E0810]
Average active and reactive power, frequency and power factor
Active and reactive energy meters.

The "Global view" screen will display all parameters listed above on a single screen. This is particularly useful in pre-commissioning phase.

14.2.4 Mains / Bus bar Global view

Global view

V1=	0 V	U31=	0 V	I1=	0 A
V2=	0 V	U23=	0 V	I2=	0 A
V3=	0 V	U12=	0 V	I3=	0 A
P1=	0 kW	Q1=	0 kVAR	cosφ1=	1.00I
P2=	0 kW	Q2=	0 kVAR	cosφ2=	1.00I
P3=	0 kW	Q3=	0 kVAR	cosφ3=	1.00I
P=	0 kW	F=	0.00 Hz		
Q=	0 kVAR	cos(φ)=	0.00I		

Figure 39 – Mains/Busbar global view

1/ Bus/Mains phase neutral voltages

This screen displays the three phase to neutral voltage measurements.

2/ Bus/Mains phase-phase voltages

This screen displays the three phase to phase voltage measurements.

3/ Bus/Mains currents

This screen displays the three current measurements.

4/ Bus/Mains kW

This screen displays the three kW measurements.

5/ Bus/Mains kVAR

This screen displays the three kVAR measurements.

6/ Bus/Mains PF

This screen displays the three power factor measurements.

7/ All Bus/Mains parameters

This screen displays all Bus/mains parameter measurements.

8/ Bus/Mains KW meter & kVAR meter

This screen displays kWh and kVARh measurements.

14.2.5 Synchronization

This page will show**:**
-Synchroscope (phase difference)
-Frequency difference(bar graph)
-Voltage difference(bar graph).
-Synch check relay status (Phase difference, **frequency** difference, voltage difference**, phase sequence**)
-**Phase Offset** (shows the parameter [E1929] set for the phase angle shift).

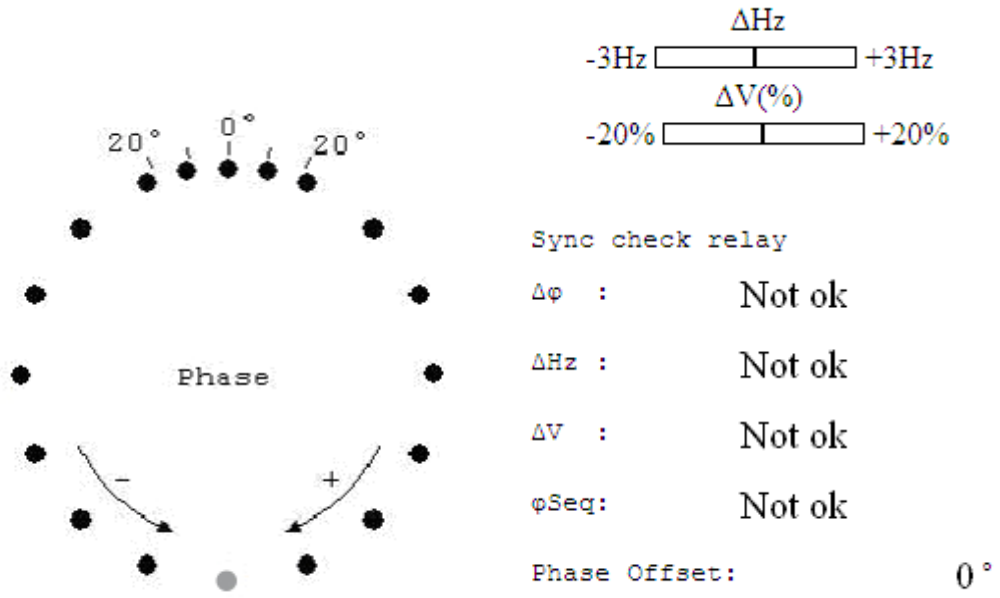


Figure 40 – Synchroscope

14.2.6 Power plant overview

This menu will show the power plant parameters (parameters shared by each MASTER unit):

1/ Generator 1 to 16 - kW

This screen will show the percentage of nominal active power supplied by each genset in real time; [E0042 to E0057]

2/ Generator 1 to 16 – kVAR

This screen will show the percentage of nominal reactive power supplied by each genset in real time; [E0132 to E0147]

3/ Generator 1 to 16 - nominal kW

This screen will show the nominal active power of each genset [E0073 to E0088]

4/ Generator 1 to 16 - nominal kVAR

This screen will show the nominal reactive power of each genset [E0089 to E0104]

5/ Generator 1 to 16 - state code

This screen will show the machine status [E2071] of each genset

14.2.7 Analogue inputs

This screen shows analogue information related to the engine.
All parameters have a bar graph display; whenever a threshold is reached, the bar graph will blink, both on the MASTER screen and on PC with browser.

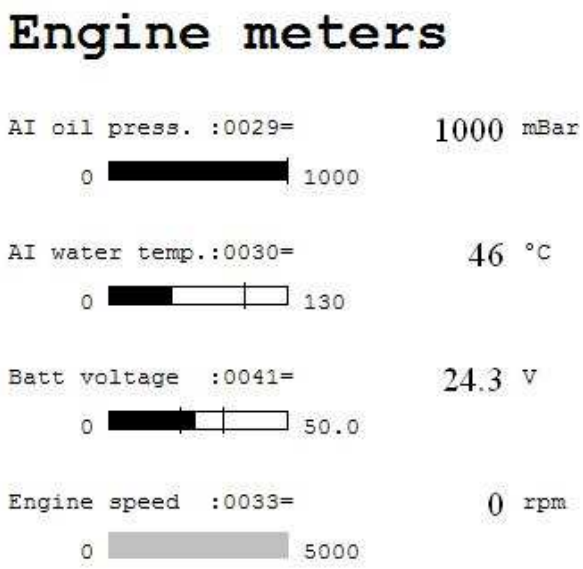


Figure 41 – Engine meters

Analogue resistive sensors: oil pressure [E0029], water temperature [E0030], spare input 1 [E0031] and spare input 2 [E0032].

14.2.8 Digital inputs/outputs

1/ Digital inputs

This menu shows the status of the 5 dedicated and **10 configurable digital inputs** connected on the "J" terminals, and the status of the emergency stop input. [E2000, E2001, E2002, E2003, E2004, E2005, E2006, E2007, E2008, E2009, E2010, E2011, E2012, E2013, E2014, E2015]
The name of each input is displayed. Input active =1, Input inactive = 0.

2/ Relay outputs & Digital transistor output

This menu shows the status of the **4 dedicated relay outputs** (fuel, crank, genset and mains breakers) and the **5 configurable digital transistor outputs**. [2016, E2017, E2018, E2019, E2020, E2021, E2022, 2023, E2024]

14.2.9 Timers

This menu shows the timer values running in real time. To change timer values, you should go to Configuration Menu.

14.2.10 Timers 1/2

No O/C ma. br. [E2073]: shows the time MASTER must wait after a start before having any action on mains breaker.
No O/C gen br. [E2074]: shows the time MASTER must wait after a start before having any action on power plant breaker.
Fail to synchr [E2075]: when synchronizing in auto mode, this timer defines the time to determine if synchronization has failed.
Ramp up timer [E2081]: shows the time to take the load with a load ramp.
Ramp dwn timer [E2082]: shows the time to lose the load with an unload ramp.
Bef power down [E2239]: shows the time to stop gensets when low load level is reached (see configuration / automatic load / unload)
Bef power up [E2240]: shows the time to start ²gensets when high load level is reached (see configuration / automatic load / unload)
MA back timer [E2091]: In changeover configuration, shows the time to wait when mains returns.

14.2.11 Timers 2/2

This menu gives all user meters, 1 to 5, hours and days.

14.2.12 Serial number / Soft version

This information screen will display the **serial number** of the MASTER you are currently using and its **software version**. This information is useful for firmware information.

14.3 CONFIGURATION Menu

This menu will allow parameter configuration.
The Basic configuration is accessible to everybody and must be configured for each application.
The Enhanced configuration is accessible to confirmed engineers and gives access to advanced parameter configuration.

14.4 - Basic Configuration Menu

Will give access to the following menus where parameters can be modified:

14.4.1 Power plant overview

1/ Power plant

Parameter [var. num.]	*possible value*	*comment*
Mast/Gen. number [E1179]:		Is the number given to this particular MASTER on the power plant.
Nb of gen. [E1147]:		Is the total number of Gensets installed on the power plant.
Nb of Masters [E4006]:		Is the total number of MASTER 2.0 modules installed on the power plant.
Mains parallel. [E1148]: only use if nb of gen. [1147] is 1	ChangeOver/0	On mains failure, plant starts and takes the load by opening mains breaker and closing bus bar breaker without interlocking. On mains return, unload plant by opening bus bar breaker and closing mains breaker without interlocking, then stop plant.
	No Break CO/1	Only available with *mains paralleling* option Same as changeover mode but loading/unloading is made without black, with ramps after synchronization with mains.
	Permanent/2	Only available with *mains paralleling* option after a start demand, MASTER will synchronize plant to mains and keep both breakers closed.
	No ch.over/3	MASTER must receive a start demand and will not manage mains breaker output. There will be no synchronization with the bus bar or the mains.
Mains regul. [E1153] only available with mains paralleling option only use if nb of gen. [E1147] is 1	Peak shav./1	MASTER will permanently vary plant power to maintain constant power supply from mains.
	Base load/2	MASTER will permanently maintain plant power.
ILS compatible [E1158]	Yes/0	Load sharing will be done via analogue bus (pins G4 and G6).
	No/1	Load sharing will be done via inter MASTER digital CAN bus (Com 2 port).
Synchro mode	Dynamic/0	Standard synchronization: will be carried out by adjusting engine speed

Parameter [var. num.]	*possible value*	*comment*
[E1177]		and generator voltage.
	Static/1	Is to be selected if breakers are closed before engine starting and generator excitation.
Deadbus manag. [E1515]	Yes/0	Dead bus management will be done via inter MASTER digital CAN bus (Com 2 port).
	No/1	External logic controls dead bus management.

Table 33 - Power plant configuration

2/ Mains electrical fault

Open breaker [E1846]: Open breaker: you select the breaker that will be opened upon a "Mains electrical fault". You can select the "**Mains**" breaker or the "Bus bar" breaker or "both".
Start on fault [E1841]: Fault start: will allow the plant to start on a "Mains electrical fault". You can select "**Yes**" to start the plant or "No".
Start delay [E1840]: is the delay between the "Mains electrical fault" and the plant start. It will delay a digital or virtual input. For an internal detection, this delay overrides the delay of the protection.
No load delay [E1842]: No load delay (**60.0**): is the delay during which the plant runs without load, when the bus bar breaker is open. If the delay is 0, the plant will never stop.

For more details, see chapter 10.2

3/ Generator electrical fault

TM re-synch. [E1843]: is the delay before the plant tries to re-synchronize with Mains after a "Generator electrical fault".
Nb re-synch. [E1844]: is the number of attempts to re-synchronize.
In the case of a generator electrical fault, the bus bar breaker is opened and the MASTER 2.0 is in state 40. In this state the alternator is de-excited (if wired) during a delay (E1265). After this delay, if the fault is still present there is a hard shut down; otherwise MASTER 2.0 tries to re-synchronize.

For more details, see chapter 10.3

14.4.2 Gen/Mains electrical settings

1/ Mains/Bus

This page describes the parameters used to configure the Mains or the bus bar voltage connected to the MASTER 2.0

MA kW <-> 20mA[1020]: is the power measured by an external transducer delivering 20 mA (or 홉 if a voltage output transducer is used) to the power input of MASTER (pins G1 and G3).
MA 0kW setting [E1021]: is the current to the power input of MASTER (pins G1 and G3) delivered by an external transducer measuring 0 kW.
Ex: a 4-20ma transducer is used. 20ma corresponds to 500KW --> E1020=500; E1021=4;
MA PT ratio [E1016]: is the ratio of your voltage transformer on the mains/busbar side (E.g. 20 kV to 100 V: type in 200).
MA back timer [E1085]: if plant is in Change Over configuration, this is the time MASTER will wait to ensure a stable return to mains.
Mains KW Meas.[E1464]: **External**: measurement of mains power by external power transducer (pins G1 and G3); **Internal**: calculation of mains power from the single phase measurement of MASTER.
Ext kW measure[E1461]: choose **10V** for voltage output external transducer, **20mA** for current output external transducer.
Mains voltage [E4008]: is the nominal Mains voltage (used for protection %).
Mains freq. [E4009]: is the nominal Mains frequency (used for protection %)

2/ Generator

This page describes the parameters used to configure the power plant.
Nominal kW [E1006]: is the nominal power of your plant.
kW nominal 2 [E1607]: is a second nominal power for your plant, activated with logical input or equations.
PT ratio [E1007]: is the ratio of your voltage transformers (E.g. 20 kV to 100 V: type in 200).
CT1 ratio [E1008]: is the ratio of your phase 1 current transformer (E.g. 100A to 5A: type in 20).
CT2 ratio [E1009]: is the ratio of your phase 2 current transformer.
CT3 ratio [E1010]: is the ratio of your phase 3 current transformer.
Speed droop [E1075]: speed droop setting in %.
RemStart delay [E1990]: delay after remote start signal.

3/ Busbar threshold control

Unload brk TM [E4038]: unload delay.
LV unload 1 [E4001]: unload threshold 1.
LV unload 2 [E4002]: unload threshold 2.
LV unload 3 [E4003]: unload threshold 3.
LV unload 4 [E4004]: unload threshold 4.
LV unload 5 [E4005]: unload threshold 5.

14.4.3 Excitation control settings

1/ AVR control

Volt droop [E1105]: is the droop sent to AVR if reactive load sharing is undertaken with droop (if not using inter MASTER CAN bus or in manual mode).
Volt setpoint1 [E1107]: first (default) voltage set point.
Volt setpoint2 [E1108]: second voltage set point (if required for PLC programming or use with digital input).
cos(ϕ)setpoint [E1110]: power factor set point when running parallel to the mains.

2/ Power factor PID

This screen lets you adjust the PID settings of the power factor control when parallel to the mains:
G= overall gain [E1119](multiplies the sum of the following settings), **P=** proportional gain [E1120], **I=** integral [E1121], **D=** derivative [E1122].

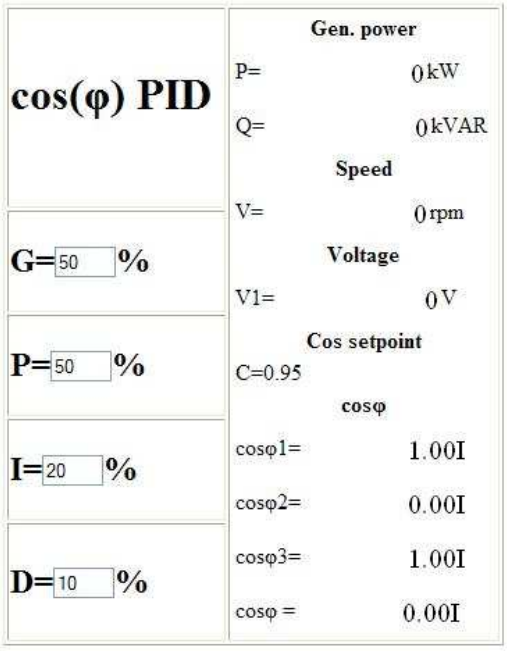


Figure 42 – Power factor PID

While you adjust the PID settings of the power factor control, the following parameters are displayed:
Generator active and reactive power (P and Q), engine speed, pf set point, pf phase 1, 2 and 3, global pf.

3/ 3/ kVAr shar. gain

When reactive load sharing is active: set the gain (**G**) for kVAr sharing [E1123].

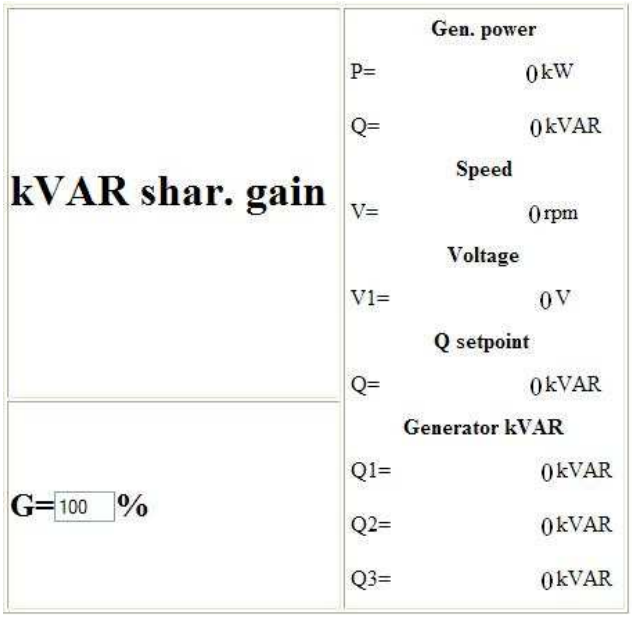


Figure 43 – kVAR shar. gain

While you adjust the PID settings of reactive power control, the following parameters are displayed:
Generator active and reactive power (P and Q), engine speed, generator Voltage (phase 1), reactive power set point, 3 phase reactive load.

14.4.4 Protections

For each of the following protections, you can set a level LV, a timer TM, and an Action CT. The action CT will be activated if the Level LV is reached after the timer TM.
Please refer to the protection configuration page or the table bellow for more details.

1/ Generator Protections

On the generator side, the following protections are available:

Protection function [Level, Timer, Function]
Gen. under freq. protection [E1025,E1026,E1027]
Gen. over freq protection[E1022,E1023,E1024]
Gen. under volt protection [E1028,E1029,E1030]
Gen. over volt protection[E1031,E1032,E1033]
Gen. mini kVAR protection[E1034,E1035,E1036]
Gen. maxi kVAR protection[E1037,E1038,E1039]
Gen. reverse kW protection[E1040,E1041,E1042]
Gen. reverse kVAR protection[E1043,E1044,E1045]
Generator mini kW protection[E1046,E1047,E1048]
Generator maxi kW protection[E1049,E1050,E1051]
Gen. max current protection[E1052,E1053,E1054]
Gen. max neutral I protection[E1055,E1056,E1057]

2/ Mains Protections

On the Mains side, the following protections are available:

Protection function [Level, Timer, Function]
Under freq. protection [E1058,E1059,E1060]
Over freq protection[E1061,E1062,E1063]
Under volt protection [E1064,E1065,E1066]
Over volt protection[E1067,E1068,E1069]
Min kVAR protection [E1408,1409,1410]
Max kVAR protection [E1411,1412,1413]
Reverse kW protection [E1414,1415,1416]
Reverse kVAR protection [E1417,1418,1419]
Min kW protection [E1420,1421,1422]
Max kW protection [E1423,1424,1425]
Phase shift protection (vector jump) [E1070,1071]
ROCOF protection [E1072,1073,1637]

14.5 - Enhanced Configuration Menu

Will give access to the following menus where parameters can be modified:

14.5.1 Power plant overview

Same menu as « Basic configuration »

14.5.2 Gen/Mains electrical settings

Same as "Basic configuration/Gen/Mains electrical settings" menu.

14.5.3 Protections

Same as "Basic configuration/Protections" menu.

14.5.4 Breaker settings

This menu is used for breaker configuration. Each of the 2 breakers (Generator and Mains) can be configured with 5 different values from table below:

0 =	open contact	close pulse
1 =	open contact	close contact
2 =	open MXcoil	close pulse
3 =	open MXcoil	close pulse
4 =	open pulse	close pulse
5 =	open pulse	close contact

Table 34 - Breaker settings

Mains brk ctrl [E1992]: This is the mains breaker control.
Gen brk ctrl [E1993]: This is the generator breaker control.

It is also possible to change the pulse timer:
UV coil rst TM [E1994]: Timer for the negative impulsion of the low voltage coil.
UV coil pre TM [E1995]: Safety timer for the low voltage coil.

14.5.5 Excitation control settings

Same as "Basic configuration/Excitation control settings" menu.

14.5.6 Active power regulation

1/ Generator kW settings

Gen low lim [E1091]: is the lower power limit of the plant; enter a value (in kW) that will prevent reverse power protection triggering.
Gen high lim [E1092]: is the upper power limit of the plant; enter a value (in kW).
Ge kWsetpoint1[E1093]: is the plant kW set point in constant production mode.
Ge kWsetpoint2[E1094]: is a second plant kW set point in constant production mode. Can be used in association with digital inputs. Optional.
Load ramp [E1151]: time to ramp up from lower limit to required power output.
Unload ramp [E1152]: time to ramp down from required power output to lower power limit.

2/ Mains kW settings (only available with mains paralleling option)

MA kWsetpoint1[E1096]: is the mains power set point in peak shaving mode.
MA kWsetpoint2[E1097]: is a second mains kW set point in peak shaving mode. Optional.

3/ kW sharing GPI

When sharing load between gensets: G= overall gain (multiplies the sum of the following settings)[E1102], **P=** proportional gain,[E1900] **I=** integral [E1901].
The Global Gain for the central Frequency is [E1902].
The right hand side of the table only displays values that allow easy setting.

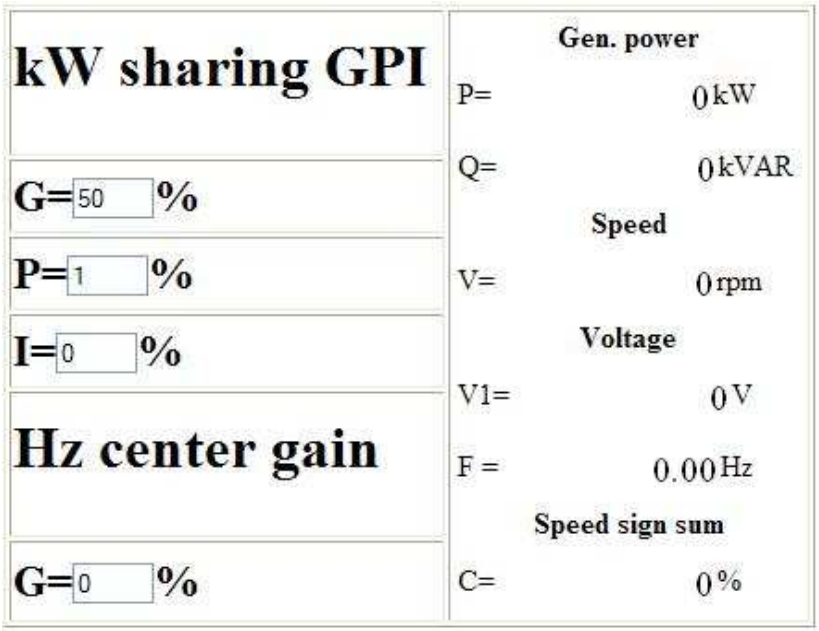


Figure 44 – kW sharing GPI

14.5.7 P= Constant (Gen//mains), (only available with mains paralleling option)

This screen lets you adjust the Proportional and Integral power management settings when a single genset is running parallel to the mains:
G= overall gain (multiplies the sum of the following settings[E1099]), **P=** proportional gain[E1100], **I=** integral[E1101].

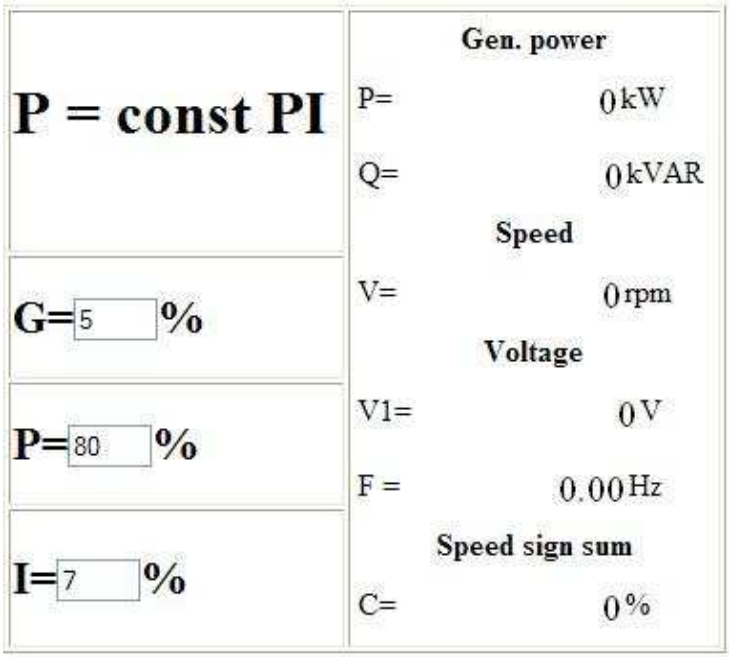


Figure 45 – P=const PI

While you adjust the PID settings of active power control, the following parameters are displayed: Generator active and reactive power (P and Q), engine speed, generator Voltage (phase 1), frequency, sum of the speed signals (in %).

14.5.8 Synchronization

1/ Synch check relay

Voltage match [E1127]: is the maximum difference (in percent) between power plant and mains voltage that allows the synch check relay to operate.
Freq. match [E1128]: is the maximum frequency difference between power plant and mains that allows the synch check relay to operate.
Phase match [E1129]: is the maximum phase angle difference allowed between power plant and mains for the sync check relay to operate.
Min volt [E1432]: is the minimal percentage of nominal voltage on both sides of the breaker to allow sync check relay to operate.
Max volt [E1433]: is the maximal percentage of nominal voltage allowed on both sides of the breaker for the sync check relay to operate.
Min frequency [E1434]: is the minimal percentage of nominal frequency allowed on both sides of the breaker for the sync check relay to operate.
Max frequency [E1435]: is the maximal percentage of nominal frequency allowed on both sides of the breaker for the sync check relay to operate.
Fail to synchr[E1150]: this timer will trigger a fail to synchronize protection if plant has not synchronized within the time you enter.
CT Fail synchr[E1928]: this selects the course of action in case of impossible synchronization; Please refer to the protection configuration for details.

2/ Voltage synchronization PID

This screen lets you adjust the PID settings of the output to AVR:
G= overall gain (multiplies the sum of the following settings) [E1130], **P=** proportional gain[E1131], **I=** integral[E1132], **D=** derivative[E1133].

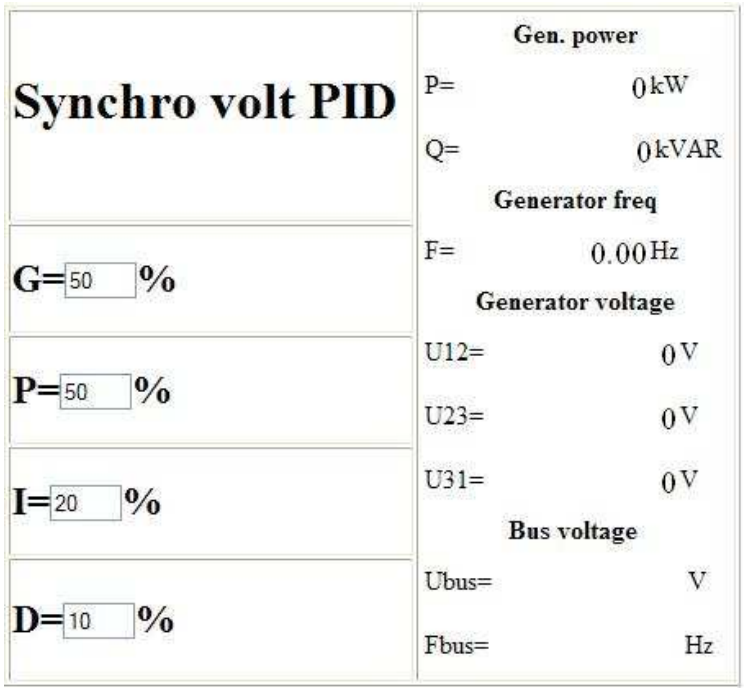


Figure 46 – Synchro volt PID

While you adjust the PID settings, the following parameters are displayed: Generator active and reactive power (P and Q), frequency, generator phase to phase Voltages (U_{12}, U_{23}, U_{31}), Bus phase to phase voltage (U_{13}), Bus frequency.

3/ Synchroscope for frequency and phase PID settings

This screen lets you adjust the PID settings for faster frequency and phase matching:
Frequency PID
G= overall gain (multiplies the sum of the following settings [E1111]), **P=** proportional gain [E1112], **I=** integral [E1113], **D=** derivative [E1114].
Phase PID
G= overall gain (multiplies the sum of the following settings)[E1307], **P=** proportional gain[E1308], **I=** integral[E1309], **D=** derivative [E1310].

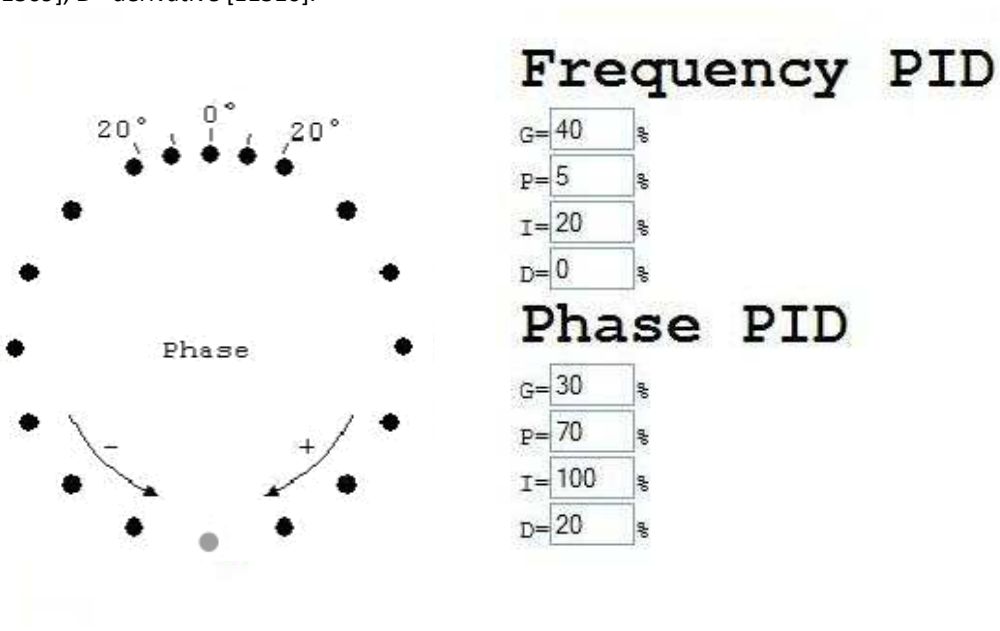


Figure 47 – Synchroscope frequency & phase PID

The internal MASTER synchroscope is displayed and lets you monitor in real time the changes you make on these parameters.

14.5.9 Digital outputs

Outputs 1 to 5: [E1260, E1261, E1262, E1262, E1264], function and polarity have to be defined. The relays "Crank" and "Fuel" can be set for other functions. See 3 below.

1/ Possible output functions:

Detailed list of useable output functions is given in chapter 8.2.1

2/ Polarity:

For each of the five outputs, two options are possible:
NE: normally energised; the output will de-energize when required, depending on its function.
ND: normally de-energized; the output will energize when required.

3/ Relay Special functions (outputs 6 and 7):

The function of relay outputs 6 & 7 can be set. Polarity cannot be changed for these outputs. The function of output 6 is set with [E1989]; The function of output 7 is set with [E1916].
If E1916= "Unused" the initial settings apply, with E2019 to the A2output (fuel).
Other functions for this output can be selected in the list.
If E1989= "Unused" the initial settings apply, with E2018 to the A1output (crank).
Other functions for this output can be selected in the list.

14.5.10 Virtual digital inputs

Virtual digital inputs are designed to offer more features to the end user. They can be programmed via equations or can copy the status of external (CAN Open linked) inputs. For virtual digital inputs 1 to 40: label, validity, direction, and function have to be defined.
Variable numbers: [E2283 to E2302 and E2565 to E2584]

1/ Label:

The name you give to the virtual input. This will be displayed in the info, alarm, and fault screens if so programmed.

2/ Validity:

Virtual input validity variable numbers: [E1348 to E1357 / E1388 to E1397 / E1640 to E1659] can be set as:
Never [E2329]: never active: should be selected if you do not use the input.
Always [E2330]: always active: input will be monitored as long as MASTER has power supply.
Post-Starting [E2192]: the input will be monitored at the end of the "safety on" timer.
Stabilized [E2331]: The input will be monitored when genset frequency and voltage are stable.
Spare scenario: [E2332]: input will be monitored as programmed in equations.

3/ Direction:

Virtual input direction variable numbers: [E1358 to E1367 / E1398 to E1407 / E1659 to E1679]. Can be set as:
NO [0]: normally open; should be selected unless the input is used for protection.
NC [1]: normally closed. This should be selected if the input is normally connected to 0V and opens when active.

4/ Accuracy

This parameter sets accuracy (number of digits after decimal point). Possible values are:

- 1
- 0.1
- 0.01
- 0.001

5/ Functions:

Virtual input function variable numbers: [E1328 to E1337 / E1368 to E1377 / E1680 to E1699] can be set as described in chapter 8.1.5. Note that both virtual and real inputs use the same functions.

14.5.11 Digital inputs

They are split into dedicated and configurable inputs. For Digital inputs 1 to 10 [E2006, E2007, E2008, E2009, E2010, E2011, E2012, E2013, E2014, E2015]: label, validity, direction and function have to be defined, as for dedicated inputs. Polarity must also be defined on input variable numbers: [E2000, E2001, E2002, E2003, E2004].

1/ Configurable input labels:

It is the name you give to the input, and will be displayed in the info, alarm, and fault screens if so programmed.

2/ Validity

Input validity variable numbers: [E1287 to E1296] can be set as:
Never: [E2329]: never active: should be selected if you do not use the input.
Always: [E2330]: always active: input will be monitored as long as MASTER has power supply.
Post-Starting: [E2192]: input will be monitored at the end of the "safety on" timer.
Stabilized: [E2331]: the input will be monitored when plant frequency and voltage are stable.
Spare scenario: [E2332]: input will be monitored as programmed in equations.

3/ Direction:

Input direction variable numbers: [E1297 to E1306].
For each of the ten inputs, four options are possible:
NO [0]: normally open; should be selected unless the input is used for protection.
NC [1]: normally closed. This should be selected if the input is normally connected to 0V and is open when active.

4/ Delays:

Delays for input variable numbers are: [E1277 to E1286]

5/ Possible functions:

Input function variable numbers: [E1267 to E1286] can be set as described in chapter 8.1.5. Note that virtual and real inputs use the same functions.

6/ Dedicated inputs

In the menu list each input is named after its pin number on the wiring of MASTER 2.0. Polarity can be **normally open** or **normally closed.** Program this according to the wiring you will have on site.
As a reminder: J1 is Mains breaker position, J2 is Bus bar breaker position, and J3 is remote start input.

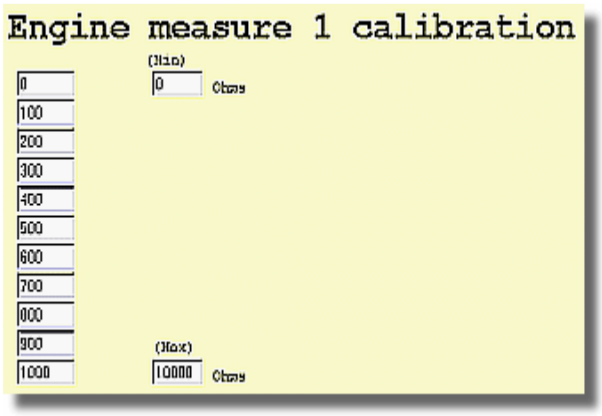
14.5.12 Configuration of analogue inputs

1/ 1/ Units

Spare Analogue measures 1 to 4: you should give them a name, and decide which unit shall be displayed among the following:
No unit, V, kV, mA, A, kA, Hz, kW, kWh, kVAR, kVARh, rpm, %, Bar, mBar, kPa, PSI, °, °C, °F, L, Gal, s, h, days, Hz/s, m3/h, L/h, Gal/h.

2/ 2/ Calibration

A/ 0-400 Ohms sensor calibration: Pressure and Temperature: this menu relates to the dedicated analogue inputs (oil pressure and coolant temperature). Please enter the pressure or temperature read by your sensors according to the resistance shown next to each box.
Oil Temperature calibration points are [E1188 to E1198], which correspond to 0 to 400 Ohms
Water Temp. Calibration points are [E1199 to E1209], which correspond to 0 to 400 Ohms.
B/ Engine measurements 1 and 2:
Spare engine measure 1 calibration points are [E1210 to E1220].
Spare engine measure 1 impedance points are [E1188 to E1198].
Spare engine measure 2 calibration points are [E1232 to E1242].
Spare engine measure 2 impedance points are [E1199 to E1209].



For each of the two spare sensors, please indicate on the right hand side (min and max boxes) the operating range of each of your sensors; then, give the value to be displayed for each tenth of difference between min and max values.
E. g: min = 3000, max =6000, gives the values corresponding to 3000, 3300, 3600, 3900, 4200, 4500, 4800,..., 5700, 6000 Ohms. These can be used in equations or displayed.

You can find a calibration graph for different sensors in application note Z090101.pdf.

14.5.13 CAN Open

1/ Input message configuration

Input messages 1 to 13:
For each message transmitted from the external block to MASTER, please specify:
mod_id_inX: For message number X (1 to 13), the ID number of the remote inputs module. [E1518 to E1530]

type_in_messX: For message number X (1 to 13), whether the inputs are "**digital**" [1]or "**analogue**"[2] if not used, choose "**Unused**"[0]. [E1531 to E1543]

nb_in_messX: For message number X (1 to 13), the number of inputs sent from the remote inputs module. [E1544 to E1556]

2/ Output message configuration

Output messages 1 to 19.
For each message transmitted from MASTER to the external block, please specify:

mod_id_out_X: For message number X (1 to 19), the ID number of the remote outputs module. [E1557 to E1569] & [E1875 to E1880]

type_out_messX: For message number X (1 to 19), whether the outputs are "**digital**" or "**analogue**"; if not used, choose "**Unused**".[E1570 to E1582] & [E1881 to E1886]

nb_out_messX: for message number X (1 to 19), the number of outputs which are sent to the remote outputs module.[E1583 to E1596] & [E1887 to E1892]

3/ Launch modules configuration

Launch modules configuration [E1603]: this is not really a menu, but a "GO BUTTON". This variable is always set to "NO" by default. When you set it to "YES", MASTER 2.0 restarts configuration of all external CANopen modules. Afterwards, MASTER 2.0 resets to "NO". It is good practice to use this after a CANopen configuration modification.

14.5.14 Modification by variable number

This menu item is very useful when you are familiar with key variable numbers, for example the ones you modify often. Simply enter the variable number, and then enter its value. Please refer to MASTER technical documentation for list of parameter or variable numbers.
Note: You can only change the parameters (settings), from E1006 to E1999. Some of these settings are not accessible from other menus.
The second field in this page allows you to configure the writing ability via Modbus or PLC (equations). This is also visible and settable in the third column of the parameters file. Y (Yes) = allowed / N (No) = not allowed.

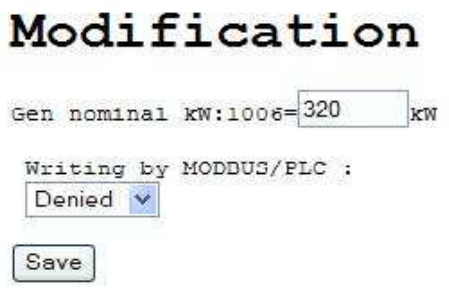


Figure 48 – Modification by variable number

14.5.15 Fifo data logger

Log on/off: [E1988] is set to "On" to enable the data logger.
Log Var 1 to **Log Var 10:** Set here the variable value you want to watch. When set to "-1" the Log Var is disabled.
These values are displayed in the Data logging display page.

14.6 SYSTEM Menu

This will give access to the following menus which display system parameters; some of which can be modified:

14.6.1 Date / Time / Meters

1/ Date / Time

Here you can choose Date format (dd/mm/year or mm/dd/year) and set Date and Time.

2/ Meters reset

You can reset the meters using the software on your PC or via the front panel by selecting "reset". The following meters are set to zero:
Gen. kW sum [E0025];
Gen. kVAR sum [E0125];
Mains kW sum [E0061];
Mains kVAR sum[E0063];
Hours run [E0065];
Nb of starts [E0027];
User meter 1 [E2657] : settable in the following page
User meter 2 [E2659] : settable in the following page
Data logging [E1988]: erases the list of alarms, faults, and logs

3/ Dedicated meter settings

For the two dedicated meters [E2657] and [E2659] you can chose:
-The name of the meter
-The unit of the meter. V, kV, mA, A, kA, Hz, kW, kWh, kVAR, kVARh, rpm, %, Bar, mBar, kPa, PSI, °, °C, °F, L, Gal, s, h, days, Hz/s, m3/h, L/h, Gal/h
-The accuracy of the meter.

14.6.2 Password / Options

1/ Passwords

This screen allows you to change passwords, from level 0 to the currently connected level. Passwords are limited to 8 characters maximum.

2/ Options

Displays only the options active on your MASTER. For more information on options, or to lock/unlock one of them, please contact your local CRE distributor. OFF is an inactive option, ON is an active option.
8: Phase offset option. This option is generally used with HIGH VOLTAGE transformer applications.

14.6.3 MASTER screen saver

1/ Introduction

The screen displayed when user does not interact with MASTER 2.0 (keys not used) is called “SCREEN SAVER”. Information displayed on this screen is automatically chosen depending on MASTER 2.0 status, as described in table below. Some parameters can also be used to customize this behaviour.

Screensaver	Description	Display in auto mode	Display in Manu mode
Synchronization column	Frequency difference (bar graph) Voltage difference (bar graph) Phase difference (column) Frequency match (OK/NOK) Voltage match (OK/NOK) Phase match (OK/NOK)	In synchronization state	When the plant is ready and the bus bar breaker is open
Plant overview	KW (in large font) Voltage (in large font) Running hours (in large font)	When the bus bar breaker is closed	When the bus bar breaker is closed
Engine overview	Crank relay output Fuel relay output Water temp digital output Oil pressure digital output Emergency stop Remote start Nb of start attempts Battery voltage (bar graph) Engine speed (bar graph)	In start and fault state	When you press start, or when in fault state
Customized screen	4 custom lines Customer logo	In wait state (plant stopped)	In other cases

	Current date and time		

Table 35 - Screensaver modes

2/ Menu

TM scr saver [1266]: set the time (in minutes) after which the front panel display will exit menus and show the screen saver.
Line 1 to Line 4: the 4 lines of text displayed in the “Customized screen” can be modified as well. Each line can be up to 28 characters in length.

Note: if you change this text from your computer, make sure your "PC language" is the same as the "local language", as the text displayed is local language related; for more information, refer to the next chapter.

14.6.4 Back light timer / Languages

1/ Back light timer

TM back light [1014]: This sets the time (in minutes) after which the front panel display backlight will be switched off. The light will be switched on again as soon as a key is pressed on the front panel.
PC language: Allows you to choose the language of the menus displayed on your computer.
Local language: Allows you to choose the language of the menus displayed on your MASTER 2.0 front panel.

14.6.5 Serial port configuration

This menu is mainly for informative purposes:

1/ COM1

This port allows synchronization, load sharing (active and reactive), dead bus management, automatic load/unload, Broadcast data...
This isolated communication port is also used for Master2.0 and GENSYS 2.0 communication. MASTER 2.0 uses a proprietary protocol.

2/ COM2

This bus is used for communication with CANopen remote I/O modules (Beckhoff, Wago...).

3/ COM3

This port is used for computer connection (USB).

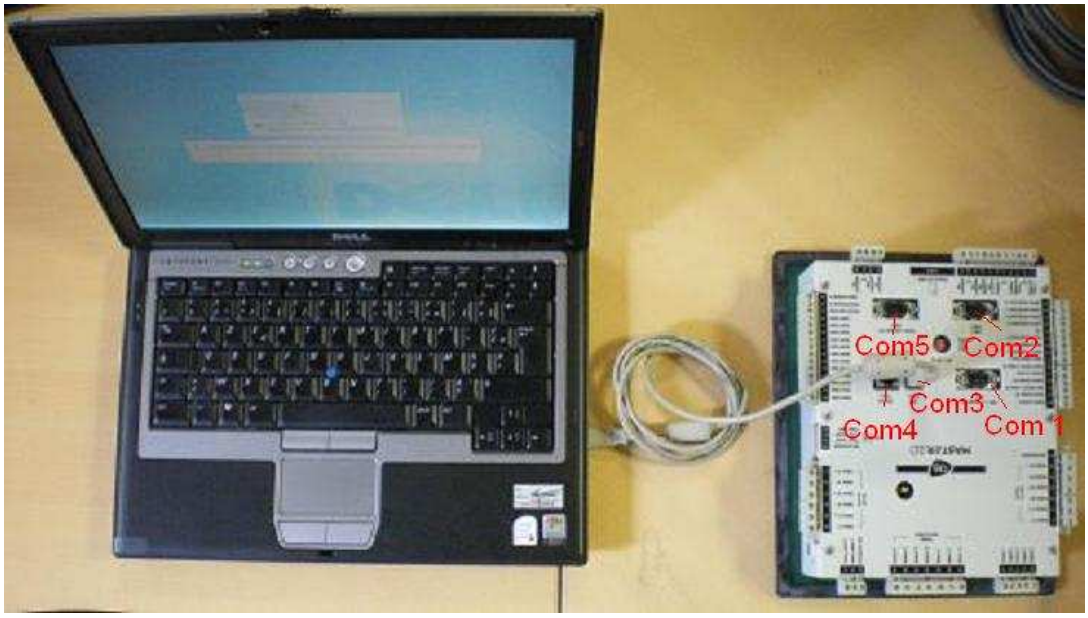


Figure 49 – Com ports

4/ COM4

Ethernet connexion.

5/ COM5

MODBUS speed [E1441]: the following speeds are available: **4800, 9600, 19200, 38400** bps.
8 data bits. No parity. 1 stop bit. Isolated. 2 wires.
Modbus address [E1634]: this parameter is used to define the MASTER 2.0 Modbus SLAVE (RTU) address.

6/ COM6

COM6 is the memory card port. No settings on this com port.

14.6.6 Serial number/Software version

This is the same item as “Display” in the first level menu.

14.6.7 Level -1 password menu

Option select [E1610]: this can be “Meters preset”, “G59”, or “None” (default). See chapter 10.5 for details.

14.6.8 MASTER to PC file

This menu is only displayed on the computer and not on the MASTER front panel.

Download.
By selecting Download MASTER_file.txt, the current configuration file will be displayed in your internet browser.
Use the File / Save as... menu of your browser to save this file.

Warning:
If you use the text file to edit a new configuration, it is strongly recommended that you use the text file uploaded from the MASTER, modify it, and download this new text file to the MASTER. Always use a text file compatible with the installed firmware version.

Warning:
File transfer is only possible when engine is stopped.

14.6.9 PC to MASTER file

This menu is only displayed on the computer and not on the MASTER front panel.

NOTE: we recommend you first save the current configuration using the “MASTER to PC file” menu before making changes.
NOTE: file transfer is only possible when engine is stopped.
Use the "browse" button to select your file, then choose the "Save" button.
When the operation is completed, a screen will appear showing:

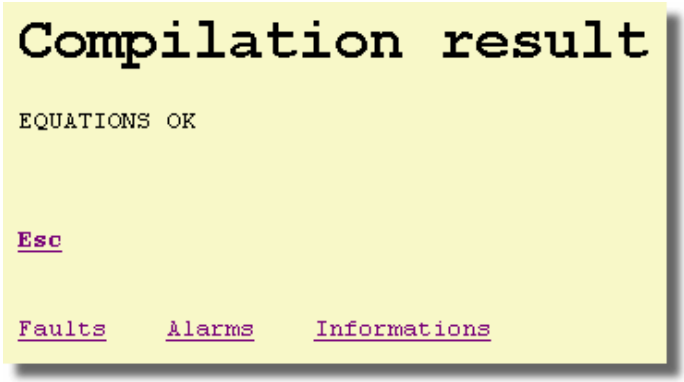


Figure 50 – Compilation result screen

14.6.10 Download logo

This menu is only displayed on the computer and not on the MASTER front panel.

This menu allows you to change the screen saver logo on the MASTER front panel.
NOTE: file transfer is only possible when engine is stopped.
NOTE: the picture must be a monochromatic BMP file of 71*50 pixels.
Use the "browse" button to select your file, then choose the "Save" button.
When the operation is completed, a screen will appear showing:

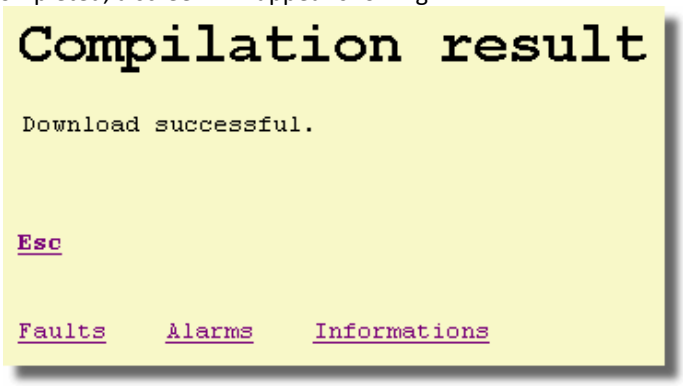


Figure 51 – Download screen

14.7 Dedicated screens

-Access to the Information page.
-Access to the Alarms page.
-Access to the Faults page.
Click BACK on your internet browser or press the button a second time to return to your previous screen.

14.7.1 Alarms

At any time and any level, you can click on the "**Alarms**" link in your browser or press the **[ALARM]** key on the front panel.
By pressing "<<" or ">>", you can change between 1st to 10th alarms and 11th to 20th alarms...etc. 50 alarms are visible.
Pressing "**Refresh**" will update the screen with last occurred alarm(s).
Pressing "**Reset**" will reset the protection(s) which were triggered.

NOTE: *The condition triggering the protection must first be corrected before resetting the alarm; failing to do this will trigger the protection again.*

14.7.2 Faults

At any time and any level, you can click on the "**Faults**" link on your browser or press the **[FAULT]** key on the front panel. Click BACK on your internet browser or press the button a second time to return to your previous screen.
This will automatically change the display and show the faults screen.
The last 50 faults are displayed as follows:
dd/mm/yy hh:mn:ss protec. label XXXX=On (or Off). XXXX stands for the variable number.

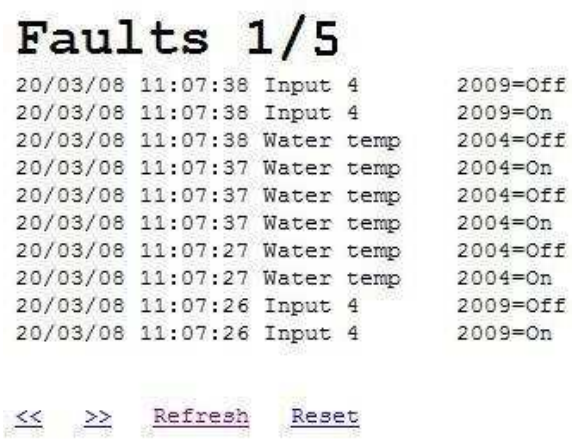


Figure 52 – Fault screen

14.7.3 Information

At any time and any level, you can click the "**Information**" link on your browser or press the **[i]** key on the front panel. Choose BACK on your internet browser or press the button a second time to return to your previous screen.
This will automatically change the display and show the information screen.

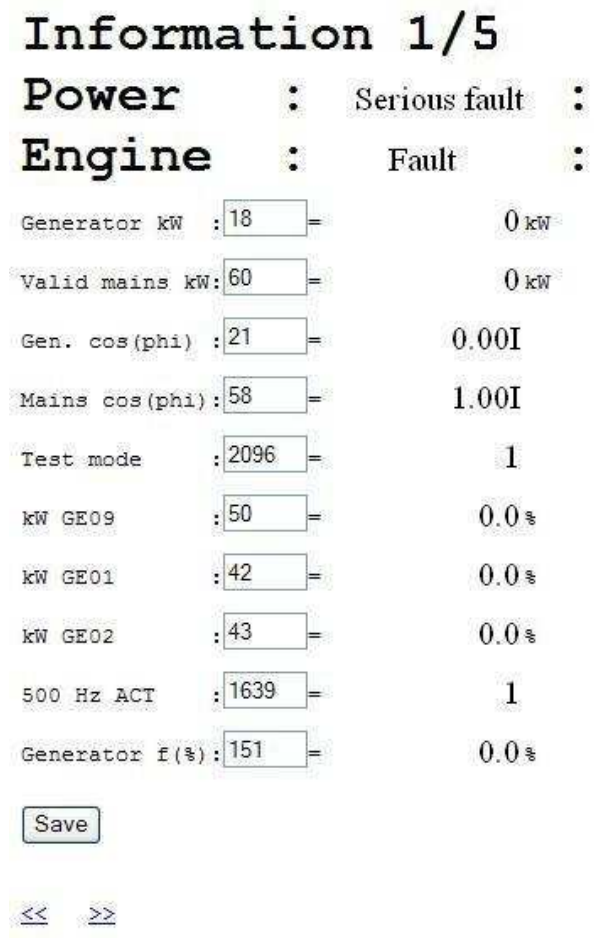


Figure 53 – Information screen

Power [E2071]: This will display the current status of the MASTER regarding power management. It will also display a state code which is dedicated to the technical support team of your local MASTER Distributor.
Engine [E2057]: This will display the current status of MASTER regarding the engine. It will also display a state code which is dedicated to the technical support team of your local MASTER Distributor.

Parameter information: You can display any parameter by simply giving its variable number. By doing so, you can customize your information screen and display 10 parameters per page (5 pages available). Please refer to the technical documentation for list of variable numbers.

15 Useful Information

This page gives access to useful information concerning different areas of the MASTER unit's functioning.

15.1.1 Speed Regulation details

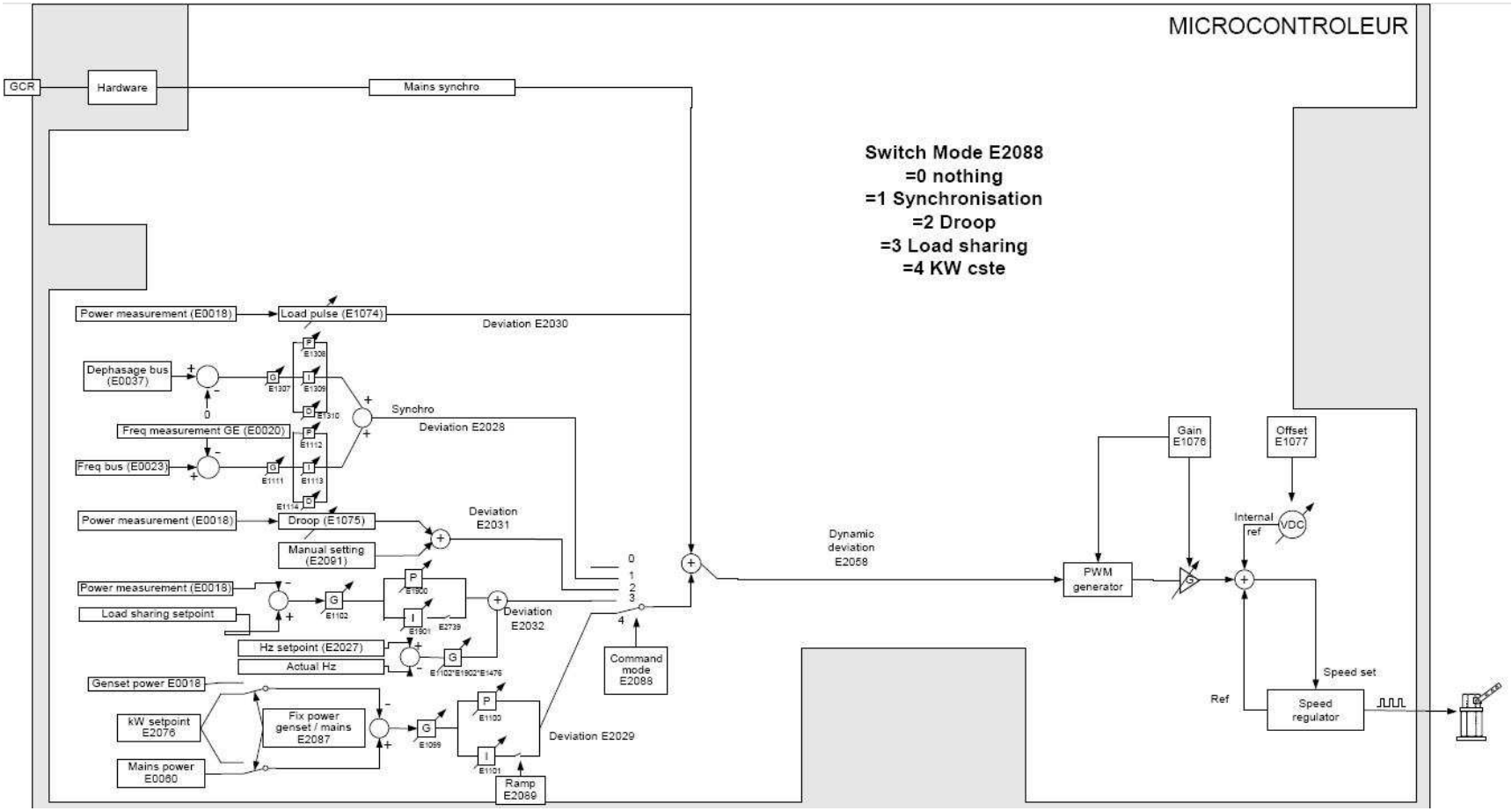


Figure 54 – Speed regulation details

15.1.2 Voltage Regulation details

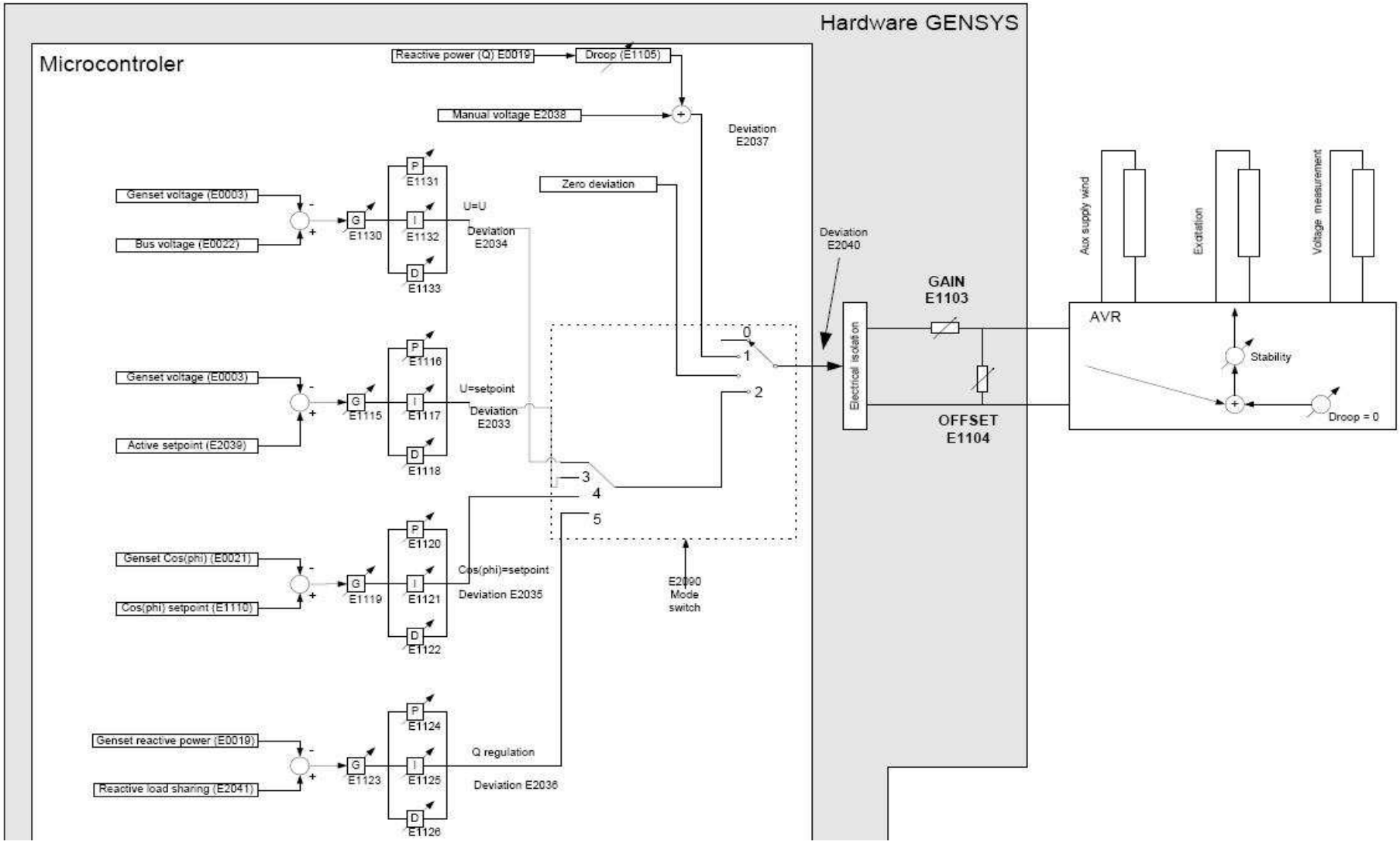


Figure 55 – Voltage regulation details

16 Variables

The list of all MASTER 2.0 variables is an EXCEL Workbook, with all defined parameters, labels, and in all languages. This EXCEL Workbook is downloadable from our website. It contains around 2500 parameters, defined in 5 different languages. This folder also contains a worksheet with a history of all different version of MASTER 2.0 firmware.
This excel file can be found in the folder at this URL:
http://www.cretechnology.com/soft/
Its name is “A53 Z0 9 0030-x Variables.xls”, with x being the current version number. The first version is A, next B … Z, AA, AB...ZZ

17 Precautions

Change over and paralleling with mains:
For safety reasons, breakers must be equipped with an independent paralleling safety relay to prevent failure of the automatic sequence, as shown in Figure 56 - Several generators warning and Figure 57 - One generator with mains warning.

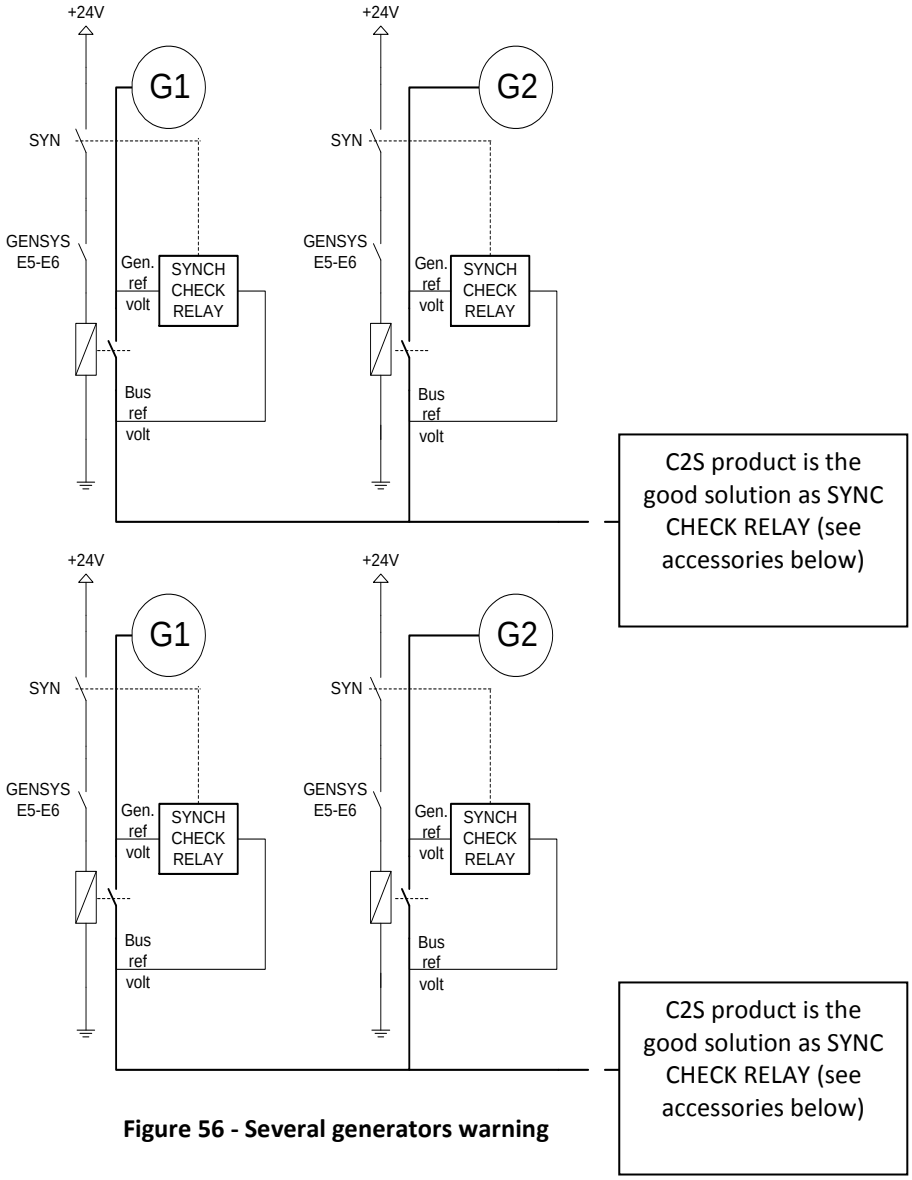


Figure 56 - Several generators warning

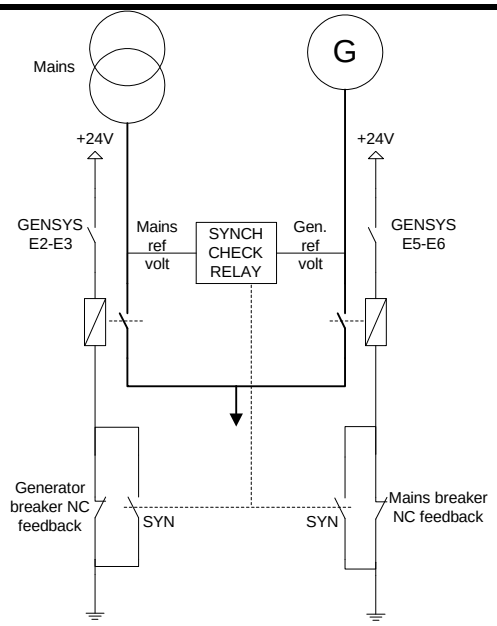


Figure 57 - One generator with mains warning

Warning:
When you use the virtual digital input in this way: "Generator electrical fault", "Mains electrical Fault", "External alarm", "External fault (Soft shut down)" or "External security (Hard shut down)", NEVER use the "Normally Open" or "Normally Close" directions but ALWAYS "Normally Open Wired Or" or "Normally Close Wired Or".

Warning:
Manual breaker opening.
When an external security device opens the breaker, the order has to be latched. MASTER 2.0 needs the feedback.

Warning:
When a power plant has several generators, even if only one generator has a GENSYS 2.0, the number of generators (E1147) must be equal or above 2. If it is 1, you may seriously damage your generator.

Warning:
The engine, turbine, or other type of prime mover should be equipped with an over speed (over temperature, or overpressure, where applicable) shutdown device that operates independently from the prime mover control device.

CAUTION:
When a power plant has several generators, each GENSYS 2.0 / MASTER 2.0 must have a different number ("Genset number" variable: E1179). If two have the same number, there is no conflict but there will be some operating problems.

18 References

A54Z Standard product reference.

Full reference follows this format: A54Z0-L00xx with xx depending on factory installed options.
Standard product is A54Z0-L0001.
Consult your dealer for complete reference.

18.1 Options

The following option can be selected and is password activated: contact your dealer for procedure.

OPT8: Transformer phase shift compensation (HV, Dyn11 …)

18.2 Accessories

A53W0 USB/B – MASTER 2.0 to PC cable – 3 m.
A40W8 DB9/DB9 - CAN© inter MASTER 2.0 cable for 2 generators - 7m.
A40W6 DB9/free wires - CAN© inter MASTER 2.0 cable for more than 2 generators or CANopen© I/O modules - 7m.
A40W3 DB9/Terminals connector to be used with more than 2 generators for double connection (with screws).
A40W4 Free wire both sides - Communication cable (RS485, CAN, RS232) - Price per meter. Length on request.
A53X0 Manual MASTER 2.0 test bench.
A24Zx CPA: active power converter (A24Z0 for 100 VAC / 5 A, A24Z1 for 230 VAC / 5 A, A24Z2 for 400 VAC / 5 A, A24Z3 for 100 VAC / 1 A, A24Z4 for 230 VAC / 1 A, A24Z5 for 400 VAC / 1 A).
A61Y1 BSDPlus: remote management box (GPRS, email, SMS …)
A25Z0 C2S is an Auto Synchronizer and Safety Column to control the paralleling of two alternating power sources.

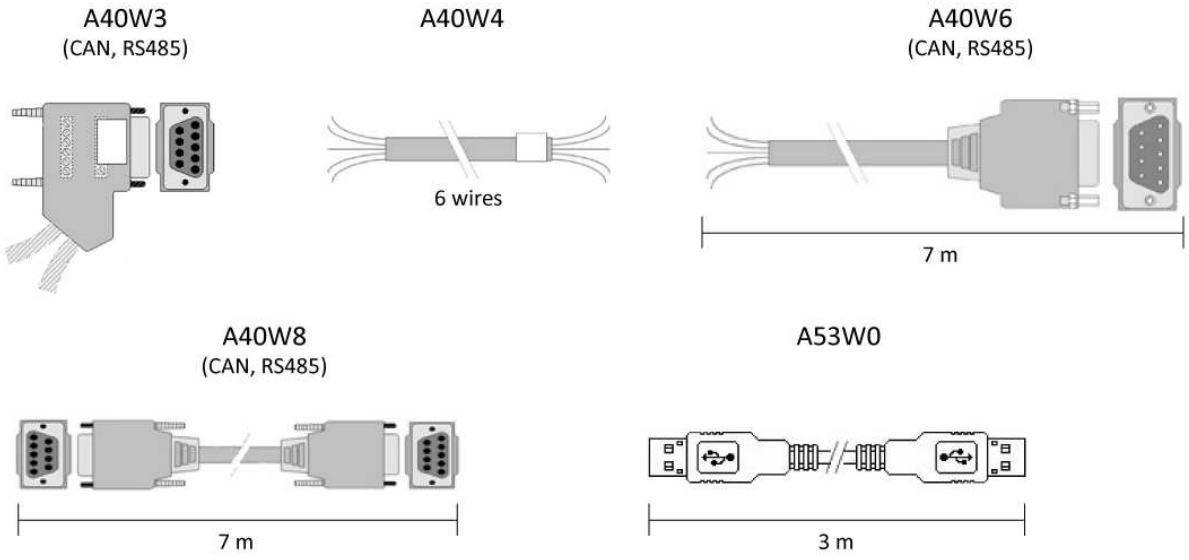


Figure 58 - Standard cables

19 Company Information

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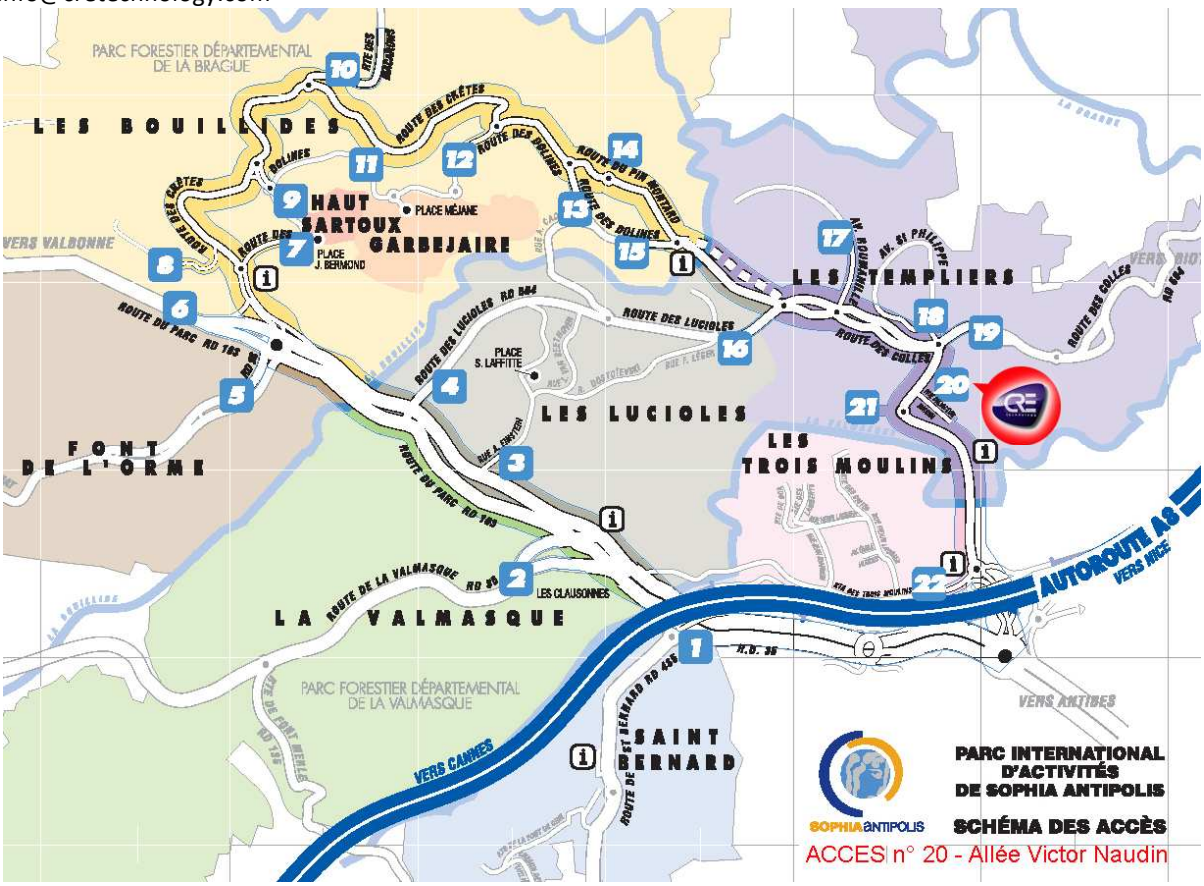

Figure 59 - Access to CRE Technology in Sophia Antipolis.

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