UNIGEN 2.0 ILS

Slave Load Sharing Unit

USER MANUAL – TECHNICAL DOCUMENTATION

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Technical documentation history

Date	Version	Comment
January, 2017	A	Initial edition

Preamble

SETTINGS

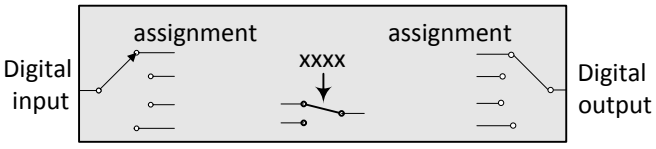
The tables whose header have an **orange**-coloured background describe settings.
Settings (and readings) that show only in CRE Config, but not on the LCD, feature a purple border in the HMI chapter as follows:

Setting	Label	Description
xxxx	xxx	*Can be set in any HMI*
xxxx	xxx	*Can be set only in CRE Config*

The setting content is referred to as [xxxx].

In the illustrations:

- Digital inputs and outputs – whether direct or through CANopen – whose assignment is preset in the CRE Config software application show as follows; the shown position has no meaning.
- Internal toggles preset through software show as switches with two throws. The code xxxx or the name of the setting shows above:



SYMBOLOGY

	Denotes a threshold monitoring
	Denotes a control loop tuning (three coefficients G, P, I)
	Denotes the need to adjust the amplitude and offset (center)

CRE Technology believes that all information provided herein is correct and reliable and reserves the right to update at any time. CRE Technology does not assume any responsibility for its use.
You can download the most up-to-date version of this documentation and different other documentations relating to UNIGEN 2.0 on our web site http://www.cretechnology.com.

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1 PRESENTATION

UNIGEN 2.0 ILS is a panel mounting electronic unit meant for the control of a single, two or three-phase low-voltage generator. It is designed to work as a slave of a PLC unit. UNIGEN 2.0 ILS can be used to control one generator included in a power plant (only load sharing – up to 32 generators).

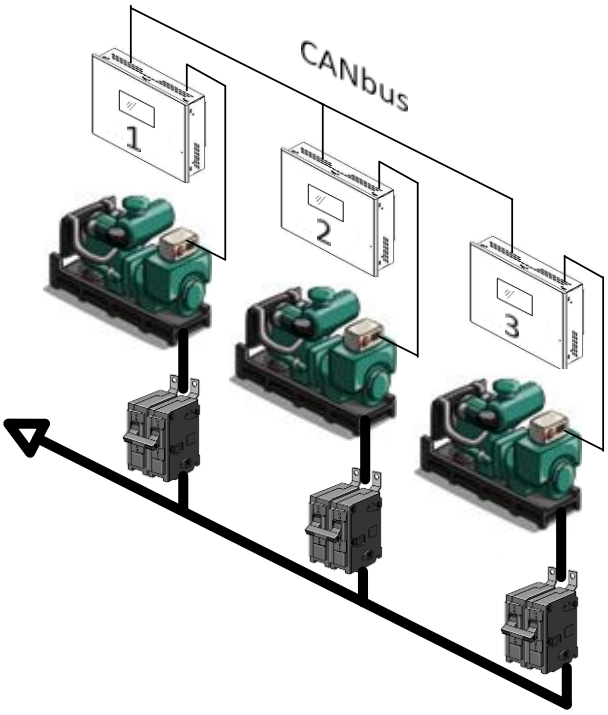
UNIGEN 2.0 capabilities include:

	PMS	ILS	SYNCHRO
Acquisition of the engine speed and the generator AC voltages	x	x	x
Acquisition of the generator AC currents	x	x	
Generator electrical protections	x	x	x
PID control in load sharing mode	x	x	
Control of actuators ; it is compatible with most speed governors (ESG) and AVR regulators	x	x	x
Synchronization before coupling	x		x
Analog inputs for reading resistive sensors	x	x	x
Extension by CANopen units (Wago, Beckhoff, VIPA, etc) : up to 32 extra digital inputs and 32 extra digital outputs	x	x	x
Link to a PLC or a SCADA via Modbus TCP	x	x	x

The engine-generator may have an Electronic Control Unit with CAN J1939 interface. J1939 and CANopen interfaces can coexist – on a second CAN media – provided they use the same bit-rate. According to the settings, the engine speed is measured by a magnetic pick-up or derived from the AC frequency.

Limits on overall active and reactive powers: 65,535 kW and 65,535 kVAR.

In this typical setup, three UNIGEN 2.0 units communicate over a CAN bus to control three generators in parallel:



Heterogeneous aggregate of generators in island mode can be controlled by UNIGEN 2.0 modules. It is preferred that the alternator winding pitches be identical. In any case, all the generators must be controlled by similar UNIGEN 2.0 units.

1.1 GENERATOR AUTOMATIC CONTROL

Two separate cascade control systems are used:

	Primary control (UNIGEN)	Secondary control
Speed	ESG control	ECU or ESG
Voltage	AVR control	AVR

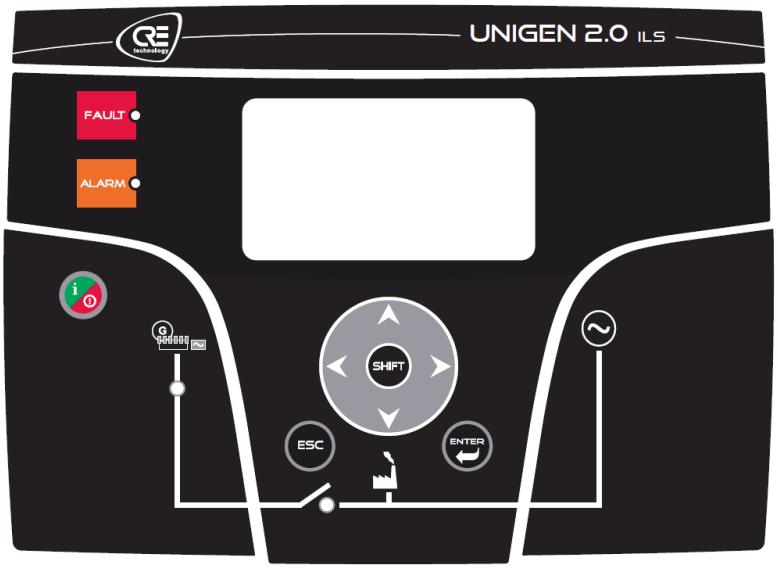
The generated voltages and currents are measured in true RMS and used to calculate the load demand across the aggregate. The load demand drive the primary control which, according to its configuration:

- Produces an analog signal Speed out+, sends pulses “+/- f” to digital outputs or writes to J1939 bus.
- Produces an analog signal AVR out+ or sends pulses “+/- U” to digital outputs.

1.2 HUMAN MACHINE INTERFACE

LCD screen characteristics:

- Size: 40 x 70mm - 1.50 x 2.75in
- Pixels: 64 x 128
- Back light: 50 cd/m2 typical, configurable
- Contrast: configurable
- Type: STN

<table>
<tr><td></td><td colspan="3">Back-lit auto-off LCD</td></tr>
<tr><td>The led blinks after a fault arises.
Acknowledged by pressing the lower button
The led blinks after an alarm arises.
Acknowledged by pressing the lower button
Press to access:
.the Fault page if new fault occurred (Fault blinks)
.the Alarm page if new alarm occurred (Al. blinks)
.pages with 2 statuses (Power and Engine) and 10 readings of special interest.
Press again to return.</td><td colspan="3"> 
</td></tr>
<tr><td></td><td>Led Gen. ready</td><td>Navigation/Edition (see below)</td><td></td></tr>
<tr><td></td><td colspan="2">GeneratorBreaker status led (lit when closed)</td><td></td></tr>
</table>

Keyboard:

Keys	Navigation mode	Edition mode
▲ ▼	Cyclic navigation through menu & settings list	Used to change the value of a setting. Hold down to change faster
◀ ▶	Cyclic navigation through pages when an item is selected in a menu and validated	–
Shift	Used with ▲▼ to in/decrease LCD luminosity Used with ◀ ▶ to adjust LCD contrast	When in manual mode and breaker is open, used with ▲▼ to increase/decrease: ▪ speed command on Speed control page ▪ voltage command on Voltage control page
	Used with to reset alarms and faults	
Esc	Return to parent menu (3 times to home) or preceding menu	Setting change rejection and return to the Navigation mode
Enter	Page opening / switch to Edition mode	Validation of the new setting and return to Navigation mode

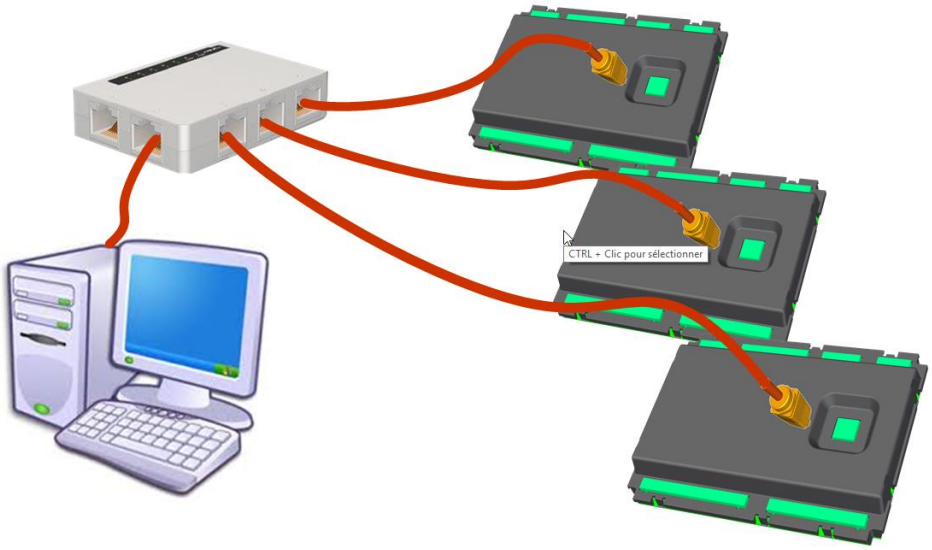
1.3 START AND POWER MANAGEMENT

UNIGEN 2.0 units in an aggregate share information through CAN bus communication. Various start strategies can be implemented to match your needs:

- In **dynamic** paralleling, the generators are **selectively** started and synchronized to the already running units. Then they can be stopped and restarted according to the load demand ("Load-Dependent Start-Stop").
- In **static** paralleling (emergency start), the generators are started **simultaneously** and the warm-up is by-passed.

1.4 SETTING AND SUPERVISION UTILITY

A Windows™ PC with the software application CRE Config 2.70 or later must be connected on the rear Ethernet socket, generally via a switch in a star network:



This allows you to preset all the UNIGEN 2.0 units when they are on desk: a text file that reflects the first UNIGEN 2.0 unit's configuration can serve as a template to deploy the setup to the other UNIGEN 2.0 units in the cluster. The CRE Config multi-tabbed interface makes it easy.

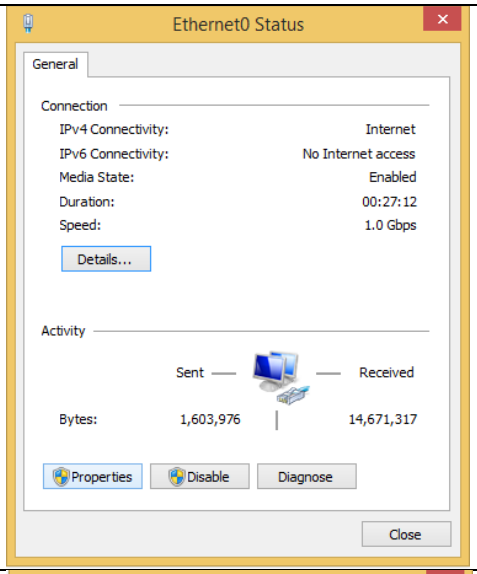
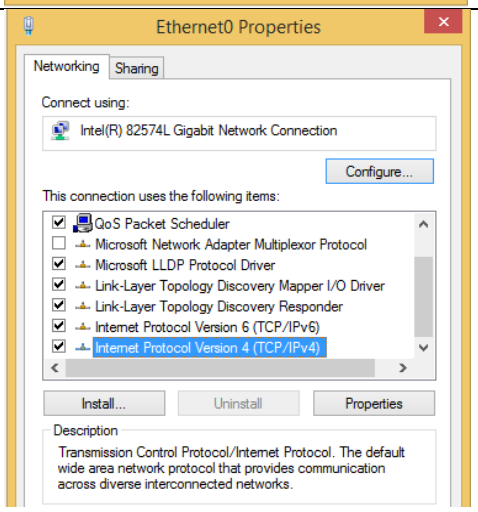
Once all UNIGEN 2.0 units are mounted, CRE Config can be used to set them up and monitor the generators. The CRE Config features a Scada section that can be used in particular as an event console to UNIGEN 2.0:

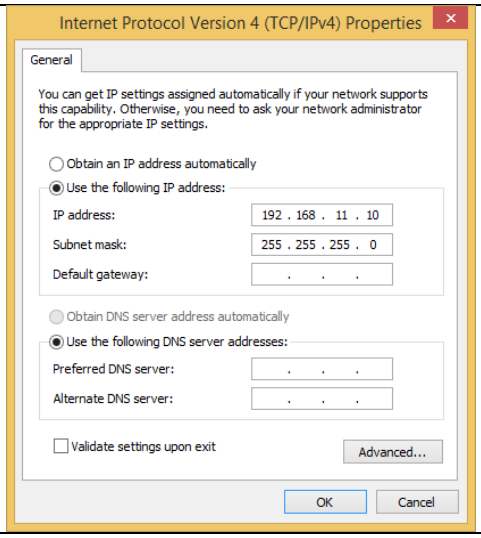
<table>
<tr><th></th><th>UNIGEN 2.0</th><th>CRE Config/Scada</th></tr>
<tr><td>Event console</td><td></td><td>
<table>
<tr><th>Time</th><th>Label</th><th>Variable</th><th>State</th></tr>
<tr><td>0h00</td><td>Breaker fault</td><td>xxxx</td><td>1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Information display</td><td>
<table>
<tr><th>Information</th></tr>
<tr><td>Power</td></tr>
<tr><td>Engine</td></tr>
<tr><td>Prod request 1</td></tr>
<tr><td>Mode AUTO</td></tr>
</table>
</td><td>
<table>
<tr><th>Label</th><th>Variable</th><th>Value</th></tr>
<tr><td>Prod request</td><td>xxxx</td><td>1</td></tr>
<tr><td>Mode</td><td>xxxx</td><td>AUTO</td></tr>
</table>
</td></tr>
<tr><td>Event logger</td><td>→ 2,000
2
1 →</td><td></td></tr>
</table>

2 INSTALLATION

2.1 ON-DESK-ETHERNET SETUP

2.1.1 Setting the PC connection

Connect UNIGEN 2.0 to a PC with a 100Ω Ethernet cord	Direct connection to PC: use a crossover cord. Connection through a switch: use a direct cord; a crossover cord such as 3-m long A53W1 is OK if the switch manages it.
Power up UNIGEN 2.0 using a stabilized power supply	Power supply range: 8…35V_{DC}
Open Windows control panel	
Click: • Local network (Windows XP) • Network and Sharing Center / View status (Windows Vista) • Open Network and Sharing Center/Change adapter settings/(Connection to) LAN/ Properties (Windows 7 & 8)	
Click Parameters (Windows XP) or Properties (Windows Vista or 7 or 8)	

Select TCP/IP or TCP/IP v4, and click Properties	
Enter a PC address that differs from the one of the UNIGEN 2.0 only by the last number, & click OK	Last number: 0 … 255; avoid 0 and 255 as they are often taken for other purposes

2.1.2 Changing the UNIGEN 2.0 IP address

To change UNIGEN 2.0 IP address, in CRE Config (or on LCD), navigate to “System/Network configuration (resp. About)”.
UNIGEN 2.0 supports the DHCP function: in this case, UNIGEN 2.0 must be connected on a network with a DHCP server. During the power-on sequence, UNIGEN 2.0 is assigned an IP address by the DHCP server. If DHCP process fails, the fixed IP address is used (factory setting: 192.168.11.1).

Note: Contact your network administrator to configure your router and module(s) to your needs.

2.1.3 Hostname

You can assign an alias to UNIGEN 2.0, in addition to the IP address; enter it in CRE Config to get connected.
To change this alias, in CRE Config navigate to System/Network configuration.
Maximum length: 16 characters. With Windows, the last character defines the type of service (0 is the usual value).
Allowed characters: reduced ANSI set; "-" and "." are allowed except at the start and end.

2.1.4 Copyright

UNIGEN 2.0 Ethernet communication uses the open source lwIP TCP-IP stack. Read copyright/disclaimer below. More details on lwIP Web site: http://savannah.nongnu.org/projects/lwip/

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2.2 IN-PANEL INSTALLATION

The unit is designed for panel mounting, which provides user with access only to the front panel.

⚠ WARNING
THE UNIT IS NOT GROUNDED
Take all measures against Electronic Static Discharges. Do not try to open the unit.
Failure to follow these instructions may damage the unit

Environmental requirements:

- Operating temperature: -30°C (-22°F) … 70°C (158°F); LCD display slows down a bit under -5°C (23°F). Avoid direct exposure to the sun
- Storage temperature: -40°C (-40°F) … 80°C (176°F)
- Altitude: up to 2,000 m (6,561 ft); on higher altitudes, recommended max. AC voltage : 100VAC

2.2.1 Unpacking

Make sure the packaging contains:

- the unit
- four caps + screws packaged apart
- a delivery bill

Unpack and keep the packaging in event of return.
Make sure the unit does not show scratches or visible defaults. Otherwise describe them on the RMA sheet (downloadable from CRE technology Web site).

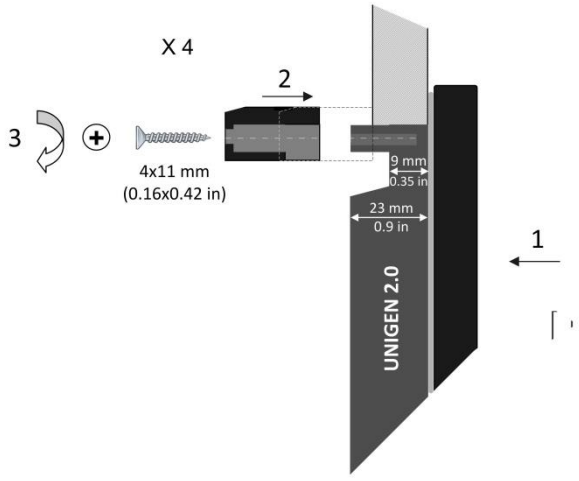
2.2.2 Installation

Preparation

1. Cut out the panel to 220x160 mm minimum (8.7 in x 6.3 in)
2. Make sure the cut-out is smooth and clean

Mounting

0	Tool: cross-head screwdriver size 1
1	Pass the unit through the panel
2	In the rear, cover each of the four spacers with a cap
3	Screw a cap against the panel
4	Repeat on the diagonally opposite spacer
5	Repeat on the other diagonal and tighten equally (do not overtighten)



2.2.3 Wiring the unit

Tool: insulated screwdriver Ø2.5 mm (0.1 in), tightening torque: 0.8 Nm (7 lb-in) max.

Accessories: 4, 5, 6, 8, 15 & 18-terminal cable connectors, protective gloves, carpet if the floor is wet.

⚠ WARNING
THE UNIT IS NOT PROTECTED
Use external fuses: ▪ Bus bar and Generator phases: 100mA/600VAC ▪ Battery positive: 5A/40VDC Install the fuses as near as possible the unit, in a place easily accessible to the user. The disconnection device must NOT be fitted in a flexible cord.
Failure to follow these instructions may damage the unit

⚠ DANGER	
	HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH ▪ The unit must only be installed and serviced by qualified electrical personnel ▪ Apply appropriate personal protective equipment (PPE) & follow safe electrical work practices ▪ Turn off power before installing or removing fuses, and before installing the unit ▪ Use a properly rated voltage sensing device to confirm the power is off ▪ Do not use renewable link fuses in fused switch
	Failure to follow these instructions will result in death or serious injury

General procedure

1. Make sure the cable connectors are NOT plugged
2. Take on protective gloves
3. Connect the wires on each cable connector in accordance with the National Wiring Regulations
4. Plug each cable connector onto the related connector
1. 5. Plug a direct Ethernet cord (RJ45, male-male, 100 m max., 100Ω; a crossover cable such as 3-m long A53W1 is OK if the switch manages it or if the link to PC is direct) and lock the rear door.

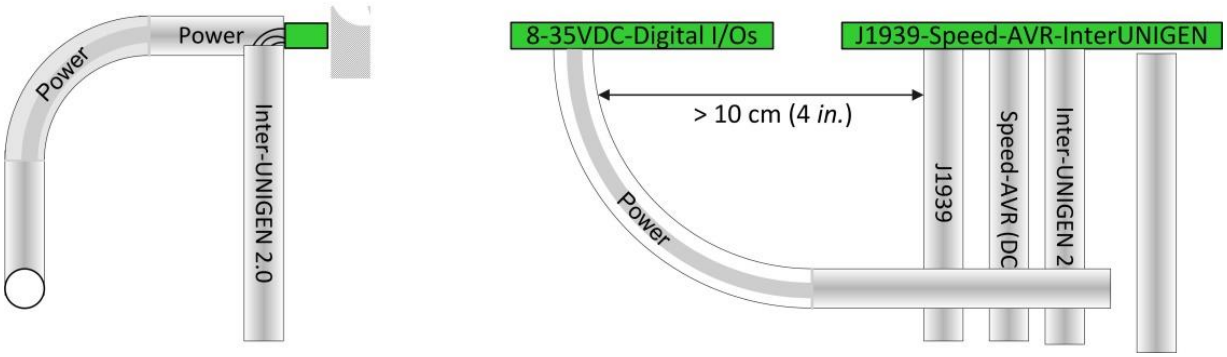
Recommandations

Wires section: 2.5 mm² (AWG13).

To avoid ElectroMagnetic Interferences, shield cables appropriately; for CAN bus, see the Appendix CAN bus Good practices.

Segregation: keep power cables separate from the CAN bus cables. The latter can be installed in the same duct as the low level DC I/O wires (under 10V).

If power & communication cables have to cross each other, do it at right angles to avoid crosstalk:



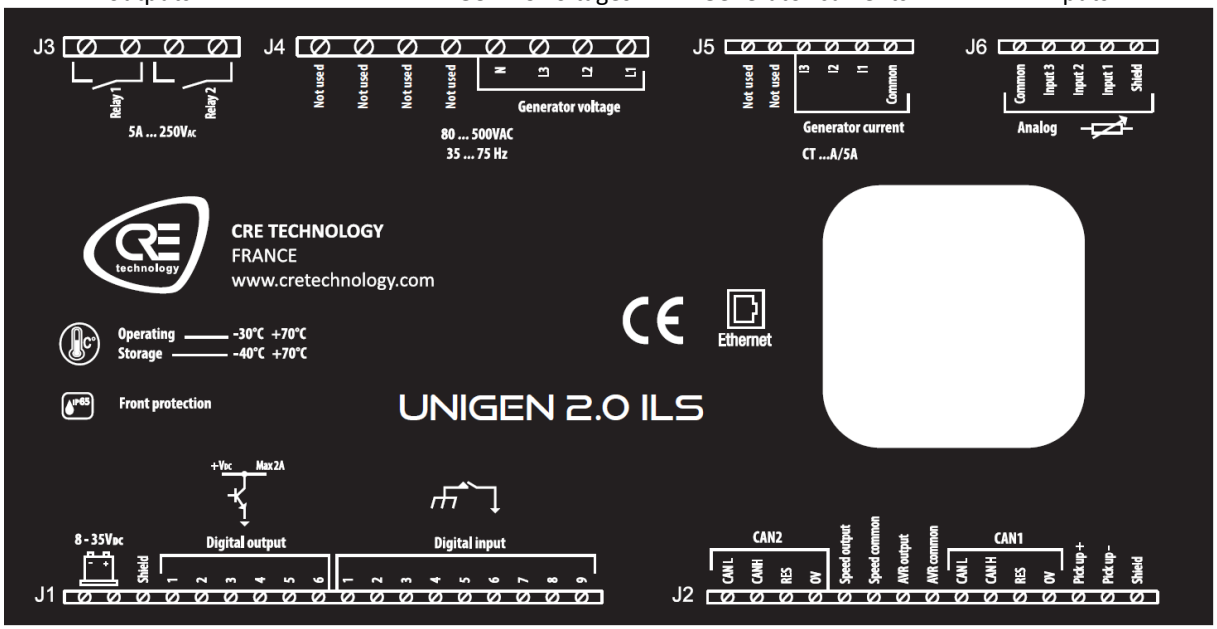
Overview

Relay outputs

Gen AC voltages

Generator currents

Analog inputs



8-35V_{DC} / Digital outputs / Digital inputs

CAN2

Speed / AVR output

CAN1

Pick-up

Upper blocks

⚠ DANGER
EXPOSED TERMINALS
Do not touch terminals L1, L2, L3 nor use non-insulated tools near them. These terminals are unprotected and will expose the user to dangerous voltages
Failure to follow this instruction will result in death, serious injury or equipment damage

Block and mark	Description	Note
Breaker commands		Normally open. Breaking capacity: 5A, 240VAC
Relay 1	Relay 1 +	
	Relay 1 -	
Relay 2	Relay 2 +	
	Relay 2 -	
AC voltages		100-480VAC, measure range: 35 … 75Hz, 100mA max; accuracy: 1%
N	Generator N	Option
L3	Generator L3	These lines must be protected externally with 100mA/600V_{AC} fuses. 1VA (Phase-to-neutral)
L2	Generator L2	
L1	Generator L1	
CT inputs		These lines must be protected externally against short circuits
Gencurrent I3	Generator I3	0… 5A. Maximum rating: 15A during 10s. Burden: 1VA. Keep the lead length short to preserve accuracy (up to 0.5% full scale deviation) External CT max ratio is 3250 (i.e. 3250:1 or, preferably, 16250:5).
Gencurrent I2	Generator I2	
Gencurrent I1	Generator I1	
Gencommon	GND	Optionally connected to CT –. For a 2-CT setup, see further
Analog inputs		0-500Ω
Common		Connect it to Battery –
Input 3	Free input	
Input 2	Free input	
Input 1	Free input	
Shield	GND	Ground plane

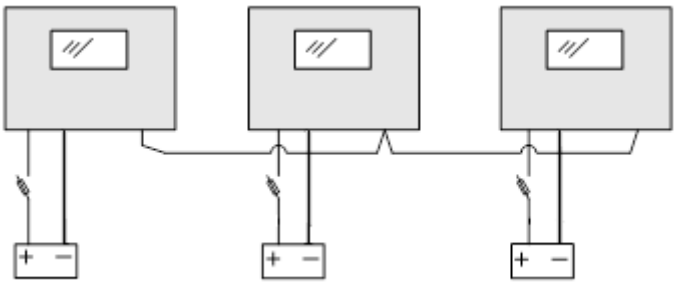
Lower blocks

⚠ WARNING

RISK OF EQUIPMENT DAMAGE

As a protection against polarity reversal, install a 6A fuse between Battery positive lug & terminal 8-35V_{DC} +.
Connect battery negative to GENSYS terminal 8-35V_{DC}– with 2.5 mm² (AWG13) cable.

Failure to follow this instruction can damage the controller



Block and Mark	Description	Note
8-35V_{DC}		**NOT protected against polarity reversal**
-	Power supply -	2.5mm² (AWG13)
+	Power supply +	8…35V_{DC}, consumed current: 130 mA at 24V (standby & operation)
Shield	GND	Generator chassis
Digital outputs		Free solid state output. State 1 at the supply voltage (max: 1.8A). Protected against short circuits. A reactive load is supported. Not isolated from power.
1	Free ouputs	
2		
3		
4		
5		
6		
Digital inputs		Free digital input with 10kΩ pull-up. Accepts NO or NC contact to 0V. Not isolated from power.
1	GE breaker feedback	
2	Other free inputs	
3		
4		
5		
6		
7		
8		
9		
CAN2: J1939-Extensions		Isolated CAN bus J1939/CANopen. Twisted pair. See *CAN appendix*
	CAN L	Blue wire
	CAN H	White wire
	Resistor –	Strap to CAN H when inner resistor must be inserted (bus ends)
Shield	0V	Connect the cable shield herein
Speed		Compatible with most speed governors. Isolated from power
Out	Speed output	±10V analog output to speed governor

Block and Mark	Description	Note
common	Speed reference	Twisted pair; length < 5m (16ft) if unshielded, < 50m max if shielded
AVR		Compatible with most regulators. Isolated from power
Out	AVR output +	Analog output ±10V
common	AVR output –	Twisted pair; length < 5m (16ft) if unshielded, < 50m max if shielded
CAN1: Inter UNIGEN		Isolated CAN© bus, use twisted pair. Refer to the *CAN appendix*
	CAN L	White wire with a blue strip (when using a CRE cable)
	CAN H	Blue wire with a white strip (when using a CRE cable)
	Resistor –	Strap to CAN H when inner resistor must be inserted (bus ends)
Shield	0V	Connect the cable shield herein
Pickup		100Hz to 10kHz. Voltage limits between + and –: 2-40V_{AC} Speed measurement. Better option than alternator voltage.
	Pickup + Pickup –	

⚠ WARNING
RISK OF EQUIPMENT DAMAGE
Switch off the unit before plugging or unplugging the CAN bus connector or disconnecting wires
Failure to follow this instruction can damage the CAN transmitter/receiver

Note: Crank dropout: the unit survives for 70 ms at 24V, and 20ms at 12V.

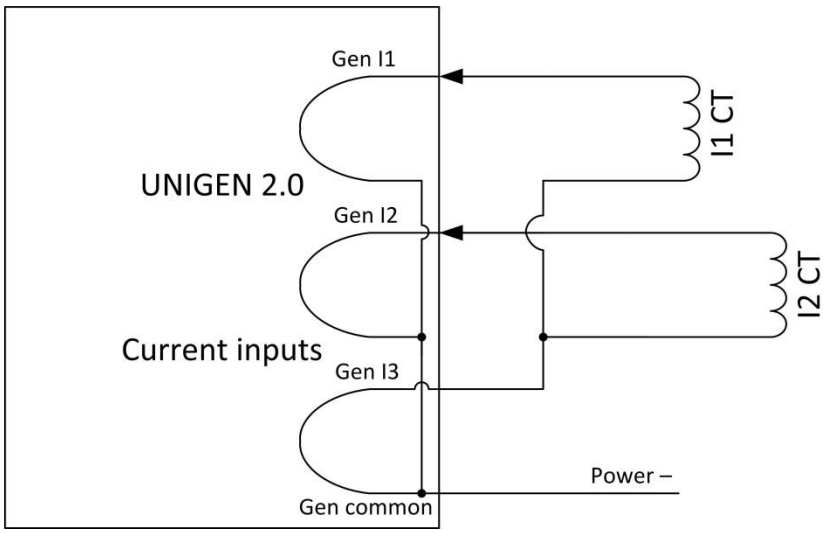
Other systems of voltage

If Biphase 180° is selected in CRE Config, connect voltages and currents to terminals L1-L3 (and N), resp. I1-I3 (and common).

If Monophase is selected, connect voltages and currents to the terminals L1-N, resp. I1 and common.

Current measurement by only two CTs

The 3-phase system must be balanced; therefore I3= – I1 –I2 and only two identical CTs are required:



This is used in middle-high voltage applications. The I3 value is less accurate.

2.2.4 Connection diagrams

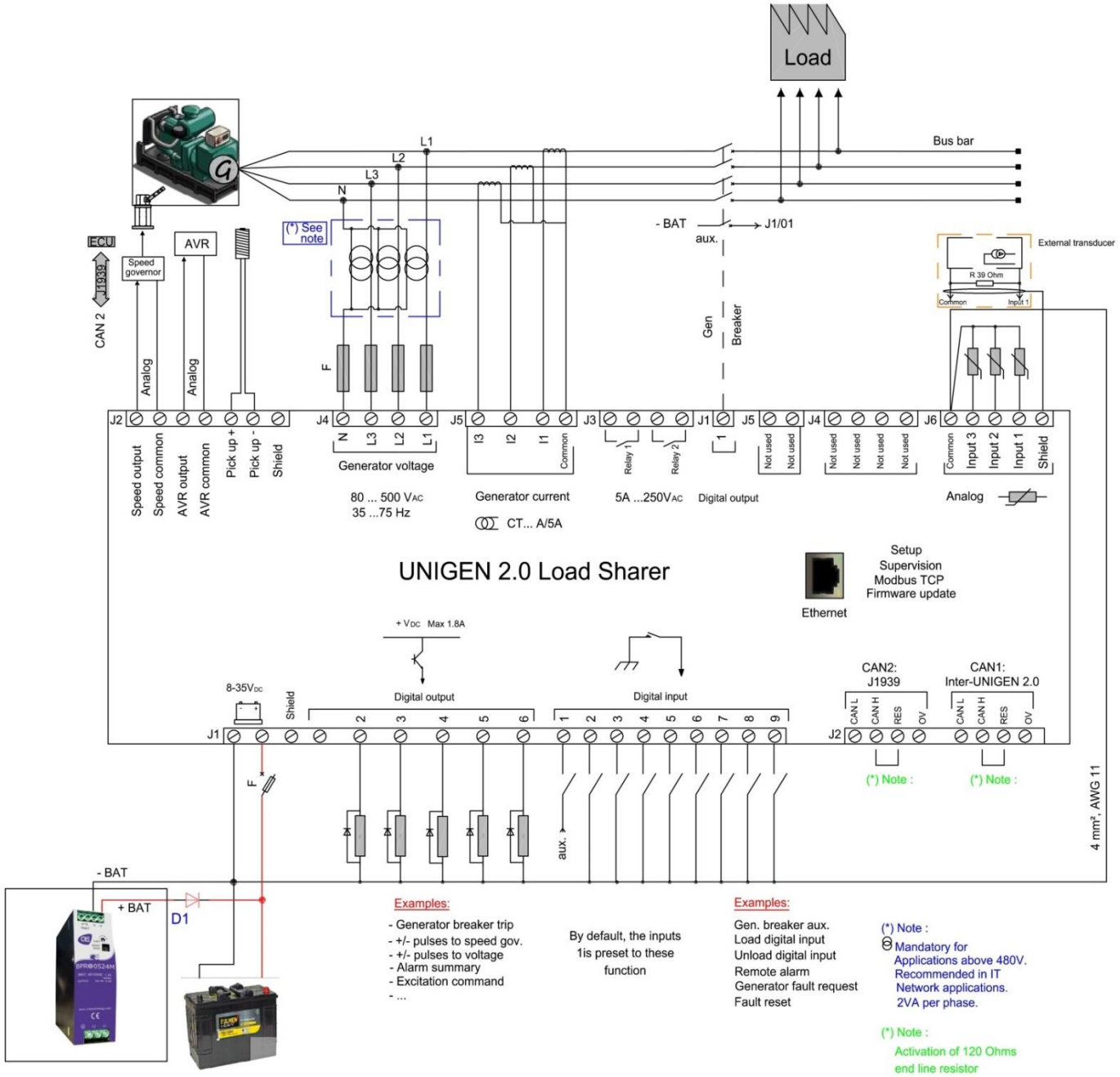
These diagrams show that the Potential Transformers can be connected in various ways:

- Star (wye) on generator side (1 insulated high-voltage terminal per PT) ; the ratio is for example

$$\frac{\text{Unom}/\sqrt{3}}{100/\sqrt{3}}$$

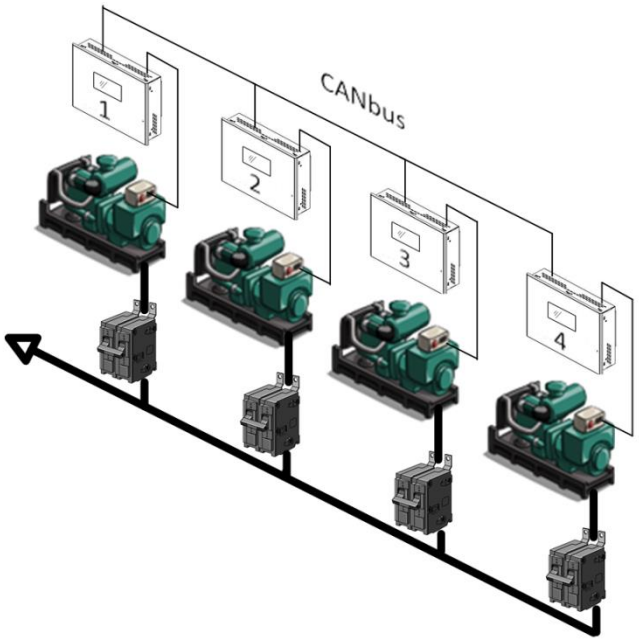
- Vee on bus side (2 insulated high-voltage terminals per PT) ; the ratio is for example

$$\frac{\text{Unom}}{100}$$


Load
Bus bar
L1
L2
L3
N
(*) See note
- BAT
J1/01
aux.
ECU
CAN 2
J1939
Speed governor
AVR
Analog
Analog
F
Gen
Breaker
External transducer
R 39 Ohm
Common
Input 1
J2
J4
J5
J3
J1
J5
J4
J6
Speed output
Speed common
AVR output
AVR common
Pick up +
Pick up -
Shield
N
L3
L2
L1
Generator voltage
80 ... 500 VAC
35 ...75 Hz
I3
I2
I1
Common
Generator current
CT... A/5A
Relay 1
Relay 2
5A ...250VAC
Digital output
1
Not used
Not used
Not used
Not used
Not used
Not used
Common
Input 3
Input 2
Input 1
Shield
Analog
UNIGEN 2.0 Load Sharer
Ethernet
Setup
Supervision
Modbus TCP
Firmware update
+ VDC Max 1.8A
8-35VDC
Shield
Digital output
Digital input
J1
2
3
4
5
6
1
2
3
4
5
6
7
8
9
CAN2:
J1939
CAN1:
Inter-UNIGEN 2.0
CAN L
CAN H
RES
0V
CAN L
CAN H
RES
0V
J2
(*) Note :
(*) Note :
4 mm², AWG 11
F
aux.
- BAT
+ BAT
D1
Examples:
- Generator breaker trip
- +/- pulses to speed gov.
- +/- pulses to voltage
- Alarm summary
- Excitation command
- ...
By default, the inputs 1is preset to these function
Examples:
Gen. breaker aux.
Load digital input
Unload digital input
Remote alarm
Generator fault request
Fault reset
(*) Note :
Mandatory for Applications above 480V. Recommended in IT Network applications. 2VA per phase.
(*) Note :
Activation of 120 Ohms end line resistor

3 APPLICATIONS

Each generator in the aggregate is controlled by a dedicated UNIGEN 2.0 PMS unit. All UNIGEN 2.0 PMS units are CAN-connected. A typical configuration for paralleling is the following:

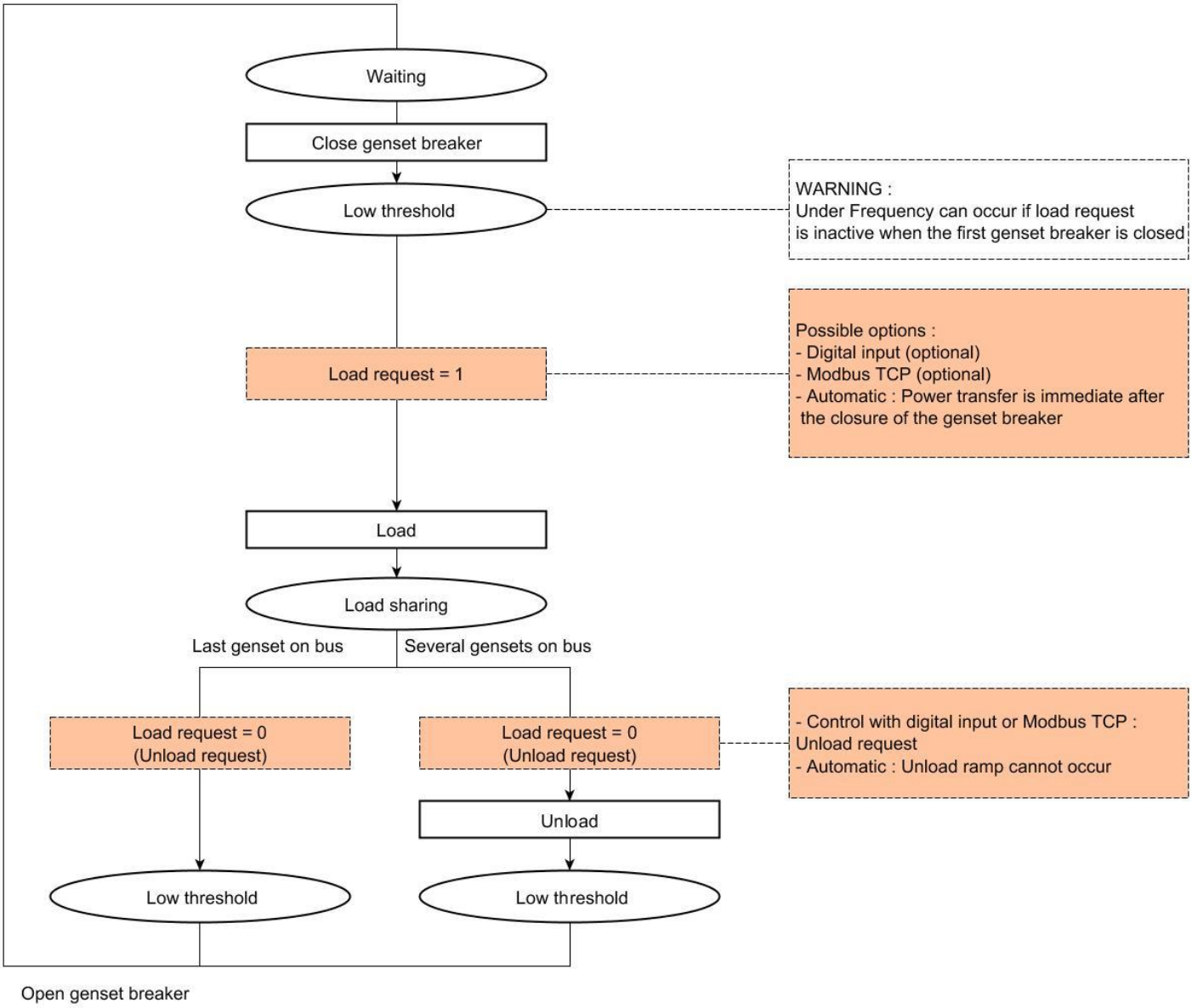


Starting from the default settings, just enter the installation specification :

Setting	Label	Value
2000	Count of gen.	1 ≤ N ≤ 32
2001	GE Number	1 to 32 (differs for each UNIGEN 2.0 on the CAN bus)

Setting	Label	Value
2050	Paralleling mode	**Unused [0]**, Static [1]

Digital inputs
<u>Mandatory</u> • Generator breaker feedback <u>Optional</u> • Load request



3.1 FIRST START

Each UNIGEN 2.0 ILS is waiting before the closure of the breaker. Breaker can be closed in two ways :

1. Using slip frequency
2. Using a synchro unit

The steps which follow the closure of the breaker are :

1. A load ramp for soft transfer (except the first prime mover on the bus bar)
2. A load sharing (kW/kVAR) according to the percent of load of each generator
3. If [2850] = 1, 2 ou 3, An election based on load demand (See 3.2.3)

Note : If a digital input (or modbus TCP variable) « Load request » is configured to control load and unload ramps, it is necessary to set this digital input to close the breaker of the first prime mover on the bus bar.

Warning : Risk of under-frequency

3.2 POWER MANAGEMENT

3.2.1 Load sharing

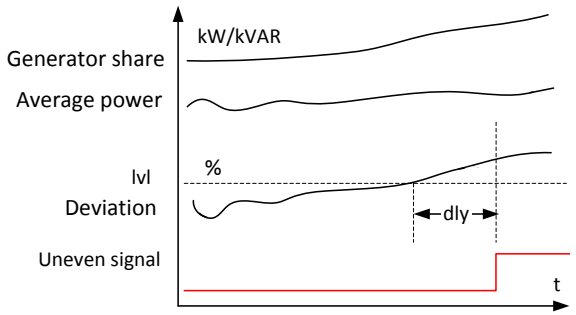
UNIGEN 2.0 is informed of the other generators' loads through the CAN bus; they share the load in proportion to their power rating. This strategy is more reliable and accurate than an analog solution.

The **speed** control is used to share the **active** load. The **AVR** control is used to share the **reactive** load. Various readings are available:

Label	Description
kW GEx	Percent of nominal active power supplied by each generator (variables 400 to 431)
kVAR GEx	Percent of nominal reactive power supplied by each generator (variables 465 to 496)
Nom kW GEx	Nominal active power supplied by each generator (variables 433 to 464)
Nom kVAR GEx	Nominal reactive power supplied by each generator (variables 498 to 529)

The shares taken by the generators are monitored on CRE Config or LCD screen.

Setting	Label	Description
3708	Uneven kW lvl	Threshold (in %) for the generator active power
3709	Unev. kW delay	Delay before raising fault
3711	Unev. kVAR lvl	Threshold (in %) for the generator reactive power
3712	Unev. kVAR dly	Delay before raising fault



The statuses and actions on alarm are as follows (the potential actions are listed in the chapter *Operation/Protections*):

Status	Label	On alarm	Description
4263	Uneven kW	3710	Generator active power is far from the average of all active powers
4264	Uneven kVAR	3713	Generator reactive power is far from the average of all reactive powers

If one generator needs to be set to a fixed setpoint, you can isolate it from the rest of the power plant by withdrawing its UNIGEN 2.0 unit from CAN bus communication, using either method:

- Set the digital input Inhibit Gen [4557 … 4588] to 1
- Change the variable [4557 … 4588] via Modbus TCP

Tuning

Prerequisites:

- Speed out & AVR outputs are scaled to match the generator. See 5.2 and 5.3.
- At least two generators are synchronized.

	Factor	Setting	Label	Default
kW sharing	P	2917	Load sharing P	20
	I	2918	Load sharing I	1
kVAR sharing	P	2959	Share Q P	20
	I	2960	Share Q I	1

Once the setting of synchronization and ramp has been done, you can adjust the load sharing. kW and kVAR share stays within 2% of that power plant average.

Note: The kW/kVAR power plant average in % as well as the kW/kVAR of the genset in % can be visualized on the LCD screen during the configuration of the PID

You can change :

- Proportionnal : to decrease the correction time
- Integral : to decrease load sharing difference

Note: Integral is used only if the frequency/voltage centering is set (See 3.4).

3.2.2 Droop

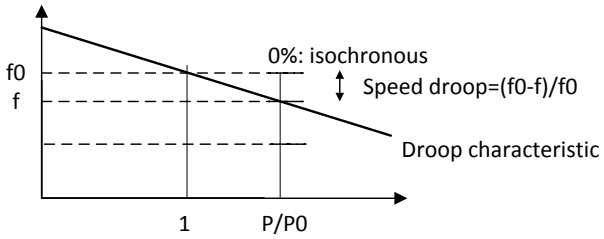
In event of a CAN bus failure, speed droop and voltage droop are allowed to share kW load and kVAR load respectively. As droop is allowed, the control does not use any integral.

Frequency droop

The droop is the allowed relative offset:

Speed Droop = (Rated no-load frequency – Base frequency)/ Rated no-load frequency

In the aggregate the generators were requested to run in proportion to their rated power i.e. with the same P/P0. As they are set with the same droop, they share the same droop characteristic. As the load demand increases, they respond to the fall in frequency by increasing their active power outputs simultaneously. The increase in the active power output counteracts the reduction in frequency. Thus they do not fight one another to control the load (no "hunting").



Voltage droop uses voltage in place of frequency

The droops are set in the UNIGEN 2.0 units, not in the ESGs/AVRs:

If 3052 is set to 8 or 9 on all the UNIGEN 2.0 units, all the generators fall back to speed and voltage droops. It matters that all the UNIGEN 2.0 units be set to the same relative deviations 2204 and 2250.

Setting	Label	Description
2204	Speed droop	% for active load sharing. Default value: 2%
2250	Voltage droop	% for reactive load sharing. Default value: 2%
3052	CAN bus fault	8 or 9

AVERTISSEMENT

Follow strictly, throughout the aggregate, the scaling procedures (amplitude -offset) of chapter 5.2 & 5.3 in order to have the best load sharing in droop

3.2.3 Load-dependant start/stop

Introduction

This function selectively phases the start and stop of the generators in an aggregate according to the current load. This prevents overload (you are advised to run generators between 70 and 85%). The CAN bus makes it possible to share load information & coordinate the actions.

Conditions required by automatic start/stop:

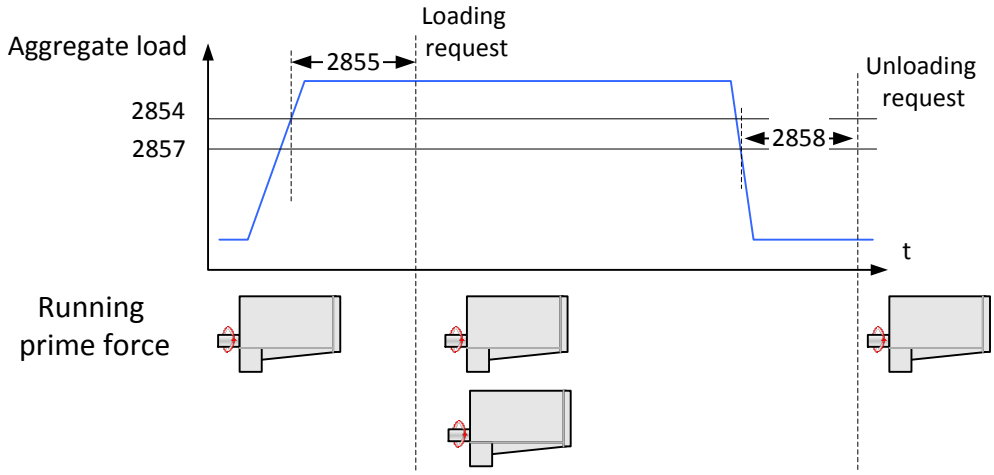
- « Load request » must be configured as « Digital input » or « Modbus TCP »
- The digital output « Start request » must be connected to start the engine
- At least 2 generators must be equipped with a UNIGEN 2.0 unit, all with identical LDSS settings
- **Optional** : Using advanced mode of CRE Config software, the digital input « UNIGEN Activation » can be set or not on each generator to be started if an overload occurs on already running generators. By default, all generators can be started if an overload occurs.

Dedicated settings are found in CRE Config/Configuration/Power management system/LDSS.

Principle

Each UNIGEN 2.0 unit is susceptible:

- To start its generator if the aggregate threshold 2854 has been exceeded during [2855]
- To stop its generator if the aggregate is under the threshold 2857 during [2858]:



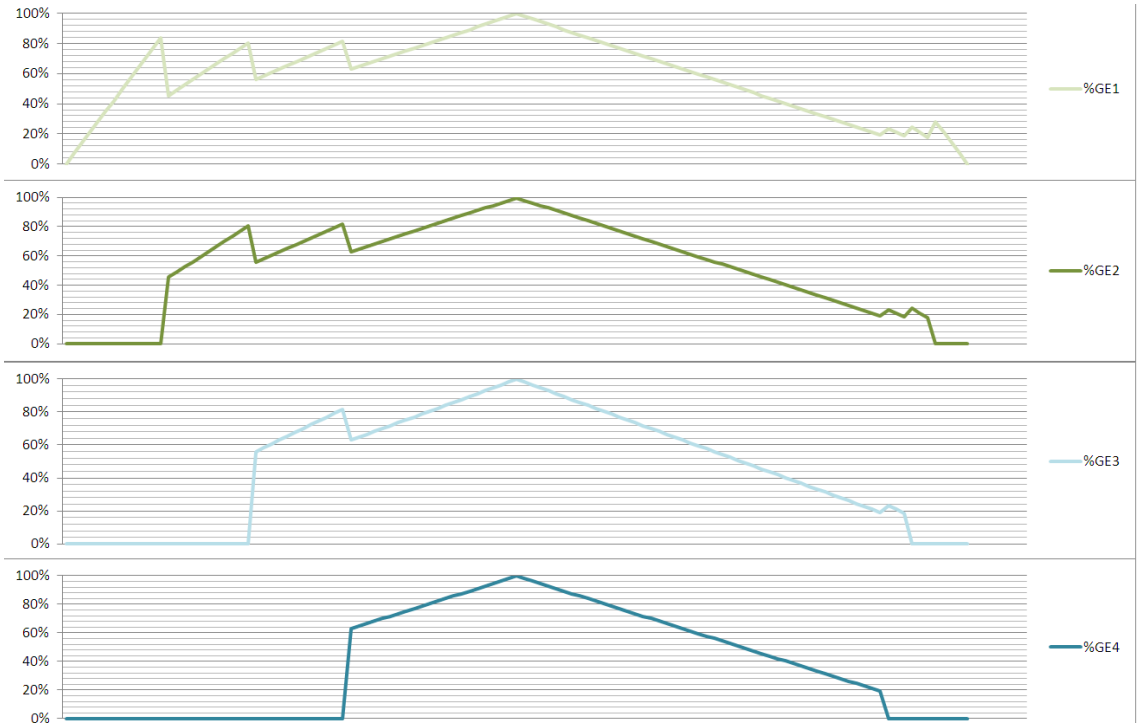
Paramètres de la centrale:

Parameter	Label	Existing values	Description
2850	Load/Unl. mode	[0] Inhibited	No automatic start/stop of generators according to the aggregate load
		[1] GE number	Generators start/stop according to the Generator number
		[2] Hours run	Generators start/stop according to the UNIGEN running hour meter
		[3] By custom	Generators start/stop according to my priority number [2863] (1 … 32)
2854	LV Load thres	Default: 80%	Percent of load on the aggregate above which another generator is requested to start and share the load
2857	LV Unload	Default: 20%	Percent of load on the aggregate under which a generator is stopped
2855	TM before load	Default: 10.0s	Delay with power above threshold 2854 before UNIGEN 2.0 requests another generator to start and share load
2858	TM before	Default: 10.0s	Delay before deciding to reduce the count of running

	unload		generators in load/unload management

Note: Preset values for Load-dependant start/stop can be loaded using the CRE Config software. Click on *and choose file « ILS_Load_dependant_start_stop.txt ».*

Example:
A 4x100kW aggregate with a load that increases linearly from 0 to 400kW, then decreases to 0kW. Start threshold 2854 is set to 80% & the stop threshold 2857 is set to 20%.
Generator #1 is permanently running. When load increases above the start threshold, generator #2 starts to supplement generator #1, then generator #3 & generator #4 start. As the load decreases, the generators are phased out in the order 4, 3, 2.



Start-stop by generator number

If this way is selected on all UNIGEN 2.0 units in the power plant, the automatic start/stop phasing is based on the generator numbers, set in CRE Config/Configuration/Power [2001]:

1. The generator with the smallest number will start first and run onwards forcefully
2. On increasing load demand, the next starts are ruled by the generator number
3. On decreasing load demand, the generators are phased out in the reverse order.

Start-stop by running hours

In this way, the generator to start/stop is automatically selected according to the UNIGEN 2.0 running hour meter:

- On increasing load demand, the next generator to start is the one with fewest running hours
- On decreasing load demand, the next generator to stop is the one with most running hours

Note: If a generator starts and goes past the hours run by a generator which is stopped, the first one does not immediately stop and the second one does not immediately start. Coordination between generators is activated only on a load/unload request, i.e. in the next start/stop on-load request on the CAN bus.

Start-stop by generator priority number

If this way is selected on all UNIGEN 2.0 units in the power plant, the automatic start/stop phasing is based on the generator **priority** numbers, set in CRE Config/Configuration/Power manag system/LDSS [2863]:

1. The generator with the smallest number will start first and run onwards forcefully
2. On increasing load demand, the next starts are ruled by the generator priority number
3. On decreasing load demand, the generators are phased out in the reverse order.

3.3 LOADING AND UNLOADING RAMP

3.3.1 Configuration

After the closure of the breaker, UNIGEN 2.0 ramps up the generator load (soft transfer) to avoid overload or an abrupt load kick (hard transfer).

Note: The digital input « Load request » can be used for staying at low limit, after the synchronization and before the opening of the breaker at the end.

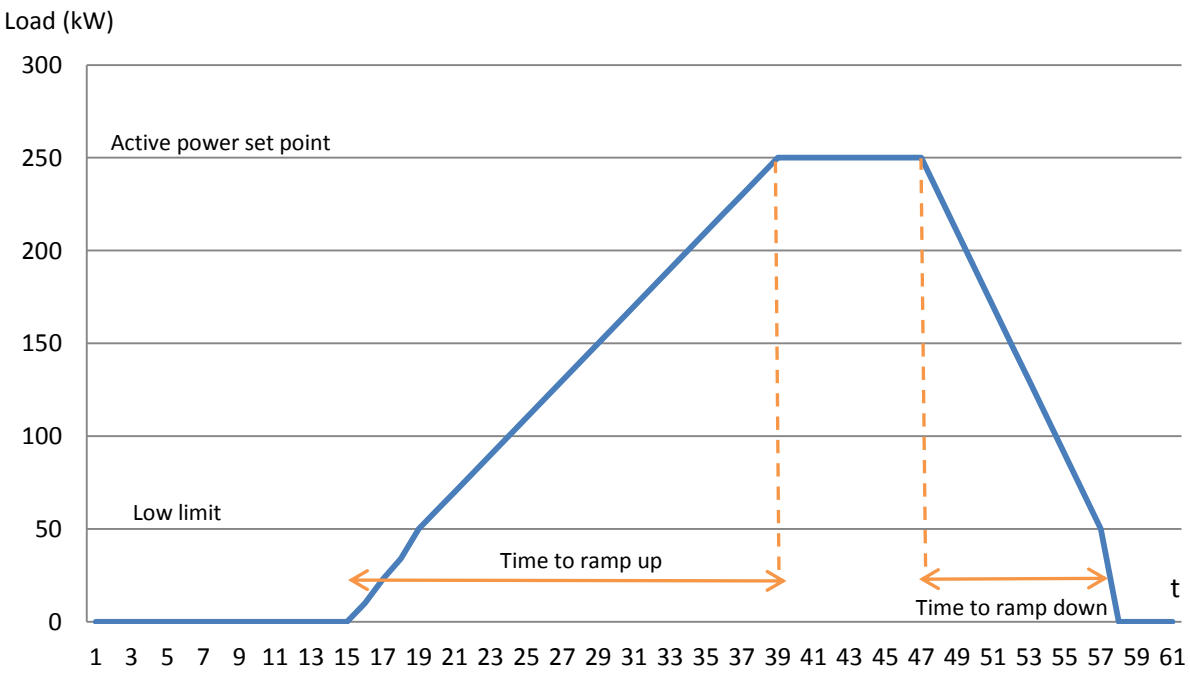
UNIGEN 2.0 calculates the average active power from the information conveyed by the Inter-UNIGEN 2.0 CAN bus. Then it starts a load ramp to reach progressively this value (kW regulation). During ramp, UNIGEN 2.0 keeps a constant power factor, set by the bus power factor before closing generator breaker, in order to do a reactive power ramp.

In the same way, when UNIGEN 2.0 must stop, an unload ramp is done.

Various settings are used in ramping up/down:

Setting	Label	Default	Description	Example
2851	Generator low limit	10kW	Wattage lower limit	50kW
2853	Loading ramp time	10.0s	Time to ramp up power from 0 to nominal power	50s (slope: 10kW/s)
2856	Unloading ramp time	10.0s	Time to ramp down power from nominal power to 0	22s (slope: 23kW/s)

Example: Nominal power = 500kW



Before isolating and stopping a generator, its UNIGEN 2.0 unit decreases its load from the current value to the low limit.

3.3.2 Tuning

Prerequisite: Speed out and AVR outputs are scaled to match the generator. See 5.2 et 5.3.
If the generator is in reverse power or does not take enough load, adjust P in menu "Configuration/ control loop /Ramp kW or kVAR" (0 … 200%).

Setting	Label	Description	Default
2913	Ramp kW P	Proportional of kW ramp	100
2967	Ramp kVAR P	Proportional of kVAR ramp	100

Notes: You can monitor both kW/kVAR setpoints and measurements during the ramp. Integral is not used during ramps.

3.4 AUTOMATIC FREQUENCY/VOLTAGE CENTERING

3.4.1 Use cases

The secondary regulations (ESG and AVR) might drift, e.g. due to thermal variations.
To counteract these effects, a strategy called frequency centering is applied by default in the aggregate.
The same applies to voltage; the voltage centering can counteract a voltage drift.
When it is used to counteract the droop created by the ESG/AVR, this strategy is called "de-drooping".

3.4.2 Settings

Associated parameters are listed in the table below :

Setting	Label	Description	Default
2927	Hz center act	Activation	1
2926	Hz center gain	Central frequency gain of lead UNIGEN	1
2970	U center act	Activation of central voltage	1

Procedure:

1. Start the engine and adjust the generator speed to get 49Hz by tuning the speed governor offset
2. Close the breaker on a dead bus bar, the frequency must return to 50Hz within 5s
3. Adjust the Hz centering gain [2926] to adjust recovery time if needed
4. Adjust the generator speed to get 50Hz by tuning the speed governor offset
5. Repeat the steps for all generators

Note: load sharing integral is used only if the frequency/voltage centering is set.

3.4.3 Functioning

Using the CAN bus, the aggregate elects a leader among the generators on bus bar. The centering is applied only to the leader and requires no extra communications whether digital or analog.

For information, the leader number is indicated in [357] variable.

The centering is a slight proportional correction that slowly brings back the frequency and voltage to their nominal value. As a result, the leader takes more of the load. Through the load sharing loop of the other generators, the load balance is regained.

If the default tuning cannot counteract the drift, hone the tuning.

3.5 START BY STATIC PARALLELING

3.5.1 Use cases

- Starting a full plant with multiple generators in an emergency on dead bus: the generators are ready to take load in the shortest possible time, without warm-up
  Bottom line: full plant availability in less than 10s typically. This meets the NEC700 requirements.

- Installation with a high voltage transformer: as the generator(s) start, the transformer core is magnetized progressively, without peaks (no transient short-circuit).

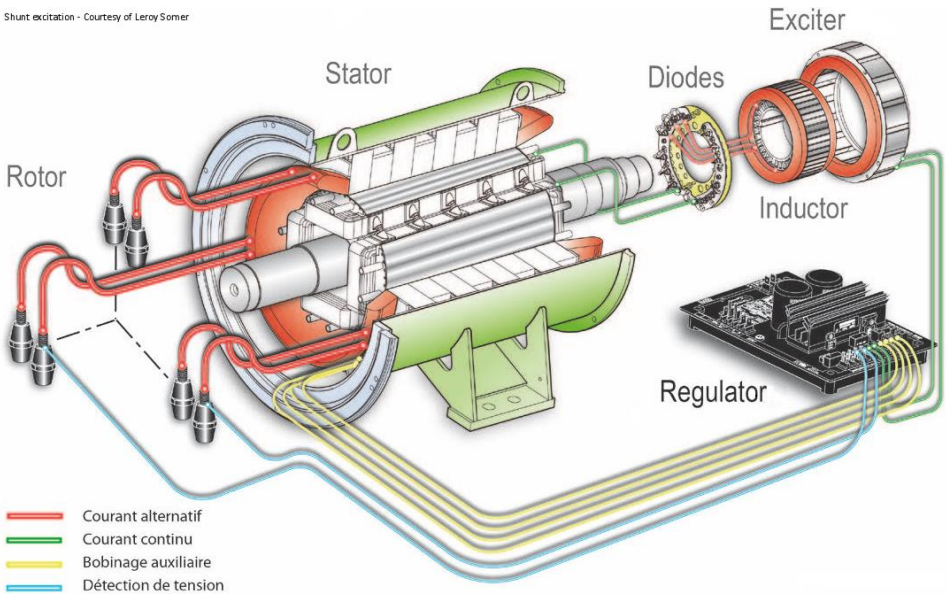
3.5.2 Conditions

On equipment:

- The alternators are identical (in particular, same winding pitch)
- The AVRs are set for static paralleling: they wait for excitation command on their first start
- All breakers must be powered by continuous voltage like $24V_{DC}$ (so as to close before AC is available)

On UNIGEN 2.0:

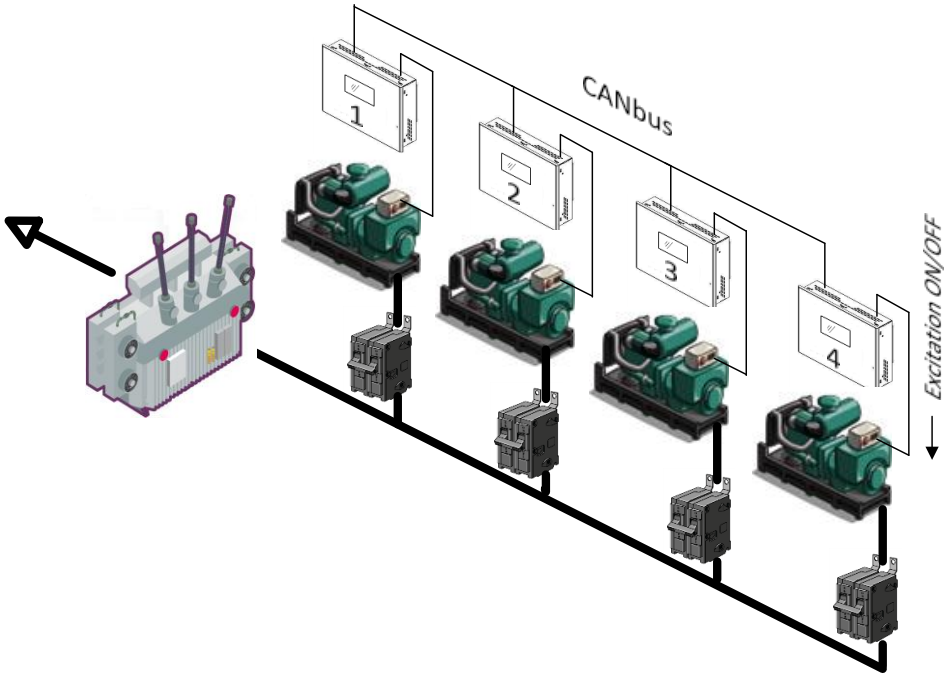
Digital inputs	Digital outputs
<u>Mandatory</u> • Generator breaker feedback <u>Optional</u> • Load request	<u>Mandatory</u> • Excitation command



Setting	Label	Default	Description
2050	Paralleling mode	Dynamic	Set it to static
2200	Speed measure	Pick-up	Necessarily measured by pick-up
2201	Number of teeth	100	To configure
2051	TM max excit	30.0s	Timeout for excitation
2053	Excit. speed	90.0%	Speed low threshold in % of nominal speed before waiting excitation. This threshold must be identical in all UNIGEN 2.0 units
2056	TM Volt stab.	5.0s	Voltage stabilization timer after excitation order before to pronounce as engine ready. This timer must be identical in all UNIGEN 2.0 units. During this stabilization, the units are working in droop mode.

Note: Presets for Static paralleling can be load using the CRE Config software. Click on and choose the file « ILS_Static_paralleling.txt ».

The generators are synchronized together through the CAN bus:



Because UNIGEN 2.0 ILS is a slave module, the closure of the breaker and the start of the engine need to be realized first. Then, all the UNIGEN 2.0 set their excitation command together :

1. Closure of the breakers (not controlled by UNIGEN 2.0)
2. Start of the engines (not controlled by UNIGEN 2.0)
3. The remanent voltage appears
4. Set « Load request » on each generator to be started (Can be set at the beginning)
5. When the speed is sufficient on every generators, CAN bus communication orders all UNIGEN 2.0 units to simultaneously activate their excitation output; as a result:
    - The nominal voltage is reached immediately at the same time on all generators

Note: If the variable « Load request » is configured as automatic, UNIGEN 2.0 will set immediately their digital output « Excitation command » once a sufficient speed is reached.

4 OPERATION

4.1 PROTECTIONS

4.1.1 General

Protections are triggered by internal and external events (alarms, faults, digital inputs, CAN bus loss …). To protect the process, the engine or the alternator, you must associate one of the predefined actions to each such event. These actions or effects are of various kinds:

- they can just raise an alarm; notice shows on the front panel (ANSI30); a summary can be reported
- they can secure the equipment: the breaker trips safe … and can activate a free protective digital output

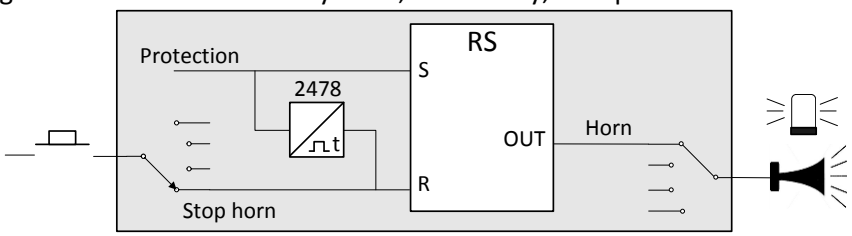
The action is an attribute of the protection: CT settings, or of inter-module CAN bus loss. The Droop effect is reserved to CAN bus fault.

Value	Action	Description
0	Disable (no action)	–
1	Generator electrical fault	The protection opens generator breaker
3	Alarm	Notice as alarm on front panel
8	Droop + Alarm	Only available on CAN bus fault [3052]

The actions are configured in CRE Config. Numerical values show only in text file. See 8.2.

4.1.2 Audio or visual annunciator

To trigger an external annunciator whenever a protection trips, connect it to an output preset to the Horn function; the signal duration is modified by 2478; alternately, an input can be used for remote reset:



Setting	Label	Description
2478	Horn delay	Duration of ring. Default value: 10s. 0 means the horn will buzz until being manually stopped

4.2 POTENTIAL ALARMS/FAULTS CATALOG

The potential alarms/faults are listed below.

- Potential Alarm/Fault: Alarm/Fault label; this text shows in the Alarm/fault pages
- Action on alarm/on fault: this variable allows you to define the associated protection type (3 potential values)

This list can be downloaded from CRE Config/System/PC transmit-receive/Action on alarm/fault".

4.2.1 Generator electrical fault

(All protections trip after a definite time, except Short circuit which trips after an IDMT; see Appendice)

Potential Alarms/Faults	ANSI	Description	On alarm	On fault
Overfrequency	81H	Generator is in over frequency	2402	2438
Underfrequency	81L	Generator is in under frequency	2405	2441
Overvoltage	59	Generator is in over voltage	2408	2444
Undervoltage	27	Generator is in under voltage	2411	2447
Min kW	37P	Generator reached a minimum of kW	2414	2450
Max kW	32P	Generator reached a maximum of kW	2417	2453
-kW	32RP	Generator is in reverse kW	2420	2456
Min kVAR	37Q	Generator reached a minimum of kVAR	2423	2459
Max kVAR	32Q	Generator reached a maximum of kVAR	2426	2462
-kVAR	32RQ	Generator is in reverse kVAR	2429	2465
Max I	50	Generator is in over current	2432 (I>)	2468 (I>>)
Max In	50N	Generator is in over neutral current	2435 (I0>)	2471 (I0>>)
Short circuit	51	Short circuit between generator phases	–	2477
Phase measure	–	Generator voltage measurement is inconsistent with configuration [2003]	2805	–
Uneven kW	90P	See 4.2.1	3710	-
Uneven kVAR	90Q	*ibidem*	3713	–

4.2.2 Engine and battery

Potential Alarms/Faults	Description	On level 1/Min	On level 2/Max
Min battery voltage	Battery voltage under the minimum	2358	2376
Max battery voltage	Battery voltage over the minimum	2361	2379
Sensor lost	Triggered if the speed is 0 and engine has started		

4.2.3 Analog inputs

Potential Alarms/Faults	Description	On level 1/Min	On level 2/Max
AN1 min/max	Activated if measurement of analog input 1 is under/over the threshold	2602	2605
AN2 min/max	Activated if measurement of analog input 2 is under/over the threshold	2610	2613

AN3 min/max	Activated if measurement of analog input 3 is under/over the threshold	2618	2621

4.2.4 Communication

Potential Alarms/Faults	Description	On level 1/Min	On level 2/Max
CAN1 bus fault	Communication problem on the inter-unit CAN (only power plant applications)	3052	–
CAN2 bus fault	A J1939/CANopen bus error is detected on CAN2.	3053	–
CANopen	An alarm is activated to indicate a CANopen communication fault.		

4.2.5 Reset

Clearing of faults/alarms:
- Locally: Shift +
- Remotely: use the “Fault reset” input function

4.3 BREAKER MANAGEMENT

UNIGEN 2.0 ILS does not allow to control directly the breaker. This needs to be done using an external product.

However, the digital output « Generator electrical faults summary » can be used to open the breaker when a protection configured as « Generator electrical fault » occurs.

The digital output « Low limit is reached » set after an unload ramp and can be used to open the breaker with an external module.

5 COMMISSIONING

5.1 INTRODUCTION

Each function produces a speed or voltage deviation based on its own GPI coefficients.
UNIGEN 2.0 feeds the sum of deviations to the output stage either as analog signals (Speed out and AVR out+) or as pulses train or J1939 frames (speed):

[4405] is the sum of all applicable speed deviations due to:

- kW regulation (Load ramp)
- kW sharing
- Frequency centering
- Manual command
- Speed droop (in event of CAN bus loss)

[4411] is the sum of all applicable voltage deviations due to:

- kVAR regulation (Load ramp)
- kVAR sharing
- Voltage centering
- Manual command
- Voltage droop (in event of CAN bus loss)

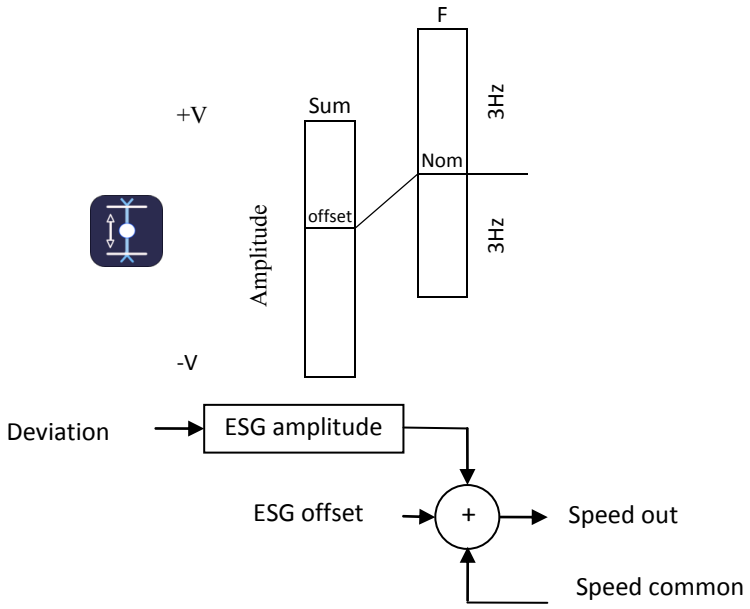
In fact, not all components contribute to the sum at one time; the sequencing is Ramp->Load sharing (+centering), and can be followed with

Reading	Label	Description
4009	Power mode	0: Nothing 2: Droop 3: Load sharing 4: Ramp (very transient)
4010	AVR cont. mode	

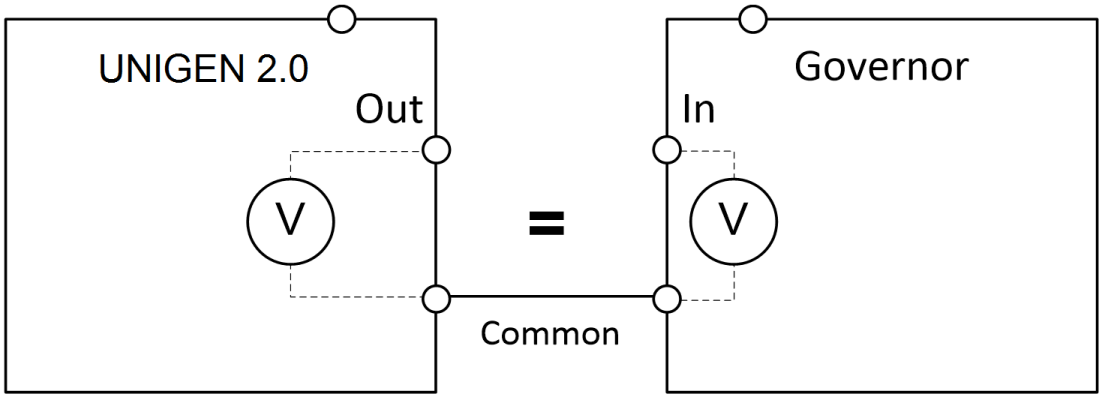
CAUTION
Follow strictly, throughout the aggregate, the scaling procedures (amplitude -offset) to have the best synchronization, load sharing and droop

5.2 ANALOG SPEED GOVERNOR OUTPUT

The Speed output signal provides the set point for ESG, used in active load sharing. It is the sum of the components listed in the section 5.1. The voltage range -10V …+10V must be fitted in amplitude and offset to allow UNIGEN 2.0 to vary the ESG set point on a correct range; the aim is that UNIGEN 2.0 can control the frequency in the +/-3Hz band around the nominal frequency:



1. Connect the speed **common wire only**



2. In “Configuration/Engine”, preset the amplitude and offset as described in the table further (if not listed, contact CRE Technology)

ESG amplitude	… V	
ESG offset	… V	
F	50Hz	Lecture
Engine Speed	1500	Lecture
Speed Sum	0000	

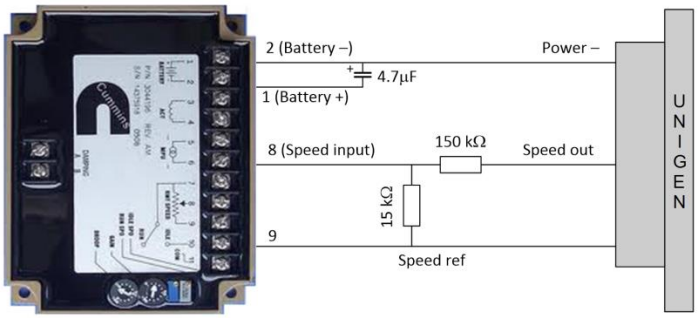
3. Start the generator
4. Trim the governor potentiometer to read 50Hz (or 60Hz)
5. Connect the Speed out signal; adjust the offset so that the frequency is 50Hz (or 60Hz)
6. Adjust Speed sum to +100% :
   - Page “Configuration/Engine”
   - With the **Shift** + ⮝ keys , adjust the amplitude so that the frequency is 53Hz (or 63Hz)
7. Return to 0%; adjust the offset if needed to get back 50Hz (or 60Hz)

8. Select the Speed Sum and adjust it to –100% with the **Shift** + ⮟ keys in order to check the variation range till 47Hz (or 57Hz)
9. Adjust the speed sum to 0%.

The next table gives both settings for various ESGs. For other models, preset amplitude and offset according the manufacturer documentation and/or contact our Customer service.

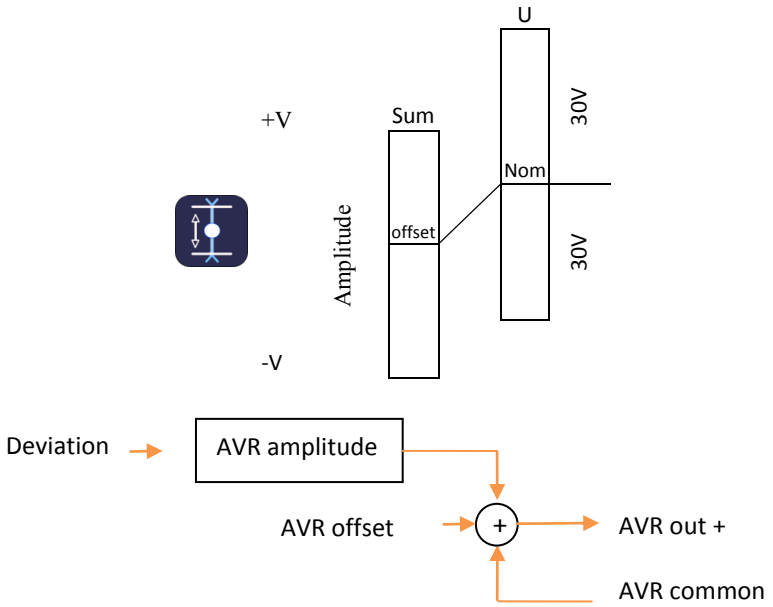
Manufacturer	Model	ESG ampl.	ESG offset	ESG input	ESG ref	Note
BARBER COLMAN	with analog input	0.5V	0V	ILS input	4V	
	DPG 2201	0.5V	0V	ILS signal	ILS+2.5V	The tuning depends on the connections
				ILS signal	Digital supply(+5V)	
				ILS signal	BAT-	
Cummins	ECM for QSK23 / QSK40 / QSK45 / QSX15 / QSK 60	2.5V	0V	11 (Barber Colman Freq. bias input)	06 (5V)	
	EFC	1.5V	0V	8	9	See schematic
	ECM (QST30)			18	15 (7,75V)	
DEUTZ FAHR	EMR	2V	2.5V	24	25	+/- 1.5 Hz not to reach EMR overspeed
Governors America Corp.	ESD5330		–5V	M	G	
	All other ESD		–5V	N	G	
GHANA CONTROL	PWC 2000			J	G	
HEINZMANN	E6			B3		
	KG6 / System E6	2.5V	2.5V	E3	A3	
	PANDAROS DC6	2V	2.5V	B3	A3	
JOHN DEERE	JDEC	2V	2.5V	L	C	Two different wirings for the same governor
				G2	5V(ref speed) 999	
mtu	MDEC	4V	0V	8	36 & 7 (5V)	
Perkins Marine Power	ECM 1300	2V	2.5V	30	5V	2 and 12 connected for external setting
VOLVO PENTA	EDC IV EDC III	1.5V	3V	Pot. signal		
WOODWARD	- 2301A/D ILS+speed - (Without U&I)	0V	3V	10 25	11 26	Shunt 14-16 Shunt 26 (com) on 0V
	2301D					
	2301A Speed only	4.5V	2.5V	15	16	16 connected to 0V
	EPG System P/N 8290-189 P/N 8290-184	2.5V	0V	11 (0.6V)	nc	Remove the shunt between 11 and 12

Because of the very high sensitivity of Cummins EFC module input, use the schematic below to connect UNIGEN 2.0 to the EFC. The resistors must be as close as possible to the speed governor terminal. This way, UNIGEN 2.0 analog speed output can be set higher (2205) according to the resistors used.



5.3 ANALOG AVR (AUTO VOLTAGE REGULATOR) CONTROL

The AVR out signal provides the set point for AVR, used in reactive load sharing ... The components of AVR output are listed in the section *5.1*. The voltage range -10V …+10V must be fitted in amplitude and offset to allow UNIGEN 2.0 to vary the AVR set point on a correct range; the aim is that UNIGEN 2.0 can control the voltage in the +/-30V band around the nominal voltage:



1. Connect the AVR **common wire only**
2. In “Configuration/Generator”, preset the amplitude and offset as described in the table further

AVR amplitude	… V	
AVR offset	… V	
V1	230V	Lecture
U31	400V	Lecture
Voltage Sum	0000	

3. Start the engine
4. Trim the AVR potentiometer to read 400V
5. Connect the AVR out signal; adjust the offset so that the voltage is 400V
6. Adjust Voltage sum to +100% :
   a. Page “Configuration/Generator”
   b. With the **Shift** + ⮝ keys , adjust the amplitude so that the voltage is 430V
7. Return to 0%; adjust the offset if needed to get back 400V
8. Adjust Voltage Sum to -100% with the **Shift** + ⮟ keys in order to check the variation range till 370V

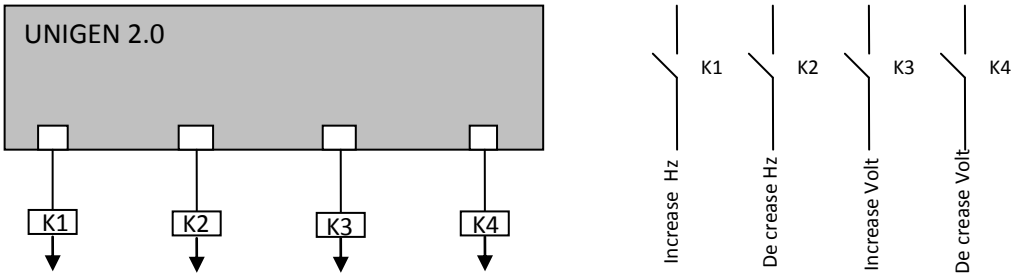
9. Adjust voltage Sum to 0%.

Table below gives both settings for various AVRs. For other models, contact our Customer service.

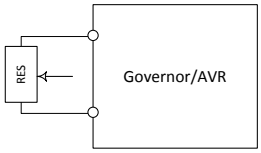
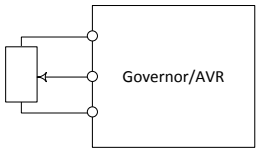
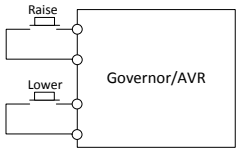
Manufacturer	Model	AVR ampl.	AVR offset	AVR out	AVR common	Comment
AEM ENGINEERED TO OUTPERFORM	R16		0V	8	Mid point of a resistive bridge betw. 7 & 9/10	
Cummins AvK	Cosimat N	4.5V	4.5V	Mn	n	
	MA329			A2(+)	A1(-)	
Basler Electric	AEC63-7 AVC63-4(A)			6	7	Remove shunt between terminal 6 & 7 of the AVR
	AVC63-12	1.0V	0V	2	3	
	DECS32-15-xxx DECS63-15-xxx DECS125-15-xxx DECS300	Use VAR control included in the DECS				
CATERPILLAR®	DVR KVAR/PF			7	45	
	VR6	1.0V	0V	3	2	
	CDVR	4.5V	0V	P12.3	P12.6	
KIA Kato Motors C.a.	K65-12B K125-10B	1.0V	0V	2	3	
LEROY SOMER	D510	10V	0V	See drawings: AVRout feeds either analog input. 0…10V bias input provides a higher range of voltage bias control. AVR com is set to 5V		
	R230/438/448/ 449	1.0V	0V	Pot input +	Pot input –	Remove the shunt
	R610 3F	4.5V	0V	22	23	
marathon electric	DVR2010					
	DVR2000E	1.5V (±10%) 3V (±30%)	0V	A	B	
MarelliMotori	M40FA640A	0.35V	0V	8	6	
	M40FA644A	3.0V	1.5V			
mecc alte spa	UVR6	2.0V	–4.5V	Pot +	Pot –	
sincro	FB			EXTPOT+	EXTPOT–	Trim potentiometer V of AVR fully counterclockwise. Remove shunt
STAMFORD power generation	MX321			A1	A2	Trim potentiometer of AVR fully clockwise
	MX341			A1	A2	
	SX440			A1	A2	

5.4 SPEED/VOLTAGE CONTROLLED BY CONTACTS/PULSES

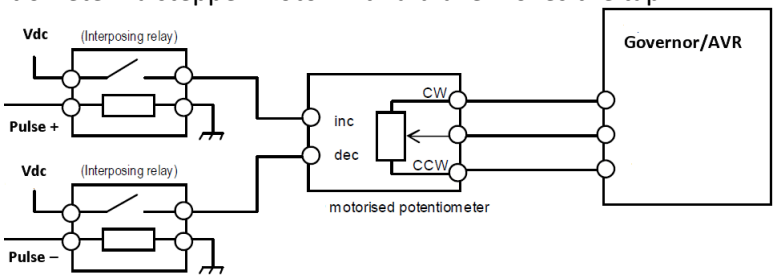
When digital outputs are connected to speed governor and/or AVR, the UNIGEN 2.0 PID controllers send speed/voltage increments/decrements by changing the state of these outputs:



Calibration device: various devices can be used depending on the governor/AVR.

Adjustable resistance	Manual potentiometer	Tapper (push-buttons)
		

A digital potentiometer, that converts the pulses into analog values, has its own settings: ΔU0 (fsd) & Time.
A motorized potentiometer: a stepper motor with a brake moves the tap



5.4.1 Setup

In "Configuration/Outputs/Digital outputs", assign to outputs a function Increase/Decrease speed/voltage by pulse.

When digital outputs are used to control speed/voltage by pulse, dedicated parameters are shown in the speed/voltage regulation control menu. Those parameters are listed in the table below.

Speed governor	Voltage regulator	Description
3650	3651	Dead band
3652	3653	Pulse width
2908	2954	Centering gain by pulse
4405	4411	Sum of all speed/voltage deviations (positive or negative) as detailed in section *5.1, p37*

A pulse is generated when the absolute value of the regulation output is bigger than the dead band setting. The higher the regulation output is, the closer pulses will be from each other. Period between two pulses can be calculated as follows:

$$Time\ between\ pulses\ (in\ s) = abs(\frac{10}{Regulation\ output})$$

Note that calculated value of the regulation output depends on the settings applied to the dedicated PIDs.

5.4.2 Speed calibration procedure

Preliminary step:

1. Adjust the resistance at mid value or set the potentiometer tap in the mid position or the tapper in the mid position (unless UNIGEN 2.0 is directly connected to the governor)
2. Check the sum of all deviations [4405]

The components of total deviation are split in two, as they are compensated in different ways. Finally, the compensations will be added.

- Set 3650 to 1.00% which is 1 percent of deviation (i.e. 0.03Hz of dead band)
- Set 3652 to 0.2s which corresponds to a 200ms pulse width

Setting for load sharing

If the generator makes too much or not enough correction during load sharing, it means that the pulse width is not properly adjusted:

- Decrease 3652 to reduce the pulse control on the governor
- Increase 3652 to have more correction on the governor

If the generator oscillates around the set point during an active phase or if it's hard to reach the set point, it means that the dead band 3650 is not properly adjusted:

- Decrease dead band 3650 to improve the accuracy around the set point
- Increase dead band 3650 if the generator oscillates in frequency or in load

If there is a digital potentiometer between UNIGEN 2.0 and the speed governor, set ΔU0 (fsd) and Time; if you don't get the desired compensation, check the following points:

- Is the potentiometer still running when UNIGEN 2.0 sends an output signal?
- Check that the speed/voltage range controlled by the potentiometer is wide enough

Note: If pulses always generate an over-compensation, then it may be because the potentiometer is still running even after the UNIGEN 2.0 pulse is finished. In this case a shunt resistor on the potentiometer input may correct the problem by ensuring a proper low level at the input when UNIGEN 2.0 issues no pulse

5.4.3 Voltage calibration procedure

To calibrate the voltage control, execute the same procedure as the speed calibration procedure:
3651: Dead band (in %),
3653: Pulse width

5.5 TESTS

Make sure that you have the latest power plant schematics and that all the cables (CAN bus, shielded cables, speed governor / UNIGEN 2.0 interface...) are ready. The HMI can be either LCD or CRE Config/Scada.

5.5.1 Individual check

Check up

1. Disconnect the breaker control cables for safety purpose
2. Check the speed governor and AVR control settings and connection
3. Check UNIGEN 2.0 settings according to the desired setup
4. Ask the technician who has wired the power plant to lock the generator breaker open
5. Check the battery voltage.

Check the protections

Make sure that at least these protections are properly set:

- Overspeed
- Overvoltage
- Reverse kW

Démarrer le générateur

Start the generator

1. Start the generator
2. Check the generator readiness led is on
3. Check that the engine speed and the generator voltage are stable and adequate (e.g. 1500rpm, 50Hz, 400VAC); the data is available in « Display/Generator »
4. On the screen « Configuration/Engine » & « Configuration/Generator », make sure the speed/voltage deviations is optimum (+/-3Hz and +/-30V) when using **Shift** + ⮝ & **Shift** + ⮟ (See 5.2 and 5.3)
5. Stop the generator

Check the loading and unloading ramp

⚠ WARNING
RISK OF OVERLOAD OR REVERSE kW
Check the wiring of the power lines, in particular the current transformer inputs.
Failure to follow this instruction can damage equipment

In any case, it matters to have power on bus bar to check the power measurements.
After paralleling, UNIGEN 2.0 starts the power management :

- In “Display/Generator”, check that the consumed powers by phase are positive and balanced. Otherwise, check the wiring.
- During the ramp, check that power follow the kW-kVAR setpoint (“configuration/Control Loops/Ramp kW-kVAR” menu) and increase proportional (2913/2967) if need.

Check the load sharing

On both UNIGEN 2.0 units, adjust the gain 2916/2958 to have a load in proportion to the generator rating (“Configuration/Control loops” menu).

In event of uneven load sharing:

1. Check the wiring direction of the current transformers and the power measurements. The power by phase must be balanced and positive.
2. Check the speed/voltage control is correctly configured and performs the same action on all speed governors.
3. Check that all engines are stable. If one or more engines oscillate in frequency (even slightly), this oscillation affects the load sharing.

Note: To improve the function, see 3.2.1.

If the load sharing is steady, but one generator always takes more load than another, adjust the off-load speeds/voltages (engine started, no paralleling) on the regulator.

6 HUMAN-MACHINE INTERFACE

UNIGEN 2.0 offers several interfaces for setup and monitoring:

- the built-in LCD screen
- CRE Config software application interface
- a PC web browser

The CRE Config software is outlined in a specific manual; specific pages are described further. The splash page text is customized in CRE Config/System/Display properties.

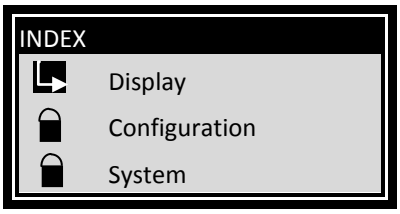
6.1 SECURITY AND OPERATIONS THROUGH THE FRONT PANEL

6.1.1 Security level and password

UNIGEN 2.0 features password-protected access levels to define which menu and items can be accessed:

Level	Default password	Authorization	Accessible pages and items
0	No password. Press **ENTER**	By default, this level is not password protected, but you can implement one	DISPLAY menu pages only
1	**1** (digit "ONE")	User level, settings and commissioning	All three menus
2	1234	Used to change advanced settings	All items (CRE Config only);

The password can be changed in CRE Config/System.



To access the Display menu, press **ENTER**.
To access the Configuration and System menus, the padlock must be released:

1. Press ⮟ to select Configuration
2. Press **ENTER** to switch to password input mode (as for other settings); the first character is represented by a black rectangle
3. Scroll the character set by pressing ⮝ till you get the desired first character and press **ENTER** to validate it
4. Shift to the next character pressing ⮞; select the value pressing ⮝ and press **ENTER** to validate it (* substitutes for each character entered)
5. Repeat for other characters
6. To validate the password, press **ENTER**

To log out, wait for the time TM password set in the System menu (default value: 5 min); then the home shows and configuration is subjected to the input of a password.

6.1.2 HMI status

To inhibit some keys or buttons, go to CRE Config/System/Button inhibition.
This can also be done through 16-bit word:

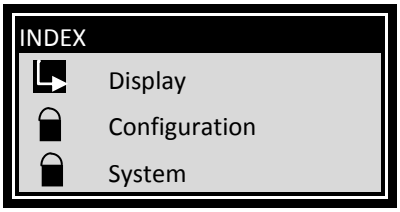
Setting	Label	Description
E3557	Button inhibit	Each bit inhibit one button/key when set to 1

Bits numbers:

Inhib.bit	8	7	6	5	4	3	2	1
Key/Button		**ESC**	**ENTER**	▲	◀	▼	▶	**SHIFT**

6.1.3 Navigation in LCD

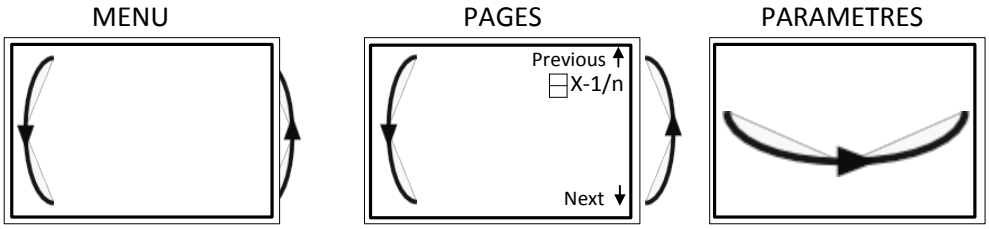
Press **ESC ENTER** and type in the level 1 password as described above to access the top level menu:



A black pointer spots the currently selected item/setting; a white one features other items/settings.
Three main menus are available on the LCD screen and the web client monitor:

- **Display** gives information on generator & busbar, & displays real-time information & status
- **Configuration** is used to hone the settings done in CRE Config/Configuration
- **System** is used to change on the fly the settings done in CRE Config/System (Date/Hour, Screen features, ...)

To cycle through the menus and menu items, press ▼ or ▲.
To cycle through the pages of lists of settings/readings, press ▶ or ◀:



6.1.4 Edition

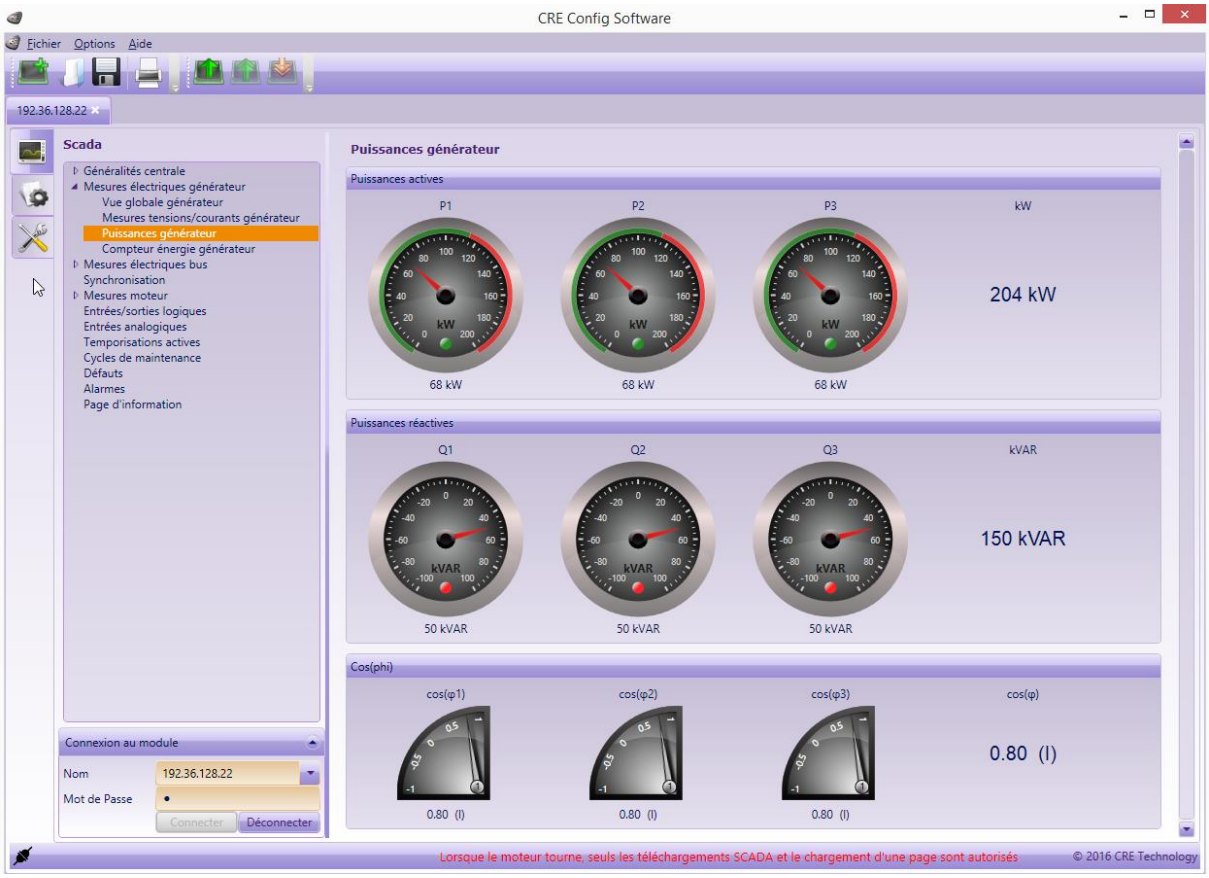
To change a setting:

1. Navigate to the setting
2. Press **ENTER** to switch to Edition mode; the current value blinks
3. Press ⮟ or ⮝ to get the new value
4. Press **ENTER** to validate the new value, **ESC** to reject it. UNIGEN 2.0 returns to Navigation mode.

It is also possible via the bus Modbus TCP. See 7.1.

6.2 SUPERVISION

If you keep the PC connected, you can monitor the generator from CRE Config/Scada through UNIGEN 2.0.



An alarm/faults handler is built-in.

Note: In the handler, the buttons are greyed out until the PC is connected to UNIGEN 2.0.

6.3 WEB SERVER

The UNIGEN 2.0 web server provides a very easy and efficient way of:

- loading/downloading configuration file.
- Downloading alarm/fault/log events
- Update firmware
- Visualize alarm/fault

To do so:

1. Connect UNIGEN 2.0 to your PC using an Ethernet direct cable
2. Start a Web browser such as Firefox or Internet Explorer
3. Type in the IP address (factory setting: http://192.168.11.1), or UNIGEN 2.0 hostname
4. When the UNIGEN 2.0 password page appears, enter your password

In the browser, the only soft key is ESC, used to return to the parent menu.

6.4 MENU VISUALISATION

L'afficheur **LCD** permet d'accéder aux informations suivantes :

- Power plant
- Generator electrical meter
- Engine meters
- Inputs/Outputs state
- About (Only level 0)

A Power plant

A carousel cycles through power plant loads (shared by up to 32 different UNIGEN 2.0 units):

Information available		Description
GE 01 … 32	kW	active power supplied by each generator: • Percent of nominal of generator • kW
GE 01 … 32	kVAR	reactive power supplied by each generator: • Percent of nominal of generator • kVAR
GE 01 … 32	Mode	State of each generator

B Generator electrical meter

These pages display in real time all generator electrical measurements in true RMS.

B- 1Global view

- Phase-to-neutral voltage of phase 1
- Phase-to-phase voltage of phase pair 3-1
- Current of phase 1
- Total power: kW, kVAR, cos(φ)

B- 2 Frequency (Hz)

B- 3 Phase to neutral (V)

- V1, V2, V3

B- 4 Phase to phase (U)

- U31, U23, U12

B- 5 Current (A)

- I1, I2, I3

B- 6 Active power (kW)

- P1, P2, P3

B- 7 Reactive power (kVAR)

- Q1, Q2, Q3

B- 8 Total power (kW and kVAR)

B- 9 Power factor

- ϕ1, ϕ2, ϕ3 I stands for Inductive, C for Capacitive (signed as per IEC convention)

B- 10 Total power factor

B- 11Energy meters

- kWh and kVARh

Notes: The frequency is available if the phase-to-neutral voltage exceeds 15VAC. These pages fit the preset voltage system (see further).

C Engine meters

C- 1

- Engine speed (RPM)
- Battery voltage

C- 2

- Running hours

D Inputs/outputs state

D- 1 Digital inputs 1-5

The name of each input is displayed with its status: active =full dot, inactive = hollow dot.

- 1 (Raw) is the status of the physical input,
- 2 (Processed) is the status after conditioning (delay, …).

D- 2 Digital inputs 6-9

Idem.

D- 3 Digital outputs

The name of each output is displayed with its state: active =full dot, inactive = hollow dot.

D- 4 Relay outputs

This menu shows the state of the two relay outputs (Generator breaker).

The name of each output is displayed with its state: active =full dot, inactive = hollow dot.

D- 5 Analog inputs 1-3

The name of each input is displayed with its

- Value if really analog
- Status if digital: active =full dot, inactive = hollow dot.

E About

These pages show only if you have entered as observer (no password). Otherwise, find it in "System/About".

1. S/N: serial number, Type (A51V1), Version, Boot version
   Host name, IP, NM (network mask), GW (gateway). See 2.1.

CRE Config/Scada gives access to readings in addition to the preceding ones.
CLOCKS

Reading	Label	Description	Timeout
4450	Loss of speed sensor	Time since the speed sensor signal is not available	2203
4465	Speed & voltage stabilization	Time generator is waiting to let engine speed & volt stabilize before taking the load (not applicable to static paralleling)	3469
4466	Voltage stabilization	Voltage stabilization counter for static paralleling	2056

6.5 CONFIGURATION MENU

To access this menu, a password is required; the **LCD** menu gives access to the following information:

- Power plant
- Generator
- Engine
- Protections (Only CRE Config software)
- Timers (Only CRE Config software)
- kW/kVAR control loops
- Modification by variable n°

The settings with a purple left border are for CRE Config only.

A Power plant

Power plant applications			
Setting	Label	Value	Description
2001	Number of module	1 … 32	Number given to this particular UNIGEN 2.0 on the CAN bus
2000	Total count of modules	1 … 32	Total count of UNIGEN 2.0 units installed on the CAN bus
2050	Paralleling mode	Unused [0]	
		Static [1]	Static paralleling: Breakers must be closed manually before the start of the engine and the activation of the digital input “UNIGEN Activation”
2003	Voltage schema	Monophase [0] Biphase 180° [1] Triphase 120° [2]	Voltage system selection

B Generator

B- 1 Generator

Setting	Label	Description
2105	Nominal kW	Generator nominal active power
2107	Nominal kVAR	Generator nominal reactive power
2102	Nominal voltage	Generator nominal voltage
2106	Nominal kW (2)	Second nominal power of the generator, activated with logical input
2108	Nominal kVAR (2)	Second nominal reactive power of the generator, activated with logical
2253	Nominal voltage (2)	Second nominal voltage of the generator, activated with logical input
2851	Low kW threshold	Minimum kW setpoint at the beginning of a ramp up after generator breaker close. KW threshold to open generator breaker during ramp down. Enter a value above [2412]
2852	High kW threshold	Only for mains applications. High threshold of the active power that the generator will not exceed when paralleling with mains.
2853	Load ramp timer	Time to ramp up from 0 to 100% of nominal power
2856	Unload ramp timer	Time to ramp down from 100 to 0% of nominal power

B- 1 Generator

Setting	Label	Description
2100	PT ratio	Ratio of the voltage transformers (Ex: 20 kV to 100 V: type in 200). Default value: 1
2101	CT ratio	Ratio of the current transformers (Ex: 100A to 5A: type in 20). Maximum ratio is 3250 (for e.g. 3250:1 or 16250:5). Default value: 100

B- 2 Generator

AVR CONTROL

Setting	Label	Description
2251	AVR amplitude	Use in case of analog voltage control. See 5.3.
2252	AVR offset	
3651	Dead band	Use in case of voltage control by pulse. See 5.4.
3653	Pulse width	
2250	Droop	Internal speed droop in case of a CAN bus fault. See 3.2.2.

C Engine

Setting	Label	Possible value	Comment
2205	ESG amplitude	0…10.0V	Use in case of analog speed control. See 5.2.
2206	ESG offset	–10.0V…+10.0V	
3650	Dead band	0.00% to 100.00%	Use in case of speed control by pulse. See 5.4.
3652	Pulse width	0.1s to 10.0s	
2204	Droop		Internal speed droop in case of a CAN bus fault. See 3.2.2.

D Protections

All protections work with :

- A threshold: triggering level of protection
- A timer: time before triggering the protection
- An action to do when the fault is present

Generator							
	Protection	1 (level 1)			2 (level 2)		
		Threshold	Delay	Action	Threshold	Delay	Action
	Over frequency	2400	2401	2402	2436	2437	2438
	Under frequency	2403	2404	2405	2439	2440	2441
	Over voltage	2406	2407	2408	2442	2443	2444
	Under voltage	2409	2410	2411	2445	2446	2447
	Mini kW	2412	2413	2414	2448	2449	2450
	Maxi kW	2415(1)	2416	2417	2451	2452	2453
	Reverse kW	2418	2419	2420	2454	2455	2456
	Mini kVAR	2421	2422	2423	2457	2458	2459
	Maxi kVAR	2424	2425	2426	2460	2461	2462
	Reverse kVAR	2427	2428	2429	2463	2464	2465
	Over current	2430	2431	2432	2466	2467	2468
	Over neutral current	2433	2434	2435	2469	2470	2471
Uneven load sharing	Uneven kW	3708	3709	3710	–	–	–
	Uneven kVAR	3711	3712	3713	–	–	–

(1) Must be under the DBR (intermittent) and MCR (Max continuous rating) curves. Refer to *Appendix Standards ISO3046.*

	Protection	k	c	α	TMS	Is	Action
See curves in Appendix	Short circuit	2472	2473	2474	2475	2476	2477
Courbe inverse selon standard IEC ; c=0	Default value	0.14	0	0.02	0.01	110	–

Note: Short-circuit protection need to configure the nominal current per one phase (E2103) via CRE Config. This nominal current and the maximum of the measure currents (between the three phases) are used to compute the percent of current that will be compare with the curve.

E Timeouts and delays

Setting	Label	Description
3469	Stabilisation	Time to wait for speed and voltage to get steady
2056	Voltage stabilisation (Static paralleling)	Time to wait for voltage stabilisation (static paralleling)
2203	TM sensor lost	Time after a "sensor lost" security fault will be triggered if no signal is read from speed measurement input
2478	Horn delay	Drop-off delay. See 4.1.2.

F Control loops

F- 1 kW control

Setting	Label	Description
2913	P	Proportional gain of ramp kW
2917	P	Proportional gain of active load sharing
2918	I	Integral of active load sharing

FREQUENCY CENTERING

Setting	Label	Description
2927 (2)	Hz center act	Activation of the frequency centering
2926 (1)	Hz center gain	Global gain of the frequency centering

(1) Select the menu item Options/Advanced or in level 2
(2) This setting can be modified using TXT file or modification by variable number menu (1 by default)

F- 2 kVAR control

Setting	Label	Description
2967	P	Proportional gain of ramp kVAR
2959	P	Proportional gain of reactive load sharing
2960	I	Integral of reactive load sharing

VOLTAGE CENTERING

Setting	Label	Description
2970 (1)	U center act	Activation of the voltage centering

(1) This setting can be modified using TXT file or modification by variable number menu (1 by default)

G Modification by variable number

This page is very useful when you are familiar with key variable numbers, for example the ones you often modify. Simply enter the variable number, and then enter its value.

Note: You can only change settings 2xxx…3xxx. Some are not accessible in regular menus.

CRE Config EXTRA SETTINGS
These settings can still be modified through the LCD (Modification by variable number).

POWER MANAGEMENT SYSTEM (LOAD DEPENDENT START/STOP)

Setting	Label	Possible value	Description
2850	Load/Unl. mode	[0] Inhibited [1] GE number [2] Hours run [3] By custom	No automatic start/stop of generators according to aggregate load Generators start/stop according to the Generator number Generators start/stop according to the UNIGEN 2.0 running hour meter Generators start/stop according to my priority number [2863] (1 … 32)
2855	TM before load	Default: 10.0s	Delay with power above threshold E2854 before UNIGEN 2.0 requests another generator to start and share load
2854	LV Load thres	Default: 80%	Percent of load on the power plant above which another engine is requested to start and share the load
2858	TM before unload	Default: 10.0s	Delay before deciding to reduce the count of running generators in load/unload management
2857	LV Unload	Default: 20%	Percent of load on the power plant under which an engine is stopped. Used when E2859 = 0
2863	Customer priority generator number		See parameter 2850

DIGITAL INPUTS AND OUTPUTS, AND CANopen

See chapters 8.3 and 7.2.

LOGGER

UNIGEN 2.0 can save up to 1350 pieces of data. In addition to Power state, up to 10 readings/statuses can be selected. This includes archived alarms and faults. They are archived on change of value.

Format:

jj/mm/aa hh:mn:ss.100ms label XXXX=YYYY . XXXX = parameter number, YYYY = value.

In CRE Config/Configuration/Logger:

- Tick the box Log on/off to enable the data logger
- Enter the codes in the text area (using the spin is NOT recommended as you have to scroll a lot).

The records can be downloaded from CRE Config or the web site.

6.6 SYSTEM MENU

It gives access to the following pages where with readings, or settings to modify:

- Date/Time
- Screen setup
- Ethernet
- About (read only)

A Date / Time

"Date / Time" allows you to modify the date and the time:

Label	Description
Date	Year/Month/Day/Day of week
Time (hh:mm)	Time adjustment (H M)

GENERATOR METER SETTING

When UNIGEN 2.0 is not connected to a new generator, set in CRE Config the initial values of energies, count of starts and running hours.

B Screen setup (Display properties and password)

Setting	Label	Default	Description
3554	Contrast	50%	Adjustment of LCD contrast from 0 to 100%
3555	Backlight	100%	Adjustment of LCD backlight from 0 to 100% of the max backlight intensity
3552	Backlight saver timeout	5 min	Time without navigation (in minutes) after which the backlight turns off. 0 means infinity.
3553	Password timeout	5 min	Time without navigation (in minutes) after which password is inactive. 0 means infinity.
3551	Screen saver timeout	5 min	Time without navigation (in minutes) after which the display exit menus and show screen saver. 0 means infinity.
–	Line 1 to Line 2	CRE Tech its URL	The two lines of text displayed in the Splash screen saver can be modified on the fly. Each line can include up to 21 characters in length

C Ethernet

This page allows to configure the Ethernet connexion with the following parameters:

- DHCP
- IP address
- Network Mask
- GateWay IP address
- HTTP port
- Modbus port

D About

This page displays some information on module and on Ethernet connection.

- Serial number (S/N)
- Module reference (type)
- Software version
- Boot software version
- Hostname
- IP address
- Network Mask
- GateWay IP address

CRE Config EXTRA SETTINGS

METERS

This page allows you to preset or reset the following meters:

- kW generator sum
- kVAR generator sum
- Running hours

SCREEN SAVER

The page displayed when the user does not interact with UNIGEN 2.0 (keys not used) is called "SCREEN SAVER". Information displayed on this page depends on the UNIGEN 2.0 status, as described in the following table. Some settings can also be used to customize this behavior.

Screensaver	Description	Mode
Generator overview	Frequency (in large font) kW (in large font) Voltage (in large font)	When the generator breaker is closed (ramp up, ramp down, load sharing)
Customized screen	2 custom lines Current date and time	In waiting state

PASSWORD

This page allows you to change passwords, from level 0 to the currently connected level. Passwords are limited to 8 characters maximum. Refer to chapter 6.1.1.

LANGUAGES

Setting	Label	Possible value	Description
3556	Language	English Francais Espanol Italian	Language of the menus displayed on the LCD and on embedded web site

Note: It is possible to add a custom language. Refer to chapter Maintenance.

COMMUNICATION PORTS CONFIG

INTER-UNIGEN CAN

This isolated communication port is dedicated to inter-unit data communication using a proprietary protocol. This bus is designed for load sharing (active and reactive), automatic load/unload,... Action to be performed upon CAN bus fault [3052] occurrence can be set (select menu Options/Advanced). The bus speed is fixed at 125kbit/s.

CANopen-J1939

This isolated bus is used for communication with CANopen remote I/O modules (Beckhoff, Wago, Vipa...) and/or electronic engines communication (J1939).

ETHERNET

This page allows you to configure the Ethernet connection to communicate with a PC. Please contact your network administrator to configure router and module(s) according to your need.

Setting	Label	Default	Description
3012	DHCP select	Disable	[Disable]: fixed IP address [Enable]: DHCP protocol (dynamic IP address) enabled
3000…3003 (1)	IP Address	192.168.11.1	Fixed IP address of the unit (DHCP disabled or in fault)
3008…3011 (1)	IP GW address	0.0.0.0	Gateway IP address (DHCP disabled)
3004…3007 (1)	IP NM	255.255.255.0	Network mask (DHCP disabled)
3013	Port HTTP	80	TCP communication port
3014	Port Mod TCP	502	Modbus TCP communication port

(1) Only available if DHCP protocol is disabled.

Notes: On CRE Config, these modifications are taken into account during power on sequence. Restart UNIGEN 2.0.

On LCD, modification of port numbers is taken into account during power on sequence. Restart UNIGEN 2.0.

6.7 DEDICATED PAGES

The dedicated pages include:

- The faults page
- The alarms page
- The information page.

At any time, you can display the faults/alarms/information on LCD screen by pushing button.

If an active fault exist and has not been acknowledged yet, the active fault page will be displayed.
Otherwise if an active alarm exist and has not been acknowledged yet, the active alarm page will be displayed.
Otherwise the information page will be displayed.

You can navigate through these dedicated pages with the high, low, left, right arrows buttons.

To return on previous page, press ESC or button.

6.7.1 Faults and alarms

The latest 15 active faults and alarms show in addition of the latest 30 archive faults and alarms. They are time-stamped as follows:
dd/mm/yy hh:mn:ss protec. label On (or Off).

To reset the tripped protections, press “SHIFT+I.

Note: Fix the condition triggering the protection before clearing the alarm; failure to do this will trigger the protection again.

To erase the Faults/Alarms archive, in CRE Config/Display/Faults or Alarms, press Erase button.

Note: Erase button will erase all archives including Faults, Alarms and loggers.

6.7.2 Information

These pages allow displaying the power current state with the associate elapsed time in this state.

In addition, 2 variables per page can be consulted.

Power [4001] displays the unit current state regarding power management.

Custom variables: To display any reading, enter its 5-digit code.

7 COMMUNICATION BUSES

7.1 MODBUS TCP

7.1.1 Capabilities

The complete list of variables is in the file ***A51V1 90030_.xls***.
Through an Ethernet communication where UNIGEN 2.0 acts as a Modbus TCP server, you can

- Upload many readings and UNIGEN 2.0 internal variables
- Download values for many UNIGEN 2.0 internal variables:

Nature	Range	Access right by nature
Readings (measurements, statuses)	0000 … 1999	Read only
Settings	2000 … 3999	Read/Write
Modes, statuses, settings	4000 … 9999	Read
Readings associated with digital inputs	4500 … 4649	Write (subject to activation)

In addition, in order to decrease load on Ethernet, the following functions are supported:

- Reading Bit Fields, listed in a dedicated tab of the file and organized in 16-bit words
- Reading contiguous configurable data block

7.1.2 Configuration

To communicate through Modbus TCP, define the following settings:

- UNIGEN 2.0 IP address set in “System/Ethernet”
- Modbus TCP port [3014], generally 502, set in “System/Ethernet”
- Modbus rights: see further

UNIGEN 2.0 handles up to 4 Modbus TCP connections. This can be used for multiple HMIs for example.

For more details on the Ethernet configuration, see the chapter 2.1.

7.1.3 Description

⚠ WARNING
RISK OF UNINTENDED EQUIPMENT OPERATION
It’s recommended to stop the engine before changing some settings
Failure to follow this instruction can damage equipment

Functions

UNIGEN 2.0 supports the following Modbus functions:

Function	Description
01, 02	Read logical values (coil status, discrete input status)
03, 04	Read holding/input registers (16 bits)
05	Write logical value (single coil)
06	Write single register (16-bit variable)
15 (0x0F)	Write multiple logical values (multiple coils)
16 (0x10)	Write multiple registers

All UNIGEN 2.0 variables are 16-bit registers. Yet it might be useful to consider them as logical values (if they are only set to 0 or 1) to simplify Modbus communication with some external PLC. If function 01 or 02 is used to read an internal register that is different from 0, then returned value will be 1.

UNIGEN 2.0 registers start from address 0. Depending on your Modbus TCP client equipment-software, you may need to use an offset of 1 when reading/writing registers as addresses may start from address 1. In this case, request address/register number 1 to access variable 0000 inside UNIGEN 2.0.

The 32-bit variables can be written to only with function 0x10.

If a digital input modifies a piece of data also to be written by Modbus, the latest request takes over the other.

Data 10000…10299 can be read by block. See further.

Access rights

The access rights depend on the parameter nature and on massive permissions. To grant massive access rights, set to 1 the corresponding bits in the word 3015:

	Writing using Modbus TCP	Reading using Modbus TCP	Not used	Not used	Not used	Not used	Writing to input function registers	Not used	Writing to Engine counters	Writing to Date/Time
Bit #	9	8	7	6	5	4	3	2	1	0
Default value	1	1	0	0	0	0	1	0	0	0

In CRE Config/System/Network configuration/Modbus access rights, just tick a checkbox:

Bit #	Label	Use
0	Writing to Date/Time	Synchronization of UNIGEN 2.0 clock. See chapter A
1	Writing to Engine meters	Manual adjustment of counters (see next table). See chapter A
2	Writing to digital input function register	
8	Reading using Modbus TCP	Opens the possibility to grant reading individual permissions
9	Writing using Modbus TCP	Opens the possibility to grant writing individual permissions

The counters, encoded on 32 bits, include:

Counters (MSB|LSB)	Label
0080|0079	Generator kWh
0082|0081	Generator kVARh
0084|0083	Engine running hours

Bit Fields

Bit fields are meant for decreasing communication bus load. They pack up to 16 logic variables inside a single register. This way a single Modbus request can be used to read a chunk of information. Each variable contains the current value of 16 logic variables such as breaker positions, faults, alarms…

They are listed out in the Bit fields tab of the document ***A51V1 90030_.xls.***
The bit fields 0956 … 0969 have latched values: a reset is required for them to return to 0.

Note: Available data are related only to faults that occurred after the latest power up sequence. Events that occurred before UNIGEN 2.0 has been power cycled are listed in the FAULT pages but NOT among the variables.

Custom blocks

To create your own blocks, use the variables 10000 … 10299 in CRE Config/Configuration/Modbus.

There are two ways to configure these blocks:

A. Configuration in CRE Config/Modbus: enter the codes of the variables to read; the readings on the registers 10000 … 10299 will be the pointed values

B. Configuration by an external device; this device must request the following:
   1. Write 1 to 3016 to enter into the configuration mode
   2. Write the codes to the desired registers (10000 … 10299)
   3. Write 0 to 3016 to enter into the read mode

Then to read your own block, you just need to read by Modbus the register 10000 to 10299.
Time stamping is done by the master.

Example:
If the configuration is as follows E10000 = 14; E10001=15; E10002=16, the reading by Modbus of the 3 registers will give to you the hours/minutes/seconds of the UNIGEN 2.0.

Later, CRE Config can upload the new configuration if needed.

Modbus communication example

The table below exemplifies a Modbus TCP client sending a reading request (function 04) of 6 registers starting from variable 0079.

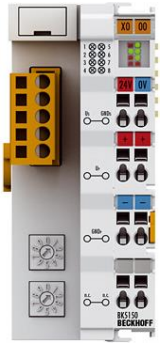
Client request		**UNIGEN 2.0 server response**	
Field	Value	Field	Value
Function code	04	Function code	04
Starting register (MSB)	00	Data bytes (=2 x count of requested registers)	6
Starting register (LSB)	79	Value of register 0079 (MSB)	*D0*
Count of registers (MSB)	00	Value of register 0079 (LSB)	*D1*
Count of registers (LSB)	06	Value of register 0080 (MSB)	*D2*
		Value of register 0080 (LSB)	*D3*
		Value of register 0081 (MSB)	*D4*
		Value of register 0081 (LSB)	*D5*

7.2 CANOPEN EXTENSION MODULES

CANopen extension modules can be used to increase the number of digital inputs and outputs of UNIGEN 2.0. Overall max. count of added inputs: 32 I and 32 O. They are read/written to every 100ms.

7.2.1 Hardware

Each bus coupler is a slave node that supports up to 64 I/O modules that offer different kinds of I/O. Outputs can be by transistors or relays. I/Os can be distributed across up to 4 daisy-chained couplers.

Manufacturer	WAGO	BECKHOFF		VIPA
Bus coupler	750-3xx	 BK5150	LC5100 (low cost, no isolation)	VIPA053-1CA00
	ID by DIP switch	ID by rotary switch	ID by DIP switch	ID by DIP switch
I/O modules	75x-4xx (inputs) 75x-5xx (outputs)	KLxxxx	All the digital I/O terminals are supported except the KL15xx, KL25x2, KL2692 and KL27x1 terminals	VIPA 021-1BF50 (inputs) VIPA022-1BF00 (outputs)

The modules are stackable and mounted on a DIN-rail. Refer to the extension module's user manual for correct wiring on the CANopen module side. Check whether the inputs/outputs are protected against short-circuits. If needed, connect the drain to the DIN rail.
Make sure there is a resistor of 120Ω between CAN H and CAN L on both ends of the cable. For details, refer to the *Appendix* CAN bus good practices.

Available bit-rates: 125/250/500 kbps, 1 Mbps.

Note : CANopen can be used in parallel with J1939 at 250 kbit/s.

7.2.2 Configuration

Setting	Label	Value	Description
3151	CANopen config	1	8 inputs + 8 outputs of coupler ID# 1
		2	16 inputs + 16 outputs of coupler ID# 1
		3	32 inputs + 32 outputs of coupler ID# 1
		4	Custom configuration, defined by more settings
3153	CANopen ID# 1	0 … 255	Identifier of the first coupler
3154	CANopen IN 1	0 … 32	Count of inputs on the first coupler
3155	CANopen OUT 1	0 … 32	Count of outputs on the first coupler
3156	CANopen ID# 2	0 … 255	Identifier of the second coupler
3157	CANopen IN 2	0 … 32	Count of inputs on the second coupler
3158	CANopen OUT 2	0 … 32	Count of outputs on the second coupler
3159	CANopen ID# 3	0 … 255	Identifier of the third coupler
3160	CANopen IN 3	0 … 32	Count of inputs on the third coupler
3161	CANopen OUT 3	0 … 32	Count of outputs on the third coupler
3162	CANopen ID# 4	0 … 255	Identifier of the fourth coupler
3163	CANopen IN 4	0 … 32	Count of inputs on the fourth coupler
3164	CANopen OUT 4	0 … 32	Count of outputs on the fourth coupler

The assignment of I/Os is done in the order of couplers and the lower variable number is associated to the lower message number configured.
The CANopen inputs and outputs have the same attributes as regular inputs and outputs except the Delay on drop-off of inputs (See chapter 8.3):

Setting	Attribute
Digital inputs 1 … 32	
3200 … 3231	Function
3232 … 3263	Delay on pick-up
3264 … 3295	Validity
3296 … 3327	Direction
Digital outputs 1 … 32	
3350 … 3381	Function
3382 … 3413	Mode (direction): 0: normally de-energized 1: normally energized

On power-up, the configuration is automatically launched. The status 3150 turns to 1.
The error time-out (3152) is 10.0s by default.

7.2.3 Mapping

CANopen inputs and outputs are accessed by their code:

- Inputs: 0800 … 0831
- Outputs: 4751 … 4782

7.3 J1939 COMMUNICATION

7.3.1 Overview

J1939 is a CAN protocol used by “electronic” motors, which include an ECU (or ECM, EMS). In the case of UNIGEN 2.0, it allows you to send commands of speed control.

Bit rate: 250kbit/s.

To use the J1939 communication:

1. Enter the “Configuration/Engine/J1939“ page
2. In the list, select the manufacturer [3100]
3. Select the ECU type [3101]
4. Connect the engine ECU and the UNIGEN 2.0 J1939 port

The pair manufacturer-ECU determines the following settings:

- UNIGEN 2.0 address on the CAN bus
- ECU address on the CAN bus
- Speed control: through J1939 or by analog output/pulses

UNIGEN 2.0 can communicate with a large number of J1939 engines. As the engine list accrues, please contact CRE Technology or your local distributor if your engine is not mentioned in this document.
In any case, if your ECU does not belong to the following list, try:

1. To select the generic ECU from your manufacturer
2. To select the GENERIC manufacturer, then modify the UNIGEN 2.0 [3103] and ECU [3102] address according to the ECU documentation (Modification by variable number)

7.3.2 Search engines list

Manufacturer [3100]	ECU [3101]
SCANIA [1]	GENERIC [0]
	S6 (DC16-45A) [1]
VOLVO PENTA [2]	GENERIC [0]
	EMS2 [1]
	EDC4 [2]
	94xGE [3]
	124xGE [4]
	1640-2GE [5]
	1643GE [6]
	D6 [7]
	D7 [8]
	D13GE-Tier3 [9]
Perkins Marine Power [3]	GENERIC [0]
	1100 (A4E)
IVECO [4]	GENERIC [0]
	NEF (EDC) [1]
	CURSOR [2]
	CURSOR9 (EDC) [3]
	CURSOR11 [4]
Cummins (1) [6]	GENERIC [0]
	QSX15-G8 (CMS570) [1]
	CM850 [2]

Manufacturer [3100]	ECU [3101]
	QSB5 (PGI 1.1) [3]
	QSB7 (PGI 1.1) [4]
	QSL9 (PGI 1.1) [5]
	QSM11 (PGI 1.1) [6]
	QSX15 (CMS570) [7]
	QSK19 (PGI 1.1) [8]
	QSK38 (PGI 1.1) [9]
	QSK50 (PGI 1.1) [10]
	QSK60 (PGI 1.1) [11]
JOHN DEERE [7]	GENERIC [0]
	JDEC [1]
CATERPILLAR® [8]	GENERIC [0]
	ADEM A4E2 (C4.4 & C6.6) [1]
[9] DEUTZ FAHR	GENERIC [0]
	EMR [1]
	EMR2 [2]
	EMR3 [3]
mtu [10] Voir Appendice MTU	ECU8 + Smart Connect [3]

(1) Cummins 109G ECU may not support speed control through J1939. ECU with Cummins G Drive firmware should support J1939 speed control

8 RESOURCES FOR SETUP & MAINTENANCE

UNIGEN 2.0 handles several files used for setup or maintenance.

The Configuration file allows you to:

- Set the value of every setting
- Change the units of analog inputs (example: V, mbar, psi, …)
- Change the accuracy when displaying analog values (example: 24V or 24.0V)
- Change the labels of inputs and the screensaver

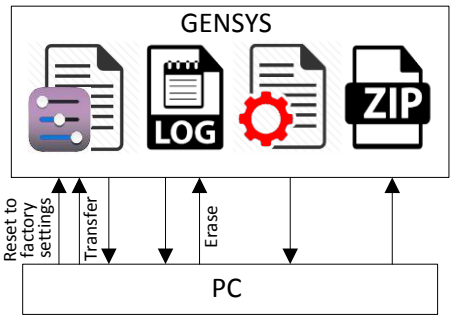
The log file contains the history of time-stamped data (alarm/faults, FIFO data as selected in CRE Config/Configuration/Logger). It is used for maintenance.

The action file contains the list of effects of alarm/faults. It is a sub-file of the text file. They are listed out in 4.1.1.

The firmware upgrade is a zip file.

8.1 FILE TRANSFER

These files can be transferred to or from UNIGEN 2.0.
Use CRE Config/System/PC transmit-receive OR the web server.



Erase and Reset to factory settings are available in CRE Config (for the latter, select Options/Advanced and connect on level 2).

8.1.1 UNIGEN 2.0 -> PC file transfer

This page allows you to download a file from UNIGEN 2.0 to the PC:

- Configuration file
- Log file
- List of actions on alarms/faults

Note: The file transfer is only possible when the engine is waiting (No synchronization, No load sharing).

Configuration file

To display the current configuration file in an internet browser, select “Configuration file”.

In the web browser, to save this file, right-click in the page with the text file, and select Save as.

CAUTION
To edit a new configuration from the configuration file, it is strongly recommended to use a configuration file compatible with the installed firmware version: 1. Upload the file from UNIGEN 2.0 2. Modify it 3. Download this new configuration file to UNIGEN 2.0

Log file

Upload the file. In the web browser, to save the file, right-click in the page with the file, and select Save as.

List of actions on alarm/fault

By selecting "Action on alarm/fault", a file containing all potential alarms/faults and their use is displayed.
To save this file, right-click in the page with the text file, and select Save as.

Example:

```
S/N:4316A1003
Type:A51V1
Version:v0.03
Bootversion:v1.20
Date:06/01/17
Hour:10h30m59s

***** Effet alarme/defaut *****

0 : Disable
1 : Gen electrical fault
3 : Alarm
8 : Droop

(1) -> level 1
(2) -> level 2

Potentiel Alarm./Def.       Parametre actuel  ANSI C37-2
V00600 CAN1 status        <-- V03052 = 8
V00602 CAN2 status        <-- V03053 = 0
……
```

8.1.2 PC -> UNIGEN 2.0 file transfer

This page allows you to send parameters file, or language file.

1. Click the "Browse..." button
2. Select the file to download
3. Click the "Save" button.

When the operation is completed, a screen shows on the PC.

Note: Before edition it is recommended to save the current configuration with the "UNIGEN 2.0 -> PC" page. The file transfer is only possible when the engine is waiting (No synchronization, no load sharing).

8.1.3 Firmware upgrade

This page allows you to upgrade to the latest firmware that can be found on CRE technology Web site. See chapter Maintenance.

8.2 TEXT FILE DESCRIPTION

8.2.1 Variable naming

The file named A51 V1 9 0030x.xls describes each variable.
The variable format is VXYYYY.

X relates to the type of variable:

- 0 and 1: a reading or a real-time value (Voltage phase 1, CAN bus fault …)
- 2, 3 and 4: a setting to store in non-volatile memory (Generator number, Nominal power …)

YYYY is the code of the variable.

The parameters are stored in a non-volatile FLASH memory in the unit. It is possible to download or upload them with a PC, which allows the user to save, modify and reuse them later.
All these values are stored in the text file. This chapter describes the layout of the file.

8.2.2 Text file description

The complete unit setup can be contained in a simple text file. This file can be downloaded from UNIGEN 2.0 to be kept on a PC. It can also be manually edited on a PC and sent to UNIGEN 2.0 to fully setup it in a single step.
This text file is made up of different blocks:

- Parameter values
- Label definitions
- Text definitions
- Unit and accuracy definitions

Parameter definition block

The block start is the {PARAMETERS} statement. Each setting (2000 … 4000) 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: V02000)
- The parameter value (Ex: 2)
- The label (optional: only for user information) (Ex: Nb of gen.)
- The minimal value (optional: only for user information) (Ex: +00001)
- The maximal value (optional: only for user information) (Ex: +00032)
- Unit

Example:

```
{PARAMETERS}
V02000        2             Nb of gen.                    +00001 +00032
V02001        1             GE number                     +00001 +00032
```

It is possible to modify the values directly in the text file before uploading it into UNIGEN 2.0. The user must be sure that the modified value is within the minimum / maximum range of the parameter. Failure to do so leads to an error message during uploading (see chapter 9.3).
It is also possible to write to an **incomplete** parameter block (not all parameters are displayed in the list). When uploaded, such a file modifies only the parameters which have been entered, the others remain unchanged. This procedure can be used to upload an old text file into a newer module or to activate special features independently.

Label definition block

The block start is the {LABELS} statement. This block is used to define custom labels for CRE Config and the LCD (digital I/Os, analog Is, CANopen I/Os, relay outputs, cycles before maintenance).
Each line of this block contains 2 elements:

- The variable number of the text, preceded by the letter L for label
- The text itself between quotes

```
{LABELS}
L01130 Sample label
```

Labels are 14 characters long.
Supported characters include [a...z], [A...Z], [0...9] and the following characters:

<space> ?! # $ ( ) * + / : ; = [ ] ^ _ . -

All other characters are NOT recommended, and will be replaced by ? characters.

Note: All custom labels apply to all languages.

Text definition block

The block start is the {TEXTS} statement. Each line of this block contains 2 elements:

- The variable number of the text, preceded by the letter T

- The text itself between quotes

This block includes two items for the logo page and one for hostname:

Text	
T0001	CRE Technology
T0002	www.cretechnology.com
T0003	Hostname

Texts are 21 characters long at most.

Units and accuracy definition block

The block start is the {UNITS} statement.
This block defines what kind of units and accuracy is associated with each analog value.
You need to define only the unit of the analog input itself. All associated parameters (thresholds for instance) are automatically modified accordingly.
The table below lists the different units supported by UNIGEN 2.0.
Only the three programmable analog inputs have an entry in this block (to get the variable number, refer to the file A51 V2 9 0030x.xls).
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 use of unit and accuracy is described in 8.3.3.

{UNITS}
U00150 14
U00151 18
U00152 00
…
A00150 1
A00151 1
A00152 0
…

The table below shows the list of codes which correspond to the supported accuracies and units. In the examples above, analog input #1 (150 variable) is displayed in mBar (Unit code = 14) and with one decimal digits (Accuracy code = 1).

Code	Accuracy	Code	Unit	Code	Unit	Code	Unit	Code	Unit	Code	Unit
		00	" "	**Power-energy**		**Pressure**		**Temperature**		**Time**	
0	1	**Electrical**		07	kW	13	Bar	18	°C	24	s
1	0.1	01	V	08	kWh	14	mBar	19	°F	25	h
2	0.01	02	kV	09	kVAR	15	kPa	**Volume**		26	days
3	0.001	03	mA	10	kVARh	16	PSI	20	L	**Time related**	
		04	A	**Rotating speed**		**Angle**		21	m^3	27	Hz/s
		05	kA	11	rpm	17	°	22	mm^3	28	m^3/h
		Frequency		**Percent**		**Mass**		23	Gal	29	L/h
		06	Hz	12	%	31	kg			30	Gal/h

8.3 I/O LINES

8.3.1 Digital inputs

Each input is tagged with a label defined in CRE Config/Configuration, and features several attributes set in the Configuration menu:

- Validity
- Direction
- Delay
- Function

Configurable input label

This is the name you give to the input. The name shows in the info, alarm, and fault screens if programmed accordingly.

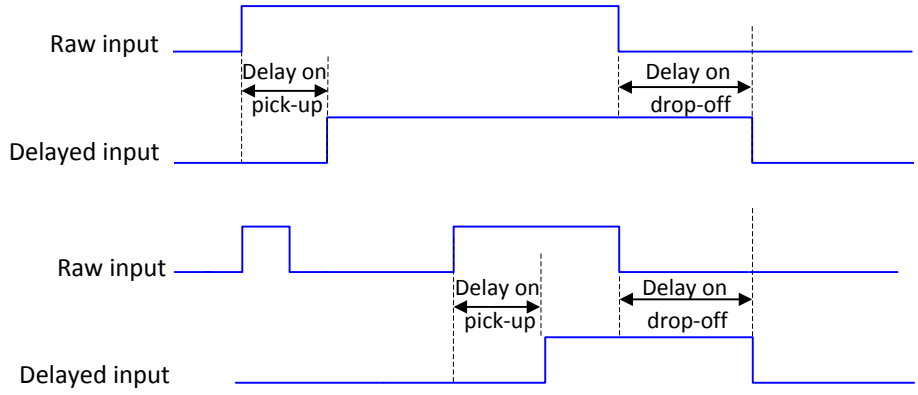
Direction

For each input, two options are available:

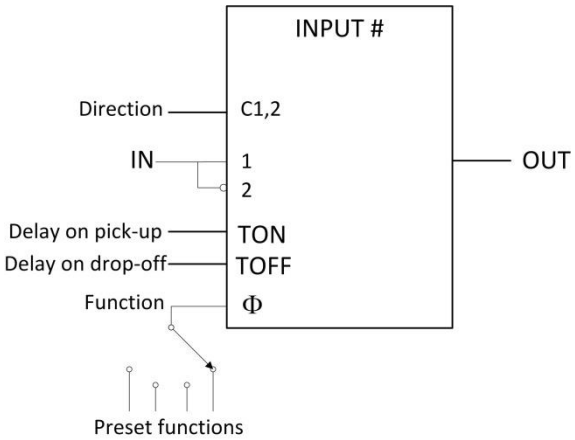
Num	Label	Function
0	Norm open	Used unless the input is used for protection
1	Norm close	Normally closed; must be selected if the input is normally connected to 0V and is opened when active

Delays

For each input, two delays can be defined in 100ms steps between 0 and 6553s.



Summary



Note: If a digital input changes a piece of data also to be written by Modbus, the latest request takes over the other. If 2 digital inputs are assigned to one function, the latest change is taken into account.

Input functions

ESSENTIAL INPUTS

Function	Use/Description	Ref. chapter
Not used	Must be selected if the input is not connected (default value generally)	
Generator breaker feedback	Generator breaker position feedback	*4.3*

UNIGEN CONTROL

Function	Use/Description	Ref. chapter
Load request	This digital input (optional) allows you to control the load ramp and the unload ramp. In this way, you can : - Keep the generator low limit after a synchronization - Keep the generator low limit after an unload ramp.	3
UNIGEN activation	In load dependant start/stop, it allows to indicate which generator must be taken in the election.	*3.2.3*

FRONT PANEL BUTTONS

Function	Use/Description	Ref. chapter
Fault reset	External reset. Alternative to local fault reset in Fault and Alarm pages	*4.2.5*
Test leds	Activates all LEDs of the module in order to check that the LEDs work	

EXTERNAL ALARMS/FAULTS

Function	Use/Description	Ref. chapter
Generator fault request	External protection set a generator fault.	*4.1.1*
Remote alarm	External protection set an alarm on the product	ibidem
Stop horn	Selective external reset; in addition, an output must be preset to Horn	*4.1.2*

ALTERNATIVE SELECTIONS

Function	Use/Description	Ref. chapter
Nominal speed 2	Alternative nominal speed selected	
Nominal voltage 2	Alternative nominal voltage selected	
Nominal power 2	Alternative nominal power (kW/kVAR) selected	

CAN BUS INHIBITION

Function	Use/Description	Ref. chapter
CAN bus inhibition GEn	Order to logically withdraw from CAN bus the UNIGEN 2.0 whose number is n.	*3.2.1*

8.3.2 Digital and relay outputs

Each output is tagged with a label defined in CRE Config/Configuration, and features several attributes set in the Configuration menu:

- Direction
- Pulse length: 0 means no pulse
- Function

Directions

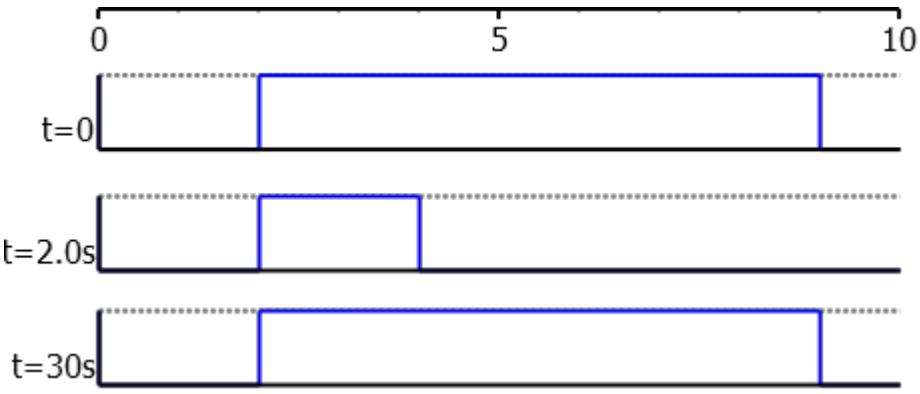
Each output can be:

- **NE**: normally energized; the output is **de**-energized when its function is activated
- **ND**: normally de-energized; the output is energized when its function is activated

Pulse length

Each digital output can be configured to act as a pulse. The pulses lengths are defined with the parameters E2761 to E2766.

Set to 0 in order to have a continuous output (No pulse).



Output functions

ENGINE COMMANDS

Function	Description	Ref. chapter
Excitation command	Static paralleling: energizes the AVR excitation relay	3.5

LEDS STATUS

Function	Description	Ref. chapter
Faults LED	Reflects the led status	
Alarm LED	idem	
Generator LED	Reflects the led status	

GENERATOR STATUS

Function	Description	Ref. chapter
Generator ready	Activated when generator voltages and frequency are stable	
Generator voltage presence	Activated if the generator is started and a voltage is detected	
Generator active power flow	Voltage detected and breaker close	
Generator stop	Activated if generator is at rest	
Available in automatic	Activated in « Load dependant start/stop» when one generator is	

	available to start (UNIGEN Activation activated)	

SPEED/VOLTAGE COMMANDS

Function	Description	Ref. chapter
Increase speed by pulse	Speed regulator requiring +/- contacts	*5.4*
Decrease speed by pulse	Speed regulator requiring +/- contacts.	ibidem
Increase voltage by pulse	*Idem* speed	ibidem
Decrease voltage by pulse	*Idem* speed	ibidem

ALARMS/FAULTS SUMMARY

Function	Description	Ref. chapter
Generator electrical faults summary	External panel. Trigger: at least one generator-detected “fault”	*4.1*
Alarms summary	External panel. Trigger: at least one generator-detected “alarm”	ibidem
Horn	External horn or flashing light. Activated whenever a protection triggers. The output is activated when one or more of summary outputs is activated, and reset on acknowledgment	*4.1.2*

In addition, most protection activations described in chapter 4.2 can be reported on a digital output. On CRE Config, they are listed by categories as shown below. These outputs are available only if the associate alarm/fault is configured.
ENGINE PROTECTION
GENERATOR PROTECTION
COMMUNICATION FAULTS

OTHERS

Function	Receiver	Ref. chapter
Unused	Must be selected if you do not connect the output (default value)	
Start request	Only « Load dependant start/stop ». This digital input must be connected to start the engine.	3.2.3
Low limit is reached	This digital output is set at the end of an unload ramp. It allows to open the breaker automatically with an external product.	

8.3.3 Analog inputs

In addition to the speed and electrical currents and voltages, three analog inputs are available. They measure a resistance 0…500Ω. However, they can serve as digital inputs or 20 mA transducer input.

Input

Each input is tagged with a name and preset to a function. It features several attributes preset in CRE Config/Configuration/Inputs/Analog inputs:

- **Accuracy** (number of digits after decimal point) among 1 / 0.1 / 0.01 / 0.001
- **Unit**, among 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
- **Calibration**, measure value according to resistor value in Ω

Calibration

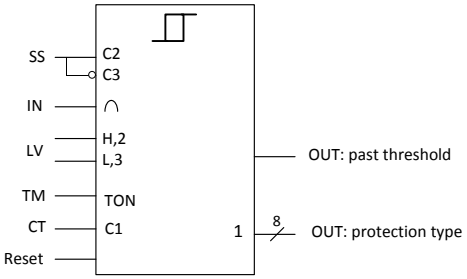
Calibration is used to estimate a reading from a resistance value by interpolation between 2 wrapping resistance values. Negative values are supported for readings. Enter a table in CRE Config /Configuration/Inputs/Analog inputs/Analog Measure Calibration or in text file.
Select the Accuracy, desired grade of details for tweaking and manual entering: 0.001, 0.01, 0.1 or 1.

Enter the limits of reading according to the sensor calibration; generally the lower limit is 0 and the slope is Range/Rating. Calculate and enter the intermediary readings to get a linear distribution.

Protections

The input threshold features several attributes preset in CRE Config/Configuration/Protections/ Analog inputs protection:

- Level (LV): limit value in units; it can be a low or high threshold
- Delay (TM): time after which the trespassing is confirmed
- Validation (CT): protection type to which the signal contributes (3 potential values; see chapter 6.1)
- Direction (SS): is it a low (0) or high (1) threshold



Summary

The attributes show in the text file:

	Threshold				
	Level	Delay	Validation	Direction	Function
AI 1 level 1	2600	2601	2602	2606	2607
AI 1 level 2	2603	2604	2605		
AI 2 level 1	2608	2609	2610	2614	2615
AI 2 level 2	2611	2612	2613		
AI 3 level 1	2616	2617	2618	2622	2623
AI 3 level 2	2619	2620	2621		

Use of an analog input as a digital input

To mimic a digital input, connect the input to Power– through a switch, and select the function to implement in the list CRE Config/Configuration/Analog inputs/Function. Refer to 8.3.1.
Then set the delay, validity and polarity.

Use of an analog input as a transceiver input

To mimic a 20mA input, connect the input with a 39Ω resistor between the analog input and the analog common, and select the function 20mA transceiver in the list CRE Config/Configuration/Analog inputs/Function. The non-linearity of the sensor can be corrected through a curve. Select the tweaking grade – the resolution in actual value – in accordance with the sensor accuracy.

9 MAINTENANCE

9.1 UPGRADING THE SOFTWARE

Prerequisite:

1. Upgrading software is done via the Ethernet connection. It's mandatory to have a PC and to connect on UNIGEN 2.0
2. Stop the generator
3. Save the current configuration as a text file; refer to chapter 8.1.1 Otherwise the default settings will be enforced (except for the Ethernet settings)
4. Disconnect all the terminals, except the power supply and Ethernet connections.

Start upgrade:

1. Connect to **CRE Config/System/PC transmit-receive** or to UNIGEN 2.0 web site
2. Select **Update firmware** and browse the archive (UNIGEN 2.0 version .zip, ex: v1.00.zip)
3. Click on **Update** button
   Alarm/Fault leds blink and state is display on LCD screen
4. Wait until ***Update firmware successful*** shows
5. If need, restore the settings from the text file previously save.

Note: During upgrading (about 2 minutes), UNIGEN 2.0 re-start. Wait until you receive the end of upgrade before using UNIGEN 2.0.

9.2 ADDING A CUSTOM HMI LANGUAGE

By default, 4 languages are available: English, French, Spanish, Italian.
In addition, two custom languages can be embedded in UNIGEN 2.0.
To add your own language, 2 steps are necessary:

1. **Translation**

- Ask for the Excel file to CRE Technology or your own dealer
- Fill in the columns for the new language: labels meant for your UNIGEN 2.0 model.
- Return the Excel file to CRE Technology or your own dealer that will send you back a .bin file

2. **Downloading**
   When you receive the related .bin file, in **CRE Config/System/PC transmit-receive**, download .bin file via **Upload file** command.
   Wait until *Download successful* shows.

Note: Unless the contrary is expressly stipulated, CRE Technology reserves the right to use your translation for other uses.

9.3 TROUBLESHOOTING

To get a history of alarms-faults, stop the generator, connect to CRE Config/System/PC transmit-receive/Download log file from UNIGEN 2.0, and click Download.

To restore factory settings into CRE Config, navigate to CRE Config/System/PC transmit-receive/Reset factory settings, and click Reset.

Message "Sensor lost" fault on start
In "Configuration/Engine/Speed control settings", check that the speed measurement origin is accurate (Speed measure = Magnetic or Alternator or J1939).
If it originates in the alternator, check the voltage presence on terminals Gen L1, L2, L3, N.

If it originates in a magnetic pick-up, check that the engine speed increases up to 1500rpm

Message "CAN bus" fault

Check the related connections, including the one of internal resistor (jumper). Refer to the *Appendix*.

For inter-UNIGEN bus, check the related settings: count of generators, number of each generator.

No J1939 communication

Check that the ECU is powered.
Check that the configuration correspond to the engine/ECU.
Check that the wiring is correct. Refer to the *Appendix*.
Power cycle UNIGEN 2.0 and ECU.
Check that the ECU and its settings are consistent with the J1939 standard.
Note: Some ECUs do not provide information if the engine is on stop.

The engine starts but runs above/below nominal speed.

Check the wiring.
Check the speed output. Refer to 5.2.

No connection with the PC: consider deactivating the firewall.

List of potential error messages when transferring a file to UNIGEN 2.0

Note: … indiquate a variable number, a label number or a text number according the error message. It will help you to locate your error in your configuration file.

ERROR 001: Only when genset is STOP

File transfer between computer and the unit should be done only when all conditions below are met i.e. when engine is stopped.

ERROR 002: Unknown file type

The file type send is unknown. Check the selected file.

ERROR 004: Write data or checksum error

ERROR 008: Update failed. Please restart update.

Write error in flash during update of the software. Restart the update of the software.

ERROR 010: Variable …. doesn't exist.

The parameter doesn't exist. Check compatibility of the version/type of the module and the configuration file.

ERROR 011: No write right on variable ….

Access to this variable is not allowed. Only parameter can be modified.

ERROR 012: No write right on label ….

Access to this label is not allowed. Check your configuration file.

ERROR 013: Text …. doesn't exist.

Access to this text is not possible because it doesn't exist. Check compatibility of the version/type of the module and the configuration file.

ERROR 014: No write right on …. unit

Access to this unit is not allowed. Check your configuration file.

ERROR 015: Need password 2 to write on …. variable

Actual password is not sufficient to access such configuration/control level.

ERROR 017: Configuration not allowing …. variable value

The actual setting of the module doesn't allow modifying this parameter with this value. Check your configuration file and the value of the parameter before sending again your configuration file.

ERROR 018: Variable …. out of range

The value of the parameter is out of range. Check your configuration file before sending again.

ERROR 019: Wrong value for …. variable

An unexpected value has been detected on this parameter. Check the value of the parameter before sending again.

Ex: a text character has been detected instead of a number.

ERROR 020: Language file not for UNIGEN 2.0

The language file send doesn't correspond to a language file for UNIGEN 2.0. Check the selected language file.

ERROR 021: Too much languages already download

The maximum number of language supported by UNIGEN 2.0 has been reached.

ERROR 022: Wrong language file version

The language file version is above to the UNIGEN 2.0 version. Upgrade your UNIGEN 2.0 with the latest version available or catch the language file compatible with your UNIGEN 2.0 version.

ERROR 023: Label …. doesn't exist.

Modifying this label is not allowed. Check the label number before sending again the configuration file.

ERROR 024: Unit …. doesn't exist.

Modifying this unit is not allowed. Check the unit number before sending again the configuration file.

ERROR 025: Wrong accuracy value on …. (0,1,2 or 3)

The value of the accuracy is out of range. The value must be between 0 and 3.

ERROR 026: Wrong unit value on …. (from 0 to xxx)

The value of the unit is out of range. The value must be between 0 and xxx.

ERROR 027: No header in language file

No header or wrong header of the language file. Check the selected language file before send it again.

ERROR 028: No filename found or too long

No filename or filename is too long. The maximum size of a filename is 40 characters. Rename file and send it again.

ERROR 029: Wrong accuracy on parameter ….

The value of the modify parameter has not the right accuracy. Check the value of your parameter before sending again you configuration file.
Ex: Below, it's missing the digit a the tenth 5.0**0**

V02205 5.0_ ESG amplitude +000.00 +010.00V

Warnings do not prevent the module to work but inform the user of a potential problem in his configuration file.

WARNING 001: Wrong size of label ….

WARNING 002: Wrong character entered in label ….

WARNING 003: Wrong size of text ….

WARNING 004: Wrong character entered in text ….

These advices indicate that entered labels/texts are too long or a character is not supported by module.

Invalid characters will be replaced by "?". The valid characters are the followings:

0123456789.-

ABCDEFGHIJKLMNOPQRSTUVWXYZ

!#$()+/:;=[]^_?*

abcdefghijklmnopqrstuvwxyz

The maximum size of a label is 14 characters and of a text is 28 characters.

Modify labels/texts according to the rules above.

WARNING 005: Too many errors...

All errors/warnings messages could not be displayed. There are probably other problems in your configuration file. Solve displayed problems and send your configuration file again in order to display the additional error/warning messages.

WARNING 006: No unit specify on unit ….

WARNING 007: No value specify on parameter ….

WARNING 008: No text specify on text ….

WARNING 009: No label specify on label ….

These warnings indicate that no value has been indicated inside the configuration file for an unit/parameter/text or label. The values will stay unchanged.

10 APPENDIX

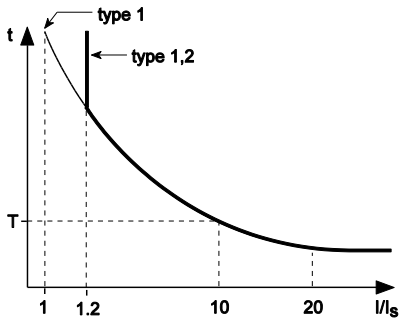
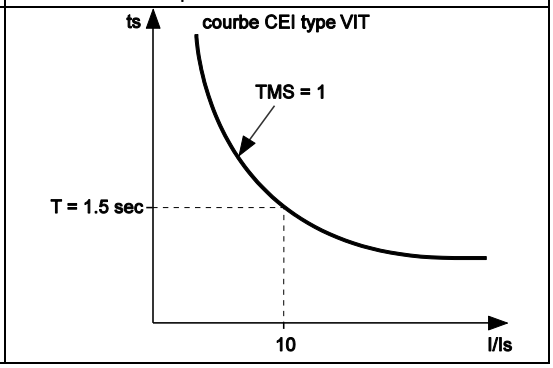
10.1 PROTECTION AGAINST SHORT CIRCUITS

The tripping time depends on the duration an alternator winding can endure an over current.

A IDMT (Inverse Definite Minimum Time) curve is defined by:

- a type (IEEE, IEC, IAC)
- Is: current for infinite time in type 1 (asymptote value); type 1.2 is not used
- T: tripping time for I= 10 x Is.
-

Definition of TMS (Time Multiplier Setting); by default, [2475] = 1:

T is the tripping time for I/Is = 10 (Is= set point, aka threshold)	TMS = 1 corresponds to T= 1.5 s at I = 10 x Is
	

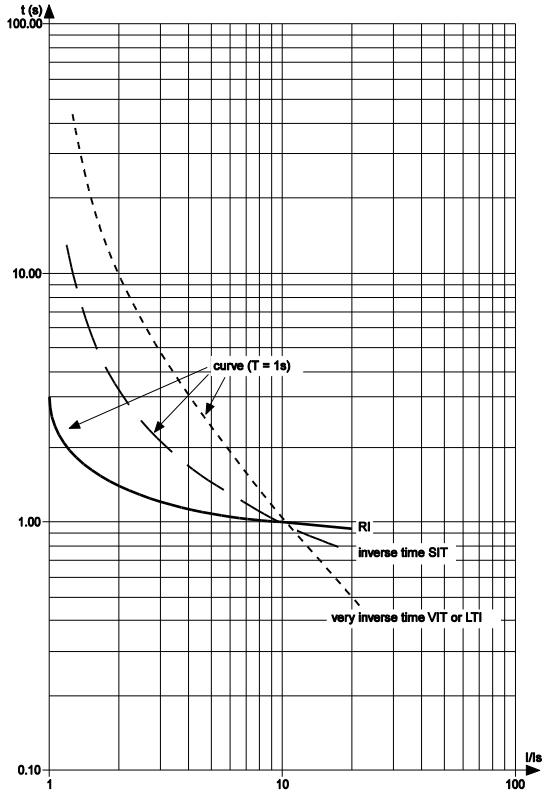
In brief, the higher the overcurrent, the faster the trip.

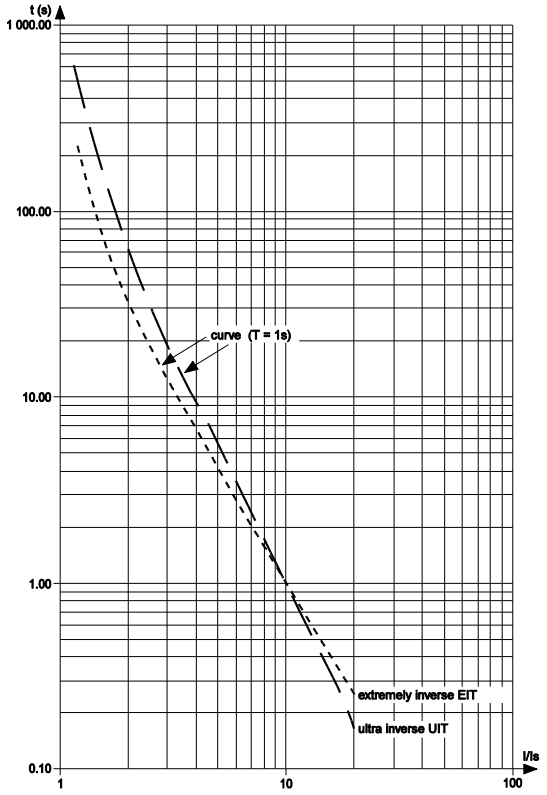
IEC CURVES

$$t(I) = TMS\ x\ \frac{k}{\left(\frac{I}{Is}\right)^{\alpha} - 1}$$

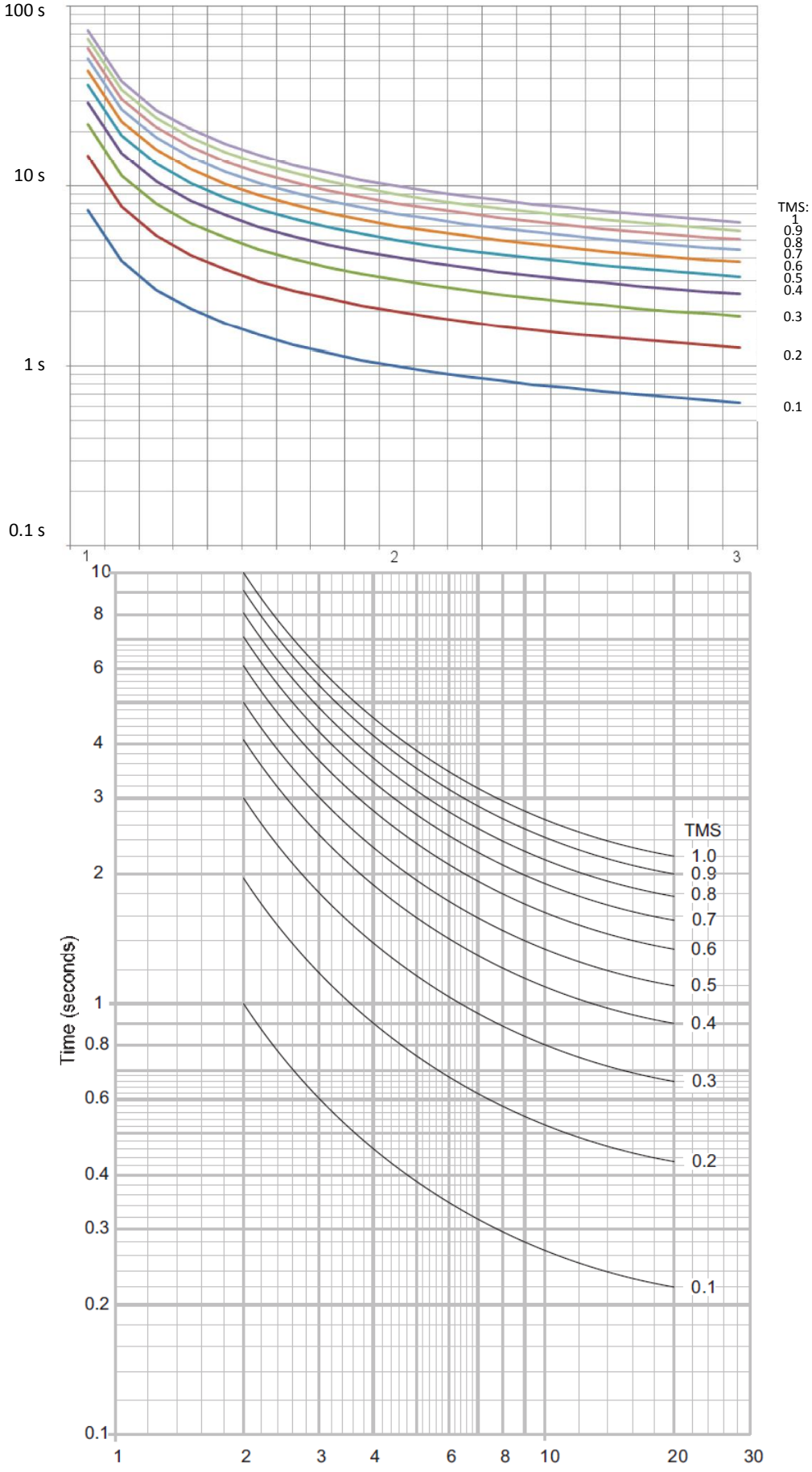
Characteristic curve	k	α (defines type A, B, C)	Selection in CRE Config	β
(Standard) inverse / A	0.14	0.02	Preset	2.97
Very inverse / B	13.5	1	Preset	1.5
Long time inverse / B	120	1	Custom	13.33
Extremely inverse / C	80	2	Preset	0.808
Ultra inverse	315.2	2.5	Custom	

The time from T curves must be divided by β to get the time from TMS curves. T curves where t=1 for I/Is=10:





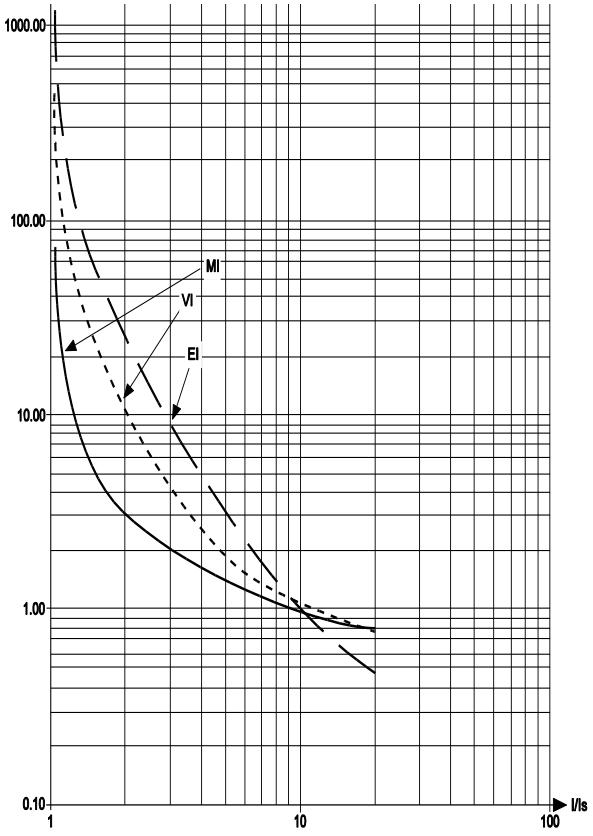
Inverse curves just above the pick-up value (not logarithmic abscissae I/Is) for various value of TMS:



IEEE CURVES

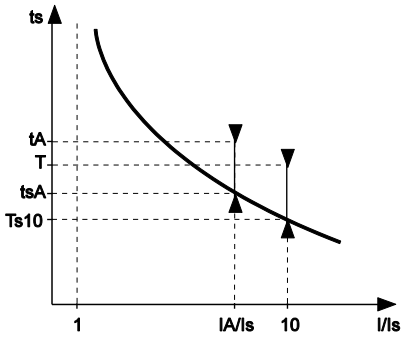
$$t(I) = TMS\ x\ (\frac{k}{\left(\frac{I}{Is}\right)^{\alpha} - 1} + c)$$

Characteristic curve	k	c	α
Moderately inverse	0.515	0.1140	0.02
Very inverse	19.61	0.491	2
Extremely inverse	28.2	0.1217	2



HOW TO DERIVE CURVES BY PARALLELISM

Say a curve is known. We know tsA (s stands for the start curve) for IA/Is (s stands for set point). Two curves with same k, α and c are parallel: K= tsA/Ts10 = tA/T. This can be used to find tA.



In the preceding curves in logarithmic plot, Ts10=1. For a given I/Is (first column of next table), find K in the row. Then ta = K x T.

I/Is	SIT IEC/A	VIT, LTI IEC/B	EIT IEC/C	UIT	RI not av.	IEEE MI IEC/D	IEEE VI IEC/E	IEEE EI IEC/F
1.0	—	—	—	—	3.062	—	—	—
1.1	24.700 (1)	90.000 (1)	471.429 (1)	—	2.534	22.461	136.228	330.606
1.2	12.901	45.000	225.000	545.905	2.216	11.777	65.390	157.946
1.5	5.788	18.000	79.200	179.548	1.736	5.336	23.479	55.791
2.0	3.376	9.000	33.000	67.691	1.427	3.152	10.199	23.421
2.5	2.548	6.000	18.857	35.490	1.290	2.402	6.133	13.512
3.0	2.121	4.500	12.375	21.608	1.212	2.016	4.270	8.970
3.5	1.858	3.600	8.800	14.382	1.161	1.777	3.242	6.465
4.0	1.676	3.000	6.600	10.169	1.126	1.613	2.610	4.924
4.5	1.543	2.571	5.143	7.513	1.101	1.492	2.191	3.903
5.0	1.441	2.250	4.125	5.742	1.081	1.399	1.898	3.190
5.5	1.359	2.000	3.385	4.507	1.065	1.325	1.686	2.671
6.0	1.292	1.800	2.829	3.616	1.053	1.264	1.526	2.281
6.5	1.236	1.636	2.400	2.954	1.042	1.213	1.402	1.981
7.0	1.188	1.500	2.063	2.450	1.033	1.170	1.305	1.744
7.5	1.146	1.385	1.792	2.060	1.026	1.132	1.228	1.555
8.0	1.110	1.286	1.571	1.751	1.019	1.099	1.164	1.400
8.5	1.078	1.200	1.390	1.504	1.013	1.070	1.112	1.273
9.0	1.049	1.125	1.238	1.303	1.008	1.044	1.068	1.166
9.5	1.023	1.059	1.109	1.137	1.004	1.021	1.031	1.077
10.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10.5	0.979	0.947	0.906	0.885	0.996	0.981	0.973	0.934
11.0	0.959	0.900	0.825	0.787	0.993	0.963	0.950	0.877
11.5	0.941	0.857	0.754	0.704	0.990	0.947	0.929	0.828
12.0	0.925	0.818	0.692	0.633	0.988	0.932	0.912	0.784
12.5	0.910	0.783	0.638	0.572	0.985	0.918	0.896	0.746
13.0	0.895	0.750	0.589	0.518	0.983	0.905	0.882	0.712
13.5	0.882	0.720	0.546	0.471	0.981	0.893	0.870	0.682
14.0	0.870	0.692	0.508	0.430	0.979	0.882	0.858	0.655
14.5	0.858	0.667	0.473	0.394	0.977	0.871	0.849	0.631
15.0	0.847	0.643	0.442	0.362	0.976	0.861	0.840	0.609
15.5	0.836	0.621	0.414	0.334	0.974	0.852	0.831	0.589
16.0	0.827	0.600	0.388	0.308	0.973	0.843	0.824	0.571
16.5	0.817	0.581	0.365	0.285	0.971	0.834	0.817	0.555
17.0	0.808	0.563	0.344	0.265	0.970	0.826	0.811	0.540
17.5	0.800	0.545	0.324	0.246	0.969	0.819	0.806	0.527
18.0	0.792	0.529	0.307	0.229	0.968	0.812	0.801	0.514
18.5	0.784	0.514	0.290	0.214	0.967	0.805	0.796	0.503
19.0	0.777	0.500	0.275	0.200	0.966	0.798	0.792	0.492
19.5	0.770	0.486	0.261	0.188	0.965	0.792	0.788	0.482
20.0	0.763	0.474	0.248	0.176	0.964	0.786	0.784	0.473

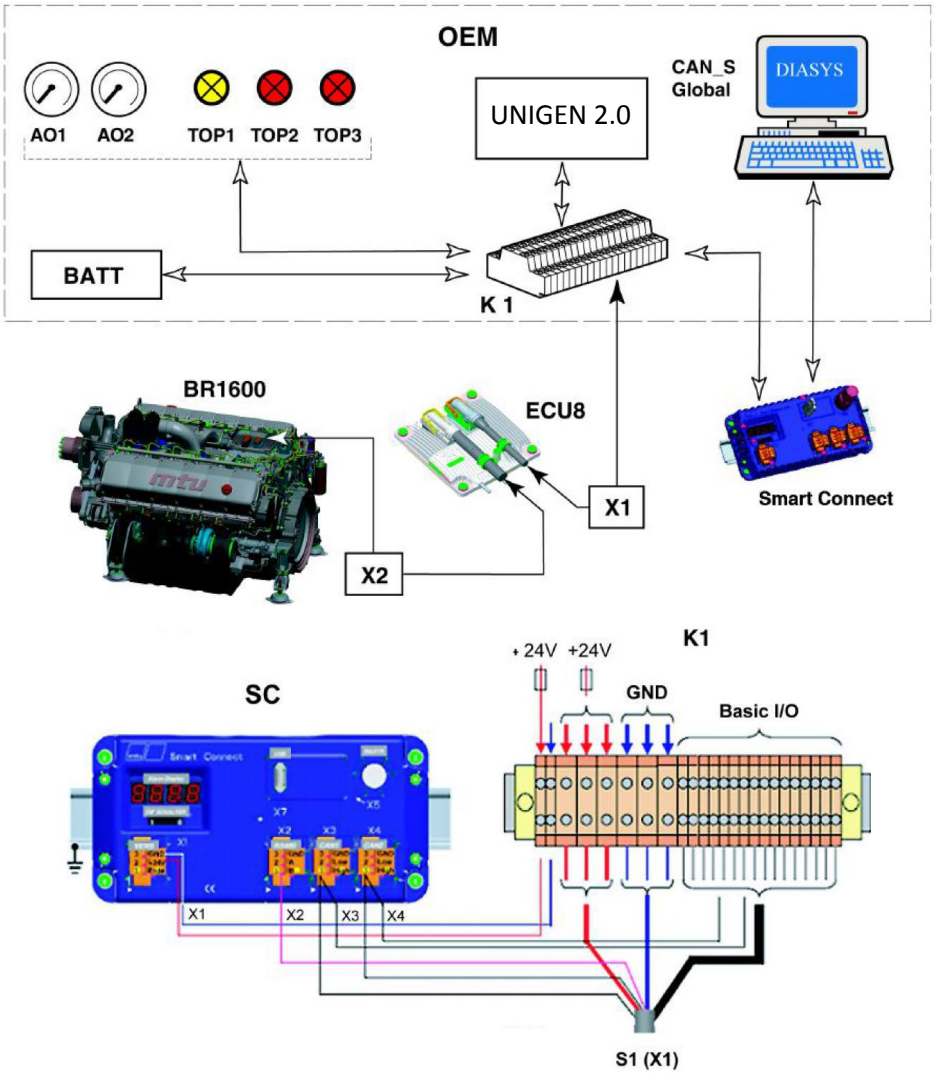
1) means Only valid for IEC curves

10.2 MTU J1939 COMMUNICATION

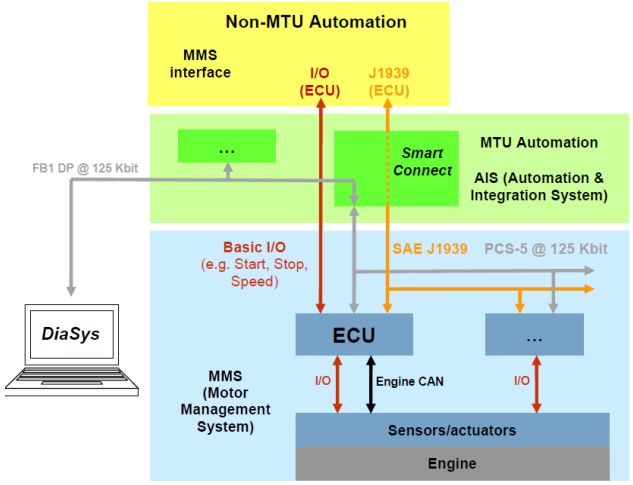
ECU 8

Smart Connect is used to:

- select the speed set point source through a 3-bit code,
- set the frequency and speed droop



Through the K1 connection box, the bus connects ECU8, Smart Connect and UNIGEN 2.0: one bus between ECU8 and Smart Connect, one bus between Smart Connect and UNIGEN 2.0. X4 is the Smart Connect J1939 CAN port.



10.3 CAN BUS GOOD PRACTICES

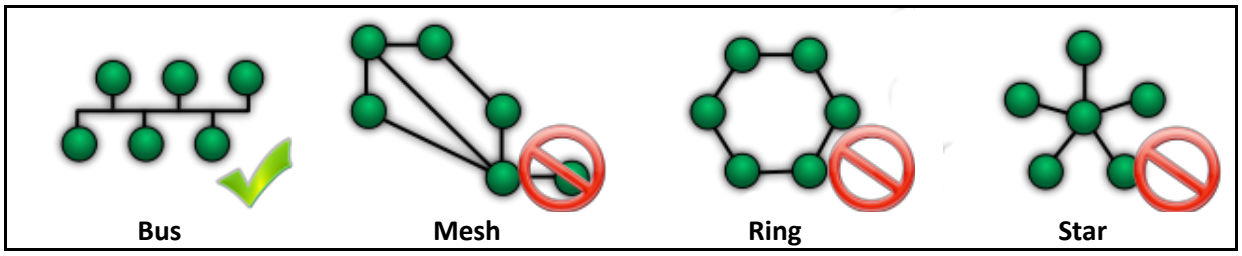
This chapter describes rules to be used to ensure reliable CAN communication. These rules must be applied to all CAN communications, including inter-UNIGEN CAN bus and ECU/remote I/O CAN bus.
In an EMI environment, use a shielded cable to connect CAN bus. The table below lists the standard CAN wiring :

Terminal	Standard CAN	Mandatory
1	Reserved	
2	*CAN-L*	*X*
3	CAN GND	X
4	Reserved	
5	CAN SHLD (optional)	
6	GND (optional)	
7	*CAN-H*	*X*
8	Reserved	
9	CAN V+ (optional)	
SHIELD		*X*

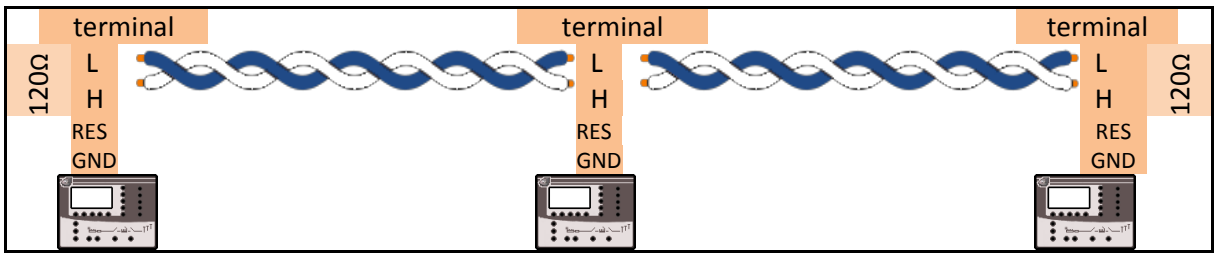
CABLES

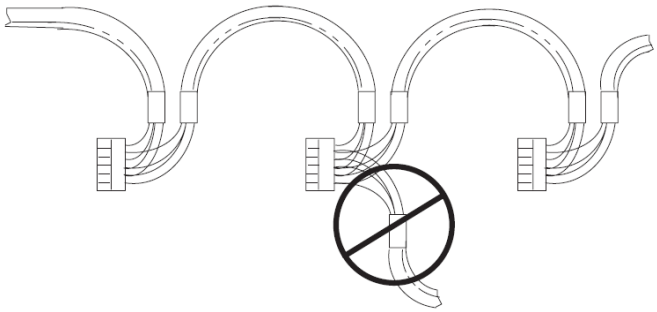
⚠ WARNING
RISK OF EQUIPMENT DAMAGE
Switch off the unit before plugging or unplugging the CAN bus connector or disconnecting the wires
Failure to follow this instruction can damage the CAN transmitter/receiver

Cables used must be selected to respond to CAN bus specificities. Always use shielded twisted wire pairs. Deploy the CAN bus in a bus (no mesh, ring or star topology) as shown below:



Both ends of the CAN bus must be terminated with a 120Ω resistor.
The next figure gives the example of three units connected through a CAN bus. Do NOT install any resistor in the middle unit and connect the incoming wire and the outgoing wire on the same terminal (max 1.5 mm² or AWG16; use preferably the same section for both).





CRE Technology provides a complete range of products aimed at installing your CAN bus (cords, wires, connectors…). Please read the document Harness information or contact your local CRE Technology distributor to help you choose equipment that fits your needs.

MAXIMAL LENGTH & BIT RATE

The maximal length of a CAN bus depends mostly on the communication speed, but also on the quality of wires and connectors used.

The following table shows the maximal length of a CAN bus depending on the bit rate.

Bit rate (kbits/s)	10	20	50	125	250	500	800
Maximal length (m)	5000	2500	1000	500	250	100	50

The next table lists the standard bit rate of each CAN protocol that can be used by a CRE Tech. unit:

Bus	Protocol	Bit rate (kbits/s)	Note
CAN1	CRE Technology protocol	125	Fixed
CAN2	CANopen	125 (default)	Can be selected between 125/250/500/1000 kbit/s (By **CRE Config** software or modification by variable number)
	J1939 + CANopen	250	Fixed

CAN1: CRE TECHNOLOGY INTER-UNITS CAN BUS

This CAN bus is used as a communication means between units from a single power plant. Features are:

- Active and reactive load sharing
- Automatic load/unload
- Static paralleling
- Other data exchange

Standard CAN bus rules apply here. Refer to previous section to connect units properly on CAN bus.

CAN BUS FAULT

CAN communication between CRE technology units is continuously checked by each unit on the CAN bus. The count of units connected to CAN bus must be the same as the count of units declared inside each unit (count of UNIGEN 2.0 units). Otherwise a CAN bus fault is triggered. This may also occur if:

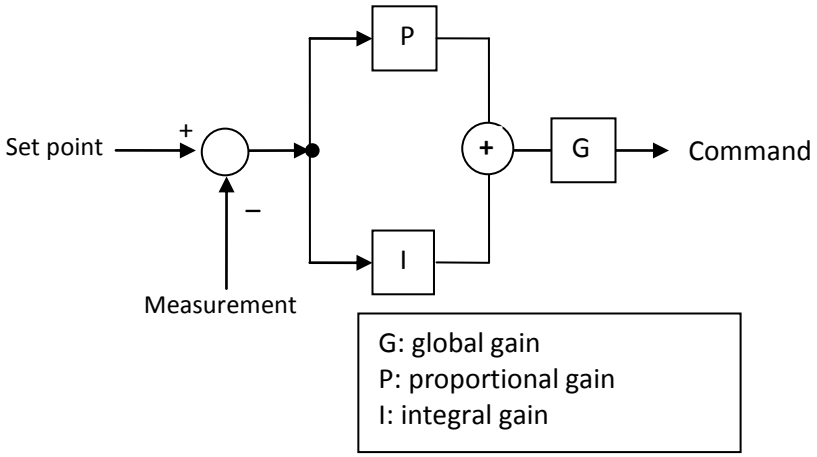
- Two or more units share the same unit number
- 120Ω termination resistors are not used correctly (see previous section)
- CAN bus cable is not properly connected.

This CAN bus fault can only be reset when the correct count of unit is seen on the CAN bus. As with every protection, the way to handle a CAN bus fault can be selected.

Note: If you disconnect a UNIGEN 2.0 from the inter UNIGEN 2.0 CAN bus, change the count of generators on ALL other UNIGEN 2.0 units of the power plant.

10.4 CONTROL LOOP TUNING

Each control is carried out by two actions: Proportional and Integral.



P adjusts the rise time (time needed for the system to reach its set point for the first time). Using only the P factor always leaves a static error between the set point and the actual value.

I reduces the deviation between the set point and the actual value.
By increasing P or I, the rise time decreases. However, the overshoot increases and may also make the system unstable (P: fast hunting, I: slow hunting).
G is a sensitivity adjustment for the other settings.

Empirical tuning:

A. First set G to 50%
B. Set the parameters P, and I to 0
C. Increase the value of P until the system becomes unstable. From this position, decrease the value of P to 60% of the previous value
D. If the system is unstable, decrease G; if it is too slow, increase G.

10.5 POTENTIELS ALARMS-FAULTS TABLE

Download the list from CRE Config/System/PC transmit-receive/Actions on alarm-fault, and tick the boxes to show how the alarms/faults contribute to severity indication and, if any, summary outputs (grey shade prompts usual choice):

	Generator Overfrequency (81H)		Generator Underfrequency (81L)		Generator Undervoltage (27)		Generator Overvoltage (59)		Min kVAR (37Q)		Max kVAR (32Q)		–kW (32RP)		–kVAR (32RQ)		Min kW (37P)		Max kW (32P)		Max I (51)		Max In (64G)		Short circuit (51)	Phase measure	Uneven kW	Uneven kVAR	Min battery voltage		Max battery voltage	
	H	HH	L	LL	L	LL	H	HH	L	LL	H	HH	H	HH	H	HH	H	HH	H	HH	H	HH	H	HH	courbe				L	LL	H	HH
1																																
3																																

1: Generator electrical Fault

3: Alarm

Notes :

1) CAN bus inter-UNIGEN faults are not shown.
2) H = level 1, HH = level2

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SKYPE: support-cretechnology.com (voice only)

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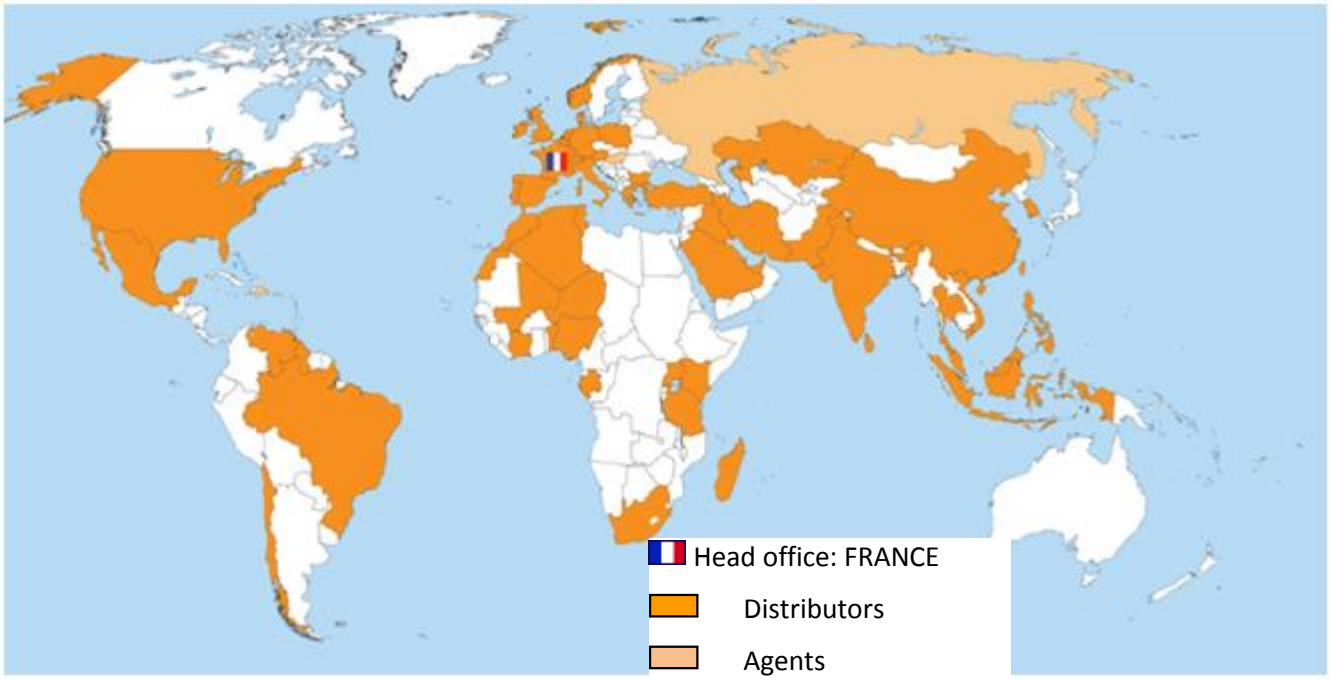

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