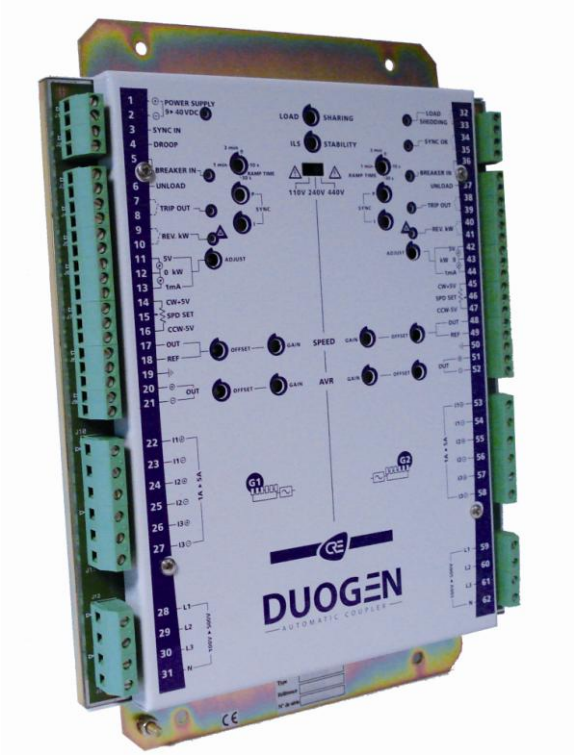
DUOGEN

Technical Documentation



"ALL IN ONE MODULE FOR THE CONTROL
OF 2 GENERATORS IN PARALLEL
TECHNICAL DOCUMENTATION"

Part Number:
A40 R0 9 0004 G En

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NOTE:

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

Motors, turbines and any other type of generator must be equipped with protections (overspeed, high temperature, low pressure,…depending on the power plant).

Any changes of the normal use of the equipment can cause human and material damage.

For further information, please contact your CRE technology distributor or the After-Sales Service Team.

All CRE Technology products are delivered with one year warranty, and if necessary we will be happy to come on site for product commissioning or troubleshooting. The company also provide specific trainings on our products and softwares.

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INFORMATION

You can download the most up-to-date version of this documentation and different other documentations relating to DUOGEN on our web site:

http://www.cretechnology.com/

NOTE :

Read the technical manual and application notes before wiring and putting DUOGEN into service.

For technical assistance and training contact your local distributor.

Safety is of the utmost importance, when Synchronising and Paralleling generators.

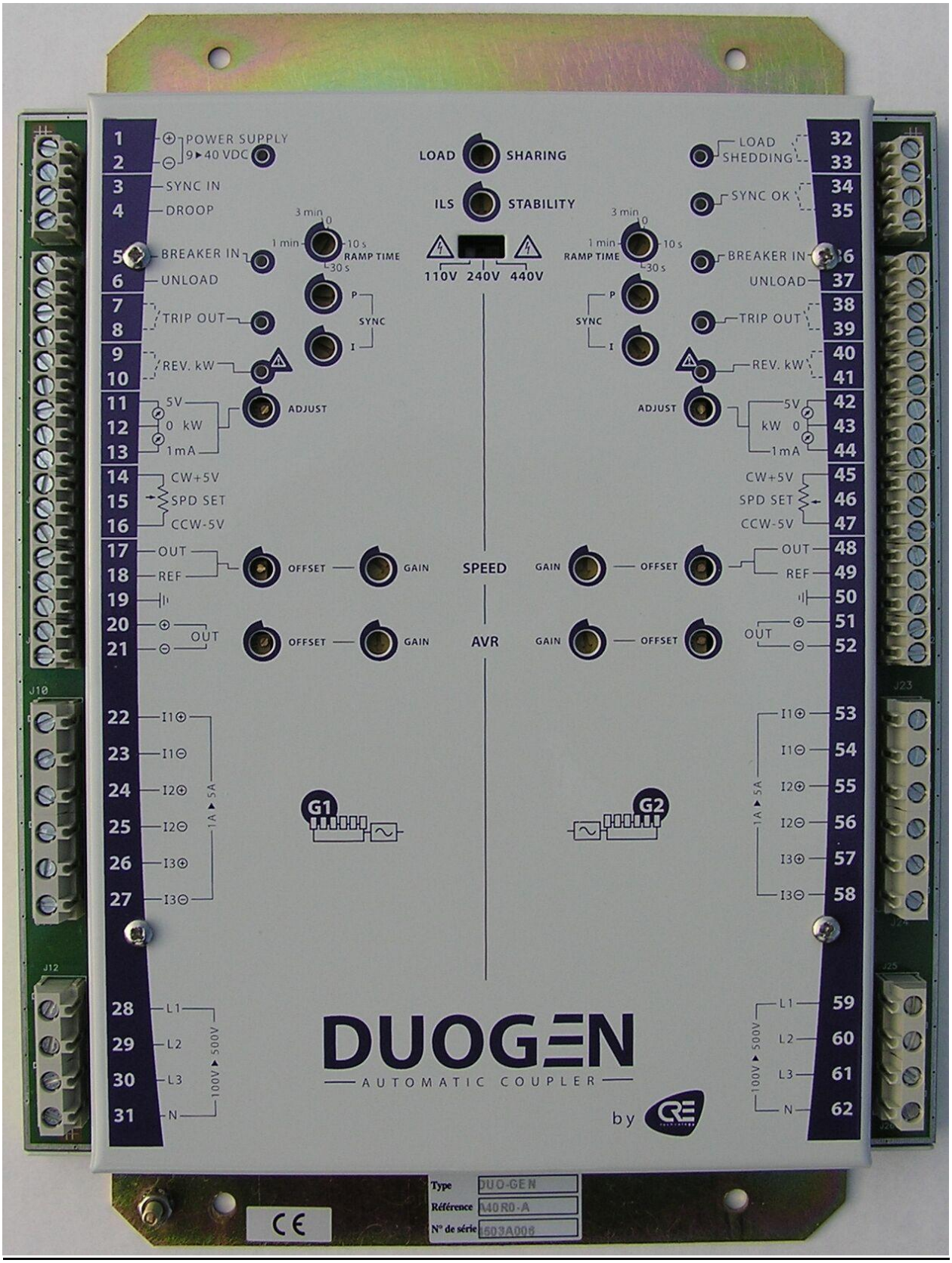
Available documentation for DUOGEN in website:

- A40R090004-_ = Technical documentation in English.
- A40R090002-_ = Technical documentation in French.
- A40R090100-_ = Application note, wiring diagram of DUOGEN with 2 automatic start modules.
- A40R090101-_ = Application note, connection to speed governors.

TABLE CONTENT

1 OVERVIEW

1.1 FRONT PANEL



1.2 A SINGLE UNIT FOR THE CONTROL OF 2 GENERATORS

DUOGEN, microprocessor based unit, controls the kW and kVAR of 2 generators in a single unit. In a technical and price effective point of view, DUOGEN is the perfect solution for the paralleling of 2 generators.

DUOGEN features are:

- Automatic and Manual synchronization.
- kW load sharing in isochronous or droop mode.
- kVAR load sharing in isochronous voltage or droop mode.
- Compatibility with all the speed governors and AVR on the market.
- Remote speed control by potentiometer.
- Internal synch check relays, useful for auto and manual synchronization.
- Load dependant start and stop of the slave generator.
- 2 reverse Kw relays, one for each generator.
- 2 analogue outputs (0-5V or 0-20mA) for kW meter display.

1.3 APPLICATIONS

Two generators in parallel, emergency power plant in change over mode:

Synchronization and load sharing of both generators are managed by DUOGEN. Automatic and Manual mode.

Two generators in parallel, emergency power in no-break change over mode:

The C2S ORANGE (CRE Auto synchronizer, ref. A25W0) manages the back synchronization with the mains.

See Application Note: A40R090100

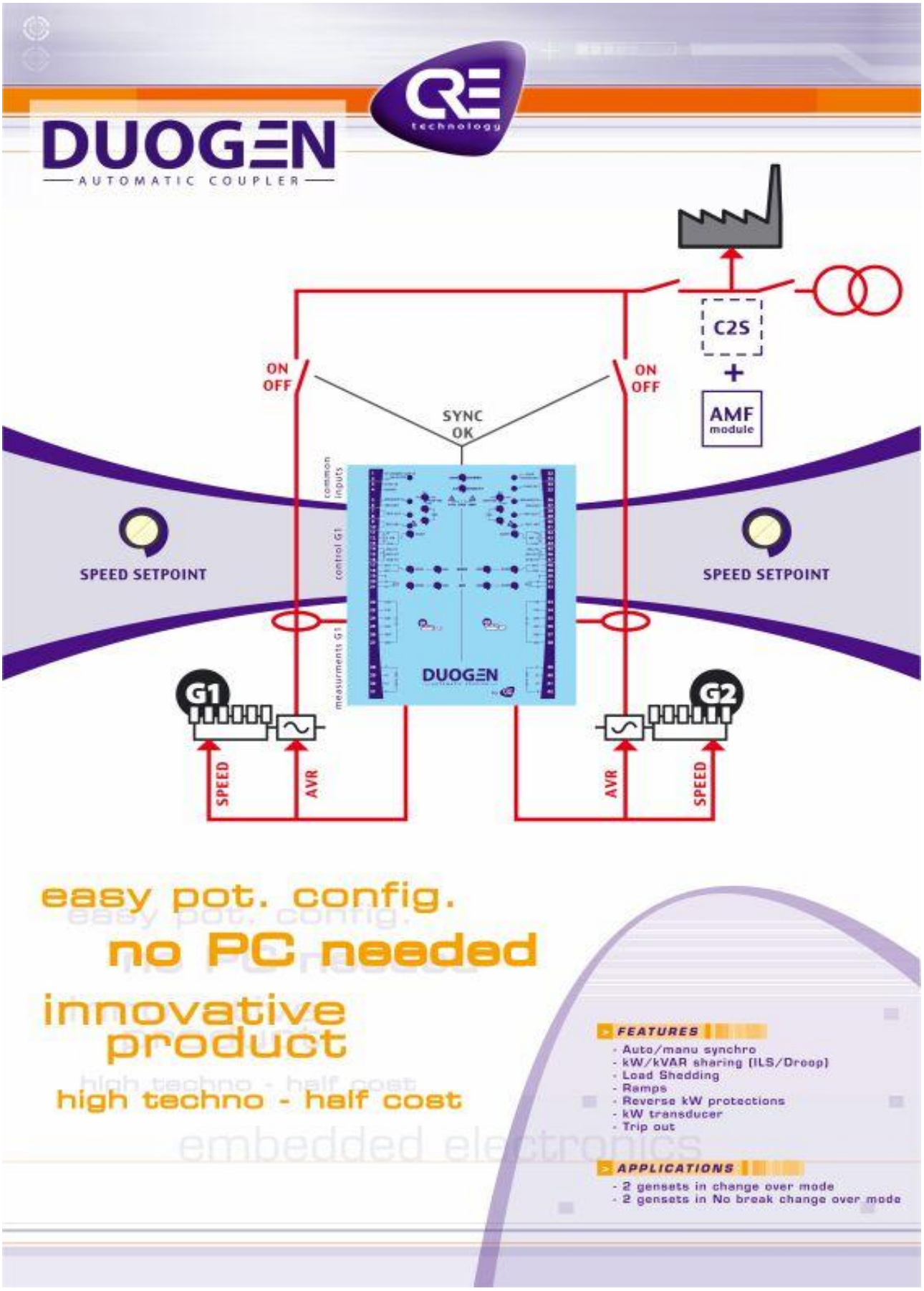
Marine Application:

DUOGEN is compatible with governors with internal droop. DUOGEN includes a de-drooping control.

The frequency of the bus bar will always be 50,00Hz or 60,00Hz.

Gas, fuel, water and steam turbines compatibility:

DUOGEN is compatible with all kind of prime movers.


DUOGEN
AUTOMATIC COUPLER
technology
C2S
+
AMF
module
ON
OFF
ON
OFF
SYNC
OK
common inputs
control G1
measurments G1
SPEED SETPOINT
SPEED SETPOINT
DUOGEN
G1
G2
SPEED
AVR
AVR
SPEED
easy pot. config.
no PC needed
innovative product
high techno - half cost
embedded electronics
FEATURES
- Auto/manu synchro
- kW/kVAR sharing (ILS/Droop)
- Load Shedding
- Ramps
- Reverse kW protections
- kW transducer
- Trip out
APPLICATIONS
- 2 gensets in change over mode
- 2 gensets in No break change over mode

2 FEATURES

2.1 SYNCH CHECK RELAY

SYNC OK output (terminal 34 + 35) permit the coupling of 2 generators when all following conditions are correct:

- Voltage of G1 and G2 within a 70 - 130% window from nominal voltage.
- Voltage difference between G1 and G2, < 10%
- Frequency of G1 and G2 within a 70 - 130% window from nominal frequency
- Phase Angle difference between G1 and G2. <+/- 10°
- Frequency difference between G1 and G2, < 0,01Hz

This relay output is always active whatever the status of the generators. The relay is closed when the conditions are correct. This output is NOT dependant of the SYNC IN (terminal 3) input.

2.2 SOFT KW TRANSFER

2.2.1 LOAD AND UNLOAD REQUESTS

The Load /Unload ramps are managed by the UNLOAD inputs (terminal 6 for G1 and terminal 37 for G2):

- UNLOAD input disconnected = when the breaker closes, the load ramp start immediately
- UNLOAD input connected to 0v = the generator starts an unload ramp.

G1 Load / Unload ramps are fully independent from G2 Load / Unload ramps.

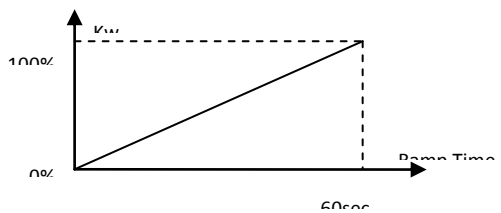
> **NOTE**: As G1 Load/Unload ramps are fully independent from G2 Load /Unload ramps, it is important to avoid loading or unloading both generators at the same time. If you do so, the frequency of the bus bars with change.

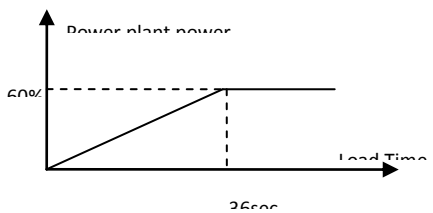
2.2.2 RAMPS

Ramp sequences:

- The first generator on the bus bars takes immediately the load with no ramp.
- The second generator load ramp stops when both generators have the same load.
- The unload ramp stops when the power reach 5% of its nominal power.
- Load and Unload ramp rates are using the same potentiometer.

The single turn potentiometer named RAMP TIME adjusts the ramp time from 0 seconds to 180 seconds. This setting is the time to transfer 100% of the nominal power.





2.2.3 END OF UNLOAD TRANSFER AUTOMATIC TRIP

TRIP OUT 1 (terminal 7 & 8) and TRIP OUT 2 (terminal 38 & 39) are used to open the breakers once the unload ramp is finished.

The relay is closed when the Kw of the generator which is unloading reach 5% of the nominal Kw. The TRIP OUT green LED confirms the activation of the relay:

- ❖LED ON = contact closed
- ❖LED OFF = contact open

2.3 REVERSE KW RELAY

DUOGEN includes 2 reverse kW relays, terminal 9 + 10 for Generator 1 and terminals 40 + 41 for Generator 2.

This relay output closes when the kW of the generator is below -5% of the nominal kW during more than 20 seconds.

The red LED is ON to confirm the activation of the relay:

- ❖ LED ON = contact closed
- ❖ LED OFF = contact open

2.4 LOAD DEPENDANT START OF SLAVE GENERATOR

The LOAD SHEDDING relay output can be used to start and stop the slave generator depending on the load request:

- ❖ If the power plant load goes below 20% of the nominal power during more than 3 minutes, LOAD SHEDDING relay will open to ask the slave generator to stop.
- ❖ If the power plant load goes above 80% of the nominal power of the master generator during 30 seconds, LOAD SHEDDING closes to ask the slave generator to start.
- ❖ If the load is between 20 and 80% of the nominal power than the actual number of generators on the bus bars will not change until 20% or 80% threshold is reached.

Note: At start up, LOAD SHEDDING relay is closed. Both generators are started because it is impossible to know the level of load before start.

2.5 KW INDICATOR

DUOGEN includes one Kw output for each generator:

- ❖ Terminal 11, 12 and 13 for generator 1
- ❖ Terminals 42, 43 and 47 for generator 2

Those outputs allow the display of the kW with a 0-5VDC or 0-20mA instrument scaled in kW.

Multi-turn ADJUST potentiometers tune the output nominal Kw to calibrate the instrument.

2.6 REMOTE SPEED CONTROL INPUT

DUOGEN includes a remote speed control input for each generator:

- ❖ Terminals 14, 15 and 16 for generator 1
- ❖ Terminals 45, 46 and 47 for generator 2

Those 3 wires inputs (+5v, cursor, -5v) are design to accept 5 K/Ohms external potentiometers.

The mid point of those potentiometers (5 turns for a 10 turns potentiometer) will generate a 0V signal to the cursor input and will not generate any speed deviation.

The maximum speed deviation is + / - 3,00Hz:

- ❖ +5V applied on cursor input will increase the speed of + 3,00Hz
- ❖ -5V applied on cursor input will decrease the speed of -3,00Hz

Those inputs can also be used as 0-5Vdc for a master PLC control. In this case the nominal speeds have to be adjusted with 2.5 V_{DC} applied on cursor inputs.

2.7 LOAD SHARING

Isochronous mode

When DROOP (terminal 4) input is opened, DUOGEN is in isochronous mode.

The LOAD SHARING potentiometer adjusts the load levels between generators:

- CW direction -> Generator 1 power increases and Generator 2 power decreases
- CCW direction -> Generator 2 power increases and Generator 1 power decreases

The ILS STABILITY potentiometer adjusts the response time of the load sharing.

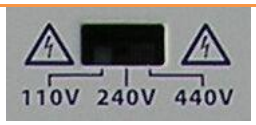
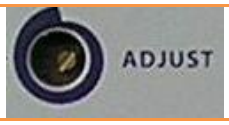
Droop mode

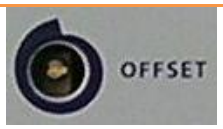
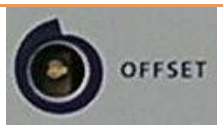
When DROOP (Terminal 4) input is connected to 0 VDC, DUOGEN is in droop mode.

Kw and Kvar load sharing are managed with Droop. Frequency and voltage droop default settings are set to 5%.

3 SETTINGS

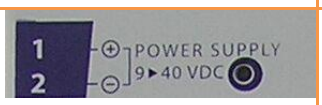
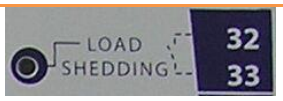
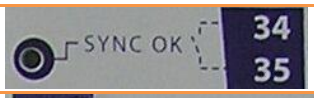
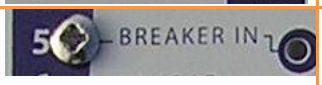
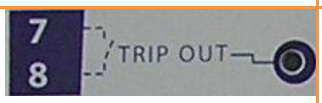
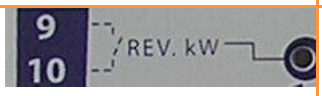
DUOGEN includes the following adjustments for calibration and settings:

Setting	Picture	Default value	Description
NOMINAL VOLTAGE		440V	3 positions switch for nominal voltage selection : Line to line voltage: 90 to 140V : position 110V 200 to 290V : position 240V 350 to 500V : position 440V Single switch for both generators. Note: if a wrong nominal voltage is chosen, there will be no damage but the calculations will be incorrect.
% LOAD SHARING		6h	Single turn potentiometer for kW balance adjustment Note : 2 identical generators, Pot adjusted at 6h Pnom G1 > Pnom G2, turn in CW direction Pnom G2 > Pnom G1, turn in CCW direction
ILS STABILITY		6h	Single turn potentiometer for load sharing response time adjustment. Single potentiometer for both generators. Note: Turn in CW direction till the generators are unstable then, turn 2 hours back in CCW direction.
RAMP TIME		0s	Single turn potentiometer (0.0 - 180s). This setting adjusts the time for LOAD and UNLOAD ramps. 1 potentiometer for each generator.
SYNCHRO Proportional SYNCHRO Integral		6h 6h	Single turn potentiometers. Proportional gain adjustment of synchronization. 1 setting for each generator. Single turn potentiometers. Integral adjustment of synchronization. 1 setting for each generator.. Synchronization adjustment: Turn P and I fully Counter Clockwise Turn P potentiometer till the generator is unstable, Come back in CCW to stop the instability. I potentiometer is adjusted with the same procedure.
ADJUST KW monitor		Not adjusted	Multi turn potentiometer (0-100%). Output span adjustment kW (0-5V or 0-20mA). One setting per generator.

OFFSET Speed control output		Not adjusted	Multi turn potentiometer (-10 to +10 V_{DC}). Adjustment of the Offset of the speed output. Used to adjust the nominal frequency of the generator (ex: 50,00Hz). One potentiometer per generator.
GAIN Speed control output		6h	Single turn potentiometer (Span from 0 to 10V_{DC}). Span adjustment of the speed control output. Used to adjust the maximum deviation asked by DUOGEN = +/-3 Hz One potentiometer per generator.
OFFSET Voltage control output		Not adjusted	Multi turn potentiometer (-10 to +10 V_{DC}). Offset adjustment of the voltage control output. Used to adjust the nominal voltage of the alternator (ie. 400 VAC) One potentiometer per generator.
GAIN Voltage control output		6h	Single-turn potentiometer (Span from 0 to 10V_{DC}). Span voltage control output. Used to adjust the maximum deviation: = +/- 8% of the nominal voltage. One potentiometer per generator.

4 DISPLAY

DUOGEN: LED displays

Led		Description
POWER SUPPLY		Green LED. This LED is ON when DC power supply (12 or 24 V_{DC}) is connected.
LOAD SHEDDDING		Green LED. This LED is ON when the relay LOAD SHEDDING is closed.
SYNC OK		Green LED. This LED is ON when synchronous condition OK
BREAKER IN		Green LED. This LED is ON when the breaker is closed. 1 LED per generator.
TRIP OUT.		Green LED. This LED is ON when the relay TRIP OUT is closed. 1 LED per generator.
REV kW		Red LED. This LED is ON when the relay REV kW is closed. 1 LED per generator.

5 TERMINALS

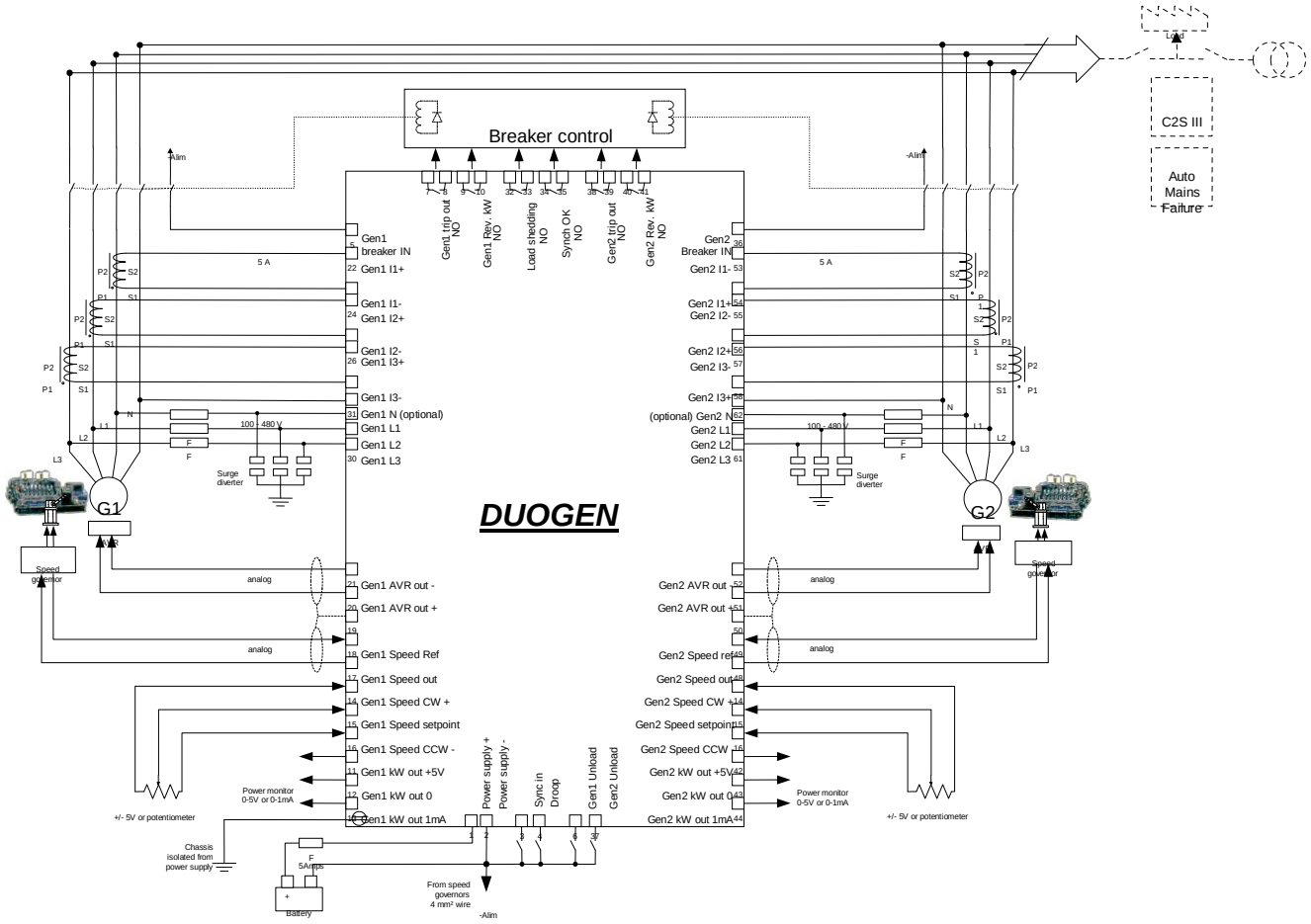
5.1 TERMINALS DESCRIPTION

Terminal n°	Description	Wire (mm² / AWG)	Commentaries
1	POWER SUPPLY +	2.5 / 14	DC Voltage from 9 to 40 V_{DC}, 10 Watt. Twist protection. Note: Terminal 2 MUST be connected to both 0v of the speed governors with a 4 mm² wire. Fuse: 5 Amps / 40 V_{DC}.
2	POWER SUPPLY -	2.5 / 14	
3	SYNC IN	1 / 18	None isolated digital input, Dry contact to 0v (10 kOhms pull-up). This input activates the automatic synchronization If G1 on the Bus bars -> synchronization of G2 If G2 on the bus bars -> synchronization of G1.
4	DROOP	1 / 18	None isolated digital input, Dry contact to 0v (10 K/Ohms pull-up). This input forces Kw and Kvar load sharing in DROOP mode.
5	G1 BREAKER IN	1 / 18	None isolated digital input, Dry contact to 0v (10 K/Ohms pull-up). This input gives the position of generator 1 breaker to the DUOGEN. Use a direct Aux contact of the breaker.
6	G1 UNLOAD	1 / 18	None isolated digital input, Dry contact to 0v (10 K/Ohms pull-up). This input generate an unload ramp of generator 1.
7	G1 TRIP OUT	1 / 18	Dry contact; normally open. 250 V_{AC}, 5A. This output controls the opening of generator 1 breaker at the end of the unload ramp.
8	G1 TRIP OUT	1 / 18	
9	G1 REV KW	1 / 18	Dry contact; normally open. 250 V_{AC}, 5A. The relay is closed when generator 1 is in reverse.
10	G1 REV KW	1 / 18	
11	G1 KW monitor (0 – 5V) +	1.5 / 16	DC analogue output 0 – 5V (Terminals 11 and 12) Or 0 – 1mAmps (Terminals 12 and 13). This output (voltage and/or current) sends the actual value of generator 1, kW.
12	G1 KW monitor (0V)	0.25 / 24	
13	G1 KW monitor (0 – 1mA) +	0.25 / 24	
14	G1 SPEED SET CW +5V	0.25 / 24	Analogue input 5 K/Ohms potentiometer or 0-5 VDC between 16 (-) and 15 (+). Use a shielded wire. This input allows a manual remote control of G1 speed.
15	G1 SPEED SET cursor	0.25 / 24 *	
16	G1 SPEED SET CCW -5V	0.25 / 24 *	
17	G1 OUT speed control output	0.25 / 24 *	Analogue output +/-10 VDC. Use a shielded wire. This output controls the speed of generator 1 (offset and gain potentiometers) this output is compatible with all speed governors of the market.
18	G1 REF from speed governor speed control output	0.25 / 24 *	
19	Shield	0.25 / 24 *	Terminal to connect the shield of the analogue signals.

20	G1 AVR OUT G1 (+)	0.25 / 24 *	Isolated analogue output +/-10 VDC. This output controls alternator 1, voltage.(offset and gain potentiometers), this output is compatible with all AVRs of the market.
21	G1 AVR OUT G2 (-)	0.5 / 20 *	
22	G1 I1+	2.5 / 14	AC current inputs from generator 1. Current: from 0 to 5 A. Max current: 15 A during 10s. Load: 1 VA. The nominal current of the secondary of the current transformers must be as close as possible to 5Amps.
23	G1 I1-	2.5 / 14	
24	G1 I2 +	2.5 / 14	
25	G1 I2 -	2.5 / 14	
26	G1 I3 +	2.5 / 14	
27	G1 I3 -	2.5 / 14	
28	G1 L1	1.5 / 16	AC voltage input measurement G1. Line to line voltage from 100 to 500 VAC . Frequency: 50 or 60 Hz. Fuses: 100 ma. / 600 VAC. Note: If the neutral input is not connected, DUOGEN will generate an internal virtual neutral point.
29	G1, L2	1.5 / 16	
30	G1, L3	1.5 / 16	
31	G1, Neutral	1.5 / 16	
32	LOAD SHEDDING	1 / 18	Dry contact: Normally open, 250 V_{AC}, 5A. LOAD SHEDDING relay is closed when the load request exceeds 80% of the nominal power -> slave generator is to start. LOAD SHEDDING relay is opened when the load request is above 20% of the nominal -> Slave generator is to stop.
33	LOAD SHEDDING	1.5 / 16	
34	SYNC OK	1.5 / 16	Dry contact normally open, 250 V_{AC}, 5A. SYNC OK relay is closed when the coupling of the generators is safe: - Voltage difference within limits. - Phase difference within limits. Frequency difference within limits.
35	SYNC OK	1.5 / 16	
36	G2 BREAKER IN	1 / 18	None isolated digital input, Dry contact to 0v (10 K/Ohms pull-up). This input gives the position of generator 2 breaker to the DUOGEN. Use a direct Aux contact of the breaker.
37	G2 UNLOAD	1 / 18	Non isolated digital input, Dry contact to 0v (10 K/Ohms pull-up). This input generate an unload ramp of generator 2.
38	G2 TRIP OUT	1.5 / 16	Dry contact; normally open. 250 VAC, 5A. This output controls the opening of generator 2, breaker at the end of the unload ramp.
39	G2 TRIP OUT	1.5 / 16	
40	G2 REV KW	1.5 / 16	Dry contact; normally open. 250 VAC, 5A. The relay is closed when generator 1, is in reverse.
41	G2 REV KW	1.5 / 16	
42	G2 KW monitor (0 – 5V) +	0.25 / 24 *	DC analogue output 0 – 5V (Terminals 11 and 12) OR 0 – 1 ma. (Terminals 12 and 13). This output (voltage and/or current) sends the actual value of generator 2, kW.
43	G2 KW monitor (0V)	0.25 / 24 *	
44	G2 KW monitor (0 – 1mA) +	0.25 / 24 *	

45	G2 SPEED SET CW +5V	0.25 / 24 *	Analogue input 5 K/Ohms potentiometer or 0-5 VDC between 16 (-) and 15 (+). Use a shielded wire. This input allows a manual remote control of G2 speed.
46	G2 SPEED SET cursor	0.25 / 24 *	
47	G2 SPEED SET CCW -5V	0.25 / 24 *	
48	G2 OUT speed control output	0.25 / 24 *	Analogue output +/-10 VDC. Use a shielded wire. This output controls the speed of generator 2.(offset and gain potentiometers), this output is compatible with all speed governors of the market.
49	G2 REF from speed governor speed control output	0.25 / 24 *	
50	Shield	0.25 / 24 *	Terminal to connect the shield of the analogue signals.
51	G2 AVR OUT G1 (+)	0.25 / 24 *	Isolated analogue output +/-10 VDC. This output controls alternator 2 voltage. Thanks to the offset and gain potentiometers, this output is compatible with all AVRs of the market.
52	G2 AVR OUT G2 (-)	0.25 / 24 *	
53	G2 I1+	2.5 / 14	AC current inputs from generator 2. Current: from 0 to 5 A. Max current: 15 A during 10s. Load: 1 VA. The nominal current of the secondary of the current transformers must be as close as possible to 5Amps.
54	G2 I1-	2.5 / 14	
55	G2 I2 +	2.5 / 14	
56	G2 I2 -	2.5 / 14	
57	G2 I3 +	2.5 / 14	
58	G2 I3 -	2.5 / 14	
59	G2 L1	1.5 / 16	AC voltage input measurement G2. Line to line voltage from 100 to 500 VAC. Frequency: 50 or 60 Hz. Fuses: 100 ma. / 600 VAC. Note: If the neutral input is not connected, DUOGEN will generate an internal virtual neutral point.
60	G2, L2	1.5 / 16	
61	G2, L3	1.5 / 16	
62	G2, Neutral	1.5 / 16	

5.2 WIRING DIAGRAM



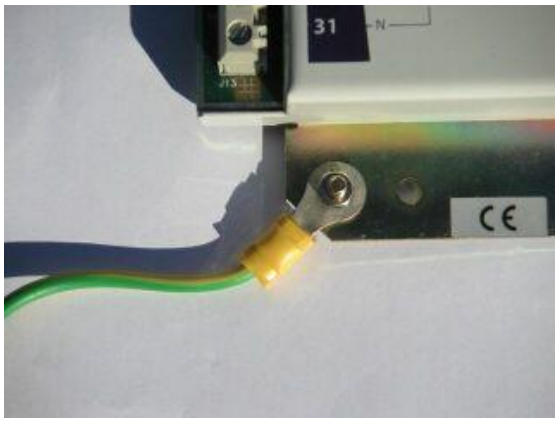
6 COMMISSIONING

6.1 CAUTION

6.1.1 GROUNGING :

DUOGEN grounding

The grounding of the chassis of DUOGEN must be done with the M5 screw. Use a 4mm² wire to connect to earth, this cable should be as short as possible.



6.1.2 WIRING RULES:

The cables with high voltage (400 VAC) and/or high current (5A) must be separated from the DC cables. All the command and digital inputs / outputs should be in the same cable path.

If you have to cross the command/DC cables with the 400V/5A cables, it is recommended to cross with a right angle.

The grounding must be done in a proper way to avoid personal injuries and for a reduction of EMC.

6.1.3 VIBRATIONS:

In case of heavy vibrations, the DUOGEN should be mounted using AV Mounts.

6.2 DUOGEN FACTORY SETTINGS CUSTOMIZATION

Please, fill the configuration form (last page of this documentation) and send it to your local CRE distributor .before receiving the DUOGEN.

The DUOGEN will be delivered with your specific settings.

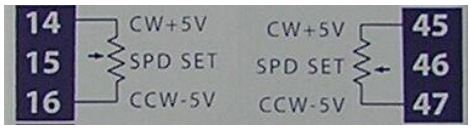
6.3 POWER PLANT START-UP

6.3.1 DUOGEN START-UP AND CALIBRATION

Caution: before starting the generating sets, please read the following part.

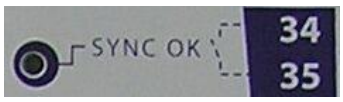
Why? To avoid any asynchronous synchronizing during the commissioning.

1. Check battery negative of DUOGEN power supply, governor 1, power supply and governor 2, power supply are all connected together.
2. Ask the electrical engineer who designed the panel to lock the circuit breakers in OFF (open) position.
3. Connect a 5 kOhms potentiometer to each « SPEED SETPOINT » inputs of DUOGEN.
4. Turn both potentiometers fully CCW.



5. Before switching ON the DUOGEN, adjust the nominal voltage switch on the range.

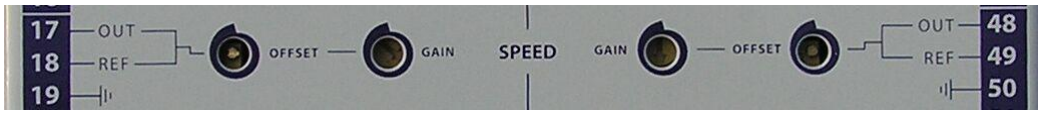
6. Disconnect terminal 34 of DUOGEN (Synch OK).



7. Disconnect AVR OUT + (terminal 20 and 51) and OUT – (terminals 21 and 52).

6.4 SPEED BIAS OUTPUTS ADJUSTMENT :

For each generator, repeat step 8 to 17.



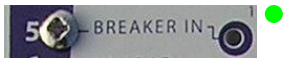
1. Generating set is stopped.
    a. Disconnect the terminal OUT. The REF terminal is still connected..
    b. Turn **GAIN SPEED CCW.**
    c. Switch ON the power supply of DUOGEN.
    d. Start the generating set.
    e. **Adjust** the frequency of the generating set to the nominal frequency (50.00 or 60.00 Hz) with the governor potentiometer.
    f. With a voltmeter, measure the voltage between the voltage reference and the speed input of the governor.
    g. Adjust DUOGEN **Offset Speed** to have the voltage between OUT and REF equals to the voltage of previous line (b.).

3. Stop the generator.
4. Turn the external potentiometer fully CCW (speed setpoint input).

Note: Without potentiometer, connect a jumper between the cursor input (15 and 17) and (46 and 47) the CCW terminal.

5. Connect the speed bias output OUT of DUOGEN
6. Start the generating set. The generator should run near the nominal frequency (50 or 60 Hz)
    a. Tune the **Offset Speed** potentiometer to reach **50.00HZ**
    b. Turn the **Gain Speed** potentiometer to reach **47 Hz** (or 57Hz). Note: Some analogue inputs of governors (Woodward DPG for example) are allowing only a +/- 3Hz deviation from the nominal frequency.
    c. Turn the external potentiometer fully CW, the frequency should reach **53Hz**. Note: The use of an external speed adjust potentiometer is recommended. If you don't have external potentiometer, add a jumper between terminal 15 and 16 and terminal 46 and 47.
    d. Adjust again the 50.00 Hz with the external potentiometer.
    e. Adjust the LOAD SHARING potentiometer at 6 O'clock.
    f. Adjust the ILS STABILITY potentiometer to 3 O'clock.

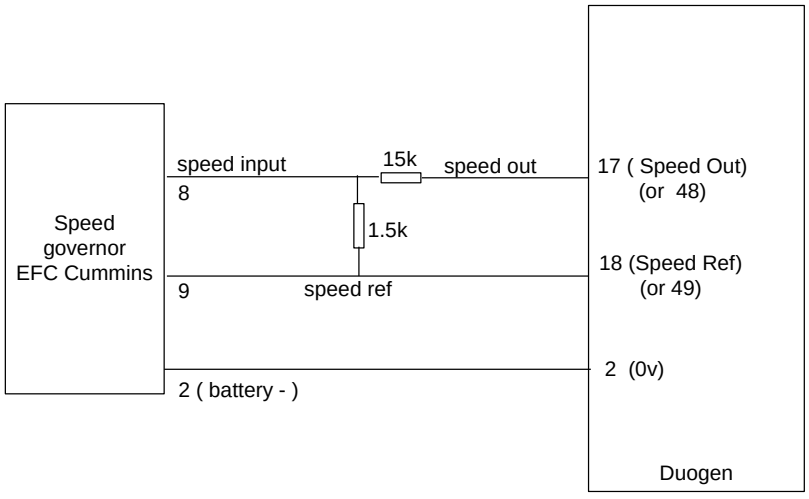
8. Close the circuit breaker of the generator. The BREAKER IN led must light.



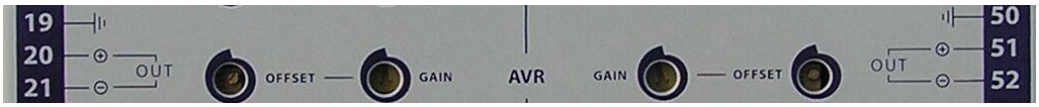
9. Apply load on the generator. The frequency of the generator should not change (DUOGEN includes a de-drooping feature).
10. Open the circuit breaker. BREAKER IN led switches OFF.
11. Stop the generating set.

Repeat steps 1 to 11 for the second generator.

Note: to connect to a Cummins EFC speed controller, the following wiring is necessary due to the sensitivity of the EFC speed input.



6.4 ADJUSTMENT OF THE 2 VOLTAGE BIAS OUTPUTS (AVR CONTROL). PRELIMINARY OPERATION.



1. Connect the outputs OUT + and OUT – to the AVR.
2. Adjust both GAIN fully CCW.

Adjustment of the 2 voltage bias outputs (AVR)

Note 1 : Unom is the nominal line to line voltage of the generator.

Note 2 : The target of this setting id to get a span of +/- 8% of Unom

Unom = 400 VAC then – 8% is more or less 370 VAC

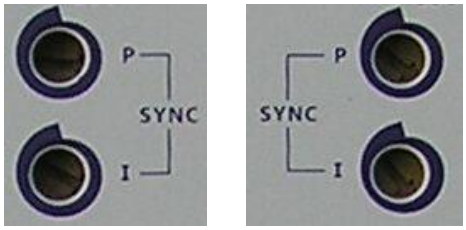
Unom = 240 VAC then – 8% is more or less 220 VAC

Unom = 110 VAC then – 8% is more or less 100 VAC

3. Adjustment of **G1**
   - Starts generating set G2
   - Adjust **G2** voltage to -8% if nominal voltage with the **G2 AVR OFFSET** potentiometer of DUOGEN (right side)
   - Start generating set **G1**
   - Adjust **G1** voltage to Unom with **AVR OFFSET** potentiometer (left side)
   - Close the circuit breaker of **G2.** BREAKER IN led should switch ON (right side).
   - Connect SYNCH IN input to 0v. Generating set G1 should not change its voltage.
   - Turn slowly in clock wise direction the **AVR GAIN** potentiometer (left side) until G1 has the same voltage of G2.
   - Wait for a stable voltage.
   - Disconnect SYNC IN input. G1 goes back to Unom.
   - Open G2 circuit breaker. BREAKER IN led switches off.

4. Adjustment of **G2**
   - Adjust **G1** voltage to -8% if nominal voltage with the **G1 AVR OFFSET** potentiometer of DUOGEN (left side)
   - Adjust **G2** voltage to Unom with **AVR OFFSET** potentiometer (right side)
   - Close the circuit breaker of **G1.** BREAKER IN led should switch ON (left side).
   - Connect SYNCH IN input to 0v. Generating set G2 should not change its voltage.
   - Turn slowly in clock wise direction the **AVR GAIN** potentiometer (right side) until G2 has the same voltage of G1.
   - Wait for a stable voltage.
   - Disconnect SYNC IN input. G2 goes back to Unom. Tune G2 voltage with the AVR OFFSET (right side). This is the final adjustment.
   - Open G1 circuit breaker. BREAKER IN led switches off.
   - Last adjustment: Adjust G1 to Unom with AVR offset (left side)
   - Stop both generators.

6.5 SYNCHRONIZATION ADJUSTMENT



1. Start both generators.
2. Close the circuit breaker of a **SINGLE** generating set. The breaker of the other must be locked OPEN.
3. Close SYNCH IN input to 0v. The other generator is synchronizing with the first one. The Breaker is still open.
4. Adjust the proportional and integral potentiometers (P & I SYNC) of the generator which is synchronizing like the following:
   - ❖ Adjust P and I fully CCW
   - ❖ Turn P till the synchronization in unstable. In this position, turn back till the instability disappears.
   - ❖ Adjust I in the same way.

Note: DUOGEN synchronization has a very good response time. Few seconds are enough to close the breaker (even with 2Hz difference).

5. When the generators are phase locked, the SYNC OK LED is switched ON.
6. With a voltmeter, directly placed on the circuit breaker itself, check that the voltage between the input and the output of the breaker is nearly 0 (less than 10 Volts for a 400 VAC system):
   - ❖ Between line 1 of G1 and line 1 of G2
   - ❖ Between line 2 of G1 and line 2 of G2
   - ❖ Between line 3 of G1 and line 3 of G2

Warning: This measurement must be done by a technician who is familiar with the commissioning of generators in parallel.

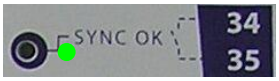
Repeat steps 1 to 6, to adjust the other generator.

7. Stop both generating sets
8. Connect the SYNCH OK output (Terminals 34 + 35)

6.6 LOAD SHARING TEST

1. Start one generator
2. Close its circuit breaker. The BREAKEN IN led switches ON.

3. Apply load on the generating set
4. Start the second generating set.
5. Connect the SYNC IN input to the 0v. The synch OK relay will close when the generators are in an acceptable window in term of phase, frequency and voltage. The SYNC OK led is lighted.



6. Adjust the stability of load sharing with ILS STABILITY potentiometer.

Adjust the load sharing balance with the potentiometer LOAD SHARING. The load should be perfectly shared

between both generators.

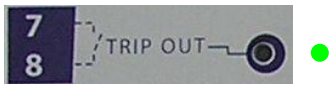
Note: If the generators are the same size, the potentiometer LOAD SHARING should be placed in half scale position.

6.8 LOAD AND UNLOAD RAMPS TEST (SOFT TRANSFER)

1. Adjust the potentiometer RAMP TIME to 30 seconds.

Note: 30s is the time to transfer 100% of nominal load. If the load to transfer is only 10% the transfer time will be 3s.

2. Connect the UNLOAD input of on generator to 0v. The generating set makes a soft transfer of the load to the other generator. Once the transfer is finished, the relay TRIP OUT is closing to ask the circuit breaker to be opened.



3. Open the UNLOAD input.
4. Close SYNC IN to 0v.
5. Synchronization of the generating sets normal sequence:
    a. SYNC OK relay closes -> The circuit breaker closes.
    b. The generator starts to take load from the other one (several second, depends on the amount of load to transfer and the setting of the Ramp time potentiometer).

Once the transfer is finished, both generating sets are taking the same load.

6.9 LOAD SHEDDING OUTPUT TEST (OPTIONAL)

1. With both generating set on the bus bar, apply a load smaller than 20% of the power plant load. After 3 minutes,

   the LOAD SHEDDING relay opens (the LED switches off) to show that a single generator is enough to supply

   the load.

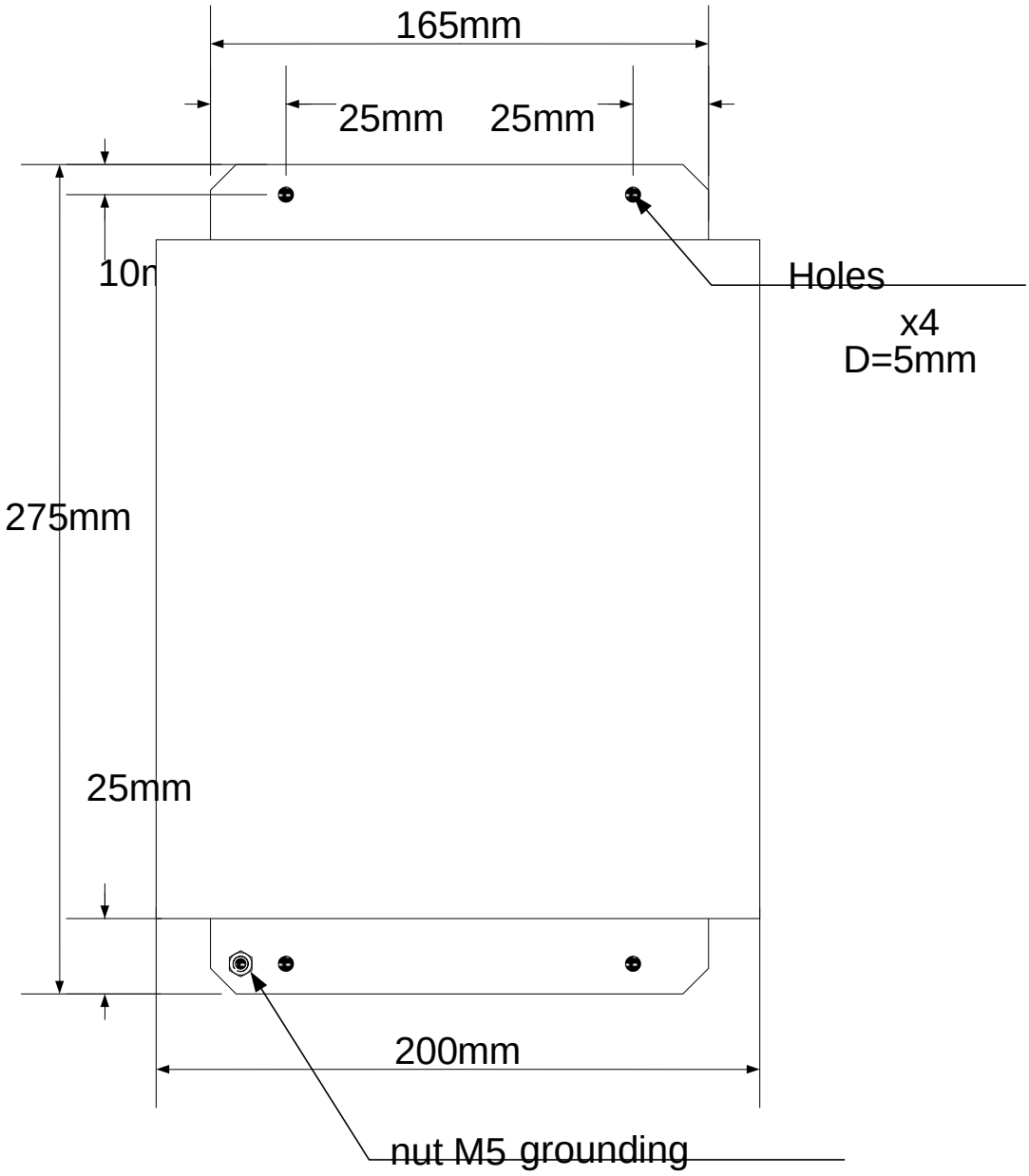
2. Stop one generator.

3. Increase the load above 80% of its nominal power. After 30 seconds the relay LOAD SHEDDING opens (the LED switches ON) to show that 2 generators are needed to supply the load.

7 ENVIRONNEMENT

- **Operational temperature:** -20 to + 85°C
- **Storage temperature:** -30 to +85°C
- **Humidity:** 5 to 95%. The PCB is tropicalized to be used in humid climate areas. Protection IP20.
- **Size:** 275x200x26mm
- **Mounting:** Can be placed in all positions.
- **Weight:** 1.5kg.
- **Directive CE:**
  - Generic emission standard : EN 50081-2, EN 50082-2
  - Generic immunity standard : EN 61000-6-2
  - Low voltage directive : 73/23EEC
- **Power supply:** 9 to 40 VDC, <1A with 12 V_{DC}; <500mA with 24 V_{DC}.
- **AC voltage inputs:** 100 to 500 V_{AC}, 100mA max. Le neutral wire can be connected or not.
- **AC currents inputs:** 0 to 5A, 1VA. Each input is isolated from the other ones
- **Possible over-current:** 15A during 10s.
- **Frequency measurement:** 45 to 70 Hz – 15 V_{AC} minimum between neutral and line.
- **Digital inputs:** NO, to be connected to 0v (internal pull up of 10 kOhms).
- **Relay outputs:** 5A, 230 V_{AC} max.
- **Remote speed control input:** potentiometer (5 kOhms) or 0-5 V_{DC}.
- **Kw monitor output (0-5 V or 0-1ma.):** the maximum load impedance for the 0-1 mA is 500 Ohms and the minimum load impedance for the 0-5 V_{DC} is 1 kOhms.
- **Speed bias output:** The frequency control is made by the adjustable 0-10 V_{DC} output. The adjustments are, Offset and Gain potentiometers.
- **Voltage bias output:** The voltage control is done via the AVR. The output is a +/-10V, output with Gain and Offset adjustments.
- **Terminals:** with screws, 2.5 mm^2.

8 DIMENSIONS



9 FACTORY CUSTOMIZATION OF DUOGEN

OBLIGATORY :

This must be filled and sent back by fax to your local CRE distributor. This form will be used by the distributor to customize the settings of DUOGEN in accordance with your application.

Nominal frequency of the power plant	50Hz ☐		60Hz ☐	
	Generator G1		**Generator G2**	
Active power **Nominal kW**				
Reactive power **Nominal Kvar**				
Voltage transformer ratio **PT**				
Current transformers ratio **CT**				
 **OBLIGATORY** Manufacturer and part number of the speed governor				

10 CRE TECHNOLOGY

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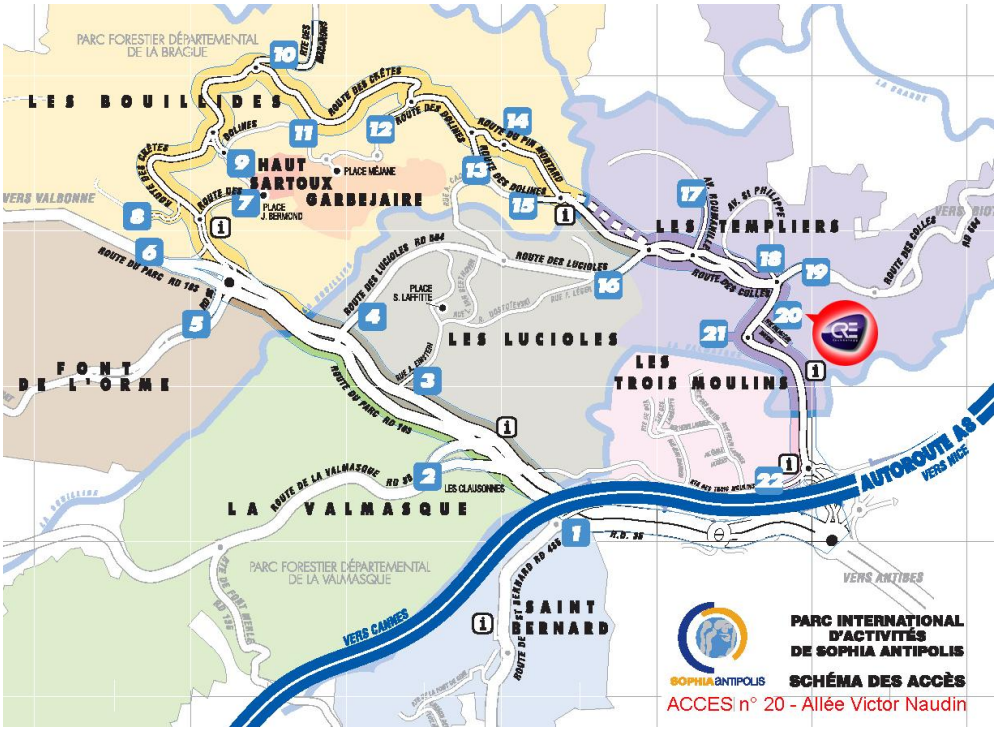
SKYPE: support-cretechnology.com

SARL au Capital de 300.000 Euros - RCS Antibes: 7488 625 000 15 N°TVA FR54 488 625 583



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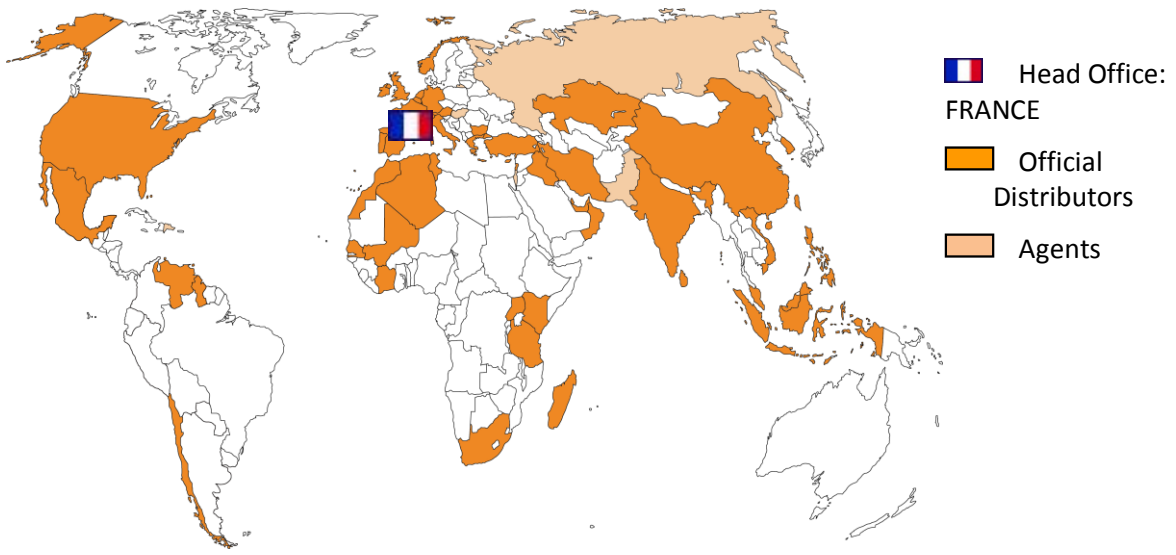

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