

# GENCON™ II *PRO* Features\*

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## 1 General

GENCON is a control system for diesel and gas powered generator-sets that integrates the functions of measurement, protection, paralleling and management. Generator-set applications include standby, load-sharing, peak-shaving and co-generation. The system is made of three parts:

### 1.1 GENCON



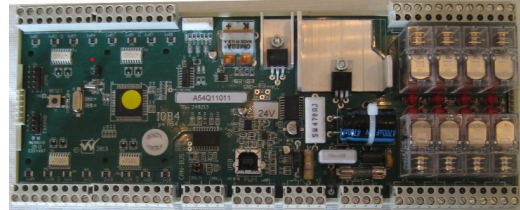
The main unit, responsible for computation, AC measurement, paralleling and communication.

### 1.2 I/O Board

The Input/Output Board, interacts with the engine and breakers. There are three models to choose from:

\*Specifications are subject to change without notice

- IOB1, a basic model with 16 digital inputs and 8 relays.
- IOB2, a model that adds 4 analog channels for accurate reading of automotive resistive sensors.
- IOB4, the advanced model that is also user Forth language programmable.



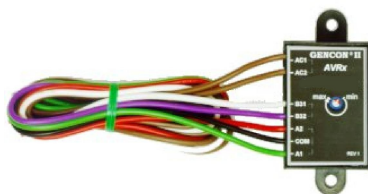
The IOB4 board includes:

- ★ 16 optically isolated digital inputs
- ★ 8 AC rated relays
- ★ K thermocouple input
- ★ 4 – 20 mA current input
- ★ 0 – 5 V analog input
- ★ 2 PWM outputs
- ★ Isolated CANbus, J1939 compliant<sup>1</sup>
- ★ USB Slave B-type port
- ★ Isolated RS485 MODBUS port (optional)



<sup>1</sup>Supports standard SAE layers J1939-71 (engine measurement & control) and J1939-73 (engine diagnostics) with proprietary ECU extensions for Cummins PGI, Caterpillar A4 and Volvo-Penta EMS2.

### 1.3 AVR<sub>x</sub>



A PWM controlled isolated voltage source, adjusts the generator Automatic Voltage Regulator setpoint.

## 2 Measurements

**GENCON** measures the electrical parameters of the gen-set 10 times per second. The measurements are true RMS and 0.5% accurate. **GENCON** averages the incoming measurements and updates most LCD displays approx. once per second.

**GENCON** measures all the electrical parameters of three-phase<sup>2</sup> generators in 4-wire and 3-wire configurations, see table 1. Also measured is one phase of the mains or the generator-bus that is the reference phase of the generator to synchronize with, see table 2. The “synchroscope” measurements, see table 3, show the difference between the generator parameters and the parameters of the reference phase.

Table 4 shows the engine related measurements. Single lead resistive senders, the common automotive type, can also be used as the IOB2 effectively cancels out its noisy ground terminal. Through the IOB4 **GENCON** can display any J1939 engine parameter as well as its own K-Thermocouple temperature, 0 – 5V and 0 – 20mA readings.

**GENCON** has three 4-digit counters that record the system’s activity, see table 5. A secret 10 year service counter is also in built for the optional “**MAINTENANCE REQUIRED**” alarm. Like the kW-Hour and the Hours-Run, the value of these counters is preserved while **GENCON**’s DC supply is switched off. The counters are protected by *two* passwords against user tampering.

<sup>2</sup>Single-phase support is available on order

	Parameter	Transducer
1	Volts Gen Phase A	None
2	Volts Gen Phase B	None
3	Volts Gen Phase C	None
4	Volts Gen Phase A-B	None
5	Volts Gen Phase B-C	None
6	Volts Gen Phase C-A	None
7	Amps Gen Phase A	5A CT
8	Amps Gen Phase B	5A CT
9	Amps Gen Phase C	5A CT
10	Amps/Per-Unit Sequence Currents	None
11	Hz Gen Frequency	None
12	kW Gen Phase A	None
13	kW Gen Phase B	None
14	kW Gen Phase C	None
15	Total kW Gen	None
16	kVA Gen Phase A	None
17	kVA Gen Phase B	None
18	kVA Gen Phase C	None
19	Total kVA Gen	None
20	kVAr Gen Phase A	None
21	kVAr Gen Phase B	None
22	kVAr Gen Phase C	None
23	Total kVAr Gen	None
24	kW-Hour Count	None
25	P.F. Gen Phase A	None
26	P.F. Gen Phase B	None
27	P.F. Gen Phase C	None
28	% THD Gen Phase A	None
29	% THD Gen Phase B	None
30	% THD Gen Phase C	None

THD = Total Harmonic Distortion

Table 1: Generator measurements

	Parameter	Transducer
1	Volts Bus/Mains Phase A	None
2	Hz Frequency Bus/Mains	None
3	% THD Bus/Mains Phase A	None

Table 2: Mains/Bus measurements

	Parameter	Transducer
1	Phase Shift	None
2	Voltage Match	None
3	Frequency Hz Slip	None

Table 3: Synchroscope

	Parameter	Transducer
1	Volts Battery	None
2	RPM Speed	Magnetic Pick-up
3	Hours-Run Count	None
4	Engine Temperature	Resistive sender
5	Oil Pressure	Resistive sender
6	Fuel Level	Resistive sender
7	Oil Temperature	Resistive sender

Table 4: Engine measurements

	Counter name
1	Engine Cranks
2	Gen-Set Runs
3	Gen-Set OnLoad
4	Service Weeks/Days

Table 5: Activity counters

	Alarm
1	Over Voltage
2	Under Voltage
3	Over Frequency
4	Under Frequency
5	Inverse Time Overcurrent
6	Negative Sequence Overcurrent
7	Harmonic Distortion
8	Illegal Phase Order
9	Reverse Power
10	Loss of Excitation
11	Loss of Mains During Paralleling
12	Voltage Not Built
13	Frequency Not Built
14	Dead Bus Protection

Table 6: Generator protection

### 3 Protection

The generator protective functions (table 6) and the engine protective functions (table 7) are based on the measurement system. All these functions have user adjustable trip-points and time-delays.

Table 8 lists the gen-set protective functions that are contact based. **GENCON** protections comply with the American NFPA level 1 recommendation.

### 4 Engine Management

**GENCON** has eleven 380Vac/10A command relays. Table 9 shows a typical use of these relays in direct engine management. **GENCON** can also be used with external Engine Control Units where it does not require, for instance, to have a magnetic pickup unit of its own.

### 5 Paralleling

**GENCON** includes all the necessary functions for running a gen-set in parallel with the mains (peak-shaving) and for running a gen-set in parallel with other **GENCON** based gen-sets (load-sharing), see table 10.

	Alarm
1	Battery High Volts
2	Battery Low Volts
3	Engine Temperature Low
4	Engine Temperature High
5	Oil Pressure Low
6	Oil Pressure High
7	Fuel Level Low
8	Fuel Level High
9	Oil Temperature Low
10	Oil Temperature High
11	RPM Over Speed
12	Engine Slow Crank
13	Engine Over Crank
14	Oil Pressure Not Built
15	Engine Shutdown Failed
16	RPM vs. Frequency Mismatch

Table 7: Engine protection

	Alarm
1	Remote Emergency Stop
2	Low Oil Pressure Shutdown
3	Low Oil Pressure Warning
4	High Temp Engine Shutdown
5	High Temp Engine Warning
6	Low Temp Engine Warning
7	Low Coolant Level
8	Low Fuel Level
9	Battery Charger Fault
10	Air Damper Closed
11	External Overload

Table 8: Engine protection (contact inputs)

	Function
1	Preheat or Idle Speed
2	Fuel Solenoid
3	Starter Crank
4	Air Damper
5	Lubrication Pump
6	Set Running Indication
7	Visual Alarm Control
8	Audible Alarm Control

Table 9: Engine control relays

	Function
1	Phase/Frequency Synchronizer
2	Voltage Matching
3	Sync Check, dwell-time or freq-slip
4	kW Load sharing, isochronous speed or droop
5	kVAr Load Sharing, constant voltage or droop
6	kW Export Control, adjustable ramp
7	kVAr Export Control, adjustable ramp

Table 10: Paralleling functions

Using the TDM firmware **GENCON** can maintain a constant generator bus frequency and voltage of up-to 8 or 14 gen-sets (a 14 set system is formed by joining two COMM II *PRO* units).

Using the MODBUS-RTU firmware the number of parallel running gen-sets is unlimited but a supervisory system (Gview) is required to maintain the bus frequency and voltage at constant levels.

**GENCON** controls the generator Hz/KWs through the governor auxiliary speed setting input or via the ECU J1939 protocol. **GENCON** controls the generator Volts/KVARs using its AVRx interface module and through the generator Automatic Voltage Regulator.

## 6 Automatic Transfer Switch

**GENCON**, as the tradition in Europe requires, has a built-in ATS logic. It includes:

- Mains Failure Detector based on the reference phase that **GENCON** measures, see table 2.
- Time Delayed Transfer Logic with an adjustable break to make delay.
- In-Phase Transfer Logic.

## 7 Applications

**GENCON** can be used in any gen-set application. In most cases it provides a complete solution. Where the requirements are non-standard, **GENCON** offers a special operating mode, the generic mode,

where it operates under the command of an external PLC.

Single gen-set applications include:

- Prime Power.
- Mains Standby.
- Mains Standby with Soft Transfer.
- Peak Shaving (aka Peak Lopping).
- Cogeneration (aka Combined Heat & Power).

Multiple gen-set applications include:

- Random Access and Dead Bus Paralleling, Load-Sharing with Power Ramp.
- Load Dependent Start/Stop Sequencing (with optional runtime count balancing).

**GENCON** can interface with most speed control (governor) and voltage regulator (AVR) models and in addition:

- It can cooperate with external engine management units.
- It can share the load with “foreign gen-set controls” through in built speed and voltage droop.

## 8 HMI/SCADA

Up to eight **GENCON** controllers can be connected via a single **Communicator**<sup>3</sup> unit to any HMI<sup>4</sup> or SCADA<sup>5</sup> system that uses the Modbus protocol, see figure 1. The maximal length of the RS485 cable is 1200m (=4000ft). The **Communicator** can also drive a 32 lamp alarm annunciator through the optional IOB3 module.

**Gpanes** is an HMI/SCADA Windows software for the standard **GENCON** firmware. **Gpanes** connects to the **Communicator** via a cable, a dial-up modem or a Modbus/TCP data link. **Gpanes**

<sup>3</sup>COMM II *PRO* model

<sup>4</sup>Human Machine Interface

<sup>5</sup>Supervisory Control and Data Acquisition

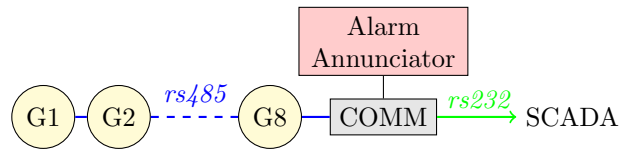


Figure 1: The Communicator

window “panes” mimic the **GENCON** controllers fascias at a near “real-time” rate and in this way make remote commissioning a practical possibility; See figure 2. **Gpanes** can be deployed safely across the Internet as it is using the Transport Layer Security (TLSv1) protocol that on site is matched by a tiny embedded Linux computer which augments the **Communicator**.

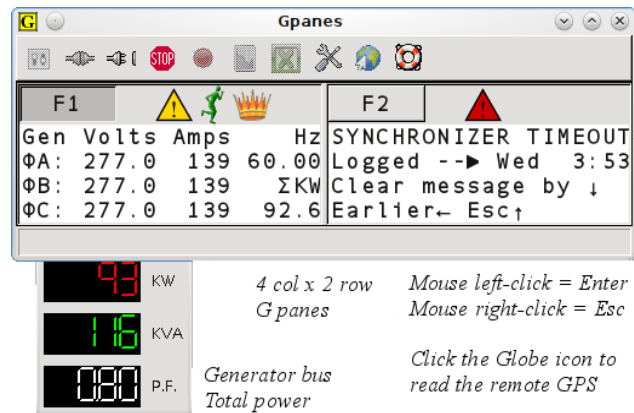


Figure 2: Gpanes

**Gpanes** also includes a subsystem for event and data logging using a round-robin database. **Gpanes** can chart any logged data interval or export the data to a spreadsheet program for further analysis. A shutdown event can automatically generate an “SOS” e-mail message.

**Gview** is an HMI software that is designed for the MODBUS-RTU variant of **GENCON** firmware. It can control an arbitrary number of controllers through multiple serial RS485 ports.

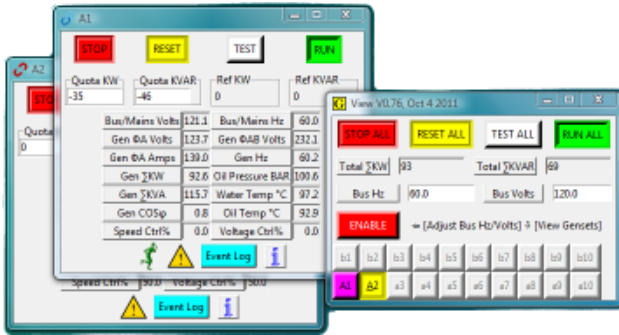


Figure 3: Gview

- Front panel, completely sealed (IP65).
- Operating temperature,  $-20^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  (storage  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ ).
- Four AC volts inputs (V1/V2/V3/V4), each electrically isolated to 7500 V (IEEE 587 class C).
- Three AC amps inputs (I1/I2/I3), each electrically isolated to 1500 V (1 minute).
- RS485 port, electrically isolated to 1600 Vac (1 minute) or 2000 Vac (1 second).

## 9 Management solutions

Secure Internet access and various gen-set management solutions are available through customized software that is installed on site in an embedded single board Linux computer.

## 10 Misc

**Display** 20 char x 4 lines LCD with backlight. User translatable texts.

**Faults logging** Last 8 reports, time tagged.


**Keys** Stop, Alarm mute/reset, 4 menu navigation keys, 10 digit keys.

**Parameters** Non-volatile field-adjustable options, set-points and delays.

**Security** Three password system.

**Indicators** High intensity shutdown, warning and activity LEDs.

## 11 Technical data

-  listing E219920 (safety standard UL508).
- Battery Voltage, 8 Vdc to 40 Vdc continuous (load-dump protected).
- Accuracy, 0.5% (true RMS).