

# SIGMA S6610 PM Module

## **User's Manual**

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# 1 Preface

The SELCO SIGMA S6610 PM module provides load depending start and stop of up to 16 generators. The S6610 module relies upon the measurements and calculations conducted by the SELCO SIGMA S6000 IO/P module, which provides integrated generator protection, basic I/O and data acquisition. Likewise, the S6610 also requires the SELCO SIGMA S6100 S/LS module to perform dead bus closure, auto-synchronization and active/reactive load sharing. The S6100 module is also used as a relay for the start and stop signals which control the engine.

## 1.1 How to use this manual

Chapter 2 Function describes the functionality of the S6610 Power Manager Module. Check here for information which functions are included.

Chapter 3 System preparation explains how to set the CAN address.

Chapter 4 gives short information about mechanical assembly of the unit.

Chapter 5 Installation gives wiring advice. Here you can find an explanation about the function of each terminal and the signal reference for those terminals.

Chapter 6 explains the RS232 configuration of the module. It starts with an explanation of each command and finishes with an overview of all commands.

Chapter 7 is the operator manual for the module. It explains the display indications, LEDs and push buttons of the module.

Chapter 8 gives an overview of the specifications of the module.

## 2 Isolation and Grounding

In marine installations ground and common reference (COM) should not be connected together. In a ship installation the hull is the “ground”. Connecting any of the COM connections on any of the modules within a SIGMA system to ground (hull) or switchboard chassis may cause instability within the system.

One, and only one, COM connection should be made between SIGMA modules. This is preferably the COM connection of the CAN bus.

The Primary and Backup 24 VDC supplies are isolated from the remaining electronics of the module and therefore also from the common reference (COM). The negative poles of the 24 VDC supplies can be connected to the common reference (COM), provided that the either one, or both supplies serves as references for auxiliary relays driven by SIGMA open collector outputs. In this case the supplies negative poles should not be connected to ground (hull) or switchboard chassis.

As a general rule:

1. COM terminals should not be connected to ground (hull) or switchboard chassis.
2. Negative poles of the primary and back-up supplies should not be connected to ground (hull) or switchboard chassis.
3. Negative poles of the primary and back-up supplies and COM can be connected together, provided that the negative poles of the primary and back-up supplies are not connected to ground (hull) or switchboard chassis.

### 3 Function

The S6610 module provides prioritised load depending start and stop of up to 16 parallel running generators. The S6610 module reads the load from each individual S6000 module through the CAN bus. The individual load measurements are used to determine the total load on the system. The S6610 module will issue a start signal to the next generator, provided that the total load exceeds a predefined start level (expressed in percent of the running capacity). Likewise, the S6610 module will issue a stop signal to a running generator if it determines that this would place the load level on the remaining running generators below the stop level. The start/stop sequence is programmable and the priority of each generator can be changed on the fly.

Additional features include on/off duty selection of individual generators, dismissal of failed generators, dismissal of manually control generators and pre-warning of large consumers with acknowledge feedback.

#### 3.1 User Interface

The structure and layout of the S6610 module configuration menu follows the standard set by the SIGMA UI module.



The S6610 module provides an easy accessible configuration option for setting and changing generator priorities on the fly. The relation between physical generator number and priority setup is shown in a clear and consistent way. Likewise the priority sequence is viewable without having to scroll or pan the contents of the display.

An S6500 module can be used to configure all parameters within the PM module, vice versa. Likewise the S6610 module can operate as a S6500 module and indicate information from all other modules including the S6610 module.

## 3.2 Load Depending Start/Stop

### 3.2.1 Sequence

The sequence determines the start/stop algorithm, which is the principle of the start/stop procedure. The operator can choose from three different sequences.

**Linear:** The linear sequence starts and stops the generators according to the assigned priority. The highest (numerical lowest) prioritised generator is the first to be started, then the second highest etc. The linear sequence stops the generators following the “last in first out” principle. The start/stop procedure for three generators can be described as 1-2-3, 3-2-1, 1-2-3.

**Cyclic:** The cyclic sequence starts and stops the generators according the assigned priority. The highest (numerical lowest) prioritised generator is the first to be started, then the second highest etc. The cyclic sequence stops the generators following the “first in first out” principle. The start/stop procedure for three generators can be described as 1-2-3, 1-2-3, 1-2-3.

**Duty Hour:** The duty hour sequence does not start and stop the generators according to their pre-assigned priorities. The generator with the lowest number of running hours is the first one started, while the generator with the most running hours is the first to be stopped. The running hours are stored in the S6100 module of the individual generator.

### 3.2.2 Priority

Each generator is assigned a unique priority. The default priority setup follows the generator number (CAN bus address). Priorities can be changed during operation causing new generators to be started before running generators are stopped.

The priority of the individual generator is stored in the S6100 module of that generator.

### 3.2.3 Start

The conditions for starting the next generator in line (according to the sequence and priority setup) are determined by the start level and the start delay. The start level is expressed as a percentage of the on-line capacity. The start delay is initiated as soon as the total load exceeds the start level. However, the S6610 module will not signal the generator to start until the start level has been exceeded continuously for the duration defined by the start delay.

The on-line capacity is calculated from the generator max current parameters (in S6000 IO/P Module) of the generators running under control of the S6610 module multiplied with the rated cos phi parameter (in S6000 IO/P Module). The total load is calculated as the sum of the active loads on generators running under control of the S6610 module.

Generators that are failed, switched to manual or off duty will not be started automatically. These generators are simply disregarded in the start/stop algorithm.

### 3.2.4 Stop

The conditions for stopping the last generator in line (according to the sequence and priority setup) are determined by the stop level and the stop delay. The stop level is expressed as a percentage of



the on-line capacity, minus the capacity of the generator which is about to be stopped. The stop delay is initiated as soon as the total load decreases below the stop level. However, the S6610 module will not signal the generator to stop until the stop level has been passed continuously for the duration defined by the stop delay.

The on-line capacity is calculated from the generator max current parameters (in S6000 IO/P Module) of generator running under control of the S6610 module multiplied with the rated cos phi parameter (in S6000 IO/P Module). The total load is calculated as the sum of the active loads on generators running under control of the S6610 module.

Generators that are failed or switched to manual will not be stopped automatically. These generators are simply disregarded in the start/stop algorithm.

### 3.3 Large Consumers

The large consumer pre-warning system consists of 10 digital inputs, 10 digital outputs and five analogue (0-10 VDC) inputs. The digital inputs (LC REQ. INPUTS) can be used to pre-warn the connection of up to 10 large consumers. The digital outputs (LC ACK. OUTPUTS) provide the feed-back signal which indicates that the required reserve capacity has been established. The five analogue inputs (LC ANALOG INPUTS) are optionally used to provide a load feed-back signal from the respective large consumer load.

When a large consumer shall be used, the respective LC input (e.g. LC1) has to be connected by a switch to the COM terminal of the S6610.

The large consumer request signal must remain active as long as the Large Consumer shall be used. After the LC request signal has been activated, S6610 will check if there is enough reserve capacity available.

If enough reserve capacity is available, the corresponding LC acknowledge output (this is an open collector output) will be activated.

If there is not enough reserve capacity available, the next available generator will be started.

Two conditions are required for an LC acknowledge output to energize (AND condition):

- LC request signal must be active
- Reserve capacity must be equal with or larger than the Large Consumer Request

In case more than one large consumer request is activated, the reserve capacity of these requests will be added to each other.

The large consumer request signal must remain activated as long as the large consumer should be used. This means that the power manager will continue to provide the reserve capacity required for this large consumer, even though the large consumer already is connected and running. As a result of this, more capacity could be established than actually required.

In order to avoid this excess capacity, the LC analogue inputs can be used (optional). This function is only available for the first 5 large consumers.

This function is of special interest when using large consumers with variable power consumptions.

The LC analogue inputs will provide feedback about how much of the plant capacity is actually used for the respective large consumer. This amount of load will be deducted from the large consumer request, thus ensuring that not more generators are being started than necessary.

Example:

- A large consumer request of 200kW is activated.
- S6610 will start enough generators for establishing a reserve capacity of at least 200kW.
- After a reserve capacity of 200kW is available, the respective LC acknowledge output will be activated and the large consumer can be used.
- If now the large consumer takes a load of 150kW the S6610 will deduct these 150kW of its 200kW LC request, as the large consumer can only take 50kW more. Thus start up of more generators than necessary can be avoided.

### **3.4 LC Non essential load trip**

The start current of electrical consumers is often much higher than their usual operational current. Therefore S6610 offers a function that gives the large consumers more capacity for their high start current by tripping the non essential loads.

There are outputs for 5 non essential loads. This function is optional and can be activated or deactivated for each large consumer and each non essential load.

When the large consumer acknowledge signal is activated, a pulse signal will trip the non essential load for 12 seconds. Each of these non essential load trips can be configured to trip after any of the large consumer requests has been activated.

Each of the non essential load trips can be configured for normally de-energized or normally energized operation. Default setting is normally de-energized operation.

The outputs for these functions are shared with the large consumer acknowledge outputs for the large consumers 6 – 10. This means that in case 10 large consumers are used, the non-essential load trip is not available.

### **3.5 Blackout clearance**

The Power Manager Module can close the breaker to a dead bus bar. For this function the dead bus closure function must be activated in the S6100 Synchronizing and Load sharing module and the DB IN and DB Out terminals of the same module must be connected (see S6100 manual).

In case a generator fails, the S6610 Power Manager Module will start the next available generator for replacement. It is possible to program the Power Manager to stop the faulty generator (otherwise only the circuit breaker is tripped).

In case of a bus bar voltage or frequency failure, a generator can be started before the voltage or frequency monitoring function of the S6100 Synchronizing and Load sharing Module has tripped the breaker, thus keeping the blackout time shorter than if the replacement generator would be started after blackout. If this function is required it must be activated in the S6100 Module.



## 4 System Preparation

### 4.1 Setting the CAN bus address

The 4-point dip-switch located on rear side of the S6610 is used to set the CAN bus address of the module. The CAN bus address is set as a binary value by 4 ON/OFF switches. Valid CAN bus addresses are 1 to 15.

It is recommended that the CAN bus address of the S6610 is set to number one. Please note that there can be only one S6610 module within a system.

The binary system works on the principle described below.

- Switch 1 represents the decimal value 1
- Switch 2 represents the decimal value 2
- Switch 3 represents the decimal value 4
- Switch 4 represents the decimal value 8

As an example, the address 1 is assigned by setting switch 1 to ON and the remaining switches to OFF.

## 5 Installation

The S6610 module is secured to a 138 x 138 mm. cut-out in the switchboard door using four screw clamps.

Please ensure that there is enough space around the module so that the plug-in terminals and RS232 connector can be removed and reinserted. The length of the cables should also allow for the easy removal and insertion of the plug-in terminals. Access to the dip-switches located at the lower right corner of the unit might also be necessary.

## 6 Connection

The S6610 module is connected using plug-in terminals. The plug-in terminals provide safe and durable connection without sacrificing ease of installation and servicing.

Wires should be good quality with a reasonably low internal resistance. It is advisable to use colour coding, as this makes trouble shooting and servicing far easier.

Please ensure that all wires are stripped properly and that the screws of the plug-in terminal rest on the copper and not on the insulation. Insufficient wire stripping is a frequent cause for poor connections.

### 6.1 Power Supply

The electronics of the S6610 module is powered by two individual supplies, the primary and the backup supply. Both the primary and the backup supply operate on a nominal voltage of +24 V DC.

The S6610 module is capable of operating on both or either one of the two supplies. However, an alarm will be raised if the backup supply fails.

The primary supply occupies terminal 1 and 2 of the *POWER SUPPLY* plug-in connectors, while the backup supply occupies terminal 3 and 4.

Terminal	Description	Signal	Connection
1	PRIMARY SUPPLY +	+24 V DC	Positive terminal of primary supply
2	PRIMARY SUPPLY -	-24 V DC	Negative terminal of primary supply
3	BACKUP SUPPLY +	+24 V DC	Positive terminal of backup supply
4	BACKUP SUPPLY -	- 24 V DC	Negative terminal of backup supply

The primary and backup supplies are isolated from each other and from the remaining electronics of the module. This means that the supply reference terminals (terminal 2 and 4) have no connection to the modules COM terminals.

The primary and backup supplies are designed to cope with relatively large voltage fluctuations, as required by the marine classification societies. However, please note that some marine classification societies require that the S6610 module is powered by the generators voltage. This is easily done through adding an auxiliary +24 V DC supply powered by the generator voltage. Please make sure that the auxiliary supply is able to cope with the power demand.

#### 6.1.1 Primary Supply

The switchboard +24 V DC power supply system is typically used as the source of the primary supply.

The front folio Primary Supply LED illuminates with a steady green light to indicate that the supply voltage is OK and within the limits of safe operation. A failure of the primary supply will cause the Primary Supply LED to turn off (after a brief delay).

#### 6.1.2 Backup Supply

The engine starter battery or the switchboard +24 V DC backup power supply system is typically used as the source of the backup supply.

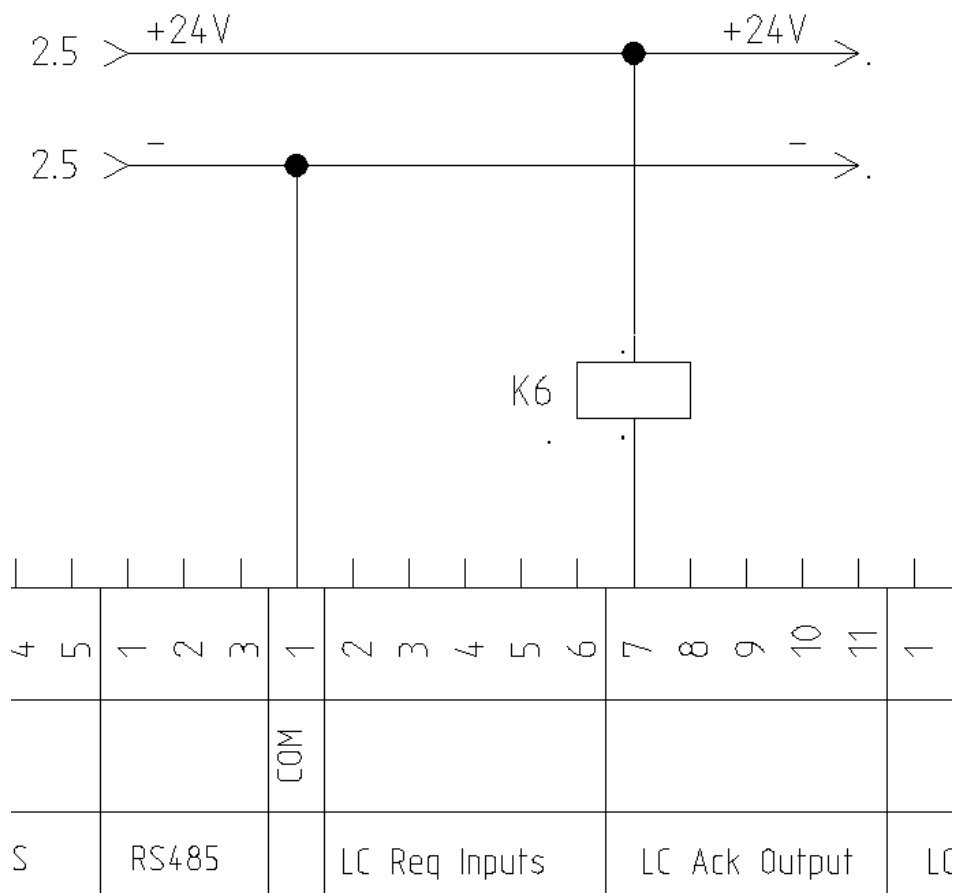
The front folio Backup Supply LED illuminates with a steady green light to indicate that the supply voltage is OK and within the limits of safe operation. A failure of the backup supply will cause the Backup Supply LED to turn off (after a brief delay) and the ALARM relay to de-energize.

### 6.2 I/O

The I/O plug-in connector houses a number of digital inputs and outputs. The digital inputs work with negative reference, meaning the inputs are considered active when at COM level and inactive when left open (disconnected). Open collector outputs are typically provided for external indication. An open collector output works as an electronic contact to COM.

**Please note that the COM terminals are isolated from the power supplies. Therefore it is necessary to connect the minus of the power supply that supplies the equipment that is to be used with the open collector output, with one of the COM terminals of the SIGMA module.**

**Example:** In case a relay is to be activated by an open collector output, the minus of the power supply of this relay must be connected with one of the COM terminals of the SIGMA Module. This power supply must be 24V DC.



PM MODULE S6610

Terminal	Description	Signal	Connection
1	LED TEST	NO contact to COM	External switch, output or relay
2	MANUAL	NO contact to COM	External switch, output or relay
3	Light Load Cancel	NO contact to COM	External switch, output or relay
4	Not used	Open Collector Output	-
5	Not used	Open Collector Output	-
6	Load demand > Plant Capacity	Open Collector Output	Output for indication
7	High Load	Open Collector Output	Output for indication
8	Low Load-	Open Collector Output	Output for indication
9	Not used	-	-
10	COM	Common reference	External reference

### 6.2.1 LED Test

The LED Test input is used to perform a remotely triggered test of the front folio LEDs. The LED test is active while at COM level.

### 6.2.2 Manual

The Manual input is used to switch the S6610 module into manual operation. The signal is active while at COM level

With S6610 in manual mode, S6610 will not perform any automatic start or stop, regardless of load or black-out situation. It can be understood as a “no generator start, no generator stop” mode.

This input only sets the S6610 into manual mode. Automatic synchronizing and loadsharing can still be active.

### 6.2.3 Light Load Cancel

In this mode automatic start of generators is still possible, however no generator will be stopped by the Power Manager anymore. Load depending stop is inactive. It can be understood as a “No generator stop” mode. It is mainly used under maneuvering

### 6.2.4 Load Demand > Plant Capacity

This is the output for the Load Demand > Plant capacity alarm. It activates in case the load demand of the installation increases above the sum of the capacities of all generators that are in Auto Mode and available for automatic load sharing.

### 6.2.5 High Load

This is an open collector output for indication that the plant load demand is higher than the start level for the next generator. It will be activated as soon as the plant load demand (plant load + large consumer request) increases above the start level for the next generator, thus indicating that the start



delay time has started. If the load demand remains above the start level during the entire start delay, the next generator will be started.

### 6.2.6 Low Load

This is an open collector output for indication that the plant load demand (plant load + large consumer request) is lower than the stop level for the next generator. It will be activated as soon as the plant load demand decreases below the stop level for the next generator, thus indicating that the stop delay time has started. If the load demand remains below the stop level during the entire stop delay, the next generator will be stopped.

### 6.2.7 COM

The COM terminal is the common reference of the S6610 module. The various digital inputs and the open collector outputs use the COM terminal as reference.

## 6.3 Relay

The relay plug-in connector includes the contacts of the ALARM relay that will de-energize on system faults.

Terminal	Description	Signal	Connection
1	ALARM 1	Relay de-energized position	ALARM signal
2	ALARM 2	Relay contact	Signal source
3	ALARM 3	Relay energized position	All OK signal

### 6.3.1 Alarm

The ALARM relay includes a relay change over contact. The alarm relay can only operate as a normally energized relay. This is to ensure that the ALARM relay will trip in case both supplies fail.

## 6.4 CAN Bus

The CAN bus is the backbone of the SIGMA system. The CAN bus carries all the measured and calculated parameters between the modules.

Terminal	Description	Signal	Connection
1	COM	Common reference	Reference of the CAN bus
2	CAN L	CAN Lo (data)	CAN Lo signal of the CAN bus
3	-	-	-
4	CAN H	CAN Hi (data)	CAN Hi signal of the CAN bus
5	-	-	-

Terminals 3 and 5 are not used.

The CAN L, CAN H and COM Wire start at one end of the total network, a termination resistor of 124 Ohm is connected between CAN L and CAN H, preferably directly on the CAN bus plug-in connector. The cable is connected from SIGMA module to SIGMA module, without T connections. On the other end of the cable again a 124 Ohm terminator resistor is connected between the CAN lines. The reference COM must be interconnected between all modules and the cable should be shielded. The shield must only be connected to chassis/ground at one end.

The maximum cable length is 40 meters. The cable type should be 0.25 - 0.34 mm<sup>2</sup> (AWG23/AWG22).

**Wires for CAN Lo and CAN Hi must be twisted (twisted-pair).**

Every SIGMA module of the installation must be connected to the same CAN bus network. Third party CAN nodes must not be connected to the SIGMA CAN bus.

## 6.5 RS485

The S6610 module includes an isolated RS485 interface.

Terminal	Description	Signal	Connection
1	REF	Reference (isolated)	Reference of the RS485 bus
2	A	RS485 A	A signal of the RS485 bus
3	B	RS485 B	B signal of the RS485 bus

It is important to note that the RS485 reference is isolated from the common COM of the module.

The 3-wire RS485 bus is connected from module to module.

A termination resistor of 150 ohm must be connected between terminal 2 and 3 at each end of the RS485 bus, preferably directly on the RS485 bus plug-in connector of the first RS485 slave and on the master.

The maximum cable length is 1000 meters. The cable type should be 0.25 - 0.34 mm<sup>2</sup> (AWG23/AWG22).

**Wires for RS 485 A and B must be twisted (twisted-pair).**

## 6.6 LC Request Inputs / LC Acknowledge Outputs

There are five inputs and five outputs in the LC REQ. INPUTS / LC ACK. OUTPUTS terminal block. The terminal block also includes a COM terminal that serves as a common reference for the inputs and outputs of the terminal block.

Terminal	Description	Signal	Connection
1	COM	Common reference	Ref. for the LC inputs & outputs
2	LC REQUEST 1	NO contact to COM	External switch, output or relay
3	LC REQUEST 2	NO contact to COM	External switch, output or relay
4	LC REQUEST 3	NO contact to COM	External switch, output or relay
5	LC REQUEST 4	NO contact to COM	External switch, output or relay
6	LC REQUEST 5	NO contact to COM	External switch, output or relay
7	LC ACKNOWLEDGE 1	Open collector output	External input
8	LC ACKNOWLEDGE 2	Open collector output	External input
9	LC ACKNOWLEDGE 3	Open collector output	External input
10	LC ACKNOWLEDGE 4	Open collector output	External input
11	LC ACKNOWLEDGE 5	Open collector output	External input

### 6.6.1 LC Request 1-5

The five LC REQUEST inputs are used for pre-warning of up to five different large consumers. An LC REQUEST input is considered active while at COM level.

After activation of large consumer request, S6610 will compare if the current reserve capacity of the installation is enough to supply the large consumer requested. If not, it will try to start additional generators to match this capacity requirement. For LC request 6-10 see .

### 6.6.2 LC Acknowledge 1-5

The five LC ACKNOWLEDGE open collector outputs provide feed-back signals to indicate that the requested reserve capacity has been established. An LC ACKNOWLEDGE output will be at COM level when it is active.

## 6.7 LC Load Feedback

The use of the five large consumer load feedback inputs is optional.

The signals to the large consumer analogue input must come from a 0-10 VDC watt-converter connected directly on the respective large consumer load.

Terminal	Description	Signal	Connection
1	COM	Common reference	Reference of the watt-converters
2	LC LOAD FEEDBACK 1	DC voltage	External watt-converter on LC 1
3	LC LOAD FEEDBACK 2	DC voltage	External watt-converter on LC 2
4	LC LOAD FEEDBACK 3	DC voltage	External watt-converter on LC 3
5	LC LOAD FEEDBACK 4	DC voltage	External watt-converter on LC 4
6	LC LOAD FEEDBACK 5	DC voltage	External watt-converter on LC 5

## 6.8 NE 1-5 Trip/ LC Acknowledge 6-10

Five digital outputs are provided to trip non-essential loads or to release the Large Consumers 6 -10. Only one of those functions can be activated for each output (see under configuration). The digital outputs are open collector outputs that operate with reference to COM.

Terminal	Description	Signal	Connection
1	NE 1 TRIP/ LC Acknowledge 6	Open collector output	External input
2	NE 2 TRIP/ LC Acknowledge 7	Open collector output	External input
3	NE 3 TRIP/ LC Acknowledge 8	Open collector output	External input
4	NE 4 TRIP/ LC Acknowledge 9	Open collector output	External input
5	NE 5 TRIP/ LC Acknowledge 10	Open collector output	External input
6	COM	Common reference	Reference

The digital outputs are at COM level when active. These No-nessential load trips are not depending on the load situation of the generators, but on the large consumer request function (see )

## 6.9 Stop Last Generator/ LC Request 6-10/ Aux. Digital Inputs

Five digital inputs are provided. The digital inputs operate with reference to COM.

Terminal	Description	Signal	Connection
1	Stop Last Generator	NO contact to COM	External switch, output or relay
2	LC Request 6	NO contact to COM	External switch, output or relay
3	LC Request 7	NO contact to COM	External switch, output or relay
4	LC Request 8	NO contact to COM	External switch, output or relay
5	LC Request 9	NO contact to COM	External switch, output or relay
6	LC Request 10	NO contact to COM	External switch, output or relay
7	AUX DIGITAL INPUT 7	NO contact to COM	External switch, output or relay
8	AUX DIGITAL INPUT 8	NO contact to COM	External switch, output or relay
9	COM	Common reference	Reference

The digital inputs must be connected to COM level in order to signal an active situation.

Terminal 1 of the auxiliary digital inputs is used for giving a stop command to all running auxiliary generators. Once activated the power manager will unload all running auxiliary generators, trip the breakers and stop the prime movers. **This input may only be activated when there is a grid or a shaft generator that can take the load of the auxiliaries.**

Terminals 2-9 are used for activation of Large Consumer Request 6-10. They work in the same way as Large Consumer Request 1-5.

## 6.10 Analogue Outputs

Two analogue outputs are provided for external indication of e.g. total load and reserve capacity. The analogue outputs operate with reference to COM. Each output can be individually configured to provide a DC voltage or current signal in relation to any one of the chosen parameters provided by the S6610 module.

The analogue outputs can be used for external indication on meters or to provide analogue readings to e.g. a PLC.

Terminal	Description	Signal	Connection
1	ANALOG OUTPUT 1 mA	DC current	External current input
2	ANALOG OUTPUT 1 V DC	DC voltage	External voltage input
4	ANALOG OUTPUT 2 mA	DC current	External current input
5	ANALOG OUTPUT 2 V DC	DC voltage	External voltage input
6	COM	Common reference	Reference

It is important to note that each analogue output is protected against short-circuit by an internal 10 k $\Omega$  resistor. The resistor is placed in series on the output terminal. The output resistor might affect the magnitude of the output signal if the internal resistance of the driven equipment is low. The principle of voltage division applies between the output resistor and the internal resistance of the driven equipment. Example: equipment with an internal resistance of only 10 k $\Omega$  would reduce a +10 V DC output voltage to +5 VDC. The two 10 k $\Omega$  resistors in series would make up a 1:2 voltage divider.

### 6.10.1 Analogue Output 1-2

Each analogue output can be configured to provide a DC voltage within the range of -10 to +10 V DC, or a DC current within the range of 0 to 20 mA.

## 7 Configuration

The S6110 module can be configured in three different ways. This section describes the configuration by RS232, as this method of configuration does not require the use of additional modules (the S6500 or S6100). The S6100 module will however require a partner S6000 module, as the S6000 provides many of the basic parameters required by the S6100.

The S6100 module is delivered with a default configuration.

### 7.1 Console Password

By default the RS232 console will operate in read-only mode. The console can be switched to read/write mode by the enable command.

ENABLE

Enable mode will prompt for a pin code. The default pin code is 0000.

The console can be switched back to read-only mode by the disable command.

DISABLE

Please note that the RS232 console pin code is separate for each module. Also, the RS232 pin code is independent from the menu pin code of the UI or PM module.

### 7.2 Start & Stop

The first thing to do is to configure the start and stop levels and delays. The generators are started and stopped according to their assigned priority (or running hours). Both the priority and the duty hour are stored within the S6100 configuration setup of the individual generator.

All active power related settings are expressed as a percentage of the nominal capacity of the generator.

The nominal capacity is calculated from the GENMAXCURRENT parameter in the S6000 IO/P Module settings multiplied with the nominal  $\cos\phi$  setting in the same unit:

$$Capacity = GENMAXCURRENT \times rated \cdot \cos\phi$$

Older software versions of S6000 IO/P Module do not contain the rated  $\cos\phi$  setting. In this case the capacity is calculated with a  $\cos\phi = 1$ . This has to be remembered when programming the power related settings, as they would have to be de-rated with the nominal  $\cos\phi$ .

#### 7.2.1 Start

The start level is expressed as the relation of the total on-line load compared to the total on-line capacity (the total capacity of those generators that are already running and under control of the S6610 Power Manager). Both parameters are calculated from the S6000 units with running generators, provided that these units are ready and under control of the S6610.

$$Start \cdot level = \frac{Load \cdot of \cdot all \cdot running \cdot generators}{Capacity \cdot of \cdot all \cdot running \cdot generators}$$

The start level is set by the following command. The start level is set in percent.

WRITE START LEVEL <percentage>

The start delay works as a filter for the start level so that the generators are not started due to short term load fluctuations.

The start delay is set by the following command. The start delay is expressed in seconds.

WRITE START DELAY <delay>

### 7.2.2 Stop

The stop level is expressed as the relation of the total on-line load compared to the total on-line capacity (the total capacity of those generators that are already running and under control of the S6610 Power Manager). Both parameters are calculated from the S6000 units with running generators, provided that these units are ready and under control of the S6610.

The capacity and load of the generator about to be stopped is excluded from the calculation.

$$\text{Stop level} = \frac{\text{Load of all running generators}}{(\text{Capacity of all running generators}) - (\text{Capacity of the generator to be stopped})}$$

Stop Level = Current load of all generators running under control of the Power Manager / (Capacity of those generators – capacity of the generator to be stopped) x 100%

The stop level should of cause be set lower than the start level.

The stop level is set by the following command. The stop level is set in percent.

WRITE STOP LEVEL <percentage>

The start delay works as a filter for the stop level so that the generators are not stopped due to short term load fluctuations.

The stop delay is set by the following command. The start delay is expressed in seconds.

WRITE STOP DELAY <delay>

## 7.3 Large Consumer Load

The load represented by each of the five large consumers can be set as active current (expressed in Ampere) or as active load (expressed in kW). The setting of the LOADCALC function determines whether the S6610 will use the active current or active load value.

### 7.3.1 Active Current Value

To set the size of a large consumer in Ampere, use the following command. The “x” represents the respective large consumer (1 to 5).

WRITE LC LOADxA <active current>

### 7.3.2 Active Load Value

To set the size of a large consumer in kW, use the following command. The “x” represents the respective large consumer (1 to 5).

```
WRITE LC LOADxP <load>
```

## 7.4 I/O & Relays

The parameters of the I/O & Relays group determine the functional behaviour of the various open collector outputs and relays.

### 7.4.1 Large Consumer Acknowledge Outputs

The large consumer acknowledge outputs can be configured to be normally de-energized or normally energized. The command is as follows. The “x” represents the respective large consumer (1 to 5). Choice can be ND or NE.

```
WRITE IORELAYS LACKxOC <choice>
```

### 7.4.2 Auxiliary Outputs

The auxiliary outputs can be configured to be normally de-energized or normally energized. The command is as follows. The “x” represents the respective auxiliary output (1 to 9). Choice can be ND or NE.

```
WRITE IORELAYS AUXxOC <choice>
```

### 7.4.3 Large Consumer triggered Non-Essential Load Trip/ Large Consumer Request inputs 6-10

In case programmed as Non Essential Load Trip these parameters control which of five Non-Essential trip outputs are triggered when a large consumer request is issued. The “x” indicates the respective large consumer, while the “y” indicates the respective non-essential load trip.

The command to establish the relation between the triggering large consumer and the non-essential load trips are as follows. The choice is YES or NO.

```
WRITE LCNELOAD LCx NEy <choice>
```

In case the choice is YES, the output is configured as a non-essential load trip output.

In case the choice is NO, the respective input is configured as Large Consumer Request Input.

## 7.5 Analogue Inputs

Configuration of the analogue inputs are set with a lower and upper reference within the range of 0 to 10 VDC (10 VDC representing the 100% level of the parameter).

### 7.5.1 Large Consumer Load Feedback

The large consumer load feedback signal is set as follows. The minimum value equals zero load, while the maximum value indicates 100% load.

Use the following command to enable or disable the input. Choice is YES or NO.



WRITE LCANAINPS LCx ENABLED <choice>

Use the following command to set the voltage at 0% load:

WRITE LCANAINPS LCx VOLTMIN <voltage>

And the voltage at 100% load:

WRITE LCANAINPS LCx VOLTMAX <voltage>

## 7.6 Analogue Outputs

The two on-board analogue outputs can be configured to signal total load, reserve capacity or inactive capacity as a voltage and current signal. This means that each analogue output consists of 1 voltage and 1 current signal.

Analogue output 1:        Current output  
                              Voltage output

Analogue output 2:        Current output  
                              Voltage output

The parameter is chosen by the following command. Choice is TL, RC or IC.

WRITE ANAOUT OUTx SRC <choice>

The signal type is chosen by the following command. Choice is VOLT or CUR (voltage or current signal).

WRITE ANAOUT OUTx SIGNAL <choice>The minimum reference value of the parameter is set by the following command.

WRITE ANAOUT OUTx SRCMIN <value>

The maximum reference value of the parameter is set by the following command.

WRITE ANAOUT OUTx SRCMAX <value>

In case the LOADCALC parameter is set to LOAD, following command will define the lower reference of the measurement given out on the analogue output. The lower reference is expressed as a percentage of the rated power of the generator.

WRITE ANAOUT OUTx SRCMINP 0

In case the LOADCALC parameter is set to LOAD following command will define the upper reference of the measurement given out on the analogue output. The upper reference is expressed as a percentage of the rated power of the generator.

WRITE ANAOUT OUTx SRCMAXP 100

In case the LOADCALC parameter is set to CUR, following command will define the lower reference of the measurement given out on the analogue output. The lower reference is expressed as a percentage of the rated active current of the generator.

```
WRITE ANAOUT OUTx SRCMINA 0
```

In case the LOADCALC parameter is set to CUR, following command will define the upper reference of the measurement given out on the analogue output. The upper reference is expressed as a percentage of the rated active current of the generator.

```
WRITE ANAOUT OUTx SRCMAXA 100
```

Use the following command to set the minimum voltage for the voltage output.

```
WRITE ANAOUT OUTx VOLTMIN <voltage>
```

And the 100% voltage for the voltage output.

```
WRITE ANAOUT OUTx VOLTMAX <voltage>
```

Use the following command to set the minimum current for the current output.

```
WRITE ANAOUT OUTx CURMIN <current>
```

And the 100% current for the current output.

```
WRITE ANAOUT OUTx CURMAX <current>
```

## 7.7 Sequence

The sequence defines the power management program (the principle of operation). Valid sequences are “Linear”, “Cyclic” and “Duty Hour”.

The sequence is configured by the following command. The choice can be either LINEAR, CYCLIC or DUTYHOUR.

```
WRITE SYS SEQ <choice>
```

Please note that the duty hour counter is stored in the S6100 configuration of the individual generator.

## 7.8 Dimming

The LCD (display) of the S6610 can be dimmed at four levels. Dimming can be set from the console by the following command (zero provides the highest intensity).

```
WRITE SYS DIMMING <value>
```

Value can be 0 to 3.

## 7.9 Load Calculation

The load calculation determines whether the LC inhibit levels are set as ampere (active current) or load (active load).

The load calculation scheme is set by the following command. Valid choices are CUR or LOAD.

```
WRITE SYS LOADCALC <choice>
```

When set to CUR the S6610 will display loads and capacities as active current, when programmed to LOAD, S6610 will display loads and capacities as power [kW]

## 7.10 Stop on Fault

The Stop on Fault function will determine whether or not the generator will be stopped if a fault is detected through its S6000 or S6100.

The Stop on Fault function is set by the following command. Valid choices are YES or NO.

```
WRITE SYS STOPONFAULT <choice>
```

If this parameter is set to NO, only the circuit breaker will be tripped, while the engine continues running.

If this parameter is set to YES, the circuit breaker will be tripped and the engine will be stopped.

## 7.11 Language

The language of the user interface (the LCD) can be set to either English or German.

The language is set by the following command. The choice can be either ENG or DE.

```
WRITE SYS LANGUAGE <choice>
```

## 7.12 RS485

The RS485 communication interface can be configured with regard to MODBUS slave address, baud rate, data bit, parity and stop bits. It is important to ensure that the address is unique on the bus and that the remaining parameters are set according to specifications.

The MODBUS slave address is set by the following command.

```
WRITE RS485 ADDRESS <Addr>
```

The data transmission rate is defined by the baud rate, which is set as follows.

```
WRITE RS485 BAUDRATE <Baudrate>
```

The parity can be set by the following command.

```
WRITE RS485 PARITY <Parity>
```

The number of data bits is set as follows.

WRITE RS485 DATABITS <Databits>

The number of stop bits is set as follows.

WRITE RS485 STOPBITS <Stopbits>

### **7.13 Restoring to factory default configuration**

The factory default configuration can be restored at any time by issuing the command:

WRITE SYS SETUPDEFAULT YES

The default configuration is then restored after the power to the module has been turned off and on.

# 8 Operation

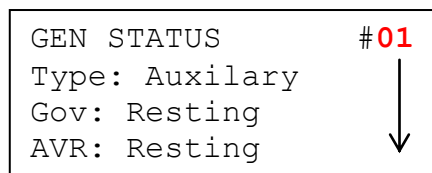
## 8.1 User Interface



### 8.1.1 Gen.

The “Gen.” button is used to switch between the individual generators. The S6610 module supports up to 16 generators. Pressing the “Gen.” button will toggle the display to show the status and the respective readings (or parameters) related to the selected generator.

The arrow on the right side of the display means that further parameters can be displayed by pressing the Page button



Following indications can be shown on this display:

Type:	Auxiliary	Generator 01 is an auxiliary generator
	Shaft	Generator 01 is a shaft generator
	Grid	Generator 01 is connected to the grid
Gov:	Resting	Engine is not running
	Power up	Engine has just been started, but generator the voltage is not yet built up.
	Freq. matching	Engine has fired, voltage is build, up frequency regulation active
	Synchronizing	Generator is synchronizing to the bus bar
	Load Ramp-up	Generator has been connected to the bus bar and is loading.
	Load sharing	Generator is in load sharing mode

Load Rampdown

Generator is unloading

VOLTAGE	#01
U1N:230V	U12:400V
U2N:230V	U23:400V
U3N:230V	U31:400V

VOLTAGE	#02
U1N:230V	U12:400V
U2N:230V	U23:400V
U3N:230V	U31:400V

VOLTAGE	#03
U1N:230V	U12:400V
U2N:230V	U23:400V
U3N:230V	U31:400V

### 8.1.2 Volt.

The “Volt.” button is used to switch the display to voltage indication. The display will show the phase-neutral and phase-phase voltages of the selected generator. It should be noted that the phase-neutral voltages are estimated when the S6000 module is configured to operate without connection to neutral.

VOLTAGE	#01
U1N: <b>230V</b>	U12: <b>400V</b>
U2N: <b>230V</b>	U23: <b>400V</b>
U3N: <b>230V</b>	U31: <b>400V</b>

### 8.1.3 Amp.

The “Amp.” button is used to switch the display to current indication. The display will show the current flowing through each of the three phases of the selected generator.

CURRENT	#01
I1: <b>20</b>	
I2: <b>20</b>	
I3: <b>20</b>	

### 8.1.4 kW

The “kW” button is used to switch the display to active power indication. The display will show the active power provided from each of the generator’s three phases, as well as the total active power. The total active power is always indicated as kW, while the indication of the active power from each phase depends upon whether the S6000 is configured to calculate active load as active current or active power.

ACTUAL POWER	#01
IA1: 20	P: 15
IA2: 20	
IA3: 20	

ACTUAL POWER	#01
P1: 5	P: 15
P2: 5	
P3: 5	

### 8.1.5 kVAr

The “kVAr” button is used to switch the display to reactive power indication. The display will show the reactive power provided from each of the generator’s three phases, as well as the total reactive power. The total reactive power is always indicated as kVAr, while the indication of the active power from each phase depends upon whether the S6000 is configured to calculate reactive load as reactive current or reactive power.

REACTIVE POWER	#01
IR1: 0	Q: 0
IR2: 0	
IR3: 0	

REACTIVE POWER	#01
Q1: 0	Q: 0
Q2: 0	
Q3: 0	

### 8.1.6 Misc.

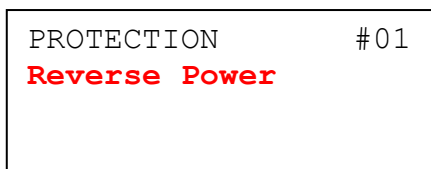
The “Misc.” button is used to switch the display to indication of miscellaneous parameters. Miscellaneous parameters include power factor (PF), frequency and VA (volt-ampere). The indication of the miscellaneous parameters takes up more than one screen (page), so the “Page” key can be used to toggle the pages.

MISCELLANEOUS	#01
PF1: 100	PF: 100
PF2: 100	FRQ: 50.0
PF3: 100	↓

MISCELLANEOUS	#01
VA1: 5	↑
VA2: 5	
VA3: 5	

### 8.1.7 Prot.

The “Prot.” button is used to switch the display to indication of protection messages for the selected generator. The protection messages can originate from the S6000 and S6100 modules. Listed protection messages can be reset (and cleared) by pressing the “Reset” button. Note that the Protection Trip LED will also ignite when protection messages are present.



Following indications can be shown on this display:

Message	Description
Overcurrent	Overcurrent trip on the respective generator
Reverse Power	Reverse Power trip on the respective generator
Short circuit	Short circuit trip on the respective generator
Over Load	Over load trip on the respective generator
Excitation Loss	Excitation loss trip on the respective generator
Volt/Freq Establish	Common alarm for over/ under voltage or frequency trip on the respective generator
Volt. Bus Establish	Common alarm for over/ under voltage trip on the respective generator
Freq. Bus establish	Common alarm for over/ under frequency trip on the respective generator
Trip CB Fault	S6000 module tried to trip the circuit breaker but the breaker didn't open
Close CB Fault	The feedback of the position of the circuit breaker is missing
Closed CB Fault	S6100 tried to close the breaker but the breaker didn't close
Sync Error	S6100 tried to synchronize but didn't succeed within the pre programmed time delay (see S6100 RS232 command AUTOSYNC SYNCTIME)
Freq Bus Deviation	df/dt protection trip on the respective generator
Abnormal CB Trip	External equipment has tripped the breaker (feedback from terminal 6, Aux I/O of S6000)
Engine start error	Power Manager has tried to start the respective engine, but the generator didn't reach acceptable voltage level within the pre-programmed time delay (see command WRITE IORELAYS STARTTIMEOUT on S6100)
Volt Estab. S6000	Over/ under voltage trip on the respective generator
Freq Estab. S6000	Over/ under frequency trip on the respective generator
Prim. Supply S6000	Primary power supply fault on S6000 of the respective generator
Sec. Suppl7 S6000	Secondary power supply fault on S6000 of the respective generator



MH Fault S6000	Internal processor fault (Measure Head) on S6000 of the respective generator.
Sync. Int. S6000	
Isolation S6000	
Prim. Supply S6100	Primary power supply fault on S6100 of the respective generator
Sec. Supply S6100	Secondary power supply fault on S6100 of the respective generator
CAN bus S6100	CAN bus communication error on S6100 of the respective generator
MH Fault S6100	Internal processor fault (Measure Head) on S6100 of the respective generator.
Sync. Ext. S6100	
Sync. Int. S6100	
Dead bus fault S6100	Handshake signal for the dead bus closure function (terminals 3 and 4 of the Engine I/O connector block of S6100) connected wrong.
Isolation	
Engine error	External engine error (feed back on terminal 5 of the Engine I/O connector block of S6100).
Load Demand > Plant Capacity	This alarm activates in case the load demand of the installation increases above the sum of the capacities of all generators that are in Auto Mode and available for automatic load sharing. The alarm is auto reset, meaning that it will clear itself as soon as the plant capacity increases above the load demand.

### 8.1.8 PM

The PM button is used to switch the display to the Power Management indications. These indications include information for the complete Installation. The messages can originate from the S6000 and S6100 modules.

The arrow on the right side of the display means that further parameters can be displayed by pressing the Page button

POWER MANAGEMENT	
Plant Load	0kW ↓
Res. Cap.	0kW ↓
Plant Cap	0kW ↓

Following indications can be shown on this display:

Plant Load	Indicates the power currently supplied to the installation by the generators
------------	--

Res. Cap.	Reserve Capacity indicates how many kW (or A) of reserve capacity is available with the generators that are currently running and under power management control.
Plant Cap	Indicates the entire capacity of all generators that are under power management control, regardless if they are running or not.
LC Request	Indicates the sum of the load of all large consumers that are requested
LC Load	Indicates the sum of the load of the activated large consumers (from the LC analogue inputs).
Load Level	Load Level indicates the percentage of utilisation of the generators currently running and under power management control.
Start Lev.	Indicates the load of the entire installation at which the next generator will be started (for load depending start).
Stop Lev.	Indicates the load of the entire installation at which the next generator will be stopped (for load depending stop).
PM Enabled	Indicates that the Power Manager Module is in automatic mode.
PM Disabled	Indicates that the Power Manager Module is in manual mode. This means the Power Manager will not start or stop any generator, regardless of load or blackout situation.
Light Load Cancel	In this mode the load depending stop function of S6610 Power Manger Module is disabled, while load depending start and blackout start are still available. This function can be used as a maneuver mode. Generators can still be started automatically according to load situation however, once started they will not be switched off in case the load is reduced below stop level.

### 8.1.9 LEDs

The S6610 module includes the following LEDs:

C/B closed:	Indicates that the circuit breaker of the currently chosen generator is closed.
Protection Trip:	Shows that the chosen generator has been tripped by a protection function (IO/P module).
In Operation:	Shows that the chosen generator is running (from IO/P module I/O).
Off Duty:	Shows that the generator has been placed off duty (through IO/P module I/O or Off Duty pushbutton).
Engine Error:	Shows that the generator has failed (through IO/P module I/O).

#### 8.1.10 **Reset**

The “Reset” button is used to reset protection messages. Protection messages are shown by pressing the “Prot.” button.

#### 8.1.11 **Test**

The “Test” button is used to perform a LED test. Keeping the “Test” button pressed will dim the LCD and the LEDs.

#### 8.1.12 **Duty**

The “Duty” button is used to toggle the selected generator to go off/on duty. There is a feedback signal on the Off Duty LED.

“Off Duty” means that the power Manager will try to replace this generator with the next available generator. In case no other generator is available, the generator set to Off Duty will continue running and wait for another generator to become available. Off Duty indication remains active until the Off Duty button is pressed again.

A generator that is stopped and Off Duty will not be started by the Power manager.

#### 8.1.13 **Mode**

The “Mode” button is used to toggle the module between indication and configuration mode.

#### 8.1.14 **Arrow Buttons**

The arrow buttons are used for menu navigation while the module is in configuration mode.

#### 8.1.15 **Enter**

The “Enter” button is used while the module is in configuration mode.

#### 8.1.16 **Yes**

The “Yes” button is used while the module is in configuration mode.

#### 8.1.17 **No**

The “No” button is used while the module is in configuration mode.

## 9 Specifications

Primary Supply:	+24 V DC (-30 % / +30 %) Isolated
Backup Supply:	+24 V DC (-30 % / +30 %) Isolated
Display:	4 x 20 Characters (backlit)
Dimming:	LEDs and Display backlit 5 steps by depressing TEST button or by RS232 command
CAN Bus	
Connection	Screw terminals, 2-wire with COM (limp back function)
Protocol:	CANOpen derivative
RS232	
Connection:	Customized plug, 4-wire (non-isolated)
Function:	Configuration, Debugging or firmware update
Protocol:	ANSI terminal
Baud rate:	1200, 2400, 4800, 9600 or 19200 baud
Parity:	None, even or odd
Data bits:	7 or 8
Stop bits:	1 or 2
EMC / EMI tests:	EN 50081-2:1993 (Generic: Residential, commercial & light industry) EN 50263:1999 (Product: Measuring relays and protection equipment)
Marine tests:	EN 60945:1997 (Marine: Navigation and radio comm. equipment and systems) IACS E10:1997 (IACS unified environmental test specification)
Connections:	Plug-in screw terminals (spring terminals available as option)
Dust and Water protection:	IP54 at front
Dimensions:	144 x 144 x 35 mm (H x W x D) cut out 138 x 138 mm.
Weight:	850 g
Fixation:	Flush mount (4 mounting brackets)

The specifications are subject to change without notice.