

SIGMA

Advanced Generator Protection and Control

- Generator protection, synchronizing and load sharing
- Power management system
- Easy to install and commission
- Control most governors/AVRs
- Worldwide support



SIGMA provides:

- well known and proven technology that ensures you a highly reliable solution
- easy and ready to install
- compatibility with most SELCO products already installed
- future update possibilities
- simple design

SIGMA provides a modern modular approach to advanced generator protection and control systems. Developed and approved for marine use, we have concentrated the design within the following areas:

- Easy to configure and operate
- Cost effective
- Versatile programming facilities
- Various interfaces for remote monitoring and data acquisition

when managing generator equipment in the most cost effective way, whether it is onboard ships or at power stations. SIGMA is based on the latest technology, presented in a sturdy, compact and modular design. You are even ensured future update possibilities as well as a guaranteed low Total Cost of Ownership (TCO).

Simplicity in design

Easy to install and use. Provides self-explanatory user interface.

Quality

SIGMA is developed to meet high demands and to fulfil the high expectations associated with SELCO products, matching the requirements for marine classification.

Compatibility

SIGMA is compatible with a wide range of SELCO components.

Communication

All function parameters can be read from external units via MODBUS-RTU and furthermore it is possible to configure the system from third party equipment (e.g. SCADA systems).

SIGMA Modules:



S6000 – IO/P Module



S6100 – S/LS Module



S6500 – UI Module – Optional



S6610 – PM Module – Optional

The S6000/S6100 may be used with or without the S6500 User Interface & the S6610 PM module depending on your requirements.

One version for all

No matter what type of speed governor & automatic voltage regulator (AVR) (electrical/mechanical) or what nominal voltage you have, there is only one SIGMA version - and a broad range of control and protection features is included.

The advanced features of SIGMA are always available and ready to use. Programming the SIGMA is done by computer using an ANSI standard terminal application (e.g. MS Windows HyperTerminal) or by using the optional user interface (UI) module.

SIGMA overview

Optimal protection, synchronizing and load sharing are crucial parameters

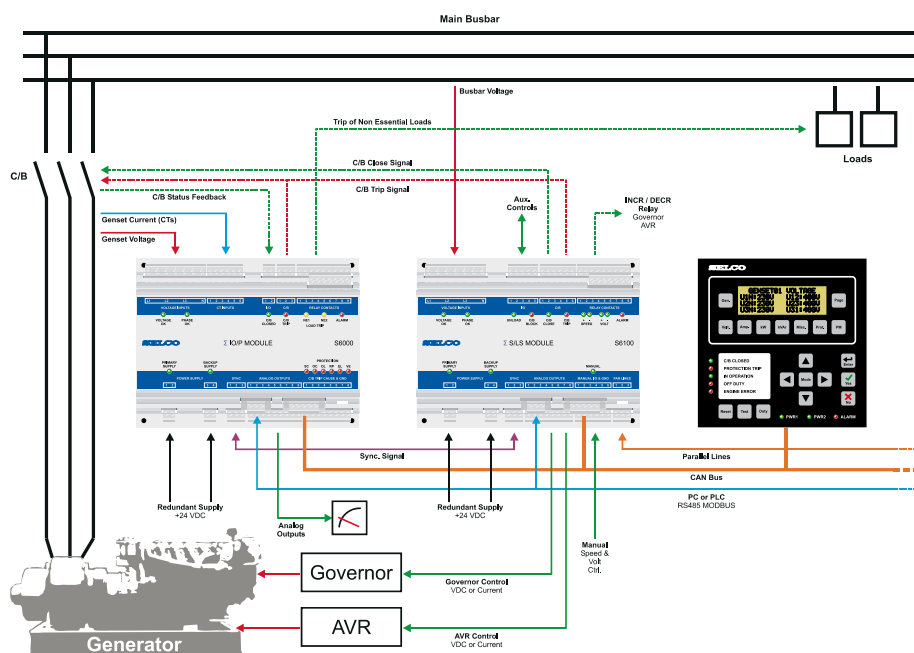


Fig. 1. Application diagram.

SIGMA S6000 IO/P Module



- 3 phase measurements
- Short circuit protection
- Over current protection
- Overload protection
- Reverse power protection
- Excitation loss protection
- Load shedding (2 levels)
- 3 analogue outputs
- RS485 MODBUS slave
- CAN Bus
- Redundant supply

The S6000 IO/P Module provides data acquisition and complete protection for a single generator.

The S6000 measures the voltages across all three phases as well as the current running through each phase. The voltage and current signals are digitally sampled by the built-in signal processor and converted to true RMS values.

The S6000 will continuously do real-time calculations of voltage, current, frequency, active/reactive power, VA, power factor etc. The S6000 can connect to generators with or without neutral.

Protection

The S6000 includes six programmable protection functions: Short Circuit, Over Current, Reverse Power, Overload, Excitation Loss and Voltage Establishment.

The protection functions can be configured with regards to trip level,

delay and relay functions. The protection works on all three phases. A dedicated LED and open collector output is provided for each protection function.

Load shedding can be done at two individual levels. Each level controls a dedicated built-in relay.

Measured and calculated parameters can be provided as V DC and mA signals on three isolated analogue outputs. The span of each output is programmable.

Interfacing

The RS485 MODBUS-RTU connection provides easy interfacing to SCADA systems and PLCs. Measured and calculated parameters are easily accessed by any device capable of operating as a MODBUS master. Configuration parameters can also be accessed and altered through MODBUS-RTU.

An RS232 connection is provided for point-to-point configuration. The S6000 can be remotely configured by "clear text" commands issued from an ANSI standard terminal application (e.g. MS Windows HyperTerminal).

The complete configuration can be stored as a text file. This text file can be inspected or changed (see figure 2), and later the (corrected) text file can be reloaded in an IO/P Module.

The total solution

Together with the S6100 and S6500, the S6000 will provide a simple, yet powerful solution to a full scale control system. Such a system will provide protection, auto-synchronization, active/reactive load sharing, and indication/SCADA connectivity.

A single variant supports nominal voltages in the range 63 to 690V AC. Secondary CT current must be specified upon delivery (5A or 1A).

Marine approval

The S6000 is designed to comply with marine requirements. The design of the circuitry and metal casing provides the best possible protection from EMC and environmental stress.

The S6000 has been thoroughly tested at an independent accredited laboratory with regards to very high vibration levels, heat, cold, humidity, salt mist, EMC emission and immunity as well as other parameters.

```

S6000-Config.txt - Notepad
File Edit Format View Help
WRITE PROTECT SC ENABLED YES
WRITE PROTECT SC LEVEL 100
WRITE PROTECT SC DELAY 200
WRITE PROTECT OC ENABLED NO
WRITE PROTECT OC LEVEL 100
WRITE PROTECT OC DELAY 5.0
WRITE PROTECT OL ENABLED YES
WRITE PROTECT OL LEVEL 100
WRITE PROTECT OL DELAY 5.0
WRITE PROTECT OL MODE PHASE
WRITE PROTECT RP ENABLED YES
WRITE PROTECT RP LEVEL -2
WRITE PROTECT RP DELAY 5.0
WRITE PROTECT RP MODE PHASE
WRITE PROTECT EL ENABLED YES
WRITE PROTECT EL LEVEL -50
WRITE PROTECT EL DELAY 5.0
WRITE PROTECT EL MODE PHASE
WRITE PROTECT VE ENABLED NO
WRITE PROTECT VE LOWLEVEL 70
WRITE PROTECT VE UPLEVEL 130
WRITE PROTECT VE DELAY 2.0
WRITE LOADTRIP NE1 ENABLED YES
WRITE LOADTRIP NE1 LEVEL 80
WRITE LOADTRIP NE1 DELAY 10.0
WRITE LOADTRIP NE1 MODE PHASE
WRITE LOADTRIP NE2 ENABLED YES
WRITE LOADTRIP NE2 LEVEL 90
WRITE LOADTRIP NE2 DELAY 10.0
WRITE LOADTRIP NE2 MODE PHASE
  
```

Fig. 2. Configuration of the SIGMA IO/P Module in text format.

SIGMA S6100 S/LS Module



- 3 phase measurements
- Voltage matching
- Frequency control
- Auto synchronization
- Active load sharing
- Voltage control
- Reactive load sharing
- Dead bus facility
- Manual synchronization
- Conventional governor/AVR
- Electronic governor/AVR
- RS485 MODBUS slave
- CAN Bus
- Redundant power supply

The S6100 reads generator parameters from the S6000 IO/P module (connected through the CAN Bus). The S6100 will also measure the busbar voltages across all three phases. The busbar voltage measurements are digitally sampled by the built-in signal processor and converted to true RMS values. The S6100 will continuously do real-time calculations of derived parameters. The S6100 can connect to generators with or without neutral.

Conventional and electronic governors

The S6100 has dedicated interfaces for both conventional and electronic governors and automatic voltage regulators. Manual control is also possible through external push-buttons.

Control

The S6100 includes voltage control, frequency control, voltage matching, automatic or manual synchronization and automatic or manual active/reactive load sharing.

Built-in relays are provided for control of conventional governors and AVRs. Isolated analogue outputs are provided for control of electronic governors and AVRs. The S6100 will work with or without droop.

An important feature of the S6100 is the compatibility with the well proven SELCO T4400 and T4800 Load Sharers, as the parallel lines of the S6100 can be configured to match the parallel lines of the T4400 or T4800.

PID control

The SIGMA S/LS module includes two modes of control. One is a control by increase/decrease relay signals intended for control of conventional (mechanical) governors and/or voltage regulators. The other is a direct electronic control by a DC voltage or current. The direct electronic control can be adapted to most electronic governors and/or voltage regulators.

The relay based control is tuned by setting stability and pulse width, while the electronic control is optimized with advanced PID control algorithms. The PID based control provides separate tuning parameters for frequency stabi-

lization, voltage stabilization, automatic synchronization and active/reactive load sharing. The PID algorithms provide very fast regulation with very little overshoot.

Interfacing

The RS485 MODBUS-RTU connection provides easy interfacing to SCADA systems and PLCs. Measured and calculated parameters are easily accessed by any device capable of operating as a MODBUS master. Configuration parameters can also be accessed and altered through MODBUS-RTU.

An RS232 connection is provided for point-to-point configuration. The S6100 can be remotely configured by "clear text" commands issued from an ANSI standard terminal application (e.g. Windows HyperTerminal).

The complete configuration can be stored as a text file. This text file can be inspected or changed (see figure 2), and later the (corrected) text file can be reloaded in an IO/P Module.

The total solution

Together with the S6000 and S6500, the S6100 will provide a simple yet powerful solution to a full scale control system. Such a system will provide protection, auto-synchronization, active/reactive load sharing, and indication/SCADA connectivity.

A single variant supports nominal voltages in the range 63 to 690 VAC.

Marine approval

The S6100 is designed to comply with marine requirements. The design of the circuitry and metal casing provides the best possible protection from EMC and environmental stress.

The S6100 has been thoroughly tested at an independent accredited laboratory with regards to very high vibration levels, heat, cold, humidity, salt mist, EMC emission and immunity as well as other parameters.

SIGMA S6500 UI Module (optional)



- Integrated multimeter
- SIGMA user interface
- SIGMA remote control
- C/B status
- CAN bus
- Pin code protected
- Redundant supply

The S6500 UI module is a flush mountable user interface for the SIGMA range of modules. The S6500 fills the role of a flush mounted digital multimeter as well as a configuration terminal. The S6500 will provide real-time readings of voltages, currents, active/reactive load, VA, frequency, etc.

A single S6500 can support up to 16 S6000 and S6100 modules. The S6500 can be used to monitor and alter parameters in parallel with an operating SCADA system.

Marine approval

As for the S6000/S6100 the S6500 is designed to fully comply with marine requirements.

Application: Synchronizing between Busbars

A unique feature of the SIGMA system is the possibility of simultaneous synchronization of already parallel running generators to another busbar section, a shaft generator or the grid. This feature is shown in the diagram in figure 3. An output (FREQ. OUT) from the

SELCO T4500 Auto Synchronizer is connected to an input (FREQ. IN) of the S6100 SIGMA S/LS modules in order to align the frequency for synchronizing.

When the "Sync On" contact is closed, the external frequency signal from the T4500 Synchronizer will be active and all internal frequency controls of the S6100 S/LS modules are disabled, as the frequency is now determined by the other busbar section, e.g. the shaft generator or the grid.

This is an example of using the well proven existing SELCO units with the SIGMA system.

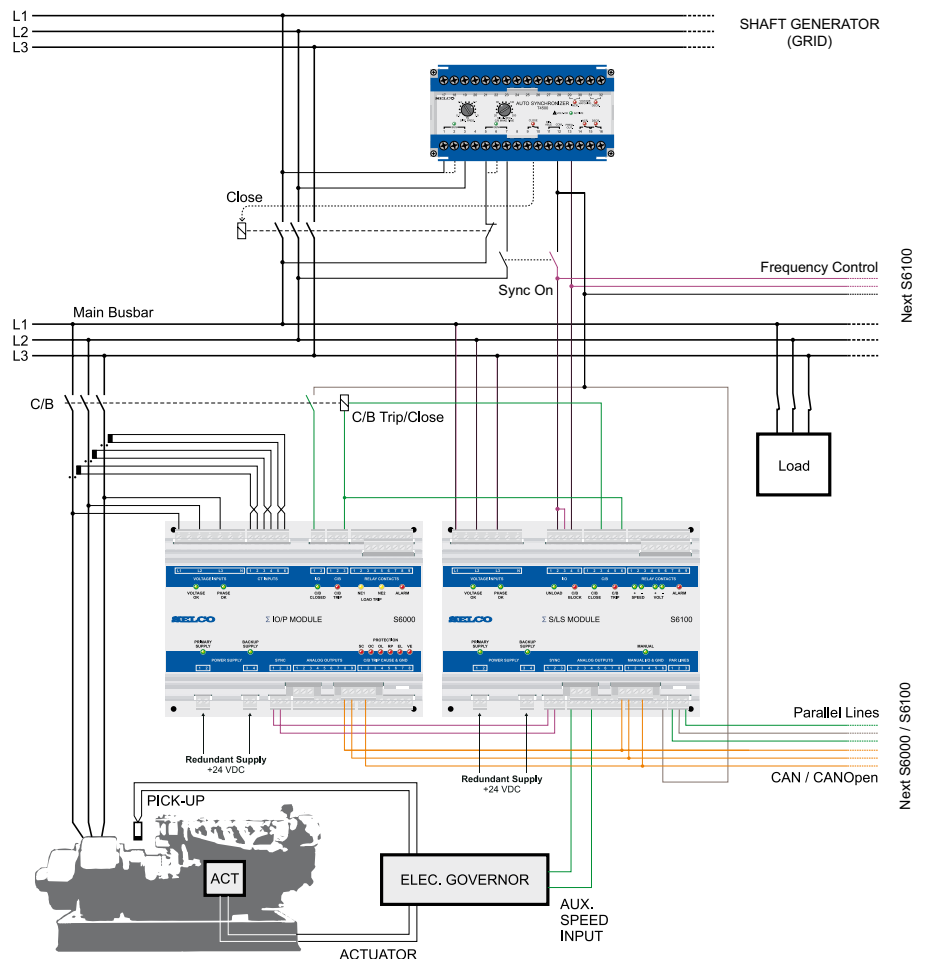


Fig. 3. Application diagram. Synchronizing parallel running generators to a shaft generator (grid).

SIGMA S6610 Power Manager Module

- Full featured Power Manager
- Load depending start and stop
- 5 large consumer requests
- 5 non essential load trips
- Blackout clearance
- 2 analogue outputs
- Automatic mode/ manoeuvre mode/manual mode
- Supports up to 16 generators
- Includes all functions of S6500 User Interface Module
- Redundant power supply

The S6610 PM Module provides power management functionality to the SIGMA system. In co-operation with the S6000 Input/ Output and Protection Module and S6100 Synchronizing/Loadsharing Module, S6610 offers load depending start and stop, large consumer request and blackout clearance functionality.

It is also possible to configure all SIGMA modules from S6610. Programming is PIN code protected.

Load depending start and stop

S6610 provides load depending start and stop functions. The start priority can be programmed to be linear, depending on running hours of each generator set (duty hour), or cyclic.

The linear sequence starts and stops the generators according to the assigned priority. The highest prioritized generator is the first to be started, then the second highest, etc. The linear sequence stops the generators after “the-last-in-first-out” principle.



Fig. 4 Three diesel gen-sets in parallel controlled by SIGMA

The cyclic sequence starts and stops the generators according to the assigned priority. The highest (numerical lowest) prioritized generator is the first to be started, then the second highest, etc. The cyclic sequence stops the generators after “the-first-in-first-out” principle.

The duty hour sequence starts and stops the generators according to their number of running hours. The generator with the lowest number of running hours is the first one to be started, while the generator with the largest number of running hours is the first to be stopped.

Large consumer request function

Five large consumers can be controlled with S6610. The large consumer (LC) request signal remains active as long as the large consumer shall be used. After the LC request signal has been activated, S6610 will make sure that the reserve capacity is equal to or larger than the power of the requested large consumer.

Optionally, a large consumer load feedback function can be activated in the S6610. This function is designed for optimizing the quantity of generators running (avoiding start of more generators than necessary).

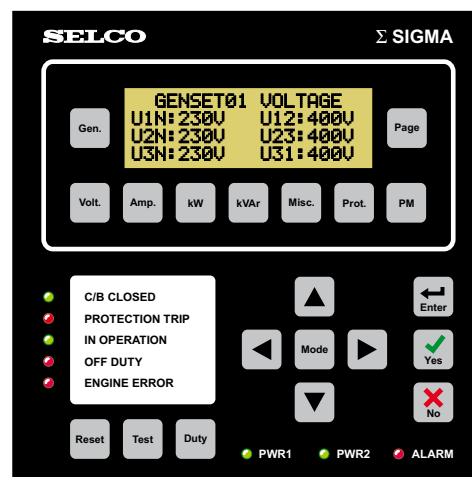
This function is of special interest in applications using large consumers with variable power consumptions. In this case, the load of the active large consumer is measured and deducted from the respective large consumer request, thus making sure that no more generators are started than what is necessary to cover the expected load.

Non essential load trip

When the large consumer request is activated, five non essential consumers can be tripped in order to give place for the start current of the large consumers.

Blackout Clearance

In case of blackout, S6610 will start up the first available generator and connect it to the dead bus bar. An interlock function ensures that only one generator at a time can be connected to the dead bus bar.



In connection with bus bar voltage and frequency failures, a pre-start of the next available generator can be chosen before the breaker trips, thus keeping the blackout time short.

Analogue outputs

Two analogue outputs can be configured as measurement converters to give an analogue signal for e.g. reserve capacity and plant load.

Automatic mode

Automatic operation of the Power Management System.

Manual mode

No generators will be started or stopped by the S6610 Power Manager Module regardless of load or blackout situation. Synchronizing and load sharing can still be in automatic mode.

No load depending stop mode

In this mode the load depending stop function of S6610 Power Manager Module is disabled, while load depending start and blackout start are still available.

This function can be used as a manoeuvre 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.

We are SELCO

Since the origin in 1960, SELCO technology has provided the electrical power generation market with high class equipment, living up to major international standards.

SELCO manufactures and supplies electronic relays and microprocessor based equipment for control, monitoring and protection of medium sized generators in parallel operation.

Primarily the products are used for generators on board ships and in compact land-based power stations where operation in parallel with the grid (utility) may also be a requirement.

SELCO also manufactures a wide range of alarm monitors, indicator panels and software for use in a broad variety of marine and industrial applications, e.g. pharmaceutical industry, food processing, petrochemical industry, machinery, off shore and energy distribution. All products undergo thorough test and inspection procedures to ensure high reliability and continuous operation in the field.

Since its establishment as an independent company in 1984, SELCO has continuously expanded its activities within the generator control and alarm monitor markets. SELCO products are marketed and sold in more than 60 countries worldwide. SELCO offers a comprehensive range of services including technical support, application support and spare part services.

SELCO staff and its partners worldwide take pride in exceeding the customers' expectations in quality and excellent service.

CUSTOMER FOCUS



The SELCO equipment has been thoroughly tested by certified laboratories with regard to high vibration levels, heat, cold, humidity, salt mist, EMC emission and immunity as well as other parameters.

SELCO products are in accordance with all significant international standards and have been approved and certified by the major marine classification societies.



