C6200 FlexGen

Generator Controller

Installation Manual

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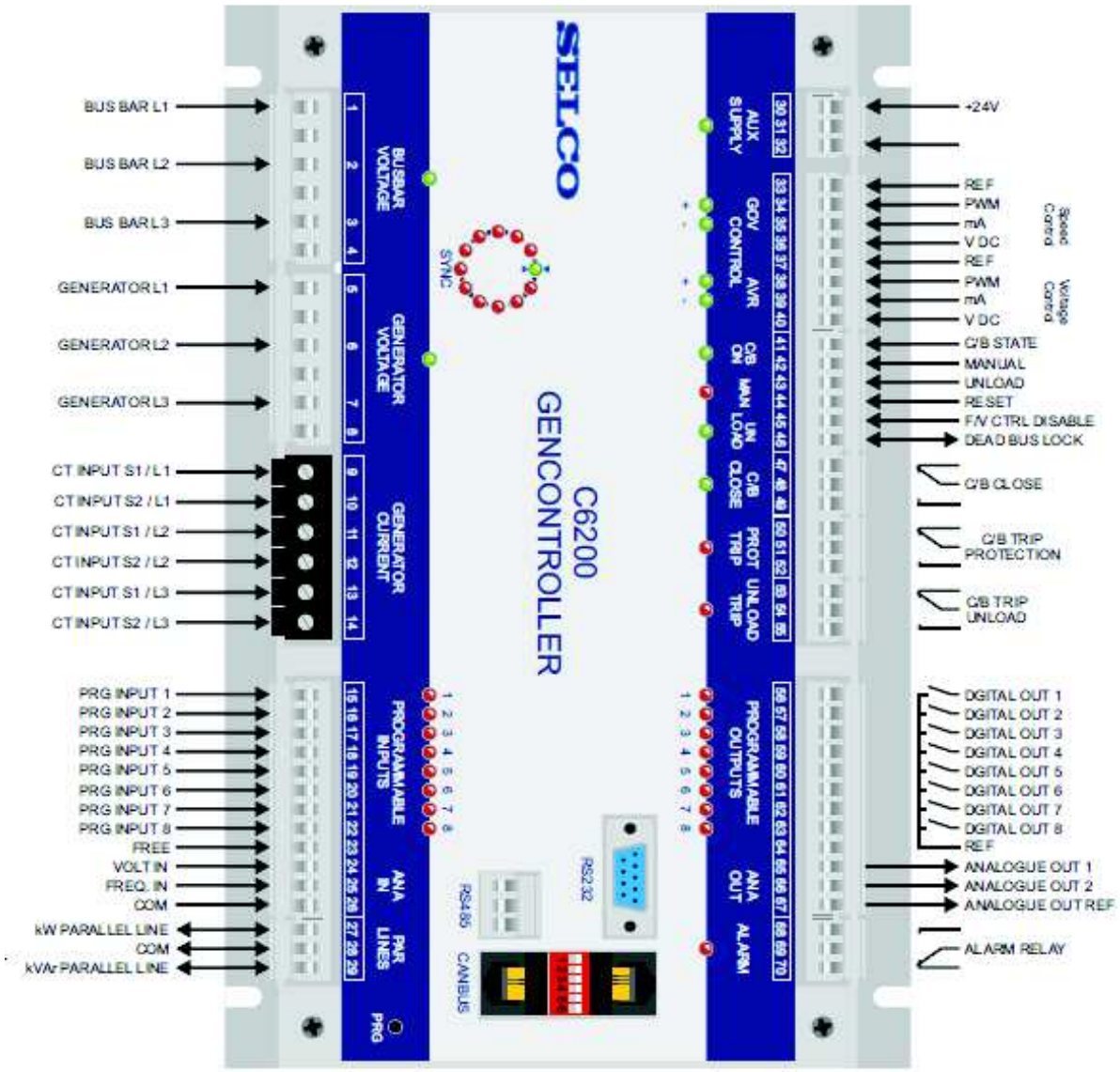
1 Preface

The Littelfuse Selco C6200 FlexGen provides integrated generator protection, frequency stabilization, voltage stabilization, check and automatic synchronisation, voltage matching, active and reactive load sharing, basic and programmable I/O and data acquisition.

The Littelfuse Selco C6200 FlexGen can operate in parallel with other C6200 FlexGen modules and interface with the C6500 User Interface Module via the on-board RS232 interface. SCADA and HMI systems can be connected via the RS485 MODBUS interface.

2 Front View


SELCO
C6200
GENCONTROLLER
BUS BAR L1
BUS BAR L2
BUS BAR L3
GENERATOR L1
GENERATOR L2
GENERATOR L3
CT INPUT S1 / L1
CT INPUT S2 / L1
CT INPUT S1 / L2
CT INPUT S2 / L2
CT INPUT S1 / L3
CT INPUT S2 / L3
PRG INPUT 1
PRG INPUT 2
PRG INPUT 3
PRG INPUT 4
PRG INPUT 5
PRG INPUT 6
PRG INPUT 7
PRG INPUT 8
FREE
VOLT IN
FREQ. IN
COM
kW PARALLEL LINE
COM
kVAr PARALLEL LINE
+24V
REF
PWM
mA
V DC
REF
PWM
mA
V DC
Speed Control
Voltage Control
C/B STATE
MANUAL
UNLOAD
RESET
F/V CTRL DISABLE
DEAD BUS LOCK
C/B CLOSE
C/B TRIP PROTECTION
C/B TRIP UNLOAD
DGITAL OUT 1
DGITAL OUT 2
DGITAL OUT 3
DGITAL OUT 4
DGITAL OUT 5
DGITAL OUT 6
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REF
ANALOGUE OUT 1
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ALARM RELAY
BUSBAR VOLTAGE
GENERATOR VOLTAGE
GENERATOR CURRENT
PROGRAMMABLE INPUTS
ANA IN
PAR LINES
PRG
AUX SUPPLY
GOV CONTROL
AVR
C/B ON
MAN LOAD
UN LOAD
C/B CLOSE
PROT TRIP
UNLOAD TRIP
PROGRAMMABLE OUTPUTS
ANA OUT
ALARM
SYNC
RS232
RS485
CANBUS

3 Installation

The C6200 FlexGen must be secured to the rear of the switch board using four 5 mm. screws. DIN rail mounting is not advisable due to the weight.

Please ensure that enough space is given around the module so that the plug-in terminals can be removed and reinserted without stressing the wires. The length of the cables should allow for the easy removal and insertion.

4 Isolation and Grounding

In marine installations ground (switchboard chassis) and common reference (COM) should not be connected together. In a marine installation the vessels hull is considered as “ground”.

Connecting any of the COM connections on the C6200 FlexGen to ground (hull) or switchboard chassis may cause electrical noise to be injected into the system.

The general rule is:

COM terminals should not be connected to ground (vessels hull) or to the switchboard chassis.

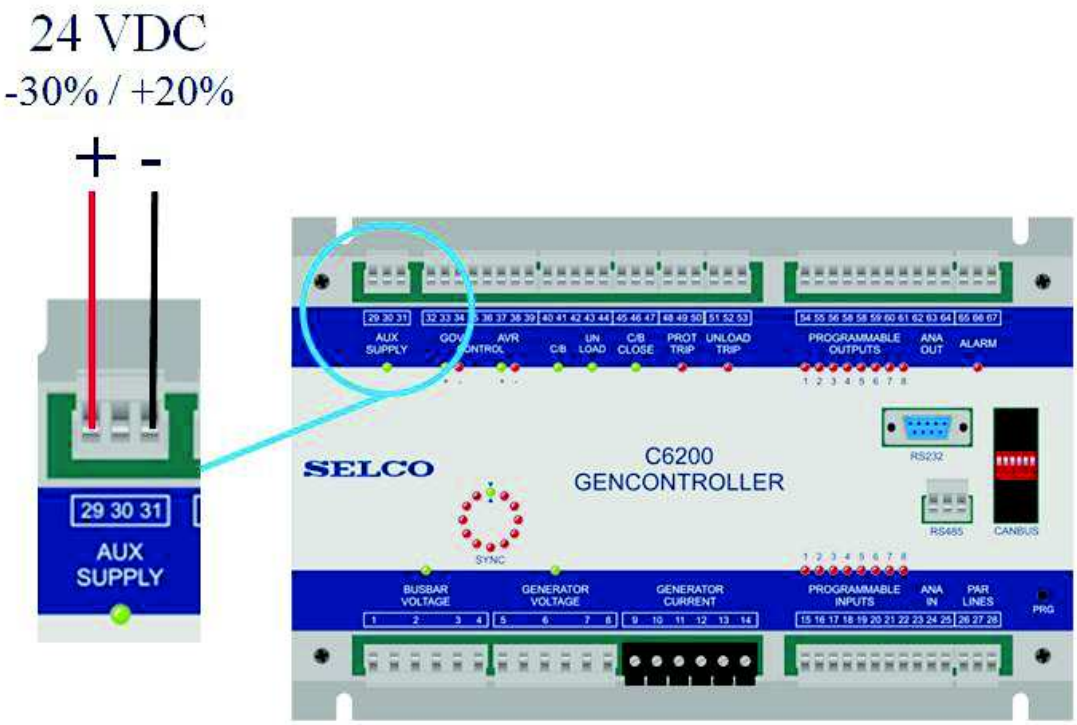
Negative poles of the power supplies should not be connected to ground (vessels hull) or to the switchboard chassis.

5 Connections

The C6200 FlexGen is wired up through plug-in terminals. The plug-in terminals provide safe and durable connections without sacrificing ease of installation and servicing. One exception is the inputs for the currect transformers, which are fixed terminals to avoid shock from accidental disconnection of live current inputs.

5.1 Power Supply

The circuitry of the the C6200 FlexGen must be powered by a single external power supply. The supply must provide a nominal voltage of +24 V DC. The C6200 FlexGen will tolerate relatively wide variations in the supply voltage (please refer to the specifications). The supply is connected to terminal 30 and 32 of the AUX SUPPLY plug-in connector.



Terminal	Signal	Description
30	+24 V DC	Positive terminal of primary supply
31		FREE (unused / no connection)
32	-24 V DC	Negative terminal of primary supply

The auxiliary power supply is not isolated from the remaining circuitry. This means that the supply reference terminal (terminal 32) has connection to the module's COM terminal.

The front AUX SUPPLY LED illuminates with a steady green light to indicate that the supply voltage is OK and within the tolerated limits for safe operation.

External switching of the supply (e.g. to power the units on and off) should be done by making or braking positive supply (terminal 30). Do not use terminal 32 to make and break the supply.

5.2 Voltage Inputs

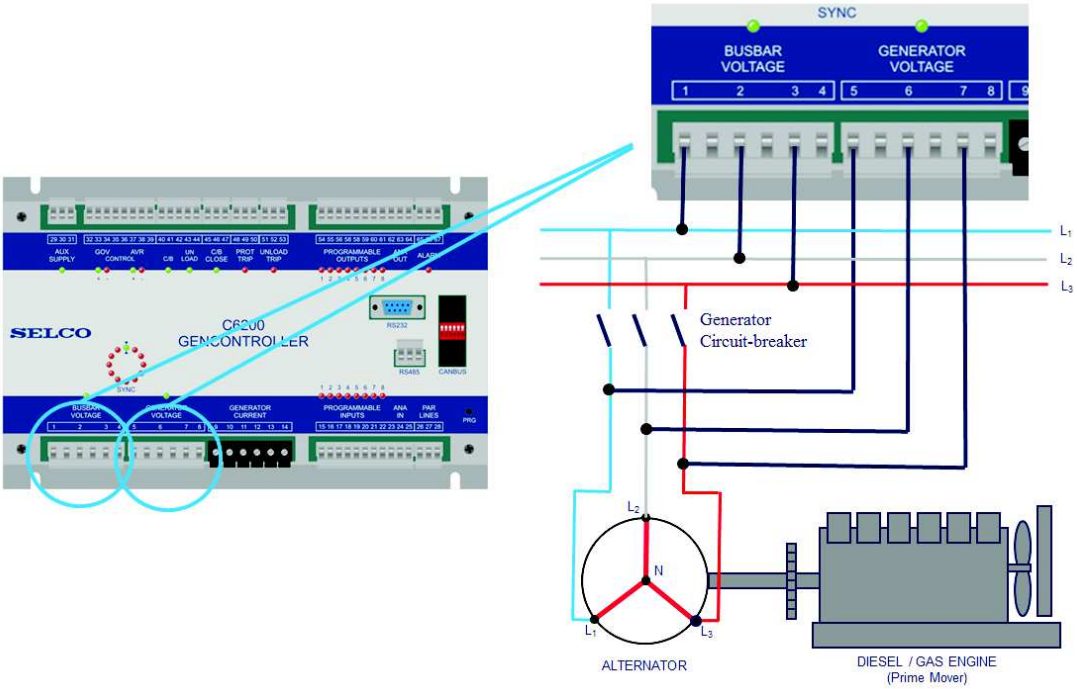
The AC voltages connect to the BUS BAR VOLTAGE and GENERATOR VOLTAGE plug-in terminals.

The voltage inputs can operate with high voltage (up to 690 V AC nominal), so precaution must be taken to avoid electrical shock and personal injury. Do not touch the voltage input plug-in terminal unless you are absolutely sure that both the busbar and generator is off. The generator should be stopped and blocked against starting – the busbar should be dead. Also make sure that there is no risk of another power source being connected to the busbar while you are working with the voltage inputs.

Voltages above 690 V AC are supported through use of external transformers (PT). When using PTs please ensure that the PT does not affect the phase of the AC voltage measurement. Phase shift in the PT will directly affect the calculation of power factor, and thereby the calculation of active and reactive currents and loads.

The phases L1, L2 and L3 of the busbar and generator voltage must be connected to L1, L2 and L3 of the busbar/generator voltage input plug-in terminals. Intermediate 2 A slow-blow fuses should be inserted between the individual phases and the related voltage inputs.

It is important that the phases are connected in the correct order (correct phase sequence). Interchanging the phases will result in an incorrect power factor calculation and thereby incorrect calculation of active/reactive currents and loads. It is important that the phases are connected to the corresponding terminals (phase 1 to L1, phase 2 to L2 and phase 3 to L3).



Terminal	Signal	Description
1	AC voltage	Bus bar phase L1
2	AC voltage	Bus bar phase L2
3	AC voltage	Bus bar phase L3
Terminal	**Signal**	**Description**
5	AC voltage	Generator phase L1
6	AC voltage	Generator phase L2
7	AC voltage	Generator phase L3

The BUSBAR VOLTAGE LED shows (by steady light) whether the voltage levels measured between the phases are within limits. The reference is the nominal phase-phase voltage (NOMVOLT) that has been entered in the configuration. The toleance is defined by the voltage OK window (VOLTOKWND) also present in the configuration.

The same scheme applies to the GENERATOR VOLTAGE LED. However, on older versions of the C6200 FlexGen the LED will also flash while the generator breaker is open. This depends on the firmware revision.

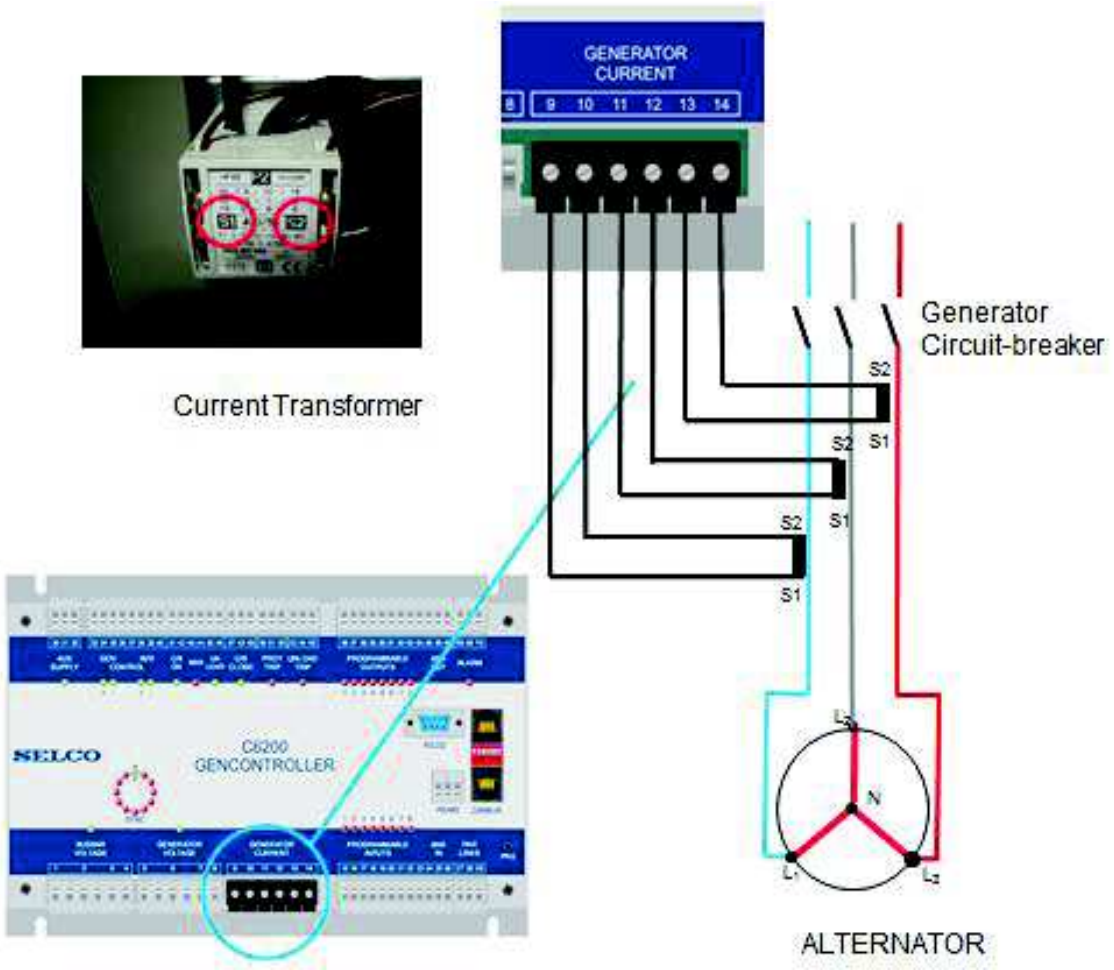
5.3 Current Inputs

The C6200 FlexGen measures current through external current transformers (CTs). The C6200 FlexGen supports 5 A CTs. Class 1 CTs for protection is recommended. The CTs can be shared with third-party equipment provided that this equipmed due not place a burden on the CTs (that the CT inputs are isolated by e.g. transformers inside the third-party equipment).

The CT ratio should cover the maximum current of the generator.

The CTs must be capable of coping with limited time short-circuit currents without going into saturation (Protection Transformers).

The external CTs connect to the GENERATOR CURRENT terminals. It is important to ensure that the direction of the current flow is correct. The current flow is usually indicated by S1 and S2 notations on the CT enclosure. S1 of the CT on phase 1 connects to terminal 9 and S2 connects to terminal 10.



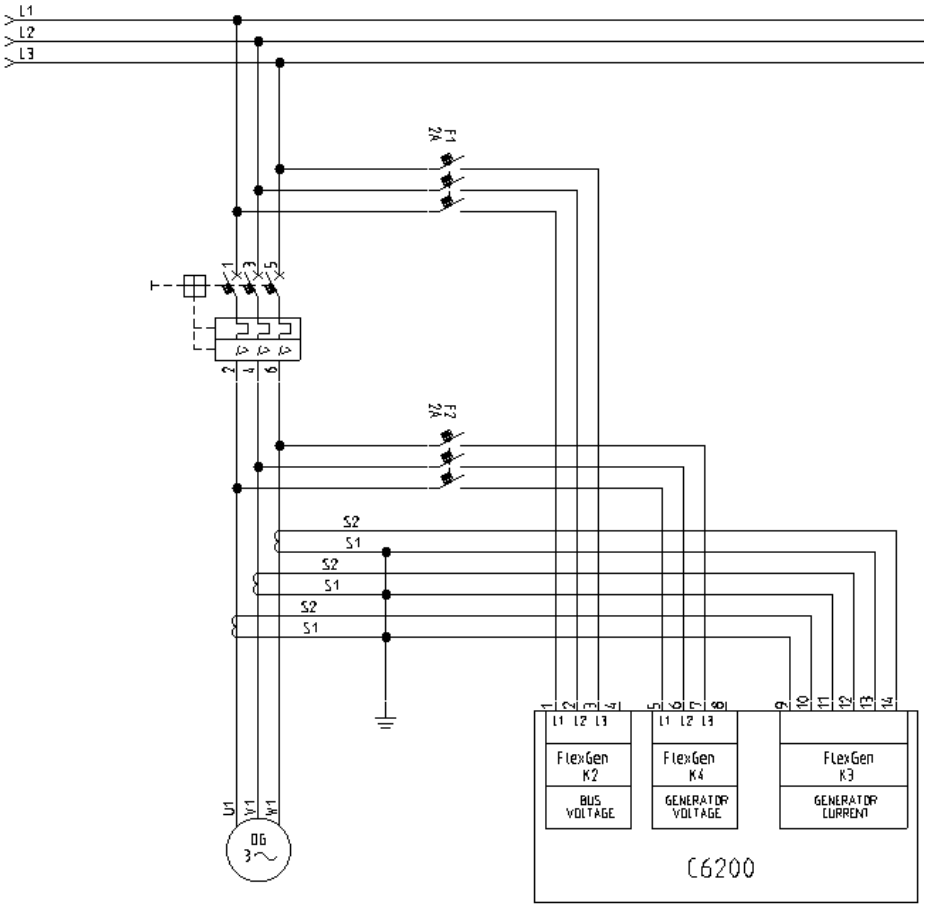
Terminal	Signal	Description
9	AC current	S1 of the CT on phase L1
10	AC current	S2 of the CT on phase L1
11	AC current	S1 of the CT on phase L2
12	AC current	S2 of the CT on phase L2
13	AC current	S1 of the CT on phase L3
14	AC current	S2 of the CT on phase L3

Make sure that the secondary side of the CT is shorted (make a connection between S1 and S2) before you disconnect the CT cables from the GENERATOR CURRENT terminals.

Please note that incorrect connection of the current transformers (e.g. by reversing the terminals S1 and S2) will result in wrong current, power and power factor readings.

Correct measurement of the current is extremely important. The C6200 FlexGen relies upon the current measurements for the calculation of power factors, active currents and loads, reactive currents and loads, integrated protection functions and load sharing.

Connection of bus & generator voltages and currents

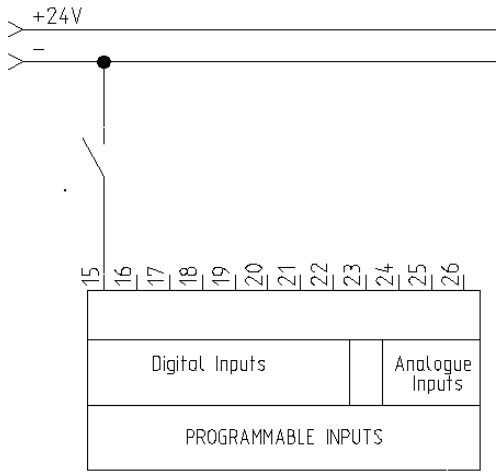


5.4 Programmable Inputs

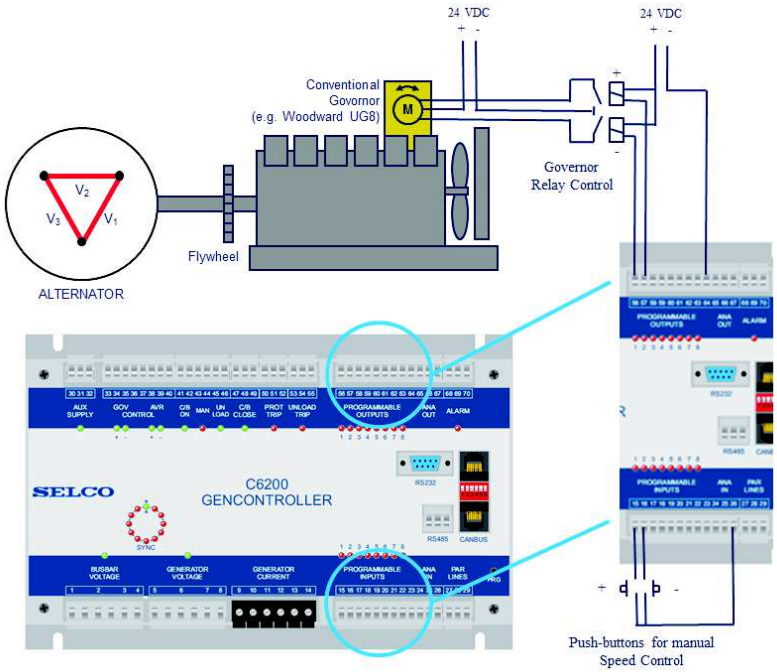
The programmable input connector provides a number of digital inputs. The digital inputs work with negative reference (COM), meaning the inputs are considered active when they are connected to minus supply, and inactive when left open (disconnected). The inputs are used for external activations of various programmable features. The functions are described in the C6200 FlexGen Configuration Manual.

Terminal	Signal	Description
15	NO contact to COM	Programmable input 1
16	NO contact to COM	Programmable input 2
17	NO contact to COM	Programmable input 3
18	NO contact to COM	Programmable input 4
19	NO contact to COM	Programmable input 5
20	NO contact to COM	Programmable input 6
21	NO contact to COM	Programmable input 7
22	NO contact to COM	Programmable input 8
23	FREE	

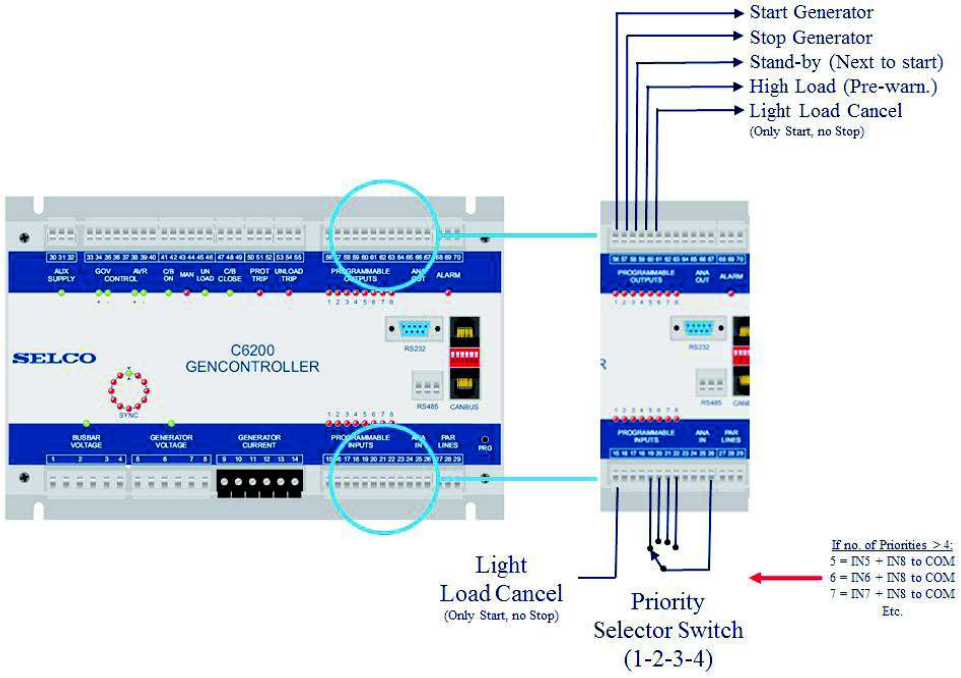
Example for connection of a digital input:



The figures on the next page show the programmable inputs and outputs being used for control of a conventional speed governor (with increase descrase relay pulses) and for load depending start and stop.



Programmable inputs and outputs used for control of conventional speed governor.



Programmable inputs and outputs used for load depending start and stop.

5.5 Analogue Inputs

The analogue inputs are used for external control of voltage, frequency and load. For example, the analogue inputs can be used when two busbar sections are to be synchronized together or when the gerator is to be synchronized to an incoming sharft generator (or the grid). The analogue inputs can also be used in case the load of the generator needs to be remotely controlled e.g. in grid paralleling application.

5.5.1 Voltage Input

The voltage input (terminal 24) is an analogue input. The input can be used for external control of the generator voltage, provided that the F/V CTRL. DISABLE input has been activated (connected to COM) or a grid parallel operation scheme is activated. The analogue control signal must be a voltage between 0 and +5 V DC. The voltage input uses the COM terminal as reference. When not used its is recommended that the voltage input is connected to COM. This is especially important if the F/V CTRL. DISABLE input is made active while no signal is provided to the voltage input.

Terminal	Signal	Description
24	0 to +5 V DC	Remote Voltage Control
26	COM	Common reference

Please note that terminal 26 (COM) is internally connected to terminal 32 (Supply minus). In rare situations "gound loops" can cause noise to be injected into the application. Ground loops happen when multiple COM connections between modules (e.g. parallel operating C6200 units) exist. Ground loops can be avoid by only using terminal 32 as the common connection point for all COM connections.

5.5.2 Frequency Input

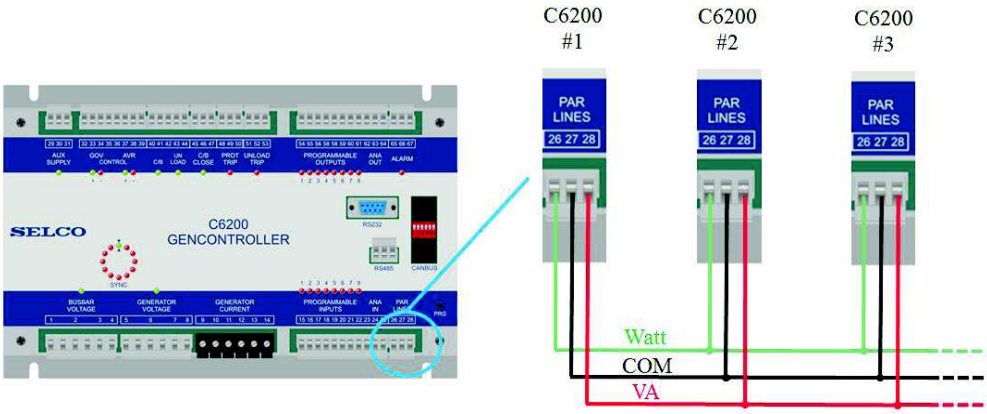
Like thr voltage input, the frequency input is an analogue input. The input can be used for external control of the generator frequency, provided that the F/V CTRL. DISABLE input is active (connected to COM) or a grid parallel operation scheme is activated. The analogue control signal must be a voltage between 0 and +5 V DC. The frequency input uses the COM terminal as reference. When not used its is recommended that the frequency input is connected to COM. This is especially important if the F/V CTRL. DISABLE input is made active while no signal is provided to the frequency input.

Terminal	Signal	Description
25	0 to +5 V DC	Remote Frequency Control
26	COM	Common reference

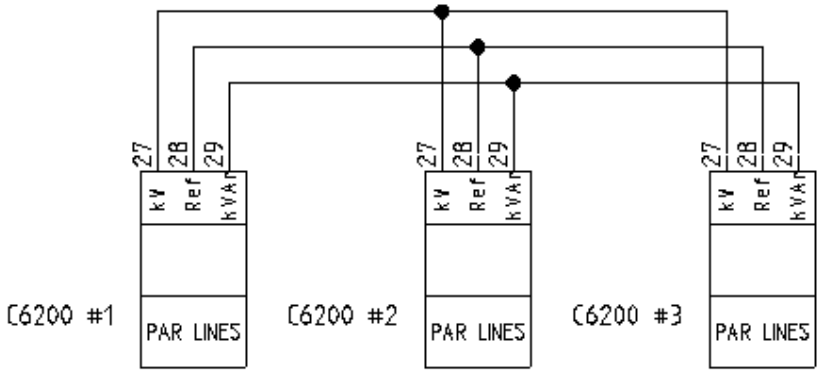
Please note that terminal 26 (COM) is internally connected to terminal 32 (Supply minus). In rare situations "gound loops" can cause noise to be injected into the application. Ground loops happen when multiple COM connections between modules (e.g. parallel operating C6200 units) exist. Ground loops can be avoid by only using terminal 32 as the common connection point for all COM connections.

5.6 Parallel Lines

The parallel lines are used for balancing the active and reactive currents/loads between parallel running C6200 FlexGen modules. The signal level of the parallel lines can also be adapted to suit other types of Littelfuse Selco load sharers (e.g. the Littelfuse Selco T4800).



Terminal	Signal	Description
27	DC voltage	kW BALANCE of other FLEXGEN modules
28	Common reference	COM of the other FLEXGEN modules
29	DC voltage	kVAr BALANCE of other FLEXGEN modules



Please note that terminal 28 (COM) is internally connected to terminal 32 (Supply minus). In rare situations "gound loops" can cause noise to be injected into the application. Ground loops happen when multiple COM connections between modules (e.g. parallel operating C6200 units) exist. Ground loops can be avoid by only using terminal 32 as the common connection point for all COM connections.

5.7 GOV/AVR Control

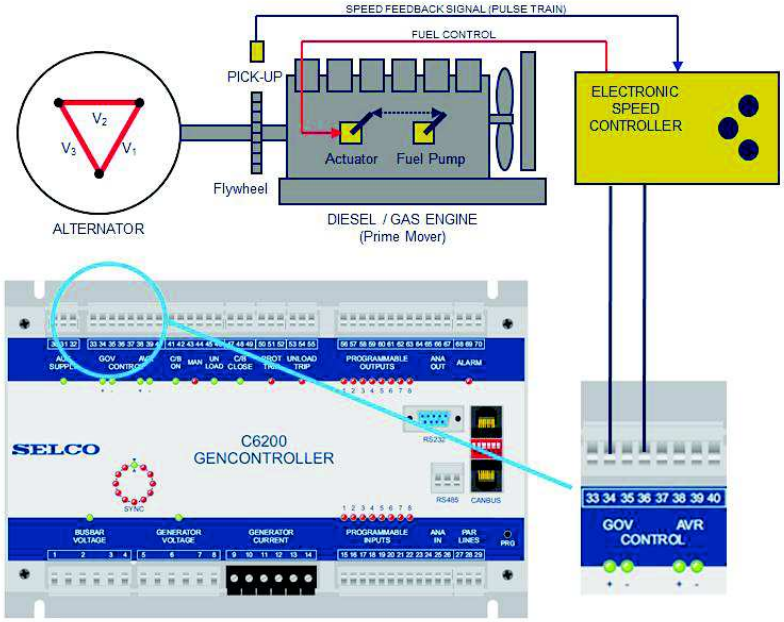
Two sets of analogue outputs are provided for the control of speed and voltage. The analogue outputs are intended for direct control of electronic speed governors and AVRs. Each analogue output can be configured to provide either a DC voltage within the range of -10 to +10 V DC, a DC current within the range of 0 to 20 mA or a PWM signal with a default base frequency of 500 Hz.

The analogue outputs are isolated from each other and from the remaining circuitry. This means that the references of the outputs have no connection to each other or to the common reference (COM).

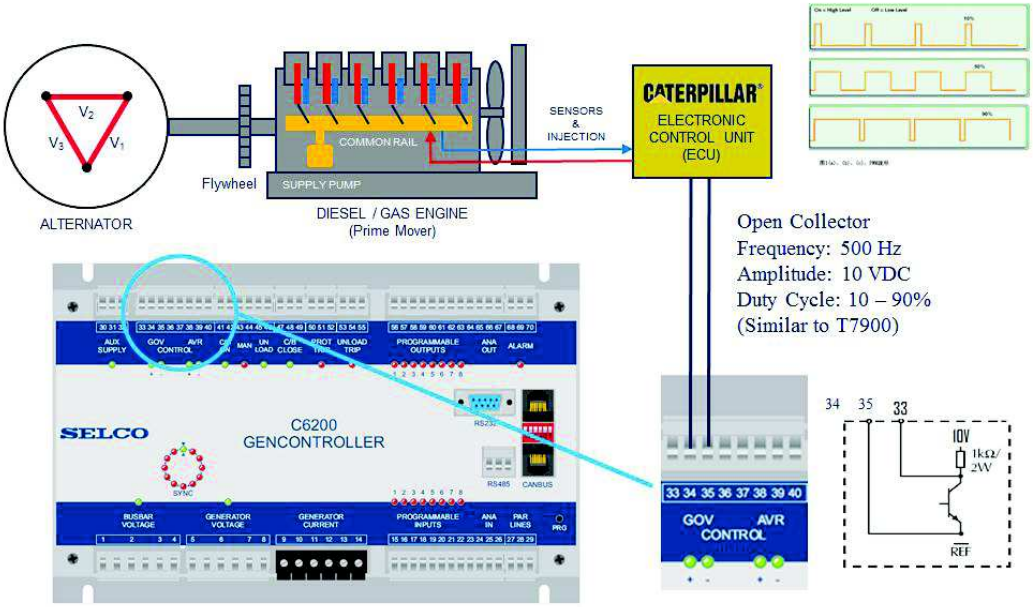
Terminal	Signal	Connection
33	reference (isolated)	Governor reference
34	PWM signal	Governor PWM input
35	DC current	Governor current input
36	DC voltage	Governor voltage input
37	reference (isolated)	AVR reference
38	PWM signal	AVR PWM input
39	DC current	AVR current input
40	DC voltage	AVR voltage input

It is important to note that each analogue output is protected against short circuit by an internal 10 kΩ resistor. The resistor is located inside the C6200 and placed in series with the output. The output resistor might affect the magnitude of the output signal if the internal resistance of the external equipment (e.g. the aux speed input of the governor) is low. The principle of voltage division applies between the output resistor and the internal resistance of the external equipment. Most governors and AVRs have high impedeance inputs, so the 10 kΩ resistance will typically not be an issue.

Example: A governor with aux speed input having an internal resistance of only 10 kΩ would reduce a +10 VDC output voltage to +5 VDC. The two 10 kΩ resistors in series would make a 1:2 voltage divider.



C6200 FlexGen controlling electronic speed governor by a DC voltage.



C6200 FlexGen controlling ECU by a PWM signal.

Note that the amplitude of the PWM signal is determined by the configuration of the DC voltage output range (e.g. 0 to 10 V DC).

5.8 Inputs

The inputs plug-in connector houses a number of general purpose inputs. The inputs work with negative reference, meaning that the inputs are considered active when connected to negative supply and inactive when disconnected.

Terminal	Signal	Description
41	C/B	External switch, output or relay
42	Manual	External switch, output or relay
43	Unload	External switch, output or relay
44	Reset	External switch, output or relay
45	F/V Ctrl Disable	External switch, output or relay
46	Dead Bus Lock	To be interconnected with the Dead Bus Lock terminals of each C6200 FlexGen module in the system

5.8.1 C/B

The C/B input provides feedback from the generator circuit breaker and is used to determine wether the breaker is open or closed. C/B is typically connected to COM through an auxiliary contact of the breaker. The breaker is considered closed when the C/B input is at COM level.

Please note that the C/B input is very important to the function of the C6200 FlexGen. The C/B input is used (together with the state af the voltage inputs) to determine the operational situation of the system.

5.8.2 Manual

Activating the manual input will prevent the C6200 FlexGen from interfering with the speed and voltage controls of the generator, unless it gets a command to do so via the programmable inputs (terminals 15 to 22). The manual input is active when at COM level and inactive if left disconnected.

5.8.3 Unload

The UNLOAD input is used to initiate a controlled unload of the generator whereafter the C6200 FlexGen will issue a trip signal to the breaker. Unload starts when the signal is put to COM level. Disconnecting the unload signal during operation will causes reload and/or reconnection of the generator.

5.8.4 Reset

Reset Alarm is used to reset the alarm relay. Reset Alarm is active when the input is at COM level.

5.8.5 F/V Ctrl. Disable

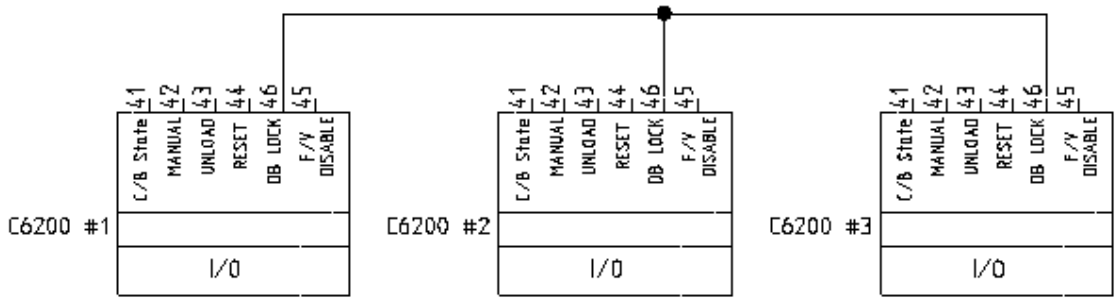
The F/V CTRL. DISABLE input is used to deactivate the voltage and frequency stabilization. This input is considered active when the input is connected to COM level, and inactive when disconnected. The signal is typically used when the generator is operated in parallel with a shaft generator or the grid (power sources that determine the voltage and frequency). Other applications are where the voltage and frequency is controlled by third-party equipment (through the voltage and frequency analogue inputs on terminals 25 and 26).

5.8.6 Dead Bus lock

The dead bus lock signal is used to prevent more than one generator from connect simultaneously to a dead bus bar (e.g. in a blackout situation).

The Dead Bus Lock signal (terminal 46) must be interconnected between all C6200 FlexGen modules that operates generator connecting to the same busbar.

Wiring of Dead bus Lock signal



5.9 Relays

5.9.1 C/B Close

The C/B close relay is a change-over relay intended for control (Closure) of the generator circuit breaker. The C/B close relay has two contact sets and is normally de-energized by default. Note that this relay can be reconfigured to normally energized operation.

Terminal	Signal	Description
47	Relay de-energized position	Breaker remote close
48	Relay contact	Signal source
49	Relay energized position	Breaker remote close

5.9.2 Protection Trip

The protection trip relay is a change-over relay intended for tripping the circuit breaker in case of a protection fault (e.g. over-curremt or reverse power). The built-in protection trip relay has two contact sets and is normally energized by default. Note that the protection trip relay can be reconfigured to normally energized operation.

Terminal	Signal	Description
50	Relay de-energized position	Breaker remote trip
51	Relay contact	Signal source
52	Relay energized position	Breaker remote trip

The protection trip relay connects to the remote trip input of the generator circuit breaker. Terminals 50 and 52 are typically not connected at the same time. Only one of these signals is taken to the breaker, depending on whether the Protection Trip relay is configured for normally energized or de-energized operation.

5.9.3 Unload Trip

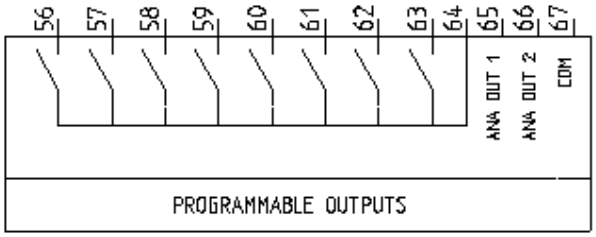
The unload trip relay connects to the remote trip input of the generator circuit breaker. Terminals 52 and 55 are typically not connected at the same time. Only one of these signals is taken to the breaker, depending on whether the unload trip relay is configured for normally energized or de-energized operation. The unload trip relay disconnects the circuit breaker after the generator has been unloaded by the unload function.

Terminal	Signal	Description
53	Relay de-energized position	Breaker remote trip
54	Relay contact	Signal source
55	Relay energized position	Breaker remote trip

5.10 Programmable Outputs

The programmable outputs are potential free relay outputs (Normally opened). The common reference of all programmable outputs is terminal 64 (REF). The outputs are used for indication and control of external equipments (e.g. common alarms or speed/voltage control relay pulses).

Terminal	Signal	Description
56	Normally open relay output	Programmable output 1
57	Normally open relay output	Programmable output 2
58	Normally open relay output	Programmable output 3
59	Normally open relay output	Programmable output 4
60	Normally open relay output	Programmable output 5
61	Normally open relay output	Programmable output 6
62	Normally open relay output	Programmable output 7
63	Normally open relay output	Programmable output 8
64	COM	Reference



5.11 Analogue Outputs

The analogue outputs are intended for use with analogue meters or external indication equipment. Each of the two outputs can be individually configured in relation to any one of the measured or calculated parameters provided within the C6200 FlexGen.

Each analogue output can be configured to provide a DC voltage within the range of -10 to +10 V DC. The two outputs both uses COM as reference.

Terminal	Signal	Description
65	DC voltage	External voltage input
66	DC voltage	External voltage input
67	Reference (COM)	Internal reference

It is important to note that each analogue output is protected against short-circuit by an internal 10 kΩ resistor. Resistors are 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 kΩ would reduce a +10 VDC output voltage to +5 VDC. The two 10 kΩ resistors in series would make a 1:2 voltage divider.

5.12 Alarm

The alarm relay includes two contact sets. The alarm relays can only operate as normally energized relays. This is to ensure that the alarm relay will trip in case the supplies fail.

The alarm relay can also be configured to trip on a protection fault.

Terminal	Description	Signal	Connection
68	Alarm Contact	Relay de-energized position	Alarm system
69	Alarm Contact	Relay contact	Signal source
70	Alarm Contact	Relay energized position	Alarm system

5.13 RS485

The C6200 FlexGen module includes an isolated RS485 interface.

Terminal	Description	Signal	Connection
Left	A -	RS485 A	B signal of the RS485 bus
Middle	B +	RS485 B	A signal of the RS485 bus
Right	REF	Reference (isolated)	Reference of the RS485 bus

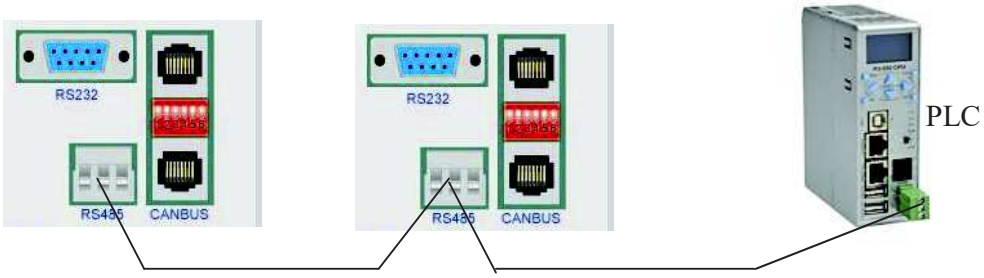
It is important to note that the RS485 reference is isolated from the common COM of the module.

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

A RS485 bus needs termination resistance (150 Ω) between terminals A and B at end end of the cable. It is not necessary to connect external termination resistors as the C6200 FlexGen contains internal resistors that can be enabled by toggeling DIP switch 5 to ON position. The termination resistor must be enabled only on the first and on the last unit on the RS485 bus.

The maximum cable length for RS485 is 1.000 meters. The cable must be twisted pair (A and B twisted inside the cable). The cable should be shielded. One end of the shield (and only one end) nust be connected to switchboard chassis.

TriCab TBE-DEXN/1P18BK Cable can be used



Set Dip-switch 7

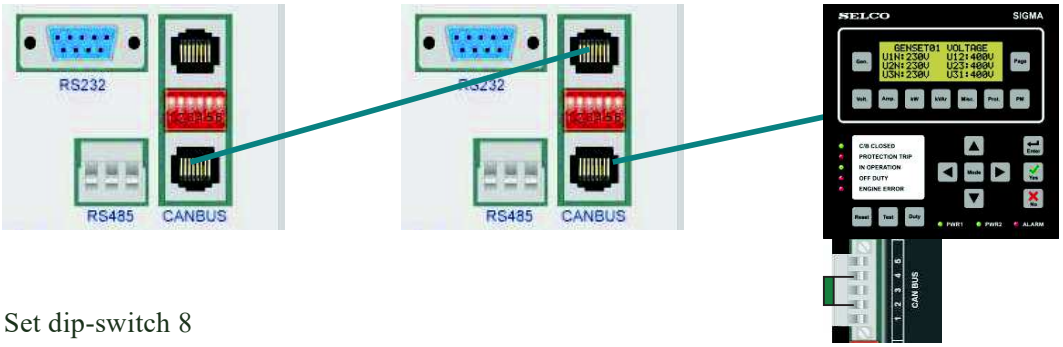
It is sometimes necessary to fix the potential of the RS485 + and – lines due to interference from other sources. This is done with two 1 kΩ resistors using a technique called “Biasing”. One resistor is fixed between RS485 B and an external +5 V DC supply, the other is fixed between RS485 A and the reference of the -5 V DC supply. The reference of the 24 VDC (terminal 32) supply must then be connected to rightmost terminal of the RS485 plug on each and every module.

5.14 CAN bus

The CAN bus is used in connection with the load dending start/stop features of the C6200 FlexGen.

The CANbus terminals are located on the front plate in the right side. The terminals are module standard used in Data communication equipment. Therefore, use standard twisted pair patch cable for CANbus wiring. The maximum cable length is 40 meters. The cable type should be 0.25 - 0.34 mm^2 (AWG23/AWG22). Cable resistance should be less than 26 mΩ per meter.

The first and the last module on the CANbus need a termination resistor (150 Ω) between lines A and B. It is not necessary to connect external resistors. The C6200 FlexGen contains internal end of line resistors for the CAN bus that can be activated by toggeling DIP switch 6 to ON position. Therefore, on the first and on the last unit on the CAN bus, DIP switch 6 has to ON. Every C6200 FlexGen module must be connected to the same CAN bus network. Third party CAN nodes may not be connected to the FLEXGEN CAN bus.

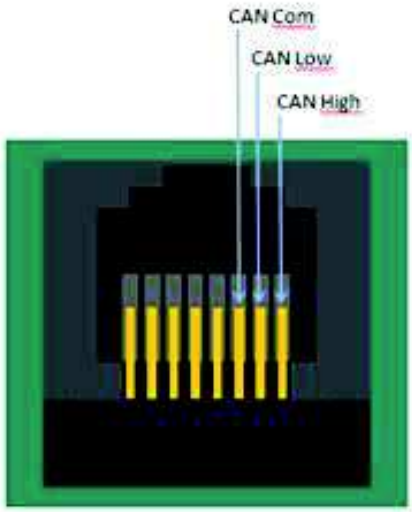


Set dip-switch 8

150Ω resistor via dip switch

150Ω resistor

RJ45 Connector for CAN bus:



6 Specifications:

Voltage supply	:	10 VDC to 36 VDC (24VDC -58% / +50%)
Generator Voltage		63V to 690V
Generator rated frequency		50Hz/ 60Hz
Generator max current		30.000A
Current transformer secondary current		5A
Power Consumption		7W
Ambient temp range		-20 ºC / +70 ºC
Vibration:		IEC 60068-2-6
Humidity:		IEC 60068-2-30
EMC:		IEC 61000-4-3:2006, IEC 61000-4-6:2004, IEC 61000-4-5:2005, IACS E10:2006 Test No.15, CISPR 16-1:1999, CISPR 16-2:2002
Relay contacts		230VAC / 2A & 30VDC / 2A
External communication		MODBUS RTU
Programmable digital inputs		8
Programmable digital outputs		8
Programmable analogue outputs		2
Current measurement		3 phase
Enclosure:		IP20
Weight		1,5 Kg / 3.31Lbs
Dimension (mm)		282 x 182 x 50mm / 11.10 x 7.17 x 1.97 Inch