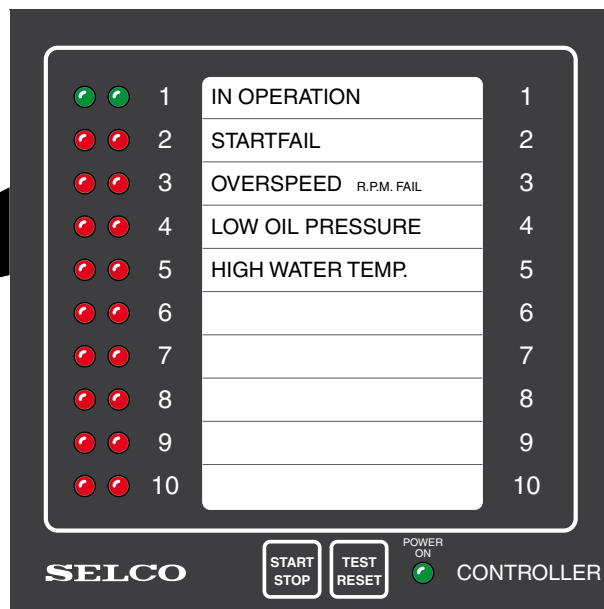
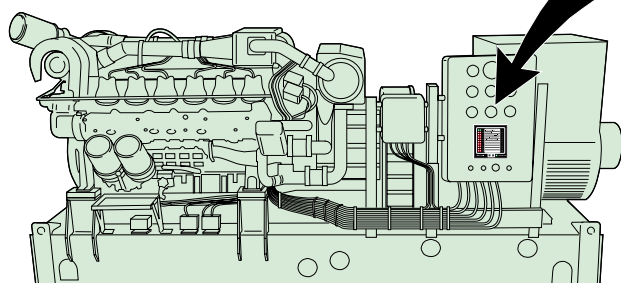


# M2000 Engine Controller

Integrated control and protection of diesel and gas engines for all purposes

Especially suited for auxiliary generator sets



- Type approved by major marine classification societies
- Compact unit for switchboard front panel mounting with standard instrument dimensions of 144 x 144 and a depth of only 35 mm
- Contains 9 shutdown channels and/or 7 alarm channels selectable
- Two powerful LEDs for each of the 10 indicating channels with windows for identification
- CE mark according to EN 50081 and 50082
- Internal tacho relay and programmable check of external circuit
- Quick installation by means of clamping fittings and plug-in terminal blocks for easy service
- Microcomputer based circuit designed for high noise immunity and high supply voltage variations
- Contains automatic test function and control of intermittent prelubrication of engine
- The blank legend card can be typed or printed and inserted between the front plates as illustrated
- Auxiliary options: M0100 Battery Back-up. M0500 Tacho-voltage Detector. M0800 IP54 Cover.

## Function

The SELCO Engine Controller M2000 has been designed to handle the complete control of a diesel generator. It controls start and stop of the engine, monitors and protects the engine during start and operation, and simultaneously indicates on the front all necessary information about the conditions of the generator set.

Start is obtained by activating input terminal 2 and after start delay (0.5-2-4-10 secs) the start will be initiated. It is possible to select up to 4 start attempts, with both crank and rest periods adjustable (5-7-10-15 secs).

When the engine fires, terminal 9 will be activated from an external tacho relay (crank disconnect) or the internal tacho unit detects in excess of 33% of the nominal frequency, and the cranking will be disconnected.

When stopping the engine by deactivating terminal 2, a generator circuit breaker trip delay is available (0-0.5-1-3 min.). Finally a shutdown delay is available for cooling purposes (0-2-4-10 min.). The stated sequence times are standard, but can be altered to suit using SELCO PC programmer N0500.

Besides the above main functions, the controller contains many other features.

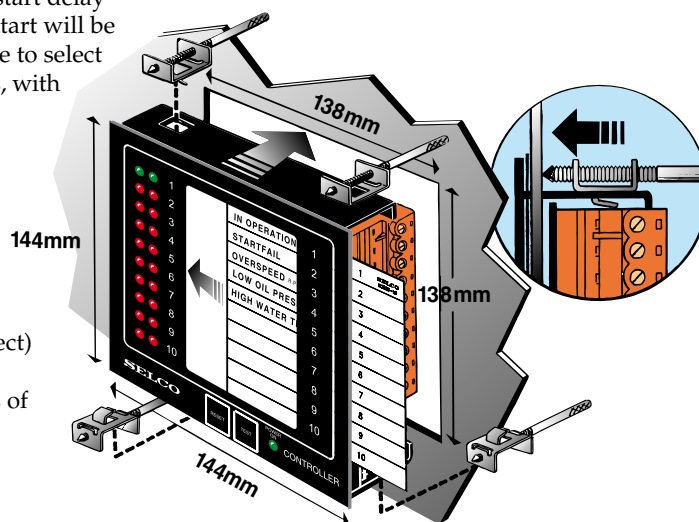


Fig. 1. Quick and easy replacement of text label.

## Inputs

- **Terminal 1:**

- PUSH START / INSTANT RESTART.**

(Is active only in manual mode). NO contact to minus. Cranking is obtained as long as 1 is activated, and crank is disconnected by receiving crank disconnect signal. Several start attempts and start failure are not in function. With S10 OFF, an 0.2 sec. signal on terminal 1 gives start, and start failure and more start attempts are active.

Is 1 connected to minus via 3.3 kΩ, start in the stop periode is obtained. The fuel valve will open and the stop coil released but cranking is only possible after the stop time has passed.

- **Terminal 2: START / STOP.**

(Is active only in automatic mode). NO contact to minus. By activation the engine is started, and by deactivation the engine is stopped.

- **Terminal 3: MODE.**

An external 3-position switch is connected here.

MANUAL (MAN.) is obtained by connecting terminal 3 to plus, and in that position start and stop can be performed via the push button on the front, and via the terminals 1 and 12.

AUTOMATIC (AUT.) with terminal 3 open, automatic start and stop is obtained by activating or deactivating terminal 2. OFF is obtained by connecting terminal 3 to minus, and in this position the engine is stopped and blocked for start.

WARNING : Is OFF considered as safety switch-off, then 18 (CRANK) must also be disconnected.

- **Terminal 4:**

- STOP + ALARM CHANNEL 7.**

NO contact to minus. The input is enabled 8 sec. after crank disconnect. This channel can be used for any engine protection or alarm function. Gives shut-down, alarm, and fast flashing on LED 7. Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened an alarm will be indicated by slow flashing LEDs.

- **Terminal 5:**

- STOP + ALARM CHANNEL 8.**

NO contact to minus. Shut-down is enabled 8 sec. after crank disconnect. Alarm is in operation with engine not

running. This channel can be used for any motor protection or alarm function. Gives shut-down, alarm, and fast flashing on LED 8. Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened an alarm will be indicated by slow flashing LEDs. With input to plus, indication without any logical function is obtained.

- **Terminal 6:**

- STOP + ALARM CHANNEL 9.**

NO contact to minus. Shut-down is enabled 8 sec. after crank disconnect. Alarm is in operation with engine not running. This channel can be used for any motor protection or alarm function. Gives shut-down, alarm, and fast flashing on LED 9. Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened an alarm will be indicated by slow flashing LEDs. With input to plus, indication without any logical function is obtained.

- **Terminal 7:**

- STOP + ALARM / EMERGENCY STOP CHANNEL 10.**

NO contact to minus. Shut-down is enabled 8 sec. after crank disconnect. Alarm is in operation with engine not running. This channel can be used for any motor protection or alarm function. Gives shut-down, alarm, and fast flashing on LED 10. Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened an alarm will be indicated by slow flashing LEDs. With input 7 to plus, emergency stop with shut-down and blocking is obtained. This functions is also active with engine not running.

- **Terminal 8: TACHO INPUT.**

The generator frequency is measured via the attached tacho detector M0500. If contact S15 is OFF, 33% of the nominal frequency (system frequency 50 or 60 Hz chosen on terminal 9) is crank disconnect, and 115% is over-speed. The first 8 sec. after start the limit is 120%.

- **Terminal 9: CRANK DISCONNECT/ SYSTEM FREQUENCY.**

NO contact to minus. With programming contact S15 ON, an external contact

signal for disconnecting cranking can be connected, for instance a tacho relay indicating that the engine is running. If the programming contact S15 is OFF, the internal tacho function is active with tacho detector M0500, and the system frequency is programmed on this terminal as follows : 9 to minus = 60 Hz, 9 open = 50 Hz.

- **Terminal 10: OVERSPEED.**

NO contact to minus. An external tacho relay set for the engine overspeed is connected and gives shut-down, and flashing on LED 3 labelled "OVERSPEED". This input terminal is active independent of S15 position. In connection with tacho detector M0500 overspeed level 100% for test is obtained with terminal 10 to plus.

- **Terminal 11: REMOTE ACCEPT / RESET / LAMP TEST.**

Two functions are obtained on this input in connection with failures on the engine. The input connected to minus via a 3.3 kΩ will disconnect the siren. The input connected to plus directly will reset the alarm and release the blocking allowing the engine to start again, provided the siren is disconnected. The input connected to minus gives disconnection of siren and alarm reset.

- **Terminal 12:**

- PUSH STOP / DELOADED TRIP**

Two functions are obtainable. NO contact to minus. The engine is stopped as long as 12 is activated. Is active only in manual mode. With S10 disconnected an 0.2 sec. impulse on terminal 12 will give continuous stop. Engine stop will be delayed if circuit breaker trip delay and cool down time functions are selected, and all automatic functions are obtainable. Is 12 connected to minus via 3.3 kΩ deloaded trip is obtained to be used on parallel running generator. 1.5 sec. after engine stop the load is small and the generator circuit breaker is tripped via output 26.

- **Terminal 13: LOW OIL PRESSURE. STOP + ALARM CHANNEL 4.**

NO contact to minus. The input is enabled 8 sec. after crank disconnect. A lubrication oil pressostat is connected. Gives shut-down and fast flashing on LED 4 labelled "LOW OIL PRESSURE". Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened,

an alarm will be indicated by slow flashing LEDs.

To ensure start by emergency generators and to avoid that the starter can be engaged when the motor is running alternative start disconnecting signal is available via this input. With S16 open - after each start attempt, before a new start attempt - the oil pressure is checked.

If oil pressure is detected, then the engine must be running and cranking will be avoided. If the oil pressure goes low within 30 sec. then starting will proceed. Otherwise an alarm and an RPM failure indication are given to show that the tacho input is out of order and the over-speed protection may be out of function.

• **Terminal 14:**  
**HIGH WATER TEMPERATURE.**  
**STOP + ALARM CHANNEL 5.**

NO contact to minus. The input is enabled 8 sec. after crank disconnect. A cooling water thermostat is connected. Gives shut-down and fast flashing on LED 5 labelled "HIGH WATER TEMPERATURE". Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened, an alarm will be indicated by slow flashing LEDs.

• **Terminal 15:**  
**STOP + ALARM CHANNEL 6.**

NO contact to minus. The input is enabled 8 sec. after crank disconnect. This channel can be used for any motor protection or alarm function. Gives shut-down, alarm, and fast flashing on LED 6. Contains possibility of circuit check or alarm by connecting input 16 to minus and mounting 3.3 kΩ across the contact. If this connection is broken or opened, an alarm will be indicated by slow flashing LEDs.

• **Terminal 16:**  
**OVERRIDE / CIRCUIT CHECK.**

Programming terminal with two functions.  
1. Override means that engine protection (shut-down) connected to terminals 4, 5, 6, 7, 13, 14, and 15 is out of function. To be used in situations where stop cannot be accepted or where supply is necessary in spite of a failure.  
2. Circuit check demands a resistor 3.3 kΩ installed directly across the monitoring contacts connected to

terminals 4, 5, 6, 7, 13, 14, and 15. A small current will now run the circuit. If this current is interrupted and with circuit check active, it will be indicated on the appropriate channel by slow flashing together with an alarm signal. This circuit can also be used for pre-alarms, with the same name as labelled on the front, by installing a NC alarm contact in series with the resistor.

Programming :  
16 to plus gives override.  
16 to minus gives circuit check.  
16 to minus via 3.3 kΩ gives both override and circuit check.  
16 open excludes both functions.

• **Terminal 33:+34**  
**DIRECT INPUT FOR MAGNETIC PICK-UP.**

The SELCO M2000C Engine Controller is provided with a direct input for magnetic pick-up.

The magnetic pick-up must be connected to the dedicated Pick-up terminals (Term. 33 and 34).

The operator must know the nominal RPM of the engine and the number of teeth on the flywheel. These two properties are used to calculate the nominal frequency. The calculation is done as follows:

$$\text{Nominal pick-up frequency} = \frac{\text{Nominal RPM}}{60} \times \text{Number of teeth on flywheel}$$

The example illustrates how to determine the range and constant settings for an engine with 160 teeth on the flywheel and a nominal speed of 1.500 RPM.

$$\text{Nominal pick-up frequency} = \frac{1500}{60} \times 160 = 4000\text{Hz}$$

The nominal frequency of the pick-up must be entered via the RS232 configuration (see programming manual) using this parameter. Nominal frequencies up to 10 kHz are possible.

**Specifications**

Pick-up input Square or sine wave, 2.5 to 33 V ac.  
Frequency range 50Hz to 10kHz.  
Tolerance, freq. meas. ±2%.

PNP/NPN (3-wire) pick-up cannot be used.

## Outputs

• **Terminal 17:**  
**START WARNING.**

A start signal on terminal 1 or 2 immediately activates start warning and it appears again before any new start attempt with a duration as set on S7 and S8 START DELAY (START WARNING). Is used for warning before automatic start.

Preglow is obtained by connecting terminal 17 and terminal 18 via two diodes. (See attached application diagram).

• **Terminal 18: CRANK.**

Is activated in the cranking sequence. A relay is connected, which activates the engine starter.

• **Terminal 19: FUEL VALVE.**

A relay is connected which will control the diesel engine fuel valve, meaning that it is active, as long as the engine starts and runs, and will be deactivated at stop of the engine (Energized to run).

• **Terminal 20: RUNNING.**

Becomes active after receiving crank disconnect signal and deactivates at motor stop. Can be used to enable an external alarm panel M1000 for pre-alarms.

• **Terminal 21: AUTO STOP.**

Becomes active at all fails, which gives shut-down on the engine.

• **Terminal 22: COOL DOWN.**

Is active during cool down and stop solenoid function. To be used for disabling automatic synchronization or for idling.

• **Terminal 23: COMMON ALARM.**

Becomes active when activating the alarm system, i.e. all protection shut-downs including start failure, all alarms or circuit checks and RPM failure. Is continuously ON but disconnected for 1 sec. with new alarms arriving.

• **Terminal 24: AIR INTAKE VALVE.**

Becomes active at shut-down for overspeed and emergency stop. Is used for alternative stop on some engines. The output goes back by reset.

• **Terminal 25: AUXILIARY LUBE PUMP.**

Becomes active for 2 min. for every 30 min., when the engine is stopped. It is used for continuous lubrication.

Immediately, after stop the first lubrication period is 20 min.

- **Terminal 26:**  
**CIRCUIT BREAKER TRIP.**  
Delivers a 5 sec. impulse for disconnecting the generator circuit breaker. It appears before cool down (run on) where the circuit breaker is disconnected, to unload the engine.
- **Terminal 27: STOP SOLENOID.**  
Becomes active for 20 sec. or 50 sec. (selected on S9) when the engine is stopped. Is used for activation of the engine's stop solenoid.
- **Terminal 28: + SUPPLY.**  
Positive supply of 12 or 24V DC.
- **Terminal 29: - SUPPLY.**  
Negative supply of 12 or 24V DC.
- **Terminal 30, 31 and 32:**  
**ALARM CONTACT.**

Separate contact for siren. Relay normally activated. Without supply voltage or in case of failures there will be contact between terminals 30 and 31. Under normal conditions with supply voltage connected there will be contact between terminals 31 and 32.

## Front Plate

- **LED 1: IN OPERATION.**  
Flashes slowly during start delay, start rest, circuit breaker trip, cool down and in the stop period. Flashes fast in crank period. Gives steady light after receiving crank disconnect signal.
- **LED 2: START FAILURE.**  
Flashes when all start attempts have been accomplished without crank disconnect signal being received.
- **LED 3: OVERSPEED (RPM FAIL).**  
Flashes for overspeed by activating

input 10 or if the frequency on input 8 exceeds 115%. Goes on steady light for RPM failure if input 9 is disconnected or if the frequency on input 8 passes below 25% without a stop signal being received. RPM failure means either unwanted engine stop or failure in the speed detection which indicates that the overspeed protection is perhaps not active. LED 3 goes on steady light if the engine is started via the oil pressure signal (S16 ON).

- **LED 4: LOW OIL PRESSURE.**  
Flashes fast by activation of input terminal 13. If circuit check is used, circuit failure or alarm gives slow flashing. Reset gives steady light.
- **LED 5: HIGH WATER TEMPERATURE.**  
Flashes fast by activating input terminal 14. If circuit check is used, circuit failure or alarm gives slow flashing. Reset gives steady light.

## Programming Switches / Rear Side

- **LED 6: STOP + ALARM.**  
Flashes fast at activation of input 15. Contains possibility of circuit check or alarm giving slow flashing indication. Reset gives steady light.
- **LED 7: STOP + ALARM.**  
Flashes fast at activation of input 4. Contains possibility of circuit check or alarm giving slow flashing indication. Reset gives steady light.
- **LED 8: STOP + ALARM.**  
Flashes fast at activation of input 5. Contains possibility of circuit check or alarm giving slow flashing indication. Reset gives steady light.
- **LED 9: STOP + ALARM.**  
Flashes fast at activation of input 6. Contains possibility of circuit check or alarm giving slow flashing indication. Reset gives steady light.
- **LED 10: STOP + ALARM.**  
Flashes fast at activation of input 7. Contains possibility of circuit check or alarm giving slow flashing indication. Reset gives steady light.
- **SINGLE GREEN POWER LED:**  
Will indicate when 24V or 12V supply is connected.
- **PUSH BUTTON START / STOP:**  
Every second time it is pushed start

respectively stop of the diesel engine is obtained. Only active in MAN. mode.

- **PUSH BUTTON ACCEPT / RESET / LAMPTEST.**

First push by failure disconnects the siren. Second push resets light and blocking. During activation lamp test is obtained.

- **Switch S1 + S2: START ATTEMPT.**

1 - 4 start attempts can be selected

ATTEMPTS	1	2	3	4
S1	ON	OFF	ON	OFF
S2	ON	ON	OFF	OFF

- **Switch S3 + S4: CRANK TIME.**

The crank duration can be programmed. If only one start attempt is selected, the crank duration is extended to 3 times the selected crank time.

SEC.	5	7	10	15
S3	ON	OFF	ON	OFF
S4	ON	ON	OFF	OFF

ONE START ATTEMPT = 3 x CRANK TIME

- **Switch S5 + S6: REST TIME.**

Here the time between start attempts is programmed.

SEC.	5	7	10	15
S5	ON	OFF	ON	OFF
S6	ON	ON	OFF	OFF

- **Switch S7 + S8: START DELAY.**  
(Start Warning).

The delay is programmed, from when input 2 is activated and until the cranking begins. This is also the duration of the output on terminal 17 START WARNING.

SEC.	0.5	2	4	10
S7	ON	OFF	ON	OFF
S8	ON	ON	OFF	OFF

- **Switch S9: STOP TIME.**

A long or a short stop time is selected on output 27 STOP SOLENOID.  
S9 ON = 20 sec. stop time.  
S9 OFF = 50 sec. stop time.

- **Switch S10: PULSE START - STOP.**

To select if the signals on terminal 1 START and 12 STOP and START/STOP push button on the front demands continuous signal or pulse signal.  
S10 ON = constant signal.  
S10 OFF = pulse signal.

- **Switch S11 + S12:**  
**CIRCUIT BREAKER TRIP.**

The delay function of the Circuit Breaker Trip output is used in emergency generator installations, where emergency supply is wanted for a definite time after normal supply is restored. This time can be adjusted with S11 and S12.

MIN.	0	0.5	1	3
S11	ON	OFF	ON	OFF
S12	ON	ON	OFF	OFF

• **Switch S13 + S14:**

**COOL DOWN TIME / RUN-ON.**

To program the run-on time, from when stop signal on input 2 is activated and until output 27 is activated. The purpose of this function is to let the diesel engine run without load, in order to cool down the engine.

MIN.	0	2	4	10
S13	ON	OFF	ON	OFF
S14	ON	ON	OFF	OFF

• **Switch S15: TACHO DETECTION.**

S15 must be in ON position in case an external tacho relay is used for speed detection.

S15 must be in OFF position in case the M0500 tacho voltage detector or a magnetic pick-up is used for speed detection.

• **Switch S16: STARTER**

**ENGAGEMENT PROTECTION.**

To obtain safe start and no cranking when the engine is running, an alternative signal from the oil pressure can be used. See input 13.

S16 ON = normal

S16 OFF = + start via oil pressure and starter engagement protection.

Now the cranking cannot be allowed until the stop time has expired after receiving a stop signal. This is to ensure that the engine is stopped completely before cranking.

- 3) With S16 open it is tested - after each start attempt, before a new start attempt - if oil pressure is present. If so, the engine is either running or the oil pressure is decreasing. Therefore, if the oil pressure goes low within 30 sec. then start commences.

If the oil pressure is still high after 30 sec. and no crank disconnect signal is present, the engine must run and RPM failure is indicated.

Warning: It must be emphasized that the part of the engine protection signaling via the terminals 4 - 5 - 6 - 7 - 13 - 14 - 15 is disconnected at override. It is only to be used in emergency situations where stop cannot be accepted or where supply is necessary in spite of a failure.

## General Information

The outputs have built-in flywheel diodes and are further protected against short-circuit with a limitation of 1A. If the current is exceeded, the appropriate output is disconnected until the output is reactivated. Incandescent lamps can activate the protection circuit, as the starting current can be 10 times the normal current, but a small bias circuit can normally solve the problem (Resistor from output to minus).

To ensure that cranking is not signalled when the motor is running, the following safety functions are included :

- 1) If the crank disconnect signal is present or lubricate oil pressure, cranking cannot be activated.
- 2) If the crank disconnect signal disappears while the engine is running, the unit will generate an alarm, and RPM failure will be indicated (LED3 steady light). Cranking will be blocked.

## Input terminals

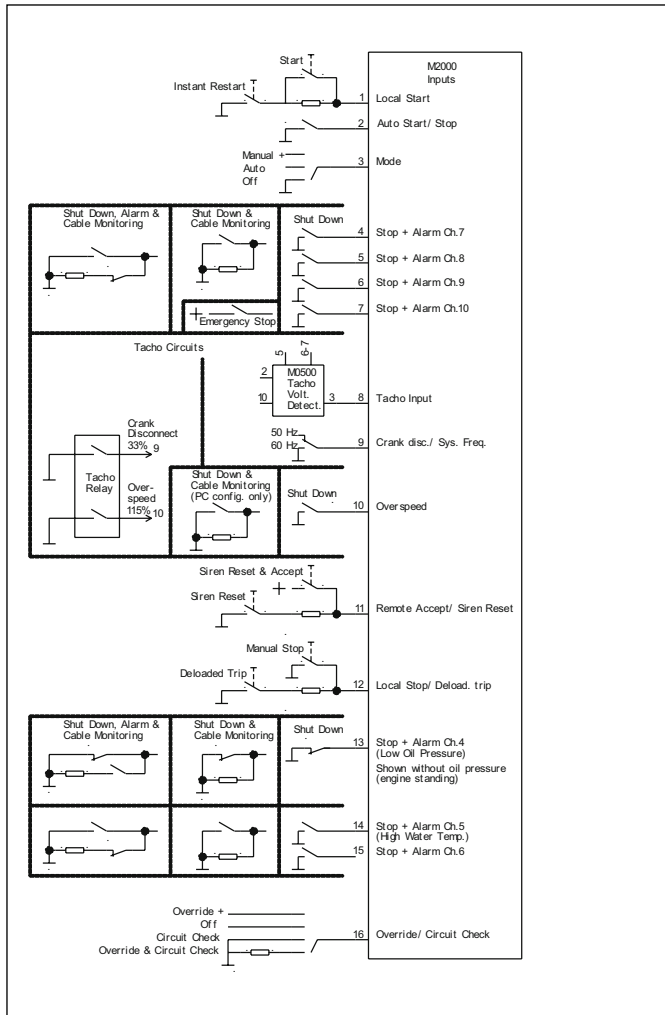


Fig. 2. Input Terminals.

## Output- and supply terminals

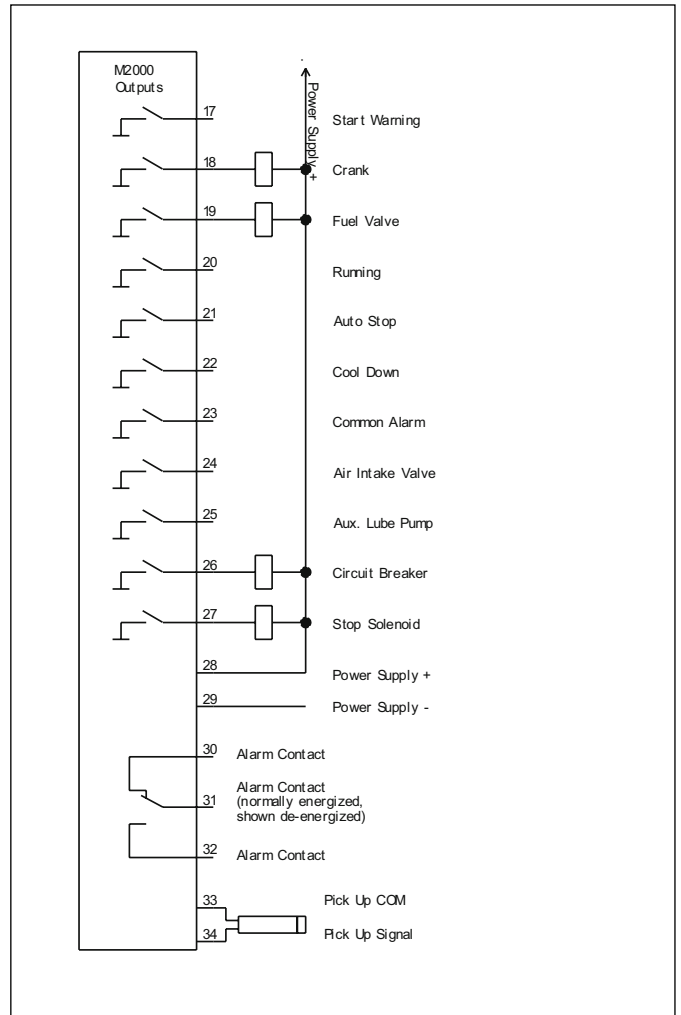


Fig. 3. Output and Supply Terminals.

## Programming table

Start attempts				
	1-	2-	3-	4 attempts
S1	on	off	on	off
S2	on	on	off	off
Crank time				
	5-	7-	10-	15 secs
S3	on	off	on	off
S4	on	on	off	off
Rest time				
	5-	7-	10-	15 secs
S5	on	off	on	off
S6	on	on	off	off
Start delay (start warning)				
	0.5-	2-	4-	10 secs
S7	on	off	on	off
S8	on	on	off	off
Stop time				
S9	on = 20 secs			
S9	off = 50 secs			
Pulse start-stop (term. 1+12)				
S10	on = continuous push			
S10	off = pulse			

Circuit breaker trip				
	0-	0.5-	1-	3 min.
S11	on	off	on	off
S12	on	on	off	off
Cool down				
	0-	2-	4-	10 min.
S13	on	off	on	off
S14	on	on	off	off
Tacho detection				
S15	on = external tacho relay			
S15	off = SELCO M0500 installed			
Starter engagement protection				
S16	on = no function			
S16	off = S.E.P. + start via oil pres. Push-buttons			
Start - stop accept-reset-lamp test				

**Example of programming of delay:**  
S7 off and S8 on will provide start delay of 2 secs.

# Specifications

## M2000 Engine Controller

### Type Approvals and Certificates

The SELCO M2000 has been designed and tested for use in harsh environments. The input and output terminals include circuitry especially designed to protect the unit from electric noise and high level voltage spikes. The unit is based on standard components providing long term durability. The M2000 unit carries the CE label and has been approved by the major marine classification societies.



American Bureau of Shipping  
 Bureau Veritas  
 Croatian Register of Shipping  
 Det Norske Veritas  
 Germanischer Lloyd  
 Lloyds Register of Shipping  
 Nippon Kaiji Kyokai (ClassNK)  
 Registro Italiano Navale  
 Romanian Register of Shipping  
 Russian Maritime Register of Shipping

### SELCO Worldwide



Voltage supply	12-24V DC $\pm$ 30% (8-32V DC)
Consumption	Max. 180mA
Inputs	7 normally open contacts, 1 tacho voltage input and 1 pick-up input
Tacho input	Square or sine wave between 0V DC and supply voltage
Pick-up input	Square or sine wave, range 2.5V AC to 33V AC
Frequency range	50Hz to 10kHz.
Tolerance, freq. meas.	$\pm$ 2%.
Frequency range	50Hz to 10kHz
Tolerance, freq. meas.	$\pm$ 2%
Outputs	11 open collector outputs, max. 150mA per channel
Siren relay contact	230V AC / 2A. 30V DC / 2A, 30W
Tolerance, delays	$\pm$ 2%
LED flash frequency	Slow flashing light: 1.25Hz $\pm$ 10%
Quick flashing light	5Hz $\pm$ 10%
Programming	16 dip-switches or via RS232 interface
Communication	RS485 interface
Protocol	MODBUS-RTU
Baud rate	1200, 2400, 4800, 9600
Parity	None
Data bits	8
Stop bits	1
Operating temperature	-20 to +70°C
Humidity	95% RH at 20°C
Vibration test	4g RMS according to IEC 60068-2-64
EMC	CE according to EN50081-1, EN50082-1, EN50081-2, EN50082-2 and EN61000-2-6
Approvals	Certified by major marine classification societies
Burn-in	50 hours before final test
Weight	0.4kg
Dimensions (H x W x D)	144 x 144 x 35mm
Panel cut out	138 x 138mm
Protection degree at front	IP54 or IP32 (see Type Description)

The specifications are subject to change without notice.

### Type Description

Type	Supply	Function
M2000.0130	12-24V DC	IP54 at front

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