



# Installation Instruction for SEM302 Standalone Engine Management

# Warning

The SEM302 allows for total flexibility in engine tuning, misuse of this product will destroy your engine

SPTRONICS holds no responsibility for any engine damage that may results from the misuse of this product

Spark Performance Electronics  
171 8<sup>th</sup> district, 6<sup>th</sup> of October City  
Giza, 12245  
Egypt  
[www.sptronics.com](http://www.sptronics.com)

## SEM302 Specifications:

Standalone engine management system based on Megasquirt MS3x Processor and firmware with enhanced inputs and output ports. This device is customizable, you can choose the features you need and add it to be built, however there are some basic features which are 2 trigger inputs, 4 analog dedicated inputs (CLT, IAT, MAP, TPS, O2), 5 analog/digital inputs, 5 digital/frequency inputs, 5V ref voltage, USB connectivity. The other feature the device capable of are controlling sequential injection on engines up to 8 cylinders, or semi-sequential up to 16 cylinders, combined with direct fire ignition for engines up to 8 cylinders or wasted spark ignition on engines up to 16 cylinders, The 4 bar internal MAP sensor can read up to 44psi of boost, 2 Programmable knocking detector circuit can be used to adjust the ignition timing, and internal switch to pull up resistor. and knocking) and 16 low side outputs to drive injectors or any solenoid valve. Bluetooth or Wi-Fi as optional connectivity, CAN bus, SD card for logging, Real time clock.

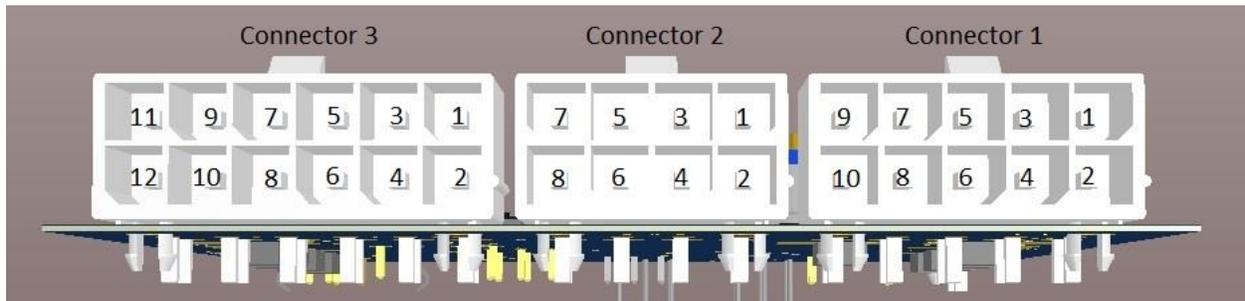
Trigger Inputs:	2 x Differential Crank Input (Hall or VR)
Injector Drivers:	8 x Saturated (8-ohm minimum, <b>High Impedance Only</b> )
Ignition Drivers:	8 x Logic level (active only coils supported)
Outputs:	8 x Low Side Output 2.5A max.
Analog Inputs:	5 x inputs can be used as analog input or as switch input.
Digital/Frequency Input:	5 x Input as switch input or frequency input, only Hall sensor supported.
Knocking Input	2 x Programmable knocking input.
Throttle Position Input	1 x 0-5V analog input.
Internal 4 bar Map sensor	Internal 4 bar map sensor.
Coolant Temperature Sensor	1 x 0-5V analog input.
Inlet Air Temperature Sensor	1 x 0-5V analog input.
O2 Sensor	1 x 0-5V analog input.
USB	1 x PC Communication
5 Volt Reference	1 x 5V output for sensor supplies.
Sensor Ground	1x Ground for sensor supplies.
CAN Bus	1x CAN Bus.
Bluetooth/Wi-Fi	Wireless communication port (Bluetooth or Wi-Fi).

**SEM302 is customizable and the specs above do not apply to all SEM302 devices, however there is least specs that comes with all SEM302:**

Trigger Inputs:	2 x Differential Crank Input (Hall or VR)
Analog Inputs:	5 x inputs can be used as analog input or as switch input.
Digital/Frequency Input:	5 x Input as switch input or frequency input, only Hall sensor supported.

Throttle Position Input	1 x 0-5V analog input.
Coolant Temperature Sensor	1 x 0-5V analog input.
Inlet Air Temperature Sensor	1 x 0-5V analog input.
O2 Sensor	1 x 0-5V analog input.
USB	1 x PC Communication
5 Volt Reference	1 x 5V output for sensor supplies.
Sensor Ground	1x Ground for sensor supplies.

## Wiring Diagram:



## Looking at front PCB connectors

### Connector 1:

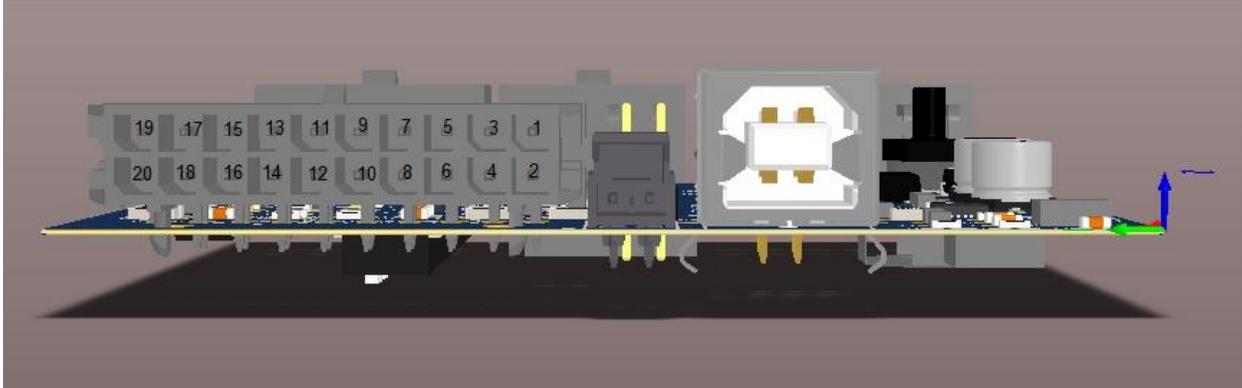
Pin	Name	Comment
1	Injector 1 output	
2	Injector 2 output	
3	Injector 3 output	
4	Injector 4 output	
5	Injector 5 output	
6	Injector 6 output	
7	Injector 7 output	
8	Injector 8 output	
9	GND	
10	GND	

## Connector 2:

Pin	Name	Comment
1	Boost output	
2	Idle output	
3	INJ1V3 output	
4	INJ2V3 output	
5	NOS1 output	
6	NOS2 output	
7	Fidle output	
8	VVT output	

## Connector 3:

Pin	Name	Comment
1	Ignition 1 output	
2	Ignition 2 output	
3	Ignition 3 output	
4	Ignition 4 output	
5	Ignition 5 output	
6	Ignition 6 output	
7	Ignition 7 output	
8	Ignition 8 output	
9	Reference voltage 5V	
10	Sensor ground	
11	Switched voltage 12V	
12	GND	



## Looking at back PCB connectors

### Connector 4:

Pin	Name	Comment
1	Crack +	
2	Crank -	
3	CAM +	
4	CAM -	
5	Throttle Position Sensor Input	
6	Coolant Temp. Sensor Input	
7	Intake Air Temp. Sensor Input	
8	O2 Analog sensor input	
9	Knocking sensor 1 input	
10	Knocking sensor 2 input	
11	ADC6 input	
12	ADC7 input	
13	ADC11 input	
14	ADC12 input	
15	ADC13 input	
16	PT4 input	
17	JS10(PT5) input	
18	PT6(datalog) input	
19	PE0 input	
20	PE2(Flex) input	

# Installation:

## Grounding:

The ECU must have an electrically secure ground connection, which means that the battery negative must be properly grounded to the chassis AND engine. The ground wire, whether it is from the battery or to the chassis and engine, must have perfect electrical conductivity. This means that there must not be any paint or rust under the wire terminal. Make sure that when you install the ground wire there is bare metal exposed where the wire contacts the vehicle component. Both of black wires should be connected to secure ground and we also recommend that the ground wire be as short as possible.

It is recommended to connect the main ground directly to the car battery ground and the ignition ground should be connect via separate wire to the chassis.

Separating the ignition ground from the main ground will reduce the noise generating from ignition coil when driving coil directly (passive coil).

2 mm wires are recommended for ground wires, minimum is 1 mm.

## Power Requirement:

The SEM302 requires a minimum supply voltage of 10V or greater to run. We recommend that the ECU be supplied with 13.8V nominal operating voltage. Ensure that the vehicle's charging system is in perfect operating condition prior to installation. The Vbatt wire should be connected to ignition switched and fused to the battery source.

## Sensors Reference Voltage and Sensor Ground:

The SEM302 has one 5V sensor voltage supply that will be needed during standalone installation. Use the Vref and Sgnd to supply all the sensors with power needed.

The Vref is fused protected by 0.5A resettable fuse.

## Trigger Inputs:

EMS302 has two differential trigger input crank input+ and crank input- for the Crank signal. Cam input+ and cam input-. Each one has an option to be connected as differential or as single input.

Mode	Connection
VR Sensor	<ul style="list-style-type: none"> <li>• Connect VR Sensor to Input+/Input- for Standalone connection</li> <li>• Connect VR+ Sensor to Input+ and leave Input- unconnected for Piggyback connection.</li> </ul>
Hall Input	<ul style="list-style-type: none"> <li>• Connect Hall sensor Input+, connect Input- to ground.</li> </ul>

For pull up option and set point adjusting please check trigger settings from software part.

## Throttle Position Sensor (TPS):

Throttle position sensor work as potentiometer which needs to be supplied with 5v and ground to generate 0-5v signal according to the throttle position. Use the Vref and Sgnd for sensor supply and connect the signal output to TPS input.

## Coolant Temp Sensor (CLT):

Coolant temperature sensor works as resistor which changes its resistance with temperature, there is internal resistor inside EMS302 valued at 2.49 Kohm to be connected with coolant sensor to form voltage divider. Use Sgnd for ground supply to sensor and CLT input from EMS302 to second sensor pin.

For pull up option please check pull up settings from software part.

## Air Temp Sensor (IAT):

Intake air temperature sensor works as resistor which changes its resistance with temperature, there is internal resistor inside EMS302 valued at 2.49 Kohm to be connected with IAT sensor to form voltage divider. Use Sgnd for ground supply to sensor and IAT input from EMS302 to second sensor pin.

For pull up option please check pull up settings from software part.

## O2 Sensor:

Oxygen sensor input can be connected to narrow band sensor 0-1V or wideband controller output 0-5V

## Analog/Digital Inputs:

Sem302 has 5 analog/digital inputs (ADC6, ADC7, ADC11, ADC12 and ADC13), each can be used as analog input or as digital input.

An/Dig input 0-5 can be connected directly to the input to read the analog value or can be used as digital input which need negative voltage to be activated (active low). With external pull up resistor.

## Digital/Frequency Inputs:

EMS302 has 5 digital/Frequency inputs (PT4, PT5, PT6, PE0, and PE2), it can be used as digital input or as frequency counter.

Digital input which needs negative voltage to be activated (active low). Frequency input to count pulses input such as vss sensor or second cam signal. Digital sensor (Hall sensor) is only supported type of input.

There is pull up 10kohm resistor to 5v connected to the input.

## Injectors:

Eight low side output each rated at 2.5A (can drive 2 high impedance injectors 12ohm and more), can be connected for 8 cylinders in sequential configuration or up to 16 cylinders in semi sequential/batched configuration.

One side of injector to be connected to switched 12v and injector negative signal from EMS302.

## Ignition Outputs:

Up to 8 Ignition outputs (rated 5V 1A max, to drive only active coils (smart coils or coils with built in igniter) not to be connected directly to drive passive ignition coil.

Unused ignition output can be used as general-purpose outputs using external driver like a solid state relay.

## General Purpose Outputs:

EMS302 has 8 additional low side outputs, each capable of generation ground signal to drive solenoid valve, relay, etc. max current 2.5A.

## Fuel Pump:

Fuel pump relay can be driven by any unused output, here is the setting for TunerStudio.

View Help

Fuel Pump and Pressure Control

- Fuel Pump Mode Open-Loop PWM
- Control Interval(ms) 20
- Fuel Pump Output Output 1
- Output Frequency 11.1Hz
- Fuel Pump Output Polarity Normal
- Pressure Regulation/Correction Vac referenced

'Fixed' automatically adjusts fuel PW.

- Static/Target Rail Differential Pressure(psi.g) 43.5
- Static/Target Rail Differential Pressure(kPa.g) 300.0
- Priming Duty(%) 100.0
- Off Duty(%) 0.0
- Minimum Duty(%) 0.0
- Maximum Duty(%) 100.0
- Pressure Sensor Input (kPa) Off
- Sensor Type Gauge
- Temperature Sensor Input Off
- Temperature Correction Off

Closed-Loop PID settings

- Proportional Gain(%) 10.0
- Integral Gain(%) 5.0
- Derivative Gain(%) 3.0

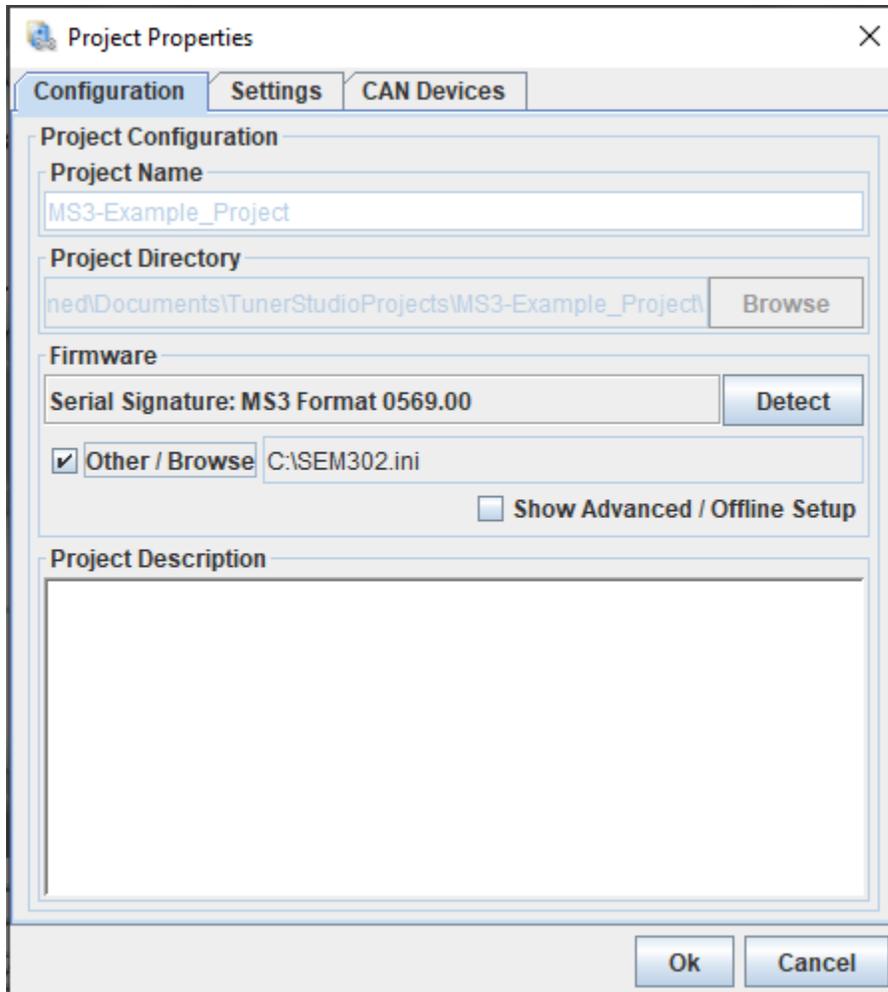
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
80.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
60.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
40.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
20.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
10.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	0	1000	2000	3000	4000	6000	
	rpm						

The values in the table specify the duty cycle percent of the control output to the pump or controller based on the RPM/load axes.

Burn
 Close

## Installing INI Settings File:

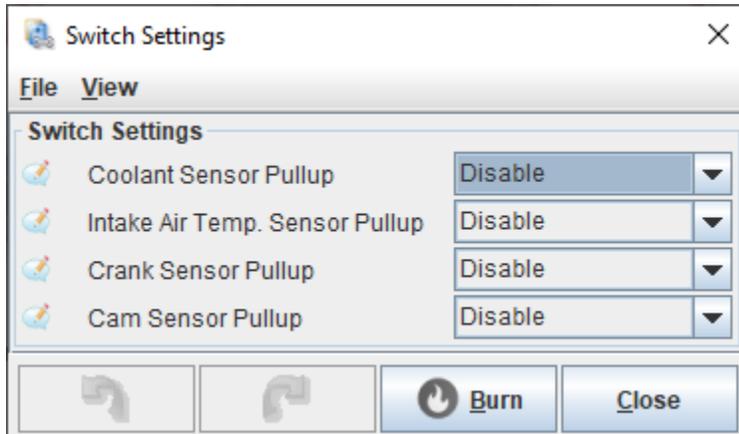
Ini file to be installed with the TunerStudio project, access the project properties from "File" -> "Vehicle Project" -> "Project Properties" then browse to file location



After the project loading again, additional menus are added to TunerStudio.

## Pull Up Menu:

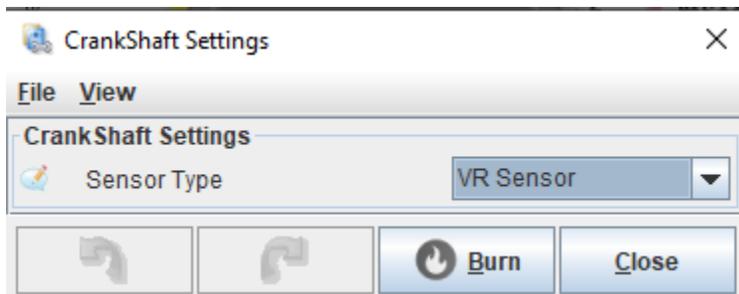
Pull up menu under “Basic/Load Settings” -> “Pull Up Switches Settings”



- Coolant Sensor Pullup: will connect CLT input to 5V through 2.49 Kohm resistor.
- Intake Air Temp. Sensor Pullup: will connect IAT input to 5V through 2.49 Kohm resistor.
- Crank Sensor Pullup: will connect CRK+ input to 5V through 10 Kohm resistor.
- Cam Sensor Pullup: will connect Cam+ input to 5V through 10 Kohm resistor.

## Crank Trigger Setting:

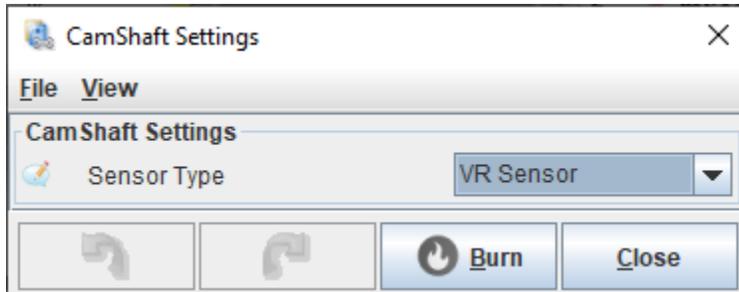
Crank settings menu under “Ignition Settings” -> “Crankshaft Trigger Settings”



- Sensor Type: the type of sensor being used VR or Hall sensor.

## Cam Trigger Setting:

Cam settings menu under “Ignition Settings” -> “Camshaft Trigger Settings”



- Sensor Type: the type of sensor being used VR or Hall sensor.

## USB Communication:

There USB port will be configured as virtual serial port (COM port), once the driver installed and the device connected you should find the new COM port in “Device Manger” menu, under “Ports (COM & LPT)” new item will be add named “USB Serial Device (COMx)”, you will use this COM port number when you connect to TunerStudio.

Here is the USB driver:

[https://sptronics.com/?attachment\\_id=4329](https://sptronics.com/?attachment_id=4329)

## Wireless Communication:

There are 2 options to be connected to EMS302 wirelessly: Bluetooth or WIFI, both way can be used with TunerStudio on Windows PC or Msdriod, Shadow Dash on any Android device. The main use for wireless communication is for monitoring or logging and it’s not recommended to tune over wireless communication.

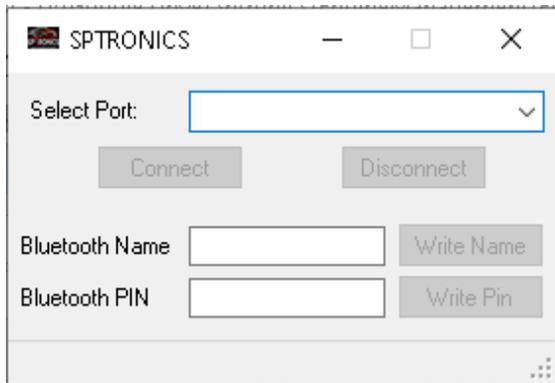
**It is not allowed flash any firmware over wireless communication.**

Pairing your PC or android device to EMS302 can be done by discovering devices around you and EMS302 will be discovered, just to connect to pair and use “1234” as the pin code.

Changing Bluetooth name or pin can be done using “BT Writer” application, available for download under download tab in the EMS302 web page.

Here is the link for BT Write application.

[https://sptronics.com/?attachment\\_id=4331](https://sptronics.com/?attachment_id=4331)



Make sure the EMS302 is not connected to TunerStudio then select the Com port connected to EMS302 then click "Connect", after that choose the name and pin required then click on the required button.

WIFI communication can be done through connection to access point named EMS302, your devices will get IP in the range 192.168.1.x. to connect to TunerStudio, MS Droid or Shadow Dash use IP 192.168.4.1 and port 23 as the setting for EMS302.

Changing access point name and adding password can be done by accessing access point configuration page, open any web browser and type 192.168.4.1, the configuration page will appear, from AP Setting you will get the option to change SSID and add password.

# Warranty

SPTRONICS warrants to the consumer that all High Performance products will be free from defects in material and workmanship for a period of twelve (12) months from date of the original purchase. Products that fail within this 12-month warranty period will be repaired or replaced at SPTRONICS's option, when determined by SPTRONICS that the product failed due to defects in material or workmanship.

This warranty is limited to the repair or replacement of the SPTRONICS part. In no event shall this warranty exceed the original purchase price of the SPTRONICS part nor shall SPTRONICS be responsible for special, incidental or consequential damages or cost incurred due to the failure of this product. Warranty claims to SPTRONICS must be transportation prepaid and accompanied with dated proof of purchase. This warranty applies only to the original purchaser of product and is non-transferable. All implied warranties shall be limited in duration to the said 12-month warranty period. Improper use or installation, accident, abuse, unauthorized repairs or alterations voids this warranty. SPTRONICS disclaims any liability for consequential damages due to breach of any written or implied warranty on all products manufactured by SPTRONICS.

SPTRONICS will not be responsible for electronic products that are installed incorrectly, installed in a non-approved application, misused, or tampered with.

Any SPTRONICS electronics product can be returned for repair if it is out of the warranty period.

There is a minimum charge of \$20.00 for inspection and diagnosis of SPTRONICS electronic parts. Parts used in the repair of SPTRONICS electronic components will be extra.

SPTRONICS will provide an estimate of repairs and receive written or electronic authorization before repairs are made to the product.