



Syvecs LTD

V1.0

S7GP

This document is intended for use by a technical audience and describes a number of procedures that are potentially hazardous. Installations should be carried out by competent persons only.

Syvecs and the author accept no liability for any damage caused by the incorrect installation or configuration of the equipment.

Please Note that due to frequent firmware changes certain windows might not be the same as the manual illustrates. If so please contact the Syvecs Tech Team for Assistance.

Support@Syvecs.com

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S7GP ECU

Overview

The Syvecs S7GP ECU is a cost-effective standalone engine management solution designed for applications that do not require extensive OEM vehicle integration, advanced body control functions, or multiple drive-by-wire systems. Built on the same proven Syvecs architecture as the S7i and S7Plus platforms, the S7GP delivers the same high-speed processing, advanced control strategies, and professional calibration environment while focusing on the features most commonly required in motorsport, classic vehicle and custom engine installations.

Unlike the S7i and S7Plus, which are often used in OEM plug-and-play applications, the S7GP has been specifically designed as a motorsport and generic wire-in ECU, featuring two fully configurable CAN buses that support both custom CAN transmit and CAN receive strategies. This makes it ideally suited to modern motorsport installations where external devices such as PDUs, dashboards, GPS modules, data loggers, and expansion modules are integrated over CAN.

When combined with the Syvecs PDU2XB or PDU3XB, the S7GP becomes an extremely capable motorsport platform. The PDU provides additional inputs, H-Bridge outputs, drive-by-wire control capability, fuel pump control, electronic actuator control, and power distribution, allowing complex modern race car systems to be implemented whilst keeping ECU costs lower than traditional high-I/O motorsport ECUs.

ECU Features

Engine & Vehicle Control

- Full engine management with live tuning via SCal software
- Sequential fuel and ignition control
- Support for naturally aspirated, turbocharged, and supercharged engines
- Variable valve timing (VVT) control
- Flex fuel support
- Torque-based control architecture
- Advanced knock control
- Closed-loop lambda control
- Configurable CAN-based sensor integration
- Multiple calibration maps and switching strategies
- Supports 1 to 8 cylinder engines
- Plus much more

Launch, Boost & Power Management

- Advanced launch control
- Rolling launch strategies
- Flat-shift and no-lift shift support
- Anti-lag strategies for motorsport applications

- Closed-loop boost control
 - Per-gear boost targets
 - Speed-based boost targets
 - Time-based boost targets
 - Nitrous control strategies
 - Water and methanol injection support
 - Torque management strategies
-

Motorsport & CAN Integration

- Two fully configurable CAN buses
- CAN transmit and receive functions
- CAN slave capability on both CAN buses
- Ideal for integration with Syvecs PDUs, dashes, GPS modules, and external devices
- Expandable via Syvecs X10 and X20 modules

When paired with a Syvecs PDU2XB or PDU3XB, the S7GP becomes a highly capable motorsport control system.

The PDU can provide:

- Drive-by-wire control
- Fuel pump control
- Cooling fan control
- Electric water pump control
- Electronic wastegate control
- Turbo actuator control
- Additional sensor inputs
- High-current outputs
- H-Bridge motor control
- Power distribution and circuit protection

This architecture allows the S7GP to focus on engine management whilst the PDU handles high-current devices and vehicle control functions, providing exceptional flexibility for race car and custom vehicle installations.

Safety & Protection

- Lean condition monitoring
 - Knock-based protection strategies
 - Oil pressure protection
 - Coolant temperature protection
 - Fuel pressure monitoring
 - Boost limit protection
 - User configurable shutdown strategies
 - Configurable limp modes
 - Sensor failure detection
 - CAN communication fault monitoring
-

Data Logging & Analysis

- High-speed onboard logging with 64mb on board memory (upgrade to 128mb possible also)
 - Logging rates up to 1000 Hz
 - Full analysis using SView software
 - Log comparison and overlay tools
-

S7GP Full Specification

Outputs

- 16 injector / PWM outputs - LowSide
- 6 ignition outputs - TTL | Smart 0-5v
- 1 main relay control output

Inputs

- 16 configurable analogue inputs
 - 4 Bipolar frequency inputs
 - 4 Unipolar frequency inputs
 - 4 Voltage inputs
 - 4 Resistive inputs with integrated pull-ups
- 1 knock input
- 1 EGT thermocouple input
- 1 wideband lambda controller input for NTK

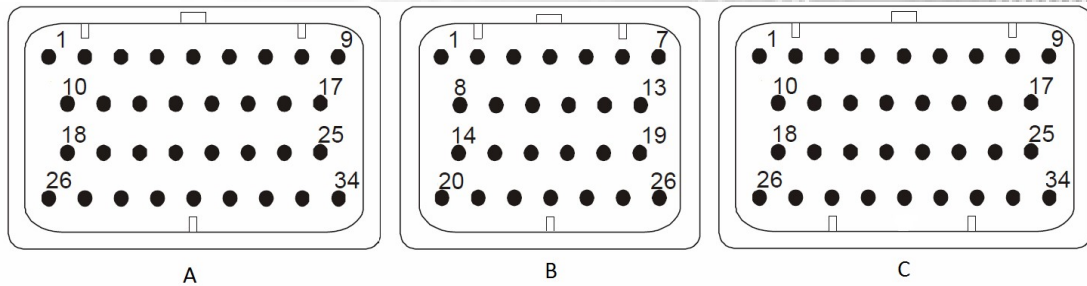
Communications

- 2 fully configurable CAN buses
- 1 Ethernet communications port
- 1 RS232 communications port

Hardware & Electrical

- Sealed aluminium enclosure
- 94-pin waterproof connector system
- Input voltage range: 6–20 V
- Reverse polarity protection
- Motorsport-grade electronics
- Operating temperature range: –40 °C to +125 °C

Syvecs S7GP Pinouts



A	DESCRIPTION	CONNECTOR A
	PART NUMBER	4-1437290-0
	NOTES:	34 Way - Key1

<i>Syvecs Description</i>	<i>S7-I Pinout</i>	<i>Function</i>	<i>Notes</i>
PWR CTR OUT	A1	MAIN RELAY OUTPUT	PULLS TO GROUND AS DEFAULT WHEN ACTIVATED VIA MAIN RELAY SWITCH C28
N/A	A2	N/A	
N/A	A3	N/A	
N/A	A4	N/A	
N/A	A5	N/A	
N/A	A6	N/A	
N/A	A7	N/A	
N/A	A8	N/A	
N/A	A9	N/A	
FUEL1	A10	INJECTOR or PWM OUTPUT	FUEL INJECTOR OUTPUTS CAPABLE OF HIGH IMPEDANCE INJECTORS ONLY OR USED AS OUTPUTS FOR DEVICES, SUPPORTS PWM AND CAN HANDLE 10AMP MAX
FUEL2	A11	INJECTOR or PWM OUTPUT	
FUEL3	A12	INJECTOR or PWM OUTPUT	
FUEL4	A13	INJECTOR or PWM OUTPUT	
FUEL5	A14	INJECTOR or PWM OUTPUT	
FUEL6	A15	INJECTOR or PWM OUTPUT	
FUEL7	A16	INJECTOR or PWM OUTPUT	
FUEL8	A17	INJECTOR or PWM OUTPUT	
FUEL9/PWM1	A18	INJECTOR or PWM OUTPUT	FUEL/ PWM OUTPUTS CAPABLE OF UP TO 10AMPS MAX, HAVE OPTION VIA HARDWARE JUMPER TO APPLY 12V PULLUP USED FOR SOME TACHOS
FUEL10/PWM2	A19	INJECTOR or PWM OUTPUT	
FUEL11/PWM3	A20	INJECTOR or PWM OUTPUT	FUEL/ PWM OUTPUTS CAPABLE OF UP TO 10AMPS MAX, HAVE OPTION VIA HARDWARE JUMPER TO APPLY 5V PULLUP USED FOR OEM FUEL PUMP CONTROLLERS
FUEL12/PWM4	A21	INJECTOR or PWM OUTPUT	
FUEL13/PWM5	A22	INJECTOR or PWM OUTPUT	FUEL/ PWM OUTPUTS CAPABLE OF UP TO 10AMPS MAX, HAVE OPTION VIA HARDWARE JUMPER TO FLYBACK DIODE, WISE TO USE WITH VARIABLE VALVE SOLENOIDS
FUEL14/PWM6	A23	INJECTOR or PWM OUTPUT	
FUEL15/PWM7	A24	INJECTOR or PWM OUTPUT	
FUEL16/PWM8	A25	INJECTOR or PWM OUTPUT	
IGN1	A26	CYL 1 IGNITION OUTPUT	TTL 5V IGNITION OUTPUTS
IGN2	A27	CYL 2 IGNITION OUTPUT	TTL 5V IGNITION OUTPUTS
IGN3	A28	CYL 3 IGNITION OUTPUT	TTL 5V IGNITION OUTPUTS
IGN4	A29	CYL 4 IGNITION OUTPUT	TTL 5V IGNITION OUTPUTS
IGN5	A30	CYL 5 IGNITION OUTPUT	TTL 5V IGNITION OUTPUTS
IGN6	A31	CYL 6 IGNITION OUTPUT	TTL 5V IGNITION OUTPUTS
PWRGND	A32	POWER GROUND	LINKED POWER GROUND
PWRGND	A33	POWER GROUND	LINKED POWER GROUND
PWRGND	A34	POWER GROUND	LINKED POWER GROUND

B	DESCRIPTION	CONNECTOR B	
	PART NUMBER	3-1437290-7	
	NOTES:	26 Way - Key1	
PWRGND	B1	POWER GROUND	LINKED POWER GROUND
CAN2L	B2	CAN2L	
CAN2H	B3	CAN2H	
KNOCK	B4	KNOCK	
N/A	B5	N/A	
N/A	B6	N/A	
VBAT	B7	12v	12V SUPPLY, All IVBAT PINS ARE JOINED ON BOARD
LAM1A	B8	Lamv / LamD1+ / LamLun1	Set Appropriate Solder Bridge Settings (SB) for desired setup NTK/ DENSO / BOSCH LSU – See Lambda Wiring – Page 17
LAM1B	B9	Lami / LamD1- / LamIP1	
LAM1C	B10	LamLIA1	
LAM1D	B11	LamGND / LamLVM1	
N/A	B12	N/A	
VBAT	B13	12V	12V SUPPLY, All IVBAT PINS ARE JOINED ON BOARD
N/A	B14	N/A	
N/A	B15	N/A	
N/A	B16	N/A	
N/A	B17	N/A	
N/A	B18	N/A	
VBAT	B19	12V	12V SUPPLY, All IVBAT PINS ARE JOINED ON BOARD
N/A	B20	N/A	
RS232RX	B21	RS232RX	RS232RX
RS232TX	B22	RS232TX	RS232TX
LANRX-	B23	Cat5 Pin2	Orange/White
LANRX+	B24	Cat5 Pin1	White/Orange
LANTX-	B25	Cat5 Pin6	Green/White
LANTX+	B26	Cat5 Pin3	White/Green

C	DESCRIPTION	CONNECTOR C	
	PART NUMBER	4-1437290-1	
	NOTES:	34 Way - Key2	
KNOCK GROUNDS	C1	KNOCK GROUND	KNOCK GROUNDS
ANGND	C2	SENSOR GND	SENSOR GROUND CIRCUIT
ANGND	C3	SENSOR GND	SENSOR GROUND CIRCUIT
N/A	C4	N/A	N/A
5V OUT	C5	5V OUT	5V OUT CIRCUIT
5V OUT	C6	5V OUT	5V OUT CIRCUIT
N/A	C7	N/A	N/A
CAN L	C8	Can Low	
CAN H	C9	Can High	
AN01	C10	BI-POLAR INPUTS	0-5V or SPEED, FREQUENCY INPUT - Pull Up Available in Software
AN02	C11	BI-POLAR INPUTS	0-5V or SPEED, FREQUENCY INPUT - Pull Up Available in Software
AN03	C12	BI-POLAR INPUTS	0-5V or SPEED, FREQUENCY INPUT - Pull Up Available in Software
AN04	C13	BI-POLAR INPUTS	0-5V or SPEED, FREQUENCY INPUT - Pull Up Available in Software
AN05	C14	UNI-POLAR INPUTS	0-5V or FREQUENCY INPUT with Fixed Thresholds - Pull Up Available in Software
AN06	C15	UNI-POLAR INPUTS	0-5V or FREQUENCY INPUT with Fixed Thresholds - Pull Up Available in Software
AN07	C16	UNI-POLAR INPUTS	0-5V or FREQUENCY INPUT with Fixed Thresholds - Pull Up Available in Software
AN08	C17	UNI-POLAR INPUTS	0-5V or FREQUENCY INPUT with Fixed Thresholds - Pull Up Available in Software
AN09	C18	VOLT-INPUTS	0-5V INPUT No Pull Up
AN10	C19	VOLT-INPUTS	0-5V INPUT No Pull Up
AN11	C20	VOLT-INPUTS	0-5V INPUT No Pull Up
AN12	C21	VOLT-INPUTS	0-5V INPUT No Pull Up
AN13	C22	RESISTIVE INPUTS	RESISTIVE 0-5V INPUTS WITH 5V PULLUP BUILT IN
AN14	C23	RESISTIVE INPUTS	RESISTIVE 0-5V INPUTS WITH 5V PULLUP BUILT IN
AN15	C24	RESISTIVE INPUTS	RESISTIVE 0-5V INPUTS WITH 5V PULLUP BUILT IN
AN16	C25	RESISTIVE INPUTS	RESISTIVE 0-5V INPUTS WITH 5V PULLUP BUILT IN
EGT1-	C26	EGT1 -	
EGT1+	C27	EGT1 +	
PWR CTR IN	C28	MAIN RELAY INPUT SW	MAIN RELAY CONTROL SWITCH, 12V SUPPLIED TO THIS PIN TURNS ON MAIN RELAY OUTPUT A1, PVBAT (B6) REQUIRES A 12V CONSTANT POWER ALSO FOR MAIN RELAY CONTROL TO WORK
N/A	C29	N/A	
N/A	C30	N/A	
N/A	C31	N/A	
N/A	C32	N/A	
N/A	C33	N/A	
N/A	C34	N/A	

General Connections

Connecting Power

The ECU has three power feeds, which can either be used to provide a redundant multiple feeds, or as a way of providing switched power to additional loads through the loom.

Example Schematic

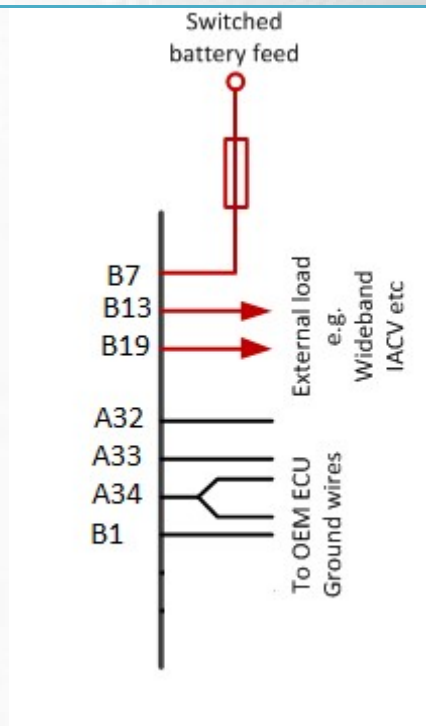


Figure 0-1 - Redundant Power Feeds and a Common grounding point.

Pin Schedule

Pin Number	Function	Notes
B7	VBAT	Use a fused Switched feed.
B13	VBAT	Use a fused Switched feed.
B19	VBAT	Use a fused Switched feed.
A32	Power Ground	Up to 2 ground wires can be paired to this pin.
A33	Power Ground	Up to 2 ground wires can be connected to this pin.
A34	Power Ground	Up to 2 ground wires can be paired to this pin.
B1	Power Ground	Up to 2 ground wires can be paired to this pin.

NOTE! Power Grounds are designed to conduct High Current loads – Do not mix Power Grounds with Analogue (AN) Grounds.

Driven/Output Connections

Ignition

The ignition channels are logic level outputs designed to control ignition coils via an additional igniter (Power transistor).

These as standard output a 5V Signal but can be raised to 12v with a Jumper change on board. Speak to Syvecs more about this directly if required.

Pin Schedule

Pin Number	Function	Notes
A26	IGN1	Logic Level (5V) output
A27	IGN2	Logic Level (5V) output
A28	IGN3	Logic Level (5V) output
A29	IGN4	Logic Level (5V) output
A30	IGN5	Logic Level (5V) output
A31	IGN6	Logic Level (5V) output

NOTE: Do not connect IGN pins directly to a IGBT coil; the low coil resistance will draw a current greater than 40ma that will damage the ECU.

Fuel Outputs

The Injection channels are only able to drive high impendence injectors. The use of Low Impendence injectors with the S7 requires a Ballast pack/resistor pack. For more information on this e-mail support@syvecs.co.uk

Fuel Outputs also have full pulse width modulation available. These outputs can be used to drive up to 10A Peak / 5A Continuous and can only pull to ground.

Pin Schedule

Pin Number	Function	Notes
A10	Fuel1	Injector Output or PWM
A11	Fuel2	Injector Output or PWM
A12	Fuel3	Injector Output or PWM
A13	Fuel4	Injector Output or PWM
A14	Fuel5	Injector Output or PWM
A15	Fuel6	Injector Output or PWM
A16	Fuel7	Injector Output or PWM
A17	Fuel8	Injector Output or PWM
A18	Fuel9	Injector Output or PWM
A19	Fuel10	Injector Output or PWM
A20	Fuel11	Injector Output or PWM
A21	Fuel12	Injector Output or PWM
A22	Fuel13	Injector Output or PWM
A23	Fuel14	Injector Output or PWM
A24	Fuel15	Injector Output or PWM
A25	Fuel16	Injector Output or PWM

Main Relay Control

The S7GP has a Main Relay control circuit which takes a 12v ignition switched feed on Pin C28 and then turns on a Main relay output pin A1 (Pulls to Ground) to energize the OEM EFI Relays that power the electronics on some vehicles.

Main Relay hold is possible to keep ECU powered up after key off for programmable amount of time, this requires IVBat to be connected to constant 12V supply.

Pin Schedule

Pin Number	Function	Notes
A1	Main Relay Output	Pulls to Ground when Circuit active
C28	Main Relay Input	Activates Main relay control when 12v is sent to this Pin



LAN Connection

Connection from the S7GP to a Laptop/PC uses a Male RJ45 plug, wired in cross over configuration.

Example Schematic

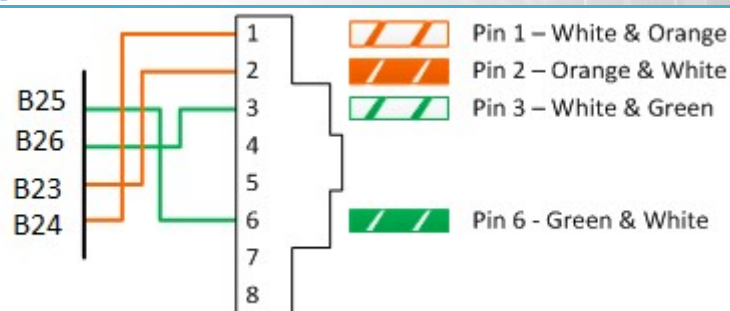


Figure 0-1 RJ45 Wiring

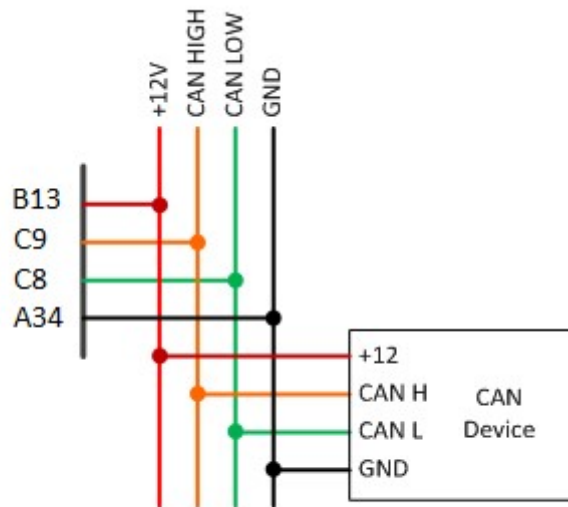
Pin Schedule

Pin Number	Function	Notes
B25	LAN Transmit -	RJ45 Pin 6 – Green & White wire
B26	LAN Transmit +	RJ45 Pin 3 – White & Green wire
B23	LAN Receive -	RJ45 Pin 2 – Orange & White wire
B24	LAN Receive +	RJ45 Pin 1 – White & Orange wire

CAN Bus

Common Area Network Bus (CAN Bus) is a widely used data interface common used in many cars and aftermarket accessories (such as Stack Data loggers and Dashes). Data is sent using the High and Low wires, which are maintained as a twisted pair.

Example Schematic



NOTE: CAN Wires must be kept as a twisted pair.

Pin Number	Function	Notes
C8	CAN1 LOW	Ensure wires are twisted pair.
C9	CAN1 HIGH	Ensure wires are twisted pair.
B2	CAN2 LOW	Ensure wires are twisted pair
B3	CAN2 HIGH	Ensure wires are twisted pair

RS232

Telemetry can data can be provided via RS232.

Example Schematic

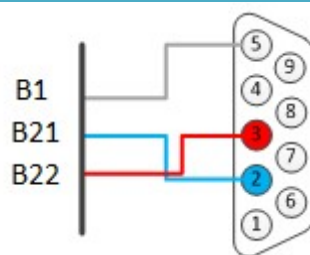


Figure 0-2 RS232 Connection

Pin Schedule

Pin Number	Function	Notes
B1	Pwr GND	DB-9 pin 5
B21	Rx	DB-9 pin 2
B22	Tx	DB-9 pin 3

Input Connections

Sensor/ Analogue Grounds (AN Grounds)

Sensors and miscellaneous analogue inputs have their own Ground pins; these grounds must be kept separate from the Power grounds shown in the first section. As there are four ground pins you may have to connect multiple grounds to some of the pins if you have more than four sensors.

Pin Schedule

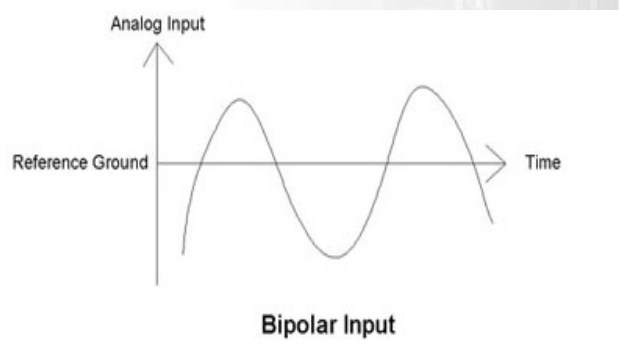
Pin Number	Function	Notes
C2	ANGND1	
C3	ANGND1	
C4	ANGND2	

Assigning Inputs

The Syvecs S7GP has 24 programmable inputs available and although they are fully configurable in Scal, they are not all the same type of input which means sensors that for example require a pull up, have to assigned to different types..... Listed below are the 4 types which are available.

Bipolar Inputs

These Inputs are able to swing above and below the reference ground meaning they can see Positive Voltage as well as Negative.



Example of sensors normally used on these Inputs are:

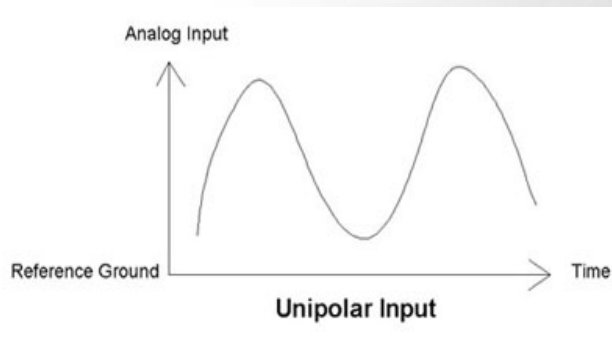
- Reluctor Crank and Cam Sensors
- ABS Sensors for wheel speed

Bipolar inputs are not just limited to the above they can also be used for any sensor that outputs 0-5volts. They are also able to provide a Pull-up through Scal

Pin Number	Scal Assignment	Notes
C10	An01	
C11	An02	
C12	An03	
C13	An04	

Unipolar Inputs -

These Inputs are only able to swing above the reference ground meaning they can only see Positive Voltage



Example of sensors normally used on these Inputs are:

- Hall Effect Crank and Cam Sensors
- Gearbox speed sensors

Unipolar inputs are not just limited to the above they can also be used for any sensors which outputs 0-5volts. They are also able to provide a Pull-up through Scal.

Pin Number	Scal Assignment	Notes
C14	An05	
C15	An06	
C16	An07	
C17	An08	

Voltage Inputs

These Inputs are able to sense a Voltage level which is linear and does not swing

Example of sensors normally used on these Inputs are:

- Manifold Pressure sensors
- Throttle Positions
- Oil Pressures

Voltage Inputs are not just limited to the above then can also be used for any sensor which outputs a 0-5volt signal but NOT able to provide a pull up.

Pin Number	Scal Assignment	Notes
C18	An09	
C19	An10	
C20	An11	
C21	An12	

Resistive Inputs

These Inputs are the same as voltage inputs in which they can accept a 0-5v but they have a fixed 3.3k 5v Pull up fitted

.Example of Sensors normally used on these Inputs are:

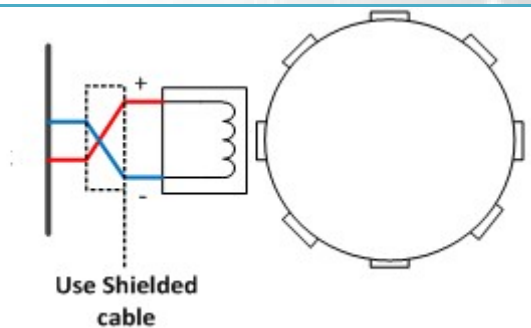
- Temperature sensors
- Calibration switches

Pin Number	Scal Assignment	Notes
C22	An13	
C23	An14	
C24	An15	
C25	An16	

Sensor Schematics - Examples

Crank Sensor – Magnetic Type

Example Schematic

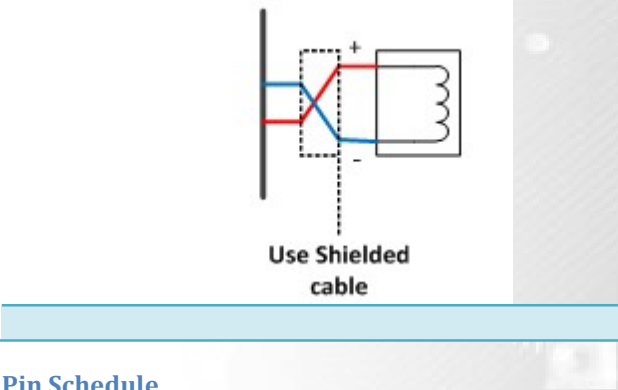


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	Crank Sensor – (Shared with Cam Sensor)
C10, C11, C12, C13	Bipolar Input	Crank Sensor+

Cam Sensors – Magnetic Type

Example Schematic

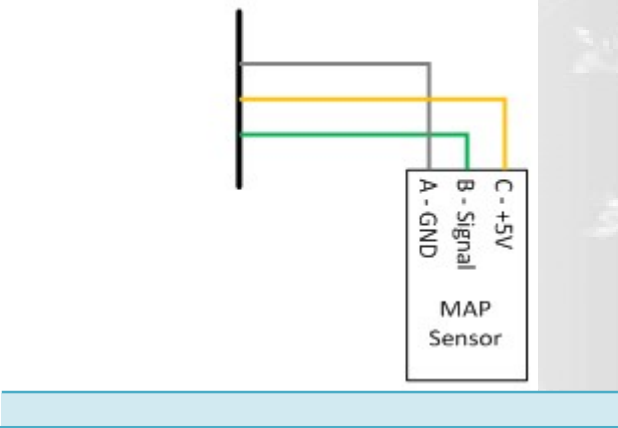


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	Cam Sensor – (Shared with Crank Sensor)
C10, C11, C12, C13	Bipolar input	Cam Sensor +

Manifold Pressure Sensor (MAP)

Example Schematic

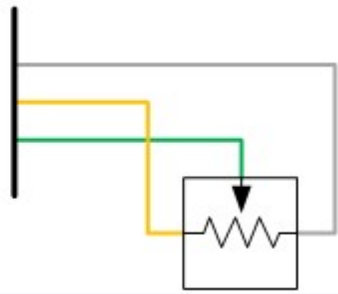


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	May be shared with multiple sensors
C5	5VOUT1	Regulated sensor power supply
C18	Voltage Input	Can use Bipolar, Unipolar or Voltage inputs

Throttle Position Sensor (TPS)

Example Schematic

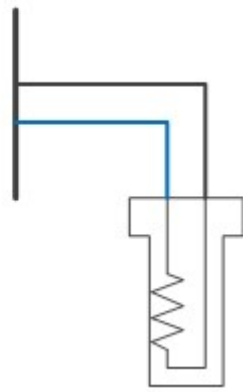


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	May be shared with multiple sensors
C5	5VOUT1	Regulated sensor power supply
C19	Voltage Input	Can use Bipolar, Unipolar or Voltage inputs

Coolant Temperature Sensor (CTS)

Example Schematic

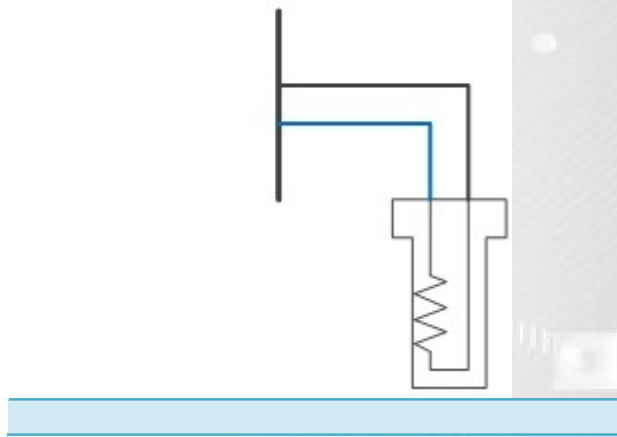


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	May be shared with multiple sensors
C22	Resistive Input	Can use Resistive inputs #1 to #4 (pins 63 to 66)

Inlet Air Temperature Sensor (IAT)

Example Schematic

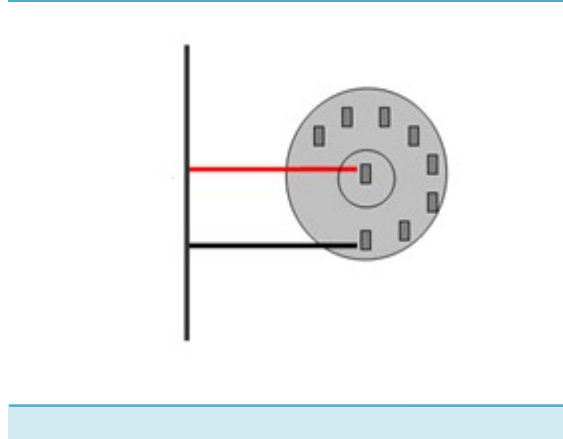


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	May be shared with multiple sensors
C23	Resistive Input	Can use Resistive inputs #1 to #4 (pins 63 to 66)

Calibration Switches

Example Schematic

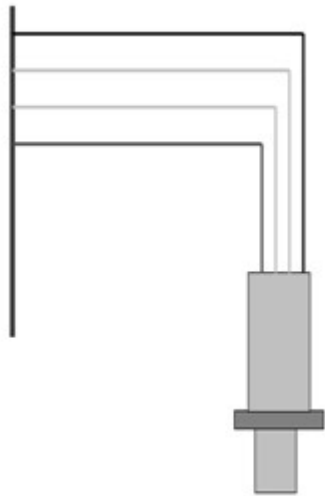


Pin Schedule

Pin Number	Function	Notes
C2	ANGND1	May be shared with multiple sensors
C24	AN15	Can use Resistive inputs #1 to #4 (pins 63 to 66) Cal Switches Require Pull Up to be On

Narrowband Lambda Sensor

Example Schematic



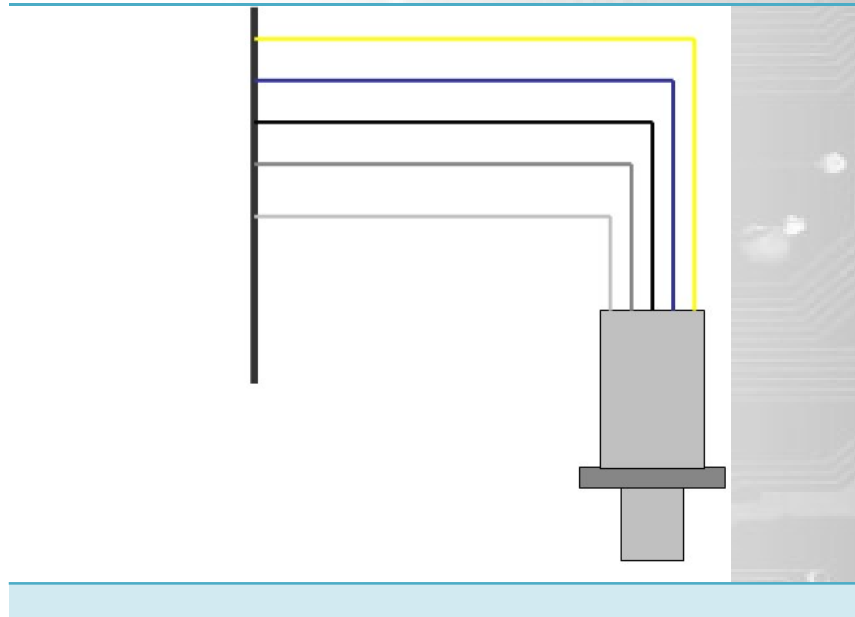
Pin Schedule

Wire Colour	Function	Pins Usable on S7-I
White	Heater	C7, C13, C19
White	Heater Drive	Any FUEL Output – Needs to be assigned in Scal on I/O Configuration
Black	Signal Ground	A34
Grey	Lambda Signal	Can use Bipolar, Unipolar or Voltage inputs

Wideband Lambda Sensor

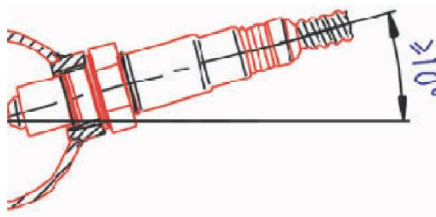
The Syvecs S7-GP has the ability to drive a NTK Wideband

Example Schematic

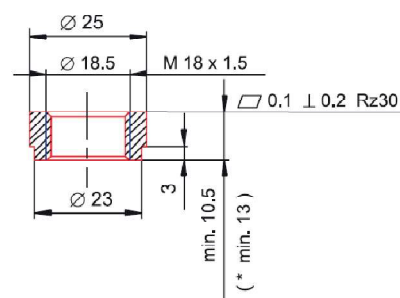


WARNING

Mounting recommendation



Recommended materials for the mating thread in the exhaust pipe
*: THexagon > 600°C or
TGas > 930°C



NTK L1H1

Lambda Sensor Input in Scal - Pin assignments needs to be Set to Lam1V, Lambda Heater Needs to be assigned to the assigned fuel output

Lambda Pin Number	Colour	Name	S7-I Pin
1	Yellow	Heater	B7 or B13 or B19
2	Orange	Heater Drive	Any Fuel or Pwm
6	Red	Nernst Cell Voltage	B8
7	White	Ion Pump Current	B9
8	Black	Signal Ground	B11

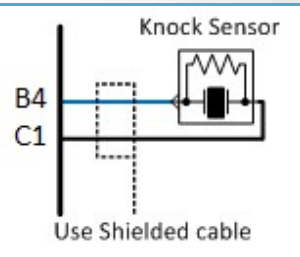
NTK L2H2

Lambda Sensor Input in Scal - Pin assignments needs to be Set to Lam1V, Lambda Heater Needs to be assigned to the assigned fuel output

Lambda Pin Number	Colour	Name	S7-I Pin
1	Yellow	Heater	B7 or B13 or B19
2	Blue	Heater Drive	Any Fuel or Pwm
6	Grey	Nernst Cell Voltage	B8
7	White	Ion Pump Current	B9
8	Black	Signal Ground	B11

Knock Sensor

Syvecs S7GP has 1 Knock inputs for a piezoelectric Example Schematic



Pin Schedule

Pin Number	Function	Notes
B4	Knock 1 Signal	
C1	Knock Grounds	

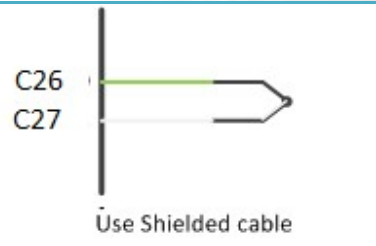
NOTE: Shield wires should be connected only at one end, common practice is to join shielding wires at the ECU end of the loom and connect them to a Power Ground wire.

EGT/Thermocouple

Syvecs S7GP has 1x K-type thermocouple inputs.

EGT1 is Selected in Scal - Pin Assignments as Thermo1+

Example Schematic



Pin Schedule

Pin Number	Function	Notes
C27	THER+	Green wire (K-type)
C26	THER-	White wire (K-type)