Syvecs LTD

V1.0

OEX - OEM ECU EXPANDER

Harware Version 4

Software Version 1.105 +

23/09/2024

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

Table of Contents

Introduction

The Syvecs OEX is a powerful OEM expander enabling advanced after market features on existing engine management systems, even going as far to fully integrate with a vehicles existing CAN networks.

The OEX has the following hardware features:

- 20 analogue inputs; 12 capable of reading speed/voltage/temp/VR sensors with individual programmable pull-ups and 8 analogue 0-5v.
- 20 high current outputs; 8 low side/high side capable (half or full bridge configurable) and 12 low side with optional internal pull-up resistors/fly-back diodes.
- 4 programmable analogue outputs (two are used if using dual internal wideband)
- 2 NTK wideband controller.
- 2 Knock Sensor Inputs
- USB For Updates and Configuration.
- 2 CAN 2.0 interfaces
- 1 xKline Interface.

The OEX has the following software features:

- 12 Sequential injectors with closed loop feedback from Onboard lambdas or OEM readings
- Internal or External Fuel Calculations from multiple internal sources or external CAN targets from and OEM ECU (Master ECU)
- Live calibrating from SCAL software via USB C
- 2 x NTK Lambda Circuits for close loop fueling with option to pickup lambda targets from OEM ECU (Master ECU)
- Dual Wastegate Control with option of internal targets or targets from OEM ECU (Master ECU)
- Dual Knock Control Circuits to externally monitor, warn and feedback to the OEM ECU (Master ECU)
- USB Datalogging to PC or External Memory Stick (up to 4000 times a second!)
- Flex Fuel Controls, change Injection parameters, boost targets and more
- Nitrous Control, wet or dry strategies with bottle pressure control
- External DBW Strategy for Older cars which want to add Drive by wire support
- LimpMode strategies with option to bring OEM ECU light on, adjust sensor voltage outputs to OEM ECU, lower boost targets, enable outputs and Limp CAN Messages
- Water injection Control with safety strategies for Level, Pressure and Flow from our WMI Module
- OBD2 Support - Pick up many OEM sensor readings including Lambda, Ignition Timing, Temperatures, MAF etc
- Lean lambda trip from our standalone Engine Control Module to add protection
- Traction Control calculation done internally on the OEX to reduce boost and send torque reduction the OEM ECU (Master ECU)
- Signal rescaling / clamping on 4 x DAC outputs to modify signals in the OEM ECU (Master ECU) like Manifold pressure sensors
- 20 Analog inputs with frequency, thermistor and ADC support
- 20 Output, 8 Half Bridge and 12 Low Side
- CAN / CANFD Support
- Crank and Cam Setup strategies from our Standalone Engine Control modules
- CAN Bridging/Forwarding between 2 CAN Bus's and ability to drop frames, then transmit own messages to keep OEM modules happy

The OEX integrates with OEM Can bus systems in the following ways, all of which can be used to your advantage.

- Reading of OEM sensors such as Manifold Pressure, Air charge, Oil and Coolant temperatures.
- Reading of calculated loads such as Torque and Fuel trims, ignition advance and Load.
- Reading of measured values such as TPS, Speed and RPM, and OEM Lambda.
- The OEX can also produce can frames for sharing information such as LimpMode, enabling the OEM CEL light.
- OBD2 Communication to extract Data and also Clear DTCs or Enable modes such as DynoMode or ABS OFF

Specifications / Maximum Ratings

Outputs

8 x Half Bridge Outputs (Support: Full Bridges, Lowside or HighSide Drive) (15Amp Peak (100ms) 8Amp Continuous)
12 x Low Side Outputs (12Amp Peak (100ms) 6Amp Continuous)
4 x DAC Outputs (-5v to 5v) – Max 65mA

Inputs

12 x Flexible Inputs supporting frequency, Sent, thermistor, bipolar
8 x 0-5v Voltage inputs
2 x NTK Lambda Inputs
2 x Knock Inputs

Communication Interfaces

USB For Updates, Configuration and memory stick logging
2 x CAN 2.0B interface for communication with other controllers or logging systems
1 x CANFD interface for communication
1 x Kline Interface

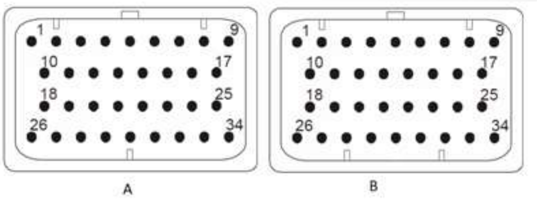
Power Supply

6 to 26V input voltage range

Physical

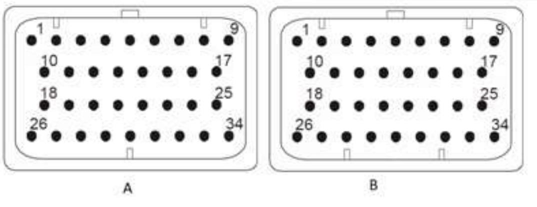
IP67 Sealed Automotive Spec -40c to 125c.
2 x 34 way Superseal 1.0 connectors
150mm x 150mm

Pinout - Connector A



A	DESCRIPTION		CONNECTOR A
	PART NUMBER		4-1437290-0
	NOTES:		34 Way - Key1
Syvecs Abbreviations	**Pinout**	**Scal Assignment**	**Description**
HBR1	A1	HBRIDGE 01	H-Bridge Output - Can be driven High or Low
PWR ON	A2		Ignition 12V Signal - OEX Wake up (Required)
AS1	A3	AN01	Flexible Input - 3k Pull Up Available in Software
AS3	A4	AN03	Flexible Input - 3k Pull Up Available in Software
AS5	A5	AN05	Flexible Input - 3k Pull Up Available in Software
AV7	A6	AN07	0-5V Input Only
AV09	A7	AN09	0-5V Input Only
VBAT1	A8		12V Supply - High Current (Required)
VBAT1	A9		12V Supply - High Current (Required)
HBR2	A10	HBRIDGE 02	H-Bridge Output - Can be driven High or Low
KLINE	A11		Kline or LinBus
AS2	A12	AN02	Flexible Input - 3k Pull Up Available in Software
AS4	A13	AN04	Flexible Input - 3k Pull Up Available in Software
AS6	A14	AN06	Flexible Input - 3k Pull Up Available in Software
AV8	A15	AN08	0-5V Input Only
AV10	A16	AN10	0-5V Input Only
5V	A17		5v Output for Sensors
HBR3	A18	HBRIDGE 03	H-Bridge Output - Can be driven High or Low
CANOL	A19		CAN 0 Low
CANOH	A20		CAN 0 High
DAC1 / NTK1 ION	A21	DAC01	Digital Outputs / NTK1 Ion Pump (White Wire)
DAC2 / NTK2 ION	A22	DAC02	Digital Outputs / NTK2 Ion Pump (White Wire)
DAC3	A23	DAC03	Digital Output - Can output -5v to +5v volts
DAC4	A24	DAC04	Digital Output - Can output -5v to +5v volts
ANGND1 / LAM GROUNDS / KNKGND	A25		Sensor Ground Connection / NTK Ground (Black Wire) / Knock Ground
HBR4	A26	HBRIDGE 04	H-Bridge Output - Can be driven High or Low
LSO1	A27	LOW-SIDE 01	Low Side Output
LSO2	A28	LOW-SIDE 02	Low Side Output
LSO3	A29	LOW-SIDE 03	Low Side Output
LSO4	A30	LOW-SIDE 04	Low Side Output
LSO5	A31	LOW-SIDE 05	Low Side Output
LSO6	A32	LOW-SIDE 06	Low Side Output
PWRGND	A33		Ground Connection - High Current (Required)
PWRGND	A34		Ground Connection - High Current (Required)

Pinout - Connector B



B	**DESCRIPTION**		CONNECTOR B
	PART NUMBER		4-1437290-1
	NOTES:		34 Way - Key2
Syvecs Abbreviations	**Pinout**	**Scal Assignment**	**Description**
VBAT2	B1		12V Supply - High Current (Required)
VBAT2	B2		12V Supply - High Current (Required)
AV17	B3	AN17	0-5V Input Only
AV19	B4	AN19	0-5V Input Only
AS11	B5	AN11	Flexible Input - 3k Pull Up Available in Software
AS13	B6	AN13	Flexible Input - 3k Pull Up Available in Software
AS15	B7	AN15	Flexible Input - 3k Pull Up Available in Software
KNOCK1	B8	KNK1	Knock Sensor 1 Input
HBR5	B9	HBRIDGE 05	H-Bridge Output - Can be driven High or Low
5V	B10		5v Output for Sensors
AV18	B11	AN18	0-5V Input Only
AV20	B12	AN20	0-5V Input Only
AS12	B13	AN12	Flexible Input - 3k Pull Up Available in Software
AS14	B14	AN14	Flexible Input - 3k Pull Up Available in Software
AS16	B15	AN16	Flexible Input - 3k Pull Up Available in Software
KNOCK2	B16	KNK2	Knock Sensor 2 Input
HBR6	B17	HBRIDGE 06	H-Bridge Output - Can be driven High or Low
ANGND2 / LAM GROUNDS / KNKGND	B18		Sensor Ground Connection / NTK Ground (Black Wire) / Knock Grounds
NTK NRNST 1	B19		NTK1 NRST Voltage (Grey Wire)
NTK NRNST 2	B20		NTK2 NRST Voltage (Grey Wire)
CAN1L	B21		CAN 1 Low
CAN1H	B22		CAN 1 High
CANFDL	B23		CANFD Low
CANFDH	B24		CANFD High
HBR7	B25	HBRIDGE 07	H-Bridge Output - Can be driven High or Low
PWRGND	B26		Ground Connection - High Current (Required)
PWRGND	B27		Ground Connection - High Current (Required)
LSO7	B28	LOW-SIDE 07	Low Side Output
LSO8	B29	LOW-SIDE 08	Low Side Output
LSO9	B30	LOW-SIDE 09	Low Side Output
LSO10	B31	LOW-SIDE 10	Low Side Output
LSO11	B32	LOW-SIDE 11	Low Side Output
LSO12	B33	LOW-SIDE 12	Low Side Output
HBR8	B34	HBRIDGE 8	H-Bridge Output - Can be driven High or Low

Connections - Power

The OEX ECU has **5** power connection points, **four** of these are high current and can be connected to a fused battery power or switched power source. **One** of them is Ignition to turn the unit on.

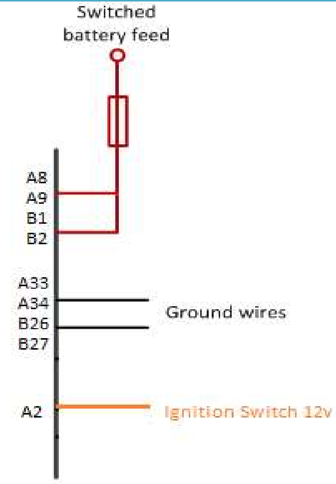
If driving motors or solenoids which pull a lot of current then ensure the correct amount of pins are connected. Each pin on the OEX ECU is able to sink around 14 amps of current. If driving multiple solenoids that pulls 20+ amps total, ensure at **least** two high current 12v pins and two power ground pins are used.

Internally **A8/A9** are linked, as well as **B1/B2**. These can either be used to provide extra current on a supply, or as a way of providing switched power to additional loads through the loom.

Pin A2 (**Ignition Sw**) switches the OEX on when supplied with a 12v supply.

Power Grounds are joined internally. The OEX ECU must have A33 and B26 connected to a good ground. If driving lots of Low Side outputs, connect A34 and B27 also share the load.

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



Example Schematic

Table 1: Pin Schedule

Pin Number	Function	Notes
A8	VBAT1	Use a fused 12v Switched feed. MUST CONNECT
A9	VBAT1	Use a fused 12v Switched feed.
B1	VBAT2	Use a fused 12v Switched feed. MUST CONNECT
B2	VBAT2	Use a fused 12v Switched feed.
A33	Power Ground	Shared Power Ground
A34	Power Ground	Shared Power Ground
B26	Power Ground	Shared Power Ground
B27	Power Ground	Shared Power Ground
A2	Power On	12v Ignition Switch – Logic Power

Connections - Outputs

Low Side Outputs

The low side outputs pull to ground when 'on'. They offer full pulse width modulation control. The outputs can be used to drive up to 12A Peak / 6A Continuous. These are suitable for injectors, solenoids, relays etc

Table 2: Pin Schedule

Pin Number	Function	Scal Assignment
A27	LSO1	LOW SIDE 01
A28	LSO2	LOW SIDE 02
A29	LSO3	LOW SIDE 03
A30	LSO4	LOW SIDE 04
A31	LSO5	LOW SIDE 05
A32	LSO6	LOW SIDE 06
B28	LSO7	LOW SIDE 07
B29	LSO8	LOW SIDE 08
B30	LSO9	LOW SIDE 09
B31	LSO10	LOW SIDE 10
B32	LSO11	LOW SIDE 11
B33	LSO12	LOW SIDE 12

Half Bridge Outputs

A **H bridge** is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used to drive electronic throttle motor applications to allow DC motors to run forwards and backwards.
Half Bridge Outputs also have full pulse width modulation available and can be driven to 12v or Ground depending on the Output drive type selection.

Output Drive Type:
Full Bridge = Pairs 2 x H-bridge outputs to offer push/pull drive for motor control, I.E HBR1&2 / HBR3&4
H-Bridge – Drives to 12v
Low Side – Drives to Gnd

Full Bridge channel paring is fixed, and you only need to assign 1 pin, for example HBRIDGE01 in full bridge mode to enable both HBRIDGE01 and HBRIDGE02 operation. You cannot for example use HBRIDGE02 and HBRIDGE03 together.

These outputs can be used to drive up to 15A Peak / 8A Continuous. If you are driving the outputs for high current devices it's extremely important to ensure the 12v and Ground wire gauge is also capable to handle the current demand. The minimum drive frequency that a H-Bridge can support is 20hz.

Table 3: Pin Schedule

Pin Number	Function	Scal Assignment
A1	H-Bridge1	HBRIDGE01
A10	H-Bridge2	HBRIDGE02
A18	H-Bridge3	HBRIDGE03
A26	H-Bridge4	HBRIDGE04
B9	H-Bridge5	HBRIDGE05
B17	H-Bridge6	HBRIDGE06
B25	H-Bridge7	HBRIDGE07
B34	H-Bridge8	HBRIDGE08

DAC Outputs

Four DAC (digital-to-analog) outputs are also present on the OEX ECU that convert a binary input number into an analog voltage output. These outputs are useful for mirroring an OEM Sensor voltage and adjusting it to keep OEM systems happy like a Manifold Pressure voltage clamp.

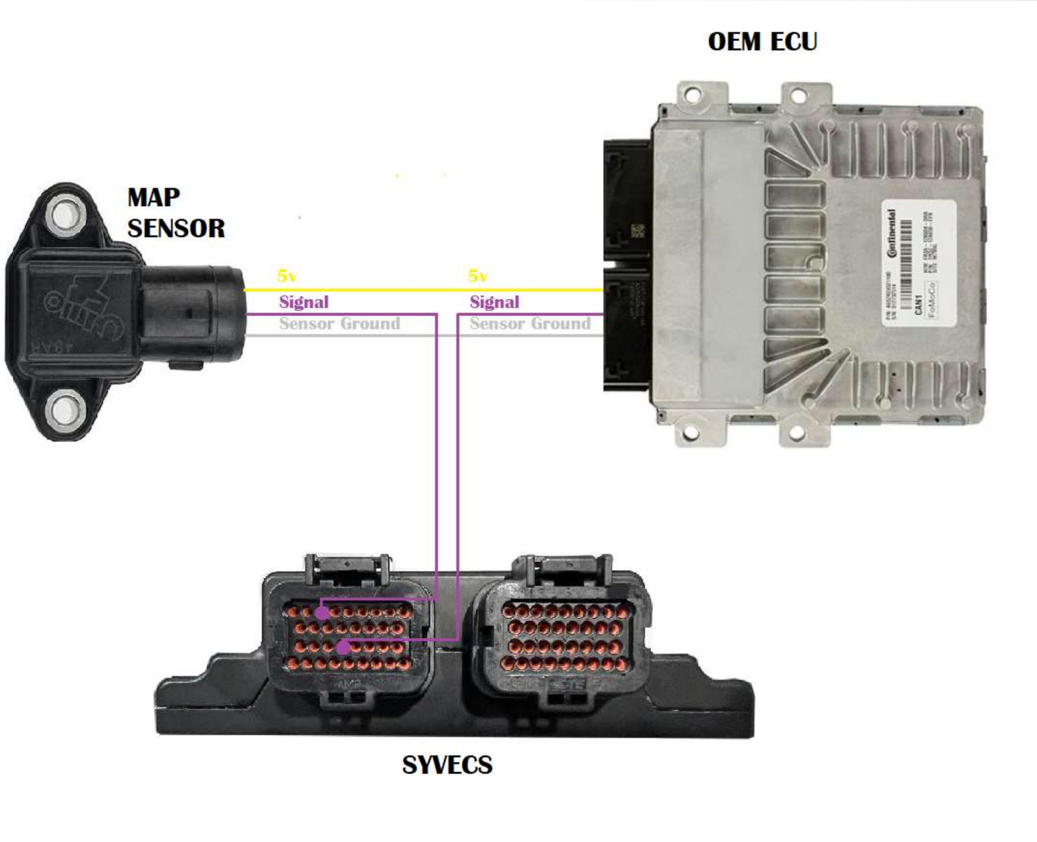
The outputs can be driven from -5v to +5v and not designed to handle much loading. Maximum current is 65ma

DAC1 and DAC2 as Default are set to drive the IonPump for NTK lambda control 1 and 2. DAC 3 and 4 are available as standard. DAC1 and DAC2 can be made available to customers but needs to be ordered this way.

Table 4: Pin Schedule

Pin Number	Function	Scal Assignment
A21	DAC1/NTK1I	DAC01 Setup for Ion Pump on OEX as Default
A22	DAC2/NTK1I	DAC02 Setup for Ion Pump on OEX as Default
A23	DAC3	DAC03
A24	DAC4	DAC04

Example: Signal INPUT into AS2 and DAC1 is used for Signal OUTPUT for adjustment to Map signal and clamp.



Connections - Sensor Supply and Grounds

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. The sensor ground pins are able to support multiple sensor connections as shown in the diagram below

Table 5: Pin Schedule

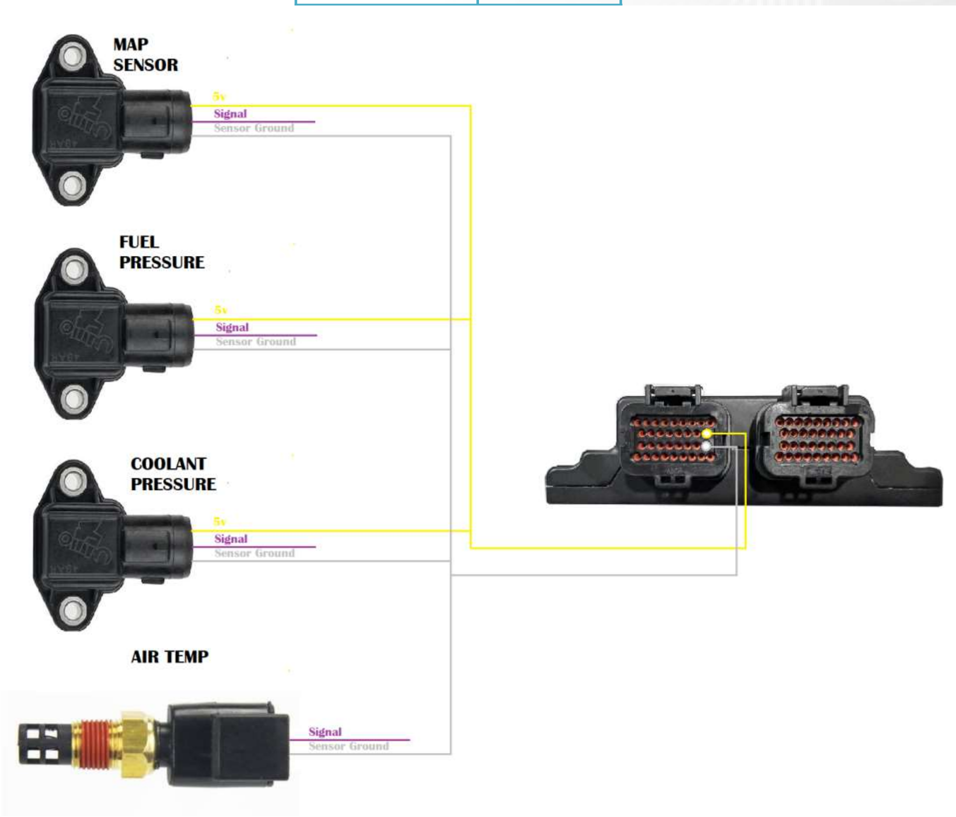
Pin Number	Function
A25	ANGND1
B18	ANGND2

5V Regulated Supply

Sensors and miscellaneous analogue inputs have their own power pins which need a stable power supply, the 5v Regulated outputs are protected and provide a stable/clean 5v which can handle 500ma Maximum. The regulated 5V pins are able to support multiple sensor connections as shown in the diagram below

Table 6: Pin Schedule

Pin Number	Function
A17	5VOUT1
B10	5VOUT2

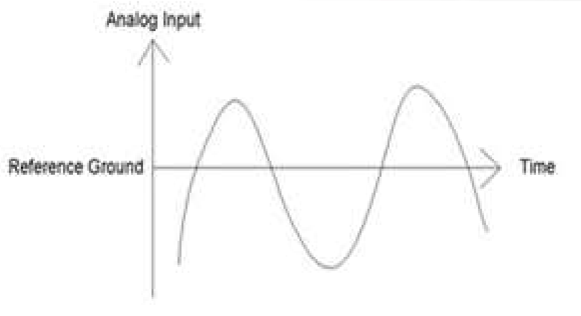


Connections - Inputs

The Syvecs OEX ECU has 20 programmable inputs available of two different types.

Flexible Inputs – AS Inputs

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



AS Input capability:

- Fully adjustable hardware trigger thresholds
- Hardware Frequency measurement
- Digital states
- 0-5v Analogue
- SENT Digital Decoding
- Thermistor (software pullup)
- MagnetoResistive Sensors

Example of typical sensor application:

- Reluctor Crank and Cam Sensors / ABS Sensors wheel speed
- Hall Sensors
- Map Sensor
- Temperature Sensor
- SENT Sensors

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 3k Pull-up through Scal when the Input Type is set as Thermistor

Table 7: Pin Schedule

Pin Number	Input	Scal Assignment
A3	AS1	AN01
A12	AS2	AN02
A4	AS3	AN03
A13	AS4	AN04
A5	AS5	AN05
A14	AS6	AN06
B5	AS11	AN11
B13	AS12	AN12
B6	AS13	AN13
B14	AS14	AN14
B7	AS15	AN15
B15	AS16	AN16

Voltage Inputs – AV Inputs

These Inputs are able to sense a Voltage level but not offer Frequency measurements.

Example of typical sensor application:

- Manifold Pressure sensors
- Throttle Positions
- Oil Pressures

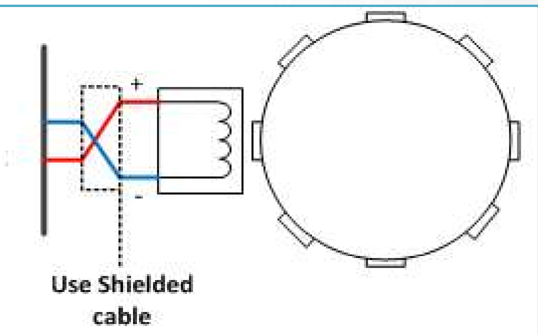
Voltage Inputs are not just limited to the above they can also be used for any sensor which outputs a 0-5volt signal. They so NOT have an internal 3k software configurable pull up. This needs to be wired externally.

Table 8: Pin Schedule

Pin Number	Input	Scal Assignment
A6	AV7	AN7
A15	AV8	AN8
A7	AV9	AN9
A16	AV10	AN10
B3	AV17	AN17
B11	AV18	AN18
B4	AV19	AN19
B12	AV20	AN20

Sensor Schematics - Examples

Speed Sensor – Magnetic Type

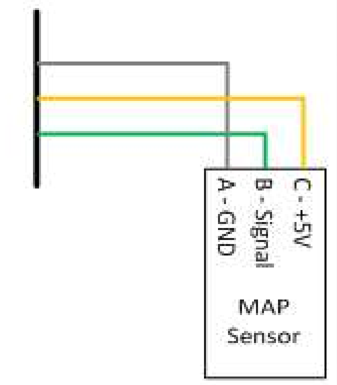


Example Schematic

Table 9: Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A4	AS3	Can use Inputs AS1-12 or AV13-20

Manifold Pressure Sensor (MAP)

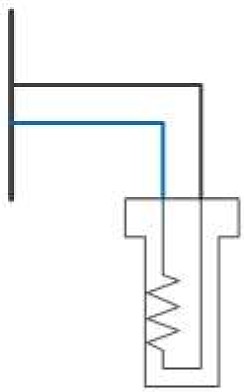


Example Schematic

Table 10: Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A17	5VOUT1	Regulated sensor power supply
B12	AV20 Input	Any Input can be used

Coolant Temperature Sensor (CTS)

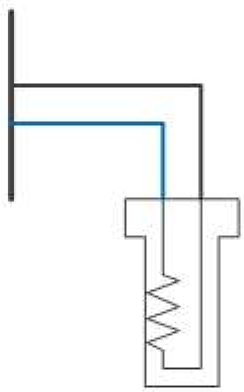


Example Schematic

Table 11: Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A4	AN3	Can use Inputs AS1-12 or AV13-20 with External pullup

Inlet Air Temperature Sensor (IAT)



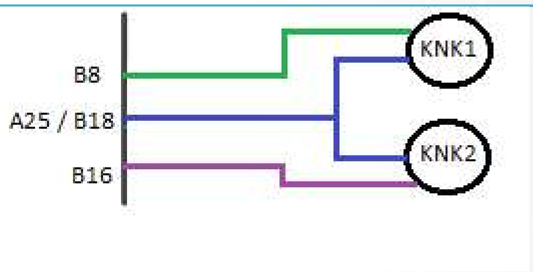
Example Schematic

Table 12: Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A4	AN3	Can use Inputs AS or AV with External pullup

Knock Sensors

The OEX allows sensing of all broadband knock sensors, connection can be done direct or T into the OEM knock sensor signal wires and connect to B8 or B16. See Knock Control section for more information.

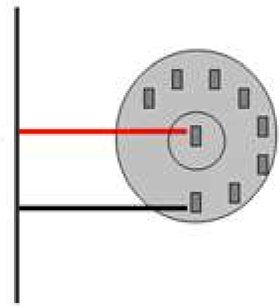


Example Schematic

Table 13: Pin Schedule

Pin Number	Function	Notes
B8	KNK1	Knock Signal 1
B16	KNK2	Knock Signal 2
A25 or B18	KNKGND	Knock Ground

Calibration Switches



Example Schematic

Table 14: Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A12	AN2	Can use Inputs AS or AV with External pullup

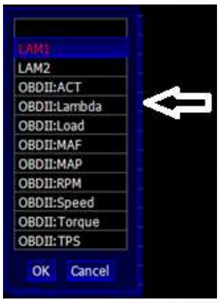
Connections - Wideband Lambda Sensors

The Syvecs OEX Controller has the ability to drive two NTK L2H2 Wideband Lambda sensors without the use of external hardware. We also have the capability to drive two denso AF sensors but this is a build-time option.

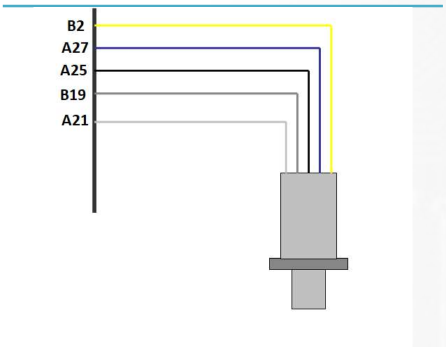
Lambda monitoring allows calibrators to see the Air Fuel Ratios inside the exhaust and also implements Limp strategies.

Please see wiring and fitting information below for an L2H2 NTK

Tip: If the vehicle you have the OEX controller fitted to already has wideband lambda support, you can use the OBDII support to grab the lambda data from the OEM Ecu.



NTK L2H2 Wiring



Example Schematic

Table 15: Pin Schedule

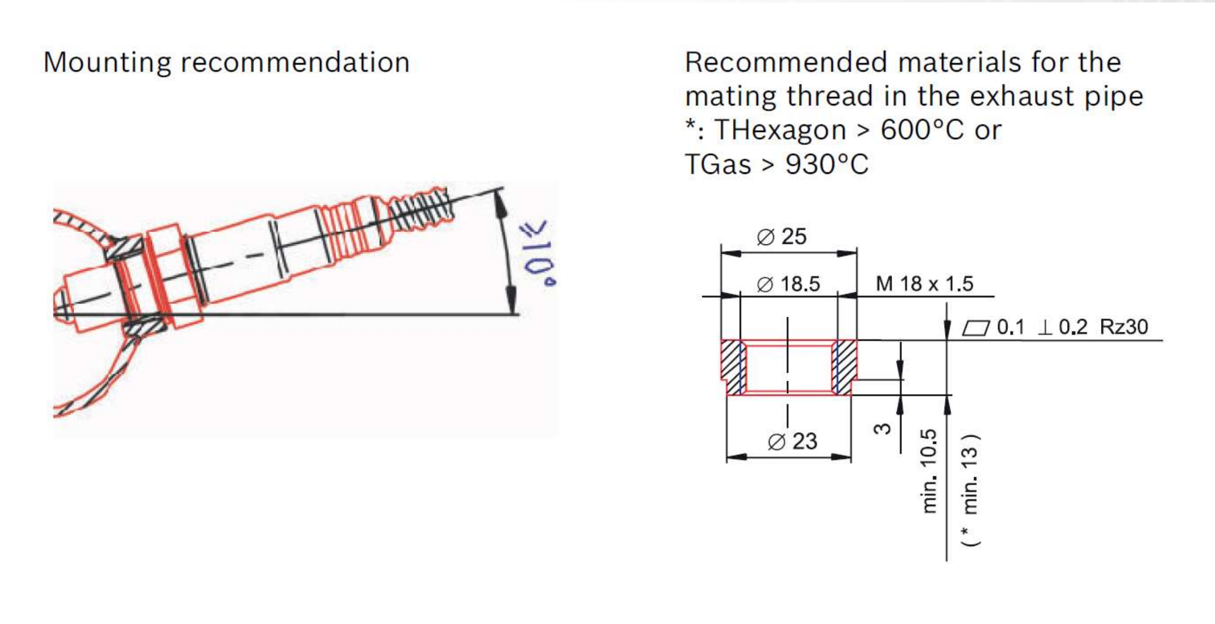
Lambda Pin	Colour	Name	OEX ECU Pin Lambda 1	OEX ECU Pin Lambda 2
1	Yellow	Heater	12v fused supply	
2	Blue	Heater Drive	Any LSO or HBR Output	
6	Grey	Nernst Cell	B19	B20
7	White	Ion Pump	A21	A22
8	Black	Signal Ground	A25 or B18	A25 or B18

NTK L2H2 Setup

After wiring in the NTK lambda you can assign the Lambda1 or Lambda2 function to the dedicated LAM input used. This is set in IO Configuration – Pin Assignments. Highlighted in Yellow.
The input setup and linearization with be as default set for an NTK L2H2 Sensor in the ecu.

The Lambda Heater control also needs to be assigned to the output used, this can be any Low-Side or H-Bridge Output on the OEX ECU. The default values set in the maps for the heater will be correct for the NKT L2H2.

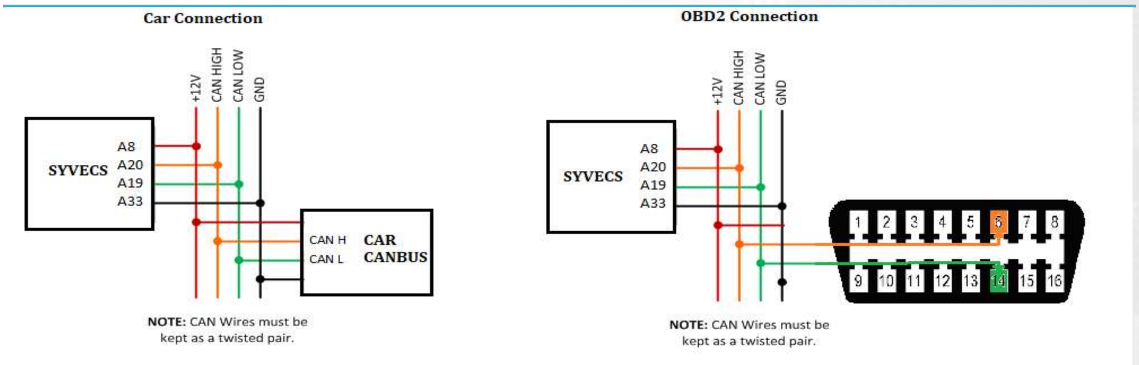
Recommended Lambda Mounting



Connections - CAN Bus

Common **A**rea **N**etwork Bus (CAN Bus) is a widely used data interface common used in many cars and aftermarket accessories (such as Data loggers and Dashes). Data is sent using the a pair of wires, which are maintained as a twisted pair.

The OEX ECU as default has 2 x CAN bus interfaces:
- CAN0
- CAN1



Example Schematic

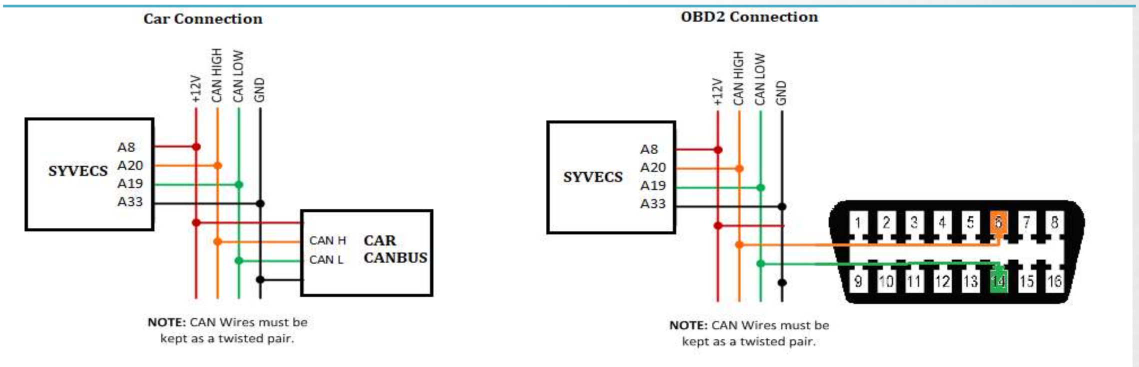
The OBDII CAN wires need to be connected as above and can be wired to either CAN on the OEX Controller

Table 16: Pin Schedule

Pin Number	Function	Notes
A19	CAN0 LOW	Ensure wires are twisted pair.
A20	CAN0 HIGH	Ensure wires are twisted pair.
B21	CAN1 LOW	Ensure wires are twisted pair.
B22	CAN1 HIGH	Ensure wires are twisted pair.

ODBII Connections

The OEX controller supports the OBDII Data receive protocol allowing users to retrieve data via the OEM ECU OBDII protocol making installation very straightforward. (please note: Not ever manufacture supports the SAE J1979 protocol we use)



Example Schematic

The OBDII CAN wires need to be connected as above and can be wired to either CAN on the OEX Controller.

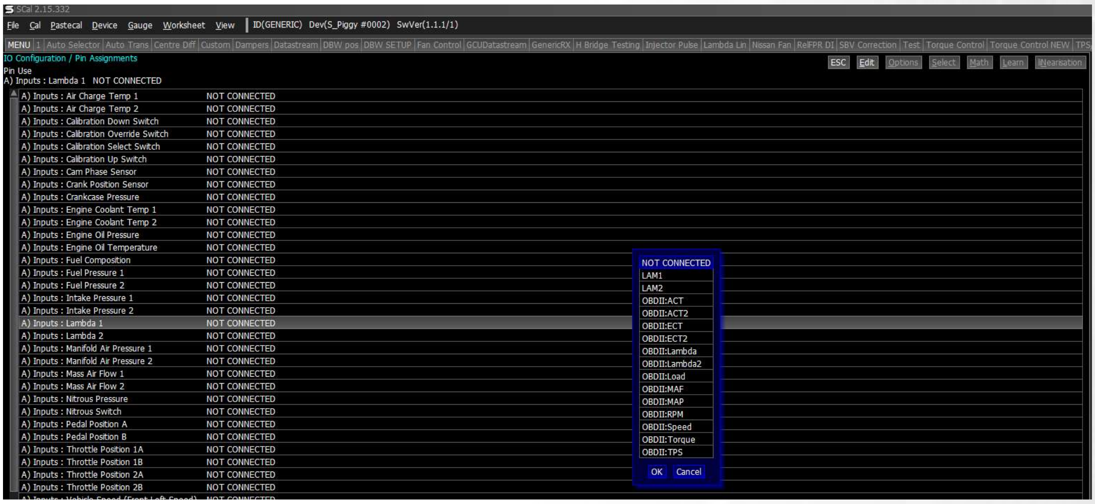
OBDII Setup

OBDII Supports: Rpm, Tps, Torque Actual, Torque Demand, Ignition Timing, Short Term Fuel bank1/2, Maf1, Map1, ACT , ECT, Lam1, Speed

Select the input you wish to assign OBDII data on and then select the OBDII: Item best suited.

Example: Lambda – OBDII Lambda

Users need to Device – Program the controller after for the setting to be applied.



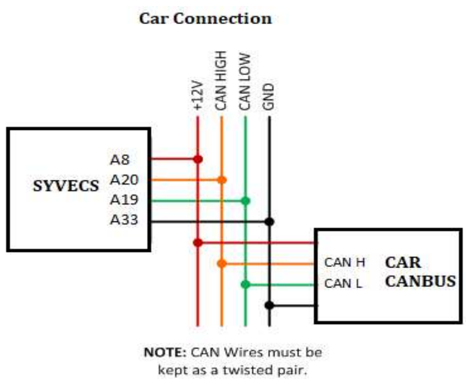
Direct CAN connection

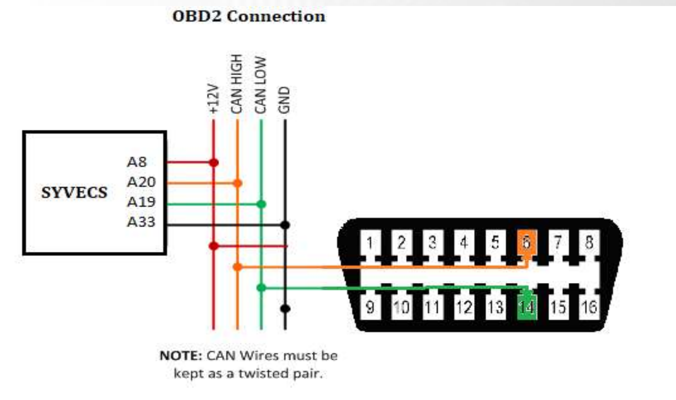
The OEX controller supports direct CAN connection to the vehicle or ECU data bus. This is a very powerful way of getting very fast real time vehicle running data.

At the end of this manual is the list of supported OEM vehicles / Aftermarket Ecu's which Syvecs support and it's expanding all the time. **Please Note**: OEM Vehicle don't all have the power-train CAN available at the OBDII connector, users may need to connect on the CAN at the ECU location.

If the vehicle/Ecu you wish to connect to is not present in the Datastream – Predefined CAN list then Syvecs also have a generic receive section for allowing calibrators to set a custom CAN receive setup.

Connecting the CAN network on your car needs to be done at the ECU location to ensure the powertrain CAN messages are present. T into the CAN wires and run them to the OEX controller.





Generic Can Receive

The generic CAN receive section allows for calibrators to setup the items they wish to recieve on the OEX by setting the Identifier, Start Bit, Length, and scaling.

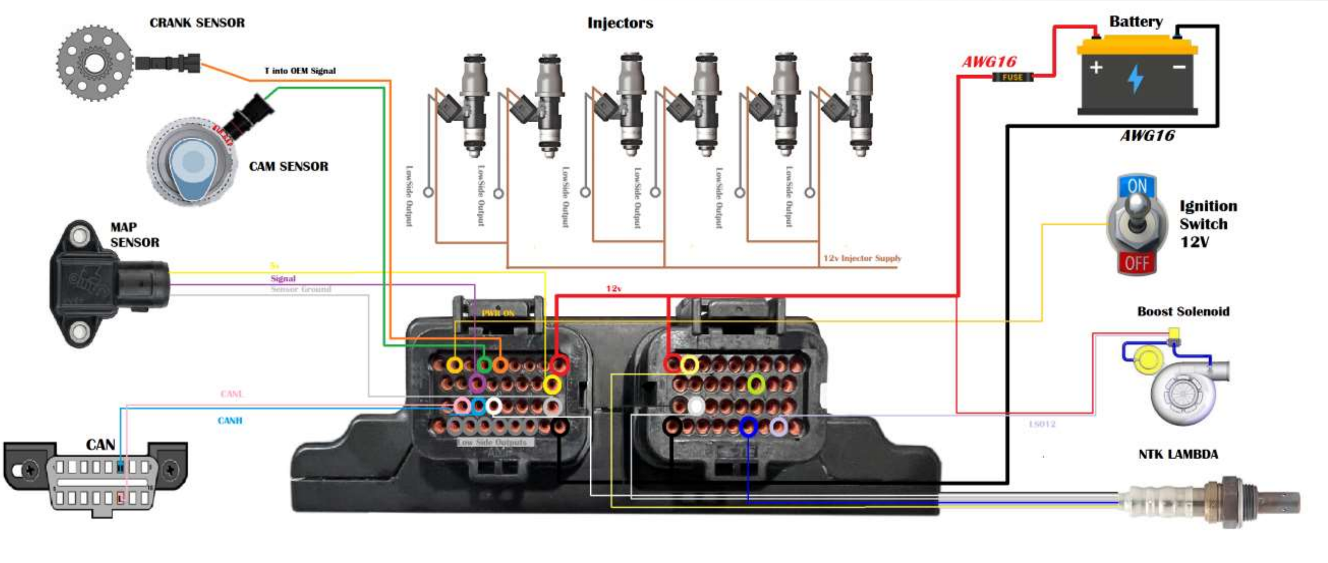
The easier way to setup the Generic CAN is to create a worksheet and add in all the maps like below to make each CANRX* maps line up.

Above you can see the RPM is setup to be received from CAN ID 0x600, data is not Little Endian, value is signed, scaling is 1.00 and is being picked up from start bit 0 with a length of 16 bits.

More info can be found on www.youtube.com/SyvecsHelp. Search for Generic Can Receive.

Please note: Any Item which is assigned in Pin Assignments will take its data from the Pin assignment and ignore the Generic CAN Rx data.

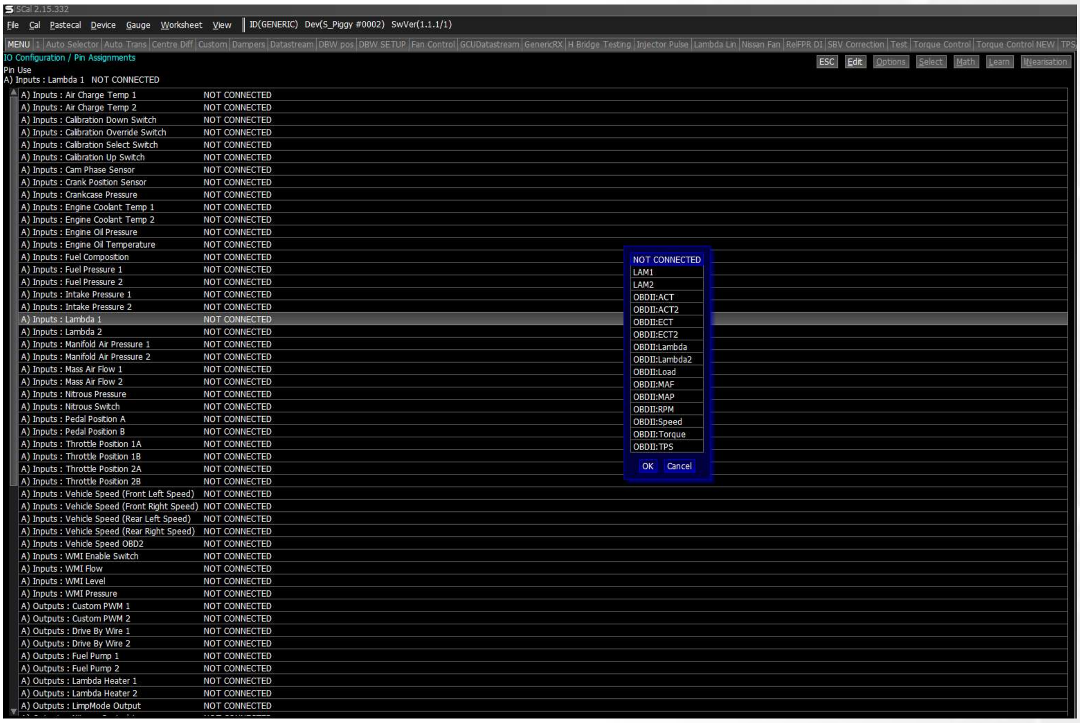
Example wiring:



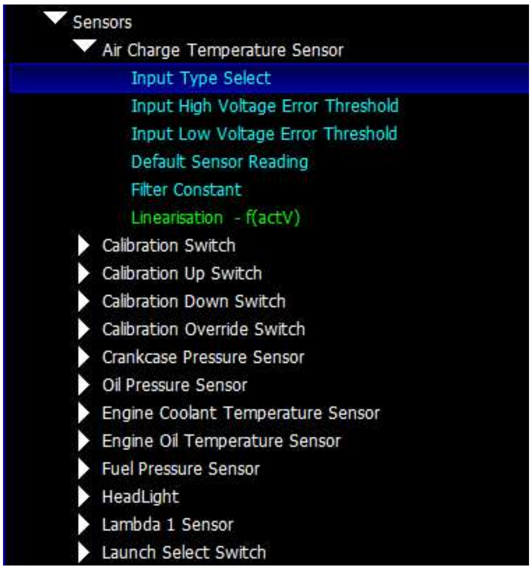
A Connector	B Connector
A2 – Ignition Switch 12v A4 – Cam Signal A5 – Crank Signal A9 – 12v Supply (high current) A12 – Map Sensor Signal A17 – 5V Supply A19 – CAN L A20 – CAN H A21 – NTK White Wire A25 – Sensor Grounds A27 – Injector 1 A28 – Injector 2 A29 – Injector 3 A30 – Injector 4 A31 – Injector 5 A32 – Injector 6 A34 – Ground (high current)	B1 – 12v Supply (high current) B2 – NTK Lambda yellow wire B18 – NTK Lambda black wire B19 – NTK Lambda grey Wire B26 – Power Ground (High Current) B31 – NTK Lambda Heater blue wire B33 – LSO12 Boost solenoid

Input - Sensor Setup

The OEX has 20 x 0-5v inputs available and these can be selected in the I/O Configuration – Pin Assignment.



Once assigned the calibrator can head to the sensors area to setup the input assigned.



Input Type Select – Allows either a 5V or Thermistor to be selected. When thermistor is selected a 3K pull up resistor is enabled on the Input.

Input High Voltage Error Threshold – Sets the high voltage level for which the TinyDash will class the input in Error

Input Low Voltage Error Threshold – Sets the low voltage level for which the TinyDash will class the input in Error

Default Sensor Reading – When the input is in Error the value in this map will applied on the Item

Filter Constant – Amount of recursive filtering to be applied to the Signal, higher the value = more filtering

Linearisation – Sets the input voltage to sensor units applied on the item

PC Connection - SCAL

The OEX ECU has a calibration stored onboard to maintain settings of the OEX ECU hardware. In order for the OEX ECU to work it must have a valid calibration present in the device and when shipping from the factory a default cal is loaded to ensure it works out of the box. Calibrators who wish to enable an Input to work in SENT decoding or setup custom CAN transmit will need to connect live to the OEX ECU.
A USB-C port is found at the back of the OEX ECU which is IP67 sealed. Use a USB-C to USB-A male/male cable to connect the OEX ECU to the computer. The S-Suite software can be downloaded from below.

https://www.syvecs.com/software/

After running the SSuite installer, open SCal and click **D**evice - **C**onnect
A OEX ECU device will be found as shown below, press Ok to proceed
The connected green icon should now be present in the top right and all the voltages/temps from onboard

the OEX ECU are listed on the right hand side.
Calibrators now have the ability to change the Input setup for each AN Input, setup custom DataStream CAN options or use the output testing (see page 18).
Press F1 for help on a map and remember that:
Green maps – Live Adjustable, changes have immediate effect
Blue maps – Require programming to take effect.

Output Testing

The OEX ECU outputs can be tested live with our Syvecs - Scal program and information on connecting to the unit can be found in the PC Connection section of the manual. After connecting to the expander via USB, users will see an area at the bottom of the calibration tree called output testing.

Here users are able to test the functions of each output by itself without the need for any master/slave CAN communication.

NOTE: ***H-Bridge Output Mode / H-Bridge Output Frequency / Low Side Output Frequency*** *maps must be set and programmed onto the device for the output testing logic of these outputs to apply. You cannot change these maps when* ***Output Test Mode Enable*** *is enabled.*

Set a frequency you wish the outputs to be driven at in **H-Bridge Output Frequency** and **Low Side Output Frequency.** Next set the **H-Bridge Output Mode** and Device - program the OEX ECU.

Output Test Mode Enable can then be enabled.

Now you can then set a duty for each output to be driven in **H-Bridge Output Test Duty** and **Low Side Output Test Duty.** These maps can be adjusted live.

If ***H-Bridge Output Mode*** map is set on Full Bridge, the paired outputs used in the full bridge individually set the drive direction.

For example: Motor is wired to HBR1 and HBR2, Output Mode is set to Full Bridge on HBR1 and 2. Increasing Duty on HBR1 output duty cell will cause the full bridge to drive the HBR1 output positive and the HBR2 output negative.

DAC Output Test Voltage is a live map which you can set the voltage that DAC1 -4 are driven at in Output test mode.

Strategy Description & Explanation

Limp Mode

The OEX limp mode is allows users to define working limits of all sensors. If these are exceeded the OEX will enable a limp strategy. Before the strategy will function it must be enabled in the Calibration Switch > Limp Modes Menu to select which Limp Mode you wish to enable.

When active Limp Mode functions in the following way:

- Send CAN messages over the OEM CAN bus (on supported vehicles) and illuminate the engine check light.
- Enable an output on when in limp mode. Useful in cases where the OEM CAN does not support this, or its not implemented.

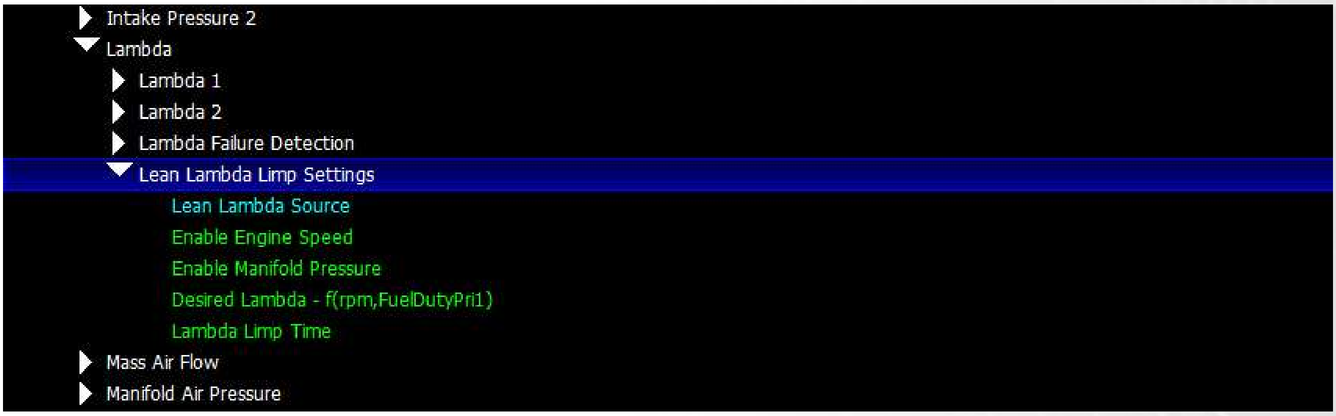
You can manually define these limits in the Sensors menu within SCal. Limp mode will also disable features such as Wastegate and Nitrous Control.

Lean Trip

Lean trip warnings act in the same way as Limp Mode and activates the same output functions. It is however a stand-alone configurable strategy.

There are three sources for the lean trip value:

- CllTarget (Closed Loop Lambda Target) from fuel base map CllTarget (also possible to receive CAN target from OEM ECU)
- Manifold Pressure
- FuelDutyPri (Final Injector Duty)



The Enable Engine Speed and Enable Manifold Pressure maps activate the Lean Lambda Strategy. From here a calibrator can set the allowed Lambda for the given Y Axis. If the Actual Lambda passes the value set in the map for time longer than set in Lambda Limp Time. Then a Lean Lambda Limp will become Active.

Crank and Cam Setup – Engine Sync

The OEX has a fully configurable Crank and Cam Setup to get the ECU SyncState into 720 which allows sequential injections. If the SyncState is not 720 then it will not inject.

The Crank and Cam Sensor setup is the first area to attack after defining the crank and cam in pin assignment to ensure the readings are reliable. This is found in the Sensors area on scal.
Calibrators can setup the input type, thresholds and trigger edge.

IMPORTANT: Its best to set the input type to 5v if you are tapping into the OEM Crank and Cam Signals so no pull up is applied to the input upsetting the OEM Ecu.

Calibrators can head the engine fundamentals area to setup the trigger settings, firing order and bank allocations

Here the number of crank teeth, gap ratios, crank trigger pattern and a single cam pulse angle can all be adjusted to suit any engine trigger setup.

If the Cam trigger is more than 1 single pulse per 720 revolution then the manual cam checklist can be setup to decode a pattern on the Cam waveform

Our support team have lots of base calibration for different engine setups to make calibrators life easier so please reach out to support@syvecs.com

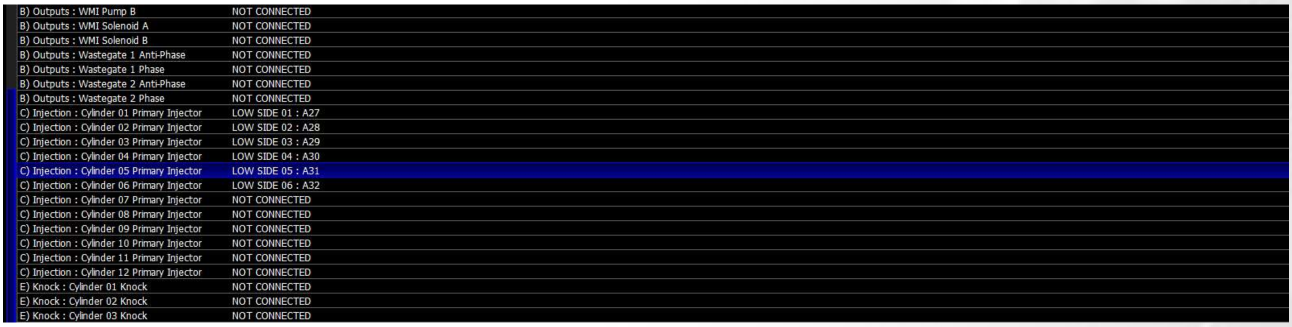
Fuel Control

The OEX has 2 modes of fuel operation which dictate how the injectors are controlled.

Internal Calculations – The Fuel flow and Injector opening calculations are worked out internally using the Fuel calibrations, corrections and flex fuel models.

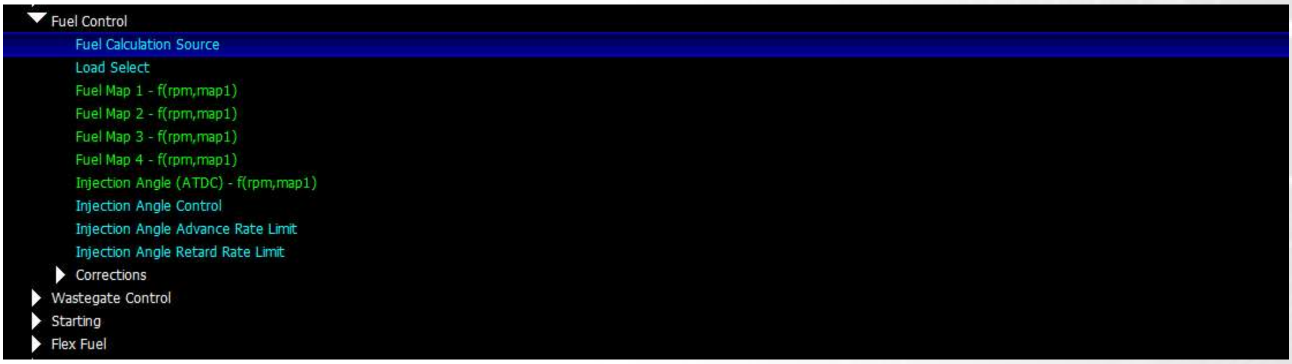
External Calculations – The Injector opening time and fuel mass is controlled from an External controller and the OEX acts as a slave based on the fuelFinalExtTarg items values. Cylinder Corrections is done internally.

Calibrators first need to define the injector outputs in the I/O Configuration – Pin Assignments



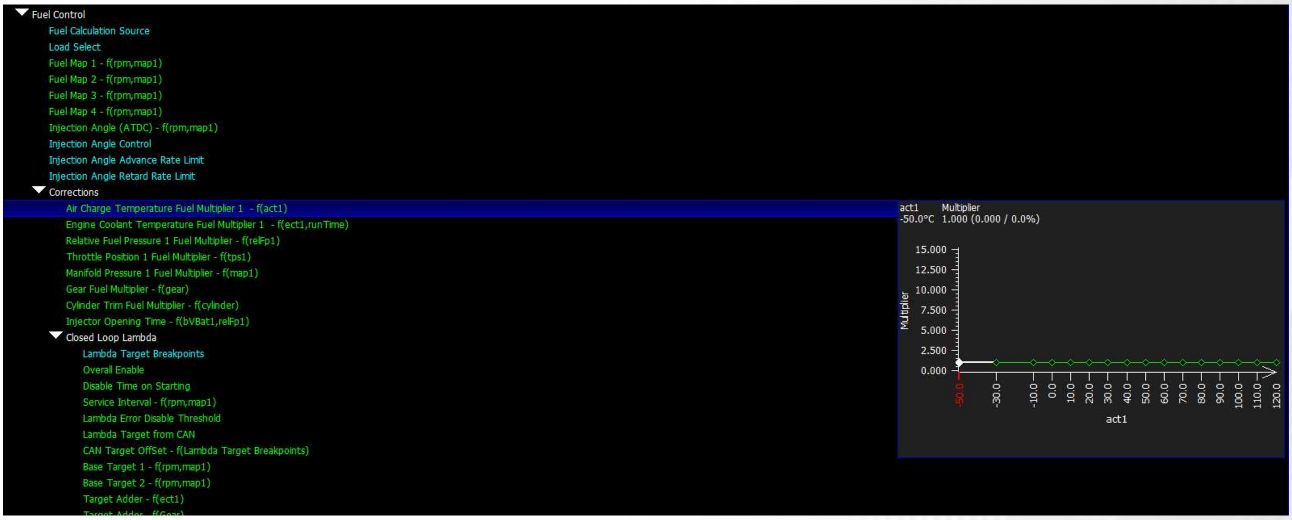
Then ensure the Firing order and Bank allocations are setup correctly in Engine Fundamentals Area

Select the Fuel Calculation source, either Internal or External



Internal Mode

If internal mode is selected, calibrators can setup the Load select to be how they wish and then populate the fuel maps, corrections and injection angles as they wish.

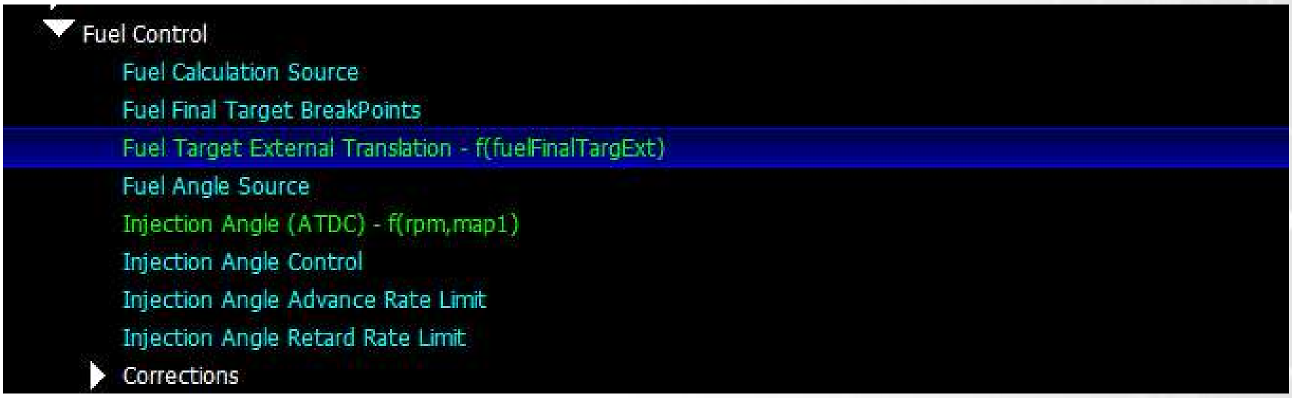


Closed Loop Lambda fuel adjustment is available which can have the lambda target set from an internal source or from an external CAN source which will need to be setup in the GenericRx Datastream area.

As two NTK lambda circuits are available on the OEX, calibrators can wire in 2 NTK lambda sensors direct or pickup the OEM ECU lambda readings using the OBD2 protocol or GenericRX CAN Setup. The Closed loop control is useful if you have the OEM Target from CAN as it keep the OEM ECU Short term trims in check which can also be monitored via OBD2.

External Mode

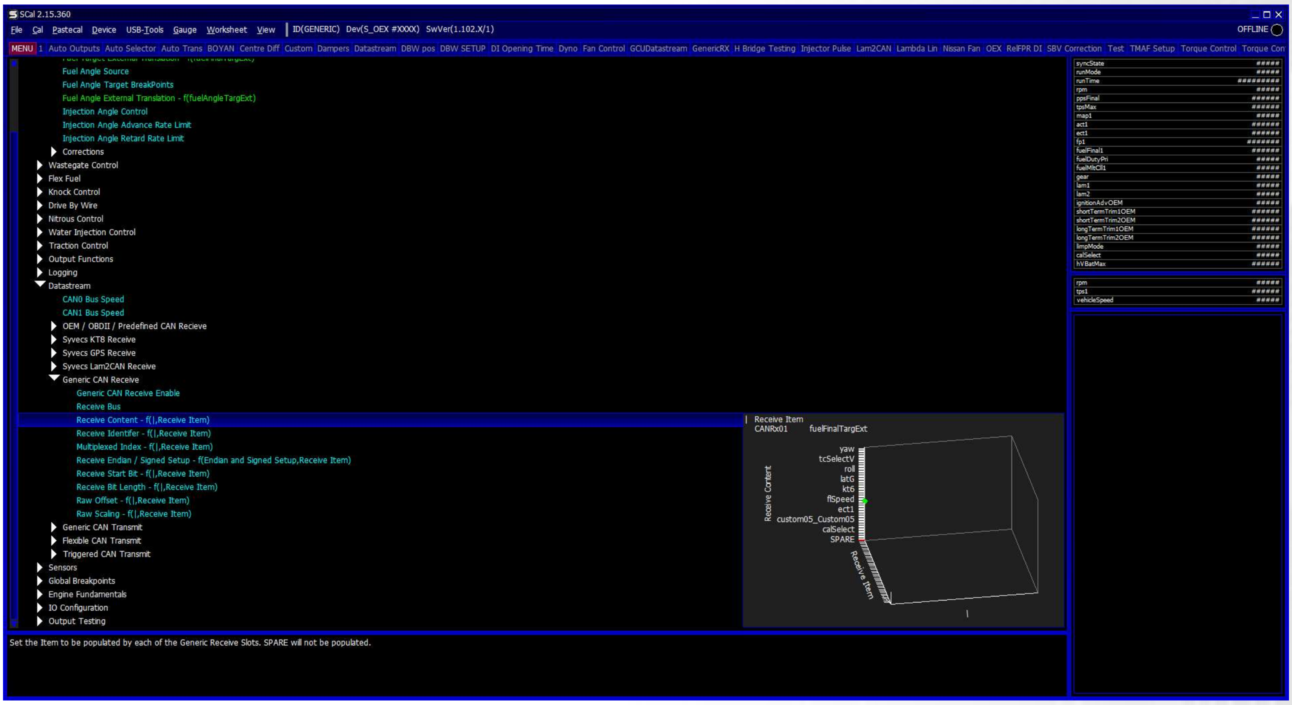
If External mode is selected, the OEX will control the Injector opening times and fuel mass from an external controllers target millisecond value and the OEX acts as purely a slave based on the **fuelFinalExtTarg** item data.



Cylinder Corrections are still controlled via the OEX internally and the fuel target linearisation can be adjusted if calibrators want to adjust the demanded fuel amounts. As Default this calibration is setup 1:1

Fuel injection angle can also be control externally with the OEX by changing the Fuel Angle Source map to External. When set to External the Fuel Angle is setup from the item – **fuelAngleTargExt.** Make sure the source which is sending the target Is matching Injection Angle Control setup in the OEX. Either Start or End.

The **fuelFinalExtTarg** and **fuelAngleTargExt** items which is used for the external calculations can be setup to be received in the DataStreeam – Generic RX area where calibrations can setup a unique CAN identifer, bit selections, scaling and offsets to match incoming CAN data.

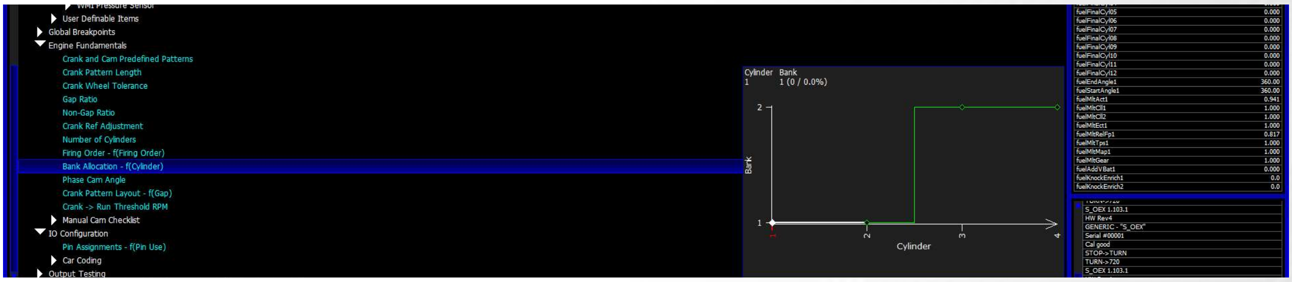


If you are using the OEX with an Ecutek Racerom patch then calibrators can select Ecutek in the DataStreeam – Predefined area which will automatically pick up the **fuelFinalExtTarg** and **fuelAngleTargExt** items and other external control items. See Ecutek CAN Comms page in this manual for more information on items transmitted and received.

Engine Bank Allocation

V Engines which fundamentally split the engine into banks need to be setup carefully on the OEX to ensure that the correct fuelling and wastegate control is applied for each section of the engine.

The bank allocation map under the fundamentals section of the calibration tree allows users to input the cylinders which are on each bank.



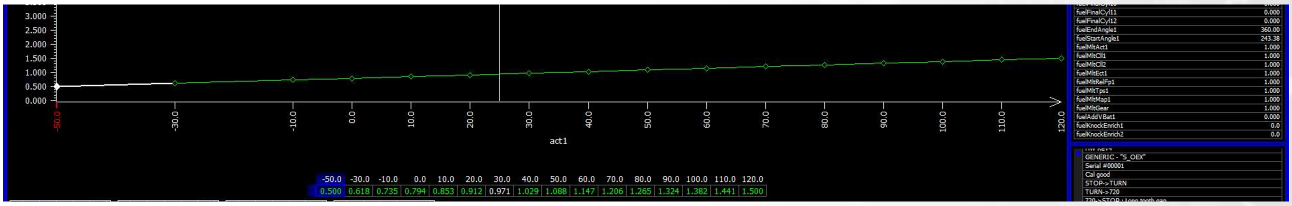
The following strategies get effected by the bank allocation:

*Internal Fuel Control
*External Fuel Control
*Internal Wastegate Control – Manifold Pressure 2 is used for DT and Err calculations
*External Wastegate Target – Manifold Pressure 2 is used for DT and Err calculations

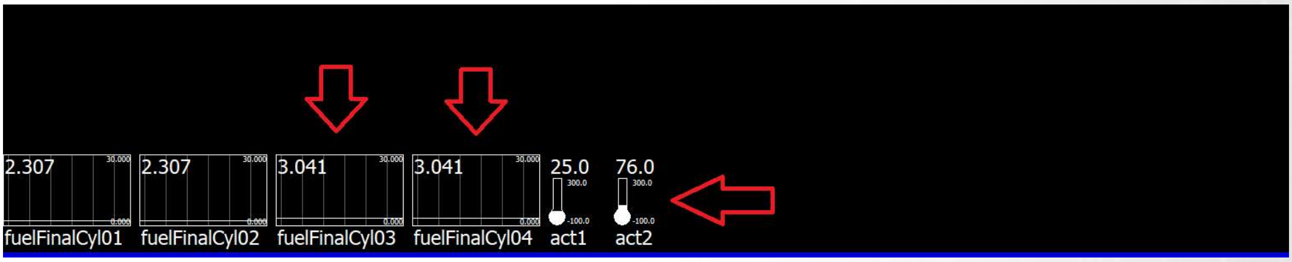
The above strategies are implementing bank corrections when the following sensors are assigned:

*Air Charge Temp 2 - Effects Fuel Control – Air Charge Temp 1 Multiplier - fuelMltAct2
*Engine Coolant Temp 2 Effects Fuel Control – Engine Coolant Temp 1 Multiplier - fuelMltEct2
*Fuel Pressure 2 - Effects Fuel Control – Relative Fuel Pressure 1 Multiplier - fuelMltRelFp2
*Lambda 2 – Effects Fuel Control – Corrections – Closed Loop Lambda - FuelMltCll2
*Manifold Pressure 2 - Effects Fuel Control – Manifold Pressure 1 Multiplier - fuelMltMap2
*Throttle Position 2 - Effects Fuel Control – Throttle Position 1 Multiplier - fuelMltTps2

If a 2nd Air Charge Temperature sensor is assigned and a 2nd bank is setup then the correction for Air Charge Temp under Fuel Control will apply based on the readings from Act2.



FuelFinalCyl03 and 04 are higher due to the increased temperature on ACT2 and fuelMltAct2 being higher



Wastegate control

The OEX can support internal strategy logic where calculations are done inside the OEM or External strategy logic where the OEX responds to external wastegate duty targets or manifold pressure targets.

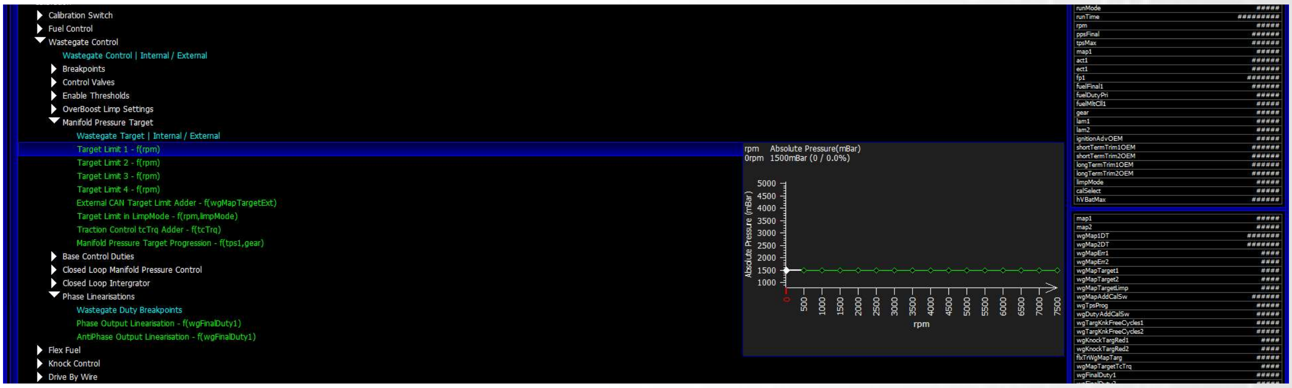
Internal Strategy Control

The Wastegate Control function is a powerful open and closed-loop capable system for controlling manifold pressure.
Key features:

- Target boost vs Throttle/RPM/Gear or CAN Target
- Closed loop control or External CAN Duty Control
- Boost reduction (system disables) if OEX detects LIMP condition.

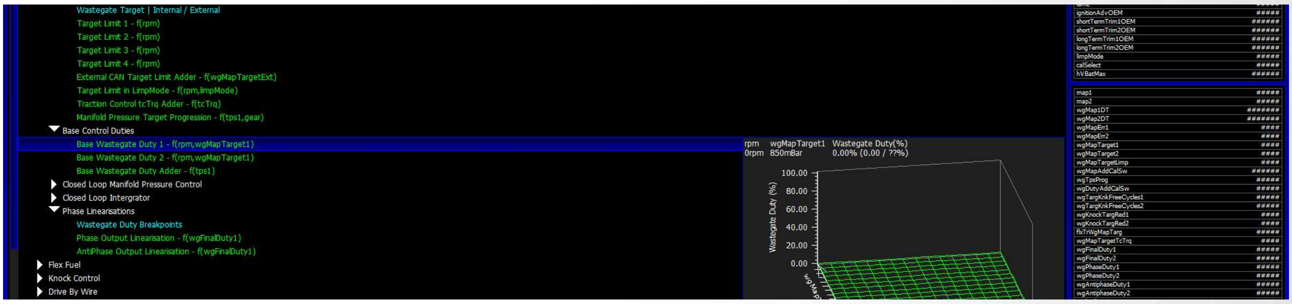
The following explains the process in configuring the Wastegate Strategy, and assumes the boost solenoid is correctly fitted and configured in **IO Configuration > Pin Assignments** (Usually Wastegate 1 Phase)

1. Set the **PWM Frequency** for the solenoid used and Output drive type, most solenoid are best control low side drive
2. Set the **Enable Engine Speed** and **Engine Throttle Position**
3. Set the desired boost level in **Wastegate Control > Manifold Pressure Target > Target Limit 1**
   This is an absolute value, taking into account atmospheric pressure. If you wanted to target 2 bar boost, you would enter 3000mBar.



4. Other target adders and multipliers can effect the wgMapTarget which can be found under the target limits and calibration switches section. This can be useful to limit the manifold pressure in the event of a LimpMode, lower gears or traction control tcTrq adjustments

5. Populate the Wastegate Base duty table for the different wgMapTarget values as a function of engine speed.
   These can be approximate as the closed loop system can be enabled on top of the base. Note that the table is boost target (wgMapTarget) VS rpm. You would expect the map to show more duty as the wgMapTarget increases. Most wastegates start to open around 20-30% Duty. It makes sense to start low and add more if required.



6. Ensure **Wastegate Control > Closed Loop Manifold Pressure Control > Enable Closed Loop Control** is enabled and setup the **PD Duty table** and **Intergrator gains** to adjust the wastegate duty based on error in the system compared to the target.
7. Choose the desired Wastegate Target Select from within **Calibration Switch > Wastegate Control > Wastegate Target Select**. In this example this must be set to 1.

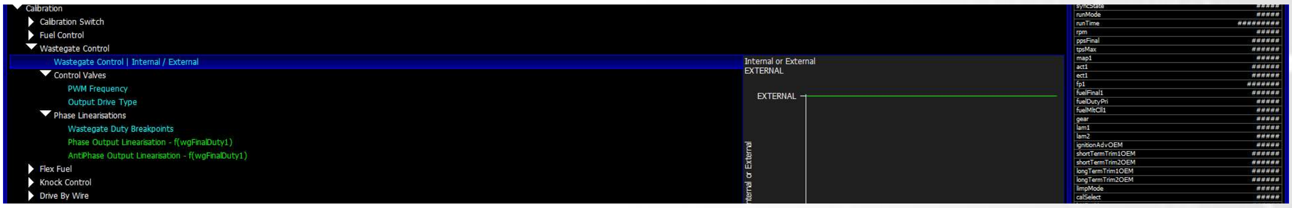
Tips:

1. **Calibration Switch > Wastegate Control > Wastegate Control Map Target Adjustment** can be configured to allow an external calibration switch to select different boost levels via means of an external configured CAL switch.
2. To monitor boost controller functions from within SCal from the top menu: **Gauge > Add** add the following: **wgMapTarget, wgBaseDuty, wgFinalDuty**. Using these values you can adjust **Wastegate Control > Manifold Pressure Target > Target Limit 1** map until the values **wgBaseDuty, wgFinalDuty** closely match during a run. These can also be configured in logging, and reviewed after.
3. Note that **Wastegate Control > Manifold Pressure Target > Manifold Pressure Target Progression** alters boost target vs TPS vs Gear. This can be tuned to match a particular application, on a per gear basis. It's a key setting to getting a turbo car to be predictable and drivable without the traditional on/off effect of almost all external boost controllers. In order for this to work, TPS will need to be configured in **IO Configuration > Pin Assignments.**
4. OverBoost Limp is useful to trigger a LimpMode in the OEX in the event the manifold pressure **exceeds the Over-Boost Manifold Pressure Limit** and **Over-Boost Allowed Time.**

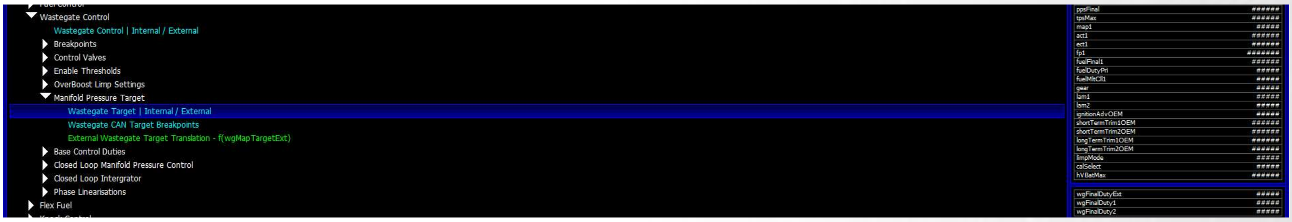
External Strategy Control

The Wastegate Control logic can also be done externally by an OEM ECU or another module which feeds in a **wgMapTargetExt** and **wgFinalDutyExt** target via CAN. This can be setup in the DataStream – Generic CAN Receive or via a preselect CAN stream.

Calibrators can select the Internal or External option for the overall control at the top of the wastegate tree.
External selection here just allows users to set a PWM Frequency, Output Drive Type and Phase Output Linearisation for driving the solenoid based on the requested **wgFinalDutyExt.**



If calibrators wish for the control strategy to still be done via the OEX but have an external system setting the target they can do this via selecting External targetting option in the Manifold Pressure target area. The OEX will then set **wgMapTarget** based on the value from **wgMapTargetExt.**



Traction Control

The Syvecs Traction control strategy is derived to provide a solution for variety of motorsports racing series, as well as road or track use. It is a multidimensional approach to dealing with varying conditions of adhesion.
Traction control is active when **Overall Enable** is ENABLED and **vehicleSpeed** exceeds **Minimum Vehicle Speed** and **Mininum Pedal Position** is exceeded.

First **wheelSpin** is calculated as (**drivenSpeed-vehicleSpeed**) / **vehicleSpeed** in %. Its important to make sure the Vehicle Speed and Driven Speed has been setup in **Sensors – Vehicle Speed Setup – Veh / Driven Select.**

The wheel spin target, **tcSpinTarg** is calculated by modifying the base values (**Spin Target** 1/2/3/4) by a calibration switch, lap distance and tune switch settings **(Calibration Switches / Traction Control / Traction Control Spin Target Adder, Calibration Switches / Traction Control / Traction Spin Target Multiplier)** and limiting the result **(Minimum Spin Target, Maximum Spin Target)**.
tcSpinErr is then calculated as **wheelSpin-tcSpin Targ**.
The overall torque reduction demand (**tcTrq**) is then calculated as **tcSpinErr** multiplied by **Base Gain** and **Calibration Swtiches / Traction Control / Traction Control Gain Tuning** and clamped by **Torque Reduction Clamp**.
The **tcTrq** is then linked into the wastegate control strategies and also can be sent very fast on CAN to OEM Controllers to do Torque limiting.

Helpful items to log at a minimum of 100Hz:

If **Overall Enable** is set to other than DISABLED is selected, then ensure that **Vehicle Speed Breakpoints**, **Steering Wheel Angle Breakpoints**, **Lateral G Breakpoints**, and **Yaw Breakpoints** are set accordingly. If the data highlighted in blue has been changed, remember to “program” the calibration into the ECU before moving on.
With Traction Control **ENABLED**, maximum wheel spin can be precisely controlled. There are three strategies to choose from.

Yaw Based Traction

Use when the rotational rate of the car around its centre of mass can be monitored. This is the best control strategy for road racing, as it compensates for rotational instability.

Lateral G Based Traction

Utilizes lateral acceleration sensor to limit the front to rear tire slip as the lateral G increases. It could sometimes be insufficient in Road Race scenario because the lateral G could decrease as tire slip increases and cause the targets to allow additional available torque from the engine thereby increasing slip further and causing the car to become unstable. This strategy is preferred for Drag Racing applications where the car is not pushed to its traction limits laterally.

Table Descriptions:

Minimum Vehicle Speed

The minimum speed for Traction control to be active

Minimum Pedal Positon

The minimum ppsFinal for Traction control to be active (ppsFinal will follow TpsMax if not assigned)

Spin Targets 1,2,3,4 – f(vehicleSpeed, latGAbs)

3D Wheel speed targets with axis based on Traction Control **Overall Enable** strategy and vehicle speed.

Minimum Spin Target

This prevents strategy activation if the slip is lower than the absolute minimum desired. In theory, the drive wheels will always have a slight amount of slip over the Un-Driven wheels. It is up to the user to determine the realistic and allowable minimum amount.

Maximum Spin Target

This is the absolute maximum allowed slip regardless of the calibration and multipliers.

Base Gain – f(vehicleSpeed)

The overall torque reduction demand **tcTrq** is calculated as **tcSpinErr** multiplied by **Base Gain.** This table is used for overall sensitivity by **vehicleSpeed**, when **tcTrq** is active. Higher numbers produce a larger TcTrq value.

Torque Reduction Clamp – f(rpm)

This sets the maximum allowed **tcTrq**.

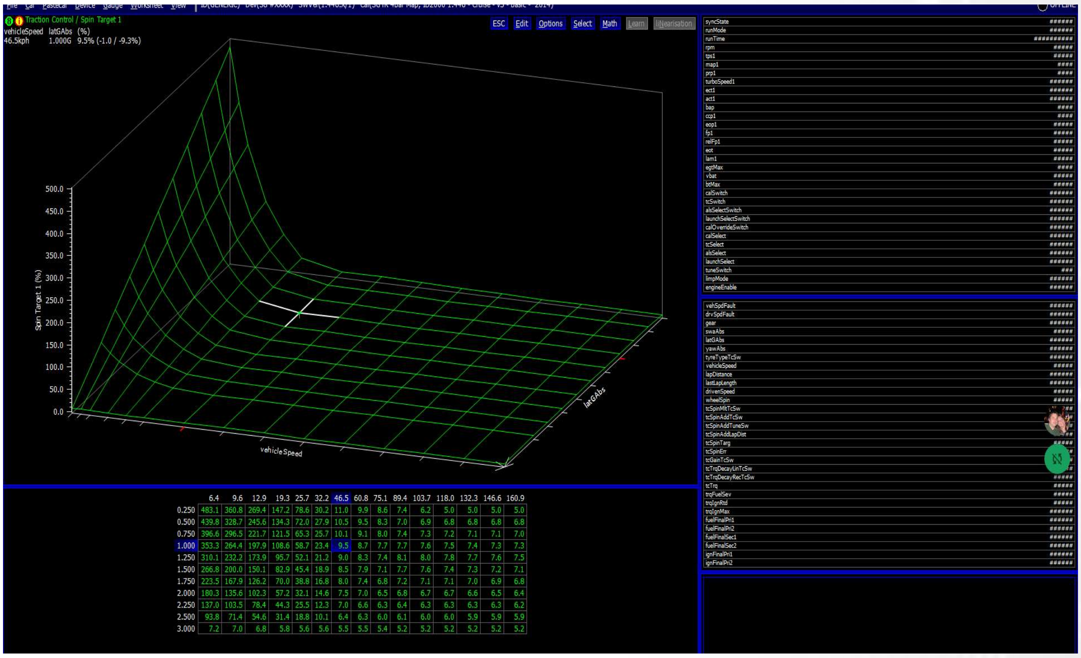
Tuning Tips:

The Traction control area of the Syvecs can be extremely effective when setup correctly, the first thing to remember is that the Target Slip tables are based on a % and the Torque reduction is only applied when the WheelSpin parameter (which is wise to log fast) is greater than the TcSpinTarg. **WheelSpin** is calculated as (**drivenSpeed-vehicleSpeed**) / **vehicleSpeed** in % so its important to remember that at slow speeds the difference in Speed between driven and Vehicle although small has a much larger % value and the slip target table needs to be set a lot higher to ensure the traction control does not apply TcTrq adjustments when difference is small.

Example of above

VSS	*MPH*	4.0	6.0	8.0	12.0	16.0	20.0	25.0	30	40	50
Driven	*MPH*	24	24	24	24	24	24	26	24	40	50
% Difference	*%*	509	306	205	103	52	22	4	0	0	0

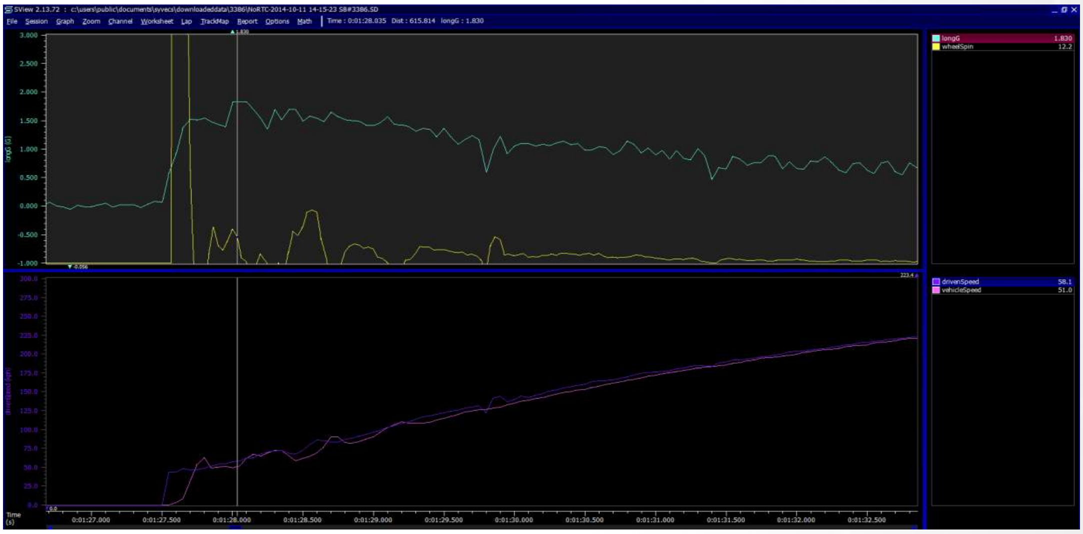
Example Traction slip table



	6.4	9.6	12.9	19.3	25.7	32.2	46.5	60.8	75.1	89.4	103.7	118.0	132.3	146.6	160.9
0.250	483.1	360.8	269.4	147.2	78.6	30.2	11.0	9.9	8.6	7.4	6.2	5.0	5.0	5.0	5.0
0.500	439.8	328.7	245.6	134.3	72.0	27.9	10.5	9.5	8.3	7.0	6.9	6.8	6.8	6.8	6.8
0.750	396.6	296.5	221.7	121.5	65.3	25.7	10.1	9.1	8.0	7.4	7.3	7.2	7.1	7.1	7.0
1.000	353.3	264.4	197.9	108.6	58.7	23.4	9.5	8.7	7.7	7.7	7.6	7.5	7.4	7.3	7.3
1.250	310.1	232.2	173.9	95.7	52.1	21.2	9.0	8.3	7.4	8.1	8.0	7.8	7.7	7.6	7.5
1.500	266.8	200.0	150.1	82.9	45.4	18.9	8.5	7.9	7.1	7.7	7.6	7.4	7.3	7.2	7.1
1.750	223.5	167.9	126.2	70.0	38.8	16.8	8.0	7.4	6.8	7.2	7.1	7.1	7.0	6.9	6.8
2.000	180.3	135.6	102.3	57.2	32.1	14.6	7.5	7.0	6.5	6.8	6.7	6.7	6.6	6.5	6.4
2.250	137.0	103.5	78.4	44.3	25.5	12.3	7.0	6.6	6.3	6.4	6.3	6.3	6.3	6.3	6.2
2.500	93.8	71.4	54.6	31.4	18.8	10.1	6.4	6.3	6.0	6.1	6.0	6.0	5.9	5.9	5.9
3.000	7.2	7.0	6.8	5.8	5.6	5.6	5.5	5.5	5.4	5.2	5.2	5.2	5.2	5.2	5.2

Once Torque is under control you can tweak the gain to adjust the levels of TcTrq calculated based on vehicle speed to make the system more or less sensitive. Generally its set more sensitive at high speeds where lose of traction can carry a lot more energy in the movement of the car.

A valuable parameter when setting up traction control is Longitudinal G which is available from a Syvecs GPS/IMU Module, you can use this to monitor how the vehicle is accelerating to maximise accel. On certain tyres, allowing the tyre to slip 5% gains more accel where friction energy from slip is added to the tyres compound to add adhesion.



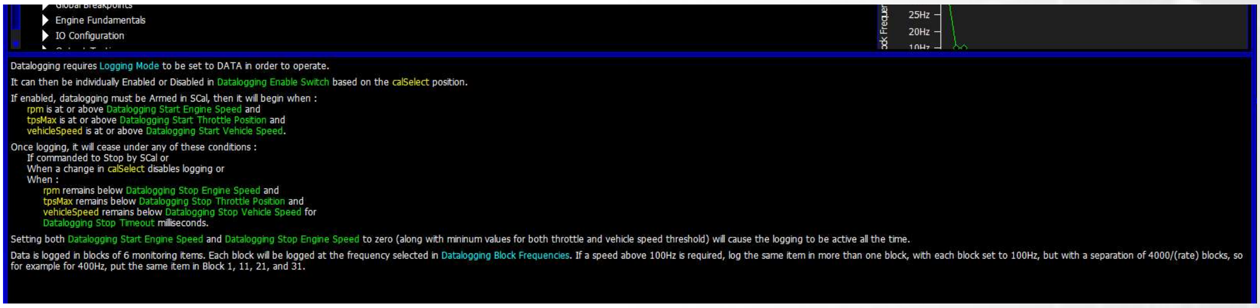
Data-logging

The OEX supports logging direct to a laptop internal memory or to an external memory stick allowing data rates up to 4000 times a second to ensure nothing is missed.

Logging start and stop trigger points can be setup in Scal which both OEX logging systems will follow.

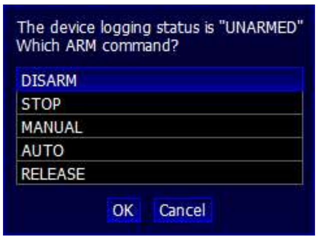
Details on setting up the items that are logged and the frequency they are logged at can be found by pressing F1 in the logging section or following instructions below.

Data is logged in blocks of 6 monitoring items. Each block will be logged at the frequency selected in DataloggingFreq. If a speed above 100Hz is required, log the same item in more than one block, with each block set to 100Hz, but with a separation of 4000/(rate) blocks, so for example for 400Hz, put the same item in Block 1, 11, 21, and 31."}



Overall, Enable or Disable status is found under the calibration switch area and is based on the CalSelect position

If enabled, datalogging must be Armed in Scal via USB-Tools - ARM Logging - AUTO.



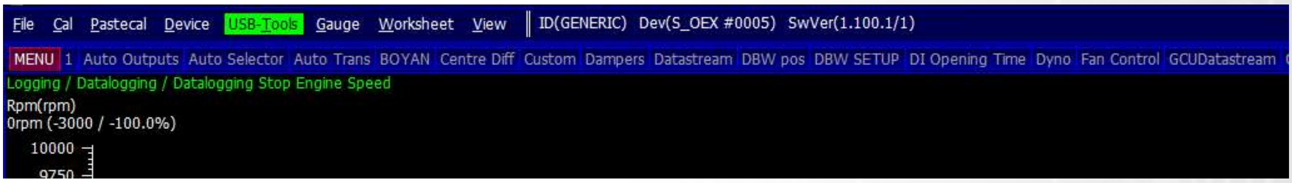
If a Memory Stick is connected then logging will be automatically Armed and arming via SCAL is not necessary

Once Auto is selected the USB-Tools will flash yellow to signal the logging system is ARMED but not logging

Logging will then begin when:

-Rpm is at or above DataloggingRpmStart and
-TpsMax is at or above DataloggingTpsStart and
-VehicleSpeed is at or above DataloggingSpeedStart and
- Datalogging Enable Cal Select (Enable)

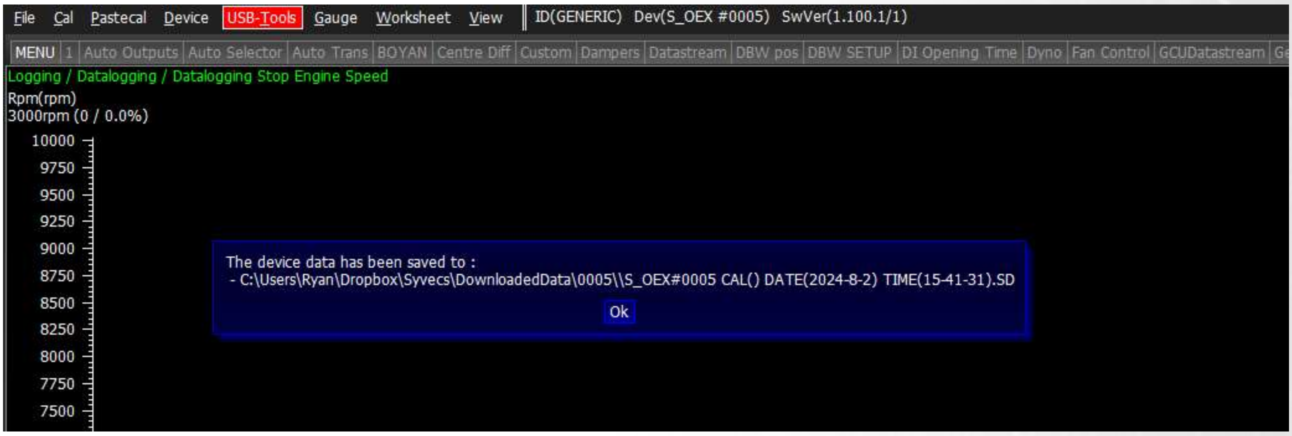
The USB-Tools will turn Green when the logging has started



Once logging, it will cease under any of these conditions :

-Commanded to Stop by SCal - USB Tools - ArmLogging - STOP
-Change in CalSelect datalogging switch disables logging
-Rpm remains below DataloggingRpmStop and
-TpsMax remains below DataloggingTpsStop and
-VehicleSpeed remains below DataloggingSpeedStop for DataloggingTimeOut milliseconds.
-USB Stick removed

When the logging stops it cause USB-Tools to change to RED and will automatically save the file into the working director for the Serial number of the device. As shown below.



Memory Stick Datalogging

The Syvecs OEX allows for external memory stick logging with speeds up to 4000hz per item. In order to achieve this a good quality USB Stick with low latency and fast read/write speeds is required, we suggest the Kingston DataTraveler Max with a Male USBC to Female USB Adaptor.
https://www.kingston.com/unitedkingdom/en/usb-flash-drives/datatraveler-max

The Drive must be programmed in FAT32 format, as standard FAT32 is only supported to 32gb in windows but a program called FAT32 Formatter can do larger. This can be downloaded here
www.syvecs.com/downloads/FAT32_Format.zip

The USB Memory stick can then be plugged into the USB port on the OEX to allow easy logging for end users.

Logging will then begin when:

-Rpm is at or above DataloggingRpmStart and
-TpsMax is at or above DataloggingTpsStart and
-VehicleSpeed is at or above DataloggingSpeedStart and
-Datalogging Enable Cal Select (Enable)

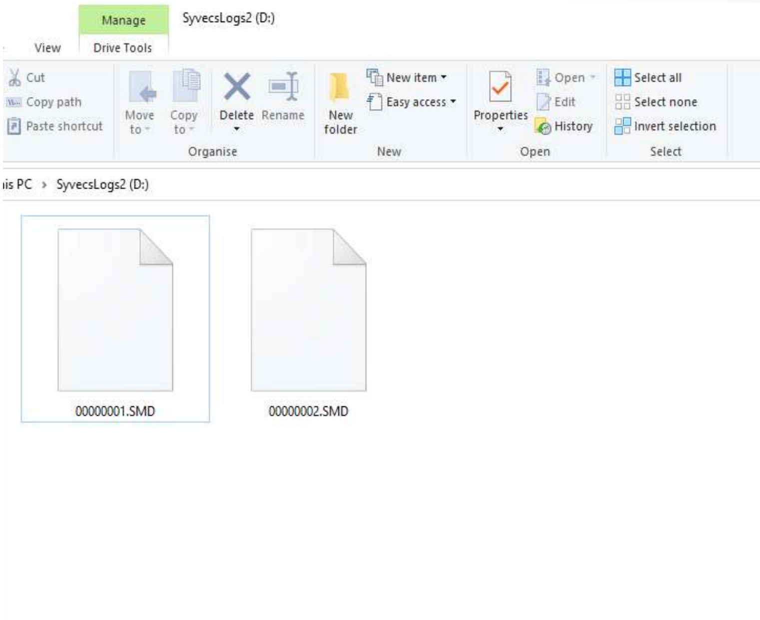
Users are then able to remove the USB Stick when logging has been disabled or the power is turned off to the OEX.

Logging will cease under any of these conditions :

-Change in CalSelect datalogging switch disables logging
-Rpm remains below DataloggingRpmStop and
-TpsMax remains below DataloggingTpsStop and
-VehicleSpeed remains below DataloggingSpeedStop for DataloggingTimeOut milliseconds.
-USB Stick removed

USB Memory Stick .SMD file conversion to .SD

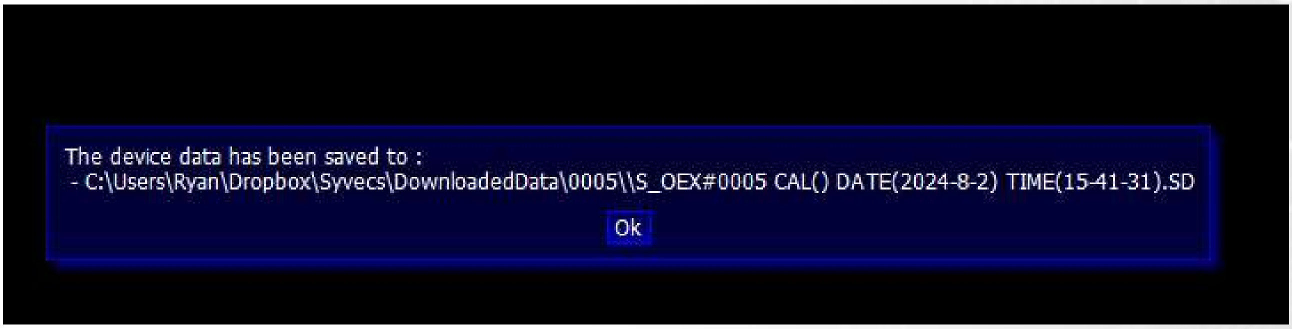
The log files saved on the USB Memory stick will be in .SMD format, these can be zipped up to a much smaller size to transfer to your dealer or support.



To convert the .SMD files to .SD files which are used with Syvecs logging program Sview, users need to open Scal and click USB-Tools – Demux Logging File

Select the USB Drive or location of the .SMD files and click OK

The files will then be converted and saved under the working directory of the OEX Serial number.



Sensor Signal Manipulation/Modifying/Output

A Key feature of the OEX is the ability to manipulate an incoming 0-5v analogue sensor value and pass it back out modified as required.

The process works like this:

1. Connect a signal to be modified to an available AN input (AN01-AN20). **Note:** It is not necessary to assign this input from within **IO Configuration > Pin Assignments** unless you require a pull up for a temperature sensor for example.
2. Connect the output of the signal to a spare DAC channel (pins A21-A24).
3. Select the desired input AN channel (as used in step 1) to **Output Functions > Signal Modifier (1/2/3/4)> Input Select**
4. Assign the above output to a Signal Modifier DAC channel from within **IO Configuration > Pin Assignments** (pins A21-A24).
5. The signal will now be passed through the relevant signal modifier and is configurable from within **Output Functions > Signal Modifier (1-4)**.

Configuration of Signal Modifiers

Each of the four Signal Modifiers has a 3D map with adjustable breakpoints, a second multiplier map based on Cal switch position and finally an output voltage clamp. The load axis on the can be changed from the top menu by using **View > Customising Options.** It is also possible to rename each Signal Modifier from this menu. This will then switch the calibration screen to show all the available customising options available within the calibration. In this case are all shown under **Output Functions** Once you have selected the Axis you want, selecting **View > Customising options** again will take you back to the main map. You will need to save this and **Device > Program** the unit for the changes to take effect

After this configuration is complete, the signal will enter AN01-02 be modified by the signal modifiers and passed back out of the chosen DAC output. Examples of this are OEM MAP sensors where intercepting and clamping this signal will allow you to run more boost with the additional fuelling requirements taken care with by the Fuel control options available within the OEX.

Custom Signal Outputs

In addition to the above. The OEX also allows you to create output voltages based on various conditions. For example: **Output Function > Signal output(1/2/3) > Output value** shows a map that will output a voltage VS RPM/Manifold pressure. Should you want to change the axis of these to another sensor that can be achieved through **View > Customising options** from the top menu. This will then switch the calibration screen to show all the available customising options available within the calibration. In this case are all shown under **Output Functions** Once you have selected the Axis you want, selecting **View > Customising options** again will take you back to the main map. You will need to save this and **Device > Program** the unit for the changes to take effect

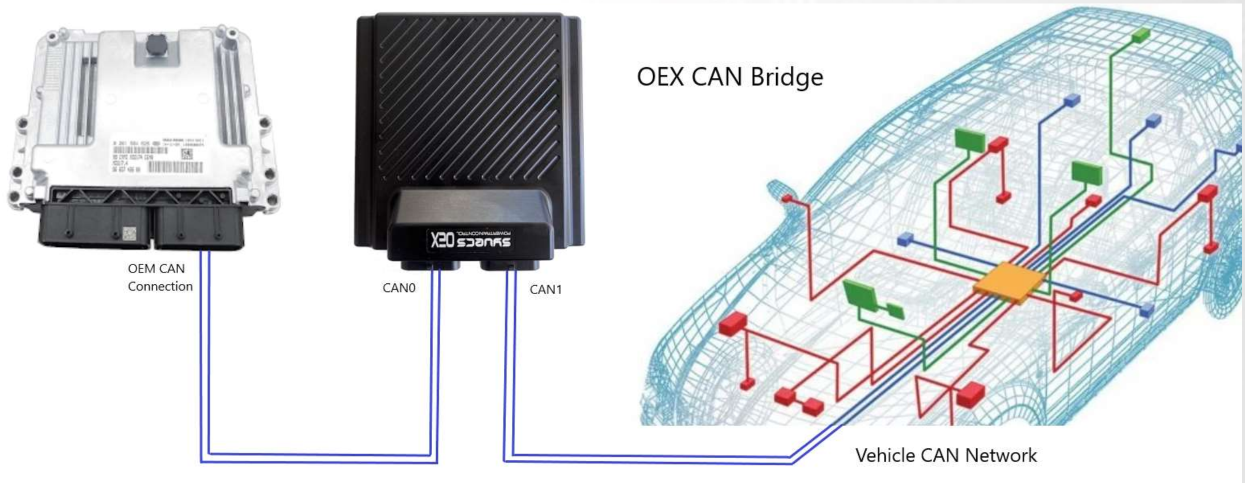
Custom Pulsed Outputs

In exactly the same way above, you can create custom PWM outputs from within **Output Function > Custom PWM Control (1 2)**. Again you are also able to select the Axis that these outputs relate as already described.

CAN bus Manipulation/Modifying

CANbus is a communication bus used in most vehicles today. When adjusting engine control in sync with the OEM Engine Control Units (ECUs), there may be instances where CAN frames need to be modified to achieve tasks like stopping torque limits from external modules, such as a gearbox ECU, or removing a CAN message/byte that is causing a warning light to appear on the dashboard.

The OEX is highly beneficial in these situations, as it allows CAN0 and CAN1 to act as a bridge or gateway with the CAN connection you want to modify. This enables calibrators to adjust the CAN data coming out of the OEM ECU before it is transmitted to the rest of the vehicle.



Calibrators can first select the option to forward the CAN frames in a specific direction. Since a CAN network typically has many TX and RX frames, it is advisable to enable forwarding in both directions: from CAN0 to CAN1 and from CAN1 to CAN0.

When forwarding is enabled, options are available to drop a CAN frame/identifier as well as to make byte adjustments in a specified CAN frame/identifier.

Dropping CAN frame/identifiers

Dropping a CAN frame/ID is done by entering the hex ID value in the "CAN Identifiers to Drop" map. To drop the 0x105 frame, you would enter 105H in the first map cell. Please note that if you want to drop multiple CAN frames/IDs, the values in the map need to increase from left to right, such as 105H, 230H, etc.

Changing a specific byte in a CAN frame/Identifier

It can be very useful to modify a single byte of data in a CAN frame/ID to remove warnings and errors on a dashboard. This is possible with the OEX by first selecting the CAN frames/IDs that the calibrator would like to adjust. A value of 0x1FFFFFFF is void, and hence no adjustment will occur.

The option is available for 8 frames to be adjusted. Enter the hex value for the frame with an "H" at the end. For example, 0x660 would be entered as 660H.

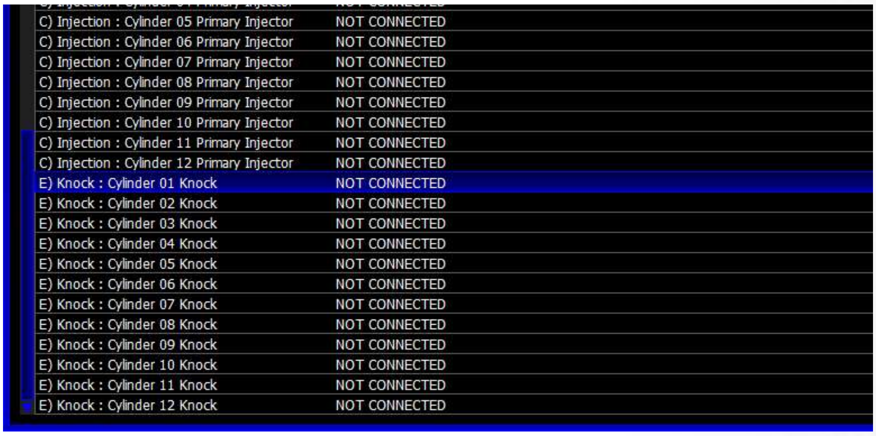
The byte adjustment table allows users to enter a new byte of data into the frame that was set above. Values of 100H mean no adjustment, and the OEX will simply forward the byte being received. If a value less than 100H is entered, it will be transmitted in the modified CAN transmission on the bridged CAN bus.

Knock Control

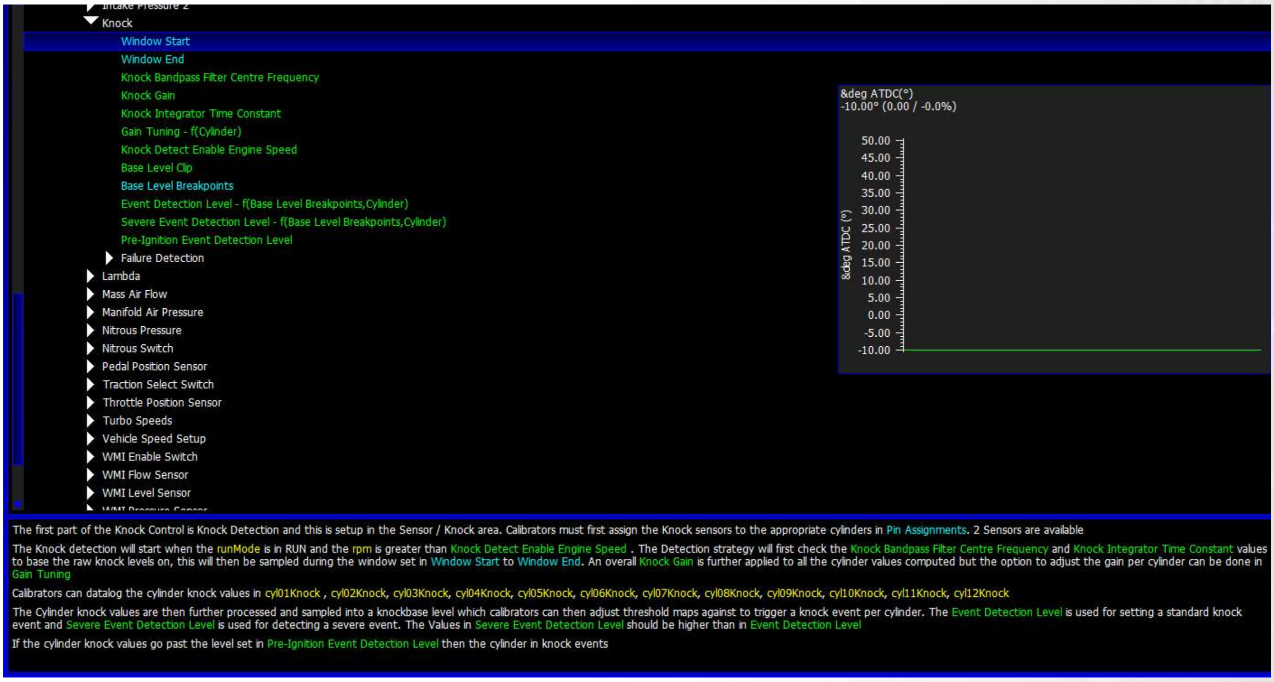
Knock Detection

The OEX has 2 on-board Knock inputs which can be connected into existing knock circuits on OEM ecu applications. This is generally done by a T connection into the Knock signals but you can also fit external knock sensors on the Engine if required and wire direct to the OEX.

The Knock sensors need assigning in the IO Configuration – Pin Assignments, here assign which Knock input is assigned to which cylinders. This is best done based on the bank allocation of your engine in which one sensor is used on each bank.



The Sensors – Knock area is the next section to go over to edit the calibrations that suit your engine and cylinder configuration. Press F1 on each map to see the help comments

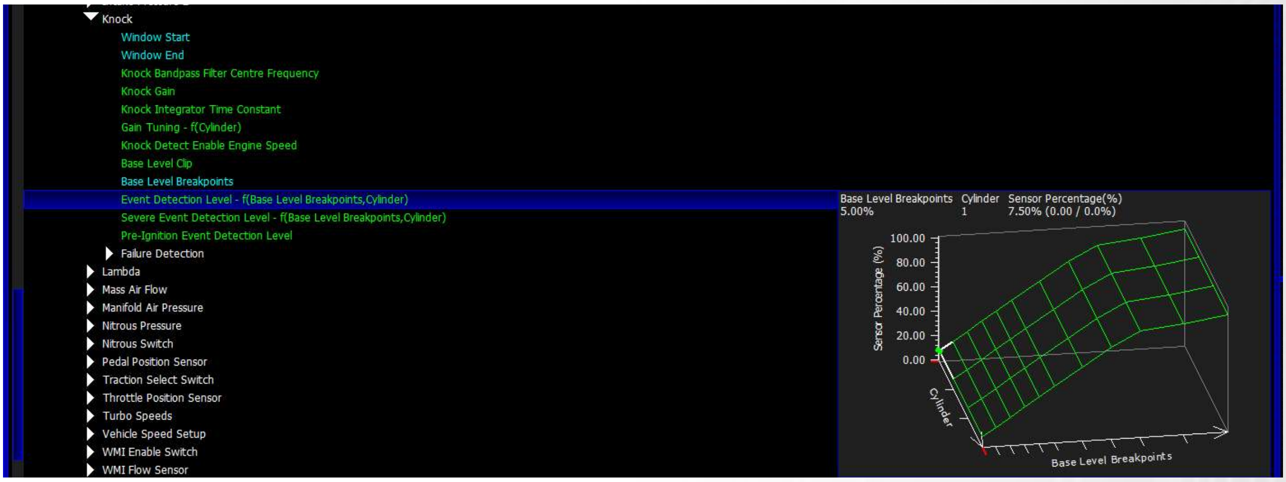


The Knock detection will start when the **RunMode** is in **RUN** and the Rpm is greater than set in ***Knock Detect Enable Engine Speed***. The Detection strategy will first check the ***Knock Bandpass Filter Centre Frequency*** and ***Knock Integrator Time Constant*** values to base the raw knock levels on, this will then be sampled during the window set in Window Start to Window End.

An overall ***Knock Gain*** is further applied to all the cylinder values computed but the option to adjust the gain per cylinder can be done in ***Knock Gain Tuning***.

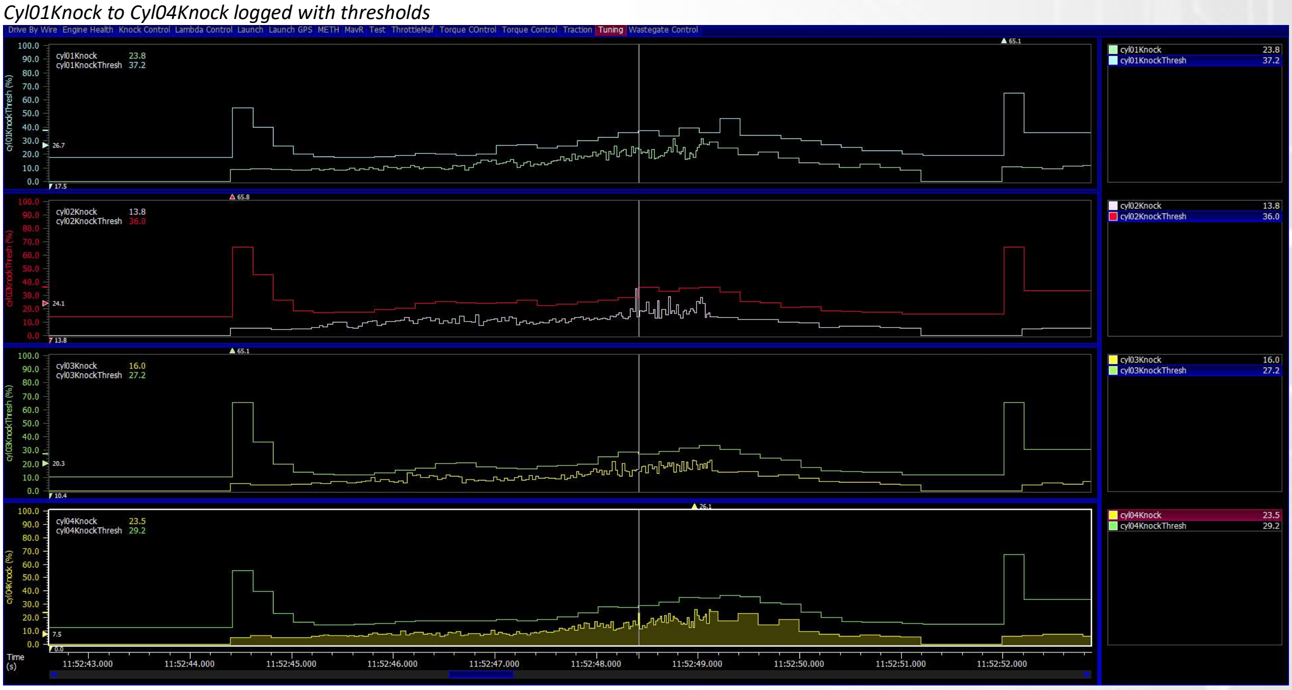
Calibrators can datalog the sampled cylinder knock values in items **Cyl1Knock** to **Cyl12Knock** which aids in spotting visually spike in knock or pre-Ignition.

The Cylinder knock values are then further processed and sampled into a knockbase level which calibrators can then adjust threshold maps against per cylinder to trigger a knock event.



The ***Event Detection Level*** is used for setting a standard knock event and ***Severe Event Detection Level*** is used for detecting a severe event. The Values in ***Severe Event Detection Level*** should be higher than in ***Event Detection Level.***

Cyl01Knock to Cyl04Knock logged with thresholds

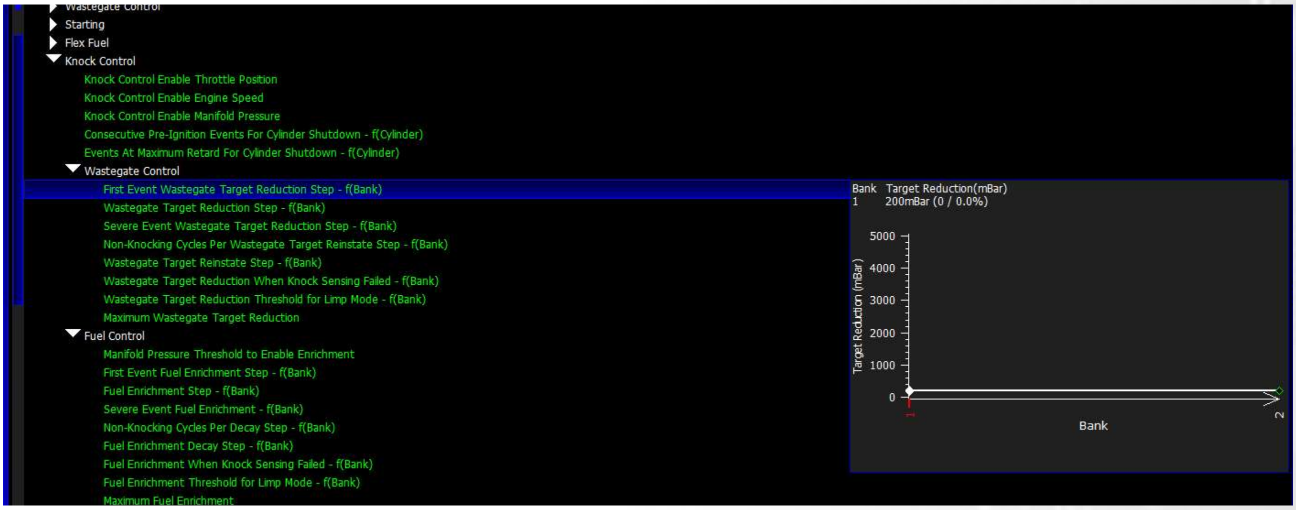


If the cylinder knock values go past the level set in Pre-Ignition Detection Level then the cylinder will be marked in error and a limp activated.

Knock Control

Once a knock event has been detected on a per cylinder basis the control strategies for knock will activate if the enable maps values have all been exceeded for Engine Speed, Throttle Position and Manifold Pressure.

The knock control is split into 2 parts on the OEX, first being wastegate adjustment and second being fuel adjustment.



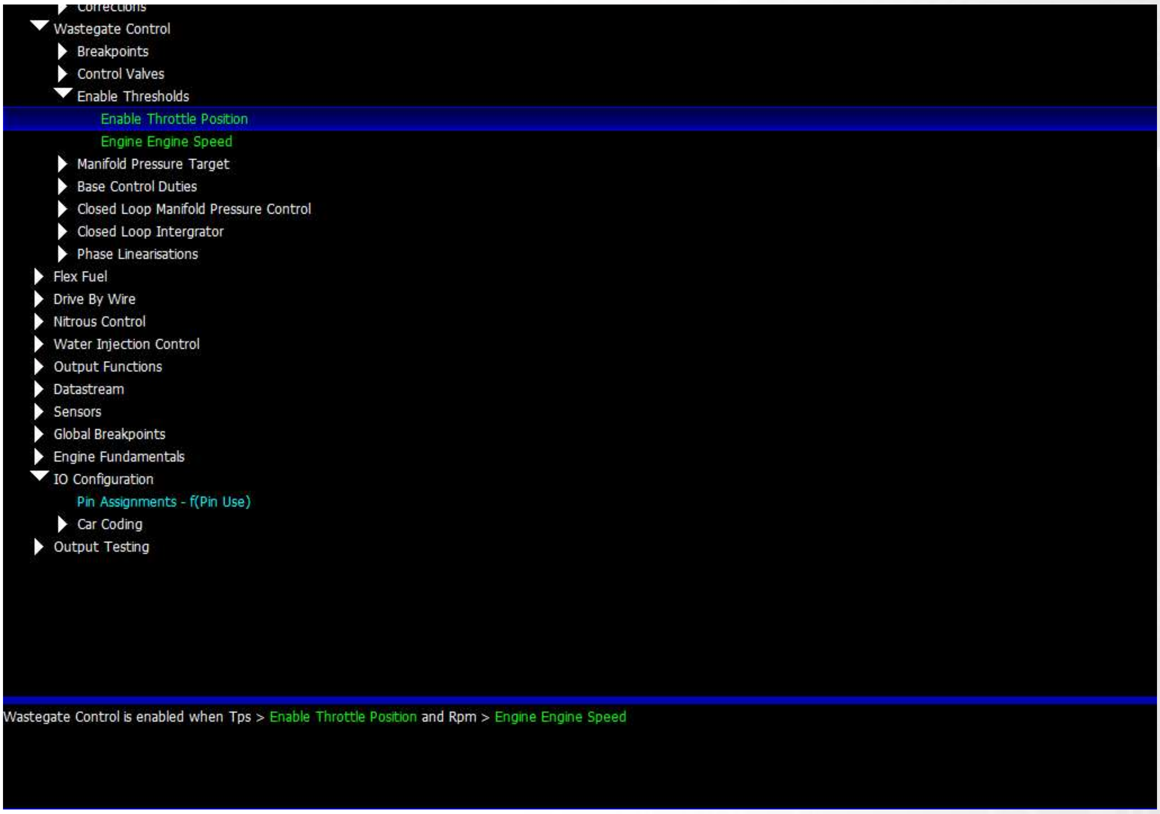
Both of these strategies are based on the following functions:

First Event – When a knock event has been detected and no knock event is currently present, this adjustment is applied.
Step – If Knock control is already active and another event has been detected then this adjustment is applied and so forth on any additional events.
Severe Event - When a severe knock event has been detected and no knock event is currently present, this adjustment is applied.
Non-Knocking Cycles – After a knock event is seen it will be removed from the current knock event list when the number of engine cycles set has been exceeded.
Reinstate step – Used when no knock events are seen, it will remove the adjustment applied based on the step amount set.

On both strategies a **Maximum Target Reduction** and **Maximum Fuel Enrichment** can be set, its important that these are set above the **Limp Mode Thresholds** so a Limp can be set when too much wastegate or fuel adjustment is applied to warn the OEM ecu and the driver via LimpMode settings.

Strategy Help

All the strategies/maps on the OEX controller have help text available for them shown on the bottom of the screen in Scal. This is shown by pressing F1 on the keyboard when in Scal when a calibration is open.



Predefined CAN Streams

The following OEM CAN streams are predefined but if not listed then dealers can use the GenericRX CAN to custom define any CAN Stream or use the OBD2 protocol available in all cars. See next section.
Check the Syvecs Forum for OEX firmware updates as more supported vehicles will be added weekly

	RPM	MAP	TPS	PPS	Mode)(Driven/Sport	Torque Actual	Torque Demand	ACT	ECT	EOT	Gear	Brake P	Speed	LatG	LongG
Audi Mk2 TTRS / RS3	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Audi Mk3 TTRS / RS3 / S3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Audi R8 Gen1	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Audi R8 Gen2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BMW E46	✓		✓	✓		✓	✓		✓	✓		✓	✓		
BMW E92	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		
Canam 2010+	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		
Canam 2022+	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		
Corvette Z06	✓		✓	✓		✓	✓		✓			✓	✓		
Evo X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
ECUMASTER	✓	✓	✓	✓				✓							
Ford Focus Mk2	✓		✓	✓	✓	✓	✓	✓	✓		✓		✓		
Ford Mustang	✓		✓	✓	✓	✓	✓	✓			✓		✓		
Honda FD2/FN2	✓	✓	✓	✓		✓	✓		✓			✓	✓		
Honda FK2/FK8	✓		✓	✓		✓	✓		✓	✓		✓	✓	✓	✓
Infiniti Q60	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Jeep 2022	✓		✓	✓	✓	✓	✓				✓	✓	✓		
Lamborghini LP520	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Lamborghini LP560	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Lamborghini Huracan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lamborghini Aventador	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LandRover Defender 90 110	✓		✓	✓		✓	✓		✓				✓		
LINKECU	✓	✓	✓	✓				✓	✓	✓			✓		
Mclaren 12c,650,675,570,600, 720,765,P1	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		
Mercedes Gen1 E55 C63	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓		
Mercedes Gen2 C63 SLS	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
Mitsubishi Evo X	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
MoTeC M1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
Nissan 370Z	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Nissan Patrol Y61	✓		✓	✓		✓	✓		✓		✓	✓	✓	✓	✓
Nissan Patrol Y62	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Nissan R35GTR	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Porsche 991 / 981 / GTS / GT2RS / GT3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Porsche 996	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Porsche 997/987	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Simos 18	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subura Impreza My15+	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓		
Suzuki 2013+	✓	✓	✓	✓		✓	✓		✓			✓	✓		
Syvecs Ecu’s	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Toyota Yaris Gr	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
Toyota LandCruiser/Lexus LX570	✓	✓	✓	✓		✓	✓	✓	✓			✓	✓		
Toyota GT86 /BRZ	✓			✓		✓	✓		✓	✓		✓	✓		
VAG Me7	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
VAG Me9	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
VAG MED17	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VW Golf Mk5/6 Seat TFSI/TSI, Audi TSI/TFSI	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
VW Golf Mk7 MQB Seat MQB Audi MQB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Yamaha YXZ	✓		✓	✓		✓	✓		✓		✓		✓		

The following After-market ECU CAN streams are supported, but check the Syvecs Forum for OEX firmware updates as more Ecus will be added.

	RPM	MAP	TPS	PPS	Mode)(Driven/Sport	Torque Actual	Torque Demand	ACT	ECT	EOT	Gear	Brake P	Speed	LatG	LongG
ECUMASTER	✓	✓	✓	✓				✓							
LINKECU	✓	✓	✓	✓				✓	✓	✓			✓		
MoTeC M1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
Syvecs Ecu’s	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

OBD2 - OEM CAN Supported

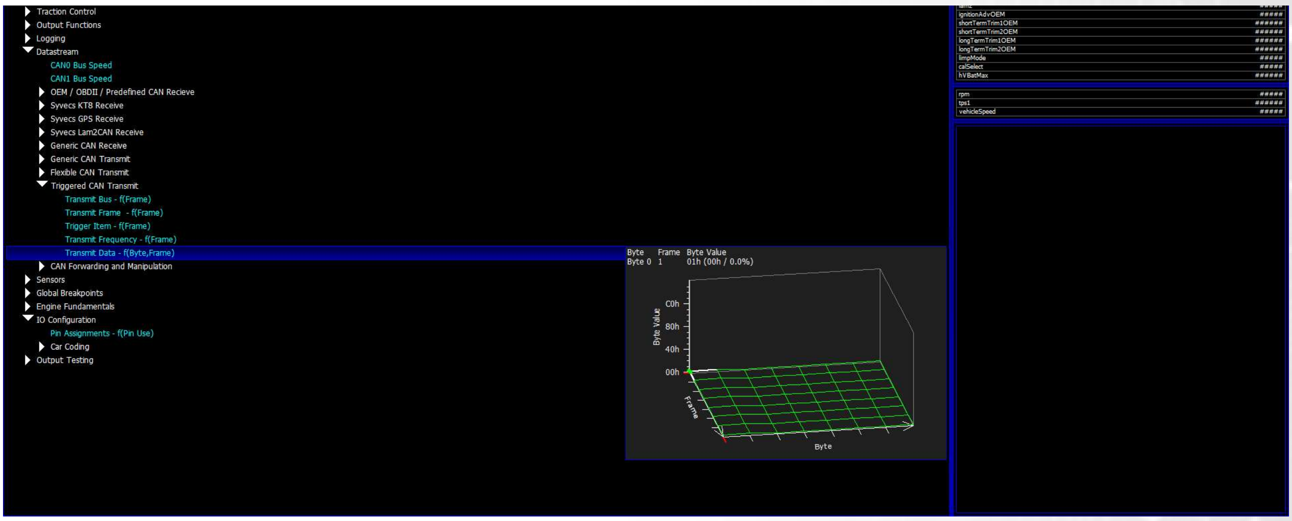
The Syvecs OEX has full OBD2 CAN support which means it can communicate with all OEM Ecus that support CANbus. However different data/PIDs are available between cars models so not all the OBD2 pin assignments show in the ***OBDII Setup*** section of this manual will be supported.

The OEX will prompt you after device programming if the PID is not supported.

The following data/PIDs are supported in the OEX and more can be added upon request.

OBDII:ACT
OBDII:ACT2
OBDII:ACT3
OBDII:ECT
OBDII:ECT2
OBDII:EOT
OBDII:FP
OBDII:IgnitionAdv
OBDII:Lambda
OBDII:Lambda2
OBDII:Load
OBDII:LongTermFuel1
OBDII:LongTermFuel2
OBDII:MAF
OBDII:MAP
OBDII:MAP2
OBDII:RPM
OBDII:ShortTermFuel1
OBDII:ShortTermFuel2
OBDII:Speed
OBDII:Torque
OBDII:TPS

Calibrators can also use the triggered CAN section of the OEX to send OBD2 0x7DF frames to clear DTC's and also enable custom features of the car like Dyno mode. As default the values are setup to clear DTC's



Ecutek RaceRom CAN Communication

The Syvecs OEX have a unique CAN link with the Ecutek Racerom to allow multiple functions paired with the OEM engine ecu's that have the Ecutek RaceRom Patch installed.

Calibrators have the ability to pickup the below from the Original ECU:

Received from Ecutek RaceRom

FuelFinalExtTarg – Fuel Injection time target for controlling sequential external injectors
fuelAngleTargExt – Fuel Injection Angle Target for controlling the start or end angle injections
wgMapTargetExt – Wastegate/Boost manifold pressure target for controlling multiple wastegates
wgFinalDutyExt – Wastegate/Boost duty target for controlling multiple wastegates
wmiSwitch – Activation signal for Water/Methanol injection system
wmiDuty – Target Water/Methanol solenoid duty
n20Switch – Activation signal for Nitrous injection system
n20Duty - Target Nitrous solenoid duty
aux1 – Auxilary output for custom functions via CM Maps in OEX
aux2 - Auxilary output for custom functions via CM Maps in OEX

Transmitted to Ecutek RaceRom

FinalFinal1 – Fuel Final injection Time
fuelAngle1 – Fuel Injection Angle
wgFinalDuty1 – Wastegate Duty
tcTrq – Torque Reduction from Traction Control
fp1 – Fuel Pressure
fuelComp – Ethanol Content %
ecp1 – Engine Coolant Pressure
calSelect – Map Selection
aux1 – Custom Input
limpMode – Limp States and OEX States

Activating this communication is done via DataStreams – OEM/OBDII/Predefined CAN Receive – ECUtek