Syvecs LTD

V1.1

X10 Gen2

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 X10 expander is a very powerful device for controlling additional I/O (Inputs and Outputs) in an automotive electrical installation. With the use of two CAN controllers, the X10 communicates with master devices to behave as a slave for it, offering the entire I/O compliment to its master device. All our ECU's (engine control units) will communicate with the X10 with just the use of 2 wires and we have also incorporated logic to allow other manufactures to be able to work with the X10 as well.

4 of the outputs on the X10 are designed to be driven to a high load or low load, making them extremely flexible in what they can offer. These h-bridge outputs can be paired to control external DC motors which are used in drive by wire applications or many other automotive applications.

6 low-side outputs which drive the outputs to ground are also useful for driving solenoids, relays and external devices. These outputs also have the ability to have internal pull-up and fly-back diodes set.

4 DAC (digital-to-analog) outputs are also present on the that convert a binary input number into an analog voltage output. These outputs are useful for sending out a voltage to external device to mirror a sensor signal for example.

While the X10 has 10 inputs not all of them share the same capabilities. 6 of the inputs (AS Inputs) are fully flexible and support frequency detection, SENT decoding, Thermistor (internal 3k pull up) and bipolar operation which means the voltage is monitored above and below the reference ground for use with VR Sensors. The remaining 4 inputs are standard 0-5v ADC inputs.

To finish off the serious I/O compliment that the X10 offers, are 2 x NTK Lambda sensor circuits which allow a sensor to be connected directly and output the oxygen ratio via CAN to the master device.

Specification

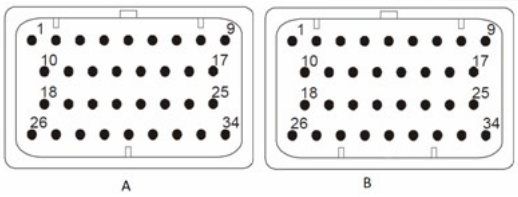
Outputs
4 Half Bridge Outputs (Support: Full Bridges, Lowside or HighSide Drive)
(15Amp Peak (100ms) 8Amp Continuous)
6 Low Side Outputs
(12Amp Peak (100ms) 6Amp Continuous)
4 DAC Outputs (-5v to 5v)

Inputs
6 Flexible Inputs supporting frequency, Sent, thermistor, bipolar
4 ADC Voltage inputs
2 NTK Lambda Inputs

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

Power Supply
6 to 26V input voltage range
Ignition Switch Logic with high current supply

Physical
Waterproof Sealed
Automotive Spec -40c to 125c
2 x 34 way Superseal 1.0 connectors
150mm x 150m



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

Syvecs Abbreviations	Pinout	Scal Assignment	Description
HBR1	A1	Slave*Out1	H-Bridge Output - Can be driven High or Low
PWR ON	A2		Ignition 12V Signal - Used only for Board Wake up
AS1	A3	Slave* AN1	Flexible Input - 3k Pull Up Available in Software
AS3	A4	Slave* AN3	Flexible Input - 3k Pull Up Available in Software
AS5	A5	Slave* AN5	Flexible Input - 3k Pull Up Available in Software
AS7	A6	Slave* AN7	0-5V Input Only
AV9	A7	Slave* AN9	0-5V Input Only
VBAT1	A8	Vbat	12V Supply - High Current (Required)
VBAT1	A9	Vbat	12V Supply - High Current (Required)
HBR2	A10	Slave*Out2	H-Bridge Output - Can be driven High or Low
KLINE	A11		Kline or LinBus
AS2	A12	Slave* AN2	Flexible Input - 3k Pull Up Available in Software
AS4	A13	Slave* AN4	Flexible Input - 3k Pull Up Available in Software
AS6	A14	Slave* AN6	Flexible Input - 3k Pull Up Available in Software
AV8	A15	Slave* AN8	0-5V Input Only
AV10	A16	Slave* AN10	0-5V Input Only
5V	A17		5v Output for Sensors
HBR3	A18	Slave*Out3	H-Bridge Output - Can be driven High or Low
CAN0L	A19		Can 0 Low
CAN0H	A20		Can 0 High
NTK1 ION	A21		NTK1 Ion Pump (White Wire)
NTK2 ION	A22		NTK2 Ion Pump (White Wire)
DAC3	A23	Slave*Out23	Digital Output - Can output -5v to +5v volts
DAC4	A24	Slave*Out24	Digital Output - Can output -5v to +5v volts
ANGND1 / LAM GROUNDS	A25		Sensor Ground Connection / NTK Ground (Black Wire)
HBR4	A26	Slave*Out4	H-Bridge Output - Can be driven High or Low
LSO1	A27	Slave*Out5	Low Side Output
LSO2	A28	Slave*Out6	Low Side Output
LSO3	A29	Slave*Out7	Low Side Output
LSO4	A30	Slave*Out8	Low Side Output
LSO5	A31	Slave*Out9	Low Side Output
LSO6	A32	Slave*Out10	Low Side Output
PWRGND	A33		Ground Connection - High Current (Required)
PWRGND	A34		Ground Connection - High Current (Required)

B	DESCRIPTION		CONNECTOR B
	PART NUMBER		4-1437290-1
	NOTES:		34 Way - Key2
VBAT2	B1	Vbat	12V Supply - High Current (Required)
VBAT2	B2	Vbat	12V Supply - High Current (Required)
N/C	B3	N/C	
N/C	B4	N/C	
N/C	B5	N/C	
N/C	B6	N/C	
N/C	B7	N/C	
N/C	B8	N/C	
N/C	B9	N/C	
5V	B10	5VOut	5v Output for Sensors
N/C	B11	N/C	
N/C	B12	N/C	
N/C	B13	N/C	
N/C	B14	N/C	
N/C	B15	N/C	
N/C	B16	N/C	
N/C	B17	N/C	
ANGND2 / LAM GROUNDS	B18		Sensor Ground Connection / NTK Ground (Black Wire)
NTK NRNST 1 / CAN3L	B19		NTK1 NRST Voltage (Grey Wire) / Can 3 Low
NTK NRNST 2 / CAN3H	B20		NTK2 NRST Voltage (Grey Wire) / Can 3 High
CAN1L	B21		Can 1 Low
CAN1H	B22		Can 1 High
N/C	B23	N/C	
N/C	B24	N/C	
N/C	B25	N/C	
PWRGND	B26		Ground Connection - High Current (Required)
PWRGND	B27		Ground Connection - High Current (Required)
N/C	B28	N/C	
N/C	B29	N/C	
N/C	B30	N/C	
N/C	B31	N/C	
N/C	B32	N/C	
N/C	B33	N/C	
N/C	B34	N/C	

General Connections

Connecting Power/Ground

The X10 has **3** power connection points, **two** of these are high current and can be connected to a fused battery power or switched power source. **One** of them is Logic Switch / Ignition Switch power and used to switch the power gate so that current is able to flow from the 2 x High current 12v pins into the Device.

If driving motors or solenoids which pull a lot of current then ensure the correct amount of pins are connected. Each pin on the X10 is able to sink around 14 amps of current, so if driving multiple solenoids that pull 20+ amps total, ensure at **least** two high current 12v pins and two power ground pins are used.

Internally **A8/A9** are linked. 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**) is for a 12v low current ignition switch supply to enable the power gate on the X10 internally, this is required on all installations.

Power Grounds are joined internally and the X10 must have at least A33 connected. If driving lots of Low Side outputs then connect A34 also to handle the current loading.

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

Example Schematic

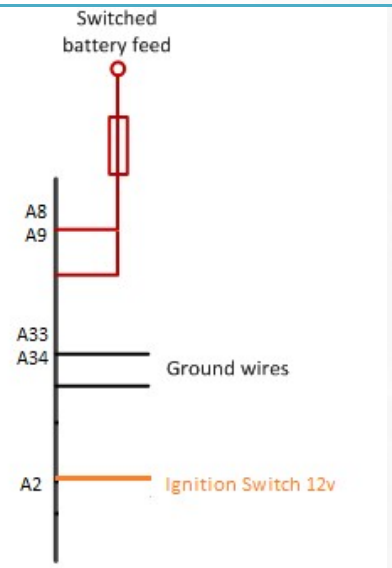


Figure 0-1 - Power Feeds and a Common grounding point.

Pin Schedule

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

Output Connections

Low Side Outputs

The low side outputs are only able to be driven to ground but offer full pulse width modulation control. The outputs can be used to drive up to 12A Peak / 6A Continuous and can only pull to ground.

Pin Schedule

Pin Number	Function	Scal Assignment
A27	LSO1	Assigned to Slave*Out5
A28	LSO2	Assigned to Slave*Out6
A29	LSO3	Assigned to Slave*Out7
A30	LSO4	Assigned to Slave*Out8
A31	LSO5	Assigned to Slave*Out9
A32	LSO6	Assigned to Slave*Out10

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

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

Pin Schedule

Pin Number	Function	Scal Assignment
A1	H-Bridge1	Assigned to Slave*Out1
A10	H-Bridge2	Assigned to Slave*Out2
A18	H-Bridge3	Assigned to Slave*Out3
A26	H-Bridge4	Assigned to Slave*Out4

DAC Outputs

A digital-to-analog output (DAC) is a circuit that converts a binary input number into an analog output. These outputs are useful for sending out a voltage to external device to mirror a sensor signal for example.

The outputs can be driven from -5v to +5v and not designed to handle much loading. Maximum 500ma

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

Controlling the outputs is done in Scal – Via a Custom table like Basic Pwm 1. Calibrators should assign the strategy to the correct Slave*Out listed below and then set the frequency for the strategy at 244hz.

0% Duty = -5v

50% Duty = 0v

100% Duty = 5v

Pin Schedule

Pin Number	Function	Scal Assignment
A21	DAC1/NTK1I	Setup for Ion Pump on Expanders as Default
A22	DAC2/NTK1I	Setup for Ion Pump on Expanders as Default
A23	DAC3	Slave*Out23
A24	DAC4	Slave*Out24

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 shown in the first section. As there are 2 sensor ground pins you may have to connect multiple grounds to some of the pins if you have more than two sensors.

Pin Schedule

Pin Number	Function	Notes
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.

Pin Schedule

Pin Number	Function	Notes
A17	5VOUT1	
B10	5VOUT2	

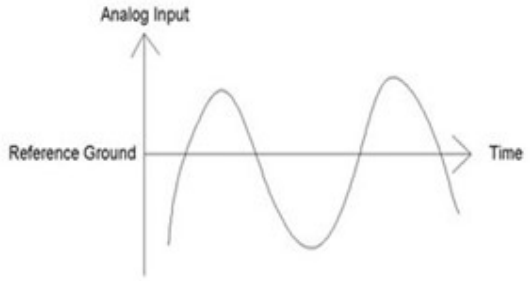
Input Connections

Input Types

The Syvecs X10 has 10 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 be assigned to different types….. Listed below are the 2 types which are available.

Flexible Input – AS Inputs

These Inputs are able to swing above and below the reference ground meaning they can see Positive Voltage as well as Negative. Fully Adjusted trigger thresholds for frequency decoding is supported on these pins and they can be used with a vast selection of other sensors from Digital, 0-5v, SENT, Thermistor and MagnetoResistive



Example of sensors normally used on these Inputs are:

- Reluctor Crank and Cam Sensors / ABS Sensors for 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

Pin Number	Input	Scal Assignment
A3	AS1	Slave*An01
A12	AS2	Slave*An02
A4	AS3	Slave*An03
A13	AS4	Slave*An04
A5	AS5	Slave*An05
A14	AS6	Slave*An06

Voltage Inputs - AV Inputs

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

Example of sensors which normally use on these Inputs are:

- Manifold Pressure sensors
- Throttle Positions
- Oil Pressures

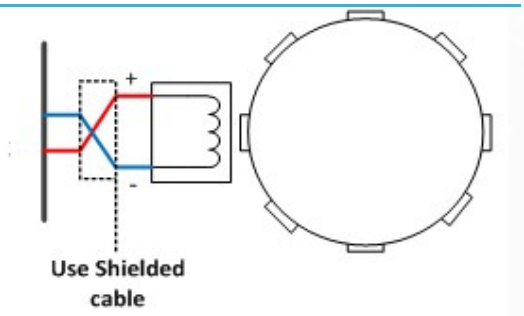
Voltage Inputs are not just limited to the above they can also be used for any sensor which outputs a 0-5volt signal. They Do NOT have an internal 3k software configurable pull up like the AS Inputs for thermistor sensors. This needs to be set externally in the loom.

Pin Number	Input	Scal Assignment
A6	AV7	Slave*An7
A15	AV8	Slave*An8
A7	AV9	Slave*An9
A16	AV10	Slave*An10

Sensor Schematics - Examples

Speed Sensor – Magnetic Type

Example Schematic

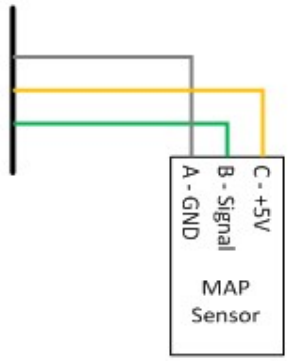


Pin Schedule

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

Manifold Pressure Sensor (MAP)

Example Schematic



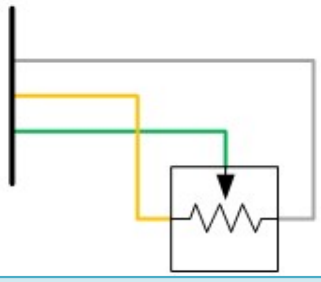
Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A17	5VOUT1	Regulated sensor power supply
AV10	AV10 Input	Any Input can be used

SENT Sensor

The X10 has the ability to work with 12 SENT protocol sensors on AS1-12. Calibrators need to connect to the X10 via USB with Scal and change the Input selection for the desired AS input to SENT (See page 17) .The SENT Protocol decoded output will then populate the slave data into the ECU on the AN input selected

Example Schematic

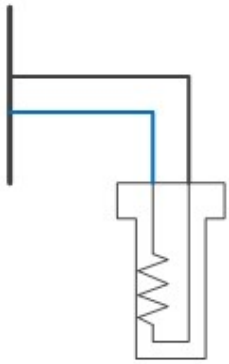


Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A17	5VOUT1	Regulated sensor power supply
A3	AS1 Input	Need to use AS1-6 and AS11-16

Coolant Temperature Sensor (CTS)

Example Schematic

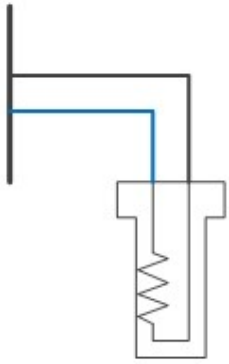


Pin Schedule

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

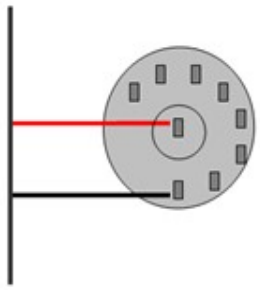


Pin Schedule

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

Calibration Switches

Example Schematic



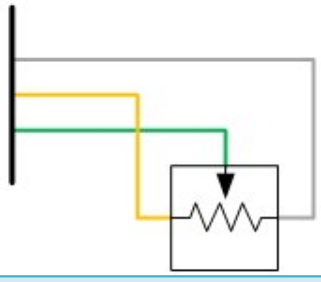
Pin Schedule

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

Digital Oil Level Sensors

Need to connect to the X10 via USB with Scal and Change the Input Selection for the desired AS input to Pulse Oil Level. The output will then populate the slave data into the ECU

Example Schematic



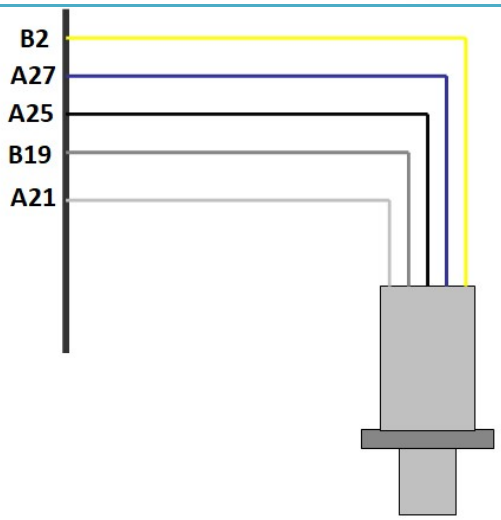
Pin Schedule

Pin Number	Function	Notes
A25	ANGND1	May be shared with multiple sensors
A17	5VOUT1	Regulated sensor power supply
A3	AS1 Input	Need to use AS1-6 and AS11-16

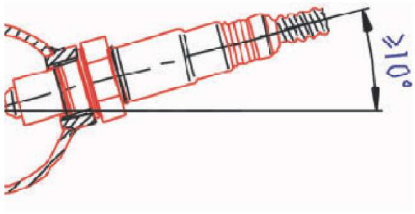
Wideband Lambda Sensors

The Syvecs X10 has the ability to drive two NTK L1H1/L2H2 Wideband Lambda sensors without the use of external hardware. Please see wiring and fitting information below

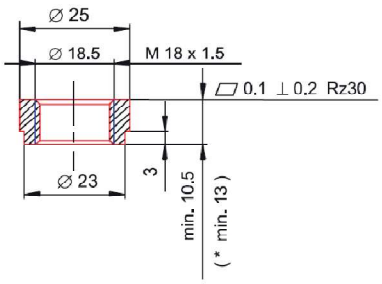
Example Schematic



Mounting recommendation



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



NTK L2H2

Lambda Sensor assignments in Scal needs to be set to Slave* AN21 for Lambda 1 and Slave* AN22 for Lambda 2.

When an X10 is connected to an S7, users can change the Lambda type via Sensors – Lambda – Sensor Type. This needs to be set to NTK.

With the S6, S8, S12 or other brands of ECU, the lambda configuration map is not present and as default the X10 will run as NTK Mode.

Lambda Heater Function In Scal can be assigned to any Output on the X10

Lamda1

Lambda Pin Number	Colour	Name	X10 Pin
1	Yellow	Heater	12v
2	Blue	Heater Drive	Any LSO or HBR Output
6	Grey	Nernst Cell Voltage	B19
7	White	Ion Pump Current	A21
8	Black	Signal Ground	A25 or B18

Lambda2

Lambda Pin Number	Colour	Name	X10 Pin
1	Yellow	Heater	12v
2	Blue	Heater Drive	Any LSO or HBR Output
6	Grey	Nernst Cell Voltage	B20
7	White	Ion Pump Current	A22
8	Black	Signal Ground	A25 or B18

CAN Bus

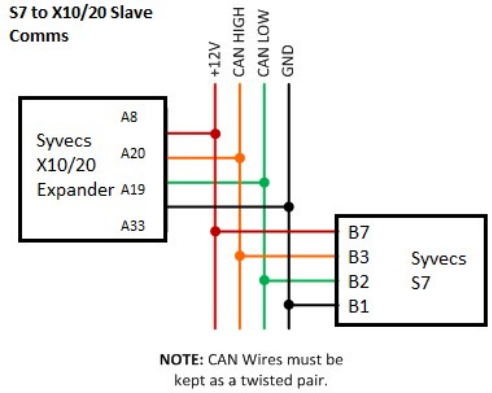
Common **A**rea **N**etwork Bus (CAN Bus) is a widely used data interface common used in many cars and aftermarket accessories (such as Data loggers and Dashes). Data is sent using the High and Low wires, which are maintained as a twisted pair.

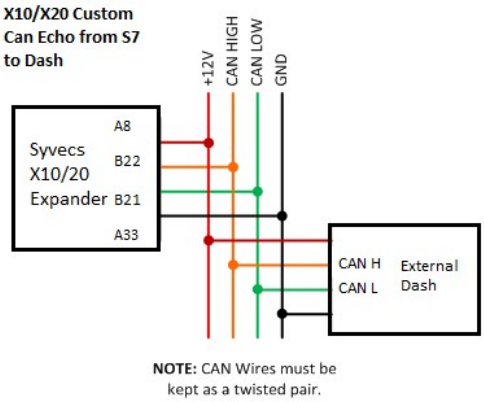
The X10 as default has 2 x CAN bus interfaces:

CAN0 is used for expander communications with the Syvecs Engine ECU. (120ohm Termination Resistor)

CAN1 is available for generic use but can be used also for bridging the custom can data from CAN0 to external dashboards. This is enabled as default for Syvecs expanders, where the custom can data from the Syvecs Engine Ecu will be passed through the expander CAN0 to CAN1. (120ohm Termination Resistor)

Example Schematics





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.

PC Connection - SCAL

The X10 has a calibration stored onboard to maintain settings of the X10 hardware. In order for the X10 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 X10.

A USB-C port is found at the back of the X10 which is IP67 sealed. Use a USB-C to USB-A male/male cable to connect the X10 to the computer. The S-Suite software can be downloaded from below.

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

After running the SSuite installer, open the program called SCal and click **D**evice - **C**onnect

A X10 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 X10 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 Blue Maps – Require programming to set

Output Testing

The X10 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.*

Green Maps – Live Adjustable

Blue Maps – Require programming to set

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 X10.

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.