Mini-Expansion Unit (MEU)
User Guide V1.2



Disclaimer

Although every care is taken with the design of this product, JT Innovations Ltd. can in no way be held responsible for any consequential damage resulting from the use of this product in your vehicle.
After market ECU systems and this Expansion Unit are design for off-road use.

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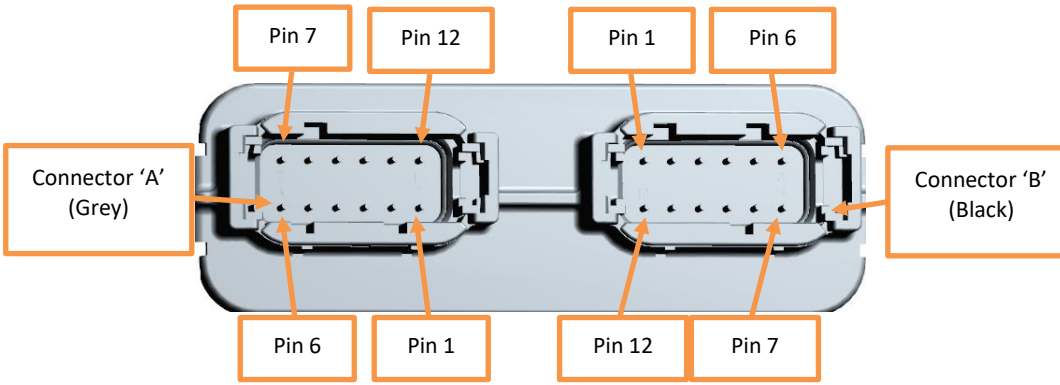
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Connector Pinout



Pin	Connector 'A' (Left, Grey)	Connector 'B' (Right, Black)
1	Lambda Virtual Ground (VM)	Sensor/Analogue Ground
2	Lambda Pump Current In (IA)	Sensor/Analogue +5V
3	Lambda Heater Drive (H-)	Input 1
4	CAN LO (internal 120Ω termination)	Input 2
5	CAN HI	Input 3
6	+12V in (internal 8A fuse)	Input 4
7	Ground	Thermocouple K+
8	H-bridge Out+ (or Half-bridge Out 2)	Thermocouple K-
9	H-bridge Out- (or Half-bridge Out 1)	Reserved (USB 0V)
10	Lambda Heater (H+) +12V	Reserved (USB +5V)
11	Lambda Pump Current Out (IP)	Reserved (USB DDP)
12	Lambda Reference (UN)	Reserved (USB DDM)

Data Connection - CANbus

The MEU connects to the Syvecs ECU via CANbus. Both the Syvecs and the MEU have built-in 120Ω termination resistors.

- Twisted-pair cable must be used for the CANbus connection.
- The "Slave-link" CANbus implementation on the Syvecs does **NOT** allow other CAN devices to be connected to the link – it is a point-to-point dedicated link used exclusively for Slave-unit communications.

Connection to a Syvecs S8 or Life Racing F88 ECU

Note that the CANbus should be connected to CAN2 on these ECUS, leaving CAN1 for connection to other CAN devices such as a Toucan or Dash product.

Bosch Lambda Sensor Connections

Connector 'A' Pin	LSU 4.9 Pin	LSU 4.2 Pin	Wire Colour	Function
1	2	5	Yellow	Virtual Ground
2	5	2	Green or Pink	Calibration resistor
3	3	4	White	Heater Drive
10	4	3	Grey	Heater +12V
11	1	6	Red	Ion Pump Current
12	6	1	Black	Nernst Cell Reference

The MEU has internal jumper links to select between the LSU4.9 (as shipped) and LSU4.2. Please contact JTi.

Syvecs I/O Configuration

Inputs

The expander provides 24 slave inputs assigned as follows:

Input, Syvecs Name	Function
Slave 1 AN #01	Input 1 analogue
Slave 1 AN #02	Input 2 analogue
Slave 1 AN #03	Input 3 analogue
Slave 1 AN #04	Input 4 analogue
Slave 1 AN #05	Input 1 digital
Slave 1 AN #06	Input 2 digital
Slave 1 AN #07	Input 3 digital
Slave 1 AN #08	Input 4 digital
Slave 1 AN #09	Barometric pressure
Slave 1 AN #10	*Lateral G (see section later re: mounting orientation)*
Slave 1 AN #11	*Longitudinal G (see section later re: mounting orientation)*
Slave 1 AN #12	*Vertical G (see section later re: mounting orientation)*
Slave 1 AN #13	*Roll (see section later re: mounting orientation)*
Slave 1 AN #14	*Pitch (see section later re: mounting orientation)*
Slave 1 AN #15	*Yaw (see section later re: mounting orientation)*
Slave 1 AN #16	Lambda
Slave 1 AN #17	EGT
Slave 1 AN #18	*GPS Vehicle Speed (RADAR)*
Slave 1 AN #19	Reserved
Slave 1 AN #20	Reserved
Slave 1 AN #21	Reserved
Slave 1 AN #22	Reserved
Slave 1 AN #23	Reserved
Slave 1 AN #24	Reserved

Note that assignments to “Slave 1” apply even on an S8 or F88 when the I/O expander is connected to the CAN2 port.

GPS and Accelerometer Data

Syvecs S6 firmware version 1.84 and later allows full GPS and accelerometer data to be received. MEU firmware version 2.2 and later makes use of this, so Slave assignments AN10 to AN15, and AN18 are not required (although the data is still present on these AN inputs).

Input "Type" (AR/AU/AV)

All 4 inputs are capable of working as voltage or unipolar input types ("AV" or "AU"), as well as providing a switchable pullup resistor by selecting the "AR" type from SCal.



The electronics of the MEU is capable of working in bipolar ("AB") mode but this requires a simple hardware change to be made. Contact JT Innovations if this is needed.

Analogue vs. Digital Inputs

The MEU only has 4 physical inputs, but these are used for 2 purposes:

1) Traditional analogue inputs, capable of measuring input signals in the range 0-5V
2) Digital switching inputs, with the MEU looking for on/off states and reporting these as 0V or 5V.

The physical input is routed to an analogue-to-digital converter to provide the 0-5V analogue signal range, but also to a comparator with a threshold comparator (Schmitt trigger) to detect on/off transition.

These digital input type is sent to the Syvecs ECU as separate "virtual" inputs, allowing you to choose the most appropriate input for the application.

Speed Measurement

All four analogue inputs are capable of speed measurement (0-1.8kHz range). This is automatically enabled when inputs 1, 2, 3 and/or 4 (the analogue inputs) are configured for functions such as wheel speed measurements.

Outputs

The MEU includes a single Full Bridge driver. This can be used as a pair of Half Bridges if needed, by appropriate configuration in SCal.

The outputs are assigned as follows:

Output, Syvecs Name	Function
Slave 1 OUTPUT #01	Full Bridge Output +, or Half-bridge #1.
Slave 1 OUTPUT #02	Full Bridge Output -, or Half-bridge #2. *Cannot be used as a half bridge output if Slave Output 1 is assigned as a Full Bridge output.*

PWM Frequency

In H-bridge mode, the PWM frequency defaults to 7.8kHz regardless of the frequency set in SCal.
In Half-bridge mode, the frequency will follow the SCal frequency of up to 10kHz.

Half-bridge Polarity

In Half-bridge mode, the outputs emulate a low-side (grounding) output, but with an internal switch between +12V and 0V rather than between ground and open circuit:

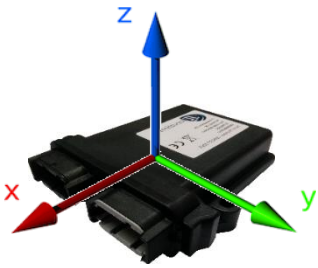
- 100% duty will result in the output being at 0V
- 0% duty will result in the output being at Battery volts (+12V nominally)

Gyro and Accelerometer Axes

The MEU is equipped with a triple axis accelerometer, to measure G-force (lateral, longitudinal and vertical), and a triple axis gyroscope, to measure acceleration (yaw, pitch and roll).

The unit must be mounted orthogonally to the vehicle's axes in order to provide correct readings: this means it must be mounted at right angle to the vehicle's: forward direction; sides; and up/down direction.

The sensor readings are transmitted to the Syvecs ECU as analogue inputs, mapped as follows:



Movement (G-force) in X direction	AN #10
Movement (G-force) in Y direction	AN #11
Movement (G-force) in Z direction	AN #12
Rotation about X axis	AN #13
Rotation about Y axis	AN #14
Rotation about Z axis	AN #15

For example, if the MEU is mounted:

- with the connectors facing straight forward (X-axis)
- the base parallel to the floor
- horizontal

then:

- Longitudinal G is movement in the x-axis, and on AN #10
- Lateral G is movement in the Y axis, and on AN #11
- Vertical G is movement in Z axis, and on AN #12
- Roll is rotation about the X axis, an on AN #13
- Pitch is rotation about the Y axis, and on AN #14
- Yaw is rotation about the Z axis, and on AN #15

Mounting in "Life Racing GPS Mode"

When used in LR GPS mode (set via the PC software, or when used as a slave unit on an S6 running V1.84 firmware onwards), the unit must be mounted with the connectors forward facing and the base of the unit parallel to the floor and horizontal.

EGT

The MEU is equipped with a K-type thermocouple amplifier.

Barometric Pressure Sensor

The internal Barometric Pressure Sensor can be utilised by setting this sensor to use the correct Slave Input in SCal.

GPS

The MEU is provided with a state-of-the-art GPS receiver with a default update rate of 50Hz. This can be adjusted between 1Hz and 50Hz using the MEU PC software, connected via USB.

An external antenna is provided. This should be connected to the RF connector between the 2 main connectors, and be mounted with a clear view of the sky through glass or fibreglass.

GPS can only be used for road speed (due to technical limitations of the Syvecs/Life Racing I/O expander CANbus datastream) unless:

- The MEU is set to “LR GPS” mode, or
- The MEU is used a slave on an S6 running firmware V1.84 or later and the MEU has firmware version 2.20 or later.

To use GPS for road speed in other circumstances, it is used as the “RADAR” sensor in SCal – make sure the I/O configuration is set to use the correct Slave Input for the RADAR speed sensor.

To deliver the correct vehicle speed:

- The *Number of Teeth* in the sensor calibration should be set to 48
- *Numbers of Teeth Per Reading* set to 1
- *Tyre Circumference* set to 2.0

Sensor Linearisation

A zip file containing linearisation files for the MEU sensors is available from our website, along with instructions on how to install these.
The following information is provided for reference.

Accelerometer Linearisation

The sensors are scaled as:

- +4G = 5V
- 0G = 2.5V
- -4G = 0V

Gyroscope Linearisation

The sensors are scaled as:

- +250°/s = 5V
- 0°/s = 2.5V
- -250°/s = 0V

Barometric Pressure Sensor Linearisation

A two-point extrapolated linearisation is needed:

- 0mBar = 0V
- 1000mBar = 1.907V

EGT Linearisation

Linearisation points are:

- -100°C = 0.312V
- 0°C = 0.559V
- 1000°C = 3.0V
- 1500°C = 4.221V
- Use an extrapolated linearisation.

MEU PC Software

This can be downloaded from the JT Innovations website (www.jti.uk.com) and allows:

- The MEU firmware to be updated.
    - There are two areas of flash memory, and any new firmware is loaded into the second area. This allows the MEU to be reverted to the factory-programmed firmware if needs be.
- GPS receiver firmware to be updated.
- GPS Update Rate to be set between 1Hz and 50Hz.
    - The default is 25Hz. Note that the amount of noise present in the measured speed increases with higher update rates. This is worse at lower vehicle speeds (typically under 50kph). The update rate should be chosen carefully, depending on the application.
- The unit may be set to “LR GPS” mode; the MEU then emulates the Life Racing AG-50 GPS unit allowing it to be used at the standard 1Mbit/s CAN data rate.
- The MEU also supports a “generic” mode from firmware version 1.30 onwards. This allows use with other ECUs, such as the Link G4+ or MoTeC. Please contact us for details.

Technical Specification

Parameter	Specification
Analogue Input Type	Unipolar, Voltage or Resistive (AU/AV/AR). Speed capable. (AB - bipolar - configuration available to special order)
Analogue Input pull-up resistor	Switchable, 3k
Analogue input voltage range	0-5V
Analogue input speed measurement	Up to 1.8kHz.
H-bridge Current	Continuous 5.0A, peak 7.0A.
H-bridge PWM frequency	Fixed at 7.8kHz in full bridge. Adjustable up to 10kHz in half bridge mode
Barometric pressure sensor range	500-1100mBar
Barometric pressure sensor accuracy	±4mBar
Accelerometer range	±4G (±2G or ±8G available to special order)
Accelerometer Accuracy	±20 mg
Accelerometer temperature stability	±0.008 %/°C
Accelerometer update rate	50Hz
Accelerometer low pass filter	16Hz
G Sensor range	±250 °/s. (±500 or ±1000 °/s available to special order)
G sensor non-linearity	0.2 %
G sensor variation over temperature range	±2 %
G sensor sample rate	50Hz
G sensor low pass filter	42Hz
GPS update rate	25Hz (adjustable using MEU PC software)
GPS speed accuracy	0.1m/s (0.36km/h)
GPS start up	29 second cold start 1 second hot start
GPS internal battery	2.3mA/hr. Provides up to 2 days of power to assist fast startup
GPS sensitivity	-165dBm tracking -148dBm cold start

Parameter	Specification
GPS Antenna (supplied)	Active omnidirectional antenna (powered, 3.3V, via MEU) with adhesive pad.
Lambda amplifier	Internal selection for LSU4.9 (default) or LSU4.2.
Lambda Heater control.	PID control to maintain accuracy.
"K" type thermocouple amplifier	temperature range 0-1500C
"K" type thermocouple amplifier accuracy	±2 °C
CANbus	Custom data rate with built in 120Ω termination resistor (termination can be deselected – consult with factory).
Physical size (plus mating connectors)	133 x 119 x 36 mm
Weight	<300g
Supply Voltage	8-25V, reverse polarity protected
Power consumption (MEU only, excluding current delivered to connected devices)	<100mA
Operating temperature range	-20 to +85°C
Connectors (supplied)	Deutsch DTM 12 way. 1x "A" coding, 1x "B" coding. SMA female jack for GPS antenna
Syvecs Firmware version required	S8 >V1.460 S6 >V1.35 (V1.84 needed for full GPS functionality)

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