TYRE PRESSURE MONITORING SYSTEM

TPS5

This rim-mounted sensor is part of a Tyre Pressure Monitoring System (TPMS) which measures absolute pressure, ambient temperature, rim temperature, inner tyre carcass temperatures and relative humidity. It is a wireless low power sensor with a user-replaceable battery

Sampling and transmission rates change depending on tyre conditions. The sensor transmits the measured data over an RF link to a compact receiver on the vehicle.

The sensor has an RFID wake-up feature, allowing individual sensors to be manually triggered to start transmitting data upon request.

The sensor has default nominal frequency range of 433 MHz. The 315 MHz version that is suitable for Japanese market is available upon request.

EXAMPLE APPLICATION
- Tyre Pressure Monitoring

ELECTRICAL SPECIFICATION
- Customer replaceable 3.6 V battery (lithium thionyl chloride)
- Sensors expected lifetime: 2 years
- Battery life dependent upon usage; theoretical lifespan can be provided upon request
- Transmission rate: Governed by the rate of change of pressure, temperature, and rotation of the wheel. Structured to preserve battery life

PRESSURE MEASUREMENT SPECIFICATION
- Absolute pressure ranges:
  - 1.3 - 3.1 Bar (Pressure failure point: 6 Bar)
  - 1.3 - 5.0 Bar (Pressure failure point: 21 Bar)
- Transmission threshold: 1.3 Bar (Abs.)
- Pressure Accuracy:
  - ±0.2 % FS (Typ.)
  - ±0.375 % FS (Max.)
- Self-compensated over the operating temperature range

TYRE CARCASS TEMPERATURE
- Infrared multipoint temperature sensor
- Object temperature: 0 °C to +200 °C
- Field of view: 120 °
- Temperature resolution: 0.78 °C/bit
- Temperature accuracy: ±3 °C*
- Repeatability: ±1 °C
- 5 tyre temperature points (T1 – T5)†

RIM TEMPERATURE
- On-board infrared single point temperature sensor
- Temperature range: -20 °C to +200 °C
- Temperature accuracy‡: 0 °C to +50 °C = ±1 °C
  +50 °C to +120 °C = ±2 °C
  >+120 °C = ±3 °C
- Temperature sensitivity: 0.05 °C

RELATIVE HUMIDITY
- On-board relative humidity sensor
- Humidity range: 0 % to 100 %
- Humidity accuracy: ±2 %
- Humidity sensitivity: 0.024 %

AMBIENT TEMPERATURE
- On-board digital temperature sensor
- Temperature measurement range: -10 °C to 194 °C
- Temperature accuracy: ±0.3 °C
- Temperature sensitivity: 0.8 °C

RF SPECIFICATION
- Nominal frequency ranges:
  - 315 MHz§
  - 433 MHz
- Nominal baud rate: 71 kbps
- Transmission range: > 5 m**
- Each sensor transmits a unique serial number
- Modulation FM (FSK) encoded serial data
- All transmitted data is encrypted
- Compatible with TPR4 receivers specific to selected nominal frequency, see page 9

WAKE-UP RFID SPECIFICATION
- Read up-to-date measurements & settings from sensors RFID tag
- Ability to force sensor into any Tx mode
- Transmission range: > 0.5 m**
- Nominal frequency ranges:
  - 915 MHz
  - 868 MHz
- Wake-up feature operational up to 95 °C
- Compatible with TPH5 unit, see page 13
- Sensor serial no. stored/readable on tag (EPC)

MECHANICAL
- Sensor weight: < 40 g
- CAD Model available on request
- Example Outline Drawing on page 3
- 2014 T6 aluminium, soft anodised and dyed black
- 6AL4V titanium alloy Battery Cover, with Balinit coating
- Valve/stud kits available upon request

ENVIRONMENTAL
- Resistant to standard motorsport fluids
- Operating temperature: 0 °C to 140 °C
- Compensated temperature: 20 °C to 140 °C
- Vibration 50 Hz to 2.5 kHz @ 40 g, 8 hrs per axis
- Bump test 50 g, ½ sine per axis

* Measured at defined wheel to tyre distance with a |To-Ta| <50 °C

† IR-Array temperature points are software configurable at the production stage. They can be configured across 12.5 ° x 120 ° Field of View. The 12.5 ° depth can be split into two equal columns. The 120 ° can be split in increments of 7.5 °. Please contact Motion Applied to discuss the available options

‡ For best results the area under the sensor should be painted matte black. Infrared sensor calibrated with to an emissivity of 0.95

§ The 315 MHz system meets Japanese MIC certification, tested to ARIB T93 Radio Standards. Certification number 203-JN1145

** RF tested in free space; RFID tested through typical tyre wall

Get in touch
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TYRE PRESSURE MONITORING SYSTEM

TPS5

RF MESSAGE FORMAT

DESCRIPTION	PRESSURE††	BOARD TEMPERATURE††	DELTA PRESSURE††	WHEEL ROTATION	TX RATE‡‡§§	Message Sequence
Off Wheel storage* **	< 1.3 Bar Abs (19 psi)	N/A	< 20 mBar/Sec	No	No Tx	No Tx
Inflated	> 1.3 Bar Abs (19 psi)	< 40 °C	< 20 mBar/Sec	No	0.05 Hz (20 s)	Configurable (max length 8) Default: 1,1,1,1...
Inflated & heated	> 1.3 Bar Abs (19 psi)	> 40 °C	< 20 mBar/Sec	No	0.1 Hz (10 s)	Configurable (max length 8) Default: 1,1,1,1,1,1,2,3...
Pressure change	N/A	N/A	> 20 mBar/Sec	No	2.0 Hz (0.5 s)	Configurable (max length 8) Default: 1,1,2,1,1,2,3...
Driving	N/A	N/A	N/A	Yes	2.0 Hz (0.5 s)	Configurable (max length 8) Default: 1,2,1,2,3...

Message 1 (4.7 ms duration)
- Team ID
- Serial Number
- Sensor Type
- Message Type
- Pressure
- Board Temperature
- Battery Voltage
- TX Life
- Acceleration

Message 2 (4.7 ms duration)
- Team ID
- Serial Number
- Sensor Type
- Message Type
- Temperature 1
- Temperature 2
- Temperature 3
- Temperature 4
- Temperature 5

Message 3 (4.7 ms duration)
- Team ID
- Serial Number
- Sensor Type
- Message Type
- Humidity
- Rim Temperature

OFF WHEEL STORAGE

Applies when the pressure is less than minimum pressure. The sensor does not transmit but continues to sample the pressure and accelerometer measurements.

REPLACEMENT BATTERY INFORMATION

- Replacement battery guide: SCR_07945

†† The temperature threshold, pressure threshold, and delta pressure thresholds are configurable upon request

‡‡ Before the sensor changes to a lower Tx rate, it will continue the transmission for 30 seconds at the higher rate. Transmission count included in data transmission. The Tx rate is configurable in any operating mode upon request. If the Tx period is shorter than 2.5 s, sample rate = Tx rate. If the Tx period is longer than 2.5 s, sample rate = 0.4 Hz (2.5 s)

§§ Rates quoted are for $V_{BATTERY}$ = 3.6 V and $T_{AMBIENT}$ = 25 °C. Rates slow down linearly with increasing $T_{AMBIENT}$ and reducing $V_{BATTERY}$. Rates are ≈ 0.63 quoted values under combined worst-case condition of $V_{BATTERY}$ = 2.5 V and $T_{AMBIENT}$ = 140 °C.

*** Applies when the pressure is less than minimum pressure. The sensor does not transmit but continues to sample the pressure and accelerometer measurements.

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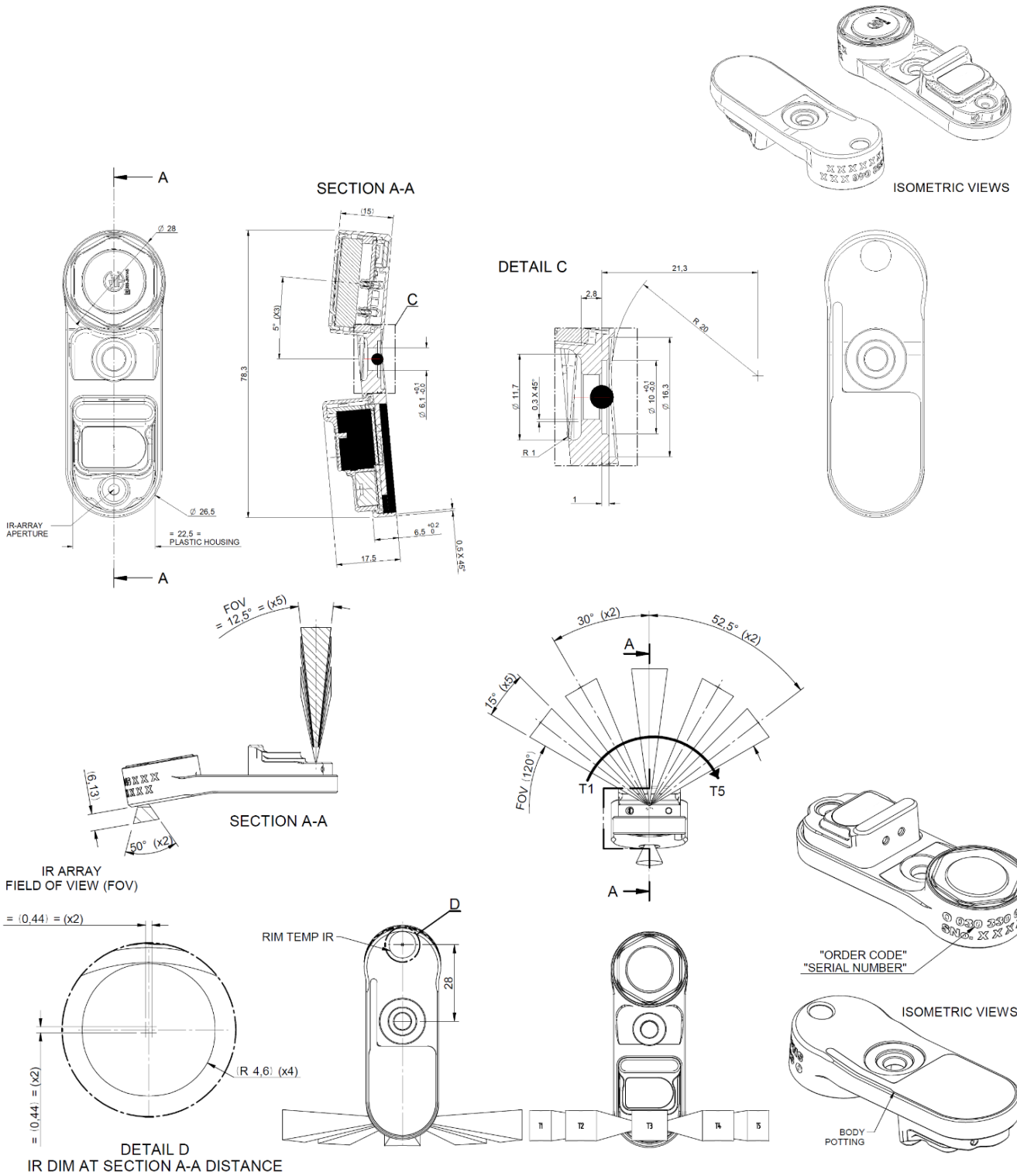
TYRE PRESSURE MONITORING SYSTEM

TPS5

OUTLINE DRAWING



TYRE PRESSURE MONITORING SYSTEM

TPS5

ORDER CODES

The following list of order codes is not exhaustive. IR array pattern is user configurable with the TPH5. Support available upon request.

Order Code	Model Description
O 030 330 046 203	TPS5, 433MHz, 3 Bar, spot configuration #000
O 030 330 046 180	TPS5, 433MHz, 5 Bar, spot configuration #000
O 030 330 046 199	TPS5, 315MHz, 3 Bar, spot configuration #000
O 030 330 046 200	TPS5, 315MHz, 5 Bar, spot configuration #000
O 030 330 990 086	Magnetic Battery Handling Tool
O 030 330 990 151	Lid Socket Tool

TYRE PRESSURE MONITORING SYSTEM

VALVE STUDS

MECHANICAL

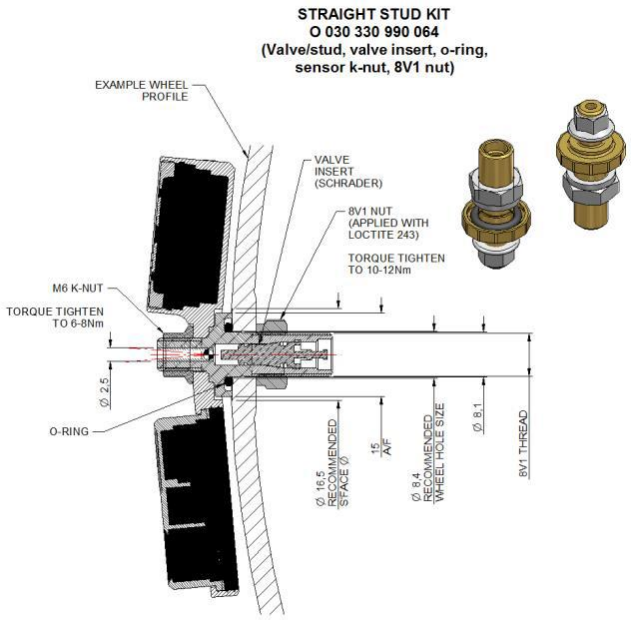
- Straight valve/stud kit available separately which contains:
  - 6AL4V titanium valve/stud with 1.5 mm inlet hole
  - Schrader valve core (fitted)
  - 200-804 Viton O-ring (fitted)
  - M6 k-nut (see drawing, page 5, for recommended torque to sensor body)
  - 8V1 nut (see drawing, page 5, for recommended torque to wheel rim)

- Right angled valve/stud kit available separately which contains:
  - 6AL4V titanium valve/stud with 1.5 mm inlet hole
  - Schrader valve core (fitted)
  - 200-804 Viton O-ring (fitted)
  - M6 k-nut (see drawing, page 5, for recommended torque to sensor body)
- Other valve angles are available, please contact Motion Applied with your requirements

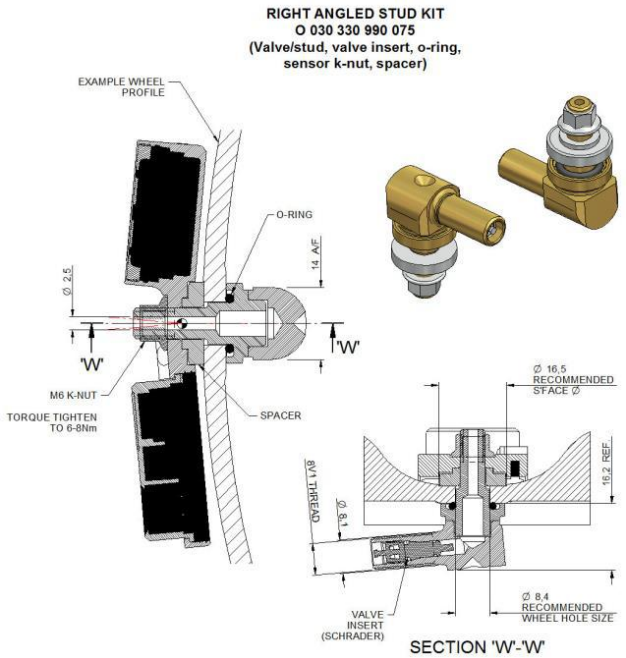
ENVIRONMENTAL

- Resistant to standard motorsport fluids
- Operating temperature +10 °C to +140 °C
- Vibration 50 Hz to 2.5 kHz @ 40 g, 8 hrs per axis
- Shock 50 g per axis, 1/2 sine for 11ms

Drawing



Order Code
Straight Stud Kit - O 030 330 990 064



Order Code
Right-Angled Stud Kit - O 030 330 990 075

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TYRE PRESSURE MONITORING SYSTEM

ANTENNAS

MOULDED HOUSING ANTENNAS

ELECTRICAL

- Omni directional
- Designed to operate at 315 MHz and 433 MHz

MECHANICAL

- Antenna weight 15 g
- Antenna cover ABS/Rubber Housing
- Outline Drawing on page 7

CONNECTIONS

Connection	Signal
Case	RF Ground
Centre	RF Out

ENVIRONMENTAL

- Resistant to some Motorsport fluids
- Operating temperature -40 °C to +70 °C
- Vibration 50 Hz to 2.5 kHz @ 40 g, 8 hrs per axis
- Shock 50 g maximum per axis, 1/2 sine for 11 ms, 5 times per axis

MACHINED HOUSING ANTENNAS

ELECTRICAL

- Omni directional
- Small low profile Helical antenna
- Designed to operate at 315 MHz[§] and 433 MHz
- A good electrical connection must be maintained between the antenna aluminium base and car mounting surface

MECHANICAL

- Antenna weight 38 g
- Antenna cover PA66 GF30 Nylon
- Antenna base 6082 aluminium alloy
- Outline Drawing on page 7

CONNECTIONS

Connection	Signal
Case	RF Ground
Centre	RF Out

ENVIRONMENTAL

- Resistant to standard Motorsport fluids
- Operating temperature +10 °C to +120 °C
- Vibration 50 Hz to 2.5 kHz @ 40 g, 8 hrs per axis
- Shock 50 g maximum per axis, 1/2 sine for 11ms, 5 times per axis

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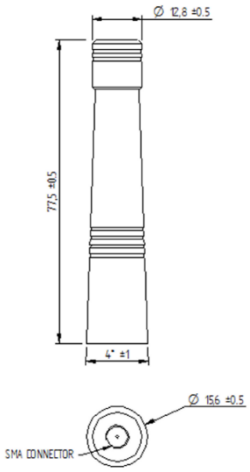
TYRE PRESSURE MONITORING SYSTEM

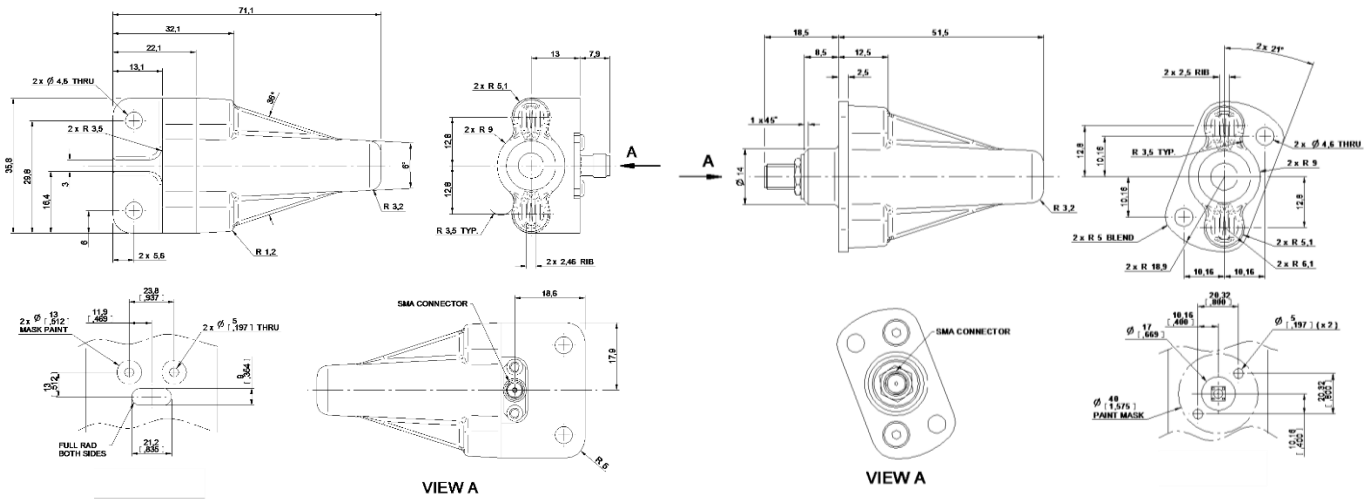
ANTENNAS

ANTENNA DIMENSIONS



All dimensions in mm

Order Code	Description	Connection
O 030 330 990 146	315MHz Moulded Receiver Antenna	SMA Male
O 030 330 990 008	433MHz Moulded Receiver Antenna	SMA Male



All dimensions in mm

Order Code	Description	Connection
O 030 330 990 105	Machined Straight Receiver Antenna	SMA Female
O 030 330 990 106	Machined Right-Angled Receiver Antenna	SMA Female

TYRE PRESSURE MONITORING SYSTEM

Supplementary Harnesses

ANTENNA EXTENSION CABLES

CABLE SPECIFICATION

- Coaxial, Double screened, 50 Ohm, ⌀3 mm (+ additional protective sleeving)
- Cable length: See order code table

ANTENNA CONNECTOR SMA SOCKET

Connection	Signal
Case	RF Ground
Centre	RF In

TPR4 - DEUTSCH CONNECTOR

CABLE SPECIFICATION

- 55 spec, 26 AWG, unscreened cable
- Cable length: See order code table

FLYING LEAD

Connection	Wire Colour
Power +	Red
Ground	Black
CAN+	Blue
CAN-	White

SINGLE CHANNEL CONNECTOR – ASX002-05SN

Connection	Pin Number
Power +	1
Ground	2
CAN+	3
CAN-	4
Not Connected	5

SINGLE CHANNEL CONNECTOR – 9 PIN D-SUB

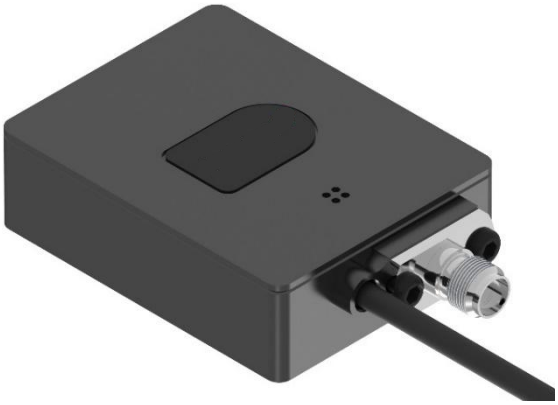
Connection	Pin Number
Not Connected	1
CAN-	2
Not Connected	3
Not Connected	4
Not Connected	5
Not Connected	6
CAN+	7
Not Connected	8
Not Connected	9

Connector pin 2 and 7 bridged with 120 Ω resistor

Order Code	Description	Connection	Cable Length
O 030 330 990 076	Antenna extension lead	SMA Male – SMA Female	1000 mm
O 030 330 990 104	Antenna extension lead	SMA Male – SMA Female	2000 mm
O 030 330 990 110	Antenna extension lead	SMA Male – SMA Male	4000 mm
O 030 330 990 081	CAN/Power mating connector lead	ASX002-05SN – D-Sub	1000 mm
O 030 330 990 123	CAN/Power Lead	Flying Lead – D-Sub	500 mm

TYRE PRESSURE MONITORING SYSTEM

RECEIVERS - TPR4



ELECTRICAL SPECIFICATION

- Supply voltage: 8 V_{DC} to 16 V_{DC}
- Supply current: <80 mA Max. at 12 V_{DC}
- CAN Bus 2.0B Active – 1 Mb/s

SENSOR MEASUREMENTS

- Pressure resolution: 1.22 mBar
- Ambient temperature resolution: 0.8 °C
- Infrared array temperature resolution: 0.78 °C
- Infrared rim temperature resolution: 0.78 °C
- Sensor diagnostics

RECEIVER MEASUREMENTS

- Supply voltage
- Board temperature
- Atmospheric pressure
- Receiver diagnostics

RF SPECIFICATION

- Modulation FM (FSK) encoded serial data
- Nominal frequency ranges:
  - 315 MHz[§]
  - 433 MHz
- Nominal baud rate: 71 kbps
- External antenna supplied. Can be mounted directly to receiver or connected via coax extension cable

MECHANICAL

- See drawing of variants on page 10
- Weight: <40 g
- Aluminium alloy body, anodised and dyed black

ENVIRONMENTAL

- Operating temperature +10 °C to +115 °C
- 10 g peak from 0 Hz to 2.5 kHz for 200 hours on 3-axis
- Resistant to standard motorsport fluids

CONNECTIONS

- Flying lead variant: 4-Core, 26 AWG, DR25, Unscreened cable.
- Connector variant: Souriau 8STA-02-05PN
- Antenna connector: SMA

CONNECTOR VERSION:

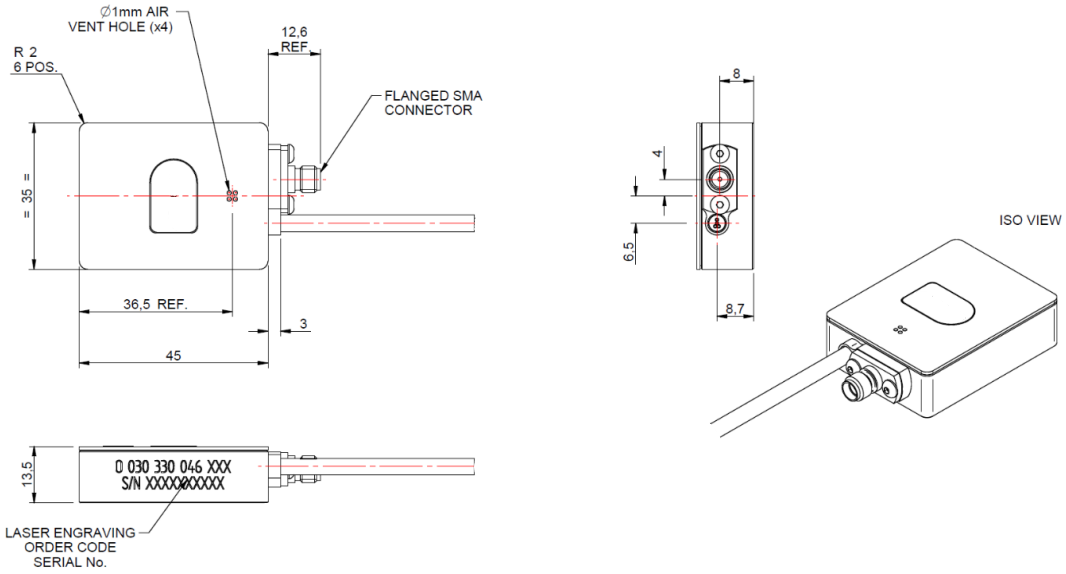
Connection	Pin Number
Power +	1
Ground	2
CAN+	3
CAN-	4
Not Connected	5

FLYING LEAD VERSION:

Connection	Wire Colour
Power +	Red
Ground	Black
CAN+	Blue
CAN-	Yellow

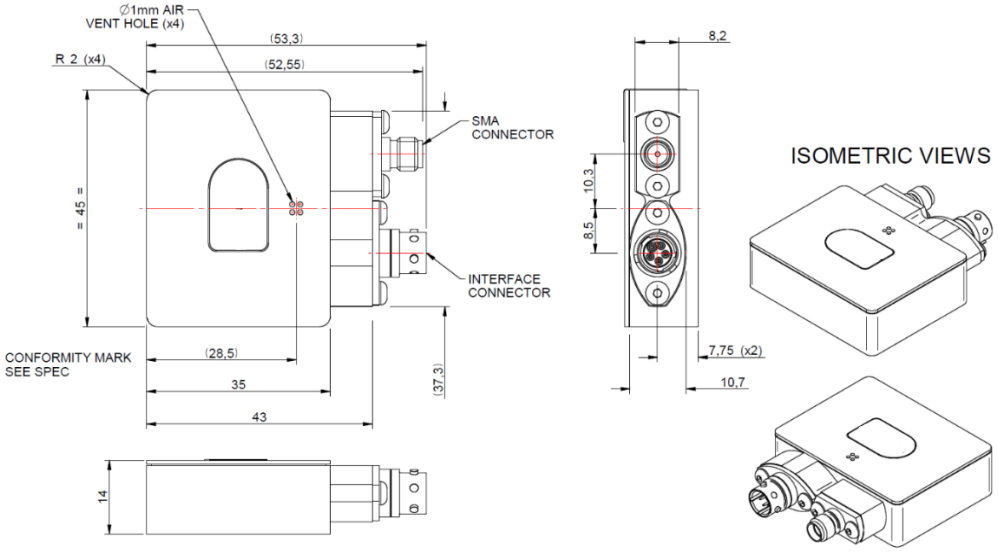
TYRE PRESSURE MONITORING SYSTEM

RECEIVERS - TPR4



All dimensions in mm

Order Code	Model Description
O 030 330 046 161	433 MHz Tyre Pressure Receiver with flying lead



All dimensions in mm

Order Code	Model Description
O 030 330 046 157	433 MHz Tyre Pressure Receiver with connector
O 030 330 046 165	315 MHz Tyre Pressure Receiver with connector

TYRE PRESSURE MONITORING SYSTEM

RECEIVERS - TPR 4-Ch - With Corner Recognition

ELECTRICAL SPECIFICATION

- Supply voltage: 8 V_{DC} to 16 V_{DC}
- Supply current: < 50 mA Max. at 12 V_{DC}
- CAN Bus 2.0B Active – 1 Mb/s

MEASUREMENT SPECIFICATION

- Pressure resolution:
  - 3 Bar – 0.7326 mBar/bit (0.0106 psi/bit)
  - 5 Bar – 1.221 mBar/bit (0.0177 psi/bit)
  - 8 Bar – 2 mBar/bit (0.0290 psi/bit)

RF SPECIFICATION

- Modulation FM (FSK) encoded serial data
- Nominal frequency ranges:
  - 315 MHz[§]
  - 433 MHz
- Nominal baud rate: 71 kbps
- Antenna supplied. Can be mounted directly to receiver or connected via coax extension cable

MECHANICAL

- Weight: < 50 g
- Aluminium alloy body, anodised and dyed black
- Outline Drawing on page 12

ENVIRONMENTAL

- Resistant to standard motorsport fluids
- Operating temperature +10 °C to +85 °C
- Vibration 100 Hz to 1 kHz random spectrum for 2 hours in connector axis

100 Hz	0.00395 g^2/Hz
200 Hz	0.08573 g^2/Hz
300 Hz	0.27121 g^2/Hz
650 Hz	0.00482 g^2/Hz
1 kHz	0.01039 g^2/Hz

CABLE & CONNECTIONS

- Power and Comms Connector – ASX002-05PN

Connection	Pin Number
Power +	1
Ground	2
CAN+	3
CAN-	4
Not Connected	5

- SMA Connector

Connection	Signal
Case	RF Ground
Centre	RF In

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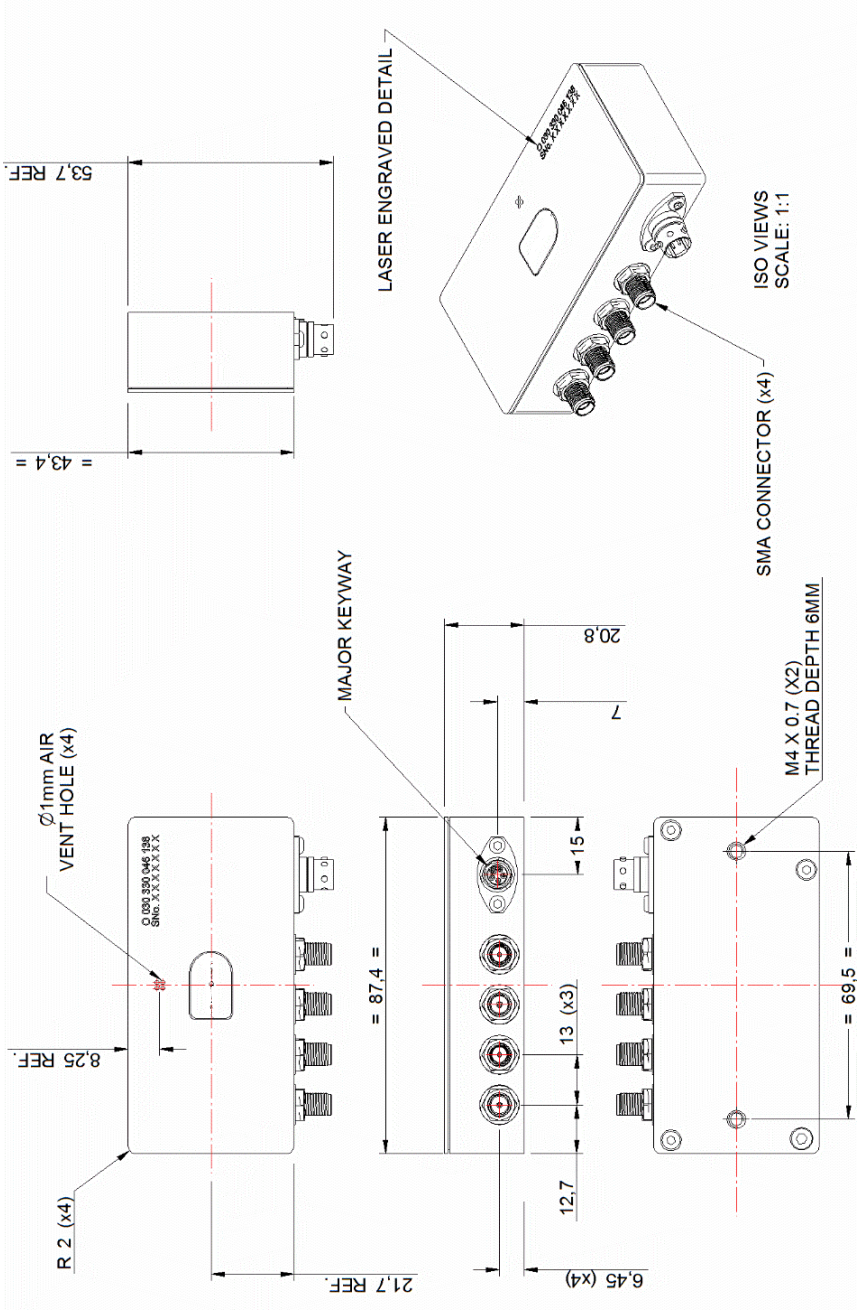
TYRE PRESSURE MONITORING SYSTEM

RECEIVERS - TPR 4-Ch - With Corner Recognition



All dimensions in mm

Order Code	Description	Connection
O 030 330 046 183	315 MHz 4 Channel Receiver with corner recognition	Connector
O 030 330 046 138	433 MHz 4 Channel Receiver with corner recognition	Connector

TYRE PRESSURE MONITORING SYSTEM

HANDHELD - TPH5 - RFID SCANNER

ELECTRICAL SPECIFICATION

- Rechargeable, interchangeable, Lithium-ion battery: 3.6 V, 10,050 mAh
- Battery life: Up to 18 hours, in intensive use
- 4.7” HD capacitive touch screen
- Adjustable LED backlight, Daylight readable, Gorilla glass 3, usage with gloves supported
- Charging station available†††

FEATURES

- ISO 18000-63 (EPC Class 1 Gen2v2)
- Max. ERP 2W (33 dBm)
- Motion Applied Application

DISPLAYED MEASUREMENTS

- Absolute pressure (Bar or PSI)
- Gauge pressure (manual entry of atmospheric pressure required)
- Board Temperature
- Battery Voltage
- Humidity
- Tx Life Count
- Tx Count
- 5 x Tyre carcass temperatures
- Rim temperature
- Maximum sensor temperature
- Estimated number of battery changes

DISPLAYED MEASUREMENTS

- Compatible with TPS5 sensors
- Team ID restricted data‡‡‡

WAKE-UP OPTIONS

- Ability to wake the sensor and force “driving mode” for ten seconds
- Ability to force the sensor into any operating mode§§§

MECHANICAL

- (H)214 mm x (W)87/72 mm x (D)135/29 mm
- Weight: 650 g

ENVIRONMENTAL

- Resistant to standard motorsport fluids
- Operating Temperature: -20 °C to 55 °C
- Storage Temperature: -20 °C to +60 °C
- Charging Temperature: 0 °C to +45 °C
- Relative Humidity: 10 %-95 % non-condensing
- Environmental Sealing: IP65
- Drop/Impact Resistance: 1.6 m

Order Code	Model Description
O 030 330 046 191	TPH5 – 868MHz**** – Team Version
O 030 330 046 193	TPH5 – 868MHz – Scrutineer Version
O 030 330 046 196	TPH5 – 915MHz†††† – Team Version
O 030 330 046 271	TPH5 – 915MHz – Scrutineer Version

††† Charging over desktop charger (0 % to 80 %) 4 hours.
‡‡‡ Scrutineer special available to view data from all teams.
§§§ This option should be used with caution to preserve battery life.
**** 868 MHz TPH5 is intended for use with 433 MHz TPS5.
†††† 915 MHz TPH5 is intended for use with 315 MHz TPS5.

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Website: www.motionapplied.com

TYRE PRESSURE MONITORING SYSTEM

GARAGE RECEIVER - TPG

ELECTRICAL

- Supply voltage: 5 V_{DC} (USB)
- Supply current: <500 mA max at 5 V_{DC} (USB)
- Compatible with USB 1.1, USB 2.0 and USB 3.0

MEASUREMENT SPECIFICATIONS

- Pressure resolution:
- 3.1 Bar - 0.7326 mBar/bit (0.0106 psi/bit)
- 5 Bar - 1.221 mBar/bit (0,0177 psi/bit)
- 8 Bar - 2 mBar/bit (0.0290 psi/bit)

RF SPECIFICATIONS

- Modulation FM (FSK) encoded serial data
- Nominal frequency ranges:
  - 315 MHz[§]
  - 433 MHz
- Nominal baud rate 71 kbps
- Antenna supplied. Can be mounted directly to receiver or connected via coax extension cable

ENVIRONMENTAL

- Resistant to standard motorsport fluids
- Operating temperature +10 °C to 85 °C
- Vibration 100 Hz to 1 kHz random spectrum for 2 hours in connector axis:

100 Hz	0.00395 g^2/Hz
200 Hz	0.08573 g^2/Hz
300 Hz	0.27121 g^2/Hz
650 Hz	0.00482 g^2/Hz
1000 Hz	0.01039 g^2/Hz

SOFTWARE

- For use with TPMSuite
- Require PEAK PCAN drivers to be installed

MECHANICAL

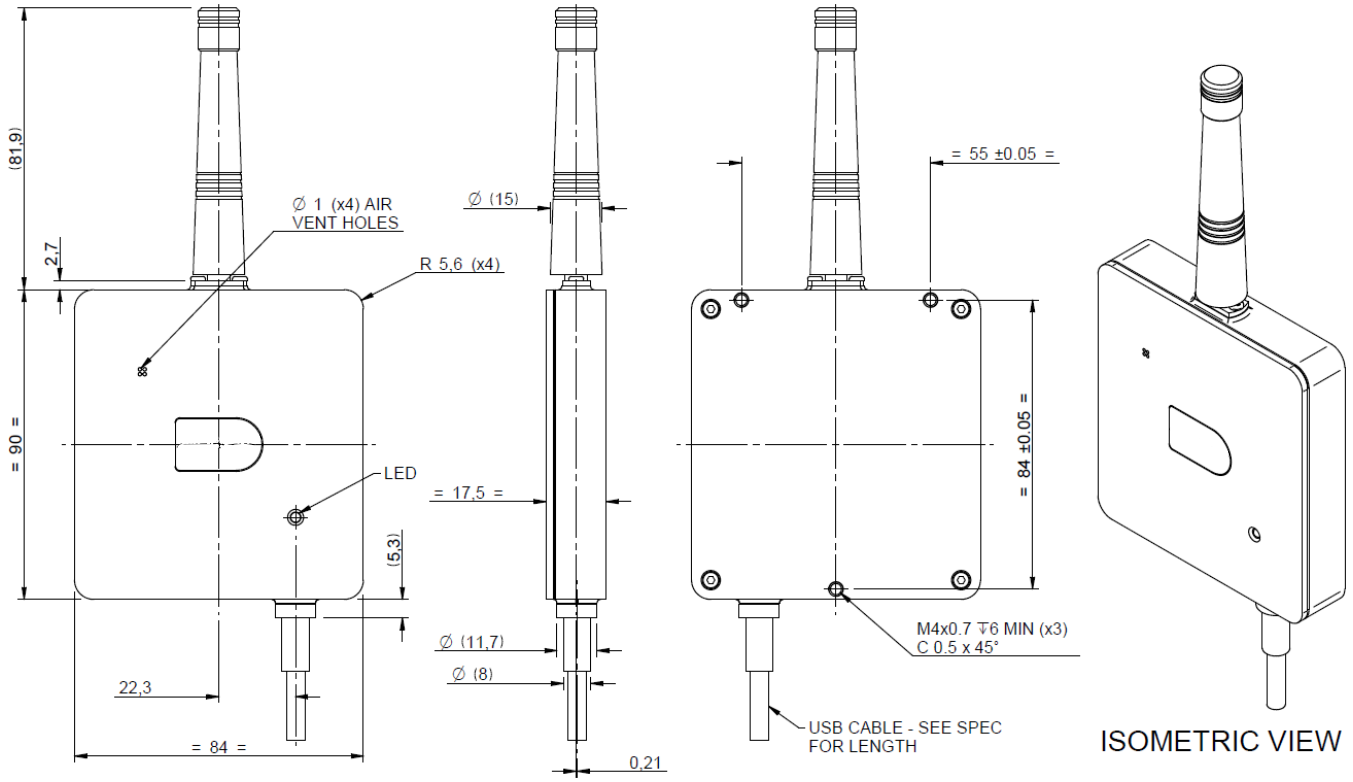
- Weight: <200 g
- Aluminium alloy body, hard anodised and dyed black
- Outline Drawing on page 16

CONNECTION DEFINITION

- USB cable length: 750 mm
- Antenna connector: SMA

TYRE PRESSURE MONITORING SYSTEM

GARAGE RECEIVER - TPG



Order Code	Model Description
O 030 330 990 135	TPG – 315 MHz Garage Receiver for TPS5
O 030 330 990 125	TPG – 433 MHz Garage Receiver for TPS5

TYRE PRESSURE MONITORING SYSTEM

TYRE PRESSURE RECEIVER SOFTWARE - TPMSUITE

CONFIGURATIONS

- Configure receiver diagnostic CAN ID
- Configure receiver diagnostic message Tx rate
- Select between a multiplexed or non-multiplexed message
- Enable the receivers permit list
- Configure the CAN ID sensor data is transmitted on
- Save configurations

PERMIT LIST

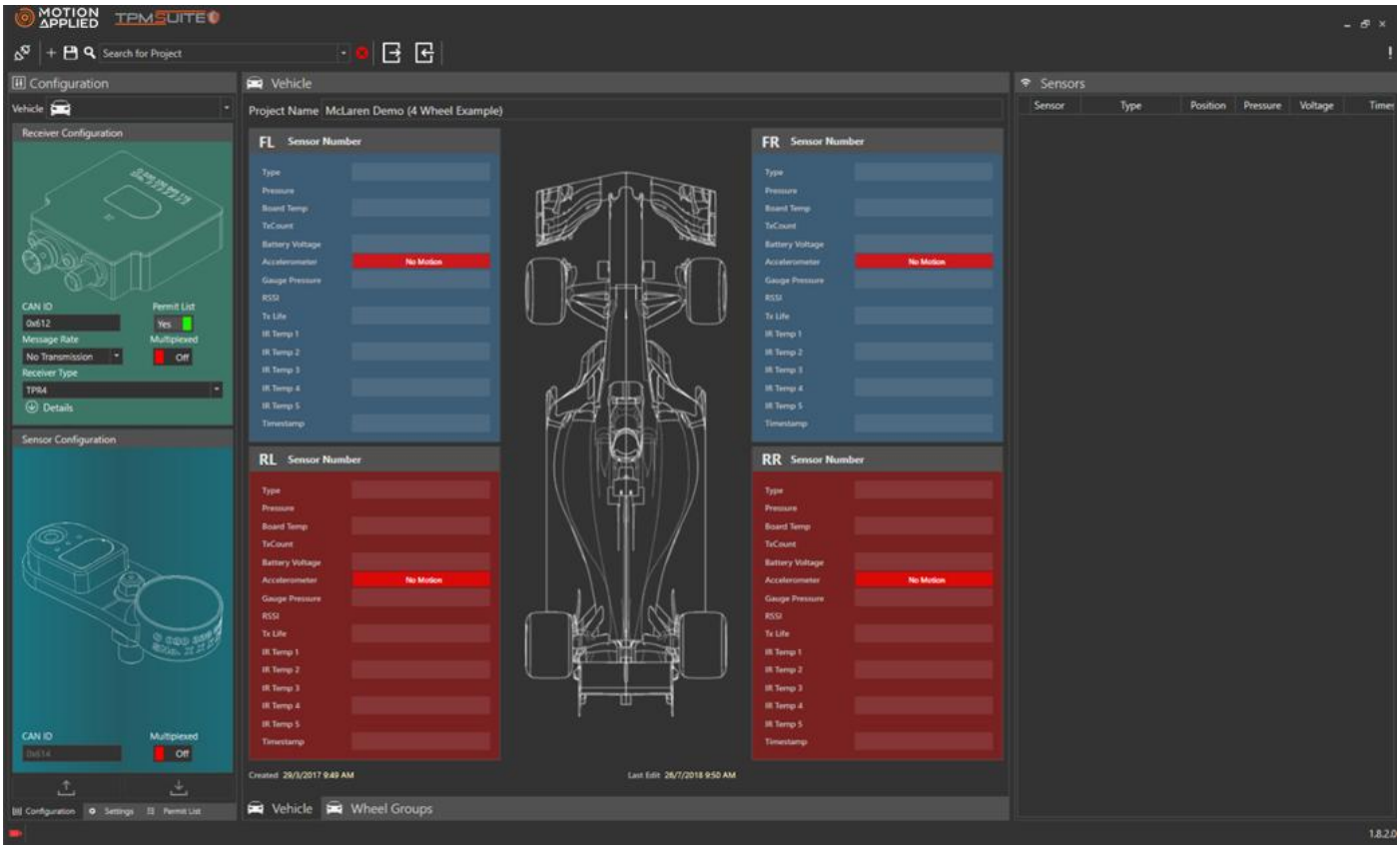
- Populate a permit list with serial numbers and CAN ID
- Export and Import permit lists

MONITORING

- Monitor a list of multiple sensors that the receiver can see
- Option to drag 4 specific sensors onto the main screen for corner monitoring

DOCUMENTATION

- A separate user manual is available upon request
- Downloadable with a licence from the Motion Applied website portal.
- Contact: sales@motionapplied.com for more information



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