Tire Monitor System
A M Bromley Limited

# Datasheet

Sensors: TMS2, TMS10, TMS12, TMS14

Receivers: TMS11, TMS16, TMS21, TMS22

Operator Interfaces: TMS27

TmsDatasheetV10

A M Bromley Limited
West Road House
26a West Road
Buxton
Derbyshire
SK17 6HF
UK

web: www.tiremonitorsystem.com
email: enquiry@ambromley.co.uk
phone: +44 (0) 1298 77166
fax: +44 (0) 1298 22044

TMS revision notes available at
http://www.tiremonitorsystem.com/revision.html

## Table of contents



### Important Notices

It is your responsibility to fully consider the implications of installing TMS sensors, and take adequate precautions to ensure the installation does not compromise the integrity of the wheel or the overall safety of the vehicle. In addition, you must accept responsibility for carrying out inspection and testing of the sensors to ensure they remain suitable for use. TMS is not a safety device and does not replace the need for regular tire maintenance.

Please do not remove any labels or identification marks on the products you have purchased, as these will help us to identify them if you should need to contact us or return them.

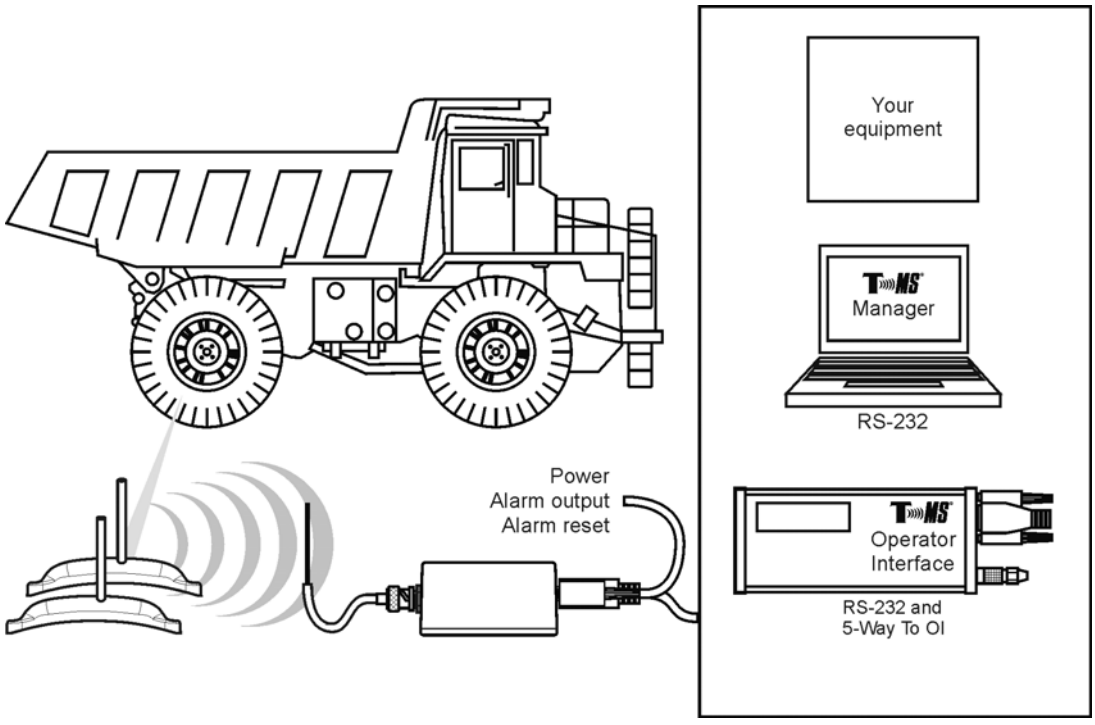
We recommend that you do not modify the product supplied. If you modify the product, you will need to ensure that it still meets the necessary standards.

TMS10, TMS11:
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

# 1. System overview

**Overview**




Battery powered TMS sensors inside each tire transmit pressure and temperature data to a TMS Receiver on the vehicle. The receiver collects the data from all sensors and allows you to view it using either our TMS Operator Interface (TMS OI) or TMS Manager Windows application or even through both at the same time. Alternatively, you can connect the RS232 to your equipment such as the vehicle network.

- TMS is typically used on large vehicles and other applications that require multiple tire pressures to be monitored. We can also supply special sensors for R&D, for evaluation of the vehicle RF performance.
- Reliable transmit and receive strategy. Software protocol recovers signal from noisy environments making the TMS more tolerant to interference.
- The sensors transmit data even while the vehicle is stationary.

# 2. Sensors

TMS sensors measure pressure and temperature and estimate their own battery condition. Every sensor has a unique identity code (ID). The four-digit ID code is printed on the product label. Periodically and on certain conditions, each sensor broadcasts its ID and measurements as a radio transmission.

There are four types of TMS sensor, specified fully in later sections. The key features are:

**TMS2, our standard sensor:**

- 433.92MHz
- Comes in an enclosure that can be fitted to a standard tire patch
- Its robust rubberised antenna gives a good transmission range.


**TMS10, standard except:**

- For compliance with FCC Part15.231, transmission power is lower then other sensors, giving it a lower range but longer battery life.
- Does not come in an enclosure; you have to arrange your own fitting method.
- Larger battery gives longer life.
- Coiled antenna supported with polyester tape.

**TMS12, standard except:**

- 315MHz.
- Does not come in an enclosure; you have to arrange your own fitting method.
- Larger battery gives longer life.
- Coiled antenna supported with polyester tape.

**TMS14, standard except:**

- Designed for R&D, tire and vehicle evaluation
- Only transmits when pressurised
- Transmits much more frequently than other sensors; has a short battery life.
- The antenna is inside the housing, which gives less range than the TMS2.


## 2.1. Fitting

Due to the wide variety of applications, our customers have used different methods of fitting sensors. You should conduct tests to determine the best method for your application.

For OTR tires, maximum speed of 50kmph, the TMS2 can be mounted in the low flex area on the side wall of the tire using the 7C tire tube patch.

You can strap TMS2 and TMS14 sensors into the wheel well using stainless steel wheel bands, which we can supply. This method is popular for initial evaluation and low volume applications.

For the TMS10 and TMS12, some of our customers have developed canisters that they mount outside the tires.

Be careful not to block the input to the pressure sensor on the PCB.

The pressure sensor is designed for use with clean dry air, no corrosive gasses.

## 2.2. Measurements

We calibrate each sensor's pressure measurement during manufacture.

Sensors need to measure temperature in order to make an accurate pressure reading. The measurement may be of use depending on where sensors are mounted, bearing in mind that it is the temperature at the sensor PCB, not necessarily the air or tire.

| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Pressure range | All | 6.0 | | 185.0 | PSI(1) |
| Pressure resolution | All | | 1.0 | | PSI |
| Pressure accuracy up to 150PSI<br>150PSI to 185PSI | All<br>All | | +/-2.0<br>+/-3.0 | | PSI(1) |
| Pressure long term drift | | | +/-0.2 | | PSI/Year |
| Temperature measurement range | Standard<br>TMS14 | -25<br>-40(2) | | +125(2)<br>+125(2) | °C |
| Temperature resolution | All | | 1.0 | | °C |
| Temperature accuracy at 25°C(3)<br>-10°C to +70°C<br>-30°C to +125°C | Standard<br>TMS14<br>TMS14 | | +/-2.0<br>+/-1.0<br>+/-2.0 | | °C |

**Note 1:** Absolute pressures, relative to a vacuum. To convert to gauge pressure, subtract atmospheric pressure, typically 14.7PSI.

**2:** Sensor firmware attempts to measure such temperatures, but we cannot guarantee it will work outside the operating temperature, defined later.

**3:** Temperature accuracy will deteriorate as the temperature deviates from 25°C.

## 2.3. Hibernation

We ship all sensors in a state of 'hibernation'. This means they do not transmit until they are pressurised for the first time.

Once pressurised the TMS2, TMS10 and TMS12 will remain active for the rest of their life unless you return them to hibernation by subjecting them to a partial vacuum.

The TMS14 returns to hibernation whenever it is not pressurised.

| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Leave hibernation above pressure | All | | 20.0 | | PSI(1) |
| Time to leave hibernation | All | 0 | | 10 | Seconds |
| Return to hibernate below pressure | Standard<br>TMS14 | | 7.0<br>18.0 | | PSI(1) |

**Note 1:** Absolute pressures, relative to a vacuum. To convert to gauge pressure, subtract atmospheric pressure, which is typically 14.7PSI at sea level.

## 2.4. Periodic transmissions

When sensors are not hibernating, they transmit periodically.

| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Periodic transmission interval | Standard<br>TMS14 | 280<br>4 | 300<br>5 | 320<br>6 | Seconds |

## 2.5. Transmit on change

In addition to the periodic transmissions, sensors also transmit if there has been a 'change of pressure': an increase or a decrease, since the previous transmission.

Sensors measure pressure every 'sample interval' so it may take this long to detect the change.

When a sensor detects a change, it transmits the new pressure once immediately and then makes a number of 'extra transmissions' at subsequent sample intervals.

| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Change of pressure | Standard<br>TMS14 | | 5.0<br>2.5 | | PSI |
| Sample interval(1) | Standard<br>TMS14 | 1.8<br>0.4 | 2.5<br>1.0 | 3.2<br>1.6 | Seconds |
| Extra transmissions | Standard<br>TMS14 | | 3<br>0 | | |

**Note 1:** Sensors have a deliberate random time variation between transmissions.

## 2.6. Sensor life

Sensors have a limited life because they have an integrated battery that you cannot replace when it has discharged. When the battery is discharged the sensor stops transmitting.

Life depends on many factors including the number of transmission made, the sample interval, the transmission power, the type of battery fitted and the temperature throughout the sensors life.

The sensors estimate their remaining life and, after every 11 normal transmissions, they transmit their remaining life.

| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Sensor life[2] | TMS2 | | 4.8[1] | | Years |
| | TMS10 | | 10.0[1] | | |
| | TMS12 | | 8.5[1] | | |
| | TMS14 | | 0.16 | | |

**Note 1:** Parameters are computed but not tested.
**2:** This is time in service, not including hibernation. Prolonged hibernation will reduce life.

## 2.7. Radio transmissions

Each time a sensor transmits, it emits two bursts, with a gap between them.

| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Transmission frequency | TMS12 | | 315.00 | | MHz |
| | Others | | 433.92 | | |
| Modulation type | All | | FSK | | |
| Emission compliance | TMS10 | FCC Part15.231 | | | |
| | Others | MPT1340 and ETS 300-220 | | | |
| Effective radiated power (ERP) approximate | TMS10 | | 1 | | µW |
| | Others | | 100 | | |
| Burst duration | All | | 52 | 60 | ms |
| Burst gap duration | All | | 19 | 20 | ms |
| Total duration | All | | 123 | 140 | ms |

## 2.8. Operating temperature

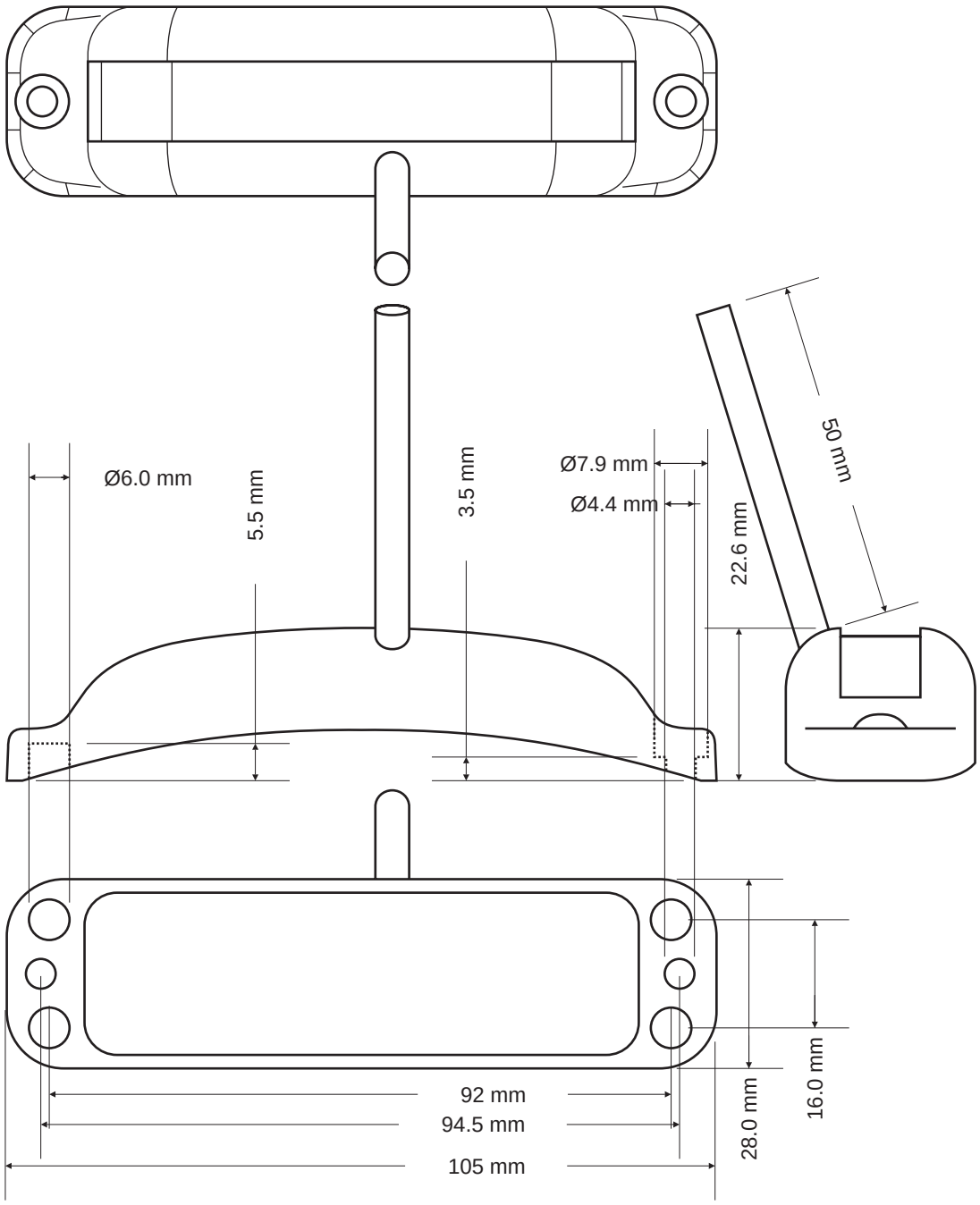
| Parameter description | Sensor | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Operating temperature | TMS2 | -25[1] | | +80 | °C |
| | TMS10 | -25[1] | | +70 | |
| | TMS12 | -25[1] | | +70 | |
| | TMS14 | -30 | | +80 | |
| Extreme temperatures | TMS10 | | | +85[2] | °C |
| | TMS12 | | | +85[2] | |
| | TMS14 | -40[3] | | +125[3] | |

**Note 1:** Sensors do no transmit below this temperature
**2:** The TMS10 and 12 will operate at this temperature for up to 2 weeks
**3:** We do not guarantee that sensors will work at ‘extreme temperatures’. If you use them outside their ‘operating temperature’, they are likely to work for a short time, but you are likely to damage them permanently.

## 2.9. Physical characteristics

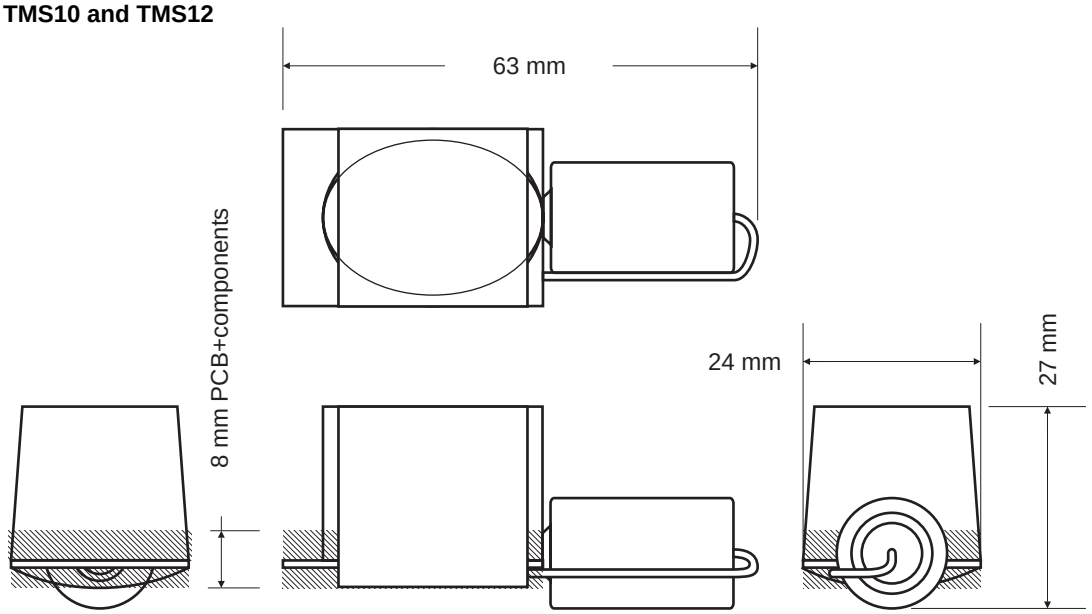
All PCBs are conformal coated with an acrylic coating which is MIL-I-46058C approved.

**TMS2**



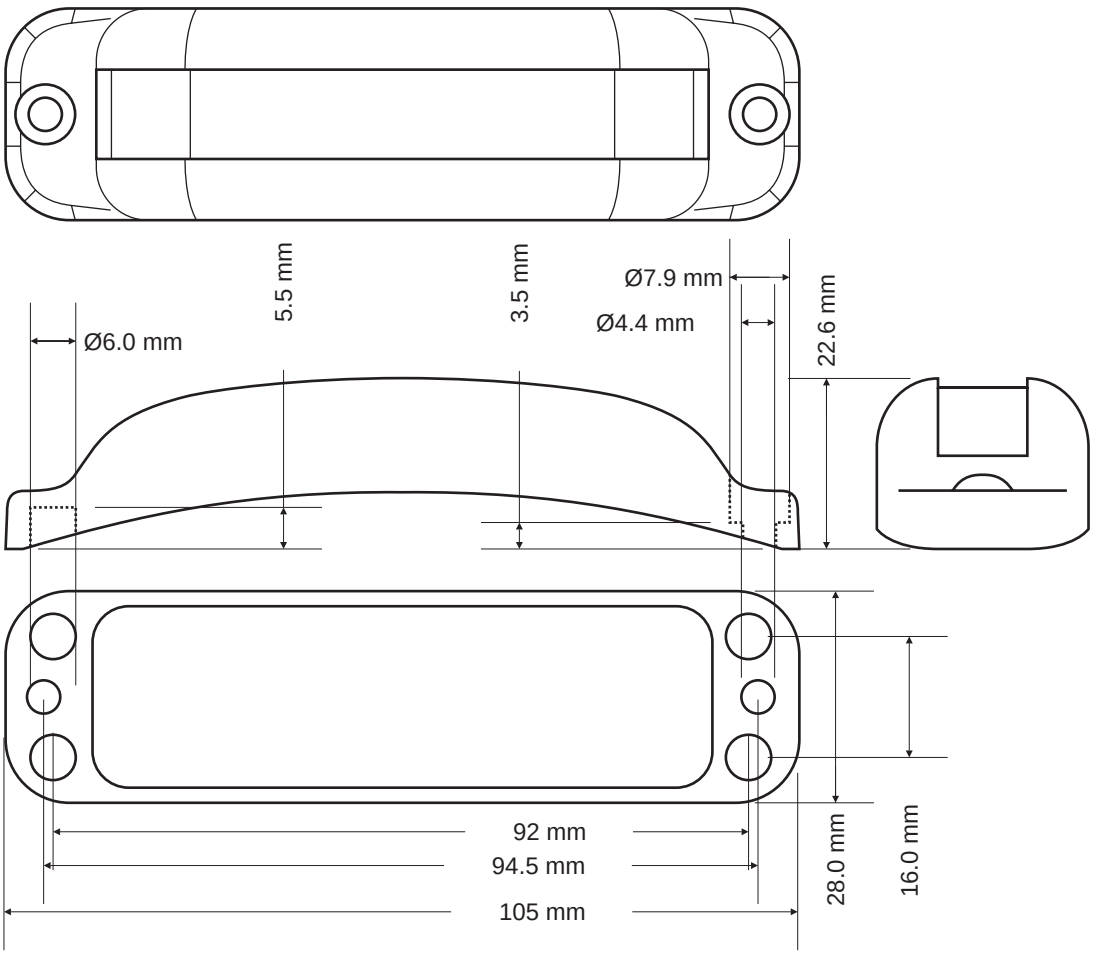

| | | |
|---|---|---|
| Mass | 35 | g |
| Enclosure material | Glass filled nylon 66 | |

**TMS10 and TMS12**




| | | |
|---|---|---|
| Mass | 16 | g |

**TMS14**




| | | |
|---|---|---|
| Mass | 34 | g |
| Enclosure material | Glass filled nylon 66 | |

# 3. Receiver hardware

The TMS Receiver collects data transmitted by TMS sensors. You can access the data through the receiver's serial RS232 interface. You can also connect a TMS OI to see the most resent transmissions and to keep a real time log.

The receiver has the option of a switched output to drive an external alarm, and can store a log of sensor transmissions. See 4 "Receiver software" for details.

You can find a detailed explanation of the different receivers in the document "TMS Receiver Application and Test Guide" available from our web site:
www.TireMonitorSystem.com/downloads.html

There are four types of TMS Receiver, specified fully in later sections. The key features are:

**TMS11, our standard receiver:**

- 433.92MHz
- Single receiving device
- PC interface, RS-232
- Vehicle interface. Power, alarm output, alarm reset.
- Up to 4 antennas may be connected

**TMS16, like a TMS11 except:**

- 315MHz for use with the TMS12 sensor


**TMS21, diversity receiver:**

- 433.92MHz
- Multiple receiving devices, one for each antenna
- PC interface, RS-232
- Vehicle interface. Power, alarm output, alarm reset.
- 4 antennas to be connected

**TMS22, like a TMS21 except:**

- 315MHz for use with the TMS12 sensor

## 3.1. Fitting

Mount the unit on the vehicle and connect the antenna(s) and the vehicle and PC interface connector.

Do not mount the unit in water spray or near exhaust pipe work or radiator airflow.

## 3.2. Antenna positioning

**Good antenna positioning is essential for reliable operation.**

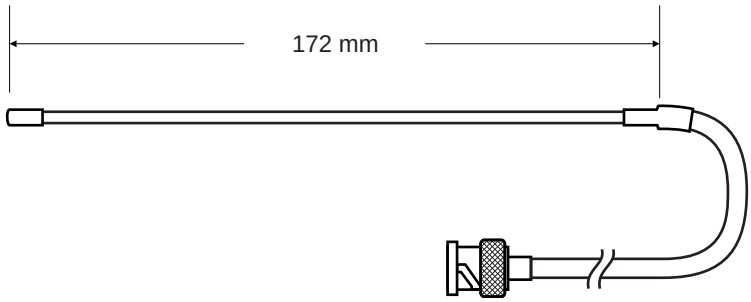
Selecting the best position for the antenna varies from vehicle to vehicle. Correct antenna positioning is different for the Standard and Diversity receivers. Please refer to the document "TMS Receiver Application and Test Guide" document available from www.TireMonitorSystem.com/downloads.html.

## 3.3. Antennas

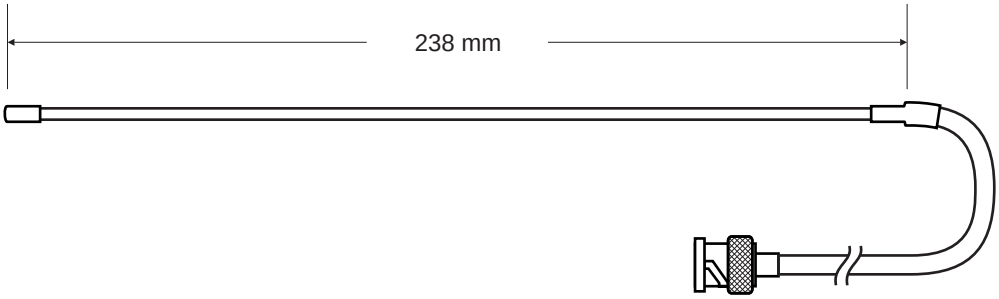
The Receiver can accept up to four BNC terminated antennas. We can supply them if required, or you can make them as described below.

To prepare an antenna fit a 50Ω BNC plug to one end of the antenna cable, RG58. At the other end, trim back the outer insulation and braid leaving a length of the inner core as shown below. This forms the antenna itself. Seal each end of the antenna using adhesive lined heat shrink.

**TMS11 and TMS21 (433.92MHz)**

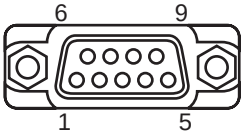



**TMS16 and TMS22 (315MHz)**




## 3.4. PC interface

**PC Interface, 9 pin D female, RS-232**

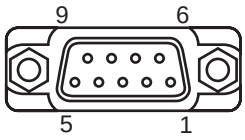



| Pin / name | Description |
|---|---|
| **2** TX | Serial from receiver to PC |
| **3** RX | Serial from PC to receiver |
| **5** 0V | GND |
| **Note:** | Straight-through serial cable is required. |

## 3.5. Vehicle interface

**Vehicle Interface, 9 pin D male**



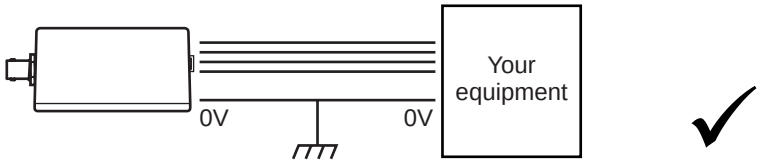

| Pin / name | Description | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| **1** SUPPLY | Voltage | +10 | | +36 | V DC |
| | Current consumption without anything connected to FAULT | | 30 | | mA |
| **4** RESET | Connect to 0v to clear alarm(1) | 5V when open. 1mA when closed. | | | |
| **5** 0V(2) | Return for SUPPLY or to connect a RESET switch | | | | |
| **6** 0V(2) | | | | | |
| **7** FAULT(3) | With no alarm voltage = SUPPLY Maximum source current | | | 200 | mA |
| | With an alarm voltage = 0V. | | | | |

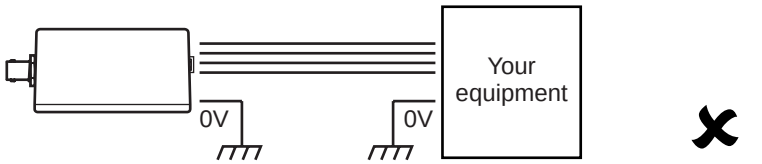
**Note 1:** Alarms are only available when using the "Memory Map RS232 interface" (section 4.3). You can configure them using "TMS Manager" (section 6).

**Note 2:** One 0V connection must be connected.

**Note 3:** The FAULT output is normally pulled up to the positive supply when there is no alarm, and is able to source 200mA. It is typically used to energize a relay where a warning lamp is connected to a normally closed pair of contacts. When there is an alarm, the FAULT output has a 10kΩ pull down to 0V. (section 5.4)

**Good wiring practice**




## 3.6. Fuse

20x5mm 250mA Anti-surge

## 3.7. Radio receptions

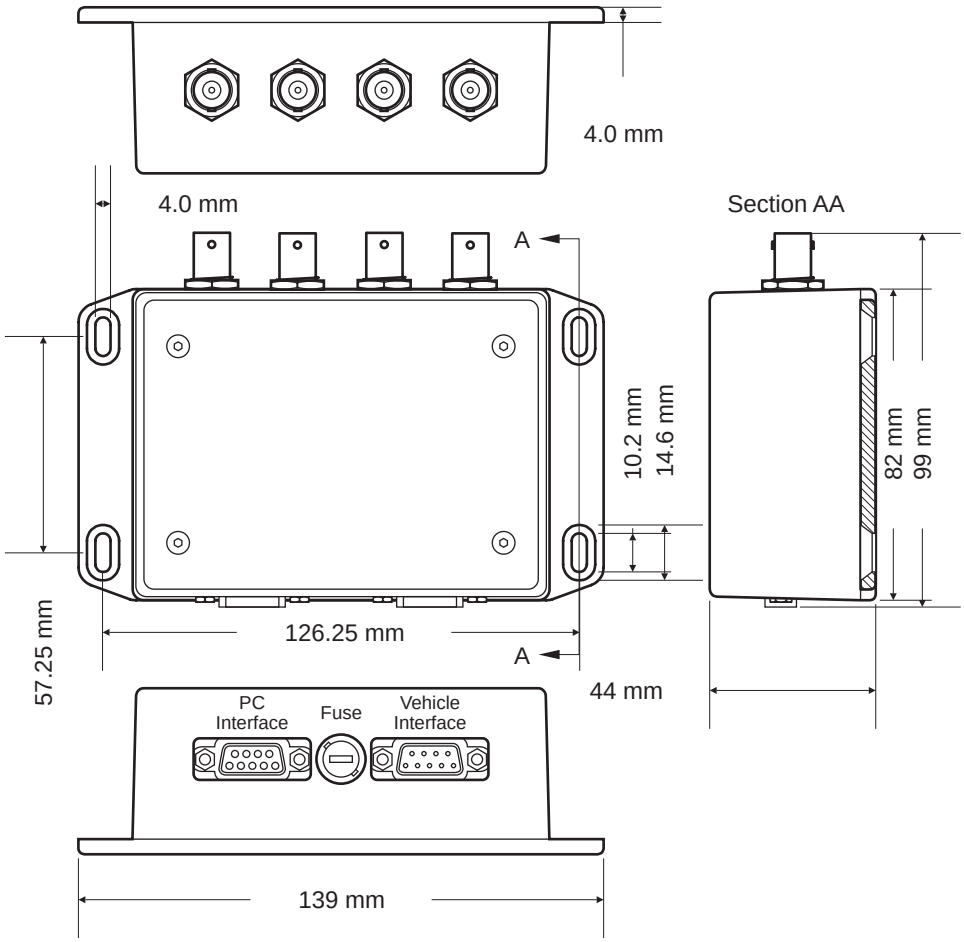
| Parameter description | Receiver | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Receiver frequency | TMS16 TMS22 | | 315.00 | | MHz |
| | TMS11 TMS21 | | 433.92 | | |

## 3.8. Operating temperature

| Parameter description | Receiver | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Operating temperature | All | -10 | | +55 | °C |

## 3.9. Physical characteristics

**TMS11, TMS16, TMS21 and TMS22**




| | | | |
|---|---|---|---|
| Mass | TMS11<br>TMS16 | 355 | g |
| | TMS21<br>TMS22 | 400 | g |
| Enclosure material | Diecast Aluminium Alloy (alloy type 360.1) | | |

# 4. Receiver software

The Receiver provides an RS232 interface to your equipment.

## 4.1. Choosing the RS232 interface

You can choose the most suitable interface for your application. The interface can be the simple 'ASCII stream' or the more complex 'memory map', both described in detail later. New units have the Memory Map interface.

To change between interfaces you need to load new firmware into the receiver. Please refer to our web site www.TireMonitorSystem.com/downloads.html for the latest firmware and instructions.

## 4.2. ASCII Stream RS232 interface

In this interface, the TMS Receiver simply sends an ASCII string whenever it receives a transmission from any TMS sensor. You may see transmissions from sensors on other vehicles nearby. It is up to your system to maintain a list of sensor IDs for each vehicle and filter out unwanted data.

The FAULT output is not supported and the RESET input (see 3.5) has no effect.

RS232 parameters: Baud 9600, Data bits 8, Parity none, Stop bits 1.

Each message is a fixed length. Numeric values have leading zeros. There is no separation between fields. The end of message is CR/LF so you can easily view the data with hyper-terminal. There are two types of message, pressure/temperature messages and a battery messages.

Example pressure/temperature message: `$PAB12123.45052\r\n`

| | |
|---|---|
| `$` | all message start with $ |
| `P` | pressure/temperature messages have P |
| `AB12` | sensor ID. Four hexadecimal digits. |
| `123.45` | pressure. Three digits, a decimal place then two digits. Here 123.45PSI |
| `052` | temperature above -40°C. Three digits. Here 12°C |
| `\r\n` | carriage return (ASCII=13) and line feed (ASCII=10). |

Example battery condition message: `$BAB12021.23000\r\n`

| | |
|---|---|
| `$` | all message start with $ |
| `B` | battery condition message have a B |
| `AB12` | sensor ID. Four hexadecimal digits. |
| `021.23` | battery percentage used, here 21.23%. We predict flat battery at 100%. |
| `000` | not currently used, may be any ASCII characters |
| `\r\n` | carriage return (ASCII=13) and line feed (ASCII=10) |

## 4.3. Memory Map RS232 interface

With the memory map interface, you can configure the receiver to monitor and produce alarms for the sensors fitted to the vehicle.

Key features of this interface:

- Once configured, the receiver can create a variety of "Alarms" (see 4.3.2 below) autonomously, without RS232 connection.
- You can register up to 16 sensors with the receiver to represent the wheels of the vehicle.
- Apart from "COM Logging Mode" (see 4.3.1 below) the receiver will only send RS232 data in response to a command.
- The receiver writes sensor transmissions to a non-volatile memory log, which you can retrieve through the RS232 interface.
- RS232 parameters: Baud 9600, Data bits 8, Parity none, Stop bits 1.
- The data exchange is binary (not ASCII). This document shows all values in hex.
- This interface has two main commands; memory read and a memory write. Through these, you can interrogate and alter the receiver and so perform all functions.

### 4.3.1. COM Logging mode

Normally a receiver only sends RS232 in response to a command. However, in COM Logging mode it will send RS232 whenever it receives a transmission from a sensor. (In this mode, the receiver behaves the same as the now unsupported TMS8 data logger.)

To start COM Logging mode set the Status1.IsComLogging flag (see 4.3.8) using a Memory Write command. You can do this with your own application or by using TMS Manager. With TMS Manager, click "Real Time Monitor" then disconnect it from TMS Manager *while it is in this state*.

If the Status1.Unfiltered flag (see 4.3.8) is clear, you will only see transmissions from registered sensors. If it is set, you will see transmissions from all sensors. In TMS Manager, the "Log Any Id" checkbox corresponds to the Status1.Unfiltered flag.

To end COM Logging mode, send a Null command (see 4.3.5). TMS Manager sends a Null command when you start it up or change COM port.

On each sensor transmission, you get a message like this: `08 00 32 AB 12 13 88 70 33 C8`

| | |
|---|---|
| `080032` | constant header |
| `AB12` | sensor ID |
| `1388` | pressure in PSI/100. Here 1388hex = 5000decimal = 50.00PSI. |
| `70` | temperature above -40°C. Here 30°C. |
| `33` | no meaning. Value may vary. |
| `C8` | checksum = ID + pressure + temperature = (AB+12+13+88+70) AND FF |

If the most significant byte of the pressure is set then it is actually battery condition message. The temperature byte has no meaning. The 'pressure' is 8000hex on a brand new sensor and gradually increases over the sensors life. We predict flat battery at FC00hex; you may see values up to FFFF if the battery lasts longer.

### 4.3.2. Alarms

You can configure the receiver so that its FAULT output (see 3.5 Vehicle interface) will go low on various alarm conditions. The memory locations (listed here, described fully in 4.3.8 Memory Map) enable and control each type of alarm. Each alarm has an alarm flag (memory bit) to say whether it is active and a separate enable flag to say whether the alarm flag will cause FAULT to go low. The possible alarms are:

- low-pressure alarm, a pressure threshold for each registered sensor
  See Status1.EnAlPressure, PressureAls and PresThresA.
- reception timeout alarm to trigger if sensors stop transmitting
  See Status1.EnAlNoRx, NoRxAls and MaxRxInter.
- sensor battery life low
  See Status1.EnAlLowBatt, LowBattAls, BattThres.
- receiver's power from the vehicle is below a set voltage
  See Status1.EnAlLowVoltage, Status2.LowVoltageAlarm and VoltLevel.
- user alarm
  See Status2.UserAlarm.

The alarms are non-volatile. You can clear alarms by setting alarm flags to zero through the RS232 interface. Alternatively you can pull the RESET input low (see 3.5 Vehicle interface), which zeros all alarm flags.

### 4.3.3. Memory Read command

Example message:
Host says: `85 00 00 AA`
Receiver replies: `11 22 33 44 55 AA`

The first byte `85` has the top bit set. This means 'Read'. The remaining 7 bits are the number of bytes to read, 5 in this case.

The next two bytes `0000` are the address to read from.

The final byte from the host is `AA`. It means message complete. If the receiver does not receive, it assumes the host has got out of sync and ignores everything until you send a Null command.

The receiver sends the 5 bytes of data it has read from addresses 0000-0004. In this case, the data was `1122334455`.

Finally, the receiver sends `AA`.

### 4.3.4. Memory Write command

Example message:
Host says: `05 0000 11 22 33 44 55 AA`
Receiver replies: `AA`

The first byte 05 has the top bit clear. This means 'Write'. In this case, read 5 bytes.

The next two bytes 0000 are the address to write to.

We now have the bytes to write, five of them in this case with values `1122334455`. These are written to addresses 0000-0004.

`AA` completes the message and works like `AA` did on read.

The receiver responds `AA` to confirm that it did the write.

### 4.3.5. Null command

Example message:
Host says: `00`
Receiver replies: `00`

The Null command clears the IsComLogging bit. It is a good way for a host to start a conversation that will not be interrupted by unsolicited messages.

You can use a Null Message to see whether the receiver is present.

You can use it to recover if the receiver has got out of sync (maybe because the RS232 lead was unplugged mid-flow). If the receiver sees an illogical sequence (e.g. not ending in AA), it ignores all inbound data until the next Null Message. To restore sync the host transmits `00`s until the receiver responds with 00s.

### 4.3.6. Upgrading the firmware

This is not a usual command. It initiates Bootload Mode allowing the firmware to be upgraded.
Host says: `80 54 6F 70`

If the host sends these 4 bytes (which look like an illegal 'read command') it causes the TMS11 to expect the bootload sequence. The bootload sequence itself is outside the scope of this document.

### 4.3.7. Memory Restrictions

Due to hardware implementation, all non-volatile locations in memory have a limited life. You can typically write to them 1 million time before failure, but this may be as low as 100,000 times. There is no limit on the number of reads. LogPos has special handling because it is updated frequently. Its life is a minimum of 16,000,000 writes (typical 160 million).

Within the first 256 bytes of memory, some variables have special handling, and the ways you can read/write them are restricted:

- When accessing 1-byte variables, the read or write must be a single byte read or write.
- When accessing 2-byte variables the read/write should be exactly 2 bytes.
- When accessing 4-byte variables the read/write should be exactly 4 bytes.
- When accessing data in the arrays, the read or write must be entirely within the array and may no overlap into another array or variable.

### 4.3.8. Memory Map

All 16 bit (2 byte) values are 'big endian' meaning that the high byte comes before the low byte.

| Address | Name | Default | Meaning |
|---|---|---|---|
| 0000 | DeviceId | 02 | Read Only. Identifies this as a TMS Receiver. May be used in future to distinguish between other devices or firmware branches. |
| 0001 | IfVersion | 00 | Read Only. The version of this memory map interface. This changes when there is a non-backward compatible change to this table. |
| 0002 | Version | 04(1) | Read Only. The version of the firmware. |
| 0003-0004 | MemSize | 8000 | Read Only. 16 bit value indicating the amount of memory in bytes that you may address through this interface. |
| 0005 | BufferSize | 10 | Read Only. The maximum number of bytes that you may write in a write message or read in a read message. |
| 0006-0008 | reserved | Undefined | undefined |
| 0009 | Status3(2) | 00 | Bit fields that you can read these to examine the machine state or alter them to change state. Bits are<br>0 EnAlPressH — If 1 then PressHAlarm causes the FAULT output to go low.<br>1 EnAlTempH — If 1 then TempHAlarm causes the FAULT output to go low.. |
| 000A | LogMask | 0D | Bit field that defines what will appear in the memory log. If you choose fewer items, each record will be smaller so more will fit.<br>A log record will consist only of the selected bytes in the order described below. For instance, the default 0D sets LogWheel, LogPressure and LogPressureL so a log record will consist of 3 bytes: 1 wheel and 2 pressure bytes.<br>0 LogWheel — A 1-byte wheel identifier with a value between 00 and 0F. Values of FF will be used if Unfiltered is set and the receiver receives from a sensor which has no wheel position.<br>1 LogId — The 2-byte sensor identifier.<br>2 LogPressure — The most significant byte of pressure. Each increment represents 2.56 PSI, rounded down. For instance, a value of 05 represents between 12.8psi and 15.36psi.<br>3 LogPressureL — Has no effect unless LogPressure is set. Gives additional resolution to LogPressure, adding 100th of PSI. The actual resolution is specified in section 2.2.<br>4 LogTemp — The temperature. Subtract 40 from LogTemp to get temperature in °C. For instance LogTemp=75 represents 35°C.<br>5 LogClock — Logs a 2-byte time. This is the value of Clock1 and Clock0 at the time of reception.<br>6 LogClockH — Has no effect unless LogClock is set. Causes a further 2 bytes Clock3.Clock2 to be logged.<br>7 reserved — Set to 0. |

**Note 1:** May have been updated. Please see www.TireMonitorSystem.com/downloads.html
**Note 2:** Only in firmware Version 4 onwards.

<table>
<tr><th>Address</th><th>Name</th><th>Default</th><th>Meaning</th></tr>
<tr><td>000B</td><td>Status1</td><td>7D</td><td>Bit fields that you can read these to examine the machine state or alter them to change state. Bits are
<table>
<tr><td>0</td><td>IsEeLogging</td><td>1 to enable memory logging. See LogMask, LogStart, LogEnd and LogPos.</td></tr>
<tr><td>1</td><td>IsComLogging</td><td>1 when in "COM Logging mode". See 4.3.1.</td></tr>
<tr><td>2</td><td>IsWrapping</td><td>If 0 then memory logging is stopped when IsFull is set</td></tr>
<tr><td>3</td><td>EnAlPressure</td><td>If 1 then any bit that is set in PressureAls, causes the FAULT output to go low.</td></tr>
<tr><td>4</td><td>EnAlNoRx</td><td>If 1 then any bit that is set in NoRxAls, causes the FAULT output to go low.</td></tr>
<tr><td>5</td><td>EnAlLowBatt</td><td>If 1 then any bit that is set in LowBattAls, causes the FAULT output to go low.</td></tr>
<tr><td>6</td><td>EnAlLowVoltage</td><td>If 1 then LowVoltageAlarm causes the FAULT output to go low.</td></tr>
<tr><td>7</td><td>Unfiltered</td><td>If 0, the receiver ignores receptions from all sensors except its 16 registered sensors. If 1 then the receiver will log any sensor that it can receive but still will not produce any alarms for these. When logging an un-registered ID, the wheel position will appear as FF.</td></tr>
</table></td></tr>
<tr><td>000C</td><td>Status2</td><td>00</td><td>Various bit fields. Normally the receiver will set these and you may clear them.
<table>
<tr><td>0</td><td>LowVoltageAlarm</td><td>The receiver sets this if the supply voltage drops below VoltLevel.</td></tr>
<tr><td>1</td><td>UserAlarm</td><td>You may set this if you want the FAULT output to go low.</td></tr>
<tr><td>2</td><td>IsFull</td><td>1 if LogPos has reached LogEnd.</td></tr>
<tr><td>3 - 7</td><td>reserved</td><td>Set to 0.</td></tr>
</table></td></tr>
<tr><td>000D</td><td>BattThres</td><td>7C</td><td>If a registered sensor transmits a battery condition above this level, the corresponding bit in LowBattAls is set.<br>The maximum value is 7F.</td></tr>
<tr><td>000E-000F</td><td>LogStart</td><td>0100</td><td>The location in memory where logging starts. The user software is responsible for setting this to point to empty memory before setting the IsEeLogging flag.</td></tr>
<tr><td>0010-0011</td><td>LogEnd</td><td>7FF0</td><td>If after logging to memory LogPos is greater or equal to this value then LogPos is set back LogStart and IsFull is set.<br>Be careful not to put this too close to the end of the memory. For instance if you set it to 7FFF, a 3 byte record might try to write on 7FFE, 7FFF, and 8000 - which would be bad as 8000 is not a valid address.</td></tr>
<tr><td>0012-0013</td><td>LogPos</td><td>0100</td><td>The location of the start of the next log record that will be written. You typically set this to the same value as LogStart and clear IsFull before setting IsEeLogging.<br>You must ensure that LogStart <= LogPos < LogEnd whenever IsEeLogging is set.<br>It is illegal to set LogPos to a value less than 100(hex). If you do, no records are logged.</td></tr>
</table>

| Address | Name | Default | Meaning |
|---|---|---|---|
| 0014-0015 | WPosUsed | 0000 | 16 bits to represent wheel positions 0-15 to show which wheel positions have a registered sensor. For example, on a 4-wheel vehicle, you might set this to 000F and just use the first 4 elements of the WheelIdA array. |
| 0016-0017 | MaxRxInter | 0708 | If EnAlNoRx is 1 and a sensor does not transmit for MaxRxInter seconds then a bit in NoRxAls is set. The default 0708 is half an hour. |
| 0018-0019 | PressureAls | 0000 | 16 bits to represent wheel positions 0-15. You can clear the alarms by setting this to 0000. The receiver sets the bit if a registered sensor transmits a pressure below PressureThreshold.<br>Also, see Status1.EnAlPressure. |
| 001A-001B | LowBattAls | 0000 | 16 bits to represent wheel positions 0-15. You can clear the alarms by setting this to 0000. The receiver sets the bit if a registered sensor transmits a battery condition below BattThres.<br>Also, see Status1.EnAlLowBatt. |
| 001C-001D | NoRxAls | 0000 | 16 bits to represent wheel positions 0-15. You can clear the alarms by setting this to 0000. The receiver sets the bit if a sensor does not transmit for MaxRxInter seconds; or if the receiver was switched off, MaxRxInter seconds from when it is switched back on.<br>Also, see Status1.EnAlNoRx. |
| 001E | VoltTimeout | 10 | A hold-off time for the LowVoltageAlarm in $8^{ths}$ of a second. For instance, the default 10hex is 2 seconds. This means that if the supply voltage goes low for more than 2 seconds you will get a fault but the fault is not triggered if it went low for just a second. This is useful when the receiver is de-powered so that it does not create a false alarm as the voltage fades. |
| 001F | VoltLevel | 4C | The level at which the power supply to the TMS11 will show a LowVoltageAlarm. The relationship between VoltLevel and actual voltage is:<br>Voltage = 0.217 * VoltLevel + 0.915<br>VoltLevel = 4.61 * Voltage - 4.22<br>So VoltLevel 4C(hex) is about 17.3V. The TMS11 will not work below about 9V, so the minimum sensible value is 25hex. |
| 0020-003F | WheelIdA | Undefined | 16 byte pairs to represent wheel positions 0-15.<br>Each should contain a different ID (Unless the corresponding WPosUsed bit is 0). Each pair of bytes contains a sensor id. |
| 0040-0041 | PressHAls(1) | 0000 | 16 bits to represent wheel positions 0-15. You can clear the alarms by setting this to 0000. The receiver sets the bit if a registered sensor transmits a pressure above PressHThres.<br>Also, see Status3. EnAlPressH. |
| 0042-0043 | TempHAls(1) | 0000 | 16 bits to represent wheel positions 0-15. You can clear the alarms by setting this to 0000. The receiver sets the bit if a registered sensor transmits a temperature above TempHThres. Also, see Status3. EnAlTempH. |
| 0044-0045 | PressHThres (1) | Undefined | The high-pressure alarm threshold for all wheels in $100^{ths}$ of a PSI. If any registered sensor transmits a higher pressure the PressHAls bit for the sensor is set. |
| 0046 | TempHThres (1) | Undefined | The high-temperature alarm threshold for all wheels in °C + 40. For instance TempHThres =75 represents 35°C. If any registered sensor transmits a higher temperature the TempHAls bit for the sensor is set. |
| 0047-005F | reserved | Undefined | Do not write here. |
| 0060-007F | PresThresA | Undefined | 16 byte pairs to represent wheel positions 0-15.<br>The low-pressure alarm threshold for each wheel in $100^{ths}$ of a PSI. For instance 2710(hex) = 10000(decimal) = 100.00PSI. If the wheel's sensor transmits a lower pressure the PressureAls bit is set. |

**Note 1:** Only in firmware Version 4 onwards.

| Address | Name | Default | Meaning |
|---|---|---|---|
| 0080-008F | BattLevA | Zeros | 16 bytes to represent wheel positions 0-15.<br>The receiver places the last 'energy count' received into this location. This value increases in proportion to the amount of energy that the TMS sensor has used.<br>The value is in the range 00-7F. |
| 0090-0093 | Clock | Zeros | A 4-byte counter that starts at 00000000 when the receiver is switched on and counts up once a second.<br>The receiver has a crystal accurate to 50 parts per million (4 or 5 seconds a day).<br>The bytes are, from high to low: Clock3, Clock2, Clock1 and Clock0.<br>Clock1.Clock0 is used in timeout handling (see MaxRxInter).<br>Altering these values while EnAlNoRx is set, and if EeLastRxTimeA is not updated, may cause the receiver set NoRxAls bits. |
| 0094-0097 | SerialNo | Varies | Do not write here. The A M Bromley serial number of the unit. Some number such as 00024110 (BCD; when displayed in hex you only see digits 0-9). |
| 0098-009F | reserved | Undefined | Do not write here. |
| 00A0-00BF | LastRxTimA | Zeros | 16 byte pairs for wheel positions 0-15.<br>When the receiver receives from a registered wheel, it copies Clock1.Clock0 into the location for this wheel. Internally this is used for the clock time-outs.<br>Altering these values while EnAlNoRx is set and if Clock is not updated may cause the receiver set NoRxAls bits. |
| 00C0-00FF | reserved | Undefined | Do not write here. |
| 0100-7FFF | log space | Undefined | This is typically used for the memory logs, but you can reserve space by altering LogStart and LogEnd and use it as you please. |

### 4.3.9. Clearing time-out alarms

To clear time-out alarms you need to write "0000" to 001C-001D. But also you need to write to 00A0-00BF LastRxTimA so that alarms do not re-occur immediately.

The value you need in each of the 16 values in LastRxTimA must be the least significant 2 bytes from 0090-0093, Clock.

Here is an example RS232 sequence to clear time-out alarms.

Host reads clock: `84 0090 AA`
Receiver replies: `AB CD 12 34 AA`

Host writes first half of LastRxTimA, using value 1234 from above:
`10 00A0 1234 1234 1234 1234 1234 1234 1234 1234 AA`
Receiver acknowledges: `AA`

Host writes second half of LastRxTimA, using value 1234 from above:
`10 00B0 1234 1234 1234 1234 1234 1234 1234 1234 AA`
Receiver acknowledges: `AA`

Host writes 0000 to NoRxAls: `02 001C 0000 AA`
Receiver acknowledges: `AA`

Now there will be no time-out alarms until at least MaxRxInter seconds have passed.

# 5. Operator Interface (TMS OI)

The TMS Operator Interface (TMS OI) plugs into a TMS Receiver. It displays a representation of a 4 or 6-wheel vehicle showing the pressure of each tire. It also creates a log of all received measurements.

**TMS27, The Operator Interface key features are:**

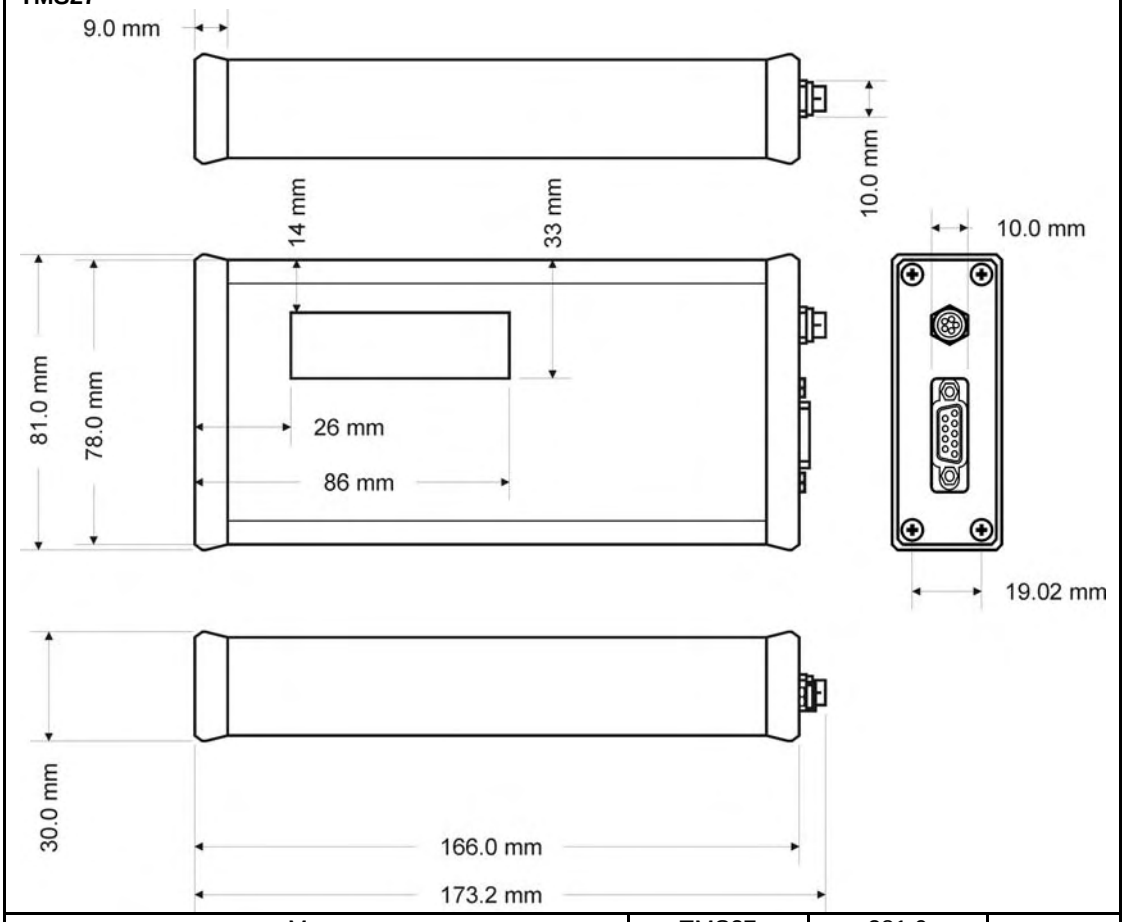
- Works with TMS Receiver (Must be running Memory Map software)
- Displays the status of each wheel including current pressure. Capable of displaying 6 wheels but is able to log more.(Logs any id)
- Logs up to 16384 receptions with real time clock (RTC)
- Can be configured through TMS Manager
- Supports alarms: low pressure, high pressure, high temperature, low battery and reception timeout
- Can sound its buzzer on alarm
- Display backlight lit when ignition input is connected.
- If TMS OI is un-powered the RTC runs on internal batteries.


## 5.1. Fitting

A velcro strip and four rubber feet will be provided to aid fitting.

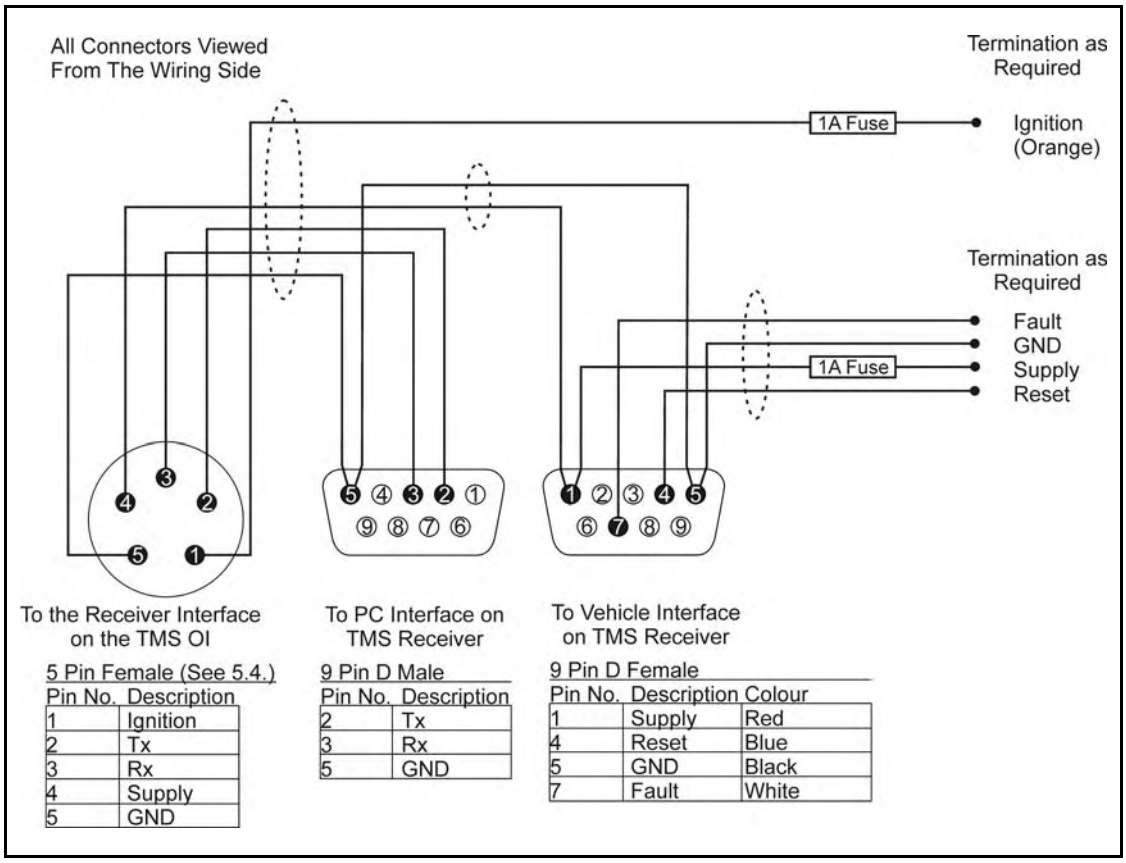
## 5.2. Physical Characteristics

**TMS27**




| | | | |
|---|---|---|---|
| Mass | TMS27 | 281.0 | g |
| Enclosure Material | Extruded Aluminium Alloy (alloy type 6063) with ABS plastic end panels | | |

## 5.3. Cable Wiring Diagram




5 Pin Female (See 5.4.)

| Pin No. | Description |
|---|---|
| 1 | Ignition |
| 2 | Tx |
| 3 | Rx |
| 4 | Supply |
| 5 | GND |

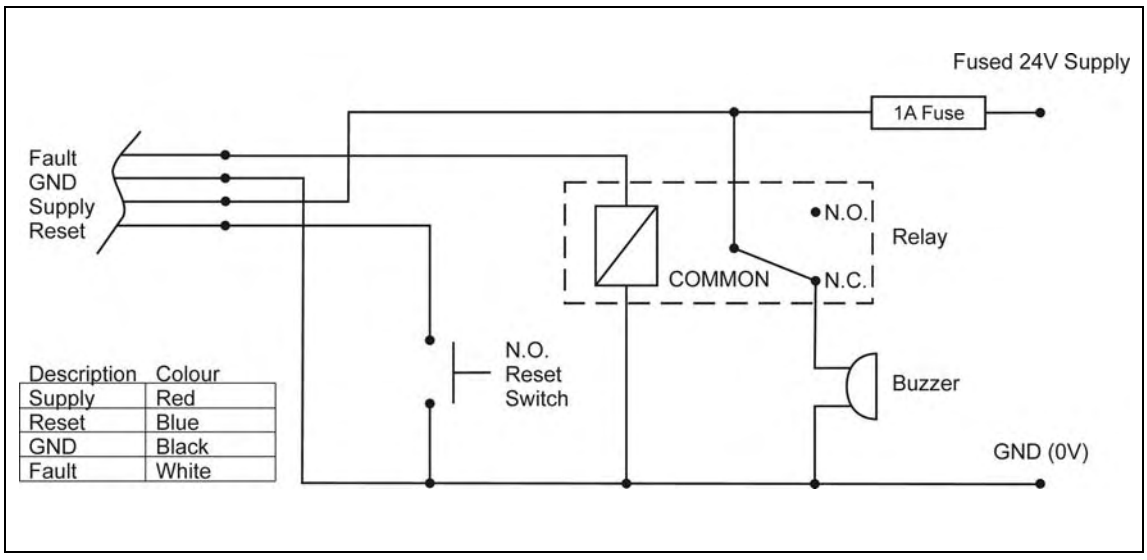
9 Pin D Male

| Pin No. | Description |
|---|---|
| 2 | Tx |
| 3 | Rx |
| 5 | GND |

9 Pin D Female

| Pin No. | Description | Colour |
|---|---|---|
| 1 | Supply | Red |
| 4 | Reset | Blue |
| 5 | GND | Black |
| 7 | Fault | White |

## 5.4. Fault and Reset Wiring

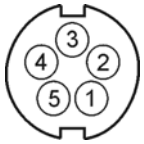



| Description | Colour |
|---|---|
| Supply | Red |
| Reset | Blue |
| GND | Black |
| Fault | White |

## 5.5. Receiver Interface

**Receiver Interface, 5 Pin Female Socket**




(Sub miniature circular connector
BINDER - 99 0096 100 05)

| Pin/Name | Description | | | | |
|---|---|---|---|---|---|
| **1** Ignition | Connect to the supply enable the backlight | | | | |
| **2** Tx | Serial from TMS OI to Receiver | | | | |
| **3** Rx | Serial from Receiver to TMS OI | | | | |
| **4** Supply | | Min | Typical | Max | Units |
| | Voltage | +12 | | +36 | V DC |
| | Current | | 100(1) | | mA |
| **5** 0V | GND | | | | |

**Note 1**: Based on 24V supply with the backlight on, a TMS Receiver connected with the sounder going.

## 5.6. PC Interface

As section 3.4

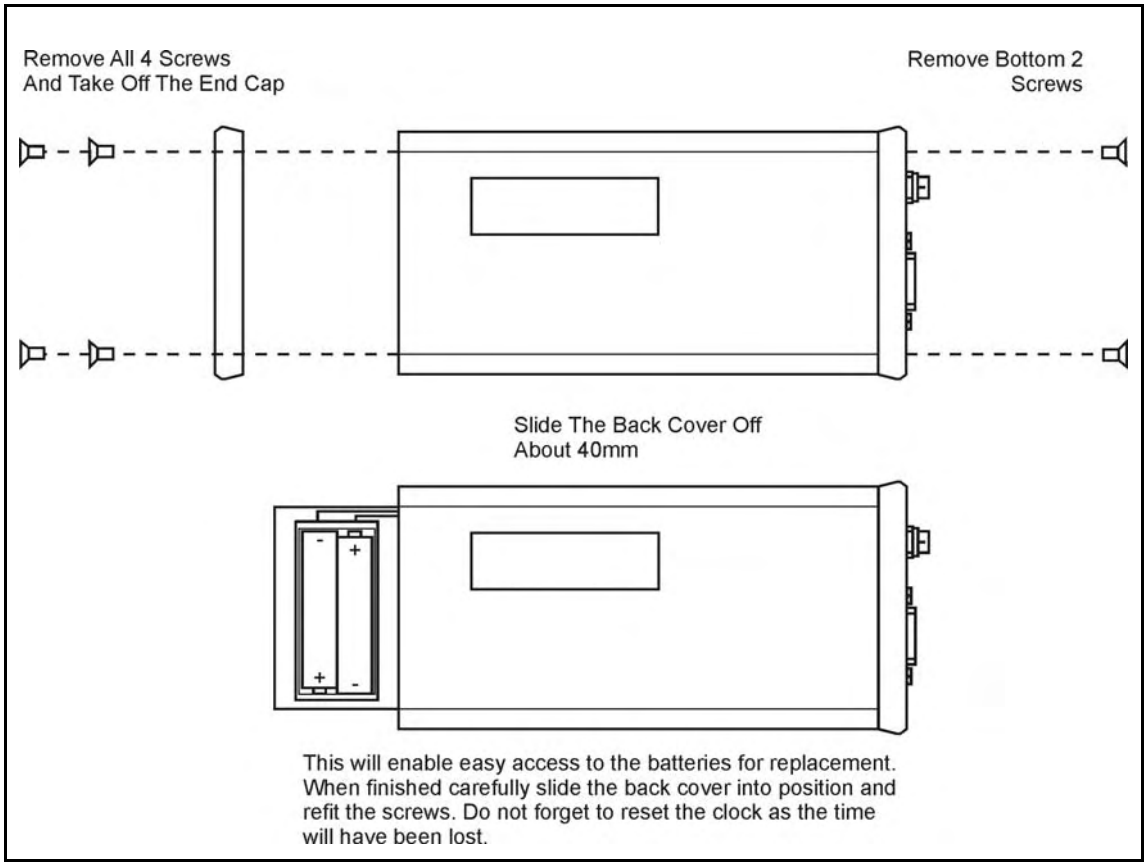
## 5.7. Backlight and Ignition Input

The ignition input can be connected to the supply to indicate that the vehicle ignition is active.
The LCD has a backlight. This comes on when the ignition input is active.

## 5.8. Back-up Battery

The TMS OI contains a pair of AAA alkaline batteries. These are only used if the TMS OI is not powered. They keep the RTC running for at least a year. Batteries can be replaced if necessary (See the image below)

It is recommended that you replace the batteries once a year. When the batteries have been changed you will need to reset the clock using TMS Manager. The manufacturer is not responsible for damage due to corrosion



## 5.9. TMS Receiver working with TMS OI

The TMS OI works by monitoring the memory log in the TMS Receiver. As part of this process it changes the TMS Receiver configuration as you plug the TMS OI as follows:

- Memory logging enabled
- COM logging disabled.
- Log wraps around when full.
- In the TMS Receiver's memory log Wheel Position, Sensor ID, Pressure and Temperature logging is enabled[(1)].

**Note 1**: If these are not enabled already on the TMS Receiver, TMS OI clears the TMS Receivers memory log when it enables them.

Through TMS Manager you can:

- Set the OI's RTC to the current time and date of your computer.
- Enable or silence the buzzer.
- Read the log memory.
- Clear the log memory.
- If a TMS Receiver is connected to the TMS OI, you can view and change any TMS Receiver configuration

Use TMS Manager to set up wheels 1 to 4 for a 4-wheel vehicle or 1 to 6 for a 6-wheel vehicle. Wheel numbers are designated:

| Wheel Position | Location |
|---|---|
| 1 | Front left |
| 2 | Front right |
| 3 | Rear left (outer if 6-wheel) |
| 4 | Rear right (outer if 6-wheel) |
| 5 | Rear left inner (6-wheel only) |
| 6 | Rear right inner (6-wheel only) |

If other wheels IDs are configured into the TMS Receiver, they are logged, but they are not displayed and there will be no warning.

## 5.10. Alarm

The TMS OI produces a warning while any fault conditions on wheels 1 to 6 are active.

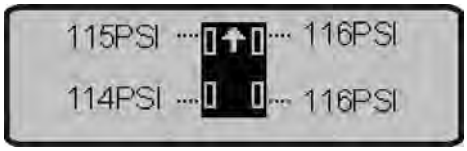
Unlike the TMS Receiver, faults do not latch and so do not need to be cleared. Faults remain active while the condition that caused them persists. For example, a low-pressure fault that starts when a tire is deflated will end automatically when the tire is inflated.

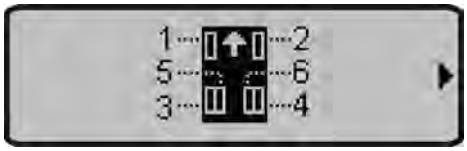
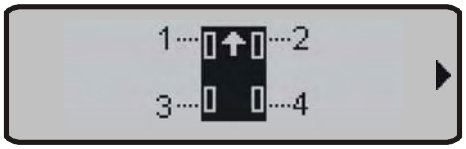
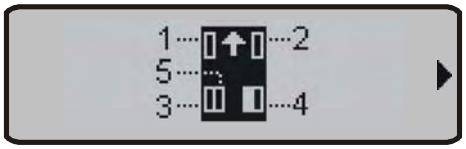
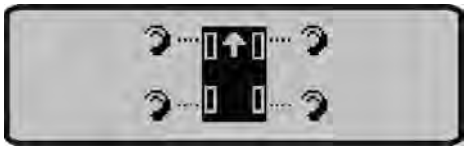
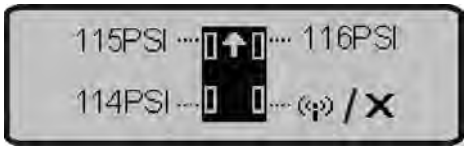
The TMS OI has a sounder that can be enabled (See 6.2) to alert you to a fault. When there is a new fault the sounder beeps 10 times (0.5s on 0.5s off). It then makes a brief reminder 'pip' (50ms beep) every 30 seconds while any alarm remains active. If all fault conditions become inactive it makes one final pip.

## 5.11. Display

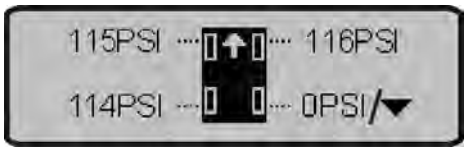
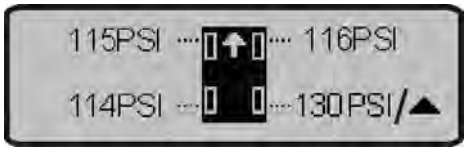
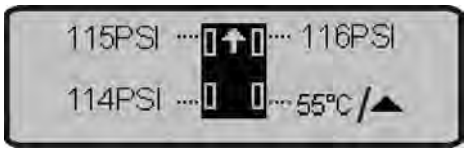
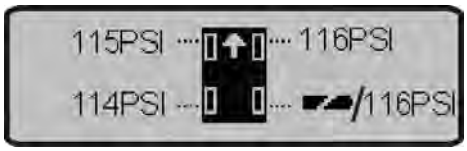
The TMS OI has a 120 by 32 pixel graphical display with backlight.

The pressure displayed is always "estimated gauge pressure" which is absolute pressure minus 14.7psi. When operational your TMS OI display will look like the image below for a four-wheel configuration.




| Description | Display |
|---|---|
| If the TMS OI is powered up and has nothing else connected it displays “No Receiver” and the current date and time. |  |
| If TMS Manager is connected but no TMS Receiver is connected to the TMS OI. A triangle is displayed on the right hand side of the display. |  |
| If TMS Manager and a TMS Receiver are connected, the TMS OI displays the wheel number. (Top image is of a six wheel configuration, the bottom of a four wheel configuration). |  <br>  |
| If the wheel is not configured it is shown as blank. (Image shows the display when connected to TMS Manager). |  |
| When first starting the TMS OI the display will show a spinning “busy” symbol. This means no data is available yet. |  |
| If reception timeouts are enabled and the set timeout period has elapsed since TMS OI started or since last reception, the TMS OI will display a radio symbol alternating with an X. (Image shows the alarm on wheel 4). |  |

| | |
|---|---|
| If low-pressure alarm is enabled and the pressure is below the set threshold it displays the pressure alternating with a down arrow. (Image shows the alarm on wheel 4). |  |
| If high-pressure alarm is enabled and the pressure is above the set threshold it displays the pressure alternating with an up arrow. (Image shows the alarm on wheel 4). |  |
| If high temperature alarm is enabled and the temperature is above the set threshold it displays the temperature alternating with an up arrow. (Image shows the alarm on wheel 4). |  |
| If battery alarm is enabled and battery used is above threshold it displays the pressure alternating with a low battery symbol. (Image shows the alarm on wheel 4) . |  |

## 5.12. Logging

Whenever it is connected to a TMS Receiver, the TMS OI logs each wheel reception. The TMS OI is capable of recording 16384 records. Based on 4 sensors being recorded with them transmitting once every 5 minutes this is approximately 14 days of continuous logging.

16384 Records/ 4 sensors / 12 Tx an hour / 24 hours in a day = 14.22 Days

It logs the date, time, wheel position, sensor ID, pressure and temperature.

If the TMS Receiver is configured to 'Log any ID', the ID will record all sensors in radio range. Otherwise it will log each of the IDs that are configured into the TMS Receiver. It logs all configured IDs, even though it only displays and alarms on wheels 1 to 6.

# 6. TMS Manager

TMS Manager is a software application to configure the TMS Receiver, download data and display data received from the sensors in real time.

You can download the program file from our web site: www.TireMonitorSystem.com/downloads.html

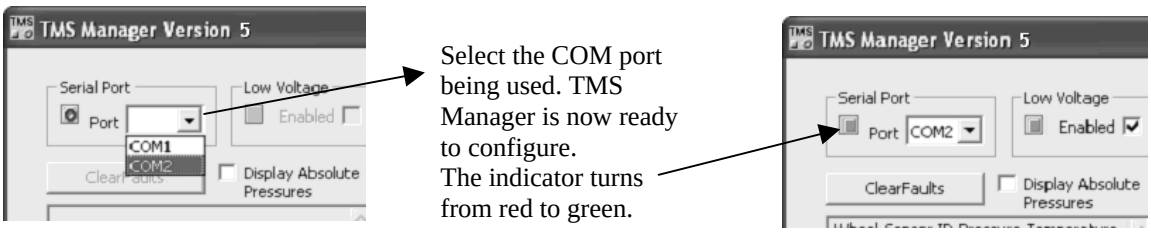
System requirements: Microsoft Windows Vista, Windows XP, Windows ME, Windows 98. 10MB of RAM

## 6.1. Getting started

STEP1
Connect the power supply to the receiver.
Do this via the vehicle interface connector.

STEP 2
Connect the computer to the 'PC Interface' connector on the receiver.
Using a straight-through 9-way serial cable connect one end to the computer COM port.
Plug the other end into the 'PC Interface' 9-way socket on the receiver.

STEP 3
Run the Windows program "TMSManager.exe"




STEP 4
Assign sensor IDs.
You can assign up to 16 TMS pressure sensors.
Click on the box next to the first wheel position that you want to assign a sensor ID.
Next, type in the sensor ID code. This can be found on the label attached to each sensor, it is a four-digit code. (The label also has the product name and a serial number, preceded by N…)
Click 'Apply'.

STEP 5
Low Pressure Level
Ensure that the relevant wheel position is enabled.
Type in the low-pressure level in PSI. Do not set the low-pressure level close to the working pressure to avoid intermittent low-pressure alarms.
Click 'Apply'.

STEP 6
Reception Timeout
If using the reception timeout feature, we advise you set it to 4 times the periodic transmission interval to avoid intermittent reception timeout alarms.
Click 'Apply'.

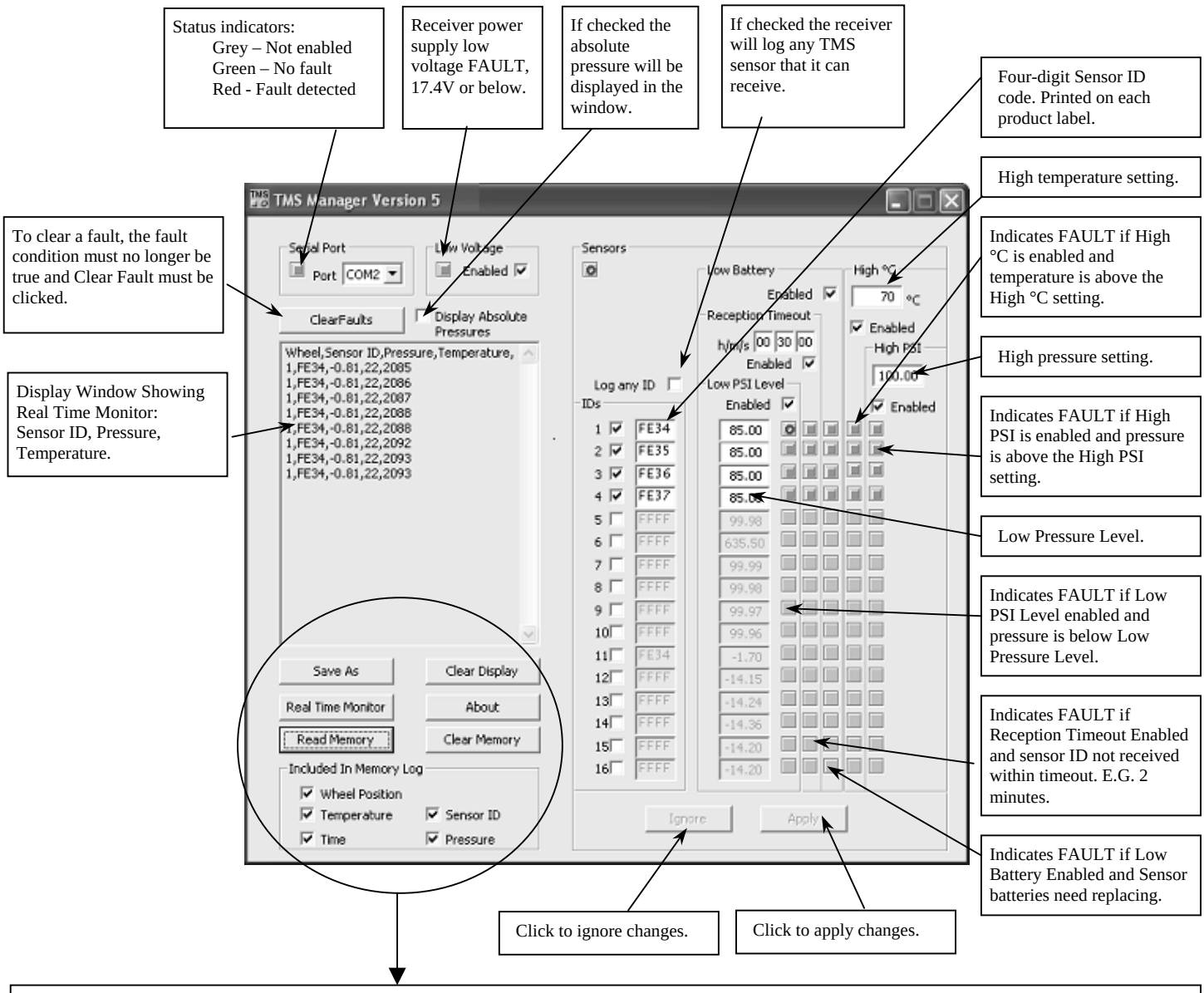
STEP 7
Enable Alarms (see 4.3.2. Alarms) by ensuring the Enabled check box is ticked for each alarm required.
Click 'Apply'.

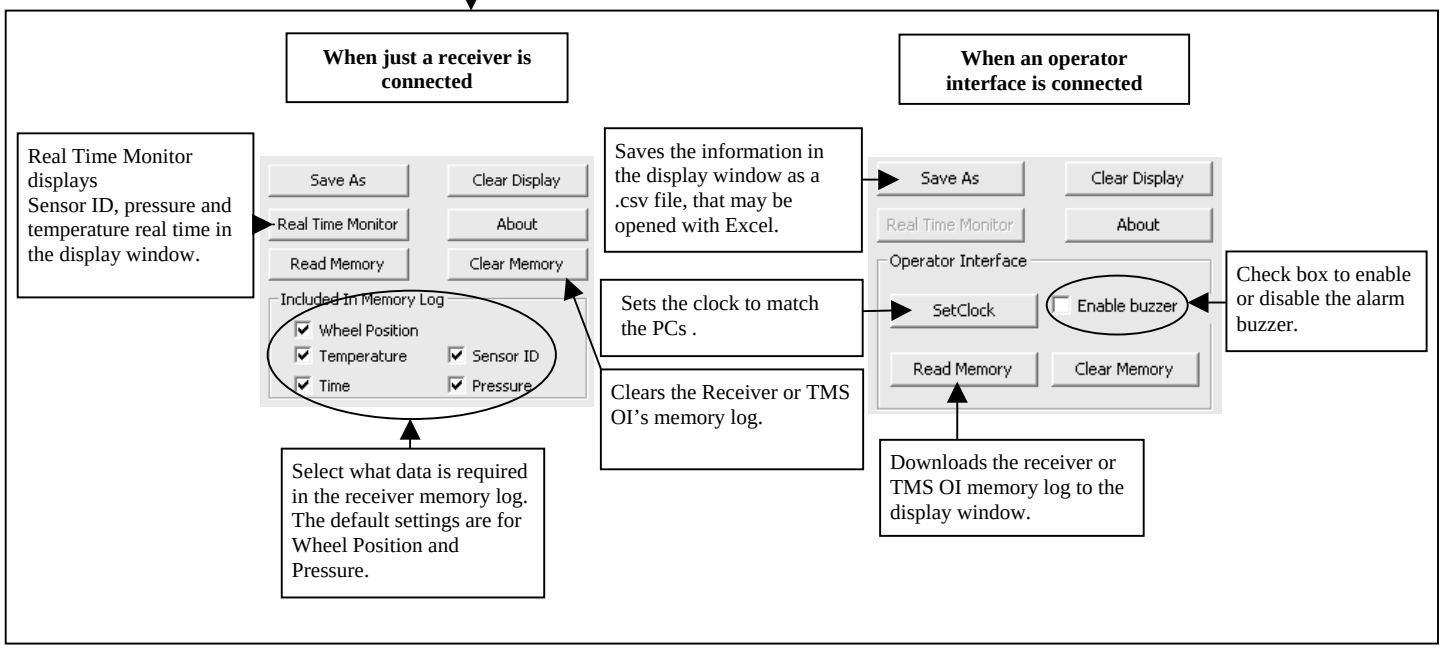
STEP 8
Log any ID. If this check box is ticked the receiver will log any TMS sensor that it can receive.

STEP 9
The system is now ready to use.

## 6.2. Features


Status indicators:
Grey – Not enabled
Green – No fault
Red - Fault detected
Receiver power supply low voltage FAULT, 17.4V or below.
If checked the absolute pressure will be displayed in the window.
If checked the receiver will log any TMS sensor that it can receive.
Four-digit Sensor ID code. Printed on each product label.
High temperature setting.
Indicates FAULT if High °C is enabled and temperature is above the High °C setting.
High pressure setting.
Indicates FAULT if High PSI is enabled and pressure is above the High PSI setting.
Low Pressure Level.
Indicates FAULT if Low PSI Level enabled and pressure is below Low Pressure Level.
Indicates FAULT if Reception Timeout Enabled and sensor ID not received within timeout. E.G. 2 minutes.
Indicates FAULT if Low Battery Enabled and Sensor batteries need replacing.
To clear a fault, the fault condition must no longer be true and Clear Fault must be clicked.
Display Window Showing Real Time Monitor: Sensor ID, Pressure, Temperature.
TMS Manager Version 5
Serial Port
Port COM2
Low Voltage
Enabled
ClearFaults
Display Absolute Pressures
Wheel,Sensor ID,Pressure,Temperature,
1,FE34,-0.81,22,2085
1,FE34,-0.81,22,2086
1,FE34,-0.81,22,2087
1,FE34,-0.81,22,2088
1,FE34,-0.81,22,2088
1,FE34,-0.81,22,2092
1,FE34,-0.81,22,2093
1,FE34,-0.81,22,2093
Save As
Clear Display
Real Time Monitor
About
Read Memory
Clear Memory
Included In Memory Log
Wheel Position
Temperature
Sensor ID
Time
Pressure
Sensors
Log any ID
IDs
Low Battery
Enabled
Reception Timeout
h/m/s 00 30 00
Enabled
Low PSI Level
Enabled
High °C
70 °C
Enabled
High PSI
100.00
Enabled
1 FE34 85.00
2 FE35 85.00
3 FE36 85.00
4 FE37 85.00
5 FFFF 99.98
6 FFFF 635.50
7 FFFF 99.99
8 FFFF 99.98
9 FFFF 99.97
10 FFFF 99.96
11 FE34 -1.70
12 FFFF -14.15
13 FFFF -14.24
14 FFFF -14.36
15 FFFF -14.20
16 FFFF -14.20
Ignore
Apply
Click to ignore changes.
Click to apply changes.


When just a receiver is connected
When an operator interface is connected
Real Time Monitor displays
Sensor ID, pressure and temperature real time in the display window.
Save As
Clear Display
Real Time Monitor
About
Read Memory
Clear Memory
Included In Memory Log
Wheel Position
Temperature
Sensor ID
Time
Pressure
Saves the information in the display window as a .csv file, that may be opened with Excel.
Sets the clock to match the PCs .
Clears the Receiver or TMS OI's memory log.
Select what data is required in the receiver memory log. The default settings are for Wheel Position and Pressure.
Operator Interface
SetClock
Enable buzzer
Check box to enable or disable the alarm buzzer.
Downloads the receiver or TMS OI memory log to the display window.

## 6.3. Memory Log (TMS Receiver)

### 6.3.1. Saving the memory log

The parameters to be logged in the memory must be selected from “Included In Memory Log”. If, for example, all the parameters where ticked in “Included In Memory Log” then these are the columns that you will get from the log:

Wheel Position, Sensor ID, Pressure, Temperature and Time (seconds since the TMS was powered).

To obtain a .CSV file you need to “Clear Display”, then “Read Memory”. When you “Save As” it simply copies everything in the display window to the file.

“Clear Memory” deletes the memory log.

The “Read Memory” button is greyed-out until records are logged.

### 6.3.2. Working out the memory log time

With 8 sensors running we calculate that it will take 42 hours to fill the memory log:

| | |
|---|---|
| Log memory in TMS11 receiver: | 32490 bytes |
| Each record is 8 bytes maximum: | Sensor ID 2 bytes<br>Pressure 2 bytes<br>Wheel Position 1 byte<br>Temperature 1 byte<br>Time 2 bytes |
| Each sensor transmits every: | 5 minutes = 12 timers per hour |
| Log time: | 32490 / 8 / 12 / 8 = 42 hours |

Sensors normally transmit every 5 minutes (see datasheet section 2.4), but will transmit more frequently if there is a change (section 2.5). If there are changes it will reduce the hours.

Logging fewer parameters will increase the log time. For example logging only sensor ID and pressure: 32490/4/12/8 = 84 hours

Once the memory log is full it will start recording over the oldest records.