

# Tyre Cavity Microphone Type TCM<sup>®</sup>-LP rev8-LP March 2020

## Product Data and Specification

### Applications:

- Tyre cavity resonances
- Tyre tread noise
- Road noise route tracking
- Tyre coast by noise testing

### Features:

- Installs securely inside the tyre
- Recharge while inside wheel
- Data immune from environmental noise
- Radio linked
- Radio controlled
- Robust design
- Retains wheel balance
- Tyres inflated as normal
- Wheels run to speeds of 160+ kph

Figure 1. TCM installed on test wheel



TCM is a remote controlled radio microphone designed to capture the noise inside the tyre's cavity.

A TCM system comprises two small curved aluminium modules, interconnecting cable, radio receiver with integral antenna, magnetic antenna with 5 metre cable., for in vehicle recording.

The two aluminium modules are tensioned against the wheel hub by a stainless steel harness. The modules are connected by a multi-core umbilical cable that includes the antenna.

The TCM is controlled by a radio key fob. On standby the TCM battery lasts 8 days and when transmitting continuously 8 hours. It can be turned off between recordings to allow recording over several days.

The radio receiver, with BNC socket, provides an output signal suitable for all analysis and recording systems.

The radio link range is dependant on wheel and vehicle body screening but is typically > 10 metres.

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## Tyre Cavity Microphone Type TCM

**Figure 2. Both TCM modules**



### Fitting the TCM inside the tyre

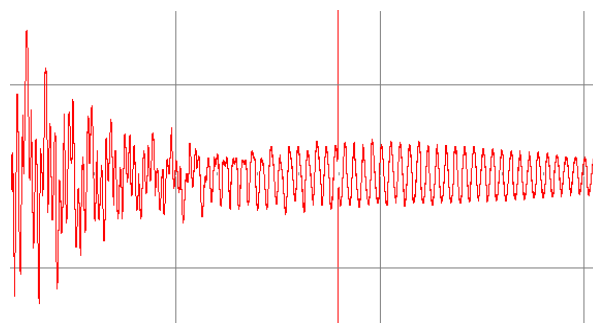
Each TCM module has a harness of stainless steel wire rope attached to each end. The harness is terminated with an eyelet. The combined length of the TCM modules & harnesses allows fitting to wheel rim sizes from 13" upwards. The TCM modules are tensioned against the wheel hub using two good quality cable ties of appropriate length. The interconnecting antenna cable is located against the wheel hub & wire rope using four small cable ties.

Once the tyre is fitted and inflated the TCM when activated, using the radio key fob, will transmit the internal tyre SPL continuously.

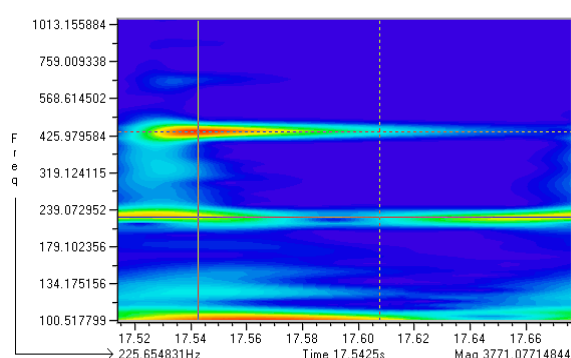
Operation of the system and static resonant frequencies can be checked by tapping the tyre. The response measured by the TCM will contain the first 6-8 cavity and structural modes. The primary cavity mode will normally be the strongest and will be at 200Hz +/- 40Hz.

Coasting down in the laboratory on a smooth steel road wheel from 100kph will reveal deep modulations of the tyre cavity resonances. When on the road the same modulation effects are observed with additional inputs from the road surface textures adding to the SPLs.

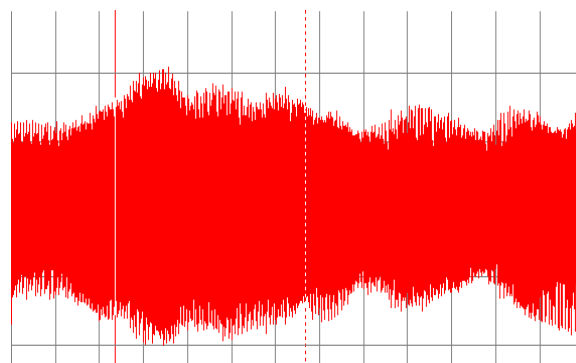
**Figure 3. Response of the Tyre cavity to a tap on the tyre tread**



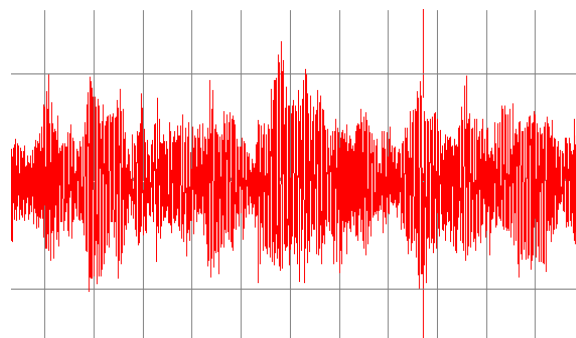
**Figure 4. Time /frequency analysis (wavelet) of a tyre tap showing two cavity and one structural mode**



**Figure 5. Cavity resonances during a laboratory coast down**



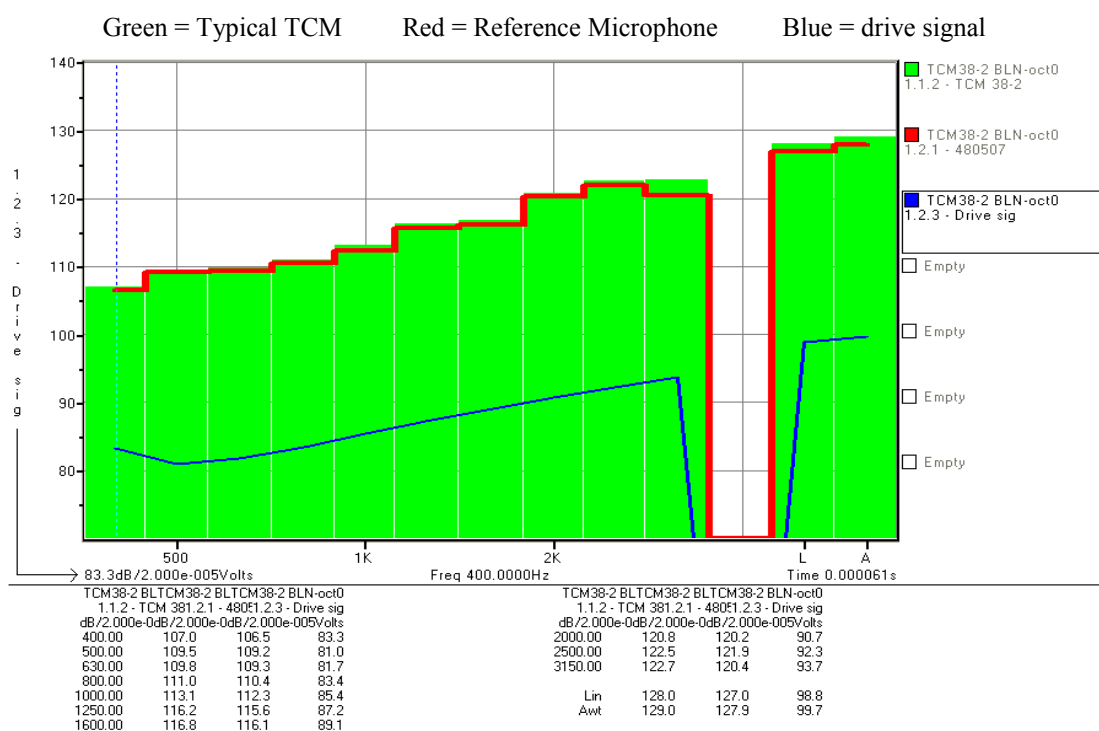
**Figure 6. Cavity resonances whilst driving on road**



## Tyre Cavity Microphone Type TCM

The TCM is designed to be used in the reverberant environment of an automotive tyre. The sensitivity of the TCM system is designed to cope with the normal shocks and inputs suffered by a tyre on a road vehicle. The calibration is therefore carried out at much higher levels than normal i.e. 130dB. The method of calibration is to compare the performance the TCM inside a travelling wave tube with that of a reference microphone. This method of calibration guarantees that each TCM will accurately measure at the very high noise levels found inside a tyre and have a flat frequency response over the frequency range of interest.

**Figure 7. Typical travelling wave tube 1/3rd Octave response of TCM compared to reference microphone**



### Specifications

Values quoted for 21 degrees C

**Nominal sensitivity:**

At 800Hz ..... 0.2mV/Pa

Frequency Response +/- 2dB ..... 50Hz-10kHz

Upper limit of dynamic range ..... 146 –150 dB re. 20µPa

dynamic range..... 80dB

Temperature range..... -10°C to + 60°C

Shock..... 10g

Output Impedance..... < 50 Ohm

Output..... BNC

Umbilical/Antenna Cable lengths..... 220/600/800/900mm

Dimensions.....length=119mm, width= 44mm, thickness= 15mm

Weight.....per module..... 190 g

## Tyre Cavity Microphone Type TCM

### **Specifications continued**

**Power supply**.....internal rechargeable battery

**Charge cycle**

**Stand-by time**..... 8 days

**Transmit time**..... 8 hours

Typical combination.....2 days standby then operate for 6 hours

(Each day on standby reduces recording time by 1hour and 5 minutes)

**Predicted battery life**..... 500 cycles

(never let the battery fully discharge as this will result in reduced capacity thereafter)

Optional the battery may be recharged while inside the tyre.

(This is achieved using a modified valve stem )

**Radio Link** (Certified for the EU; operate only in test cells and private test tracks where RF regulations differ from EU)

**Activation radio range**..... 5-15 metres

**Data transmission range**..... (dependant on wheel up to )... 3-15 metres

### **Accessories included**

**Number**

*Umbilical cable with integral antenna*

2

*Vehicle external magnetic mount for antenna*

1

*5 meter RF cable (magnetic mount to BNC)*

1

*Battery charger*

1

### **Three (3) Year Warrantee extendable to five (5) years**

Fitting the TCM inside the tyre cavity and the environment inside the tyre are less than benign. To make TCM ownership as risk free as possible Bay Systems offers a three (3) year warrantee. This can be extended to five years @ 15% of current list price.

The guarantee covers the repair or replacement of the entire TCM system, provided no seal has been broken, for all failures except the destruction of the TCM due to detachment inside the wheel or damage caused by tyre fitting machines. In the case of tyre fitting and detachment inside the wheel a replacement TCM will be offered at a 40% reduction to current list price.

N.B. As technology and requirements evolve the performance of the TCM will change; please check that you have the most recent specification and pricing information.

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