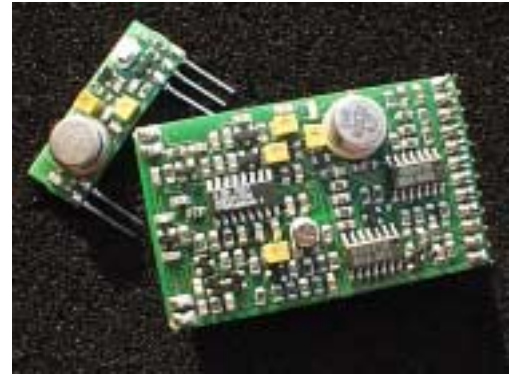


## UHF Radio Telemetry Receiver Module

UK Version - RXM-418-10

Euro Version- RXM-433-10

**The RXM-UHF radio receiver and the matching DTI approved transmitter (TXM-UHF) are self contained, PCB mounting modules capable of transferring analogue or digital data up to a distance of 200m.**



left: TXM Transmitter

right: RXM Receiver

### Features:

- PCB Mounting
- 418 MHz SAW controlled wide band FM reception
- Selective double conversion superhet
- Sensitive typ. 0.35 $\mu$ V for 10dB S/N
- High data rates, 10 kbps
- Analogue and Digital data outputs
- Receive signal strength output
- Carrier detect output
- Jamming signal detector
- Fast enable time. < 5ms for duty cycle power save use
- Logic compatible supply (5.0V @ 20 mA)
- Antenna Tamper sensing
- 433.92MHz version available

These modules are most commonly employed in Wireless Security systems.

The transmitter is approved to DTI (RA) specification MPT 1340 thus avoiding the need to submit the finished product for approval. The receiver provides all the outputs necessary to satisfy the requirements of a class 5, BS6799 wireless alarm system.

The modules are also suitable for general purpose telemetry/telecommand where their small size and high data rates may be used to advantage.

### Typical applications include:-

- Domestic and commercial security
- Guard patrol/lone worker protection
- Medical Alert/Nurse Call system
- Mobile panic attack
- Computer networking
- Remote industrial process monitoring
- Data transfer through hazardous environments
- Lighting control, Garage door openers
- Fire alarms
- Picture/antique protection alarms
- Remote control, Access control

## Absolute Maximum Rating

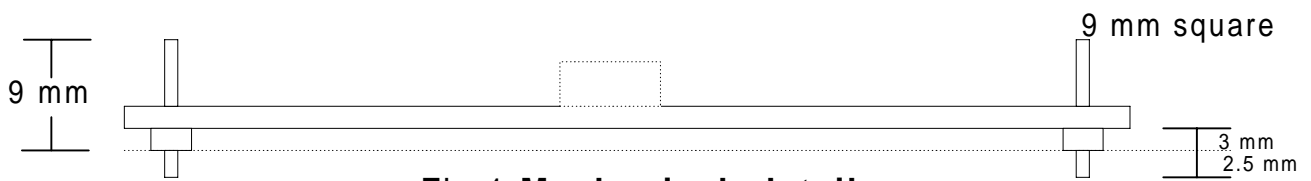
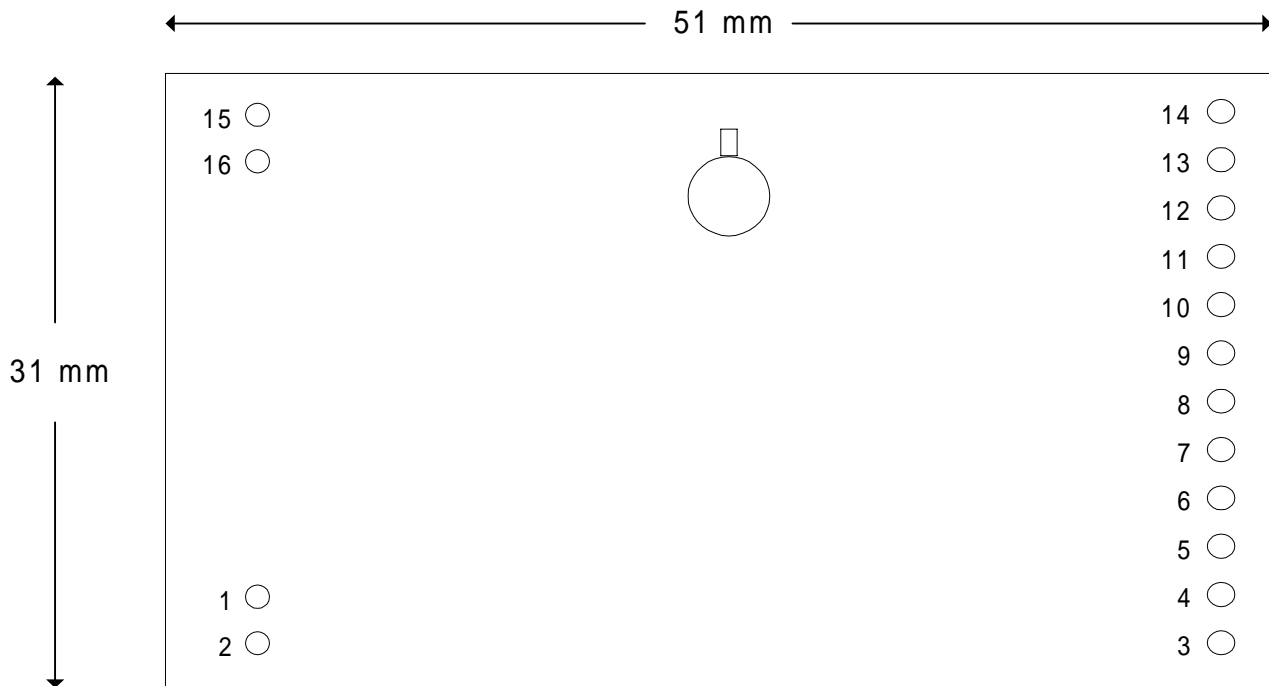
Supply voltage Vcc, pin 13	-0.3V to +8.0V
RF input, pin 1	0dBm
Any input or out put pin	-0.3V to Vcc V, $\pm$ 10mA
Operating temperature	0°C to +40°C
Storage temperature	-40°C to 100°C

## Performance Data

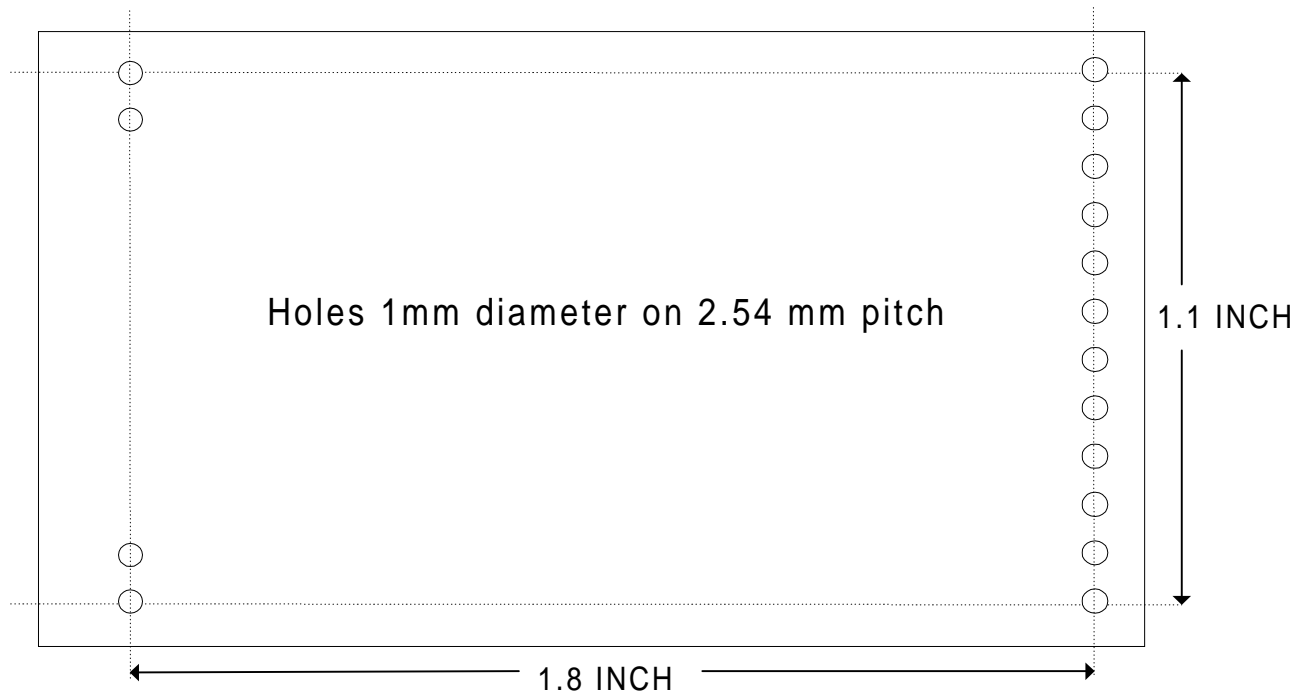
ambient temperature	20°C
supply voltage	+5.0V unless noted otherwise
test circuit	Fig 3

Parameter	Min	Typical	Max	Units	Notes
Operating supply range (Vcc) pin 13	4.5	5.0	5.5	V	
Supply current pin 13	17	21	27	mA	
Receive frequency	-	418	-	MHz	
Overall frequency accuracy	-80	0	+80	kHz	1
Sensitivity for 10dB S/N pin 1	-	0.35	1.0	$\mu$ V	2
Sensitivity for 20dB S/N pin 1	-	0.7	2.0	$\mu$ V	2
Jam det, threshold pin 1	-	10	-	$\mu$ V	
Carrier det, threshold pin 1	-	3	-	$\mu$ V	
RF input impedance pin 1	-	50	-	$\Omega$	
IF bandwidth	-	250	-	kHz	3
AF output level pin 4	-	400	-	mV <sub>pp</sub>	2,3
AF bandwidth, -3dB pin 4	DC	-	10	mV/kHz	4
Logic low, pin 6,8,10,11	0	0.2	0.5	V	5
Logic high, pin 6,8,10,11	4.5	5	5	V	6
Antenna tamper detector pin 1	0	-	5	k $\Omega$	9
Sig. strength dynamic range pin 9	20	30	-	dB	
Sig. strength FSD pin 9	3.0	3.3	3.6	V	
Sig. strength O/P resistance pin 9	6.6	6.8	7.0	k $\Omega$	
enable time pin 11	-	2	5	ms	3,7
signal detect time pin 11	-	1	3	ms	3,8

- notes -
1. Temperature 0°C to 40°C
  2.  $\pm$  25 kHz deviation, 2 kHz tone
  3. 3 $\mu$  V input
  4. The conversion slope is -ve on the 418 MHz version
  5. 10mA sink
  6. No load, (from 22k $\Omega$  internal pullup)
  7. From application of supply to carrier detect low
  8. From application of signal to carrier detect low
  9. For logic high on pin 8



**Fig 1 Mechanical detail**



**Fig 2 PCB mounting detail (top view)**

## Pin Description

pin 1	<b>RF IN</b>	The receiver antenna connects to this 50Ω input. A 22 kΩ pull up resistor, internal to the module is used for 'tamper' sensing on this pin.
pin 2	<b>RF GND</b>	This pin should be connected to any ground plane against which the antenna works. It is internally connected to pin 3,14,15 & 16
pin 3	<b>0V</b>	Ground for supply
pin 4	<b>AF</b>	This is the FM demodulator output. It has an output impedance of 330Ω and a standing DC bias of approximately $\frac{V_{CC}}{2}$
pin 5	<b>Min</b>	The voltage on this pin is the peak -ve at pin 4 (AF). A resistor between this in and pin 7 (Max) controls the data slicer's transient response.
pin 6	<b>Data out</b>	This CMOS compatible output from the data slicer is a squared version of the signal on pin 4 (AF). This signal is used to drive external digital decoders, it is true data (ie as fed to the transmitters data input).
pin 7	<b>Max</b>	The voltage on this pin is the peak +ve at pin 4 (AF).
pin 8	<b>Tamper</b>	This CMOS compatible output goes low if the DC resistance of the antenna exceeds 5kΩ to 0V.
pin 9	<b>RSSI</b>	Received Signal Strength Indicator. 0V to 3.3V.
pin 10	<b>JAM</b>	This CMOS compatible output goes low when a strong greater than a period of time determined by a capacitor on pin 12 (JAM TC)
pin 11	<b>DET</b>	This CMOS compatible output goes low when an incoming signal has sufficient strength to provide a clean decodable signal at pin 6 (DATA).
pin 12	<b>JAM TC</b>	A capacitor between this pin and ground controls the jamming detectors delay time.
pin 13	<b>Vcc</b>	Positive supply of 5V ± 10%. The supply must be clean, stable (<10mV ac) and free of high frequency digital noise. A 10μF supply decoupling capacitor is recommended.
pin 14,15,16	<b>0V</b>	Ground to earth plane

## Typical Performance Data

ambient temperature 20°C  
 supply voltage +5.0V  
 test circuit Figure 3

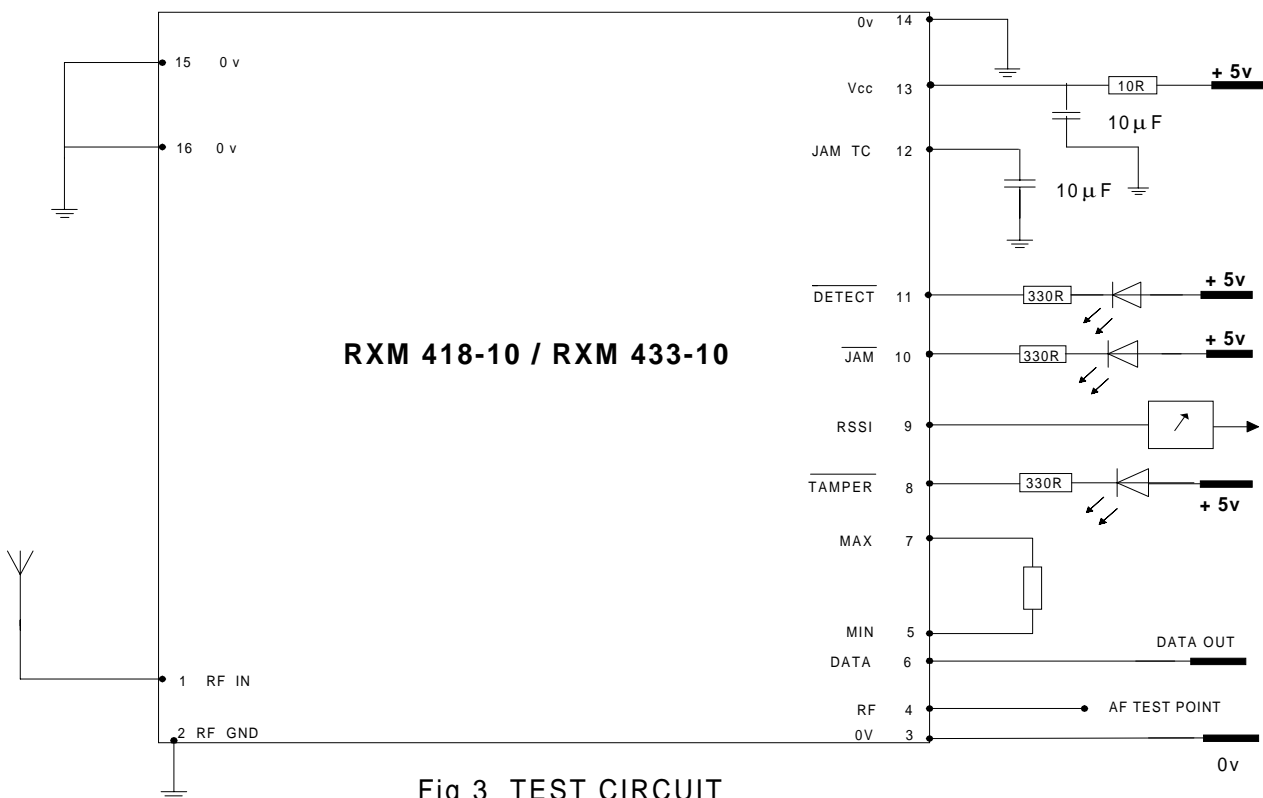
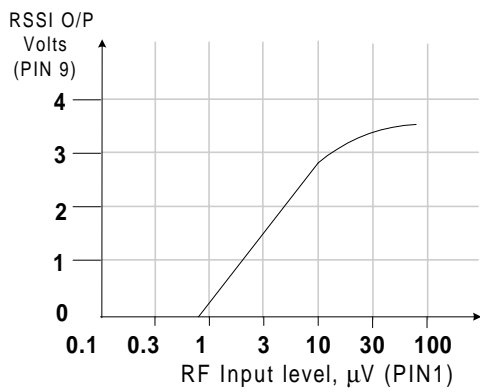
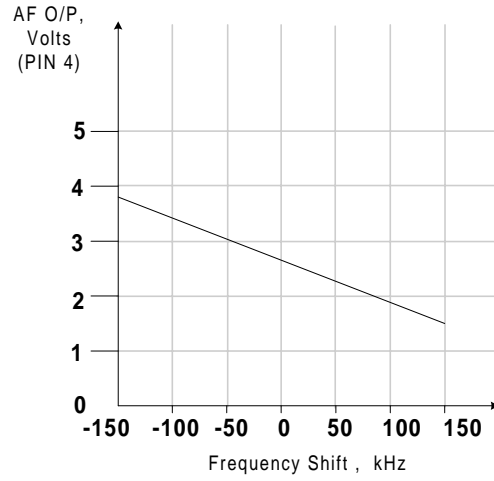
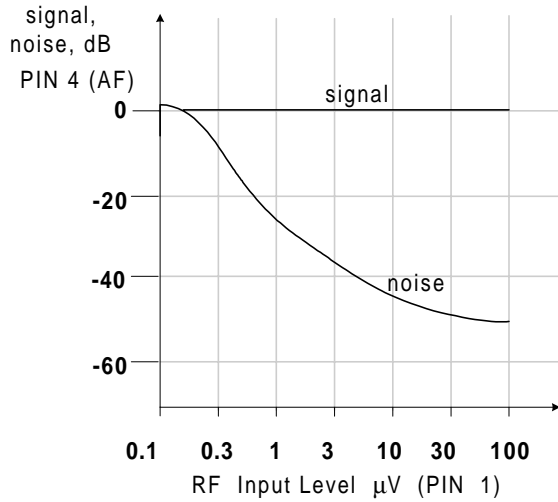
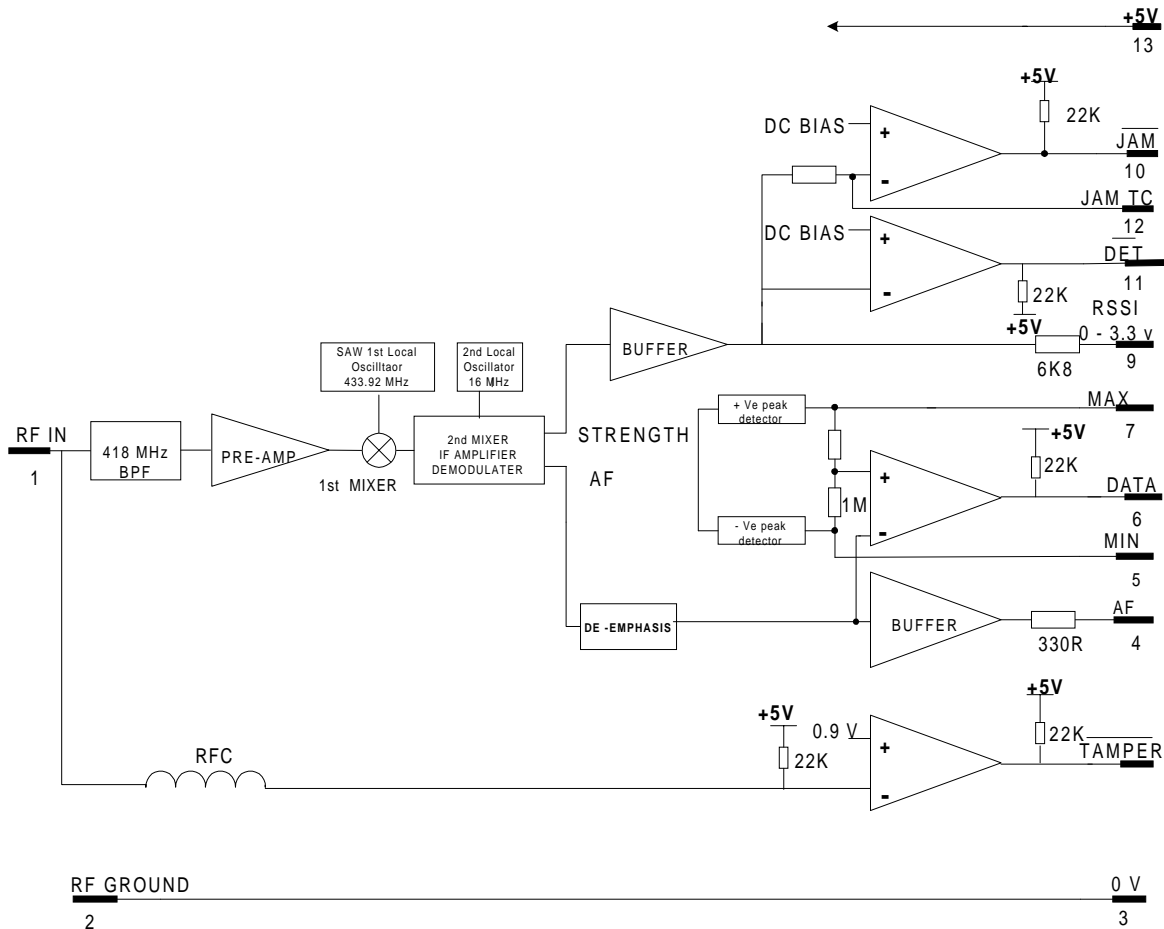


Fig 3 TEST CIRCUIT

## Application Notes



Internal block. Fig 4

The simplest applications of the module requires only 3 connections, +5V supply, ground and the data output. A simple quarter wave antenna (17cm of wire or track on pin 1) will give good results. A 10µF supply decoupling capacitor is recommended directly on pin 13.

### ANTENNA

The positioning of the antenna is of the utmost importance and is the main determining factor of system range, the following notes should assist in obtaining optimum performance:-

Keep it clear of other metal in the system, particularly the 'hot' end. The best position by far, is sticking out the top of the product. This is often not desirable for practical/ergonomic reasons thus a compromise may need to be reached. If an internal antenna must be used try to keep it away from other metal components, particularly large ones like transformers, batteries and PCB tracks/earth plane. The space around the antenna is as important as the antenna itself.

Keep it away from interference sources, bad interference can easily reduce system range by a factor of 5. High speed logic is one of the worst in this respect, fast logic edges have harmonics which extend into the UHF band and the PCB tracks radiate these harmonics most efficiently.

Single chip microprocessors and ground planed logic boards reduce this problem significantly. A simple test for interference is to monitor the RSSI output of the receiver, there should be no change in the reading when the logic circuits are run or held reset. Interference can also be easily identified by listening to the AF output of the receiver, smooth white noise should be heard.

## ANTENNA TYPES

Any of the integral antenna shown in the data sheet for the transmitter module (TXM-418-5) is suitable for use on the receiver. Additionally a coax fed external dipole or ¼ wave ground plane antenna may be considered if system range is paramount. A 2.2kΩ resistor wired across the coax at the antenna end will allow tamper detection (cutting) of the coax using at the tamper sense facility in the receive module; pin 8 will go low if the coax is cut.

## DATA SLICER

A CMOS compatible data output is available on pin 6, this output is normally used to drive a digital decoder IC or a microprocessor which is performing the data decoding. The signal detect output on pin 11 may be used to gate the data output before it is supplied to a decoder, however this should only be done on systems with 'weak' digital coding i.e where there is a danger of the decoder giving false outputs on the 'noise data' which is present on pin 6 when no valid signals are being received. Systems with good CRC, checksum or repeat code verification will not require the 'noise data' to be gated off and as a result will be able to decode weaker signals (ie greater range).

The data detect output on pin 11 is normally used for duty cycle power saving for portable equipment where battery life is a problem. By pulsing the receiver on/off the average supply current may often be reduced by a factor of 20 or more depending upon the system requirements, the data detect output is valid 5ms after application of the supply and is used to inhibit the power saving while data decoding is done.

The data slicer in the receiver module is designed to accept data with a wide range of pulse widths and mark: space ratio's. The voltage waveform on pin 4 (AF) is fed to 2 peak detectors, one +ve, one -ve and a comparator threshold is set half way between the max and min voltage, a small amount of hysteresis is applied. The data on pin 6 is the output of this comparator.

The data slicer has a transient response time, this is the settling time/hold time of the peak detectors. It is programmable by an external resistor between pin 5 & 7 (min & max). With no resistor fitted (normal use) the data slicer settles in approx 300ms from reception of a coded signal (ie the first 300ms of signal may be corrupt at the data output) and will pass pulse widths up to 50 ms of continuous 1 or 0.

A resistor between pin's 5 & 7 shortens these time ie

Resistor Value (pin 5 to 7)	Code Preamble (minimum length)	Longest 1 or 0 allowed
Open Circuit	300ms	50ms
1 MΩ	150ms	25ms
220 kΩ	30ms	5ms
47 kΩ	7.5ms	1.3ms

## JAMMING DETECTOR

provides a logic 0 on pin 10 when a strong signal of greater than 10 $\mu$ V is being received. The detector may be set to give a delayed output by connecting an electrolytic capacitor between pin 12 (JAM TC) and 0V. The delay is approximately  $0.7s/\mu F$  ie a 10 $\mu F$  capacitor will need the jamming signal to be present for 7s before pin 10 goes low. The delay time will be subject to the electrolytic's tolerance so may vary widely. For accurate/long delays it is recommended that a delay of 7s (10 $\mu F$ ) to be used and the jam signal be fed to a digital timer to determine the required delay.

## AF OUTPUT

This output is the FM demodulator's output after buffering and de-emphasis. Since it is taken before the data slicer in the module, it may be used to drive external data slicers/demodulators in cases where the internal data slicer is not suitable. This is the case where an analogue subcarrier is being employed eg 2 tone AFSK or DTMF tones. In these cases the AF Output is used to drive the FSK/DTMF decoder directly.

The AF Output is also a very useful test point for listening for signals or interference. The output will drive low impedance headphones via a 10 $\mu F$  DC blocking capacitor for monitoring purposes. The phones should not be left connected during normal system operation as their low impedance will cause a certain amount of audio distortion which may upset the on board data slicer, if permanent audio monitoring is required a Hi-Z (>1k $\Omega$ ) buffer should be used to drive the headphones.

The AF Output is DC coupled to the FM demodulator thus the DC level varies with the frequency of the incoming signal and may be used to check frequency shifts / drifts between the transmitter and receiver.

Note - the polarity of this signal is different on different frequency versions of the module, check the specific data sheet for polarity.

## RSSI (Signal Strength) OUTPUT

This is also very useful for monitoring the performance of the radio link. It is a 0V to 3.3V signal which increases logarithmically with increasing incoming signal strength. There is an internal 6.8k $\Omega$  resistor in series with this output so that a 0.5mA fsd meter may be connected directly to this output for monitoring purposes. In more sophisticated systems this signal may be fed to an A-D converter to automatically monitor the integrity of the radio link.

## Additional Reading

BS 6799	- British Standard for Wire-free intruder alarm systems
BS 4737	- British Standard for Intruder alarm systems in buildings from British Standards Institution - 0171 629 9000
MPT1340	- DTI type approval specification for 418MHz Telemetry from Department of Trade and Industry 0171 211 0502 or 0171 211 0505 e-mail: library@ra.gtnet.gov.uk
ARRL HANDBOOK	- Excellent radio engineering text
ARRL ANTENNA BOOK	- Practical antenna design book from Radio Society of Great Britain - 01707 659 015 or 01707 663 279



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