RVC 400T FCC Certification Application
FCC ID# N8K-4401B

RVC400T Transmitter
Circuit Description

Keypad
Four momentary buttons are constructed with contacts on the circuit board (etched as part of the traces on the board) and metal snap dome components affixed with tape. Pressing a rubber pushbutton on the front panel of the hand-held transmitter pushes an integral rubber plunger that in turn presses the metal dome and causes the contacts to close. These domes are specified for several million operations before failure and only make contact while the operator is holding pressure on the front panel rubber pushbutton. They can not be "latched" down and therefore ensure only momentary operation.

Code Generator Chip
The code generator integrated circuit is connected to the four keypad switches as outlined above, as well as a 4MHz resonator, a led indicator, a low battery detection circuit, and an RF transmitter module. As long as a button is being held down, the code generator applies power to the transmitter module and emits the control code for the button to the RF transmitter module.

Low Battery Detection Circuit
This circuit generates a logic signal that is used to feed to the generator chip. When the battery is low, the open collector output of the detection circuit is pulled low, and this low signal is used by the code generator chip to determine when to flash the led.

RF Transmitter Module
An "Off the shelf" complete turn-key module (p/n TXM-418-F) requiring power, input signal, and antenna connections is utilized. Please see the attached data sheet provided by Radiometrix.

T-Pad Attenuation Circuit
A 3 resistor circuit is used to provide a matched attenuator between the RF output of the transmitter module and the antenna. During certification testing it was found that this attenuator is not needed and this 3 resistor network is strapped with 0 ohm resistors enabling a "straight through" connection from the output of the transmitter module to the antenna.

Antenna & Ground System
A helically wound antenna is utilized which consists of 26 turns of .020" diameter wire on a 0.125" diameter nylon form. It is installed in a small grommet protruding from the end of the enclosure and then soldered directly to the circuit board. This is a **permanently installed antenna and is not replaceable by the end user.** The unit must be sent back to the factory for repair or replacement if broken.

Block Diagram
The attached block diagram details all circuit functions introduced above and also shows all of the oscillators in RVC400T device.

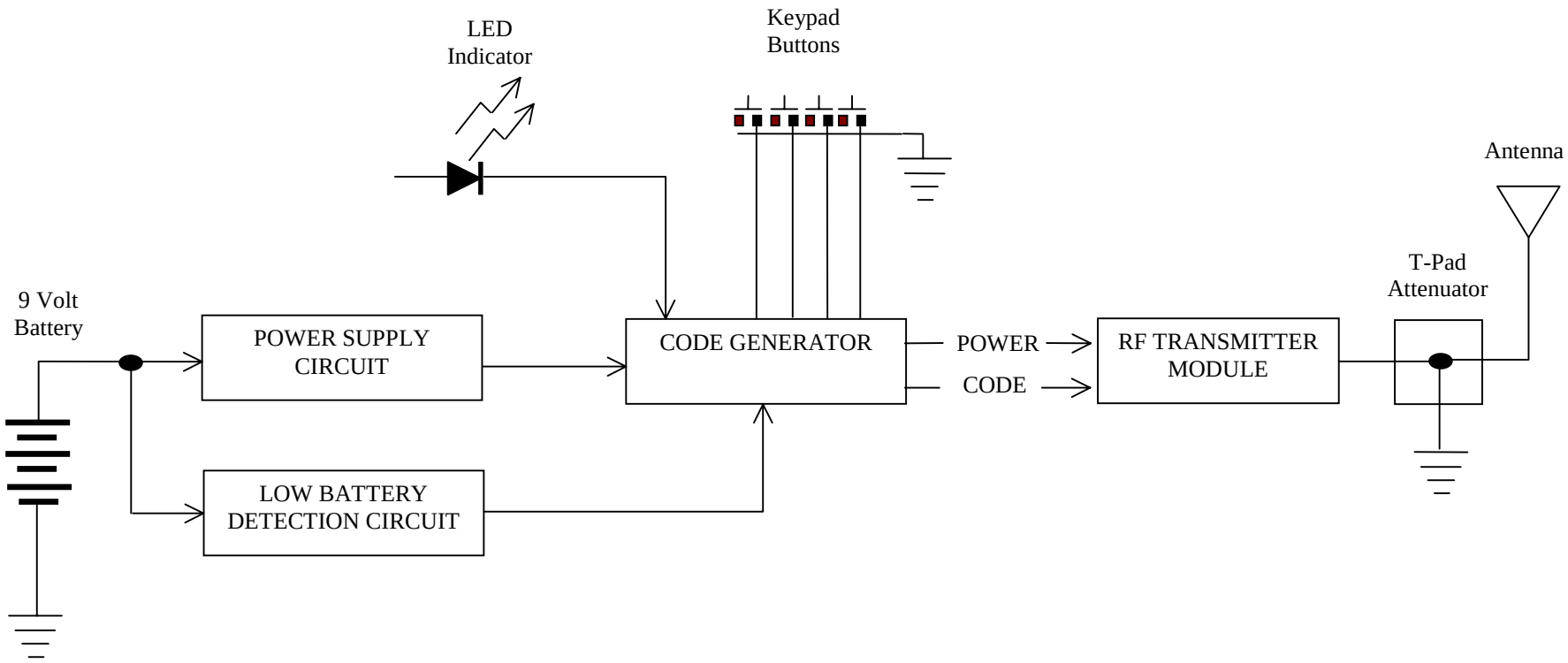
Schematic Diagram
The attached schematic diagram details all circuit components and interconnections.

NOTE ON TRANSMISSION OF BUTTON CODES

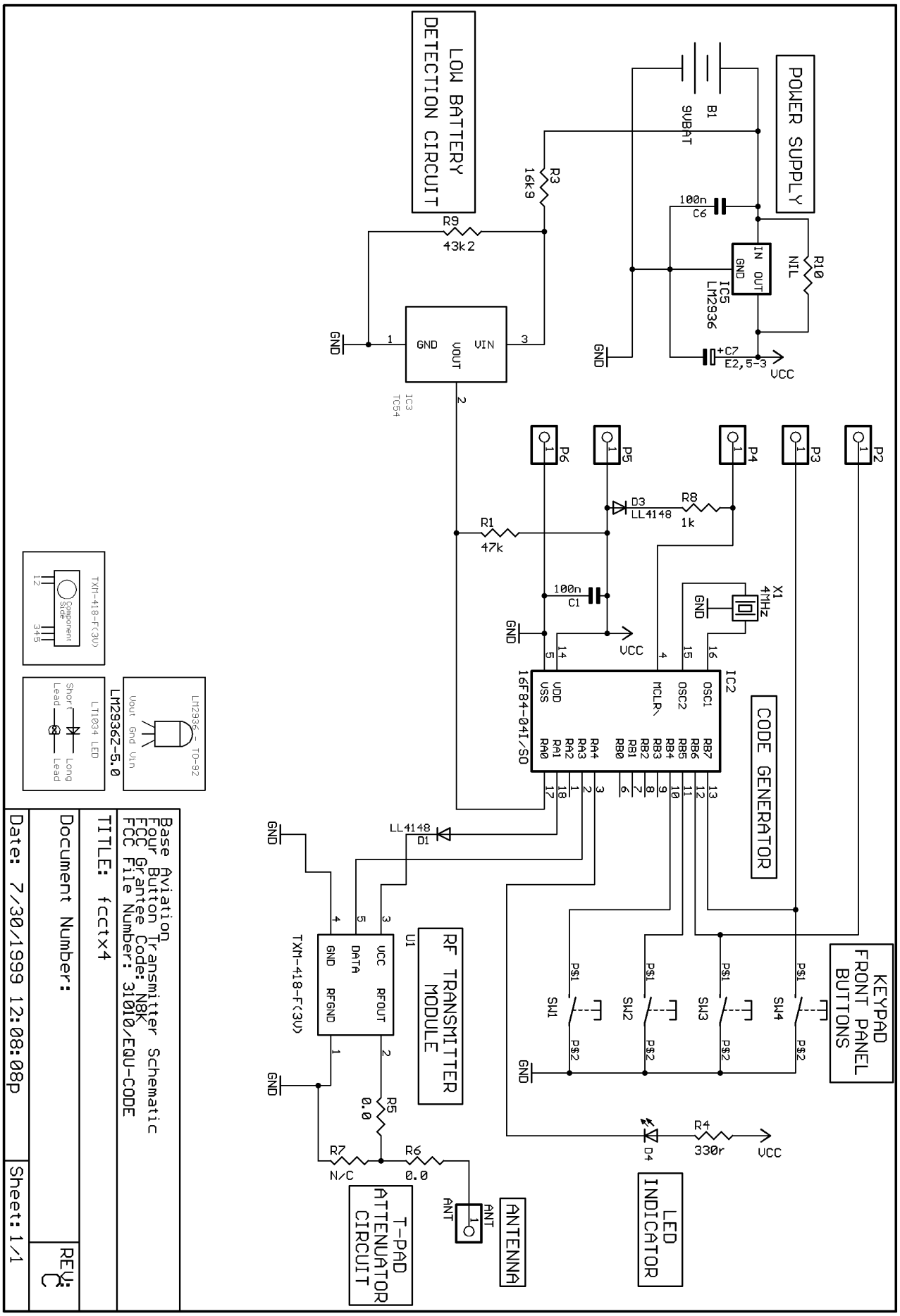
The RF Transmitter Module used in this transmitter is an off the shelf product produced in England. The manufacturer's data sheets and technical information have been included as part of this information package.

Much of the data sheets and literature from this manufacturer, refer to the transmission of "data" and "serial data streams" using this device.

BASE AVIATION IS NOT TRANSMITTING DATA OR SERIAL INFORMATION WITH THIS MODULE - CONTROL CODES ONLY ARE BEING TRANSMITTED to signal the receiver that the hand-held transmitter's momentary push buttons are being pressed.



BASE Aviation Ltd.		FCC Grantee Code – N8K
Title: RVC 400T - Four Button Transmitter Block Diagram		Rev: 0
Date: September 14/99	Drawn By: **Stephan Beyea**	SHEET 1 of 1


POWER SUPPLY
B1
9VBAT
LOW BATTERY DETECTION CIRCUIT
R3
16k9
R9
43k2
100n
C6
IC5
LM2936
IN
GND
OUT
R10
NIL
+C7
E2,5-3
VCC
GND
IC3
TC54
GND
VOUT
VIN
P6
P5
P4
P3
P2
D3
LL4148
R8
1k
R1
47k
100n
C1
X1
4MHz
CODE GENERATOR
IC2
16F84-04I/SO
MCLR
OSC1
OSC2
VDD
VSS
RA0
RA1
RA2
RA3
RA4
RB0
RB1
RB2
RB3
RB4
RB5
RB6
RB7
KEYPAD FRONT PANEL BUTTONS
SW1
SW2
SW3
SW4
P$1
P$2
LL4148
D1
U1
TXM-418-F(3V)
GND
DATA
VCC
RFOUT
RFGND
RF TRANSMITTER MODULE
R5
0.0
R7
N/C
R6
0.0
R4
330r
D4
LED INDICATOR
ANT
ANTENNA
T-PAD ATTENUATOR CIRCUIT
TXM-418-F(3V)
Component Side
LT1034 LED
Short Lead
Long Lead
LM2936 - TO-92
Vout Gnd Vin
LM2936Z-5.0
Base Aviation
Four Button Transmitter Schematic
FCC Grantee Code: N8K
FCC File Number: 31010/EQU-CODE
TITLE: fcctx4
Document Number:
REV:
Date: 7/30/1999 12:08:08p
Sheet: 1/1

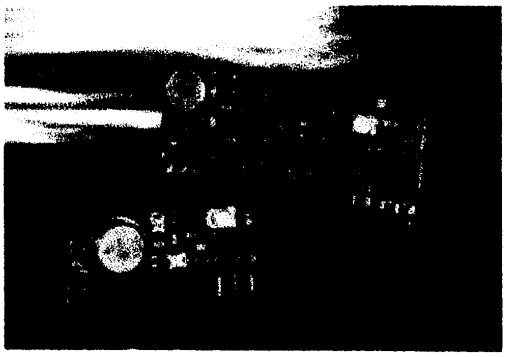
Radiometrix Ltd

Issue 5, 4th October 1995 **TXM-UHF**

UHF Radio Telemetry Transmit Module

UK version: **TXM-418-A / TXM-418-F**
Euro version: **TXM-433-A / TXM-433-F**

The TXM-418-A and TXM-433-A integrate a low power FM UHF radio transmitter on a small module. Together with the matching SILRX-418-A or SILRX-433-A receiver a one-way radio data link can be acheived over a distance upto 200 metres on open ground.



top: SILRX-418-A receiver bottom: TXM-418-A transmitter

Typical features include:

- PCB Mounting, space saving SIL style
- SAW controlled wide band FM transmission
- Licence Exempt, UK type approved to DTI (RA) specification MPT 1340
- High data rates, 5kbps and 10kbps (-F version)
- Analogue or Digital data input
- Wide supply range 6.0V to 9.0V

The transmitter 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 further approvals. The RXM-418-A receiver provides all the outputs necessary to satisfy the requirements of a class 5, BS6799 wireless alarm system. The SILRX-418-A is a lower cost receiver ideal for battery powered and fixed applications.

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 systems
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

Brief description

The TXM-418 is designed to work with the matching receiver (SILRX-418). With the addition of simple antenna the pair may be used to transfer serial data up to 200m. The range of the radio link is very variable and depends upon many factors, principally, the type of antenna employed and the operating environment. The 200m quoted range is a reliable operating distance over open ground using 1/4 whip antenna at both ends of the link at 1.5m above ground. Smaller antenna, interference or obstacles (e.g. building etc.) will reduce the reliable working range (down to 30m in extreme cases). Increased antenna height, slow data or a larger receive antenna will increase the range (our best is 3km). We recommend that the module evaluation kit, EVAL-418-A, can be used to assess the reliable working range under the anticipated conditions of use.

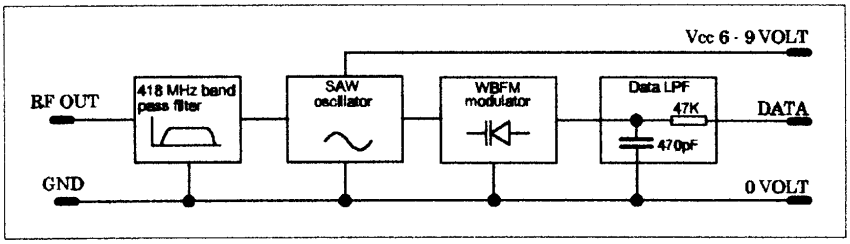


figure 1: TXM's block diagram

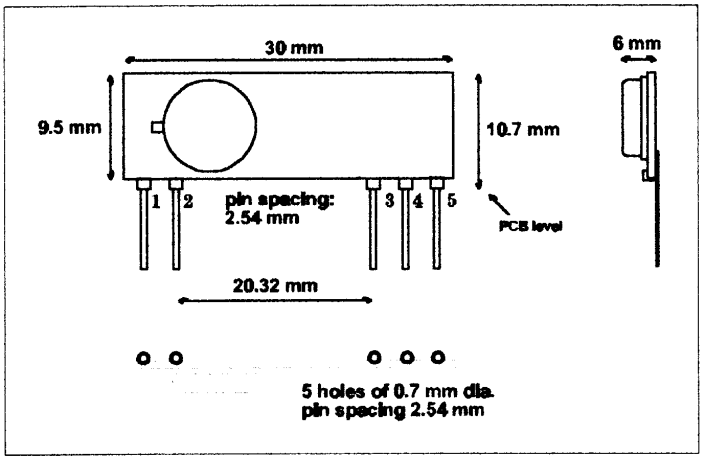


figure 2: mechanical dimensions

Pin Description

pin 1	RF GND	This pin should be connected to the ground plane against which the integral antenna radiates. It is internally connected to pin 4 .
pin 2	RF OUT	Connects to the integral antenna. Output impedance is 50Ω.
pin 3	Vcc	Positive supply , supply voltages from +6V to +9V may be used.
pin 4	Vss	0V connection for the modulation and supply.
pin 5	DATA IN	Should be driven directly by a CMOS logic device running on the same supply voltage as the module.

Performance data TXM-418-A and TXM-433-A

Not Applicable

Absolute Maximum Ratings:

Supply voltage Vcc	pin 3	-0.7V	to	+ 12V
Modulation input	pin 5	-0.7V	to	+ 9V
Operating temperature		-10 °C	to	+ 55 °C
Storage temperature		-40 °C	to	+ 100 °C

Performance Data:

ambient temperature:	20°C
supply voltage:	+8.0V, unless noted otherwise
test circuit:	figure 3

Parameter		Min	Typical	Max	Units	Notes
Operating supply range (Vcc)		6.0	-	9.0	V	-
Supply current,	Vcc = 6.0V	3.0	6.0	10.0	mA	-
	Vcc = 9.0V	5.0	10.0	17.0	mA	-
Radiated power (ERP)	Vcc = 6.0V	-16	-10	-7	dBm	1
	Vcc = 9.0V	-13	-8	-5	dBm	1
Transmit frequency (Frf)			418.00 / 433.92		MHz	-
Initial frequency accuracy		-80	-	+80	kHz	-
Overall frequency accuracy		-95	-	+95	kHz	2
Spurious radiation		meets MPT 1340 on 418 MHz				3
FM deviation (+/-)		15	25	40	kHz	4
Modulation Bandwidth (-3dB) analogue		DC	-	10	kHz	4
Modulation digital pulse width		100	-	-	µs	5

Notes

1. Module on 50mm square ground plane, helical antenna
2. Supply 6V to 9V, temp -10°C to +55°C.
3. <-54 dBm in bands 41-68, 87.5-118, 162-230 & 470-862 MHz
   <-36 dBm else where below 1GHz , <-30dBm above 1GHz
4. Standard modulation: 2kHz square wave, 0 to Vcc
5. High or Low pulse.

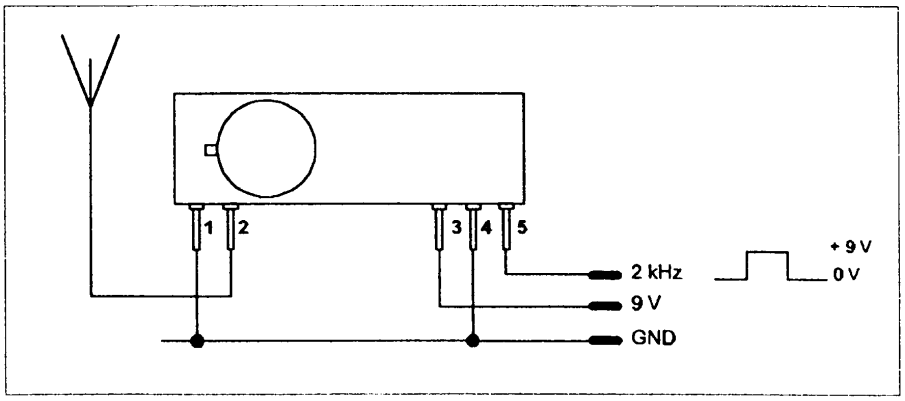


figure 3: TXM A-version test circuit

Performance data TXM-418-F and TXM-433-F

Absolute Maximum Ratings:

Supply voltage Vcc	pin 3	-0.7	to	+ 6V
Modulation input	pin 5	-0.7	to	+ 13V
Operating temperature		-10°C	to	+ 55°C
Storage temperature		-40°C	to	+ 100°C

Performance Data:

ambient temperature:	20 °C
supply voltage:	3.0V, unless noted otherwise
test circuit:	figure 4

Parameter		Min	Typical	Max	Units	Notes
Operating supply range (Vcc)		2.7	3.2	4	V	-
Supply current,	Vcc = 2.7V	3.0	6.0	13.0	mA	-
	Vcc = 4.0V	5.0	10.0	17.0	mA	-
Conducted power in to 50 Ω	Vcc = 2.7V	-	-5	-	dBm	1
	Vcc = 3.6V	-	0	-	dBm	1
Transmit frequency (Frf)			418.00 / 433.92		MHz	-
Initial frequency accuracy		-85	0	+85	kHz	-
Overall frequency accuracy		-95	0	+95	kHz	1
Spurious radiation		meets MPT 1340 on 418 MHz				2
FM deviation (+/-)		15	25	40	kHz	3
Modulation Bandwidth (-3dB) analogue		DC	-	20	kHz	3
Modulation digital pulse width		50	-	-	µs	4

Notes

1. Supply 2V to 3.6V, temp -10°C to +55°C.
2. <-54 dBm in bands 41-68, 87.5-118, 162-230 & 470-862 MHz
   <-36 dBm else where below 1GHz , <-30dBm above 1GHz
3. Standard modulation: 2kHz square wave, 0 to Vcc
4. High or Low pulse.

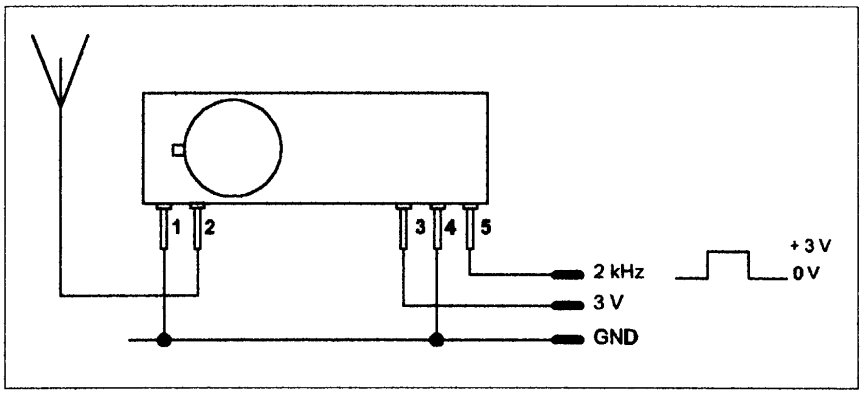


figure 4: TXM F-version test circuit

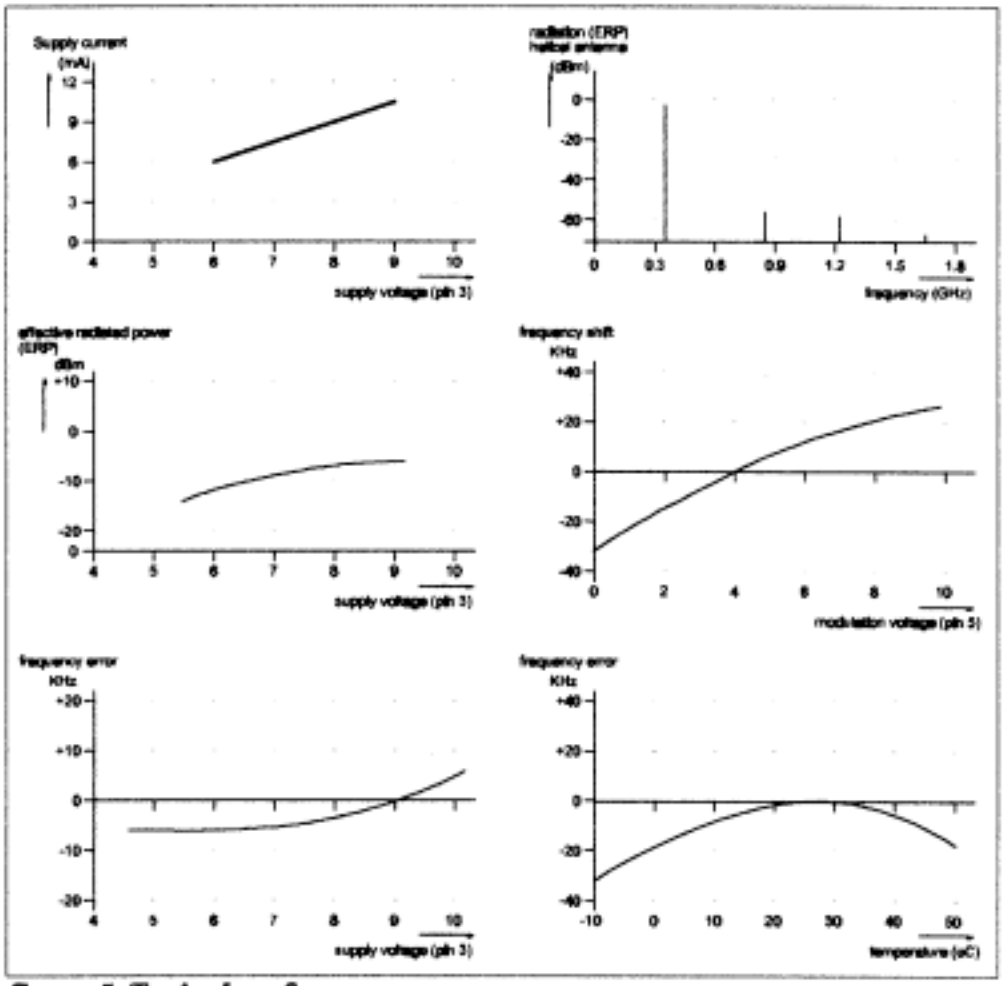


figure 5: Typical performance curves

The TXM-UHF transmitter requires only a data modulation input, supply, ground and an antenna.

Power supply requirements

- The module will operate over the range 6V to 9V and is typically powered by either 9 Volt 'PP3'.
- The module is not reverse polarity protected. Reverse supply voltages higher than 2V will cause damage and must therefor be externally protected against.

Modulation requirements

- The TXM-UHF transmitter has a DC to 10kHz modulation bandwidth and will accept direct analogue (AFSK) or digital data. A modulation low-pass filter (10kHz @ -6dB, 1st order) is use internally.

- Although the modulation bandwidth of the transmitter extends down to DC as does the AF output of the receivers, it is not possible to pass data with a DC component due to frequency errors & drifts between the transmitter and receiver. Frequency differences between the transmitter and receiver will produce a DC offset error which causes the data slicer in the receiver module to give errors on long high or low pulses which exceed the maximum pulse width, see the receiver's data sheet for more detailed information.

- Data Input, pin 5, is normally driven directly by CMOS logic levels from a data encoder IC. There is a wide range of encoder/decoder IC's available which may be used with the modules:

MM57C200, 57410	National Semiconductor
UM3750	UMC
HT12 series	Holtek
MC14026	Motorola
AS2787	Austria Systeme International GmbH

- The encoder normally being run on the same supply voltage as the transmitter. Analogue drive eg. 2 tone FSK, is also possible, the pk to pk level should be between 5V and 9V peak to peak and must not drive pin 5 below 0V. There will be some 2nd harmonic distortion due to the varactor modulator (typ. <15%), this may be reduced if necessary by predistortion of the analogue waveform

Antenna requirements

Three types of integral antenna are recommended and approved for use with the module:

A) Helical: Wire coil, connected directly to pin 2, open circuit at other end. This antenna is very efficient given it's small size (20mm x 4mm dia.). The helical is a high Q antenna, trim the wire length or expand the coil for optimum results. The helical de-tunes badly with proximity to other conductive objects.

B) Loop, A loop of PCB track tuned by a fixed or variable capacitor to ground at the 'hot' end and fed from pin 2 at a point 20% from the ground end. Loops have high immunity to proximity de-tuning.

C) Whip This is a wire, rod ,PCB track or combination connected directly to pin 2 of the module. Optimum total length is 17cm (1/4 wave @ 418MHz) Keep he open circuit (hot) end well away from metal components to prevent serious de-tuning. Whips are ground plane sensitive and will benefit from internal 1/4 wave earthed radial(s) if the product is small and plastic cased

Antenna selection chart

	A	B	C
	helical	***loop***	***whip***
Ultimate performance	**	*	***
Easy of design set-up	**	*	***
Size	***	**	*
Immunity proximity effects	**	***	*
Range open ground to similar antenna	80m	50m	120m

The antenna choice and position directly controls the system range. 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.

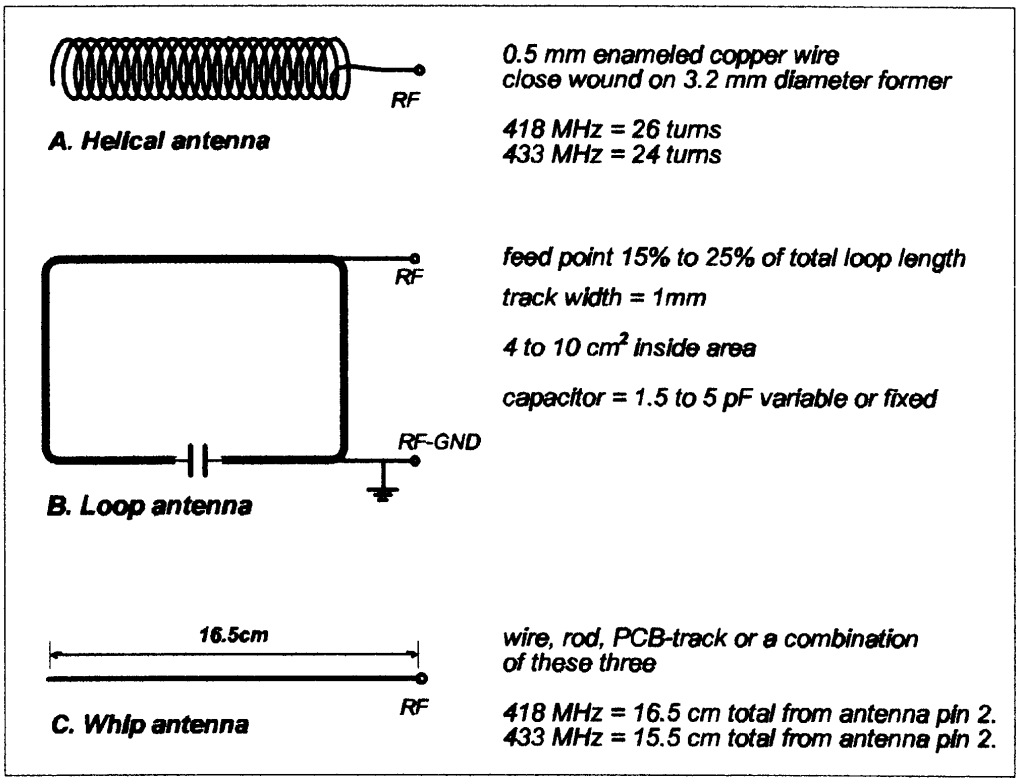


figure 6: Antenna configurations

CONFORMANCE to MPT1340 REQUIRES THAT:-

1. *"All transmitters shall use integral antennas only. Receivers may use an external antenna or an integral antenna. In this specification, an integral antenna is defined as one which is designed to be connected permanently to the transmitter or receiver without the use of an external feeder" (MPT 1340 Dec 1987)*

2. *The equipment in which the module is used must carry an inspection mark located on the outside of the equipment and be clearly visible. The minimum dimensions of the inspection mark shall be 10 x 15 mm and the letter and figure height must be no less than 2mm. The wording shall read "* ***MPT 1340 W.T. LICENCE EXEMPT*** *".*

3. *The trimmer control on the module must not be easily accessible to the end user. This control is factory set and must never be adjusted.*

4. *MPT 1340 is the type approval specification issued by the RA (DTI) and may be obtained from the RA's library service on +44 (0)171 211 0502/0505.*

Ordering information
SAW based OEM Transmit and Receive modules.

TXM-418-A	UK Transmitter on 418 MHz, Type approved to MPT1340
TXM-418-F	Fast transmitter on 418 MHz, Type approved to MPT1340
RXM-418-A	matching UK receiver module on 418 MHz
SILRX-418-A	Low current UK receiver module on 418 MHz
BiM-418-F	Bi-directional short range module on 418 MHz
RPC-418-A	Self-contained module wich integrates the BiM transceiver with a Radio Packet Controller
EVAL-418-A	Evaluation kit for TXM & RXM
EVAL-418-B	SILRX supplementary PCB for EVAL-418-A
BiM-KIT	Evaluation kit for BiM-UHF modules.

All modules are available in a 433.92 MHz version for use in other European countries.

All Radiometrix's products are designed and manufactured in England

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Radio and EMC Regulations

The Intrastat commodity code for all our modules is : 8542 4090. The purchaser of Radiometrix sub-assemblies must satisfy all relevant EMC and Radio regulations which apply to the finished products in the country of use.

(End of TXM data sheet)

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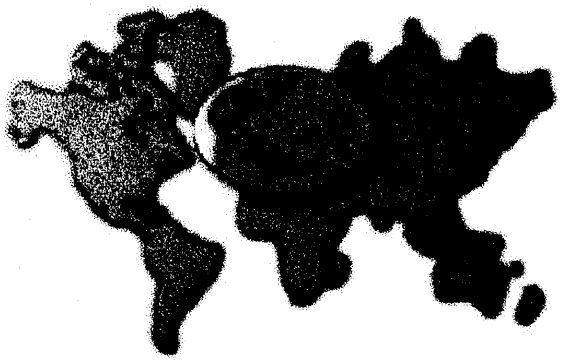

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