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UHF FM Data Transmitter and Receiver Mo

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Issue: 0150-1-2WW **TX3A & RX3 data sheet** **5 Febr**

European Versions	:	**TX3A-869-64/RX3-869-64**
North American Versions	:	**TX3A-914-64/RX3-914-64**

The TX3A and RX3 are miniature UHF radio transmitter & receiver modules designed for PCB mounting. They allow the simple implementation of data links at speeds up to 64kb/s and distances up to 30m in-building or 120m over open ground.

Features:

- Frequencies available as standard: 869.85MHz, 914.5MHz
- CE certified by independent Notified Body
- Verified to comply with Radio standard EN 300 220-3 by accredited Te
- Verified to comply with EMC standard EN 301 489-3 by accredited Tes
- North American version conforms to FCC part 15.249
- Data rates up to 64kbps
- Fully screened

Available for operation in the 868-870MHz band in Europe and the 902 band in North America, both modules combine full screening with inter ensure EMC compliance by minimising spurious radiation and susceptil TX3A & RX3 will suit one-to-one and multi-node wireless links in such as car and building security, EPOS and inventory tracking, remote indus monitoring and data networks. Because of their small size and low pow requirements, both modules are ideal for use in portable, battery-powere such as hand-held terminals.

Transmitter – TX3

- Crystal-locked PLL, FM modulated at up to 64 kb/s
- Operation from 2.2V to 12V @ 7.5mA
- Built-in regulator for improved stability and supply noise rejection
- 1mW nominal RF output
- Enable facility
- Update of the original TX3 with enhanced performance

Receiver – RX3

- Single conversion FM superhet with SAW front end filter
- Operation from 2.7V to 12V @ 9.5mA
- Built-in regulator for improved stability and supply noise rejection
- 64kb/s, -98 dBm sensitivity @ 1ppm BER
- RSSI output with 75dB range
- Enable facility

Functional description

The TX3A transmitter module uses a frequency modulated crystal-locked PL between 2.2V and 12V at a current of 7.5mA nominal. At 3V supply it deli 0dBm (1mW) RF output. The SIL style TX3A measures 32 x 12 x 3.8 mn pins.

The RX3 module is a single conversion FM superhet receiver capable of han of up to 64kb/s. It will operate from a supply of 2.7V to 12V and draw receiving. The RX3 features a fast power-up time for effective duty cycle po a signal strength (RSSI) output with 70dB of range. Full screening and a S filter give good immunity to interference. The SIL style RX3 measures 48 x excluding the pins.

TX3 transmitter

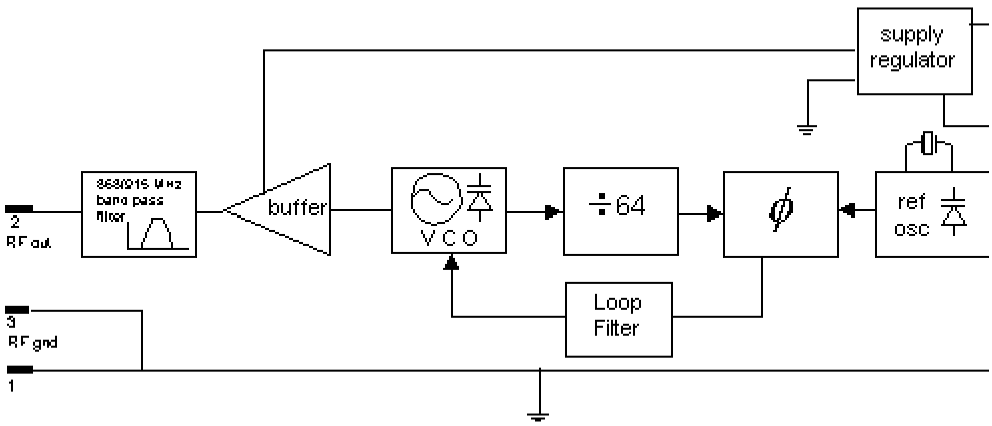
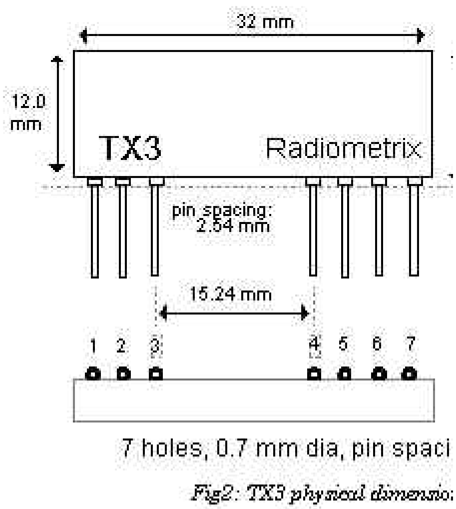


Fig 1 :TX3 block diagram

Pin description

RF GND *(pins 1&3)*

RF ground, internally connected to the module screen and pin 6 (0V). These pins should be directly connected to the RF return path - e.g. coax braid, main PCB ground plane etc.



RF OUT *(pin 2)*

50Ω RF output to the antenna. Internally DC-isolated. See antenna section of apps notes for details of suitable antennas.

En *(pin 4)*

Tx enable. <0.15V or o/c shuts down module (current <1µA). >1.7V enables t
Impedance ~1MΩ.

Vcc *(pin 5)*

+2.2V to +12V DC supply. Max ripple content $0.1V_{p-p}$. Decoupling is not ger
required.

0V *(pin 6)*

DC supply ground. Internally connected to pins 1 & 3 and module screen.

TXD *(pin 7)*

DC-coupled modulation input. Accepts serial digital data at 0V to 2.5V levels.
applications notes for suggested drive methods. Input is high impedance (>1M

RX3 receiver

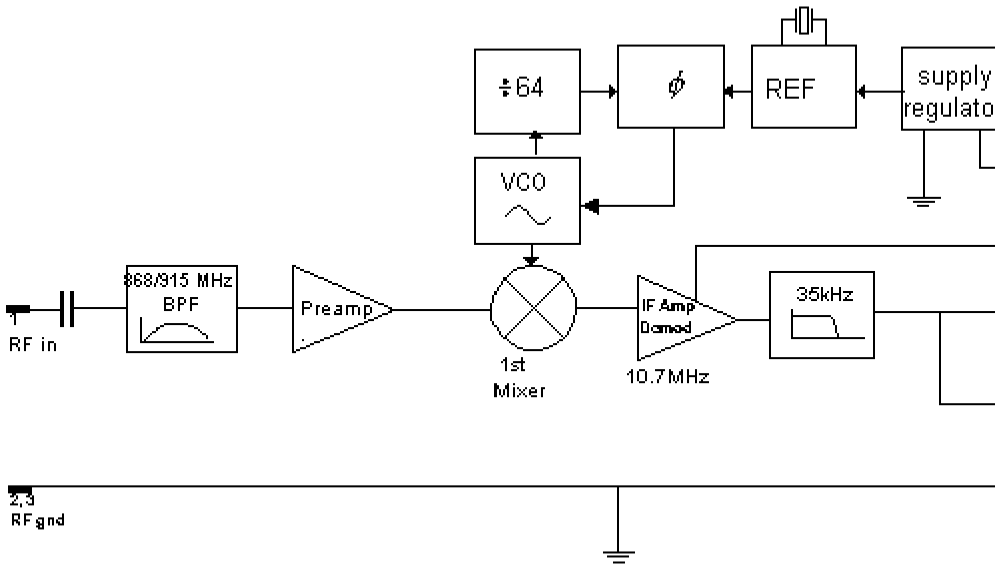


Fig.3: RX3 block diagram

Pin description

RF IN *(pin 1)*

50Ω RF input from antenna.
Internally DC-isolated. See
antenna section of
applications notes for

suggested antennas and feeds.

RF GND *(pins 2 & 3)*

RF ground, internally connected to the module screen and pin 6 (0V). These pins should be connected to the RF return path - e.g. coax braid, main PCB ground plane etc.

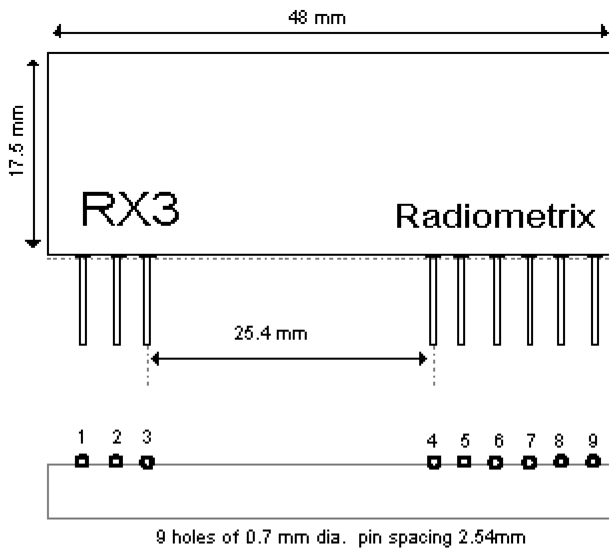


Fig.4: RX3 physical dimensions

En*(pin 4)*

Rx enable. <0.15V shuts down module (current <1µA). >2V enables receiver. ~1MΩ. nominal.
Observe slew rate requirements (see application notes)

RSSI *(pin 5)*

Received signal strength indicator with >65dB range. See applications notes f characteristics.

0V *(pin 6)*

DC supply ground. Internally connected to pins 2 & 3 and module screen.

Vcc *(pin 7)*

+2.7V to +12V DC supply. Max ripple content $0.1V_{p-p}$. Decoupling is not ger required.

AF out *(pin 8)*

Buffered and filtered analogue output from the FM demodulator. Standing DC approx. External load should be >50kΩ // <100pF. **NOTE:** AF waveform fror **inverted**.

RXD *(pin 9)*

Digital output from the internal data slicer. The data is true data, i.e. as fed to t Output is "open-collector" format with internal 10kΩ pullup to Vcc (pin 7).

Absolute maximum ratings

Exceeding the values given below may cause permanent damage to the modul

Operating temperature	-20°C to +70°C
Storage temperature	-40°C to +100°C

TX3A

Vcc (pin 5)	-0.3V to +16V
TXD (pin 7)	±7V
En (pin 4)	-0.3V to +Vcc V
RF OUT (pin 2)	±50V DC, +10dBm RF

RX3

RSSI, Vcc, RXD (pins 5,7,9)	-0.3V to +6V
En, AF (pins 4,8)	-0.3V to +Vcc V
RF IN (pin 1)	±50V DC, +10dBm RF

Performance specifications: TX3 transmitter
(Vcc = 3.0V / temperature = 20°C unless stated)

	pin	min.	typ.	max.	ur
DC supply					
Supply voltage	5	2.2	3.0	13	V
Supply current	5		7.5	9.5	m
RF					
RF power output @ Vcc = 2.2V	2		-1		dI
RF power output @ Vcc≥2.8V	2		0		dI
Harmonics / spurious emissions	2		-55	-45	d
Initial frequency accuracy		-25	0	+25	k
FM deviation (peak)			±27		k
Baseband					
Modulation bandwidth @ -3dB		0		35	k
Modulation distortion (THD)			5	10	9
TXD input level (logic low)	7	-0.2	0	+0.2	V
TXD input level (logic high)	7	+2.3	+2.5	+3	V
Dynamic timing					
Power-up time (En → full RF)			1.0	1.5	n

Notes:

1. RF output is automatically disabled below 2.2V supply voltage.
2. RF output terminated with 50Ω resistive load.
3. Meets or exceeds EN/FCC requirements at all frequencies.
4. With 0V – 2.5V modulation input.
5. To achieve specified FM deviation.
6. See applications information for further details.

Performance specifications: RX3 receiver
(Vcc = 3.0V / temperature = 20°C unless stated)

	pin	min.	typ.	max.	units
DC supply					
Supply voltage	7	2.7	3.0	12	V
Supply current	7		9.5	11	mA
RF/IF					
RF sensitivity @10dB (S+N)/N	1,8		-103	-97	dBm
RF sensitivity @ 1ppm BER	1,9		-98	-92	dBm
IP_3 at RF input	1		-14.5		dBm
Max operational RF input	1		-10		dBm
RSSI threshold	1,5		-115		dBm
RSSI range	1,5	65	75		dB
IF bandwidth			180		kHz
Image rejection	1	40	45		dB
½-IF spurious rejection	1		50		dB
±1MHz spurious rejection	1		67		dB
LO leakage, conducted	1		-75	-70	dBm
Baseband					
Baseband bandwidth @ -3dB	8	0		35	kHz
AF level	8		200		$mV_{P.}$
DC offset on AF out	8	0.9	1.3	1.7	V
Distortion on recovered AF	8		1	5	%
Load capacitance, AFout / RXD	8,9			100	pF
Dynamic timing					
Power up with signal present					
Power up to valid RSSI	4,5		5.5	7	ms
Power up to stable data	4,9		15	18	ms
Signal applied with supply on					
Signal to valid RSSI	1,5		1.6	2	ms
Signal to stable data	1,9		1	10	ms
Time between data transitions	9	15.6		1250	µs
Mark : space ratio	9	20	50	80	%

Notes:

1. See applications information for further details.
2. Meets or exceeds EN/FCC requirements at all frequencies.
3. For received signal with ±27kHz FM deviation.
4. AF waveform on pin 8 is inverted.
5. 50kHz offset. Typically 5ms for on-channel signal.
6. Typically 1ms for on-channel signal, 10ms for 50kHz offset.
7. For 50:50 mark to space ratio (i.e. squarewave).

8. Average over 50ms period at maximum bit rate.

Module test circuits

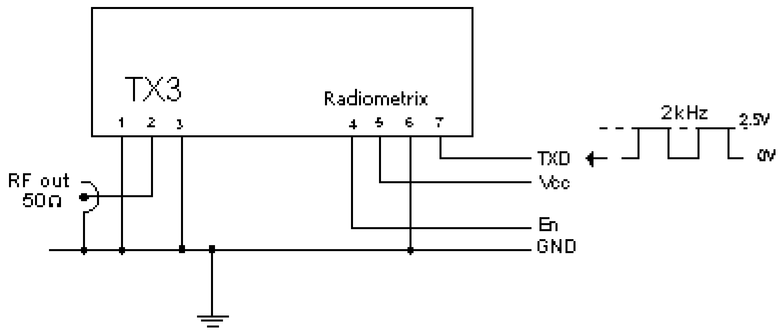


Fig.5: TX3A test circuit

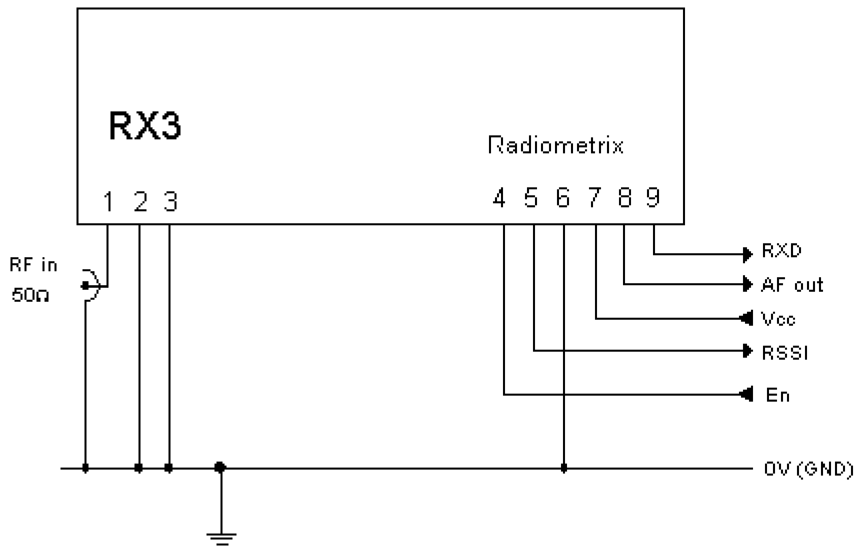


Fig.6: RX3 test circuit

Applications information

Power supply requirements

Both modules have built-in regulators which deliver a constant 2.85V to the n when the external supply voltage is 2.9V or greater, with 40dB or more o rejection. This ensures constant performance up to the maximum permitted ra the need for external supply decoupling except in cases where the supply ra poor (ripple/noise content >0.1V_{p-p}).

Note, however, that for supply voltages lower than 2.85V the regulator inoperative and supply ripple rejection is considerably reduced. Under these ripple/noise on the RX3 supply rail should be below 10mV_{p-p} to avoid probler

If the quality of the supply is in doubt, it is recommended that a 10µF low-E similar capacitor be added between the module supply pin (Vcc) and ground, 10Ω series feed resistor between the Vcc pin and the supply rail.

The Enable pin allows the module to be turned on or off under logic control DC supply to the Vcc pin. The module current in power-down mode is less th **NOTE:** If this facility is used, the logic control signal must have a slew rate more. Slew rate less than thsi value may cause erratic operation of the on- and thereforethe module itself.

The TX3A incorporates a low voltage shutoff circuit which prevents any erratic operation by disabling the RF output if the supply voltage drops belo This feature is self-resetting, i.e. resorting the supply to greater than 2.2V w restore full RF output from the module.

TX3 modulation requirements

The module will produce the specified FM deviation with a TXD input to amplitude, i.e. 0V "low", 2.5V "high". Reducing the amplitude of the data value (usually as a result of reducing the supply voltage) reduces the t deviation to typically ±22kHz at the lower extreme of 2.2V. The receiver will quite happily and no significant degradation of link performance should be result.

Where standard 2-level digital data is employed with a logic "low" level of logic "high" level applied to TXD may be any value between +2.5V and + operation. However, if using multi-level or analogue signalling the max excursion of the modulation applied to TXD must not exceed +2.5V or wave will result. If the input waveform exceeds this level a resistive potential di used at the TXD input to reduce the waveform amplitude accordingly. Thi impedance (>1MΩ) and can usually be ignored when calculating required resi

Data formats and range extension

The TX3A data input is normally driven directly by logic levels but w analogue drive (e.g. 2-tone signalling). In this case it is recommended that DC-biased to 1.25V approx. with the modulation ac-coupled and limited to $2.5V_{p-p}$ to minimise distortion over the link. The varactor modulator in the T some 2^{nd} harmonic distortion which may be reduced if necessary by pred analogue waveform. At the other end of the link the RX3 AF output is u external decoder directly.

Although the modulation bandwidth of the TX3A extends down to DC, a output of the RX3, it is not advisable to use data containing a DC com because frequency errors and drifts between the transmitter and receiver o operation, resulting in DC offset errors on the RX3 audio output.

The RX3 incorporates a low pass filter which works in conjunction with sim the TX3A to obtain an overall system bandwidth of 32kHz. This is suitable f of data at raw bit rates up to 64kb/s. The adaptive data slicer in the RX3 has b accept a maximum time between data transitions of 1.25ms, in order to kee reasonably fast. It will function reliably down to a bit rate of approximately 1 the code in use contains no long 1s or 0s (i.e. Manchester or similar).
RXD output on pin 9 of the RX3 is "true" sense, i.e. as originally fed to the tr

In applications such as longer range fixed links where data speed is r importance, a significant increase in range can be obtained by using the slowe rate together with filtering to reduce the receiver bandwidth to the minim Because of the limitations of the internal data slicer, in these circumstances output should be used to drive an external filter and data slicer.

The audio output waveform on pin 8 of the RX3 is inverted, i.e. in the opposi originally fed to the transmitter. This should be borne in mind if using the RX drive other circuitry.

RX3 Received Signal Strength Indicator (RSSI)

The RX3 receiver incorporates a wide range RSSI which measures the incoming signal over a range of 60dB or more. This allows assessment of l available margin and is useful when performing range tests.

The output on pin 5 of the module has a standing DC bias of typically 0.25V rising to 1V at maximum indication. The RSSI output source impedance is hig external loading should therefore be kept to a minimum.

Typical RSSI characteristic is as shown below:

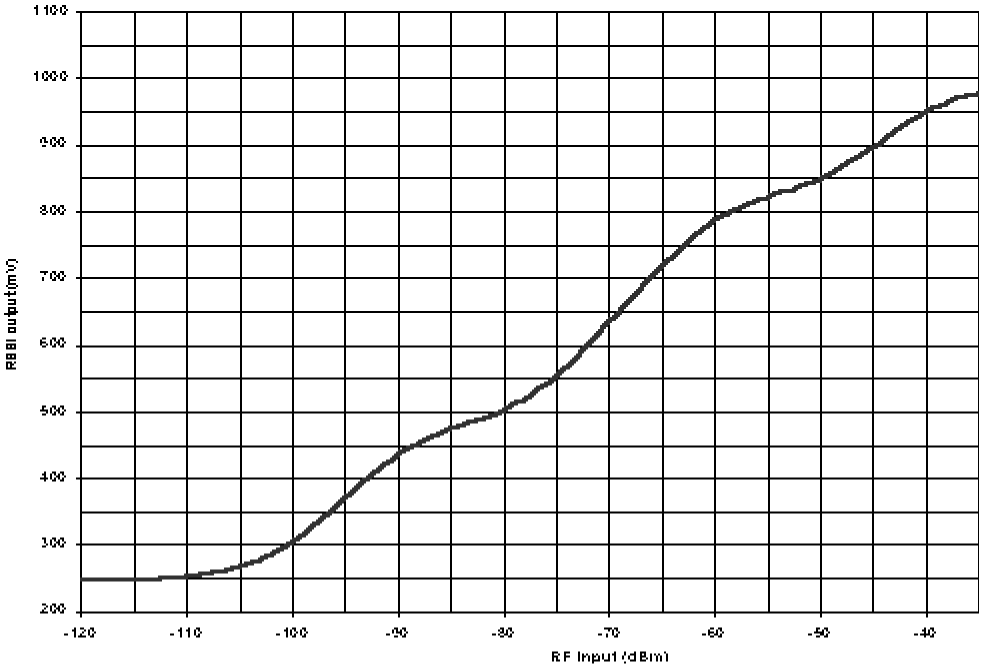


Fig.7: RX3 RSSI response curve

To ensure a reasonably fast response the RSSI has limited internal decoupl ground. This results in a small amount of audio ripple on the DC output module. If this is a problem further decoupling may be added at the exper speed, in the form of a capacitor from pin 5 to ground. There is no upper lim of this capacitor.

Operating the RX3 and TX3 in close proximity

The RX3 receiver will start to overload if the on-frequency RF input level ex with resultant degradation in performance. It is sometimes possible to exce operating the TX3A in very close proximity to the RX3, particularly if antennas. It follows that if the TX3A and RX3 are combined in a transceive they should be operated in half-duplex mode if overload problems are to b only the transmitter or receiver should be active at any one time).

Expected range

Predicting the range obtainable in any given situation is notoriously difficult many factors involved. The main ones to consider are as follows:

- Type and location of antennas in use (see below)
- Type of terrain and degree of obstruction of the link path
- Sources of interference affecting the receiver
- "Dead" spots caused by signal reflections from nearby conductive objec
- Data rate and degree of filtering employed (see page 7)

Assuming the maximum 64kb/s data rate and ¼-wave whip antennas on both receiver, the following ranges may be used as a rough guide only:

1. Cluttered/obstructed environment, e.g. inside a building **30m**
2. Open, relatively unobstructed environment **120m**

It must be stressed, however, that range could be much greater or much figures. Range tests should ***always*** be performed before assuming that a parti be achieved in any given application.

Antenna considerations and options

The choice and positioning of transmitter and receiver antennas is of the utm and is the single most significant factor in determining system range. The f apply particularly to integral antennas and are intended to assist the user i most effective arrangement for a given application.

Nearby conducting objects such as a PCB or battery can cause detuning or s antenna which severely reduces efficiency. Ideally the antenna should stick o of the product and be entirely in the clear, however this is often no practical/ergonomic reasons and a compromise may need to be reached. antenna must be used try to keep it away from other metal components and attention to the "hot" end (i.e. the far end) as this is generally the most detuning. The space around the antenna is as important as the antenna itself.

Microprocessors and microcontrollers tend to radiate significant amounts of r hash, which can cause desensitisation of the receiver if its antenna is in c 900MHz is generally less prone to this effect than lower frequencies, but pro arise. Things become worse as logic speeds increase, because fast logic edges generating harmonics across the UHF range which are then radiated effective tracking. In extreme cases system range can be reduced by a factor of minimise any adverse effects, situate the antenna and module as far as pos such circuitry and keep PCB track lengths to the minimum possible. A groun highly effective in cutting radiated interference and its use is strongly recomm

A simple test for interference is to monitor the receiver RSSI output voltage

be the same regardless of whether the microcontroller or other logic circuitry :
reset.

Depending on the application and bearing in mind applicable legal requiremen
variety of antenna types may be used with the TX3A and RX3.

Integral antennas generally do not perform as well as externally mounted
they result in physically compact equipment and are the preferred choic
applications. The following can be recommended:

Whip (¼-wave). This consists simply of a piece of wire or rod connected tc
one end. The lengths given below are from module pin to antenna tip
interconnecting wire or tracking. This antenna is quite simple and performs
if used in conjunction with a ground plane. This will often be provided by the
the module is mounted, or by a metal case.

Base-loaded whip. This is a shortened whip, tuned by means of a coil inser
This coil may be air-wound for maximum efficiency, or a small SMT inducto
space is at a premium. The value must be carefully chosen to tune the parti
whip in use, making this antenna more difficult to set up than a ¼-wave whip.

Helical. This is a more compact but slightly less effective antenna formed
wire. It is very efficient for its size, but has high Q and tends to suffer badly
caused by proximity to nearby conductive objects. It needs to be carefully tr
performance in a given situation and the required dimensional tolerances car
achieve repeatable, nevertheless It can provide a very compact solution.

Loop. A loop of PCB track, tuned and matched with 2 capacitors. Loops
inefficient but have good immunity to proximity detuning, so may be prefe
range applications where very high component packing density is necessary.

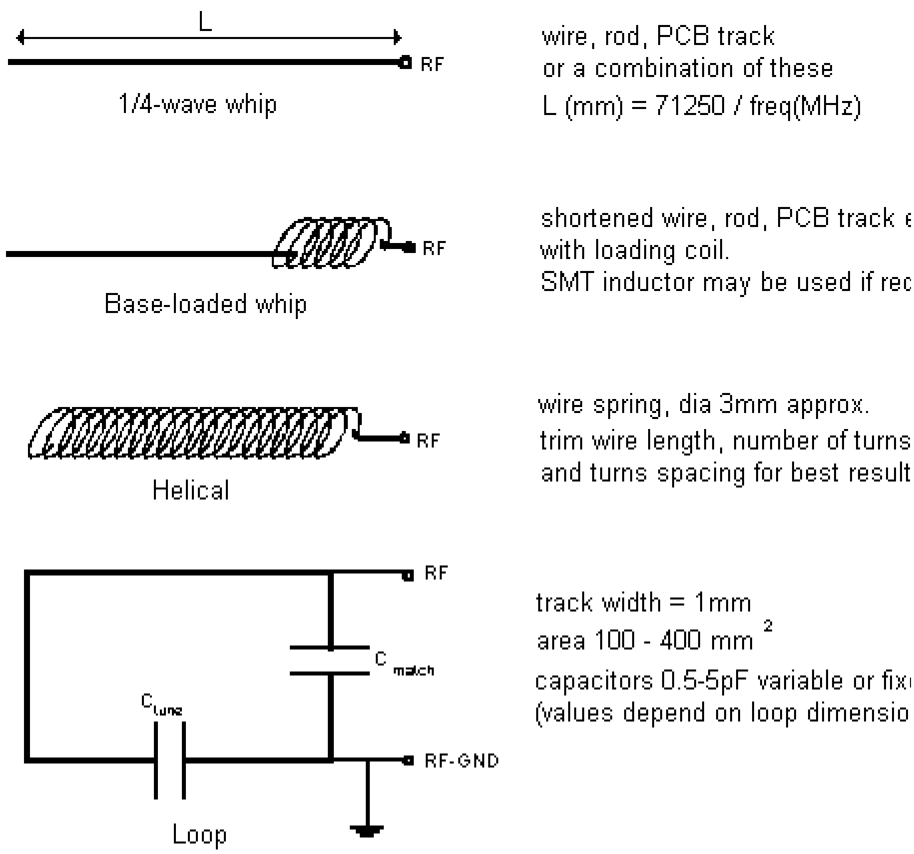


Fig.8: Integral antenna configurations

Integral antenna summary:

	Whip	Loaded whip	Helical	L
Ultimate performance	***	**	**	
Ease of design set-up	***	**	*	
Size	*	***	***	:
Immunity to proximity effects	**	*	*	*

External antennas have several advantages if portability is not an issue. They optimised for individual circumstances and may be mounted in relatively gooc away from sources of interference, being connected to the equipment by coax from the usual whips, helicals etc, low-profile types such as microstrip patche: effective at these frequencies. Suitable antennas are available from many diffe and are generally supplied pre-tuned to the required frequency.

Type Approval requirements: Europe

The modules are CE certified by independent notified body. They are desig with European type approval standard EN 300 220-3 and EMC standard I when used in accordance with the information contained in this leaflet. provisons apply:

1. The modules must not be modified or used outside their specification lir
2. The modules may only be used to transfer digital or digitised data. Anal and/or music are not permitted.
3. The equipment in which the TX3A is used must carry the approval text

of its exterior labelling. Minimum preferred text height 2mm.
4. The TX3 must not be used with gain antennas such as multi-element Ya this may result in allowed ERP or spurious emissions levels being excee

Type Approval requirements: USA

Radiometrix TX3A and RX3 modules are sold as component devices external components and connections to function. They are designed t FCC Part 15.249 regulations, however they are not approved by t purchaser understands that FCC approval will be required prior t operation of any device containing these modules.

1. Antennas must be either permanently attached (i.e. non-removable) or n connector which is unique or not commonly available to the public.
2. The user must ensure that the TX3A/antenna combination does not radi the maximum permitted level of 50mV/m at 3m distance (FCC Part 15.
3. The appropriate FCC identifying mark and/or part 15 compliance staten clearly visible on the outside of the equipment containing the module(s)

Module mounting considerations

The modules may be mounted vertically or bent horizontal to the motherb layout practice should be observed – in particular, any ground return required or feed should be connected directly to the RF GND pins at the antenna end and not to the 0V pin which is intended as a DC ground only. All connectin be kept as short as possible to avoid any problems with stray RF pickup.

If the connection between module and antenna does not form part of the a should be made using 50Ω microstrip line or coax or a combination of both (but not essential) to fill all unused PCB area around the module with ground

Variants and ordering information

The TX3A transmitter and RX3 receiver modules are manufactured in the fol as standard:

For European applications in the 868-870MHz band:
Frequency = 869.85MH

TX3A-869-64	Transmitter
RX3-869-64	Receiver

For USA applications in the 902-928MHz band:
Frequency = 914.5MHz

TX3A-914-64	Transmitter
RX3-914-64	Receiver

Other variants can be supplied to customer requirements, at different freq optimised for specific data speeds and formats. Please consult the fact information.

Limitation of liability

The information furnished by Radiometrix Ltd is believed to be accurate and reliabl reserves the right to make changes or improvements in the design, specification or m subassembly products without notice. Radiometrix Ltd does not assume any liability application or use of any product or circuit described herein, nor for any infringeme other rights of third parties which may result from the use of its products. This data nor implies warranty of any kind, including fitness for any particular application. Th may be subject to radio interference and may not function as intended if interference NOT recommend their use for life critical applications.
The Intrastat commodity code for all our modules is: 8542 6000.

R&TTE Directive

After 7 April 2001 the manufacturer can only place finished product on the market u of the R&TTE Directive. Equipment within the scope of the R&TTE Directive may d compliance to the essential requirements specified in Article 3 of the Directive, as ap particular equipment.
Further details are available on Radiocommunications Agency (RA) web site:
http://www.radio.gov.uk/topics/conformity/conform-index.htm

**** END OF TX3A/RX3 DATA LEAFLET ****

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Registered in England; Company Number 3465761

Bison Bede Compact RF Transmitter Tx04

Operational Description.

2 October, 2003

The Bison Bede Compact RF Transmitter Tx04 is a battery powered radio frequency remote control designed to operate the Bison Bede Compact range of stairlifts. It uses a Radiometrix TX3 transmitter module transmitting 1 mW at 914 MHz. The system transmits one of three remote commands to the stairlift (up, down and park) together with identification information designed to prevent interference between lifts and other users of the 914 MHz frequency band.

Power Supply

A PP3 9V battery powers the transmitter. In standby all electronic circuits on the transmitter system are isolated from the battery. The action of closing any one of the three control switches connects the battery to the power supply. The radio module is then powered directly from the battery while the control circuits are powered at 5V from a voltage regulator circuit.

When the control switches are released the battery feed is lost and the system powers down.

A voltage clamp monitors the battery voltage allowing an LED to illuminate when a battery voltage exceeding 7V powers the system up. This indicates the system is active and the battery is healthy.

Digital Circuits.

The digital word transmitted by the system is produced by a microprocessor (Microchip 12F675) in response to the control signals sent to it. Three switches are mounted on the PCB to be operated by the user indicating the required lift function (up, down or park). In addition a control input is made or broken by cutting a PCB track; this input is used to change the digital word to prevent lifts operating in close proximity responding to the same transmitter.

A pulse train of seven pulses is generated by the microprocessor. The pulses are 5v. A logic 1 is represented by a 300us pulse, a zero by a 150us pulse.

Pulses are spaced at 500us. The first four pulses represent a code identifying the signal to the receiver; the next three pulses represent the position of the three control inputs. The data word is repeated every 6ms for as long as a control button is pressed.

Transmitter

The data word from the microprocessor is used to drive a NPN transistor that shifts the 5v data to an 8v level. The signal is then fed into the “data in” pin on the Radiometrix TX3 module which converts the signal to a 914 MHz FM signal. The TX3 module is provided with a 40mm whip antenna that is part of the PCB artwork.

System Block Diagram