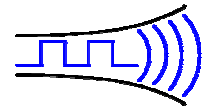


NEW

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LMT2/LMR2

UHF Narrow Band FM Low Cost multi channel radio modules

The LMT2 transmitter and LMR2 receiver modules offer a multi channel, low power, and reliable data link. This makes the LMT2/LMR2 pair ideally suited to those low power applications where existing wideband modules have insufficient range, or where low cost multi-channel operation is needed without compromising on RF specification or regulatory requirement.



Figure 1: LMT2 transmitter and LMR2 receiver

Features

- Conforms to EN 300 220-3 and EN 301 489-3
- High performance double superhet. PLL synthesizer with TCXO
- quasi-dc (peak sampling) data recovery circuit (for enhanced performance on unbalanced datastreams)
- SAW front-end filter
- Data rates up to 5 kbps for standard module
- Usable range over 1km
- Fully screened. Low profile
- Feature-rich interface (RSSI, analogue and digital baseband)
- Re-programmable via RS232 interface
- Low power requirements

Applications

- Handheld terminals
- EPOS equipment, barcode scanners
- Data loggers
- Industrial telemetry and telecommand
- In-building environmental monitoring and control
- High-end security and fire alarms
- DGPS systems
- Vehicle data up/download
- Heavy vehicle/machinery controls

Technical Summary

- Operating frequency: 433.875-434.650MHz (EU band)
458.525 - 459.1MHz (UK band)
- Other custom UHF bands
- 32 channels
- Transmit power: +10dBm (10mW) / +20dBm (100mW)
- Supply range: 3.1 – 15V (TX @ 10mW and RX), 4.1 – 15V (TX @ 100mW)
- Current consumption: 34mA @ 10mW, 90mA @ 100mW (transmit) and 20mA (receive)
- Data bit rate: 5kbps max. (standard module)
- Receiver sensitivity: -118dBm (for 12 dB SINAD)
- Serial configuration by inverted RS232 at 3V CMOS level

LMT2 10mW narrowband transmitter

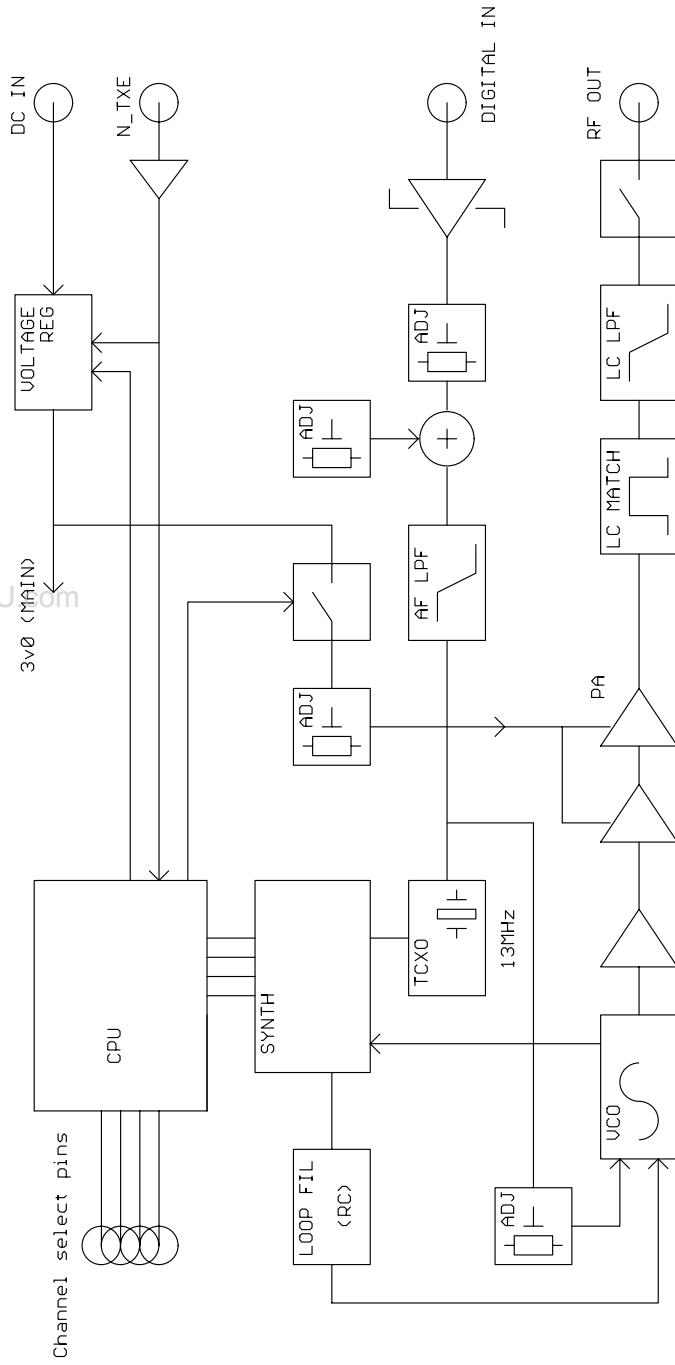


Figure 2: LMT2 block diagram

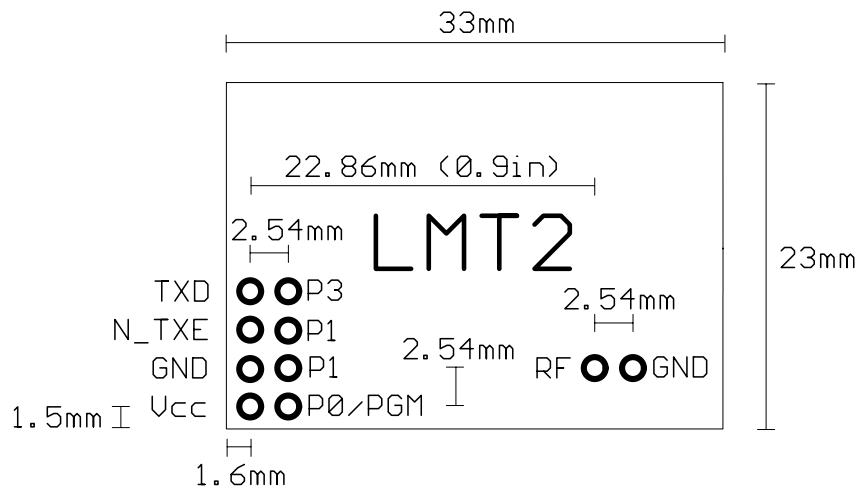


Figure 3: LMT2 footprint (top view)

Pin description - LMT2

| Pin | Name | Function |
|-----|-------------------------|--|
| 1a | Vcc | 3.1 – 15V power supply (@ 10mW) 4.1 – 15V power supply (@ 100mW) |
| 2a | 0V | Ground |
| 3a | $\overline{\text{TXE}}$ | Transmit Enable (active low) |
| 4a | TXD | DC coupled input for 3V CMOS logic. $R_{in}=47k\Omega$ |
| 5a | No pin | Not present in LMT2 |
| 1b | P0/PGM | Parallel Channel select LSB Serial frequency programming / configuration ¹ |
| 2b | P1 | Parallel Channel select |
| 3b | P2 | Parallel Channel select |
| 4b | P3 | Parallel Channel select MSB |
| 5b | No pin | Not present in LMT2 |

Notes:

1. Serial programming is by an inverted, CMOS logic level, 2400 baud RS232 datastream applied to the P0 pin.
2. Channel select inputs have pullups (50k Ω) to 3v internal rail. Do not exceed 3V logic levels on this port.
3. Channel select inputs are active low
4. $\overline{\text{TXE}}$ has a 100k Ω pullup to Vcc
5. All pins are on an 0.1" grid
6. The pins 5a/b are not present, but are included in footprint for compatibility with other units in this family
7. In the 'off' state a PIN switch open circuits the RF output pin. There are no 'off' state spuri.
8. 10mW unit will operate (with marginally reduced specifications and lower (6-8mW) output power) from a 3.0V rail. This must be well regulated and without noise or ripple, as in this state the unit's internal regulator no longer operates, and provides no supply rejection.
9. 100mW versions should not be run continuously from supply voltages > 9v

LMR2 narrowband receiver

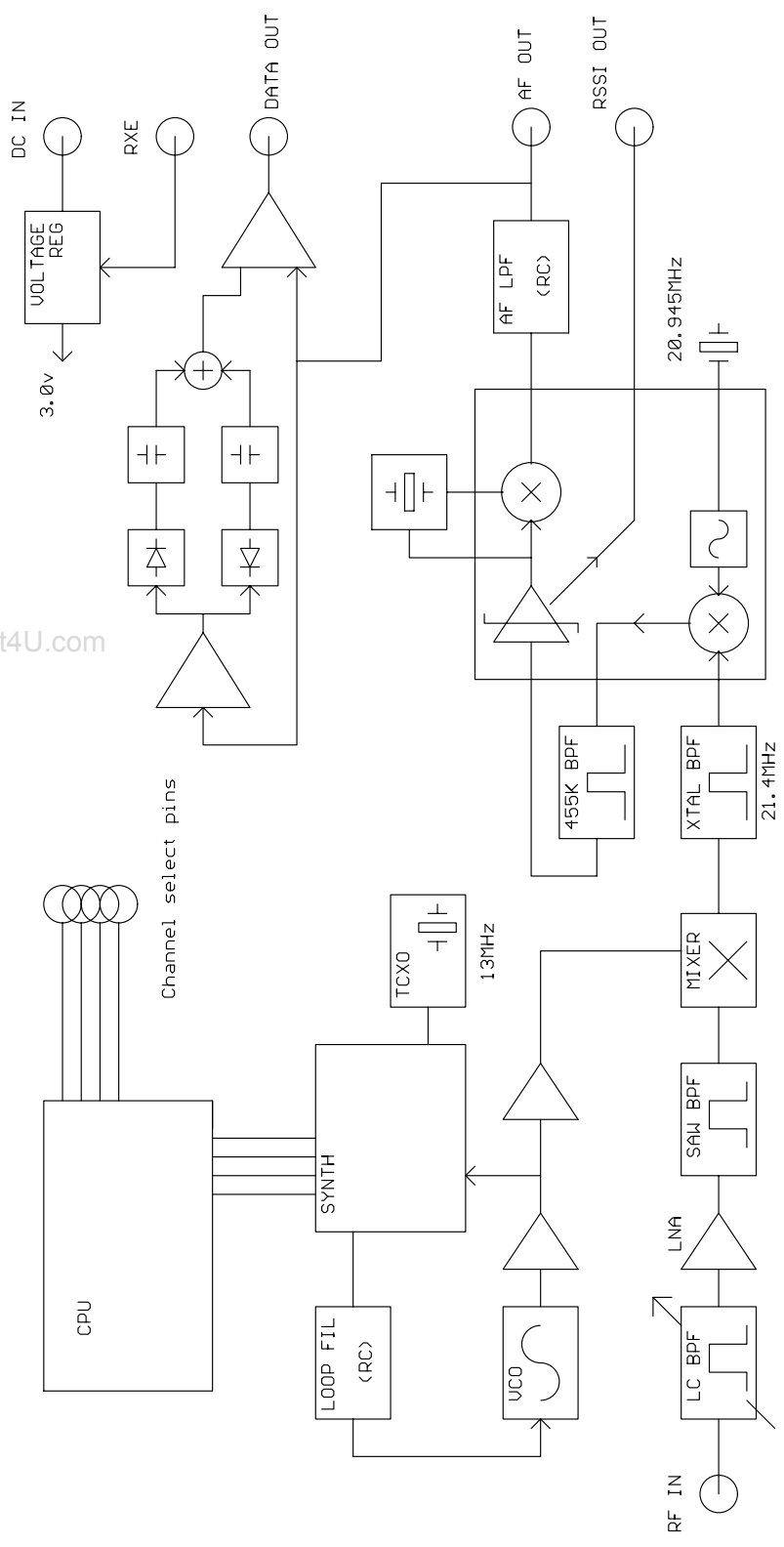


Figure 4: LMR2 block diagram

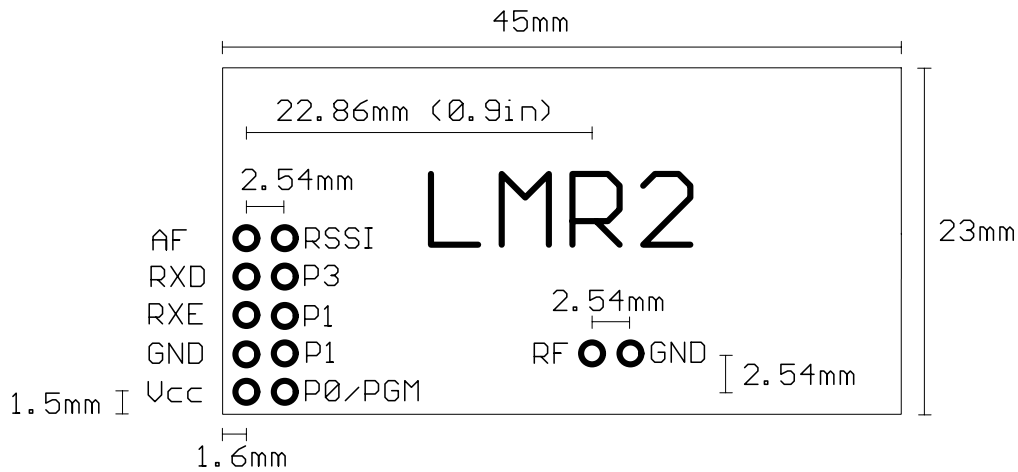


Figure 5: LMR2 footprint (top view)

Pin description - LMR2

| Pin | Name | Function |
|-----|--------|--|
| 1a | Vcc | 3.1 – 15V power supply |
| 2a | 0V | Ground |
| 3a | RXE | Receiver Enable (active high) |
| 4a | RXD | Data out (open collector, no pullup) |
| 5a | AF out | 700mV p-p audio. DC coupled, approx 0.8v bias. |
| 1b | P0/PGM | Parallel Channel select LSB Serial frequency programming / configuration ¹ |
| 2b | P1 | Parallel Channel select |
| 3b | P2 | Parallel Channel select |
| 4b | P3 | Parallel Channel select MSB |
| 5b | RSSI | DC level between 0.5v and 2.2v. 60dB dynamic range |

NOTES:

1. Serial programming is by an inverted, cmos logic level, 2400 baud RS232 datastream applied to the P0 pin.
2. Channel select inputs have pullups (50kΩ) to 3v internal rail. Do not exceed 3v logic levels on this port.
3. Channel select inputs are active low
4. All pins are on an 0.1" grid
5. Data recovery circuit used for RXD is not a simple 'average and compare' type. It is a peak sampling quasi-DC coupled design, allowing a greater than usual flexibility in data format.
6. Unit will operate (with marginally reduced specifications) from a 3.0v rail. This must be well regulated and without noise or ripple, as in this state the unit's internal regulator no longer operates, and provides no supply rejection.

Serial interface commands

2400 baud RS232. 8 bit data, no parity, 1 start bit, 1 or 2 stop bits.

Serial data is sent to the unit on one of the parallel channel select pins (P0). It is very important that the unit does not 'decode' switch bounce in ordinary operation as a command string, or spurious re-writing of the e2prom will result. For this reason the user must send the 16 character string ENABLESERIALMODE (followed by a carriage return) to activate the serial command mode before sending any of the command strings listed below. Command mode is disabled on power down, or on reception of a # character. To successfully program the unit, it must be enabled (RXE high (rx) or TXE low (tx)).

| | |
|---------------|--|
| GOCHAN aa | Serially select channel aa, where aa is ch0 to ch31 |
| LOAD aa nnnnn | Set value of N register for channel aa, where aa is Channels 0 to 31 |
| SETPAR | Channel selected by 4 bit parallel inputs (ch0 to ch15 only) |
| SETSER | Channel selected by most recent GOCHAN operation |
| RVALUE rrrr | Set value for R register |
| SINGLE nnnnn | Set value of N for single channel operation. N value NOT stored in EEPROM |
| <cr> | Process entry |
| / | Clear all buffers |
| # | Disable command mode |

aa = a two digit channel number from 00 to 31

nnnnn = synthesizer N register value (up to 65535)

rrrr = synthesizer R register value (up to 16383)

$$N_{TX} = \frac{f_{RF}}{f_{Channelspacing}} = \frac{433.900MHz}{25kHz} = 17356 \qquad R = \frac{f_{TCXO}}{f_{channelspacing}} = \frac{13MHz}{25kHz}, \text{ So } R=520$$

$$N_{RX} = \frac{f_{RF} - 21.4MHz}{f_{Channelspacing}} = \frac{433.900MHz - 21.4}{25kHz} = 16500$$

Note: A pause of at least 50ms must be allowed between command strings (EEPROM programming time).

SINGLE mode does not store the N value in EEPROM. Therefore the unit is inoperative after a power down until either another valid SINGLE command is received, or mode is changed by a GOCHAN, SETPAR or SETSER command. SINGLE mode is intended for frequency agile applications.

LMT2, LMR2 channels are spaced at 50kHz interval into two frequency groups. 50kHz spacing between sequential channels minimises adjacent channel interference.

e.g. 433MHz band

| Serial or Parallel channel select | Frequency (MHz) | Serial channel select | Frequency (MHz) |
|-----------------------------------|-----------------|-----------------------|-----------------|
| | | 16 | 433.875 |
| 0 (P3:P0 = HHHH)* | 433.900 | | |
| | | 17 | 433.925 |
| 1 | 433.950 | | |
| | | 18 | 433.975 |
| 2 | 434.000 | | |
| | | 19 | 434.025 |
| 3 | 434.050 | | |
| | | 20 | 434.075 |
| 4 | 434.100 | | |
| | | 21 | 434.125 |
| 5 | 434.150 | | |
| | | 22 | 434.175 |
| 6 | 434.200 | | |
| | | 23 | 434.225 |
| 7 | 434.250 | | |
| | | 24 | 434.275 |
| 8 | 434.300 | | |
| | | 25 | 434.325 |
| 9 | 434.350 | | |
| | | 26 | 434.375 |
| 10 | 434.400 | | |
| | | 27 | 434.425 |
| 11 | 434.450 | | |
| | | 28 | 434.475 |
| 12 | 434.500 | | |
| | | 29 | 434.525 |
| 13 | 434.550 | | |
| | | 30 | 434.575 |
| 14 | 434.600 | | |
| | | 31 | 434.625 |
| 15 (P3:P0=LLLL)* | 434.650 | | |

Note: Parallel select pins: H=3V, L= 0V

Condensed specifications

| | |
|----------------------------|---|
| Frequency | 433MHz EU band, and 458MHz UK band As supplied: EU version: 433.875 - 434.65MHz (25kHz steps) UK version 458.525 - 459.1MHz (25kHz steps) Other custom UHF bands |
| <i>Frequency stability</i> | ±1.5kHz |
| <i>Channel spacing</i> | 25kHz |
| <i>Number of channels</i> | 16 channels controlled by parallel port or 32 via RS232 interface |
| Operating temperature | -10 °C to +60 °C (Storage -30 °C to +70 °C) |
| Spurious radiations | Compliant with ETSI EN 300 220-3 and EN 301 489-3 |

| Transmitter | |
|---------------------------|---|
| Output power | +10dBm (10mW) ±1dB (factory adjustable 1 - 25mW) +20dBm (100mW) ±1dB (factory adjustable 25 - 100mW) |
| Peak deviation | ±3kHz |
| TX on switching time | 30ms from TXE transition |
| Modulation type | FSK (F3D) |
| TX modulation bandwidth | DC – 5kHz (3V CMOS compatible) |
| Adjacent channel TX power | <-37dBm |
| TX spurious | <-45dBm (no RF output in Standby) |
| <i>Supply</i> | |
| Voltage | 3.1V – 15V (1-25mW) 4.1 – 15V (25 – 100mW) |
| Current | 34mA @ 10mW (nominal) 65mA @ 50mW (nominal) 90mA @ 100mW (nominal) <5µA standby (TXE high or floating) |
| Inputs | data (CMOS/TTL compatible) |
| Size | 33 x 23 x 9mm |
| Interface | <i>User</i> 10 (8) pin 0.1" pitch dual row (5+5) header |
| | <i>RF</i> 2pin 0.1" pitch |
| Recommended PCB hole size | 1.2mm |
| Receiver | |
| Sensitivity | -118dBm for 12dB SINAD |
| S/N ratio | 35dB (min), 40dB (typ) on AF output |
| AF bandwidth (-3dB) | 4kHz |
| image | <-60db |
| Othr spurious | <-70dbm |
| Blocking | Better than 84dB |
| Adjacent channel | <-60dB |
| LO re-radiation | -70dBm |
| <i>Supply</i> | |
| Voltage | 3.1V – 15V |
| Current | 20mA receive <1µA standby (RXE low) |
| Outputs | RSSI, audio, data (quasi DC data recovery circuit) |
| Size | 46 x 23 x 9 mm |
| Interface | <i>User</i> 10 pin 0.1" pitch dual row (5+5) header |
| | <i>RF</i> 2pin 0.1" pitch |
| Recommended PCB hole size | 1.2mm |

RX Received Signal Strength Indicator (RSSI)

The LMR2 has wide range RSSI that measures the strength of an incoming signal over a range of 60dB or more. This allows assessment of link quality and available margin and is useful when performing range tests.

The output on pin 5b of the module has a standing DC bias of up to 0.5V with no signal, rising to 2.5V at maximum indication (RF input levels of -40dBm and above). $\Delta V_{min-max}$ is typically 2V and is largely independent of standing bias variations. Output impedance is 40k Ω . Pin 5b can drive a 100 μ A meter directly, for simple monitoring.

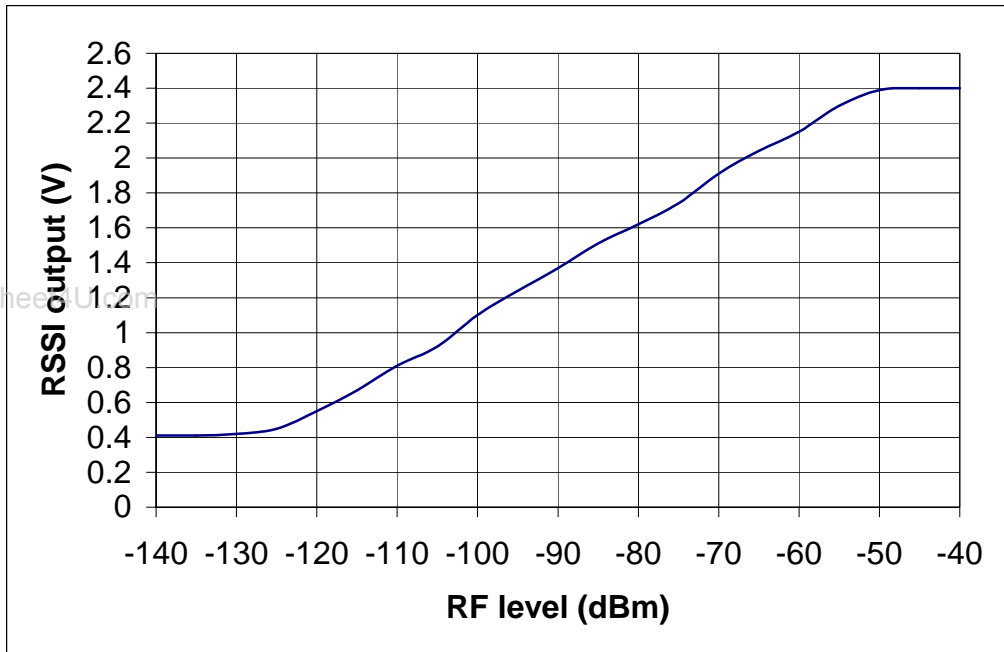


Figure 6: typical RSSI level with respect to received RF level at LMR2 antenna pin

Antenna requirements

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

- A) **Whip** This is a wire, rod ,PCB track or combination connected directly to RF pin of the module. Optimum total length is 16.4cm (1/4 wave @ 433MHz). Keep the 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
- B) **Helical** Wire coil, connected directly to RF pin, 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.
- C) **Loop** A loop of PCB track tuned by a fixed or variable capacitor to ground at the 'hot' end and fed from RF pin at a point 20% from the ground end. Loops have high immunity to proximity de-tuning.

| | A | B | C |
|--------------------------------------|-------------|----------------|-------------|
| | <i>whip</i> | <i>helical</i> | <i>loop</i> |
| Ultimate performance | *** | ** | * |
| Easy of design set-up | *** | ** | * |
| Size | * | *** | ** |
| Immunity proximity effects | * | ** | *** |
| Range open ground to similar antenna | 500m | 200 | 100 |

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.

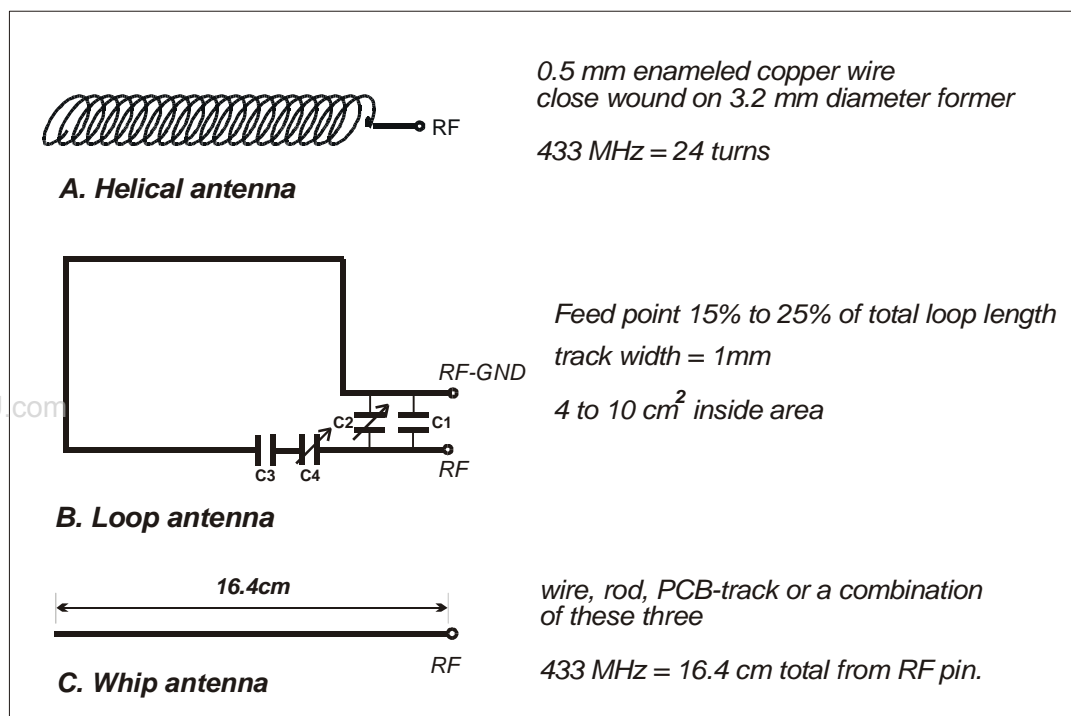


Figure 7: Antenna types

Ordering Information:

| Part No. | Description | Frequency band (MHz) | RF power (mW) | Channel spacing (kHz) | Data rate kbps |
|-----------------|-------------|----------------------|---------------|-----------------------|----------------|
| LMT2-433-5 | Transmitter | 433.875-434.650 | 10 | 25 | 5 |
| LMR2-433-5 | Receiver | 433.875-434.650 | | 25 | 5 |
| LMT2-458-5 | Transmitter | 458.525 - 459.1 | 100 | 25 | 5 |
| LMR2-458-5 | Receiver | 458.525 - 459.1 | | 25 | 5 |
| | | | | | |
| LMT2-433-5-12k5 | Transmitter | 433.875-434.650 | 10 | 12.5 | 5 |
| LMR2-433-5-12k5 | Receiver | 433.875-434.650 | | 12.5 | 5 |
| LMT2-458-5-12k5 | Transmitter | 458.525 - 459.1 | 100 | 12.5 | 5 |
| LMR2-458-5-12k5 | Receiver | 458.525 - 459.1 | | 12.5 | 5 |
| | | | | | |
| LMT2-433-10 | Transmitter | 433.875-434.650 | 10 | 25 | 10 |
| LMR2-433-10 | Receiver | 433.875-434.650 | | 25 | 10 |
| LMT2-458-10 | Transmitter | 458.525 - 459.1 | 100 | 25 | 10 |
| LMR2-458-10 | Receiver | 458.525 - 459.1 | | 25 | 10 |

Note: Also available on the other UHF band frequencies subject to SAW filter availability. e.g. 315, 419, 429, 448, 465MHz etc.

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After 7 April 2001 the manufacturer can only place finished product on the market under the provisions of the R&TTE Directive. Equipment within the scope of the R&TTE Directive may demonstrate compliance to the essential requirements specified in Article 3 of the Directive, as appropriate to the particular equipment. Further details are available on The Office of Communications (Ofcom) web site:

<http://www.ofcom.org.uk/radiocomms/ifi/>

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