UHF Narrow Band FM Low Cost multi channel radio modules

The TLC2H transmitter RLC2H receiver modules offer a low power, reliable data link in an industry-standard pin out and footprint. This makes the TLC2H/RLC2H 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: RLC2H receiver & TLC2H transmitter

Features

- 433MHz version conforms to EN 300 220-3 and EN 301 489-3
- High performance double superhet. PLL synthesizer with TCXO
- SAW front-end filter
- Data rates up to 5 kbps for standard module
- Usable range over 500m
- 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
- Any custom frequency on 433MHz – 435MHz
- 32 channels in 433MHz band
- Transmit power: +10dBm (10mW)
- Supply range: 3.1 - 15V (Transmit), 3.7 – 15V(Receive)
- Current consumption: 34mA (transmit), 18mA (receive)
- Data bit rate: 5kbps max. (standard module)
- Receiver sensitivity: -120dBm (for 12 dB SINAD)
- Serial configuration by inverted RS232 at 3V CMOS level
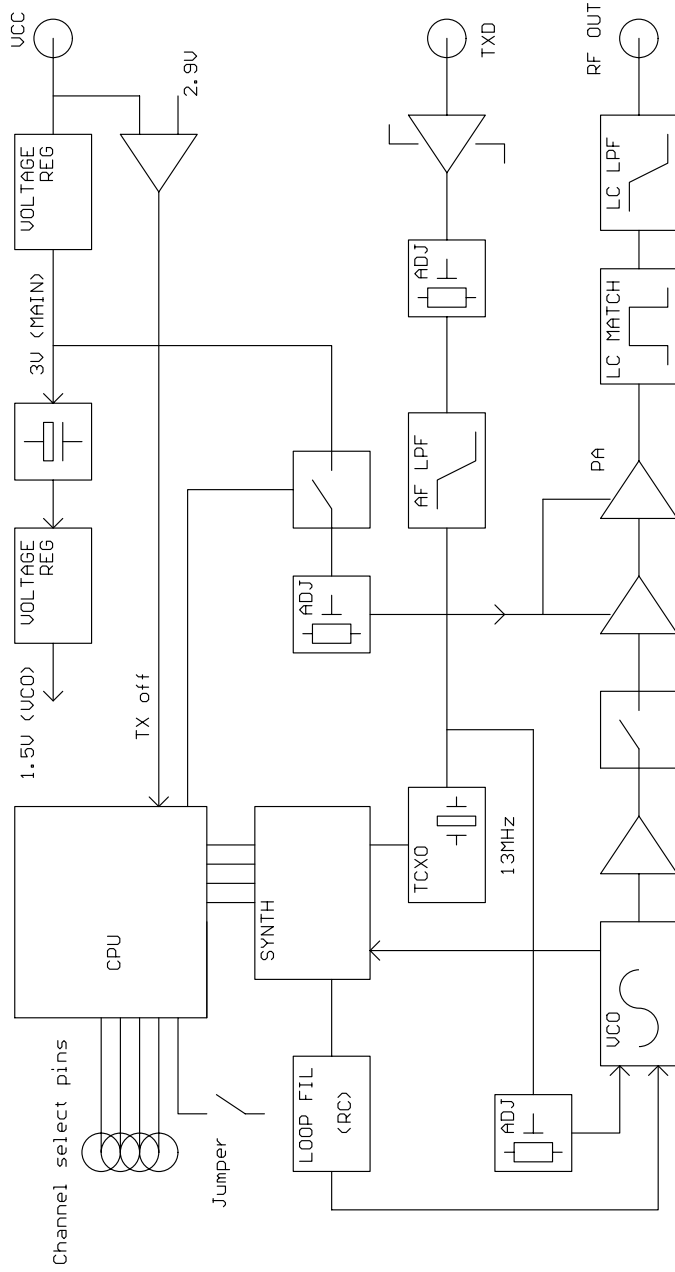
TLC2H 433
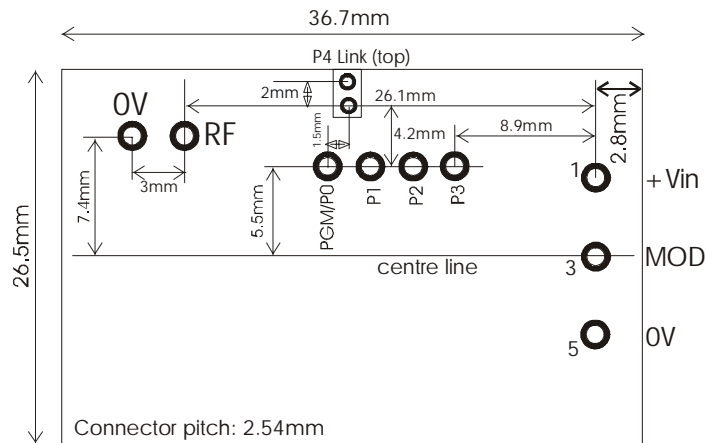

Figure 2: TLC2H block diagram

Figure 3: TLC2H footprint (top view)

Pin description – TLC2H

Pin	Name	Function
1	Vcc	3.1 – 15V DC power supply
2	No pin	Not present in TLC2H
3	TXD	DC coupled input for 3V CMOS logic. R_{in}=47kΩ
4	No pin	Not present in TLC2H
5	0V	Ground
P0/PGM	Parallel channel select LSB, bit 0	True logic (0V = low). Weak pullup to 3V; Serial frequency programming / configuration[1]
P1	Parallel channel select, bit 1	True logic (0V = low). Weak pullup to 3V
P2	Parallel channel select, bit 2	True logic (0V = low). Weak pullup to 3V
P3	Parallel channel select, bit 3	True logic (0V = low). Weak pullup to 3V
P4 Jumper	Parallel channel select MSB, bit 4	Jumper inserted, P4=0 (Channel 00 – Channel 15 at 50kHz step) Jumper clear, P4=1 (Channel 16 – Channel 31 at 50kHz step)

Notes:
1. Serial programming is by an inverted, CMOS logic level, 2400 baud RS232 datastream applied to the P0 pin.
2. Parallel channel select is by 4 pin parallel input (LSB selected by a 2mm header, accessed through a hole in the can)
3. Channel select inputs have pullups (10K) to 3V internal rail. Do not exceed 3v logic levels on this port.
4. Transmitter will shutdown if Vcc falls below about 2.9v
5. TXD: logic low < 1.3v, logic high > 1.7v. TXD maximum voltage = 10v
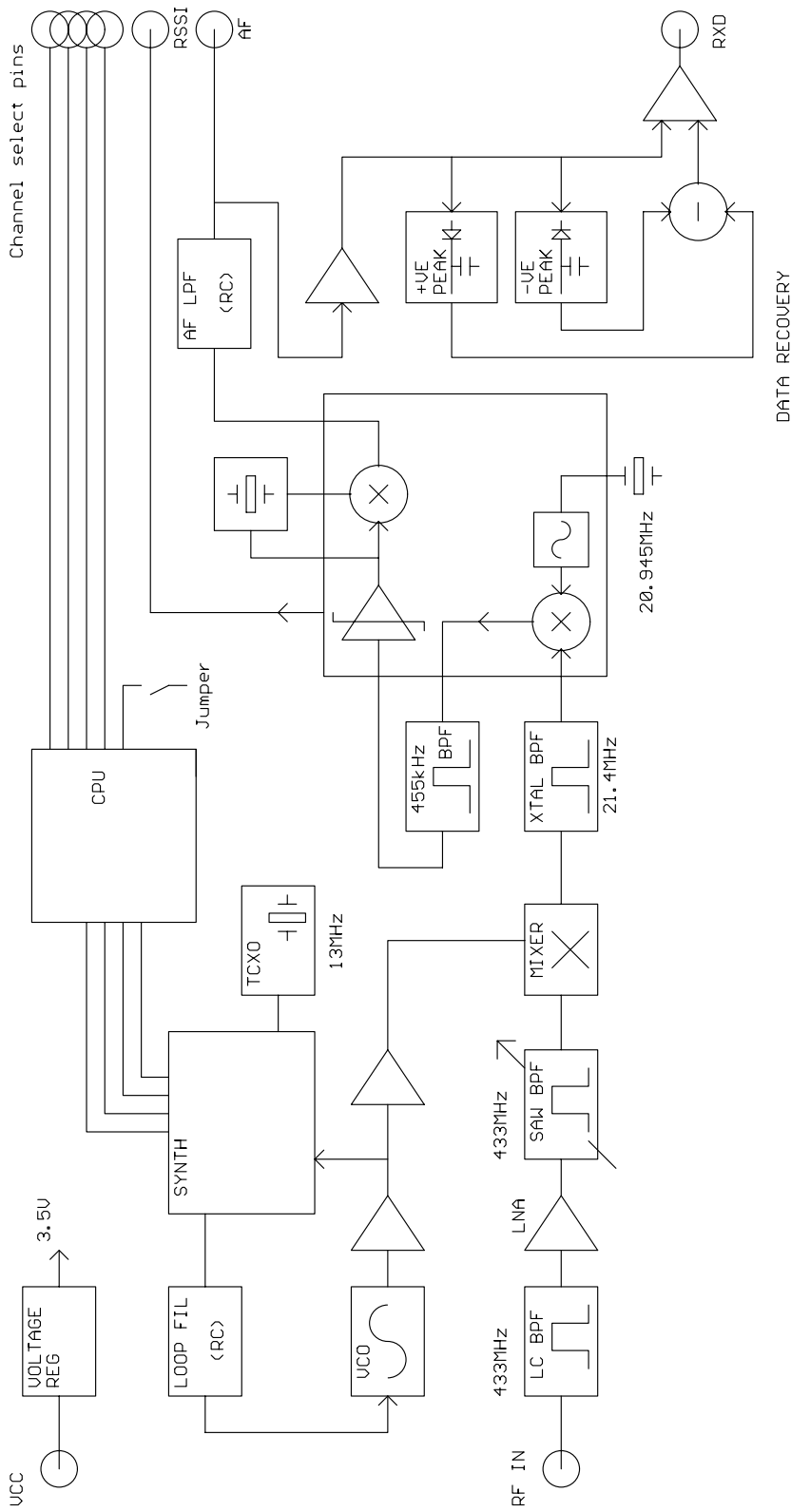
RLC2H 433
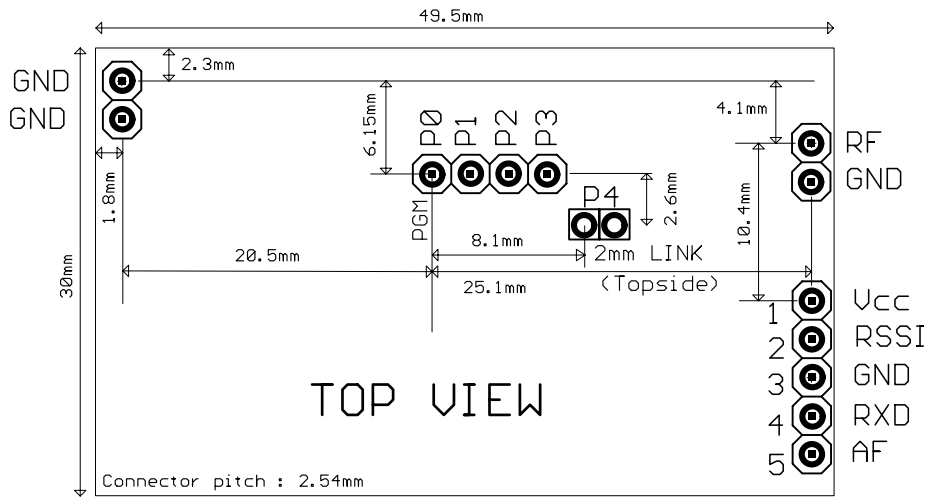

Figure 4: RLC2H block diagram

Figure 5: RLC2H footprint (top view)

Pin description – RLC2H

Pin	Name	Function
1	Vcc	DC supply (3.7V to 15V, at 18mA).
2	RSSI	0.5V-2.5V DC level. 60dB dynamic range. 40kΩ output impedance
3	0V	Ground
4	RXD	Open collector digital data output with internal 47kΩ pull-up to Vcc
5	AF	600mV $_{pk\text{-}pk}$ audio. DC coupled, approx 0.8V bias.
P0/PGM	Parallel channel select LSB, bit 0	True logic (0V = low). Weak pullup to 3.5V Serial frequency programming / configuration[1]
P1	Parallel channel select, bit 1	True logic (0V = low). Weak pullup to 3.5V
P2	Parallel channel select, bit 2	True logic (0V = low). Weak pullup to 3.5V
P3	Parallel channel select MSB, bit 3	True logic (0V = low). Weak pullup to 3.5V
Jumper P4	Parallel channel select Jumper	Jumper inserted, P4=0 (Channel 00 – Channel 15 at 50kHz step) Jumper clear, P4=1 (Channel 16 – Channel 31 at 50kHz step)

NOTES:

1. 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. Maximum time between data transitions: 250ms
2. Serial programming is by a 2400 baud inverted 'RS232' (3V CMOS levels) datastream applied to the P0 pin. If connection to a true RS232 port is desired, then a suitable inverting level shifter / buffer (MAX232 or NPN switch transistor) is needed.
3. Parallel channel select is by a 4 pin parallel input (MSB selected by a 2mm header, accessed through a hole in the can). 3V CMOS levels should be used.
4. As supplied the frequency table is thus: ch 0-15   433.875 – 434.625 MHz (50KHz steps)
   ch 16-31   433.9 - 434.65 MHz (50KHz steps)

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 EEPROM will result. For this reason the user must send the 16 character string ENABLESERIALMODE to fully enable 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.

GOCHAN aa	Serially select channel XX, where XX is 0 to 31
LOAD aa nnnnn	Set value of N register for channel aa, where aa is Channels 0 to 31
SETPAR	Channel selected by 5 bit parallel inputs (4pins + jumper)
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)

$$N_{TX} = \frac{f_{RF}}{f_{Channelspacing}} = \frac{433.875MHz}{25kHz} = 17355 \qquad R = \frac{f_{TCXO}}{f_{channelspacing}} = \frac{13MHz}{25kHz}, \text{ So R=520}$$

$$N_{RX} = \frac{f_{RF} - 21.4MHz}{f_{Channelspacing}} = \frac{433.875MHz - 21.4}{25kHz} = 16499$$

Note: *A pause of at least 25ms 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.

TLC2H, RLC2H channels are spaced at 50kHz interval into two frequency groups. 50kHz spacing between sequential channels minimises adjacent channel interference. P4 jumper link determines which frequency group is selected.

Channel (Jumper P4 inserted)	Frequency (MHz)	Channel (Jumper P4 clear)	Frequency (MHz)
0	433.875		
		16	433.900
1	433.925		
		17	433.950
2	433.975		
		18	434.000
3	434.025		
		19	434.050
4	434.075		
		20	434.100
5	434.125		
		21	434.150
6	434.175		
		22	434.200
7	434.225		
		23	434.250
8	434.275		
		24	434.300
9	434.325		
		25	434.350
10	434.375		
		26	434.400
11	434.425		
		27	434.450
12	434.475		
		28	434.500
13	434.525		
		29	434.550
14	434.575		
		30	434.600
15	434.625		
		31	434.650

Condensed specifications

Frequency	433.875-434.675MHz (custom variants on 433MHz – 435MHz)
Peak deviation	±3kHz
Frequency stability	±1.5kHz
Channel spacing	25kHz (12.5kHz by special order)
Number of channels	32 channels selected via RS232 interface or 2 x 16 groups by parallel port

Operating temperature	-10 ºC to +60 ºC (Storage -30 ºC to +70 ºC)
Spurious radiations	Compliant with ETSI EN 300 220-3 and EN 301 489-3

Transmitter	
Output power	+10dBm (10mW) ±1dB (1mW or 5mW by special order)
TX on switching time	50ms from power up
Modulation type	FSK (F3D)
TX modulation bandwidth	DC – 5kHz (3V CMOS compatible)
Adjacent channel TX power	<-37dBm
TX spurious	<-45dBm

Transmitter		
Supply		
Voltage	3.1V – 15V	
Current	34mA nominal transmit	
Inputs	analogue, data (CMOS/TTL compatible)	
Size	37 x 27 x 8mm	
Interface	*User*	3pin 0.2" pitch molex
	Channel	4pin 0.1" pitch molex
	RF	2pin 3mm pitch
Recommended PCB hole size		1.2mm

Receiver		
Sensitivity	-120dBm for 12 dB SINAD	
image / spurious / adjacent channel	<-60dB	
Blocking	<-85dB	
LO re-radiation	<-60dBm	
Supply		
Voltage	3.7V – 15V	
Current	18mA	
Outputs	RSSI, audio, data	
Size	50 x 30 x 10mm	
Interface	*User*	5pin 0.1" pitch molex
	Channel	4pin 0.1" pitch molex
	RF	2pin 0.1" pitch molex
Recommended PCB hole size		1.2mm
Power on to valid audio		28ms
Power on to stable data out (50:50 mark / space)		50ms

Notes:

When RX is on and a transmitter keys up, again a 50ms period is required to stabilise data output mark/space. i.e. allow at least 50ms of preamble

RX Received Signal Strength Indicator (RSSI)

The RLC2H 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 2 of the module has a standing DC bias of up to 0.4V with no signal, rising to 2.5V at maximum indication (RF input levels of -40dBm and above). ΔVmin-max is typically 2V and is largely independent of standing bias variations. Output impedance is 40kΩ. Pin 2 can drive a 100μA meter directly, for simple monitoring.
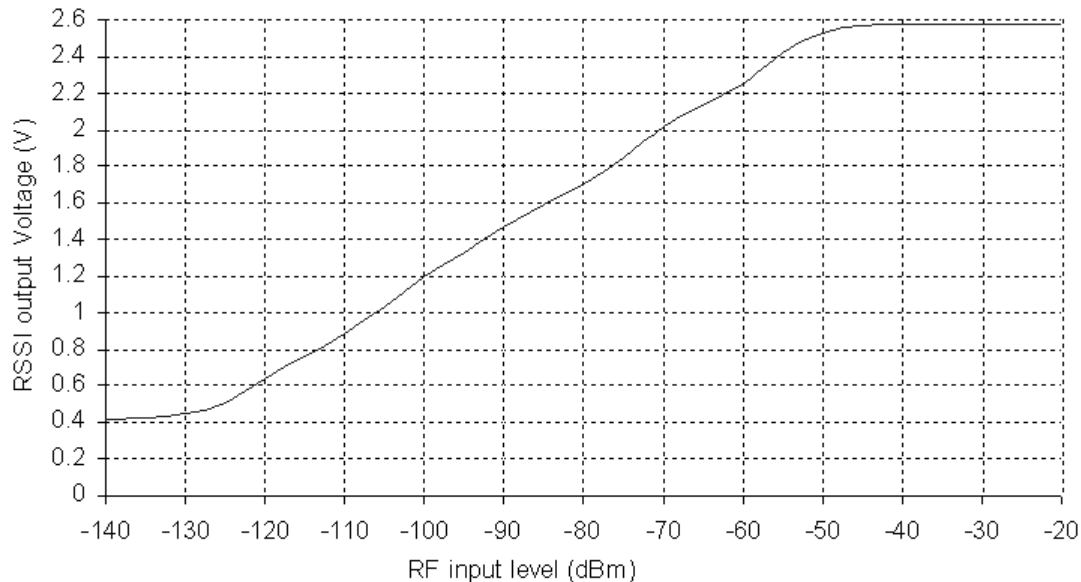

Figure 6: RSSI level with respect to received RF level at RLC2H antenna pin

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**
	whip	*helical*	*loop*
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.
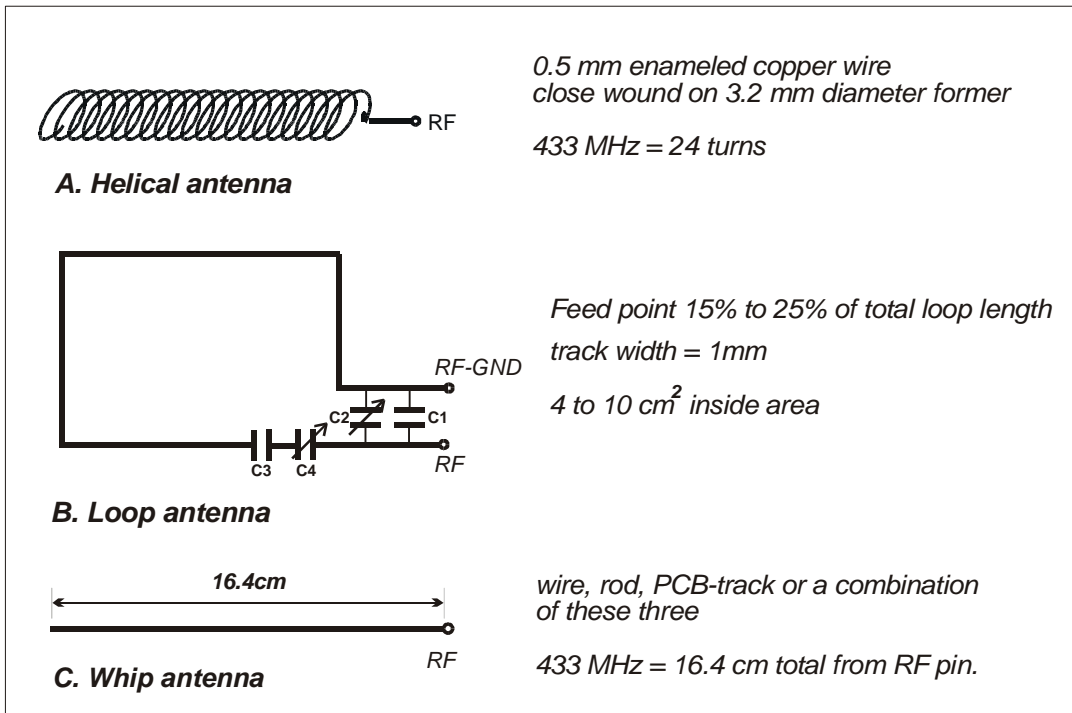

Figure 7: Antenna types

Variants and ordering information

Part No.	Description	Frequency band
TLC2H-433-5	Transmitter	433.875-434.650MHz
RLC2H-433-5	Receiver	433.875-434.650MHz

Other variants can be supplied to individual customer requirements at frequencies from 433MHz to 435MHz and/or optimised for specific data speeds and formats. Please consult the Sales Department for further information.

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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 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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