NEW

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PLT/PLR

NBFM Multichannel Data Packet Link Radios

Inexperienced users of ISM band radio modules often require a totally transparent interface. This can require considerable processing power, and buffer memory, to be provided in the radio device.

The more experienced user, on the other hand, may not want to write a raw radio interface, but desires a module that gives more control over the datastream than a 'beginners' solution.

The PL radios represent such a compromise solution.

Figure 1: PLT transmitter and PLR receiver

Features

- Conforms to EN 300 220-3 and EN 301 489-3
- High performance double superhet. PLL synthesizer with TCXO
- SAW front-end filter
- User interface speed: 9600bps for standard module
- Usable range over 1km
- Fully screened. Low profile
- Re-programmable via RS232 interface
- Low power requirements

Applications

- Wireless 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: 173.200 - 173.325MHz (UK band)
  150.825 - 152.450MHz (Australian Band)
  433.875 - 434.650MHz (EU band)
  458.525 - 459.1MHz (UK band)
- Other custom VHF and UHF bands
- 32 channels @ 25kHz channel spacing
- 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

PLT / PLR data packet link radios

The PL modules use the hardware of the existing LMT/LMR transmitter receiver pair, combined with completely new firmware to produce a simple to use but readily controllable data link

Both radios have a similar pinout. The bidirectional DATA pin requires an inverted RS232 data interface, at 3V CMOS logic levels (Both DATA and FLOW are bidirectional. As outputs they are open drain pins with 50K pullups to the internal Vcc, and 470 series protection resistors. Do not exceed 3v on these pins).

The $\overline{\text{CMD}}$ pin selects the operating mode: If pulled low, then serial data is routed to a command interpreter (see 'programming') . If high (floating) then received bytes are loaded into the buffer (the PLR receiver only inputs data in command mode of course).

When the buffer is full, the transmitter either sends a databurst immediately, or waits for a command from the user

The transmitter data buffer size is pre-set by a user command (from 1-32 bytes)

The data format uses is modified biphase at a peak data rate of 2500 bits per second.
Each burst consists of a framing sequence, a two byte address, a two byte checksum, and a variable length (1-32 bytes) data 'payload'. The payload length information is coded into the framer sequence.

Minimum length (1 byte) bursts take about 70mS (including all transmitter setup and power on/off timings), while a full 32 byte burst requires over 250mS.

Data transfer rate is limited by the interface's inability to receive data while transmitting a burst (if FLOW is high, then the PLT is not listening to the serial port at all), or to decode received packets while in the process of outputting one

The standard products use a 9600 baud user interface speed. Slower versions are also available (1200, 2400 and 4800 baud, with suffixes -1, -2, and -4). The baud rate is not user programmable.

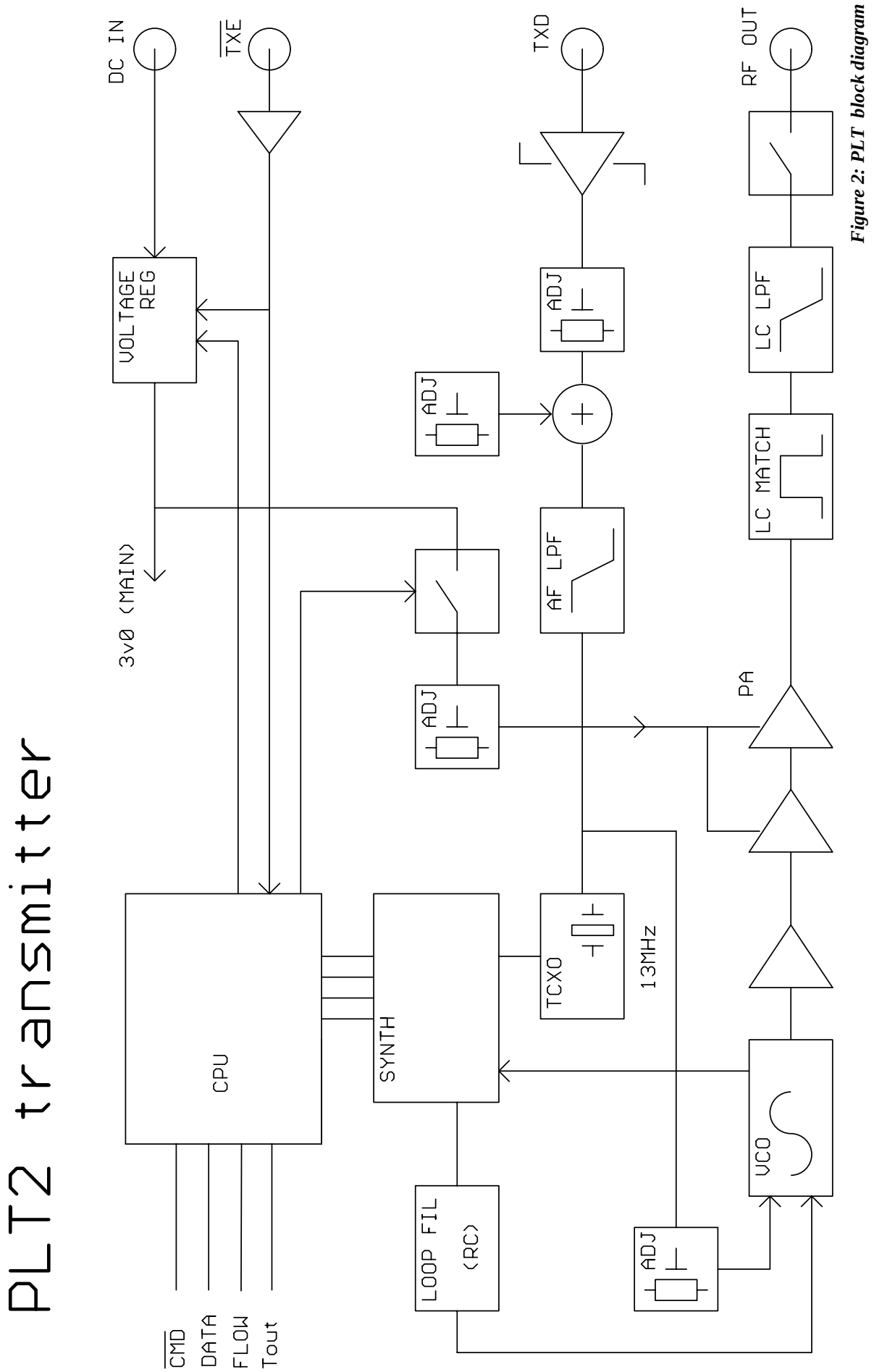

Figure 2: PLT block diagram

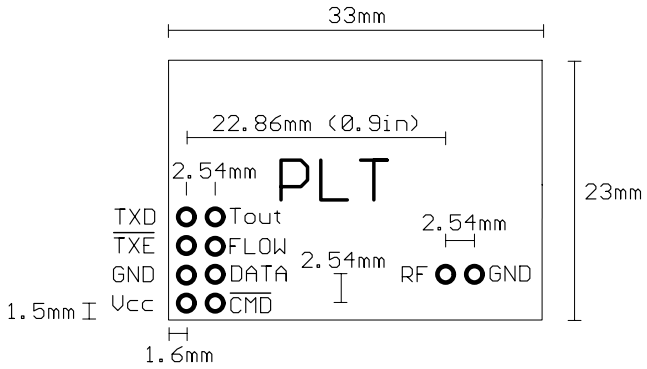

Figure 3: PLT footpint (top view)

***Pin description* – PLT**

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	(link to 4b)
1b	$\overline{\text{CMD}}$	Command mode select input
2b	DATA	Serial data out/in
3b	FLOW	Buffer full / busy output
4b	T_{out}	(link to 4a)

Notes:

1. This pinout is very similar to the LMT radios but the serial data is on pin 2b (not 1b, which is here used as the command mode select input)
2. Serial programming is by an inverted, CMOS logic level, 2400 baud RS232 datastream applied to the DATA pin (2b).
3. $\overline{\text{TXE}}$ has a 100kΩ pullup to Vcc
4. All pins are on an 0.1" grid
5. In the 'off' state a PIN switch open circuits the RF output pin. There are no 'off' state spuri.
6. 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.
7. 100mW versions should not be run continuously from supply voltages > 9v
8. Do not exceed 3v logic levels on any input (4v for 100mW PLT units)

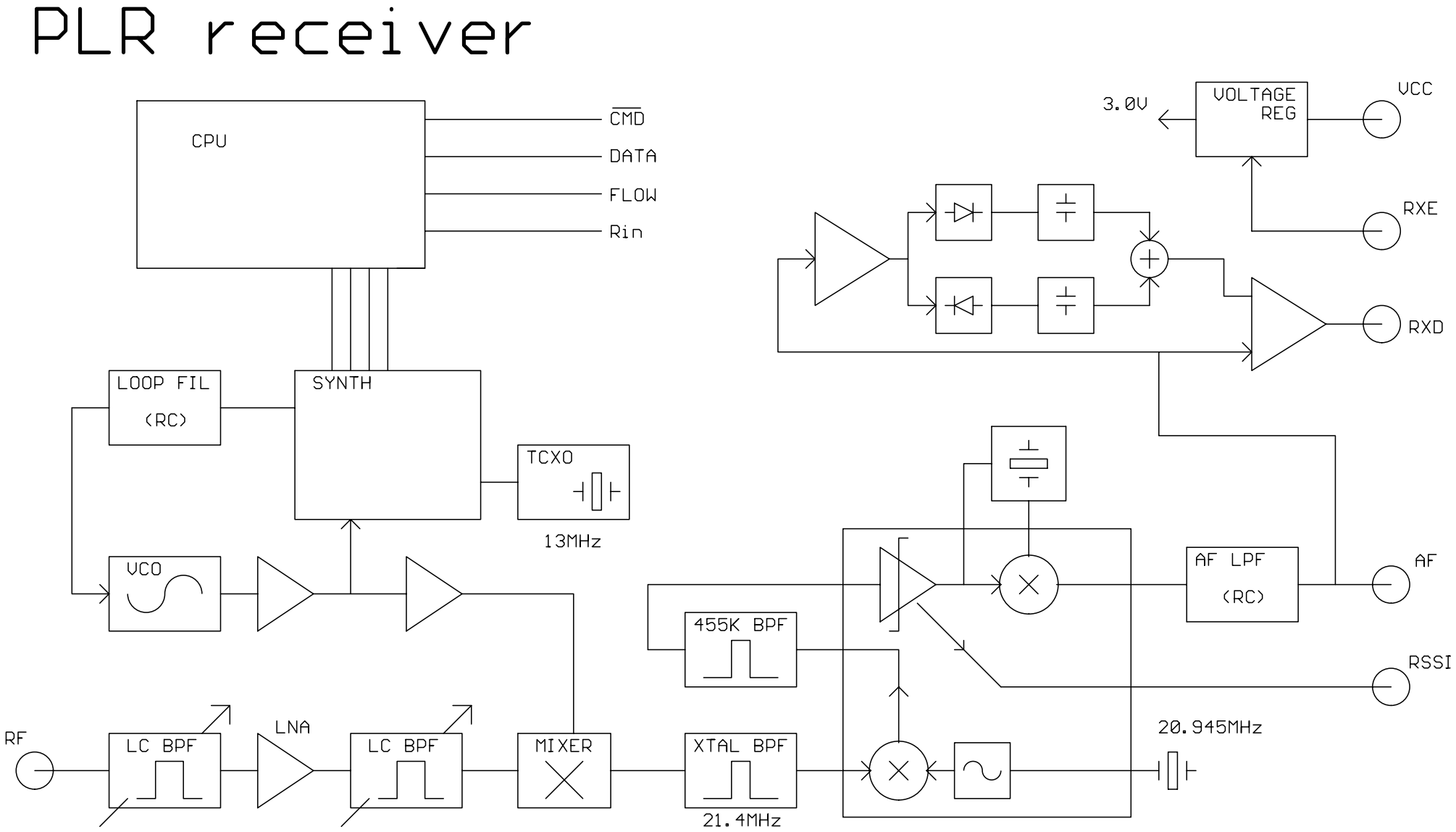

Figure 4: PLR block diagram

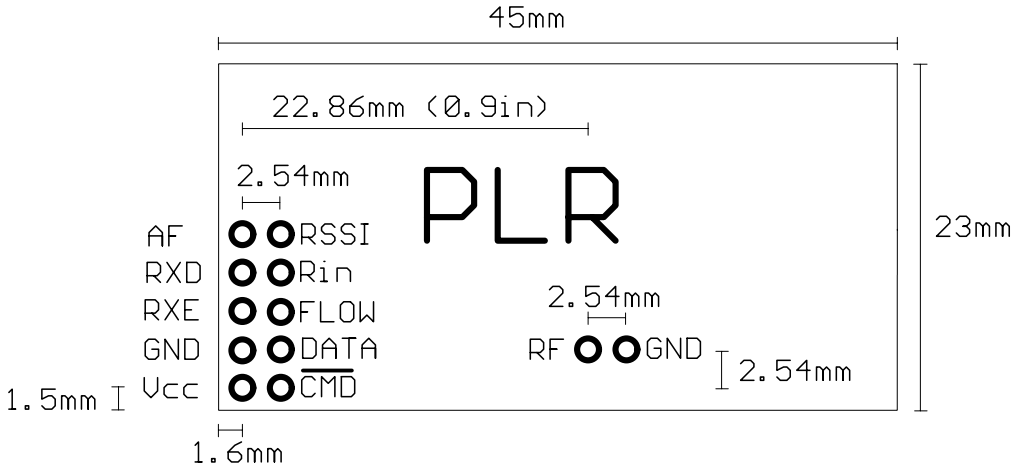

Figure 5: PLR footpint (top view)

***Pin description* – PLR**

Pin	Name	Function
1a	Vcc	3.1 – 15V power supply (@ 10mW)
2a	0V	Ground
3a	RXE	Receiver Enable (active high)
4a	RXD	(link to 4b)
5a	N/C (AF out)	700mV p-p audio. DC coupled, approx 0.8v bias
1b	$\overline{\text{CMD}}$	Command mode select input
2b	DATA	Serial data out/in
3b	FLOW	Valid data/serial output in progress
4b	R_{in}	(link to 4a)
5b	RSSI	DC level between 0.5v and 2.2v. 60dB dynamic range

NOTES:

1. This pinout is very similar to the LMR radios but the serial data is on pin 2b (not 1b, which is here used as the command mode select input)
2. Serial programming is by an inverted, CMOS logic level, 2400 baud RS232 datastream applied to the DATA (2b) pin.
3. All pins are on an 0.1" grid
4. 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
5. Do not exceed 3v logic levels on any input

Serial interface commands

A 9600 baud cmos level 'inverted RS232 format' (1 start bit, 8 data, 1or 2 stop bits, no parity) is used.

Serial data is sent to the DATA (2b) pin.

These units employs a sub-set of the programming commands used by standard LMT/LMR modules. As the DATA pin is dedicated to serial communication only, the 'ENABLESERIALMODE' command used for LMT/LMR string is NOT required.

To successfully program the unit it must be in active state (RXE high, or TXE low), and CMD must be pulled low. Provision should be made to force the unit into this state while programming (either a jumper, or a third pin on the programming connector, could be used). The basic units do not provide local echo, but this is a provision on the evaluation interface boards

Commands	Function	Note
GOCHAN aa	Serially select channel aa, (ch0 to ch31)	Responds with OK
LOAD aa nnnnn	Set value of N register for channel aa, (Channels 0 to 31)	Responds with OK
SINGLE nnnnn	Direct override of N register value	Responds with OK
RVALUE rrrr	Set value for R register	Responds with OK
AVALUE bbbbb	Set value for unit address	Responds with OK
BVALUE bb	Set buffer size (1 – 32, PLT only)	Responds with OK
SVALUE bb	Set ascii value of 'send' character	Responds with OK
MVALUE bb	Set mode byte (0-255, PLT only)	Responds with OK
ADDR aa	Volatile short address	No response
CHAN aa	Volatile channel select	No response
TEST	Transmitter test (carrier on, 250Hz square wave. PLT only) (any character sent to the unit will exit 'test' mode)	
<cr>	Process entry	Ascii 13
/	Clear all buffers	Ascii 47
<	Clear data buffer	Ascii 60
>	send burst (if data buffer isn't empty)	Ascii 62

aa = a two digit channel number from 00 to 31
bb = buffer size from 1 to 32
mmm = mode byte value (0-255)
sss = ascii value of 'send' character (enabled by mode bit 5) (0-255)
nnnnn = a synthesizer N register value, (up to 65535)
rrrr = the synthesizer R register value, (up to 16383)
nnnnn = address (up to 65535)

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

VHF PLT units have 10MHz, not 13MHz reference oscillators:

$R = \frac{f_{TCXO}}{f_{channelspacing}} = \frac{10MHz}{25kHz}$, So R=400 (for VHF PLT)

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

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

The MODE byte

This is a value stored in EEPROM, that selects the various operating functions of the radio. Be careful. By setting this incorrectly you can disable your radio link

Factory default (send when buffer full, clear buffer on exit from setup mode) is selected by MVALUE 0

Functions of the mode byte bits.

Bit0 when zero the PLT will send when it's buffer is full
Bit1 when zero the PLT clears the data buffer on exit from command mode

Bit2 set: send burst on entering command mode (if buffer has any data in it)
Bit3 set: send burst on stop-bit over-run (ie: serial pin is low for more than 1.04mS)
Bit4 set: clear data buffer on stop-bit over-run
Bit5 set: send burst on receiving the character specified by SVALUE in the datastream
Bit6 set: send burst if the gap following a character exceeds approx 4.2mS
Bit7 reserved

Additionally, there are a few command mode characters that can be used :

> send burst (if data is present in the buffer)
< clear data buffer

Obviously: bit 3 and bit 4 should not be set at the same time
bit 1 should be set if a command mode controlled send is used with a 'bouncy' n_CMD drive (switch)
if bit 2 is set then it doesn't matter what bit 1 is doing !

Bit 6 (timeout mode) is best used with BVALUE 32 and other bits inactive

To generate a stop-bit over-run, either pull down the serial input pin for over 1.04mS (1 byte at ` 9600 baud),
Or send a 00 (null, CTRL @ character) at a slower baud rate

Condensed specifications

Frequency	433MHz EU, 458MHz / 173MHz UK and 151MHz Australian bands As supplied: EU version: 433.875 - 434.65MHz UK version: 458.525 - 459.1MHz 173.200 - 173.325MHz Australian version: 150.825 - 152.450MHz Other custom VHF and UHF bands
Frequency stability	±1.5kHz
Channel spacing	25kHz
Number of channels	32 (controlled via RS232 interface)
Operating temperature	-20 ºC to +55 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 (factory adjustable 1 - 25mW) +20dBm (100mW) ±1dB (factory adjustable 25 - 100mW)
Peak deviation	±3kHz
Modulation type	2.5kbps FSK (biphase) data stream
TX modulation bandwidth	DC – 5kHz (3V CMOS compatible)
Adjacent channel TX power	<-37dBm
TX spurious	<-45dBm (no output in Standby)
Supply	
Voltage	3.1V – 15V (1-25mW) 4.1 – 15V (25 – 100mW)
Current	35mA @ 10mW (nominal) 65mA @ 50mW (nominal) 100mA @ 100mW (nominal) <9µA standby (TXE high or floating)
Inputs	data (CMOS/TTL compatible)
Size	33 x 23 x 9mm (BiM sized footprint, new pinout)
Interface *User*	10 (8) pin 0.1" pitch dual row (5+5 or 4+4) header
RF	2pin 0.1” pitch
Recommended PCB hole size	1.2mm
Receiver	
Sensitivity	-115dBm for <0.1% data errors)
AF bandwidth (-3dB)	4kHz
image	<-60db
spurii / adjacent channel	<-65db
blocking	- 84dB
LO re-radiation	-60dBm
Auxiliary outputs	RSSI, audio
Supply	
Voltage	3.1V – 15V
Current	20mA receive
	<1µA standby (RXE low)
Size	46 x 23 x 9mm
Interface *User*	10 pin 0.1" pitch dual row (5+5) header
RF	2pin 0.1” pitch
Recommended PCB hole size	1.2mm

RX Received Signal Strength Indicator (RSSI)

The PLR receiver 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). ΔVmin-max is typically 2V and is largely independent of standing bias variations. Output impedance is 40kΩ. Pin 5b can drive a 100μA meter directly, for simple monitoring.

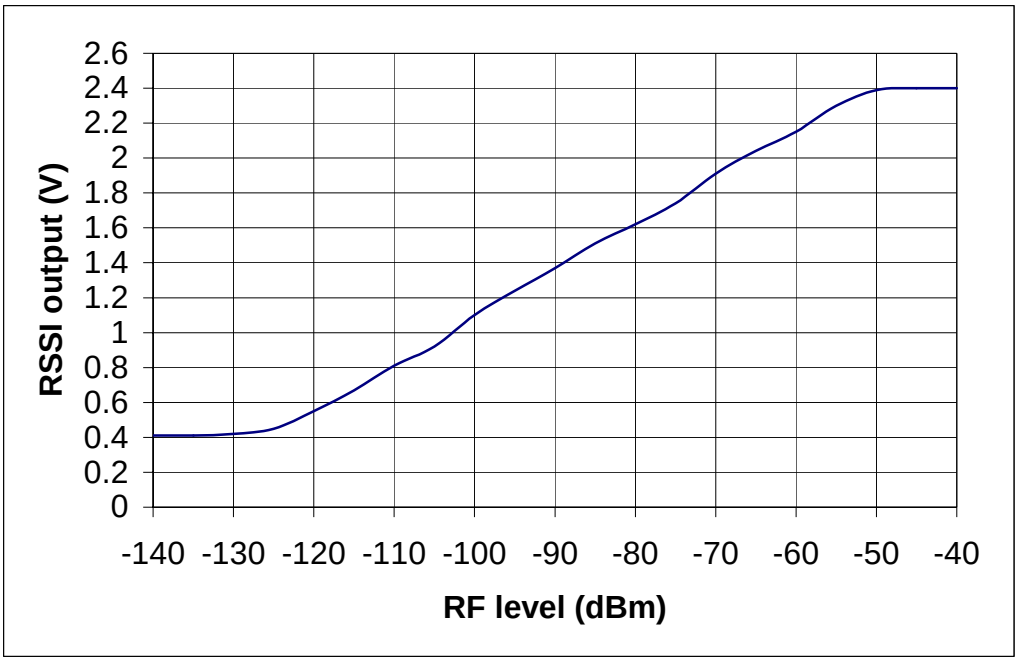

Figure 6: typical RSSI level with respect to received RF level at PLR antenna pin

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.

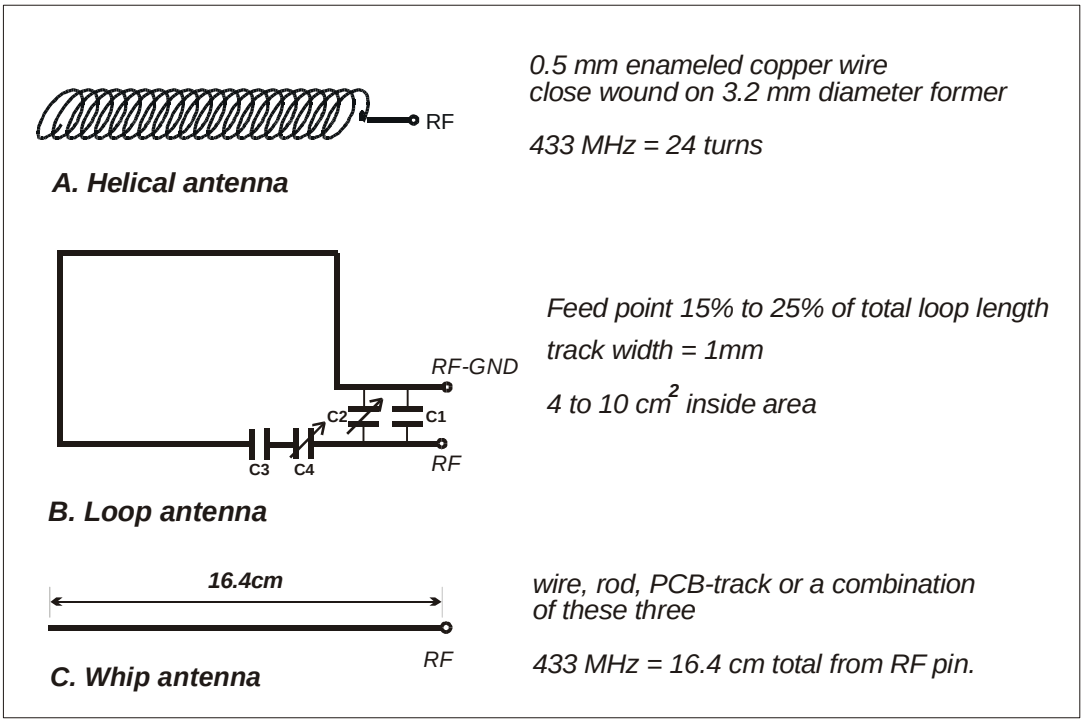

Figure 7: Antenna types (for 433MHz)

Ordering Information:

Part No.	Description	Frequency band (MHz)	Supply (V)	RF power (mW)	Data rate
VHF					
PLT1-173-9	Transmitter	173.200 - 173.325	3.1 -15	10	9600bps
PLR1-173-9	Receiver	173.200 - 173.325	3.1 -15		9600bps
PLT1-151-9	Transmitter	150.825 - 152.450	4.1 -15	100	9600bps
PLR1-151-9	Receiver	150.825 - 152.450	3.1 -15		9600bps
UHF					9600bps
PLT2-433-9	Transmitter	433.875-434.650	3.1 -15	10	9600bps
PLR2-433-9	Receiver	433.875-434.650	3.1 -15		9600bps
PLT2-458-9	Transmitter	458.525 - 459.1	4.1 -15	100	9600bps
PLR2-458-9	Receiver	458.525 - 459.1	3.1 -15		9600bps

***Notes**:*

1. *The standard products use a 9600 baud user interface speed. Slower versions are also available (1200, 2400 and 4800 baud, with suffixes -1, -2, and -4). e.g.: PLT1-173-4 (for 4800 baud)*
2. *PLT/PLR are available on number of other VHF and UHF frequencies. Other UHF band frequencies are subject to SAW filter availability. e.g. 315, 419, 429, 448, 465MHz etc*

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The Intrastat commodity code for all our wireless 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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