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LMT0/LMR0

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27MHz HF Narrow Band FM multi channel radio modules

The LMT0 transmitter and LMR0 receiver modules offer a 10kHz channel spacing multi channel, low power, and reliable HF data link. This makes the LMT0/LMR0 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: LMT0 transmitter and LMR0 receiver

Features

- Conforms to EN 300 220-2 and EN 301 489-3
- High performance double superhet. PLL synthesizer with TCXO
- 6 channels (standard). Up to 16 parallel select or 32 serial select channels
- quasi-dc (peak sampling) data recovery circuit (for enhanced performance on unbalanced datastreams)
- Data rates up to 4 kbps for standard module
- Usable range over 1km
- Fully screened. Low profile
- Feature-rich interface (RSSI, analogue and digital baseband)
- Re-programmable via UART interface
- Low power requirements

Applications

- Radio Control (R/C) Radio Service under FCC Part 95 subpart C
- Radio model control
- Telemetry and telecommand
- Wireless door entry systems
- Simple On/Off switching
- In-building environmental monitoring and control
- Security and fire alarms
- Vehicle/machinery controls

Technical Summary

Frequencies:	10mW 26.957-27.283MHz Non-specific Short Range Devices (SRD) 100mW 26.995, 27.045, 27.095, 27.145, 27.195, 27.255MHz Remote control Any 0.5MHz wide sub-band in 26-28MHz
Transmit power:	+10dBm (10mW) @ 4.1V; +20dBm (100mW) version also available
Receiver sensitivity:	-115dBm (for 12 dB SINAD)
Supply range:	4.1V – 15V Transmitter
	3.1V – 15V Receiver
Current consumption:	40mA @ 10mW Transmit; 100mA @ 100mW Transmit 20mA Receive
Data bit rate:	4kbps max.

Evaluation platforms: NBEK + LM Series carrier

LMT0 HF multi-channel transmitter

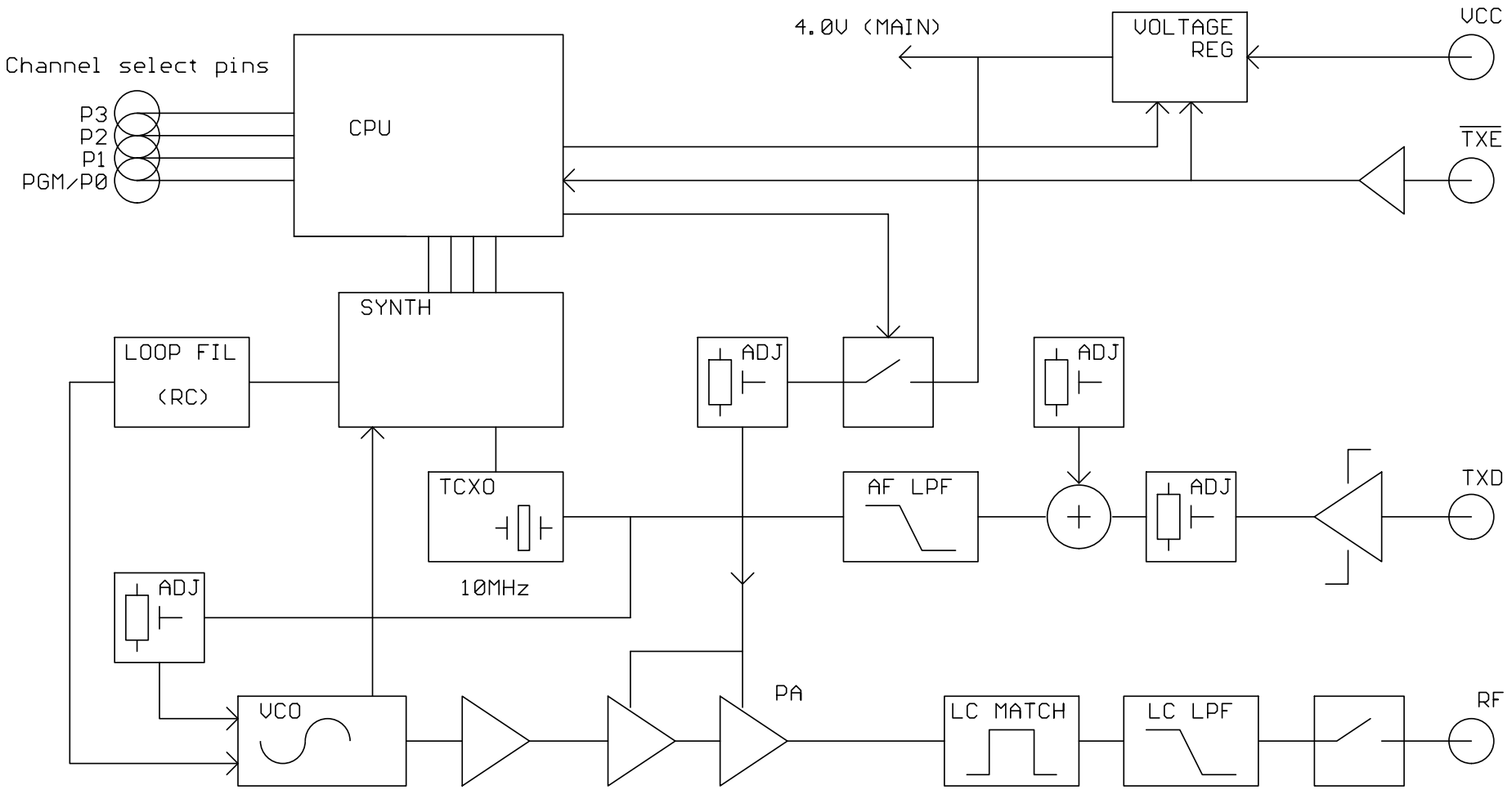


Figure 2: LMT0 block diagram

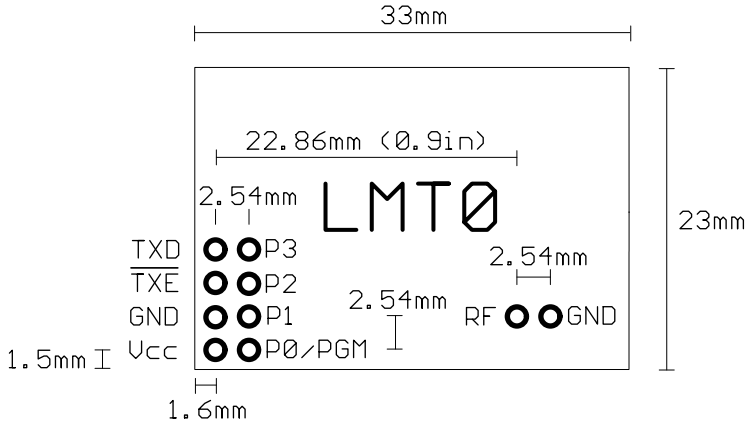


Figure 3: LMT0 footprint (top view)

Pin description – LMT0

Pin	Name	Function
1a	Vcc	4.1V – 15V power supply
2a	0V	Ground
3a	$\overline{\text{TXE}}$	Transmit Enable (active low)
4a	TXD	DC coupled input for CMOS logic. R_{in}=47kΩ
5a	No pin	Not present in LMT0
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 LMT0

Notes:

1. Serial programming is by an inverted, CMOS logic level, 2400 baud UART data stream applied to the PGM pin.
2. Channel select inputs have pull-ups (50kΩ) to 4V internal rail. Do not exceed 4V logic levels on this port.
3. Channel select inputs are active low
4. $\overline{\text{TXE}}$ has a 100kΩ pull-up 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

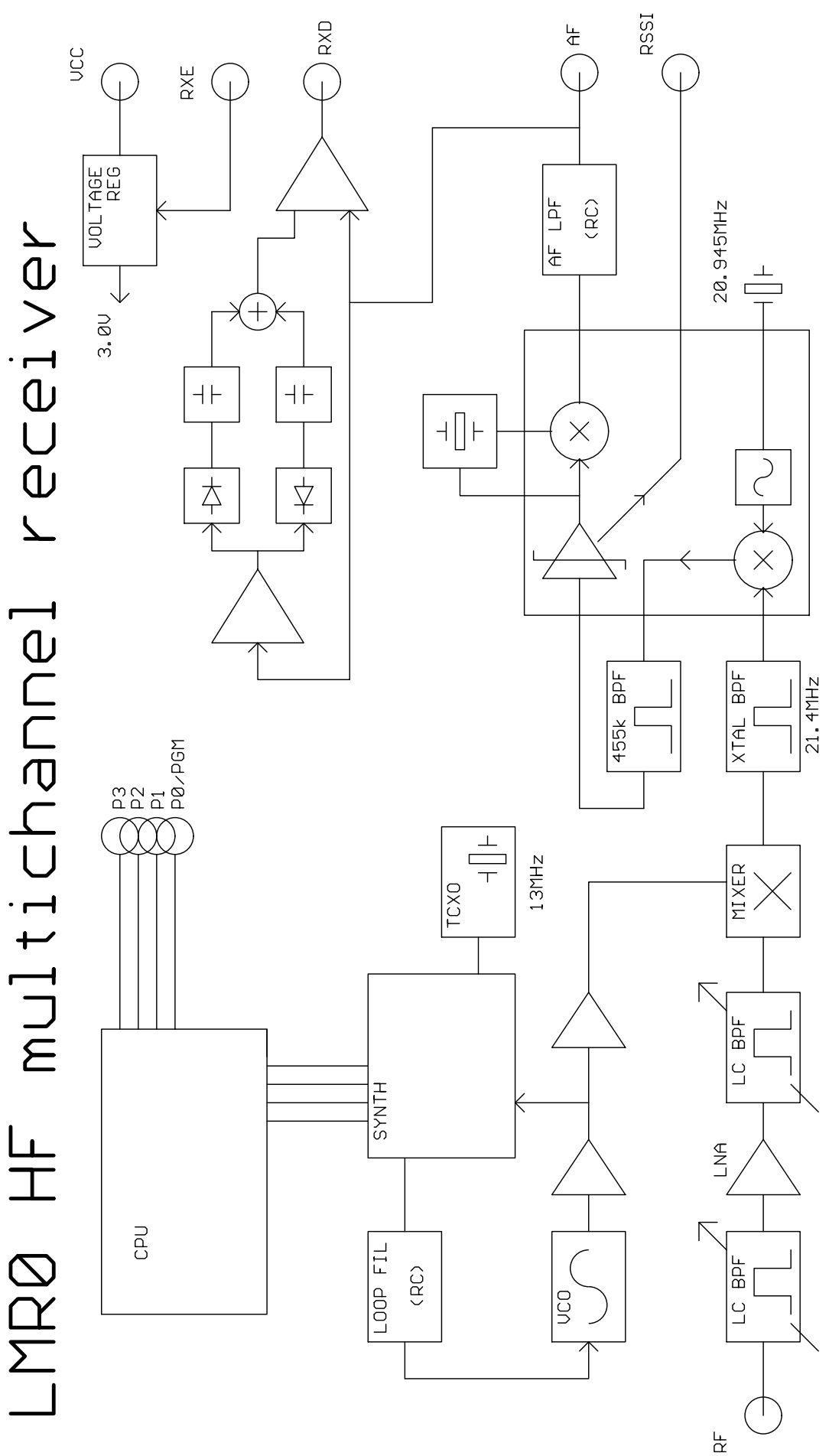


Figure 4: LMR0 block diagram

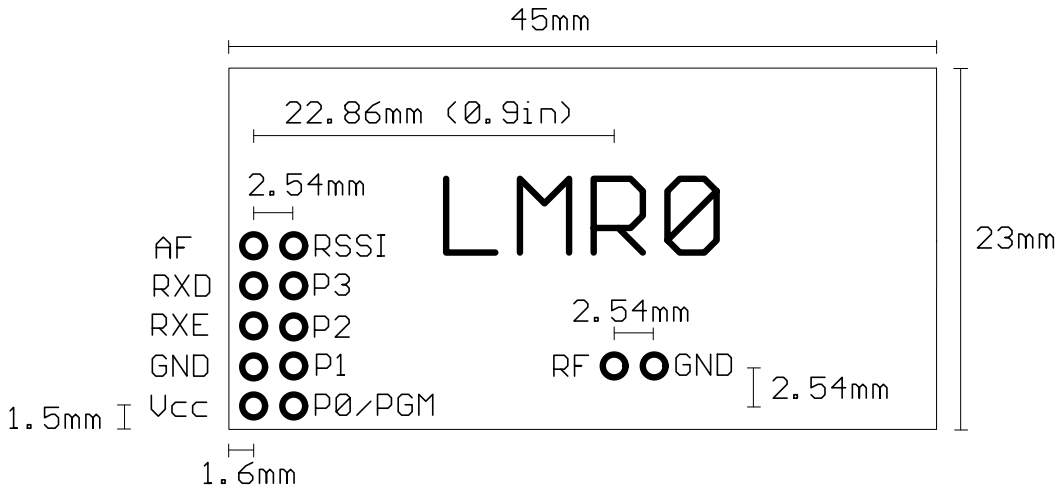


Figure 5: LMR0 footprint (top view)

Pin description – LMR0

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 pull-up)
5a	AF out	600mV 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 UART data stream applied to the P0 pin.
2. Channel select inputs have pull-ups (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. 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.
6. A quasi-DC data extractor is provided, to better deal with mark - space errors in simple coder schemes
7. Compared to a standard LMR, the AF output has the opposite 'sense'.
   Data output polarity is, however, the same.

Serial interface commands

2400 baud UART. 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)).

The LMT0 / LMR0 modules are supplied in one of two possible software versions, depending on the frequency table setup. The usual load-out (used for the default 6 channel “radio control” version) is the eight channel version described below. If a 32 channel unit has been ordered, then these radios will be supplied programmed with the standard LMT1 / LMR1 software, and are programmed using the commands detailed in those data sheets

The 8 channel LM series software is a little unusual, in that it provides a unique R divider value for each channel, rather than storing a single value common to all. This in turn allows the use of comparison frequencies higher than the 5kHz that would otherwise be necessary to set up the FCC specified frequencies (a comparison frequency below 10kHz will result in unacceptably slow PLL setting, and compromised switching speed)

Unfortunately, the mathematics necessary to generate the relevant N / R values is somewhat involved, and most users will be unlikely to need to reprogram the channel table. Further information can be obtained from Radiometrix, if needed.

GOCHAN a	a Serially select channel a, where a is ch0 to ch7
SETPAR	Channel selected by 4 bit parallel inputs (ch0 to ch7)
SETSER	Channel selected by most recent GOCHAN operation
RVALUE rrrr	R register value used for SINGLE operation (only)
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

a = one digit channel number, from 0 to 7
nnnnn = synthesizer N register value (up to 65535)
rrrr = synthesizer R register value (up to 16383)

Frequency table programming commands are as follows:

LDTXN a nnnnn	Set value of N register for channel a (LMT0 only)
LDTXR a nnnnn	Set value of R register for channel a (LMT0 only)
LDRXN a nnnnn	Set value of N register for channel a (LMR0 only)
LDRXR a nnnnn	Set value of N register for channel a (LMR0 only)

Notes:

1. *A pause of at least 50ms must be allowed between command strings (EEPROM programming time)*
2. *In 'SINGLE' mode 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.*
3. *When calculating the PLL operating frequency Fc = F(ref) x N / R, please note that the LMT0 has a 10MHz reference, while the LMR0 uses 13MHz*
4. *Unlike most other Radiometrix receivers, the LMR0 design places the local oscillator 21.4MHz ABOVE the channel frequency. N value must be calculated accordingly*

Default Transmitter and Receiver N, R values

Frequency	TXN	TXR	RXN	RXR
26.995MHz	1069	396	2658	714
27.045MHz	1144	423	2303	618
27.095MHz	970	358	1854	497
27.145MHz	1816	669	2782	745
27.195MHz	1716	631	3996	1069
27.255MHz	834	306	2560	684

$$f_{comp} = \frac{f_{VCTCXO}}{TXR} = \frac{10MHz}{358} = 27.932961kHz$$

Comparison Frequency (f_{comp}) >10kHz

$$TXN = \frac{RF}{f_{comp}} = \frac{27.095MHz}{27.932961kHz} = 970$$

48.495MHz (LO) = 27.095MHz (RF) + 21.4MHz (IF)

$$f_{comp} = \frac{f_{VCTCXO}}{RXR} = \frac{13MHz}{497} = 26.156942kHz$$

$$RXN = \frac{RF + IF}{f_{comp}} = \frac{27.095MHz + 21.4MHz}{26.156942kHz} = 1854$$

Condensed specifications

Frequency	26.995, 27.045, 27.095, 27.145, 27.195, 27.255MHz (Standard) Any 0.5MHz wide sub-band in 26-28MHz (General)
Frequency stability LMT0 *LMR0*	±1.0kHz ±0.5kHz
Channel spacing	10kHz
Number of channels	6 channels (standard) 16 channels controlled by parallel port or 32 via serial 4V level UART interface
Operating temperature	-20 ºC to +70 ºC (Storage -30 ºC to +70 ºC)
Spurious radiations	Compliant with ETSI EN 300 220-2 and EN 301 489-3 Meets FCC Part 95
Transmitter	
Output power	+10dBm (10mW) ±1dB nominal [factory fixed RF power variants] +20dBm (100mW) ±1dB nominal
Peak deviation	±1.2kHz
TX on switching time	30ms from $\overline{TXE}$ transition
Modulation type	FSK (F3D)
TX modulation bandwidth	DC – 4kHz (CMOS compatible)
Adjacent channel TX power	<-37dBm
TX spurious	<-40dBm (<-54dBm in forbidden bands) No RF output in Standby
Supply	
Voltage	4.1V – 15V
Current	40mA for 10mW transmission 100mA for 100mW transmission <5μA standby ($\overline{TXE}$ high or floating)
Inputs	Data (CMOS/TTL compatible)
Size	33 x 23 x 9mm
Interface *User*	10 (8) pin 0.1" pitch dual row (5+5) header
RF	2pin 0.1” pitch
Recommended PCB hole size	1.2mm
Receiver	
Sensitivity	-115dBm for 12dB SINAD
Image, Spurii	<-60db
Blocking	Better than 90dB
LO re-radiation	-70dBm
Supply	
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 *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 LMR0 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 2.2V 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.

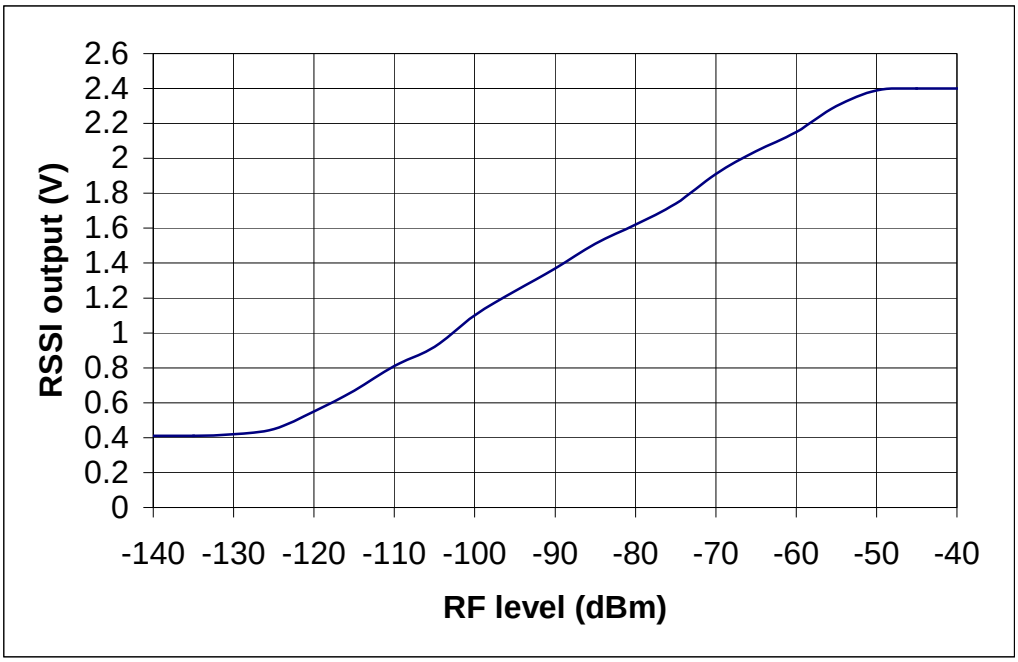


Figure 6: typical RSSI level with respect to received RF level at LMR0 antenna pin

Ordering Information:

Part No.	Description	Channel Frequencies (MHz)	RF power (mW)	Channel Spacing (kHz)	Data rate kbps
LMR0-27-4	Receiver	CH0: 26.995, CH1: 27.045MHz, CH2: 27.095, CH3: 27.145MHz, CH4: 27.195, CH5: 27.255MHz	10	10	4
LMT0-27-4	Transmitter				
LMT0-27-4-100mW	Transmitter	CH0: 26.995, CH1: 27.045MHz, CH2: 27.095, CH3: 27.145MHz, CH4: 27.195, CH5: 27.255MHz	100	10	4

Note: 25mW, 100mW version is intended for use in USA, Australia, NZ and only for model control in Europe

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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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