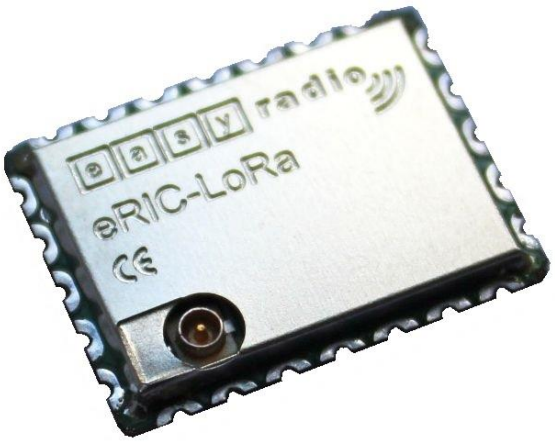


Product image for illustration Purposes only

The easyRadio eRIC-LoRa (Long Range) RF transceiver module uses Chirped Spread Spectrum (CSS) modulation together with DSP (Digital Signal Processing) to achieve greater range than traditional devices using OOK, FSK or GFSK modulation.

In addition, sensitivity and blocking performance are improved giving high interference immunity whilst still offering low power consumption.

The module is a complete sub-system that combines a high performance low power RF transceiver, a microcontroller and a voltage regulator.

Key operating parameters can be changed and configured by sending simple 'text' (ASCII character) commands to the module.

Features

Chirped Spread Spectrum technology
Pin compatible with eRIC series RF modules
uFL RF connector for remote antennas
Point to Point communication
Half duplex transparent Serial Data Input and Output
Up to 180 bytes per packet
Familiar easyRadio commands
Built in temperature sensor
'Flash' firmware upgrades. New features and updates can be quickly programmed using LPRS tools

Key Parameters

Frequency Range: 860 – 1000MHz
Frequency Bands : 868/915MHz
Receiver sensitivity: down to -137dBm
Multi-channel operation
RF Power output: up to +20dBm (100mW)
Receive current consumption: 15mA
RSSI dynamic range: 127dB
Line of Sight (LoS) range - 5km-10km +

User Programmable Options:

Spreading factors 6: to 12
Error correction rate
Selectable Bandwidth: 125, 250, 500kHz
Over air bit rates of up to 300 kbps offer effective 37.5 kbps data rate
Host Data Rate: 2.4kbps – 115.2kbps

The variable spreading factor and error correction rate allow the user to optimise the bandwidth to provide a balance between sensitivity (range) and data rate.

Applications

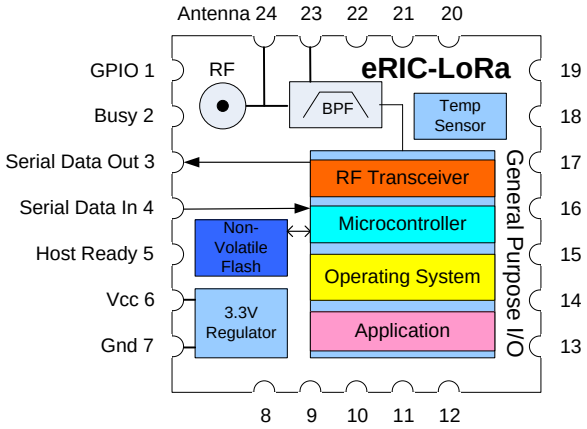
Required range is above 1km or transceiver is in poor RF location
Suburban security alarms - void buildings, caravan or car storage sites, warehouses
Rural security, farm buildings/equipment, livestock monitoring, remote irrigation pumps
Data collection and monitoring over a wide area

eRIC-LoRa Transceiver

The easyRadio eRIC-LoRa RF transceiver module is a complete sub-system that combines a high performance low power RF transceiver, a microcontroller and a voltage regulator.

The Serial Data Input (SDI) and Serial Data Output (SDO) by default operate at the standard 19,200 Baud and two handshake lines provide optional flow control to and from the host. The easyRadio Transceiver can accept and transmit up to 180 bytes of data, which it buffers internally before transmitting in an efficient over-air code format.

Any other eRIC-LoRa transceiver, within range and on the same settings, that 'hears' the transmission will decode the message and place the recovered data within a receive buffer that can then be downloaded to the receiving host for processing and interpretation. Radio transmission and reception is bi-directional (half duplex) i.e. transmit OR receive but not simultaneously. Extra internal buffers however, allow the user to upload data while a download is in progress giving the appearance of fully duplex data flow.



Pin/Pad Description

Pad No	Name	Description	Notes
1	GPIO	General Purpose digital I/O	
2	Busy	Clear to Send (CTS) function Digital output	Indicates that transceiver is ready to receive serial data from the Host. Low – Transceiver Ready, High – Transceiver not Ready
2	GPIO	General Purpose digital I/O	Optional use as GPIO or A-D Input
3	SDO	Rx Serial Data Out (Default)	Digital output - Connect to Host serial input
4	SDI	Tx Serial Data In (Default)	Digital input - Connect to Host serial output
5	Host Ready	Request to Send (RTS) function Digital input	Used to indicate that Host is ready to receive serial data from the Transceiver Low – Host Ready, High – Host Not Ready Weak (35k) pull down enabled. Optional A-D Input
6	Vcc	Operating Supply Voltage	Internal 3.3V regulator operates from +2.4V to +6V Input. Supply should be 'clean', noise and ripple free
7	Gnd	Power Ground	0V Ground
8 - 22	GPIO	General Purpose digital I/O	Connect as described.
22	Reset		Optional hardware Reset pin/pad. TBA
23	RF Gnd	RF Ground – 0V	Connect to antenna ground and local ground plane. Internally connected to Power Ground 0V
24	RF	50R RF Input/Output	Connect to suitable antenna via 50R PCB trace or use the alternative UFL connector

Notes

3.3V Regulator will function (no regulation) below drop out voltage. Internal RF IC can operate down to 2.4V and still provide rated RF power output.

GPIO Pins/pads are configured (by default) on power up or upon 'Reset' as inputs with internal weak pull downs. Therefore, exercise caution when connecting to external circuitry.

Pins/Pads 1-7 are physically (Pin/pad sequence) and electrically compatible with easyRadio eRA400/900 Transceivers.

Interrupt function available on Pins/pad 1, 2, 5, 17, 18, 19

Mechanical

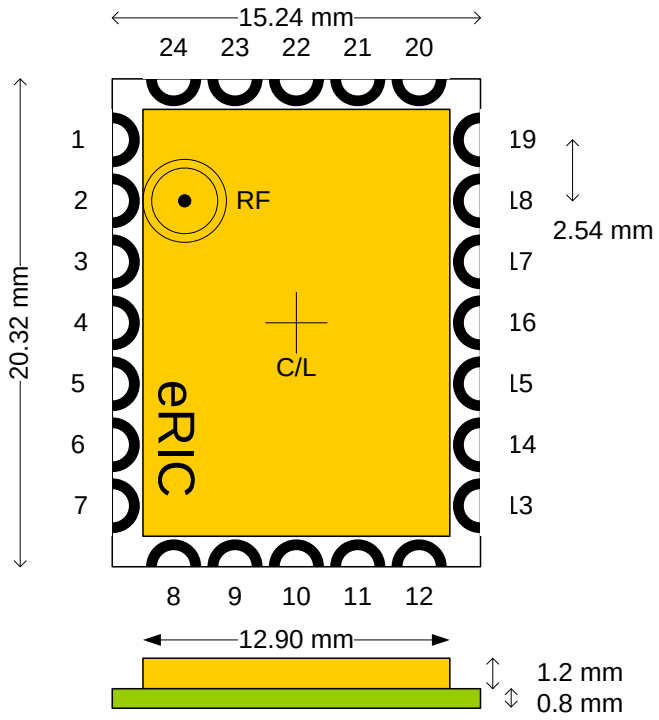


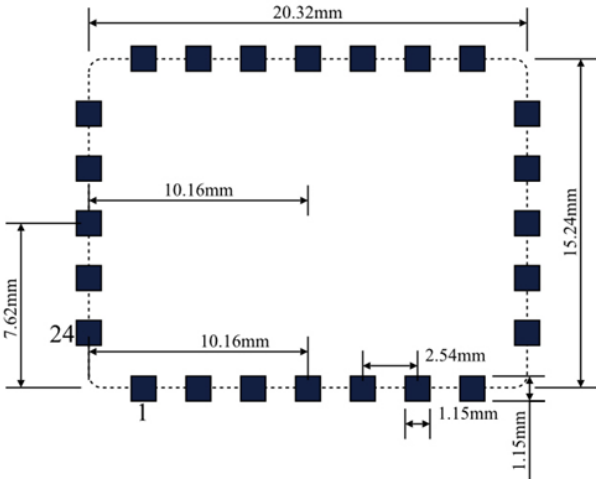
Figure 1 Mechanical Drawing

PCB Layout Notes

Pitch of the castellated connection pads is 2.54mm. Pads 4 & 16 and 10 & 22 are on centre line (C/L) of module

It is recommended that the module is mounted on a double sided PCB and that the area below the module be flooded with additional copper ground plane. This should be connected to pad 23 (RF Ground) and pad 7 (Power Gnd).

The recommended pad layout is shown below. Pads should be solid with no hole.



eRIC is designed for reflow soldering. Please contact LPRS Technical Department for further details and the suggested thermal profiles.

Absolute Maximum Ratings

Operating Temperature Range	-40° C to +85° C
Storage Temperature Range	-40° C to +85° C
Vcc	- 0.3 to + 5.5 Volts
All Other Pins (N.B.)	- 0.3 to +3.3 Volts
Antenna	+10dBm - Should be protected to prevent damage from ESD

Performance Data: eRIC-LoRa. Supply +5.0 Volt ± 5%, Temperature 20° C

DC Parameters	Pin	Min	Typical	Max	Units	Notes
Supply Voltage (Vcc)	6	2.5	3.3-5.0	6.0	Volts	
Transmit supply current	6	18	90	125	mA	40mA at +10dBm 90mA at +17dBm 125mA at +20dBm
Receive supply current	6		10	11.2	mA	2
Interface Levels						
Data Output Logic 1			3.1		Volts	10k load to +Vcc supply
Data Output Logic 0			0.1		Volts	10k load to +Vcc supply
Logic Output Current				25	mA	
Data Input Logic 1		2.0		3.6	Volts	See Notes
Data Input Logic 0				0.2	Volts	
Input Pull-ups			100		KΩ	1
RF Parameters						
Antenna Impedance	24		50		Ohms	
Frequency Range		860	-	1000	MHz	Please refer to local ISM licence free radio regulations. See ER Frequency commands
Frequency Regional	EU	868	869.85	870	MHz	See ER Configuration commands
	USA	902	915	928	MHz	
RF Power Output	24		+7	+7	dBm	868MHz - 50Ω load
	24		+17	+20	dBm	915MHz - 50Ω load
Frequency accuracy			±10		ppm	Overall
Harmonics/Spurious Emissions			-47	< -36	dBm	Meets EN 300 220-3
Over Air Bit Rate				300	Kbps	
Receiver		**SF6**		**SF12**		
Sensitivity		-122		-137	dBm	At 125kHz bandwidth (SF 6 - 12)
		-119		-134	dBm	At 250kHz bandwidth
		-116		-131	dBm	At 500kHz bandwidth
Serial Data Rate		2.4	19.2	115.2	Kbps	Host interface
Logic Timing						
Initial Power Up Time			1		mS	2,3
Mechanical						
Size			15 x 20 x 2.2		mm	
Pin Pitch			2.54		mm	(Standard 0.1 Inches)
Weight			1.5		grams	

Notes:

1. The 'Host Ready Input' and the 'Serial Data Input' have 'weak' internal pull-ups enabled.
2. The transceiver will then be ready to receive (default) or transmit. It would normally be left in this powered state ready to receive data.
3. During power up the 'Busy' Output line goes high and then goes low when ready for use.

Notes

The module operates internally from the output of an on-board 3.3 Volt low drop regulator. This regulator will still provide an (un-regulated) output below its drop out voltage, down to the minimum operating voltage (1.8V) of the RF IC which at 2.4V allows up to +20dBm RF output.

The logic levels of the input/output pins are therefore between 0 Volt and the actual output voltage of the internal regulator. Outputs will drive external logic operating at 3.3 Volts. Resistors (10k typical) should be fitted in series with input data lines when interfacing to external 5V logic outputs to prevent driving excess current into inputs and thus damaging them.

The internal Vreg is not brought out to a specific pin/pad. Should there be need to connect external pull up resistors then connection should be made to a spare GPIO pin/pad configured as a 'High' output.

The serial inputs and outputs are intended for connection to a UART or similar low voltage logic device. Do not connect any of the inputs or outputs directly to an RS232 port. The transceiver module may be permanently damaged by the voltages (+/- 12V) present on RS232 signal lines.

When handshaking is enabled the 'Host Ready' Input should be held at 0 Volt (Ground) in the idle state.

On power up the transceiver is, by default configured to receive data.

Power Supply

The supply used to power the transceiver should be 'clean' and free from ripple and noise (<20mV p-p total). It is suggested that 100nF ceramic capacitors be used to de-couple the supply close to the power pins of the transceiver. The use of 'switch mode' power supplies should generally be avoided as they can generate both conducted and radiated high frequency noise that can be very difficult to eliminate. This noise may considerably reduce the performance of any radio device that is connected or adjacent to such a supply.

Antennas

The eRIC transceiver can be used with the various common types of antenna that match the 50Ω RF Input/Output such as a monopole (whip), a tuned helical antenna, a PCB loop antenna or a ceramic 'chip' antenna.

Monopole antennas are resonant with a length corresponding to one quarter of the electrical wavelength (Lambda/4). They are very easy to implement and can simply be a 'piece of wire' or PCB track which at 434MHz should be 16.4cms in length. This should be kept straight, in 'free space' and well away from all other circuitry, conducting objects and metalwork and should preferably be connected directly to the Antenna pin (24) of the eRIC transceiver.

If the antenna needs to be remote it should be connected via a 50Ω coaxial feeder cable or transmission line. A 50Ω transmission line can be constructed on FR4 board material by using a 3mm wide PCB track over a ground plane and this should be kept as short as possible.

The eRIC transceiver is also fitted with UFL (U.FL) RF Connector wired in parallel with pin 23 (RF Gnd) and pin 24 (RF In/Out). LPRS can supply suitable antennas fitted with matching connectors and low loss cable assemblies.

Helical antennas are also resonant and generally chosen for their more compact dimensions. They are more difficult to optimise than monopole antennas and are critical with regard to any surrounding conducting objects that can easily 'de-tune' them. They operate most efficiently when there is a substantial ground plane for them to radiate against.

PCB loop antennas are the most compact antennas but are less effective than the other types. They are also more difficult to design and must be carefully 'tuned' for best performance.

Chip antennas are attractive as they are compact and if used in accordance with the manufacturer's specifications can provide very good performance.

The Internet can provide much useful information on the design of Short Range Device (SRD) Antennas.

Please Note: To meet US FCC requirements the modules must be used with the specified antennas (TBA) that were used for testing.

easyRadio eRA Configuration Command Set

Key operating parameters of eRA module can be changed and configured by sending the 'text' (ASCII character) commands detailed below. These commands can be executed using 'easyRadio Companion' software, any 'Terminal' software operating on a PC or from the host microcontroller.

The commands should be sent exactly as shown: i.e. case sensitive with no spaces between characters.
Commands are not executed until the Acknowledgement sequence (ACK) is sent to and processed by the module.

To send the commands follow this procedure:

Send Command from host: e.g. ER_CMD#U5 (Set UART BAUD to 38400)
Wait for the completion of the echo of the Command from the module. e.g. ER_CMD#U5
Send the ACK command as the three upper case ASCII characters 'A' 'C' 'K' in sequence with no spaces

Commands ending with '?' (see below) do not require any ACK.

Host Serial Communication Settings					
Command	**UART Data Rate**	✓	Tick Indicates Factory Default setting		
ER_CMD#U1	2400				
ER_CMD#U2	4800				
ER_CMD#U3	9600				
ER_CMD#U4	19200	✓			
ER_CMD#U5	38400				
ER_CMD#U6	31250		MIDI - Musical Instrument Digital Interface (Not supported by PC UARTS)		
ER_CMD#U7	76800		(Not supported by PC UARTS)		
ER_CMD#U8	115200				
ER_CMD#U?	Get UART Value		The module replies with the current UART data rate value E.g: ER_CMD#U2 - No 'ACK' is required		
ER_CMD#A70	No Parity	✓	Data = 1 Start, 8 Data, No Parity, 1 Stop		
ER_CMD#A71	Even Parity		Data = 1 Start, 8 Data, 1 Parity, 1 Stop		
ER_CMD#A72	Odd Parity		Data = 1 Start, 8 Data, 1 Parity, 1 Stop		
ER_CMD#A40	Disable Fast ACK	✓			
ER_CMD#A41	Enable Fast ACK		See notes below		
Transmit RF Power Output Settings					
				eRIC-LoRa	**Units**
				868 / 902-928	MHz
ER_CMD#P0				-2 / -1	dBm
ER_CMD#P1				-1 / 1	dBm
ER_CMD#P2				0 / 3	dBm
ER_CMD#P3				1 / 5	dBm
ER_CMD#P4				2 / 7	dBm
ER_CMD#P5				3 / 9	dBm
ER_CMD#P6				4 / 11	dBm
ER_CMD#P7				5 / 13	dBm
ER_CMD#P8				6 / 15	dBm
ER_CMD#P9		✓		7 / 17	dBm
			N.B. RF Power Output is restricted by EU & US regulations		
ER_CMD#P?	Get Power Value		The module replies with the current power value. e.g: ER_CMD#P9 - No ACK is required.		
RF Channel Settings					
ER_CMD#Cx	Where x = Channel Number in decimal		E.g. For Channel 1: ER_CMD#C1 or ER_CMD#C01 (leading zero) or ER_CMD#C001 Uppercase 'C' stores value in EEPROM		
ER_CMD#cx	As uppercase C		Lowercase 'c' does not store value in EEPROM		
ER_CMD#C?	Get Channel Value		The module replies with the current channel setting E.g: ER_CMD#C9 - No ACK is required.		
Signal Bandwidth					

				Bandwidth		Data Rate @ S/F = 12		
ER_CMD#B0	Set Signal Bandwidth			125	kHz	300	bps	After sending these commands the Channel number will be reset to Channel 0
ER_CMD#B1				250	kHz	600	bps	
ER_CMD#B2			✓	500	kHz	1200	bps	
Band Plan								
ER_CMD#b0	0		✓	869.850			MHz	Band base/start frequency Europe/ USA
ER_CMD#b1	1			903.000			MHz	
Frequency Settings								
ER_CMD#F	Set Absolute Frequency			Sets the absolute frequency to xxxxxxxx in Hex E.g. ER_CMD#33DCAC20 sets the radio frequency to 870100000Hz. This will override until another 'b' command is sent				Frequency of Channel 0
ER_CMD#F?	Get current Frequency value			Returns the current frequency value as 8 bytes of Hex E.g. ER_CMD#F? Returns 33DCAC20 which is 870100000MHz				Frequency of Channel 0
Spreading Factor								
	S/F	**Chips**		**Bandwidth kHz**			**Data Rate**	
				125	**250**	**500**		
ER_CMD#s0	6	64		9375	18750	37500	bps	Coding Rate = 1
ER_CMD#s1	7	128		5469	10938	21875	bps	
ER_CMD#s2	8	256		3125	6250	12500	bps	
ER_CMD#s3	9	512		1758	3516	7031	bps	
ER_CMD#s4	10	1024	✓	977	1953	3906	bps	
ER_CMD#s5	11	2048		537	1074	2148	bps	
ER_CMD#s6	12	4096		293	586	1171	bps	
Miscellaneous								
ER_CMD#R0	Reset Module (POR)			Reset module and retrieve all Power On Reset values				
ER_CMD#R1	Reset to Defaults			Restores all factory default settings				
ER_CMD#A10	Encryption Off		✓	LPRS Proprietary Encryption for P2P				
ER_CMD#A11	Encryption On							
ER_CMD#A50	Handshaking Off		✓					
ER_CMD#A51	Handshaking On							
ER_CMD#a00	RSSI Off		✓	Received Signal Strength Indicator				
ER_CMD#a01	RSSI On			Each received packet delivered is preceded by the 8 bit RSSI value of the received packet				
Test Modes								
ER_CMD#T3	Get Firmware Revision			Returns module firmware revision string E.g. eRA400TRS V3.6.23				
ER_CMD#T4	RAW Data Out			Output on the CTS pin				
ER_CMD#T7	Read on-chip temperature Sensor			Example reply: -15.0'C or 23.7'C				
ER_CMD#T8	Last Packet RSSI			Returns the Hex value of the RSSI (Received Signal Strength Indicator) register measured on the last valid packet				
ER_CMD#T9	RSSI Value			Return current live RSSI in HEX string				
Other Special Commands								
ER_CMD#L8?	Get Serial Number			Returns the unique 4 byte module serial number in Hex. E.g. 40 00 00 56 No ACK required				
Group ID Setting								
ER_CMD#L7 xxxx	Enable Group ID			E.g. ER_CMD#L74578 sets the group ID as 0x4578				
ER_CMD#L7 0000	Disable Group ID							
ER_CMD#L7?	Get Group ID value			Returns the 4 byte Group ID number in Hex				

Channel Frequencies

Each channel frequency is calculated relative to the Start Frequency of the channel, the Channel Number and the Channel Spacing/Band width.

Three commands control the values of each of these parameters:

ER_CMD#bn	Where n is the Start Frequency in MHz of the Band Plan being used	b
ER_CMD#Cn	Where n is the integer Channel Number	c
ER_CMD#Bn	Where n is the Channel Spacing/Bandwidth in kHz	s

The centre frequency of each channel is calculated using the formula:

Centre Frequency $(f) = b + cs + \frac{s}{2}$

Where

Band plan Start Frequency
Channel Number
Channel Spacing/Bandwidth

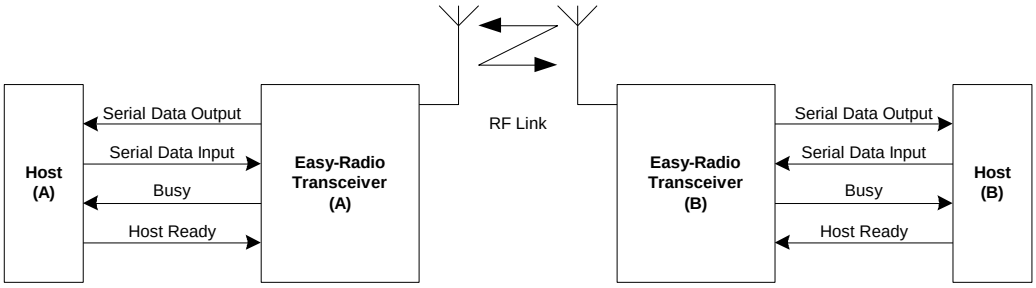
Example

b = 0
c = 1
s = 500kHz

f = 869.850MHz + 1 x 500kHz + 500kHz/2 = **870.600MHz**

Application & Operation of eRIC-LoRa Transceiver

The diagram below shows a typical system block diagram comprising hosts (user's application) connected to easyRadio transceivers. The hosts (A & B) will be monitoring (collecting data) and/or controlling (sending data) to some real world application.



Typical System Block Diagram

The hosts provide serial data input and output lines and two 'handshaking' lines that control the flow of data to and from the easyRadio Transceivers. The 'Busy' output line, when active, indicates that the transceiver is undertaking an internal task and is not ready to receive serial data. The 'Host Ready' input is used to indicate that the host is ready to receive the data held in the buffer of the easyRadio Transceiver.

The host should check before sending data that the 'Busy' line is not high, as this would indicate that the transceiver is unable to reliably receive further data. It should also pull the 'Host Ready' line low and check that no data appears on the Serial Data Output line.

The Busy output is active all the time regardless of handshaking setting. The host Ready is enabled by the handshaking setting command.

Timing Specifications		Units	Notes
Host Serial Input/Output	2400, 4800, 9600, 19200, 38400, 31250 (MIDI), 76800 & 115200	baud	1
Host Character Format	1 Start, 8 Data, No Parity, 1 Stop	Bits	2
End of Data Delay	2 x BAUD Byte Duration	mS	3
RF Transmit duration	Depends on Bandwidth and data rate setting	mS	4
Buffer Size	180	Bytes	5

Notes

1. Data is inverted i.e. Start Bit is logic low. The inputs are intended for direct connection to a microcontroller UART or to RS232 inputs and outputs via an RS232 Level translator such as a Maxim MAX232, which invert the logic of the RS232 signals. This allows direct connection to, for example a microcontroller UART. The data rate is user programmable (Default 19200 baud) and may differ between individual units within a system.
2. 1 start, 8 data, 1 stop = 10 bits @ 104uS/bit = 0.52mS/character at 19200 Baud. (Default)
3. The 'End of Data' delay is fixed at twice the character time.
4. A fixed package overhead of xx is added to all packets.
5. The buffer size is limited to 180 bytes. Sending more than 180 bytes will cause loss of data.
6. CTS pin will go high 2 bytes before the buffer is full. This allows characters already sent to be accepted by the ER module.

Product Order Code

Name	Description	Order Code
eRIC-LoRa	CE/FCC/IC Certified Radio Module	ERIC-LORA

Please contact the sales office for availability of other variants of the standard product. The software interface can be customised to specific requirements for high volume applications.

easyRadio Advanced Firmware Versions

Version	Date	Revision	Known Issues
4.1.11XXX	January 2016	Initial Release	

Document History

Issue	Date	Revision
0.1	February 2017	Provisional datasheet
0.2	May 2017	Minor corrections
1.0	May 2017	Release
1.1	June 2017	Typo corrections
1.2	November 2017	Clarification of Min / Max operating frequency
1.3	January 2018	Corrections and clarifications

Changes to this Document This data sheet has been updated to reflect changes throughout the range of LPRS modules. Specific changes are recorded in the documentation history above.

Copyright See: www.lprs.co.uk

Disclaimer See: www.lprs.co.uk

Terms and Conditions of Use See: www.lprs.co.uk

Contact Information For further information or technical assistance please contact:

Low Power Radio Solutions Ltd.
Two Rivers Industrial Estate
Station Lane, Witney
Oxon, OX28 4BH
England

Tel: +44 (0)1993 709418
Fax: +44 (0)1993 708575
Web: http://www.lprs.co.uk
Email: info@lprs.co.uk
Technical: technical@lprs.co.uk