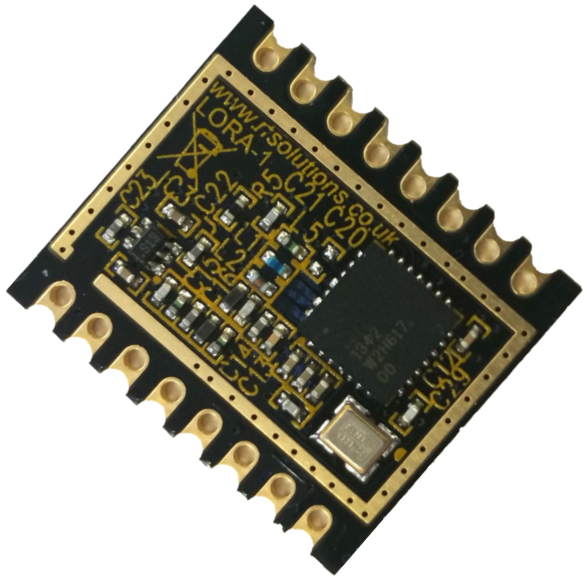
LongRange Transceiver

Features

- Upto 16KM Range
- Integrated LoRa™ Modem Semtech SX1272
- Highly Efficient Inetgral Impedance Matching Network
- Provides Full Functionality of the RFIC:
- 157 dB maximum link budget
- +20 dBm at 100 mW constant RF output vs. V supply
- +14 dBm high efficiency PA
- Built in RF switch
- High sensitivity: down to -130 dBm
- Bullet-proof front end: IIP3 = -12.5 dBm
- 89 dB blocking immunity
- Small Form Factor: 23mm x 20mm
- Programmable bit rate up to 300 kbps
- Low RX current of 10 mA, 100nA register retention
- FSK, GFSK, MSK, GMSK, LoRaTM and OOK modulation
- Built-in bit synchronizer for clock recovery
- Preamble detection
- 127 dB Dynamic Range RSSI
- Automatic RF Sense and CAD with ultra-fast AFC
- Packet engine up to 256 bytes with CRC
- Built-in temperature sensor and low battery indicator



Applications

- Home Automation
- RF Alarms
- Sensor networks
- Telemetry
- Meter Reading
- Irrigation Systems
- General Purpose Wireless Applications

Introduction

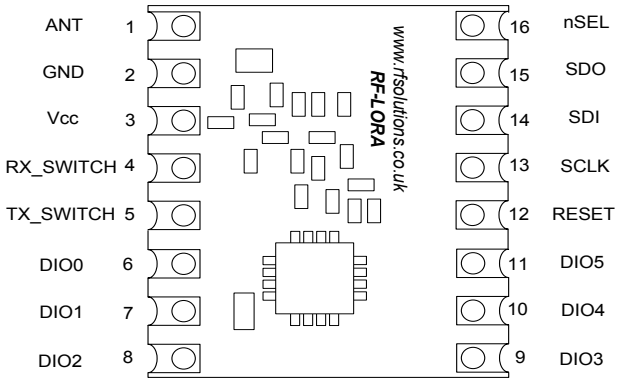
The RF-Lora module is an extremely high performance, cost effective plug and play radio module featuring the Semtech SX1272 LoRa™ long range providing ultra-long range spread spectrum communication and high interference immunity within minimal current consumption.

The RF-LORA module is a complete design enabling a Plug and Play Modular design. All circuitry, crystal, RF Changeover Switch impedance matching network and track layout to provide a simple digital interface and direct antenna connection, enabling a plug in RF solution with maximum efficiency. Programming of the module is via SPI interface

Using the RF-Lora enables a fast and easy time to market solution with cost effective License exempt hardware.

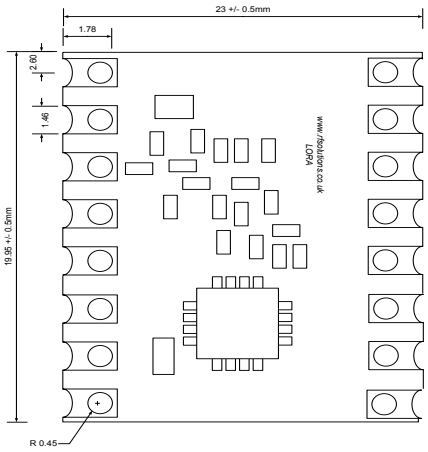
The RF-LORA Module is CE compliant and FCC approved (pending) meaning that this module can be used in a final application without further FCC approval or testing on condition that certain procedures are followed (please see later in this datasheet) .

Pin Description

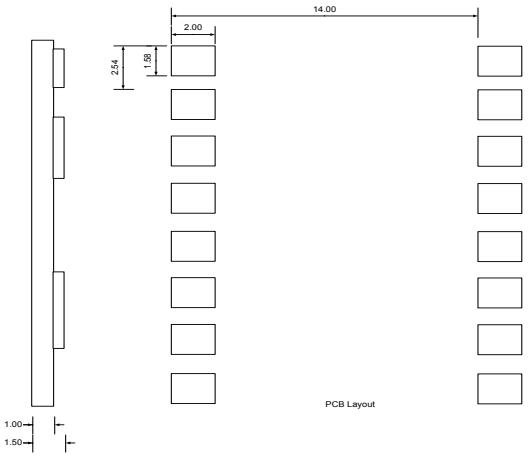


PIN	Definition	Direction	Function
1	Antenna	In/Out	Antenna pin connection. Keep short (50phms Impedance)
2	GND	-	Ground connection
3	Vcc	In	Power connection
4	RX_SWITCH		
5	TX_SWITCH		
6	DIO0	In/Out	Digital I/O software configured
7	DIO1	In/Out	Digital I/O software configured
8	DIO2	In/Out	Digital I/O software configured
9	DIO3	In/Out	Serial Interface Select Input (0 – VDD V): Provides select/enable function for 4-line serial data bus.
10	DIO4	In/Out	Digital I/O software configured
11	DIO5	In/Out	Digital I/O software configured
12	RESET	In	Reset Trigger Input
13	Serial Clock	In	SPI Serial Clock Input
14	Serial Data In	In	SPI Serial Data Input
15	Serial Data Out	Out	SPI Serial Data Output
16	nSEL		

Mechanical Dimensions



Suggested Layout



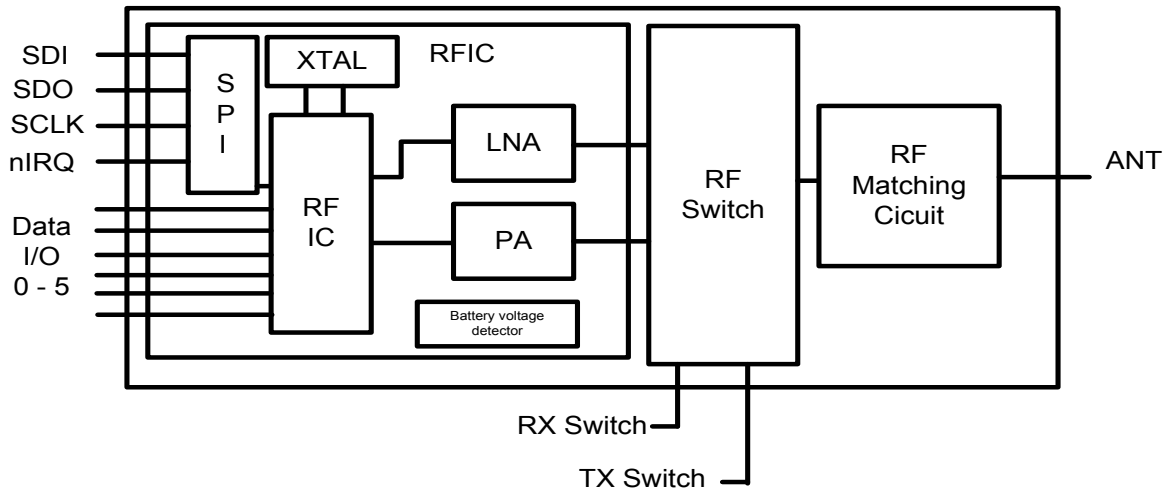
DIP Version

The RF-LORA is a SMT package RF Module however may be convertedto DIL package by soldering two 9 way IDC pin Headers along each edge

Part Numbers

Part Number	Description
RF-LORA-868-SO	FM Transceiver Module, pre set to 868MHz
RF-LORA-915-SO	FM Transceiver Module, pre set to 915MHz

Block Diagram



Application Resources

The RF-LORA is a ready to use application of the Semtech SX1272.
Access to the programming and configuration of Semtech 1272 Transicevier are via the module interface SPI line.

The RF-LORA has been developed with Semtech to provide a low cost platform application of the 1272 transceiver providing optimal design realisation and easy integration within the end application.
The most important aspect of any RF Module is to maximise the performance of the transceiver at the external module pads.
In particular the impedance matching network which is the most sensitive section of the RF module design.
In order to maximise signal propagation to the external pin of the module requires a specific layout which is not (usually) the smallest physical size (beware of small RF modules!).
Many RF Module manufacturers simply reproduce the IC manufacturers data characteristics where in practice the Module RF performance is considerably lower.

In order to provide the most upto date setup the configuration there is little point in this document duplicating the Semtech 1272 programming and setup guide.

Programming, configuration and further resource data is available from: Semtech at:

SX1272 Datasheet

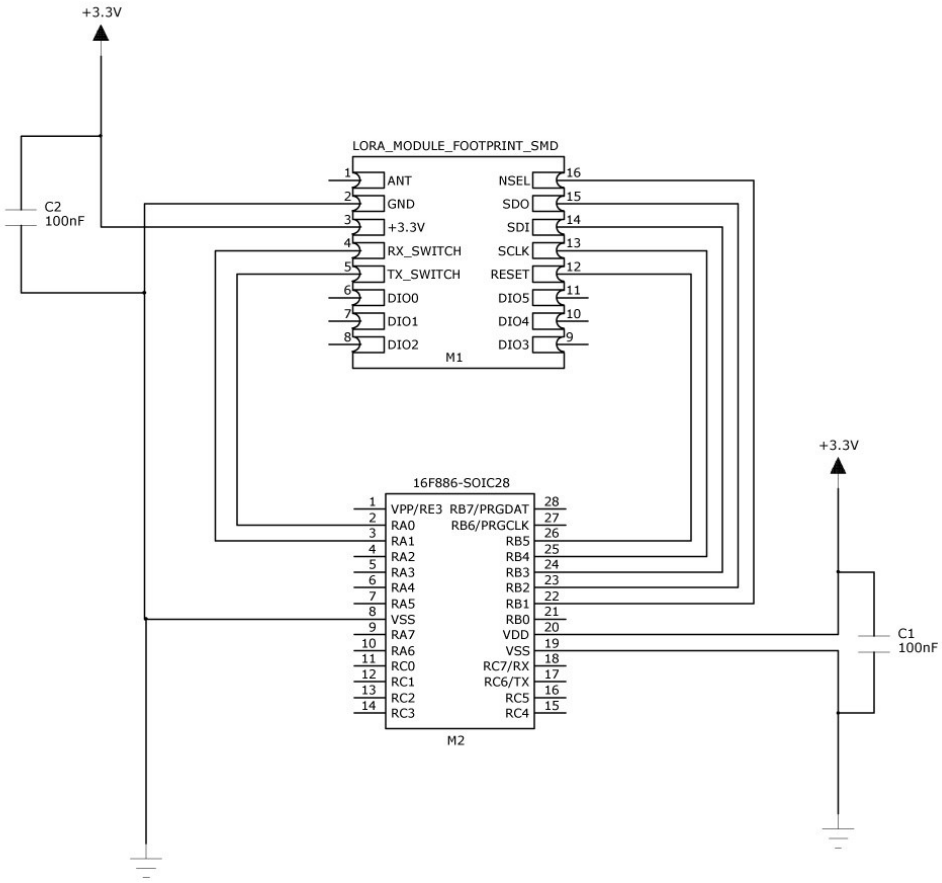
LoRa Calculator: fast evaluation of link budget, time on air and energy consumption

http://www.semtech.com/images/datasheet/etsi-compliance-sx1272-lora-modem.pdf

Packet Error Rate Firmware User Guide

LoRa Modem Designer's Guide

Application schematic Interfacing a PIC™ Micro Controller



The above schematic shows an easy interface to a PIC Microcontroller

This is the schematic we used in the range testing boards we built which is shown later in this datasheet.

We also have application source code available for download. This configures the RF Lora Module for maximum range.

Ping-Pong Walk Test application
Also available is the source code for our ping pong program used to range test.
In order to use this two application boards are required, one acts as a beacon transmitter, the other as the beacon receiver. Both Boards have a Green LED which is illuminated when transmitting, and a red LED which is illuminated when receiving.
The Transmitter board transmits an RF beacon every second. (Green LED flashes to indicate transmission)
When the receiver receives the beacon (Red LED Flashes) it immediately sends an acknowledge beacon back to the transmitter (Green LED flashes)
The Transmitter board then indicates reception of the acknowledgment by flashing its Red LED.
This enables a one man range test, by placing either board in a fixed location and monitoring the beacon signals

Electrical Specifications

Absolute Maximums

Symbol	Parameter	Minimum	Maximum	Unit
V_{dd}	Positive power supply	-0.3	+3.9	V
V_{in}	Voltage on Digital Inputs	-0.3	Vdd+0.3	V
V_{in}	Voltage on Analogue Inputs	-0.3	Vdd+0.3	V
RX	Max Rx input power		+10	dBm
T_{op}	Operating temperature	-40	+85	°C
T_{st}	Storage temperature	-55	115	°C

Recommended Operating Conditions

Symbol	Parameter	Minimum	Maximum	Unit
V_{dd}	Positive power supply	2.2	3.7	V
T_{op}	Working temperature	0	55	°C

DC Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage Range	V_{DD}		1.8	3.3	3.6	V
Power Saving Modes	$I_{Shutdown}$	RC oscillator, main digital regulator, and low power digital regulator OFF.	—	30	—	nA
	$I_{Standby}$	Register values maintained.	—	50	—	nA
	I_{Ready}	Crystal Oscillator and Main Digital Regulator ON, all other blocks OFF.	—	2	—	mA
	ISPI Active	SPI active state		1.35		mA
TUNE Mode Current	I_{Tune_RX}	RX Tune	—	6.5	—	mA
	I_{Tune_TX}	TX Tune	—	6.9	—	mA
RX Mode Current	I_{RX}		—	10	—	mA
TX Mode Current	I_{TX}	RFOP = +20dBm on PA Boost RFOP = +17dBm on PA Boost RFOP = +13dBm on PA Boost RFOP = + 7dBm on PA Boost	—	125 90 28 18		mA

Power Consumption FSK Modulation

The table below give power consumptions figure based on the following parameters
VBAT1 = VBAT2 = Vcc = 3.3V
Temp= 25degC
Fxosc=32MHz, Frf=915MHz, Pout= +13dBm.
2 level FSK modulation without pre-filtering, FDA=5KHz, Bit Rate=4.8kbps

Symbol	Description	Conditions	Typ	Max	Unit
IDDSL	Supply Current Sleep Mode		0.1	1	uA
IDDIDLE	Supply Current Idle Mode	RC Oscillator enabled	1.5		uA
IDDST	Supply Current Standby Mode	XTAL Oscillator enabled	1.4	1.6	mA
IDDFS	Supply Current Synthesizer Mode	FSRx	4.5		mA
IDDR	Supply Current Receive Mode	LnaBoost off LnaBoost on	10.5 11.2		mA
IDDT	Supply Current Transmit Mode	RFOP=+20dBm on PA_BOOST RFOP=+20dBm on PA_BOOST RFOP=+20dBm on RFO pin RFOP=+20dBm on RFO pin	125 90 28 18		mA

Power Consumption LORA Modulation

The table below give power consumptions figure based on the following parameters
Vcc = 3.3V
Temp= 25degC
Fxosc=32MHz, Frf=915MHz,, Bandwidth = 125KHz, Spreading Factor = 12, Error Correction = 4/6
Packet Error Rate = 1% with CRC on Payload enabled
Pout= +13dBm.
Payload length = 10bytes, Preamble =12 symbols (programmed register Preamble length = 8)

Symbol	Description	Conditions	Typ	Max	Unit
IDDR_L	Supply current in receiver loRa Mode	LnaBoost off, BW=125KHz LnaBoost off, BW=250KHz LnaBoost off, BW=500KHz	9.7 10.5 12		mA
		LnaBoost on, BW=125KHz LnaBoost on, BW=250KHz LnaBoost on, BW=500KHz	10.8 11.6 13		mA
IDDT_L	Supply Current Transmitter Mode	RFOP=13dBm RFOP=7dBm	28 18		mA
IDDT_H_L	Supply Current Transmitter Mode	Using PA_BOOST pin RFOP=17dBm	90		mA

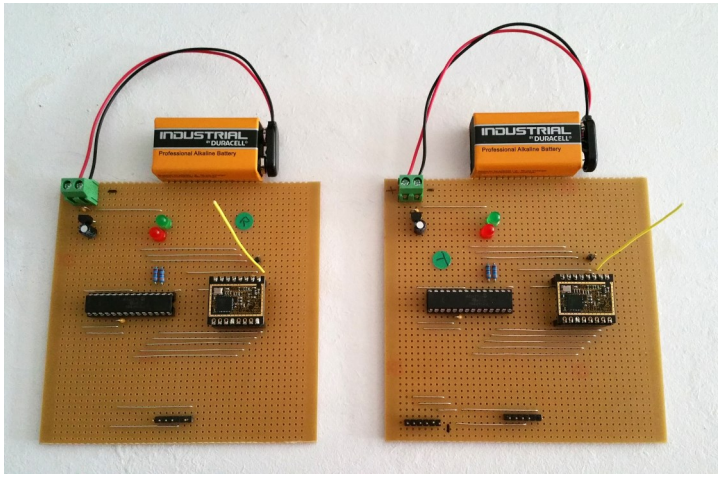
Range Test Notes

Transmitter and Receiver boards were built using simple Veroboard and a PIC microcontroller . The Transmitter sent a beacon signal at 1 second interval. The receiver acknowledged this signal back to the transmitter.

A simple piece of wire was used as antenna for both boards

This test was designed to represent a real life application, as it is often difficult to design any application with all RF features ideally suited to the RF!

i.e. the antenna was not 100% ideal, there was no antenna ground plane, the motherboard was rudimentary,



Our Range Testing was conducted on Brighton to Shoreham Seafront providing an open Line of Sight Test.

1. The Transmitter was placed Receiver was mounted on a plastic wheelie bin and the receiver was hand held at ~5ft from the ground .
2. The Receiver was carried on the dashboard of a car along the seafront. Line of sight was not achieved until the receiver was at least 9km distance
3. As the receiver travelled away from the transmitter Line of sight was lost . A Reliable signal was observed to about 3K range, thereafter the signal became intermittent. When the Transmitter and Receiver regained Line of sight a reliable signal was again observed. This continued for the available distance (about 12KM) at which point the terrain prevented further testing. At the longest available range the signal was 100% reliable.

Test conditions

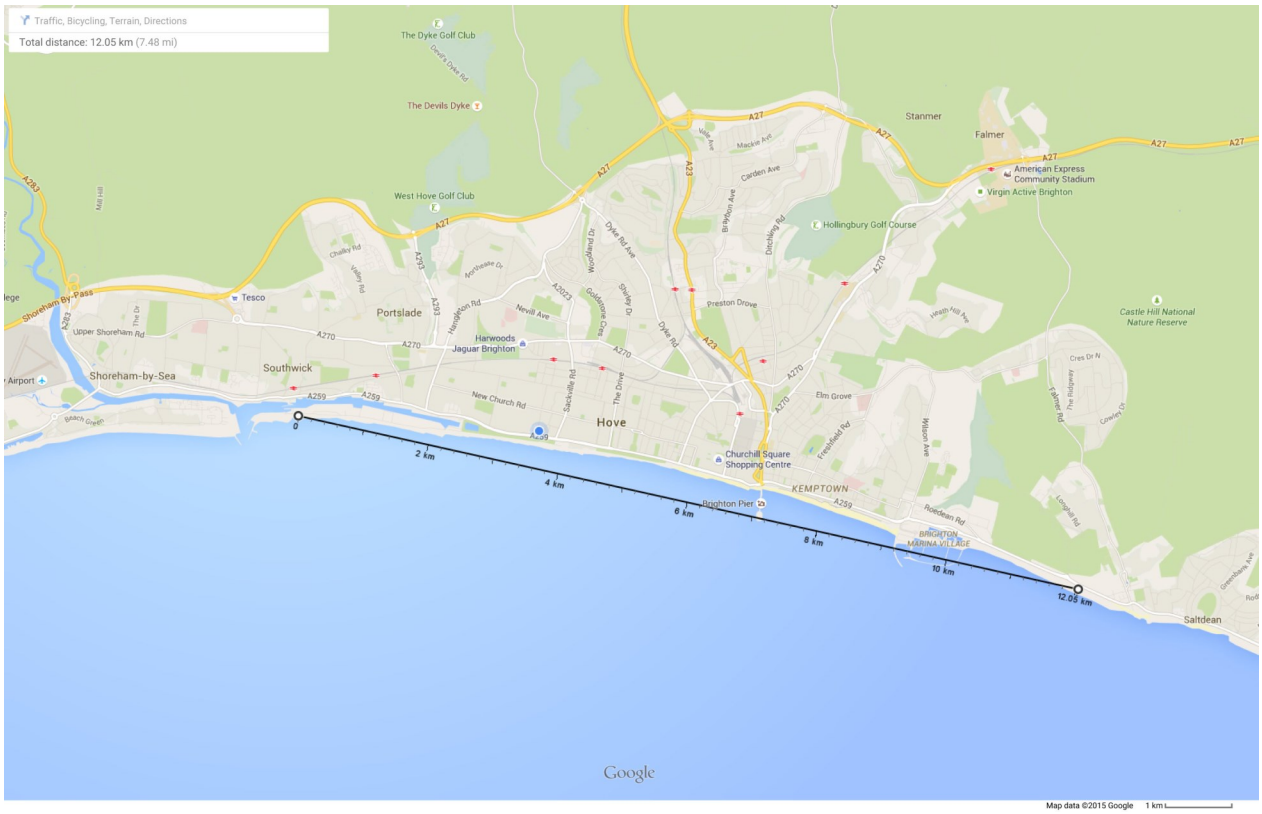
- T_A = +25 °C
- V_{DD}= +3.3 Vdc
- Dry, Broken Sunshine, Relative Humidity 45%
- RF input and output levels can typically be achieved at the antenna port after filtering components.

Conclusion

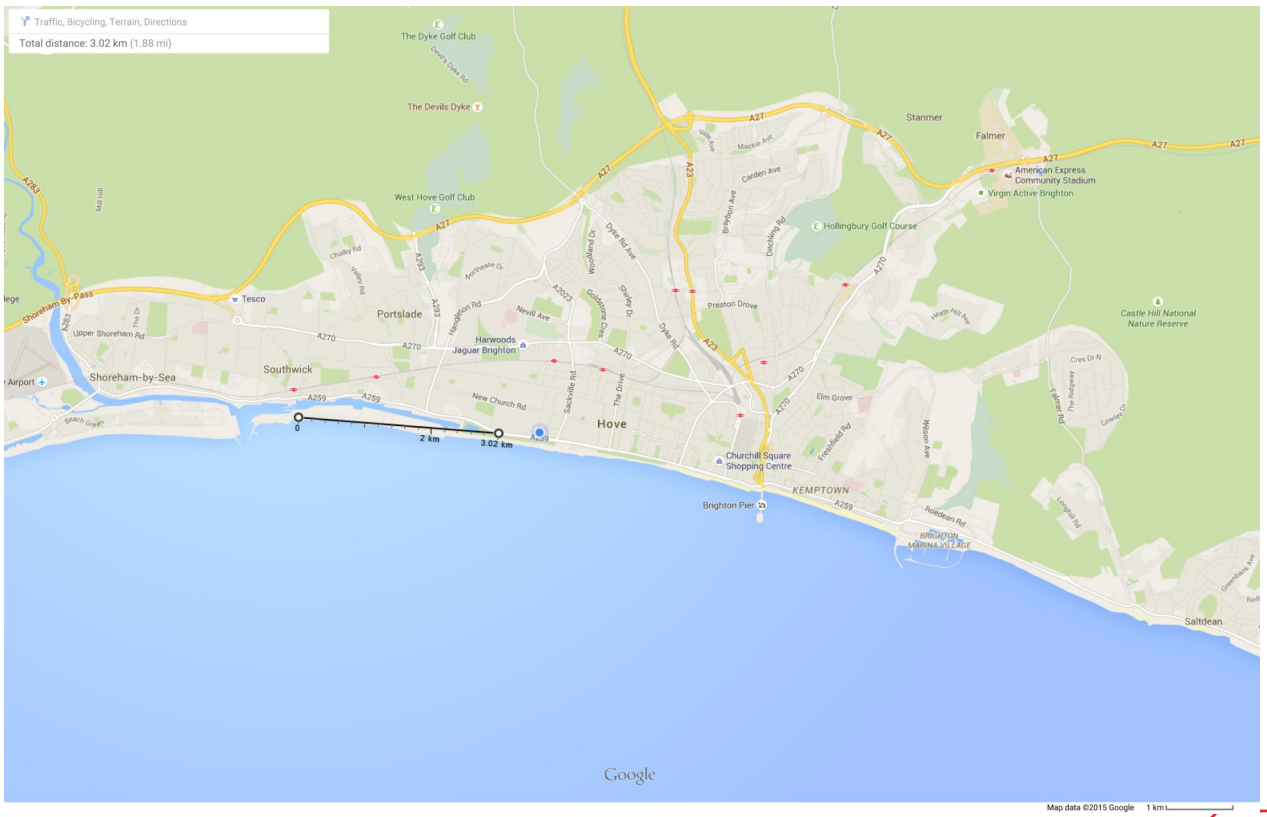
The product performed as expected. Unfortunately we ran out of land to test a LOS beyond 12Km ,so the maximum range is further than tested here.

It is also clear that the product performs considerabley better when in LOS.

Range Test Results L.O.S, we ran out of land to extend further

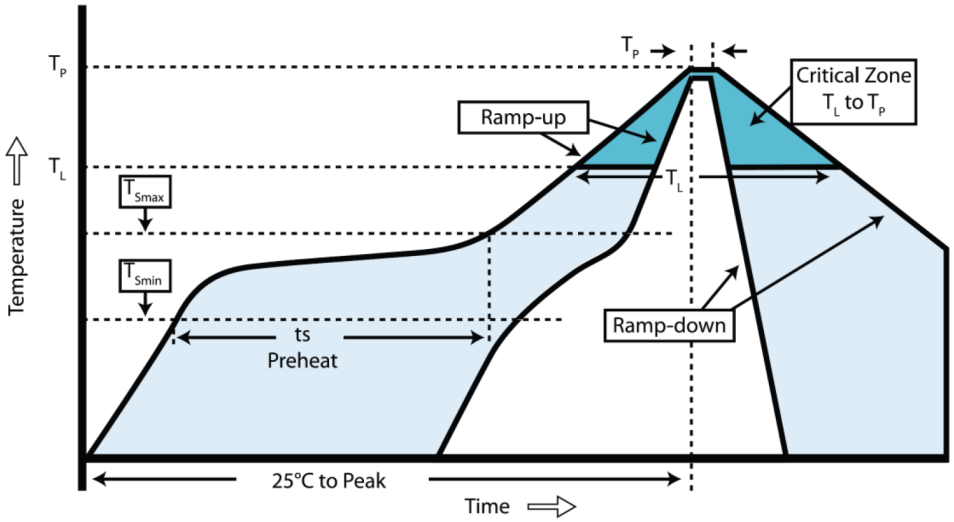


Range Test Results N.L.O.S, This is subjective as the buildings were random!



RF LoRa Transceiver

RF LoRa module re-flow guide



Profile feature	Value (lead free)
Ramp up rate	3°C /s
Pre-heat temperature - Temperature Min (T_{Smin}) - Temperature Max (T_{smax}) - Pre-heat time	 150°C 200°C 60-100s
Peak temperature (T_P)	240°C
Time at T_P	10-20sec
Ramp down rate	6°C/s
Time from 25°C to peak	8 mins max.

RF Solutions Ltd. Recycling Notice
Meets the following EC Directives:

DO NOT
Discard with normal waste, please recycle.

ROHS Directive 2002/95/EC
Specifies certain limits for hazardous substances.

WEEE Directive 2002/96/EC
Waste electrical & electronic equipment. must be disposed of through a licensed point. RF Solutions Ltd., fulfills its WEEE membership of an approved compliance scheme.

This product WEEE collection obligations by

Waste Batteries and Accumulators Directive 2006/66/EC
Where batteries are fitted, before recycling the product, the batteries must be removed and disposed of at a licensed collection point.

Environment Agency producer registration number:
WEE/JB0104WV.

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