

Fcc Certified LoRa Transceiver

Features

- Upto 16KM Range
- Integrated LoRa™ Modem Semtech SX1272
- Highly Efficient Integral 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, LoRa™ 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
- FCC “modular” Certified enabling application without further FCC testing.



Applications

- Home Automation
- RF Alarms
- Sensor networks
- Long Range Telemetry
- Meter Reading
- Irrigation Systems
- Wireless Applications
- Alarms

Description

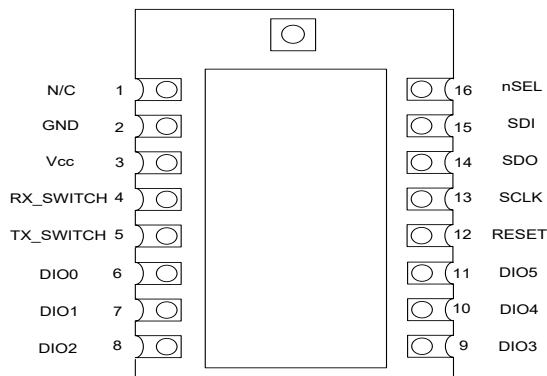
The RF-LAMBDA 915MHz module is an extremely high performance, cost effective radio module featuring the Semtech SX1272 LoRa™ long range providing ultra-long range, spread spectrum communication and high interference immunity within minimal current consumption.

This module including crystal, RF Changeover switch, impedance matching network and track layout provide a simple digital interface and direct antenna connection. This enables a plug in RF solution with maximum efficiency. Programming of the module is via SPI interface.

Using the RF-LAMBDA enables a fast and easy to market solution with cost effective license exempt hardware.

The RF-LAMBDA Module is CE compliant (868MHz) and FCC Certified. Providing that certain procedures are followed. (please refer to application schematic later in this datasheet the end application requires no further FCC certification).

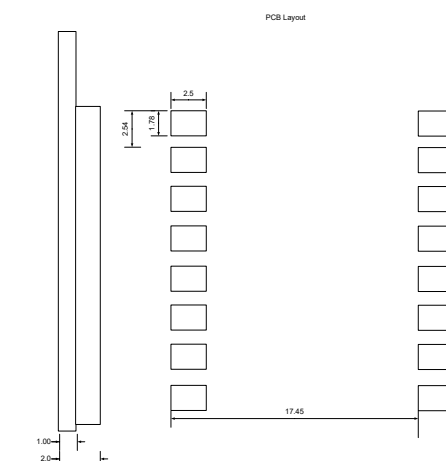
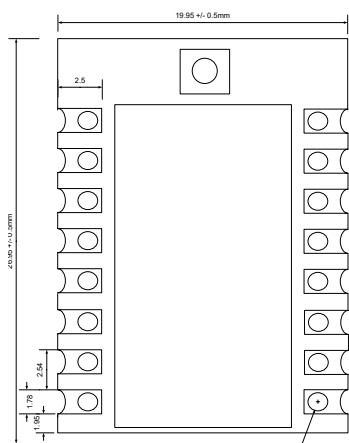
RF-LAMBDA Pin Description



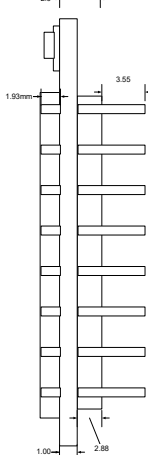
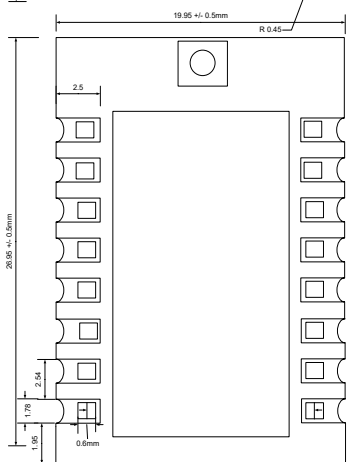
Mechanical Dimensions

Suggested Layout

SMT Version



DIP Version



Part Numbers

Part Number	Description	Package
LAMBDA-9S	FM Transceiver Module, 915MHz	SMT
LAMBDA-9D	FM Transceiver Module, 915MHz	DIP

LAMBDA LoRa Transceiver



Pin Description

PIN	Definition	Direction	Function						
1	Antenna	In/Out	Antenna pin connection. Keep short (50ohms Impedance)						
2	GND	-	Ground connection						
3	Vcc	In	Power connection						
4	RX_SWITCH	In	Enable RX RF Path Active High <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>TX PIN5</td> <td>RX PIN4</td> </tr> <tr> <td>RX Mode</td> <td>0</td> <td>1</td> </tr> </table>		TX PIN5	RX PIN4	RX Mode	0	1
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	TX PIN5	RX PIN4							
TX Mode	1	0							
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	Digital I/O Software configured						
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 Out	Out	SPI Serial Data Output						
15	Serial Data In	In	SPI Serial Data Input						
16	nSEL	In	Device Select Active Low						

FCC / CE Certification

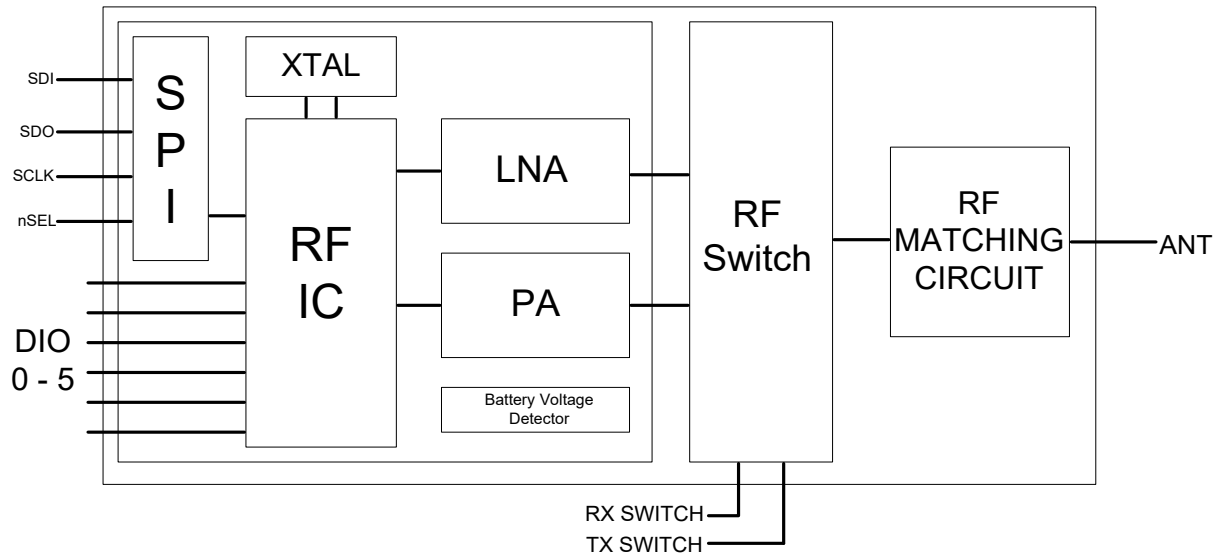
Lambda has the benefit of being an FCC part15 certified RF Module.

This enables the Lambda module to be incorporated within an product and rely on the Lambda module FCC certification for the end product without further testing or FCC certification with the following conditions.

1. The antenna to be used is either FLEXI-SMA-915 or FLEXI-SMA90-915
2. The finished product will display a label which is directly visible as follows: Contains FCC ID: P9OLAMDA9

Please note that although The radio characteristics are covered by the Lambda modular FCC ID of the grant, it is still the responsibility of the manufacturer to perform final checks on the product, such as ensuring the radiated transmitted power is within limits, and to assess the worst case spurious emission is within the FCC requirements of CFR47 Part 15. Plea

Block Diagram



Application Resources

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

The RF-LAMBDA has been developed with Semtech to provide a low cost platform application of the 1272 transceiver. This offers 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 pad of the module, a specific layout is required 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.

To ensure that the latest details in programming this device are offered, we have not included the 1272s programming information in this document.

You can find the datasheet at the link below:

[SX1272 Datasheet](#)

Programming, configuration and further resource data including;

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

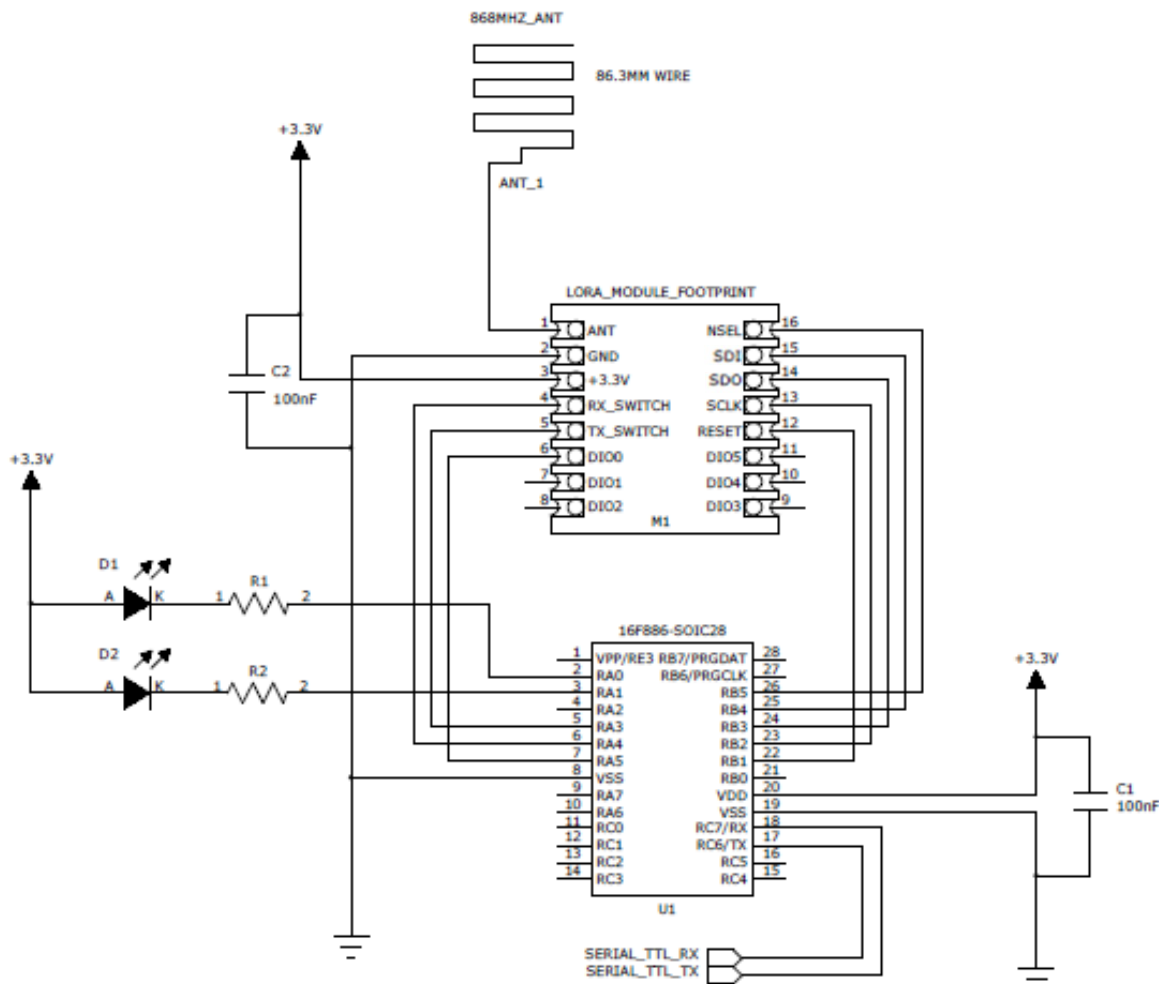
Packet Error Rate Firmware User Guide.

LoRa Modem Designer's Guide.

is available from Semtech at the below links:

[Semtec Website](#)

Application schematic Interfacing a PIC™ Micro Controller



The above schematic shows an easy interface to a PIC Microcontroller

This is the same application circuit that we used for range testing (please see our range test information later in the document).

We also have application source code available for download on our website. This configures the RF LoRa Module for maximum range.

Walk Test application

Also available is the source code used to carry out a simple range test. In order to use this two application boards are required, one acts as a beacon transmitter, the other as the beacon receiver. The TX board will illuminate the GREEN LED when transmitting and the Receiver will illuminate the RED LED when RECEIVING. The Transmitter board transmits an RF beacon every second (Green LED flashes to indicate transmission). 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	$V_{dd}+0.3$	V
V_{in}	Voltage on Analogue Inputs	-0.3	$V_{dd}+0.3$	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 gives power consumptions figures 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	125 90 28 18		mA

Power Consumption LORA Modulation

The table below gives power consumption figures 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_H_L	Supply Current Transmitter Mode	Using PA_BOOST pin RFOP=17dBm	90		mA

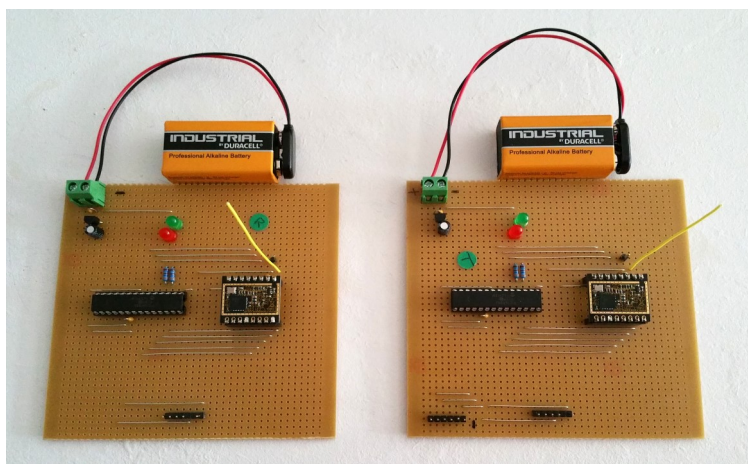
PLEASE NOTE: RFO is not connected on the RF-LAMBDA the RF out is connected through PA-BOOST only.

Range Test Notes

Transmitter and Receiver boards were built using simple Vero board and a PIC microcontroller (16F886). The transmitter sent a beacon signal at 1 second intervals. The receiver acknowledges this signal back to the transmitter.

A simple piece of wire was used as antenna for both transmitter and receiver.

This test was designed to represent a real life application. It is often difficult to design an application with all RF features to an optimum potential i.e. the antenna was not 100% ideal as there was no antenna ground plane, and 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 mounted on a plastic wheelie bin 4ft from the ground.
2. The Receiver was carried on the dashboard of a vehicle (5ft above ground) 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

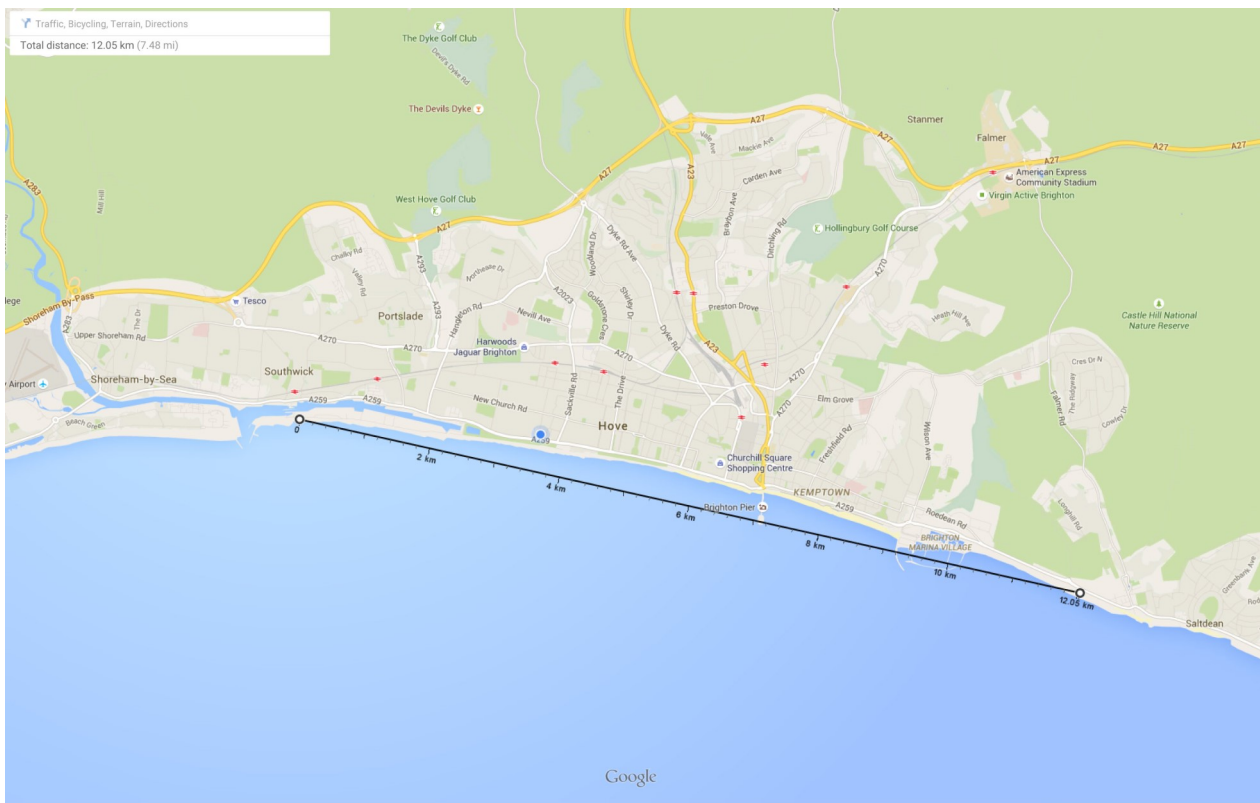
- $T_A = +25\text{ }^\circ\text{C}$
- $V_{DD} = +3.3\text{ Vdc}$
- Dry, Broken Sunshine, Relative Humidity 45%
- RF input and output levels can typically be achieved at the antenna port after filtering components.

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.

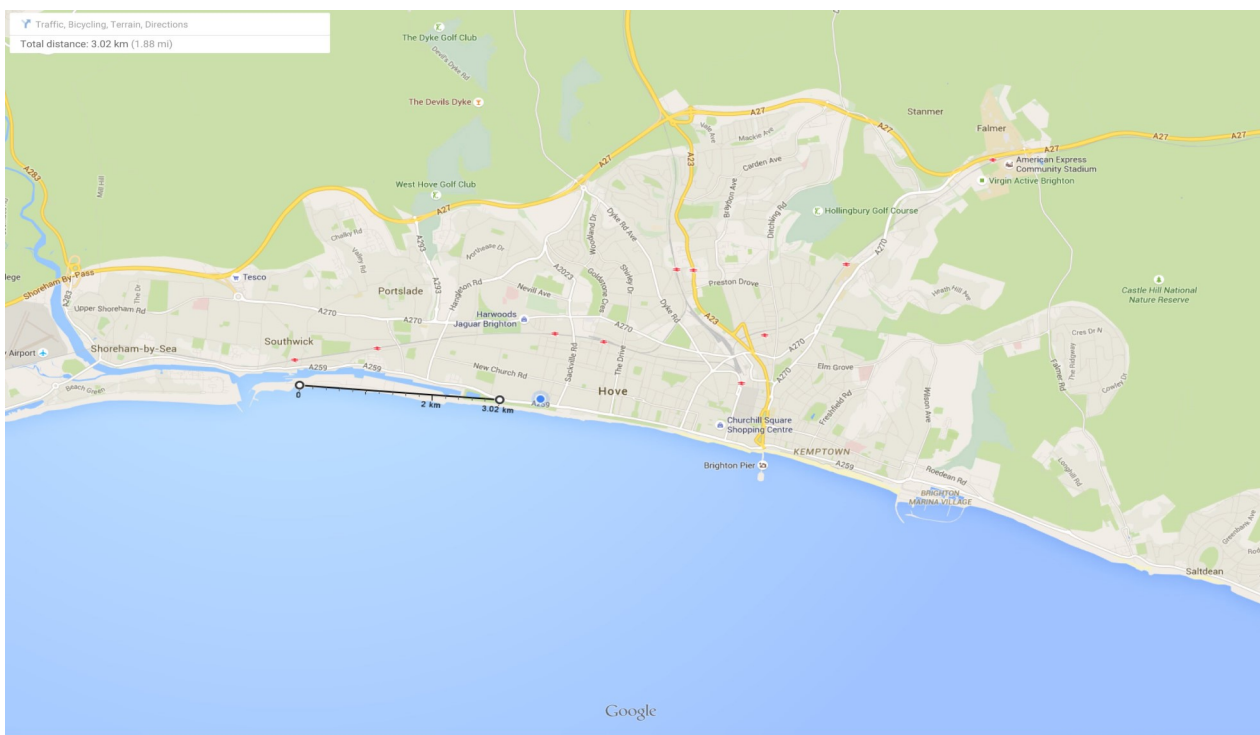
It is also clear that the product performs considerably better when in LOS.

Range Test Results (Line of Sight)



Range Test Results (Non Line of Sight)

This is subjective as the buildings were random!



FCC / CE Certification

Lambda has the benefit of being an FCC part15 certified RF Module.

This enables the Lambda module to be incorporated within a finished product and utilise the Lambda module FCC certification for the finished product with the following conditions.

1. The antenna to be used is either FLEXI-SMA-915 or FLEXI-SMA90-915
2. The finished product will display a label which is directly visible as follows:

Contains FCC ID: P90LAMDA9

Please note that although The radio characteristics are covered by the Lambda modular FCC ID of the grant, it is still the responsibility of the manufacturer to perform final checks on the product, such as ensuring the radiated transmitted power is within limits, and to assess the worst case spurious emission is within the FCC requirements of CFR47 Part 15.

Plea

FCC / CE Certification

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

No software is provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

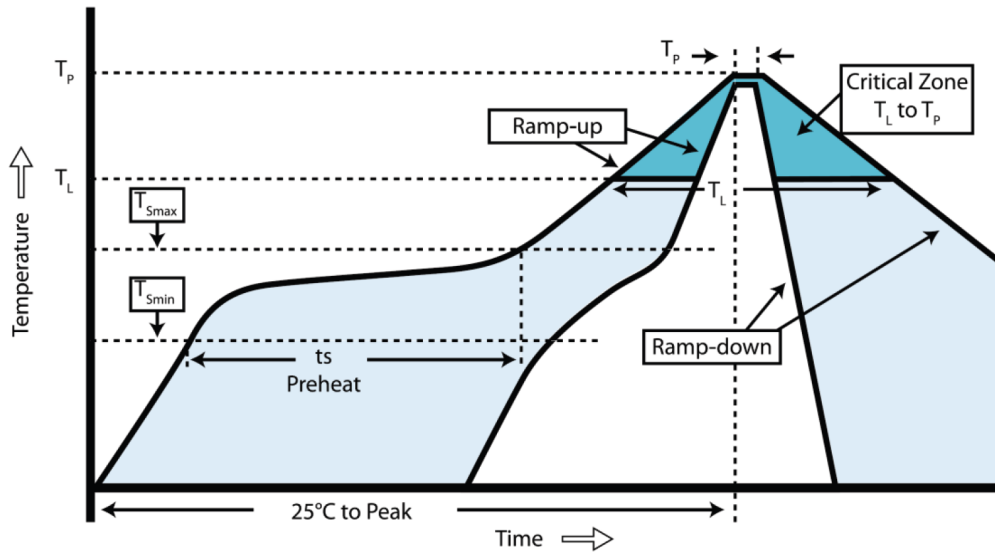
End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "**Contains FCC ID: P90LAMDA9**".

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

RF LoRa module re-flow guide



Profile feature	Value (lead free)
Ramp up rate	3°C /s
Pre-heat Temperature <ul style="list-style-type: none"> - 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



This product WEEE collection obligations by scheme.

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