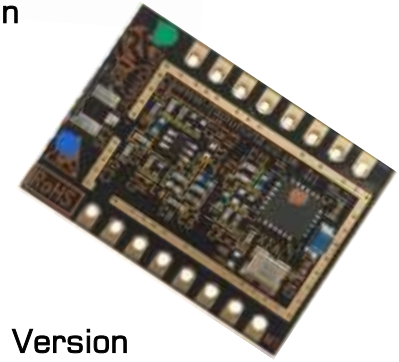
+22dBm LoRa 868/918MHz Transceiver

Features

- 20KM+ Range (12 miles)
- Integrated LoRa™ Modem **Semtech SX1262**
- Highly Efficient Integral Impedance Matching Network
- Provides Full Functionality of the RFIC:
- High Rx sensitivity: down to -148 dBm
- Tx +22 dBm @118mA constant RF output
- +14 dBm high efficiency PA
- 170 dB maximum link budget
- Built in RF switch
- 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 4.6 mA, (LoRa Operating Mode)
- LoRa,FSK,GFSK,MSK,GMSK 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
- 868MHz CE Compliant
- 918MHz "Modular" FCC Certified for use in USA
- Australia Certification Pending



C Version



Open Version

Applications

- RF Alarms
- Sensor networks
- Long Range Telemetry
- Meter Reading
- Environmental Sensors
- Building Control & Automation
- Agricultural Applications

Description

The LAMBDA62 RF module is a class leading, cost effective radio module featuring the Semtech SX1262 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.

The LAMBDA62 Module is CE compliant. Providing that certain procedures are followed. (Please refer to application schematic later in this datasheet).

Part Numbers

Open module (no shield can, antenna output on Pin 1)

Part Number	Description	Package
LAMBDA62-8S	FM Transceiver Module, 868MHz	SMT
LAMBDA62-8D	FM Transceiver Module, 868MHz	DIP

Part Number	Description	Package
LAMBDA62-9S	FM Transceiver Open Module, 918MHz	SMT
LAMBDA62-9D	FM Transceiver Open Module, 918MHz	DIP

Shielded Module (with shield can, antenna output ufl connector)

Part Number	Description	Package
LAMBDA62C-9S	FM Transceiver Shielded Module 918MHz	SMT
LAMBDA62C-9D	FM Transceiver Shielded Module, 918MHz	DIP

FCC / CE Certification

LAMBDA62C-9S and D have 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 FLEXI-SMARP-918
2. The finished product will display a label which is directly visible as follows:

Contains FCC ID: P9OLAMBDA62

Please note that although The radio characteristics are covered by the Lambda62 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.

In keeping with the requirements of FCC the chosen antenna for any application must be is a non standard connector type to ensure that the antenna used is part of a fixed installation i.e. cannot be changed e.g. a Reverse Polarity Connector type.

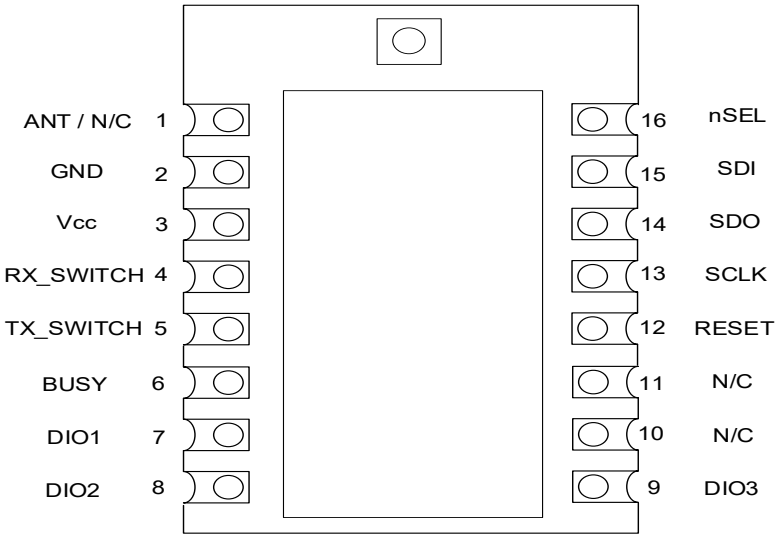
Operational Description in the 900MHz Band

A 32MHz crystal oscillator drives the Semtech SX1262. The RF output goes an RF SPDT switch enabling the TX output to be switched on. There is no external ground to the module other than the circuit board and the screen can. The supply voltage is 2.2 to 3.7 volts dc.
In order to comply with the Modular FCC certification (so as to avoid full FCC certification tests on the finished product) and approved antenna must be used which it type FLEXI-SMARP-918 (Antenna Flexi 1/4 Wave 918MHz SMA Male Reverse Polarity unity gain of +2dBi,).
A stock UFL to reverse SMA cable is available (part no CBA-UFLSMAFRP10IP - UFL to waterproof SMA RP, 100mm long).

The centre operating frequency of the transmitter is 918MHz (917.5MHz – 918.5MHz) which is in the license free band of 902 to 928MHz, and within the license free band of 915 to 928MHz for Australia) The module operates on a single frequency only.

Feature:
Frequency range: 918MHz (917.5MHz – 918.5MHz)
Modulation Type: CSS
Antenna gain: 2dBi
Crystal: 32MHz

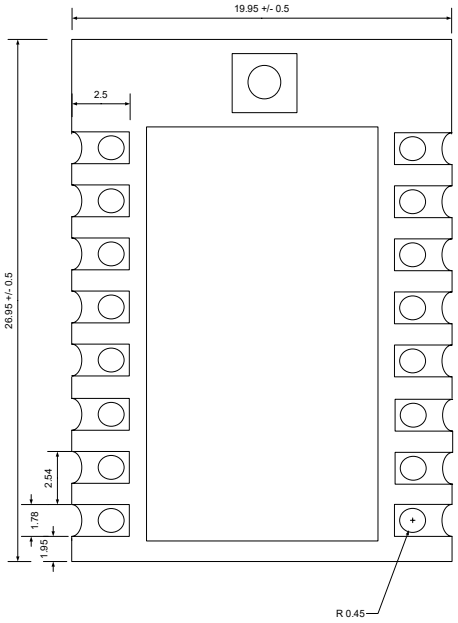
Pin Description



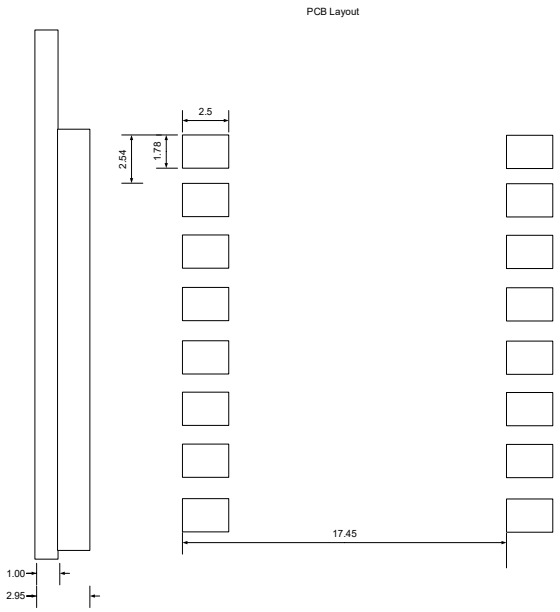
PIN	Definition	Direction	Function
1	Antenna	In/Out	Versions without Screen can: Antenna connection "C" Versions with screen can: No Connect
2	GND	-	Ground connection
3	Vcc	In	Power connection
4	RX_SWITCH	In	Enable RX RF Path Active High | | TX PIN5 | RX PIN4 | | RX Mode | 0 | 1 |
5	TX_SWITCH	In	Enable TX RF Path Active High | | TX PIN5 | RX PIN4 | | TX Mode | 1 | 0 |
6	Busy	Out	Indicates LAMBDA Module/EX1262 is Busy
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	N/C		No Connect
11	N/C		No Connect
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

Mechanical Dimensions

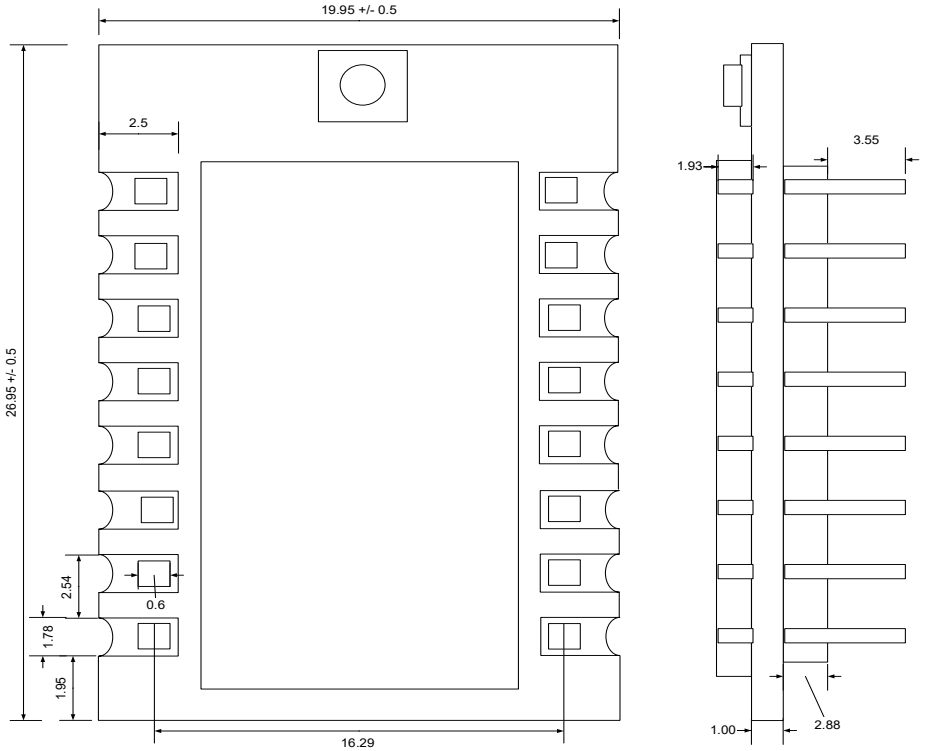
SMT Version



Suggested Layout



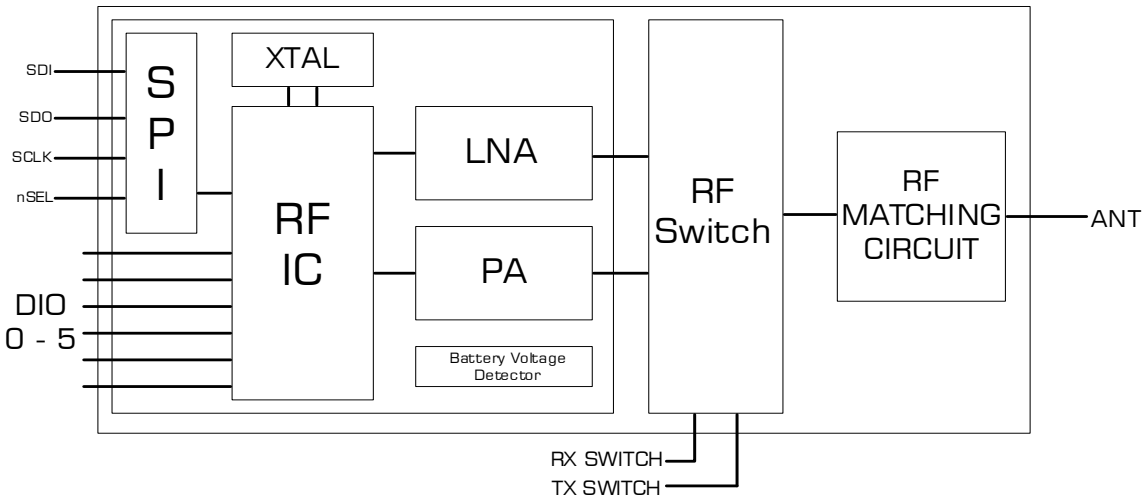
DIP Version



Pins
2.54mm Pitch
0.64mm Square post

All dimensions in mm

Block Diagram



Application Resources

The LAMBDA62 is a ready to use application of the Semtech SX1262.
Access to the programming and configuration of Semtech 1262 Transceiver are via the modules interface SPI line.
The LAMBDA62 has been developed with Semtech to provide a low cost platform application of the SX1262 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 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.
We have measured the conducted power transmitted from the LAMBDA62 ufl connector at +22.4dBm, which demonstrates the efficiency of the LAMBDA62 module.
RF Solutions has some example firmware (in assembler) which is freely available.

To ensure that the latest details in programming this device are offered, we have not included the 1262s programming information in this document.

The datasheet is readily available online along with additional resource material :

Programming, configuration and further resource data including;

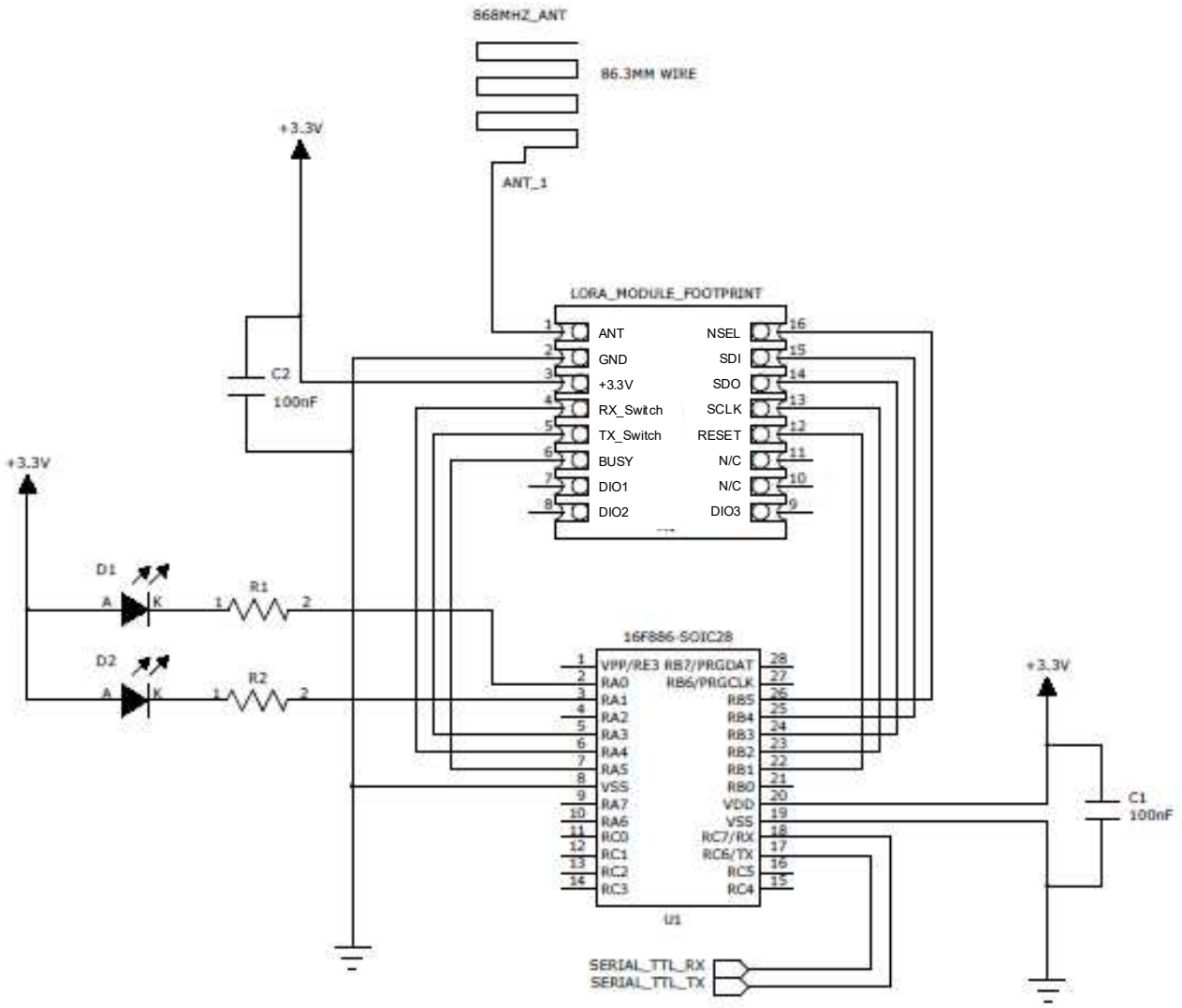
LoRa Calculator: fast evaluation of link budget, time on air and energy consumption.

Packet Error Rate Firmware User Guide.

LoRa Modem Designer's Guide.

is available from Semtech Inc 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.

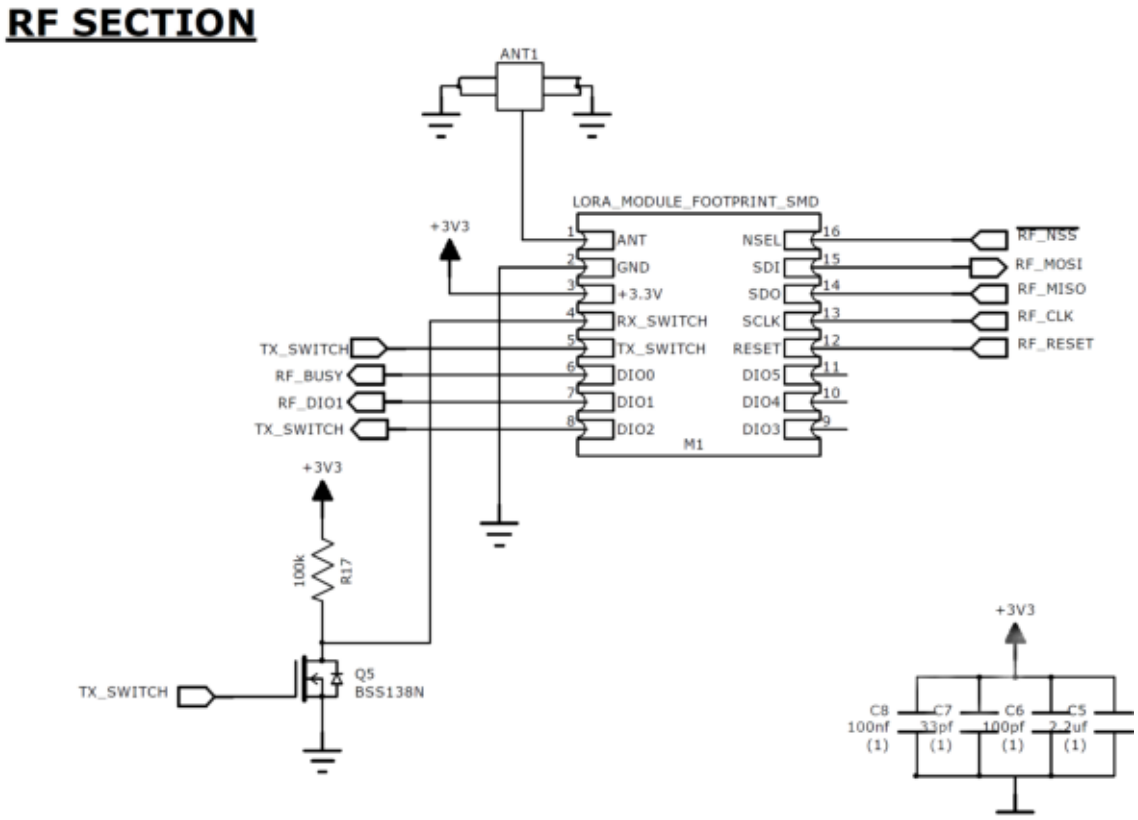
Walk Test application

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.

Controlling the Transmit / Receive RF Switch

The LAMBDA62 has two inputs to control the onboard RF Switch which connects the impedance matching network / antenna to the Transmit / Receive circuit.
There are two connections in order to provide three states (TX, TX, Disconnected)

Although this requires two I/O Lines this can be reduced to one by using a simple inverting Transistor as shown below,
The TX Switch input can be controlled from the host Micro or, as in the example below by using one of the DIO lines from the LAMBDA62 module as an output to control.



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	1.8	3.7	V
T_{op}	Working temperature	-40	85	°C

DC Characteristics

Parameter	Symbol	Test Condiion	Min	Typ	Max	Unit
Supply Voltage Range	V_{DD}		1.8	3.3	3.7	V
Power Saving Modes	$I_{Shutdown}$	All blocks of IC OFF.	—	160	—	nA
	$I_{Standby}$	Register values maintained.	—	600	—	nA
	I_{Ready}	Crystal Oscillator and Main Digital Regulator ON, all other blocks OFF.	—	0.6	—	mA
TX Mode Current	I_{TX}	RFOP = +22dBm @ 868/915MHz RFOP = +20dBm RFOP = +17dBm RFOP = + 14dBm	—	118 102 95 90		mA

Note:
Set Regulator Mode should be set to 0 (LDO Mode)
The hardware design uses the internal LDO regulator (not the SMPS DC-DC), we chose not to implement the internal BUCK regulator because in our experience, when a battery is reaching end of life the voltage it provides starts to drop and then avalanches in a non linear curve in a short time.
It is only at this stage that the SMPS provides a benefit over and above the LDO regulator, and considering the cost of the large inductor the SMPS requires its not justified for a marginal extension in time the circuit obtains.
If the SMPS is required please contact our Sales Dept.

Power Consumption in Transmit mode

Symbol	Frequency Band	Conditions	Power Output	Typical	Unit
IDDTX	868/918MHz	+22dBm +20dBm +17dBm +14dBm	+22dBm +20dBm +17dBm +14dBm	118 102 95 90	mA mA mA mA
		Optimal Settings for low current and output power. Please see SX1262 PA optimal settings in Datasheet.	+20dBm +17dBm +14dBm	84 58 45	mA

Receive Mode Specifications

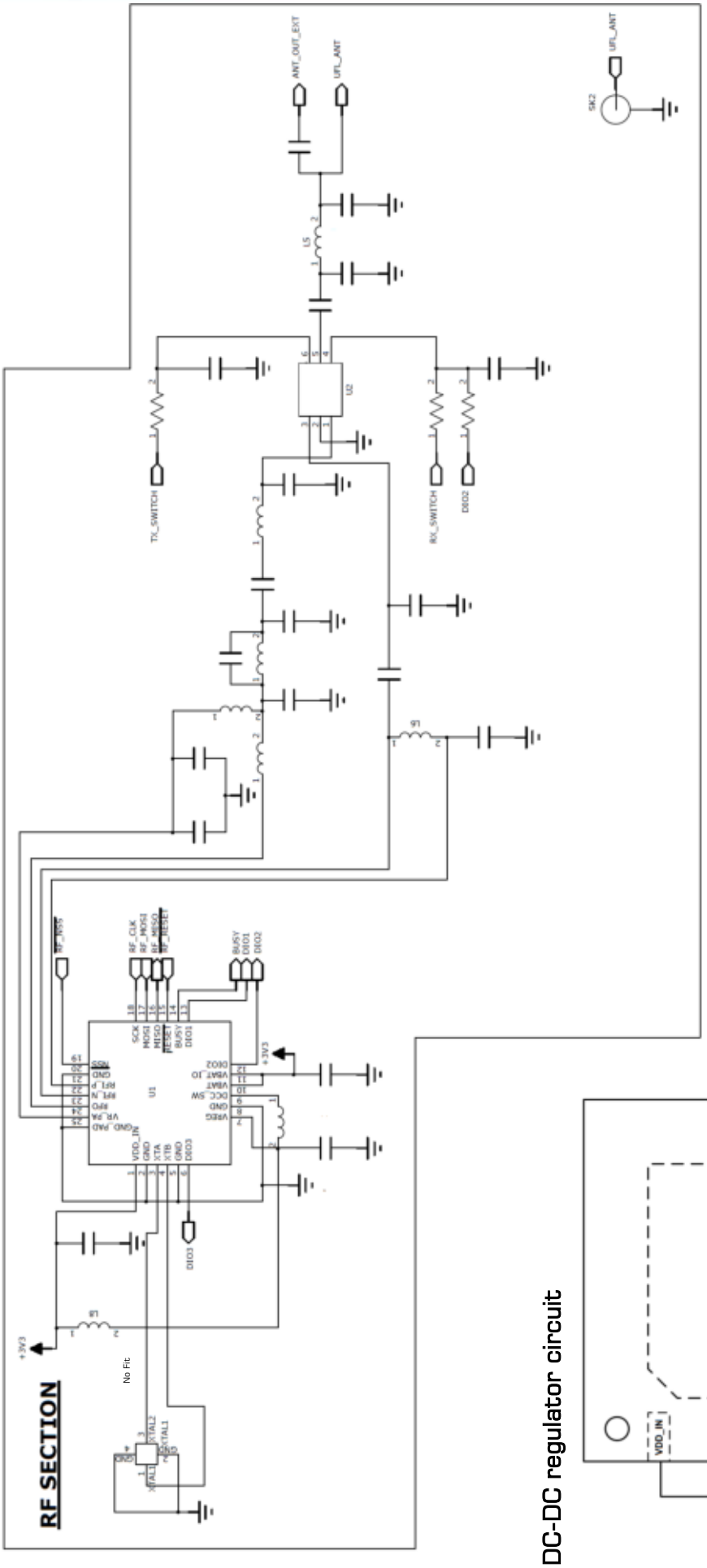
Symbol	Description	Conditions	Typ	Max	Unit
RXS_2FB	Sensitivity 2-FSK RX boosted gain	BR_F=0.6 kb/s FDA=0.8 KHz BW_F=4KHz BR_F=1.2 kb/s FDA=5 KHz BW_F=20KHz BR_F=4.8 kb/s FDA=5 KHz BW_F=20KHz BR_F=38.4 kb/s FDA=40 KHz BW_F=160KHz BR_F=250 kb/s FDA=125 KHz BW_F=500KHz	-125 -123 -118 -109 -104		dBm dBm dBm dBm dBm
RXZ_LB	Sensitivity LoRa RX boosted gain	BW_L=10.4 KHz SF=7 BW_L=10.4 KHz SF=12 BW_L=125 KHz SF=7 BW_L=125 KHz SF=12 BW_L=250 KHz SF=7 BW_L=250 KHz SF=12 BW_L=500 KHz SF=7 BW_L=500 KHz SF=12	-134 -148 -124 -137 -121 -134 -117 -129		dBm dBm dBm dBm dBm dBm dBm dBm
CCR_F	Co-channel Rejection FSK		133		dB
CCR_L	Co-channel Rejection LoRa	SF=7 SF=12	5 19		dB dB
ACR_f	Adjacent channel Rejection FSK	Offset = +/- 50KHz	45		dB
ACR_L	Adjacent channel Rejection LoRa	Offset = +/- 1.5 x BW_L BW_L=125 KHz SF=7 BW_L=125 KHz SF=12	 60 72		dB

General Specifications

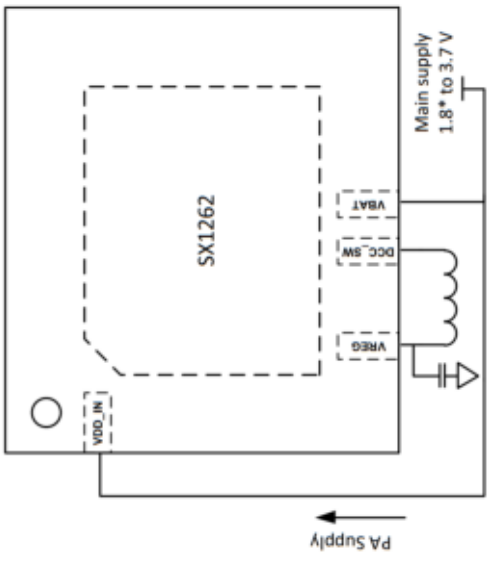
Symbol	Description	Conditions	Min	Typ	Max	Unit
FR	Synthesizer Frequency Range	SX1261**	150		960	MHz
FSTEP	Synthesizer Frequency Step			0.95		MHz
PHN	Synthesizer Phase Noise 868/918MHz	1 KHz offset 10 KHz offset 100 KHz offset 1 MHz offset 10 MHz offset		-75 -95 -100 -120 -135		dBc/Hz
TS_FS	Synthesizer wakeup time	From standby to XOSC Mode		40		uS
TS_HOP	Synthesizer hop time	10MHz step		30		uS
TS_OSC	Crystal Oscillator Wakeup time	From Standby_RC		150		uS
OSC_TRM	Crystal Oscillator trimming range for crystal frequency error compensation	Min/max specification	+/-15	+/-30		Ppm
BR_F	Bit Rate FSK	Programmable Min Modulation index is 0.5	0.6		300	Kb/s
FDA	Frequency Deviation FSK	Programmable FDA + BR_F/2=<250KHz	0.6		200	KHz
BR_L	Bit Rate LoRa	Min for SF12 BW_L=7.8KHz Min for SF12 BW_L=500KHz	0.018		62.5	Kb/s
BW_L	Signal BW, LoRa	Programmable	7.8		500	KHz
SF	Spreading Factor for LoRa	Programmable chips/symbol=2^{SF}	5		12	
VTCXO	Regulated voltage range for TCXO voltage supply		1.6	1.7	3.3	V
ILTCXO	Load current for TCXO regulator					mA
TSVTCXO	Startup time for TCXO regulator	From enable to regulated voltage within 25mV from target				uS
IDDTCXO	Current Consumption for TCXO regulator	Quiescent current Relative to load current		1	702	uA %
ATCXO	Amplitude voltage for external TCXO applied to XTA pin	Provided through a 220ohm resistor in series with 10pF Cap	0.4	0.6	1.2	Vpk-pk

The module contains the Semetch SX1262 which is capable of these operating frequencies however the module contains an impedance matching network which is optimised for operation at 868/915, operating at other frequencies will be impractical.

Module Schematic



DC-DC regulator circuit



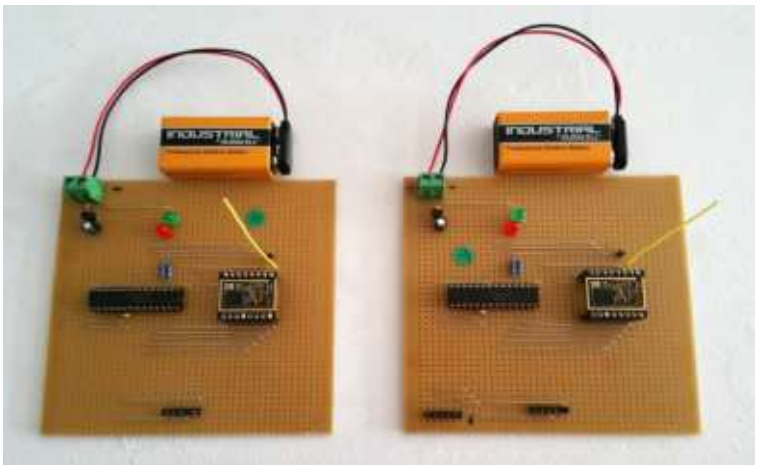
See 5.1.3 of the SX1262 Datasheet Figure 5-3 for further details.

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 °C
- V_{DD}= +3.3 Vdc
- Dry, Broken Sunshine, Relative Humidity 45%

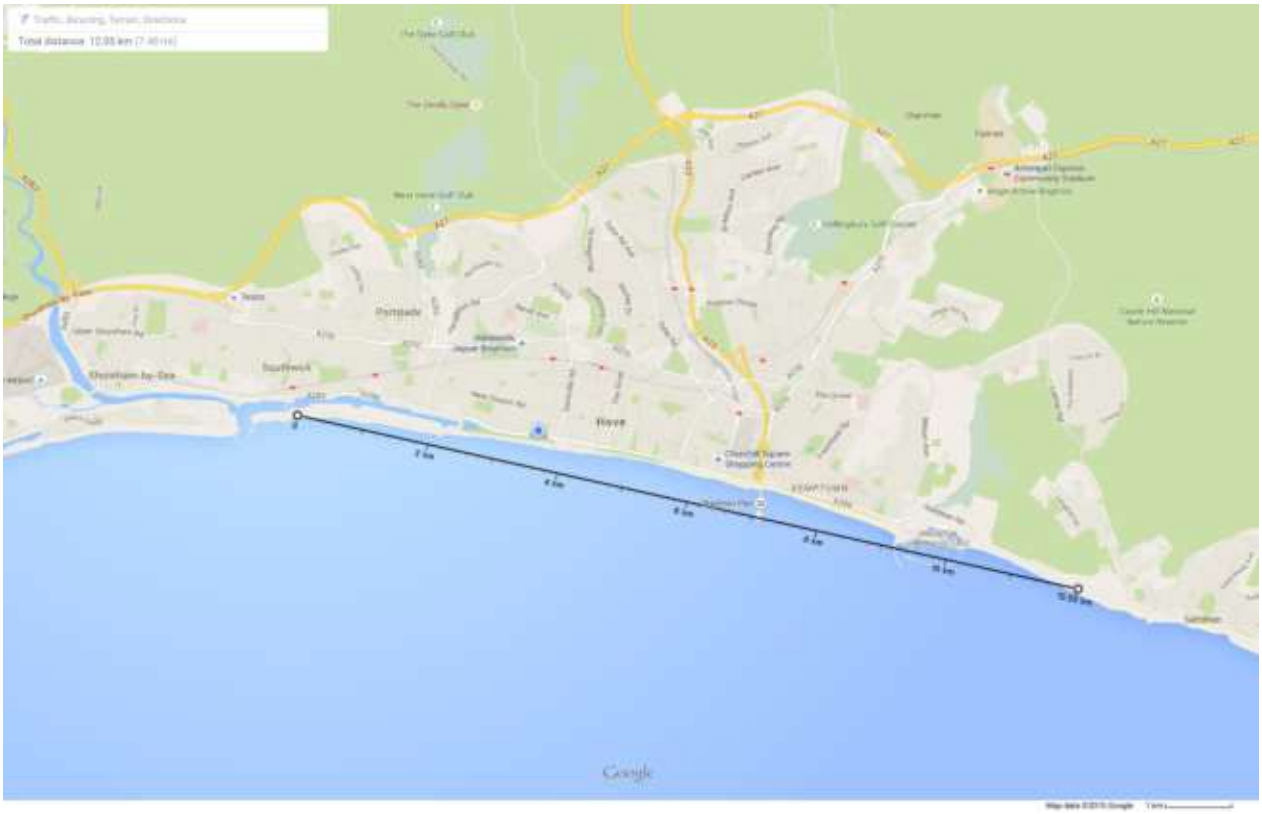
RF input and output levels can typically be achieved at the antenna port after filtering components.

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.

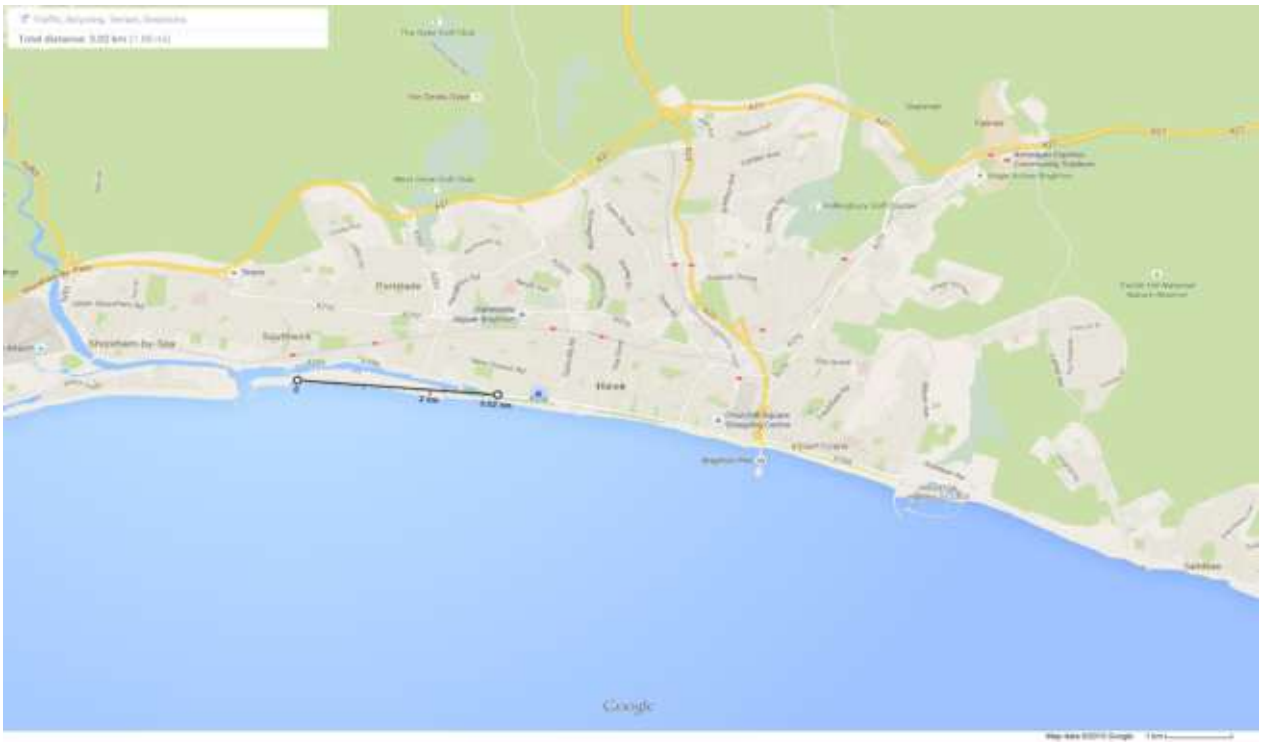
It is also clear that the product performs considerably better when in LOS.

Range Test Results (Line of Sight)



Range Test Results (Non Line of Sight)

This is subjective as the buildings were random!



LAMBDA62 Types and Device Marking

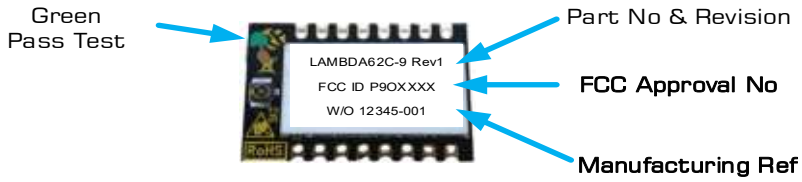
The LAMBDA62 RF module is available at 868 and 915MHz in the following types:
LAMBDA module is CE Compliant and at the time of writing is being submitted for modular FCC part 15 certification.

Note:

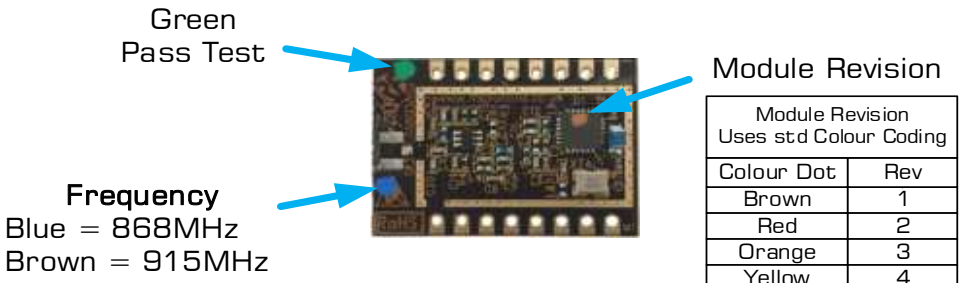
868MHz: Open module with antenna connection via pin 1 of the module. This provides the lowest cost whilst achieving CE Compliance

915MHz: With Screen Can fitted and antenna connection via ufl. This is in order to achieve Fcc Certification.

Module with Screen Can & UFL



Open Module

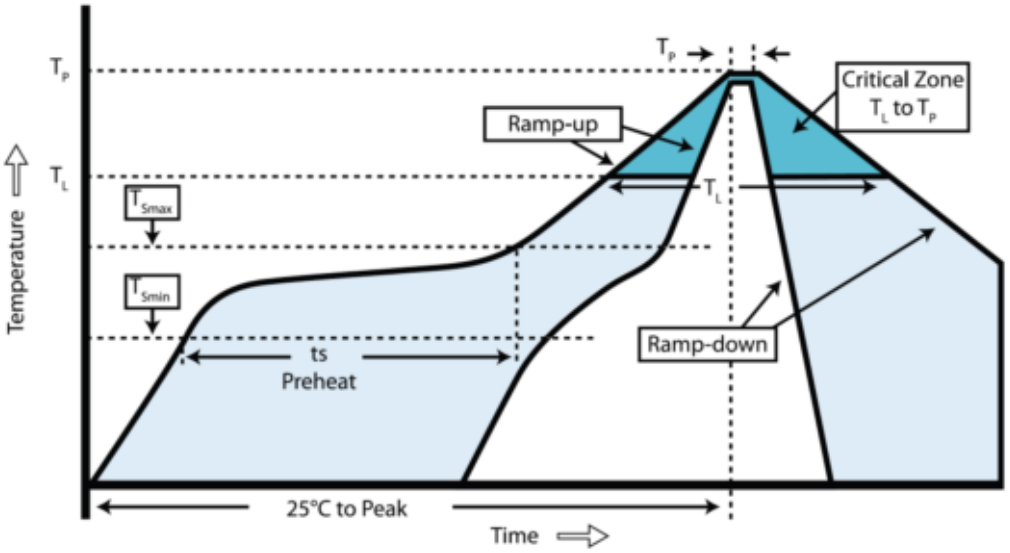


Module Revision Uses std Colour Coding	
Colour Dot	Rev
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

REVISION CHANGE HISTORY			
Part	**New Revision**	**Date**	**Change / Fix**
All versions	**2**	**9/1/20**	Because of Long Leadtime the internal RF switch has been changed to an alternative component part
All versions	**3**	**2/2/21**	Update to the Impedance matching network to improve ERP which is now +22dBm

Module Re-flow Guide

LAMBDA62 is a 4 layer PCB, re-flow is based on IPC/JEDEC JSTD020C July 2004.



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.

Additional FCC requirements when using the P9OLAMBDA62

Provided the installation requirements are followed, further radio performance testing is not required when using this FCC modular approved product. The complete product that the module is used in requires the wording on the finished product label to include "Contains FCC Module ID: P9OLAMBDA62". Unintentional radiated spurious emissions must be performed on the finished product in accordance with FCC Part 15.109 requirements, the limits as for a Class B product. The antenna cable assembly CBA-UFLSMARP-10 must be used to provide a non-standard reverse SMA bulkhead connector. It is recommended that the FLEXI-SMA-918 (reverse SMA connector) antenna is used, which is available from RF Solutions. The antenna must not have a maximum gain greater than 2dBi. Colocation of transmitters is not recommended without further radio testing to ensure the maximum declared EMF is not exceeded. It is recommended not to operate the transceiver with persons closer than 20cm to the antenna. Refer to FCC KDB996369 D04, Module Integration Guide for additional information.

LAMBDA62 LoRa Transceiver

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ES - Por la presente, RF Solutions Limited declara que el tipo de equipo radioeléctrico definido dentro de este documento es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente: www.rfsolutions.co.uk

ET -Käesolevaga deklareerib RF Solutions Limited , et käesolev raadioseadme tüüp määratletud selles dokumendis vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: www.rfsolutions.co.uk

FI -RF Solutions Limited vakuuttaa, että radiolaitetyyppi määratletud selles dokumendis on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: www.rfsolutions.co.uk

FR - Le soussigné, RF Solutions Limited , déclare que l'équipement radioélectrique du type défini dans ce document est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: www.rfsolutions.co.uk

HR - RF Solutions Limited ovime izjavljuje da je radijska oprema tipa definirani u ovom dokumentu u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: www.rfsolutions.co.uk

HU - RF Solutions Limited igazolja, hogy a dokumentumban meghatározottak szerint típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: www.rfsolutions.co.uk

IT - Il fabbricante, RF Solutions Limited , dichiara che il tipo di apparecchiatura radio definito all'interno di questo documento è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet: www.rfsolutions.co.uk

LT - Aš, RF Solutions Limited , patvirtinu, kad radijo įrenginių tipas apibrėžta šiame dokumente atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: www.rfsolutions.co.uk

LV - Ar šo RF Solutions Limited deklarē, ka radioiekārta kas definēts šajā dokumentā atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: www.rfsolutions.co.uk

MT - B'dan, RF Solutions Limited , niddikjara li dan it-tip ta' tagħmir tar-radju definit f'dan id-dokument huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej: www.rfsolutions.co.uk

NL - Hierbij verklaar ik, RF Solutions Limited , dat het type radioapparatuur gedefinieerd in dit document conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: www.rfsolutions.co.uk

PL - RF Solutions Limited niniejszym oświadcza, że typ urządzenia radiowego zdefiniowane w tym dokumencie jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym: www.rfsolutions.co.uk

PT - O(a) abaixo assinado(a) RF Solutions Limited declara que o presente tipo de equipamento de rádio definido neste documento está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: www.rfsolutions.co.uk

RO - Prin prezenta, RF Solutions Limited declară că tipul de echipamente radio definit în acest document este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: www.rfsolutions.co.uk

SK - RF Solutions Limited týmto vyhlasuje, že rádiové zariadenie typu definované v tomto dokumente je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: www.rfsolutions.co.uk

SL - RF Solutions Limited potrjuje, da je tip radijske opreme opredeljeno v tem dokumentu skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: www.rfsolutions.co.uk

SV - Härmed försäkrar RF Solutions Limited att denna typ av radioutrustning definieras i detta dokument överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress: www.rfsolutions.co.uk

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Meets the following EC Directives:

DO NOT

Discard with normal waste, please recycle.

ROHS Directive 2011/65/EU as amended by 2015/863/EU

Specifies certain limits for hazardous substances.

WEEE Directive 2012/19/EU

Waste electrical & electronic equipment. This product must be disposed of through a licensed WEEE collection point. RF Solutions Ltd., fulfils its WEEE obligations by membership of an approved compliance scheme. Environment Agency Registration Number WEE/JB0104WV.

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