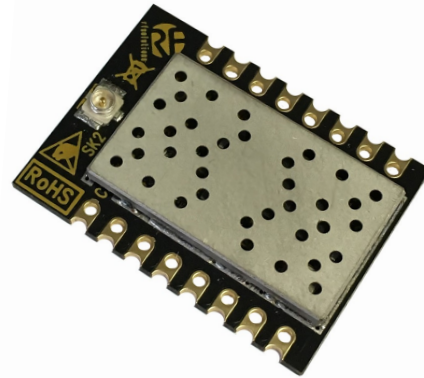




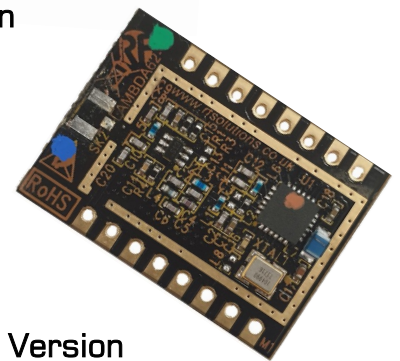
+22dBm LoRa 868/918MHz Transceiver

Features

- 20KM+ Range
- Integrated LoRa™ Modem **Semtech LLCC68**
- Highly Efficient Integral Impedance Matching Network
- Built in RF switch
- Small Form Factor: 23mm x 20mm
- Provides Full Functionality of the RFIC:
- 151 dB maximum link budget (LLCC68)
- +22 dBm or +15 dBm high efficiency PA
- Low RX current of 4.6 mA
- Integrated LDO
- Programmable bit rate from 1.76 kbps up to 62.5 kbps LoRa and 300 kbps FSK
- High sensitivity: down to -129 dBm
- 88dB blocking immunity at 1 MHz offset
- Co-channel rejection of 19 dB in LoRa mode
- FSK, GFSK, MSK, GMSK and LoRa modulation
- LoRa TX/RX BW= 125-250-500KHz
- LoRa SF= 5-6-7-8-9 for BW= 125KHz
- LoRa SF= 5-6-7-8-9-10 for BW= 250KHz
- LoRa SF= 5-6-7-8-9-10-11 for BW= 500KHz
- Built-in bit synchronizer for clock recovery
- Auto Channel Activity Detection (CAD) with ultra-fast AFC
- Built-in bit synchronizer for clock recovery
- Preamble detection
- 868MHz CE Compliant
- 918MHz for use in USA & Australia "Modular" FCC Certificate Pending



C Version



Open Version

Applications

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

Description:

The LAMBDA68 RF module is a class leading, cost effective radio module featuring the Semtech LLCC68 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 provides 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 LAMBDA68 Module is CE compliant. Providing that certain procedures are followed. (Please refer to application schematic later in this datasheet).

LAMBDA68 LoRa Transceiver



Part Numbers:

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

Part Number	Description	Package
LAMBDA68-8S	RF Transceiver Module, 868MHz Surface Mount	SMT
LAMBDA68-8D	RF Transceiver Module, 868MHz Dil In Line Package	DIP

Part Number	Description	Package
LAMBDA68-9S	RF Transceiver Module, 918MHz Surface Mount	SMT
LAMBDA68-9D	RF Transceiver Module, 918MHz Dil In Line Package	DIP

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

Part Number	Description	Package
LAMBDA68C-9S	RF Transceiver Module Shielded, 918MHz Surface Mount	SMT
LAMBDA68C-9D	RF Transceiver Module Shielded, 918MHz Dil In Line Package	DIP

Operational Description in the 900MHz Band

A 32MHz crystal oscillator drives the Semtech LLCC68. 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.

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

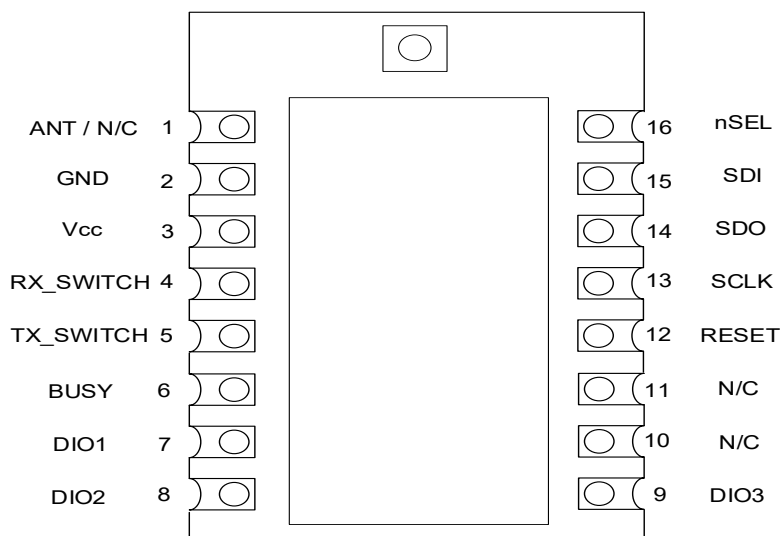
Antenna gain: 2dBi

Crystal: 32MHz

LAMBDA68 LoRa Transceiver



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 <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
	TX PIN5	RX PIN4							
RX Mode	0	1							
5	TX_SWITCH	In	Enable TX 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>TX Mode</td> <td>1</td> <td>0</td> </tr> </table>		TX PIN5	RX PIN4	TX Mode	1	0
	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						

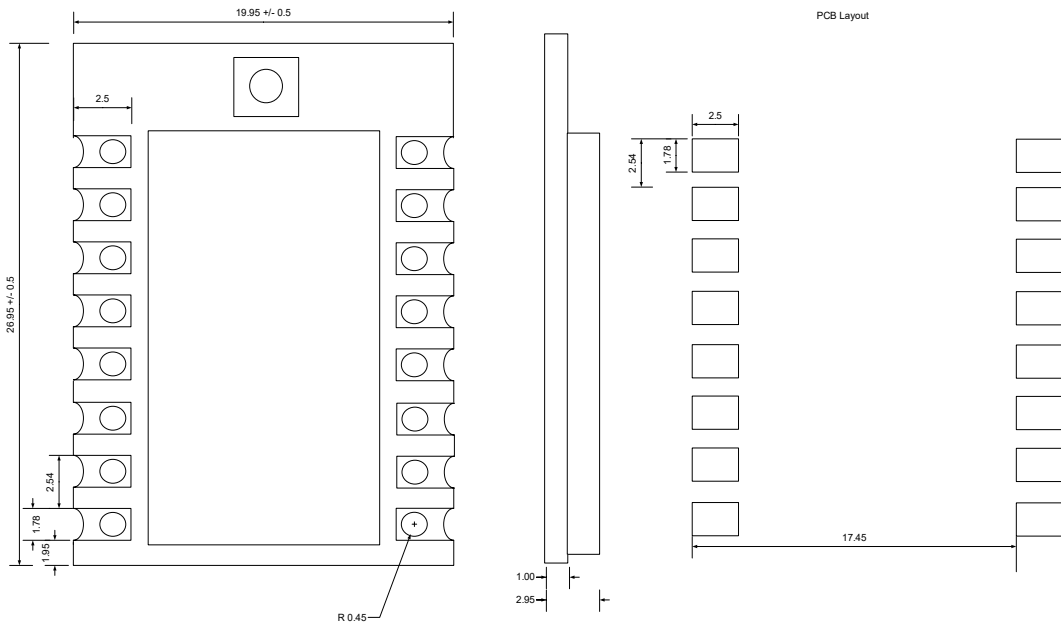
LAMBDA68 LoRa Transceiver



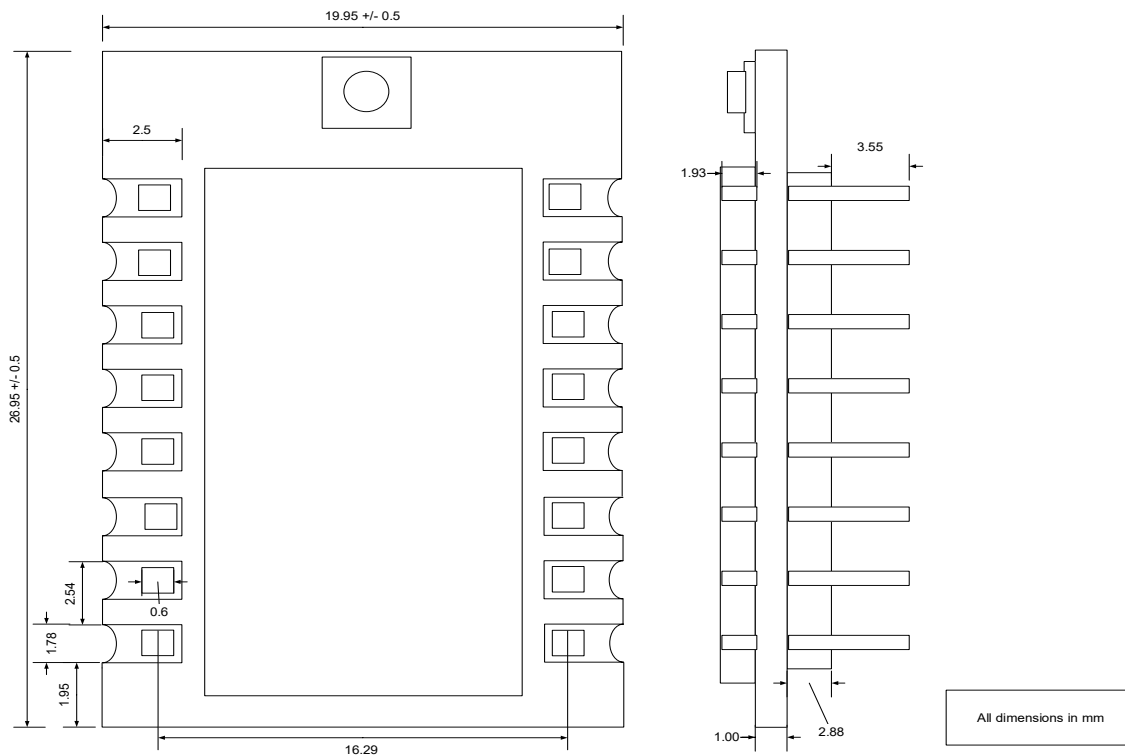
Mechanical Dimensions:

SMT Version:

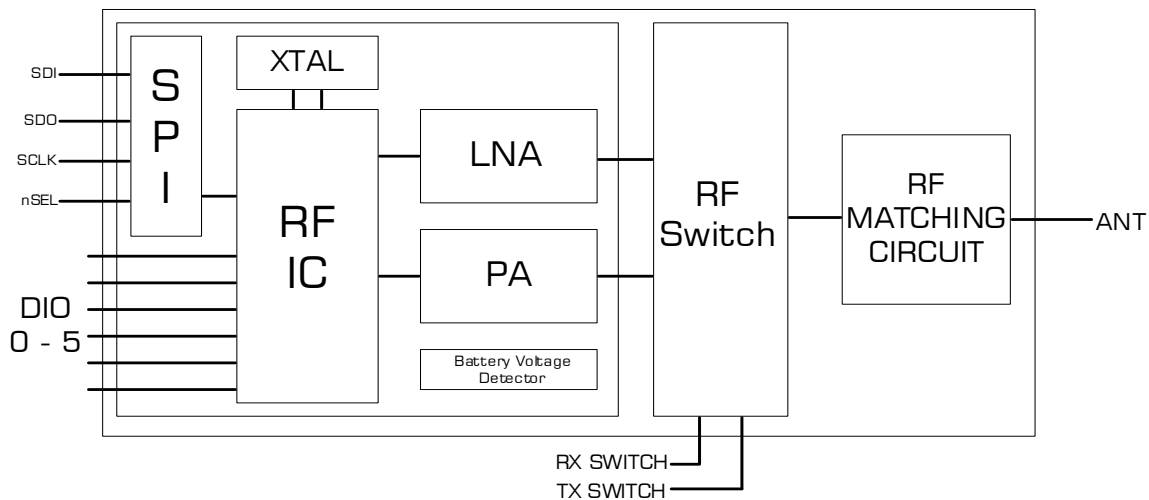
Suggested Layout



DIP Version:



Block Diagram:



Application Resources:

The LAMBDA68 is a ready to use application of the Semtech LLCC68.

Access to the programming and configuration of Semtech LLCC68 Transceiver are via the module SPI interface.

The LAMBDA68 has been developed with Semtech to provide a low cost platform application of the RF Transceiver IC. 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.

We have measured the conducted power transmitted from the LAMBDA68 ufl connector at +22dBm, which demonstrates the efficiency of the LAMBDA68 module.

To ensure that the latest details in programming this device are offered, we have not included the LLCC68 programming information in this document.

You can find the datasheet at the link below:

[LLCC68 Datasheet](#)

Programming, configuration and further resource data including;

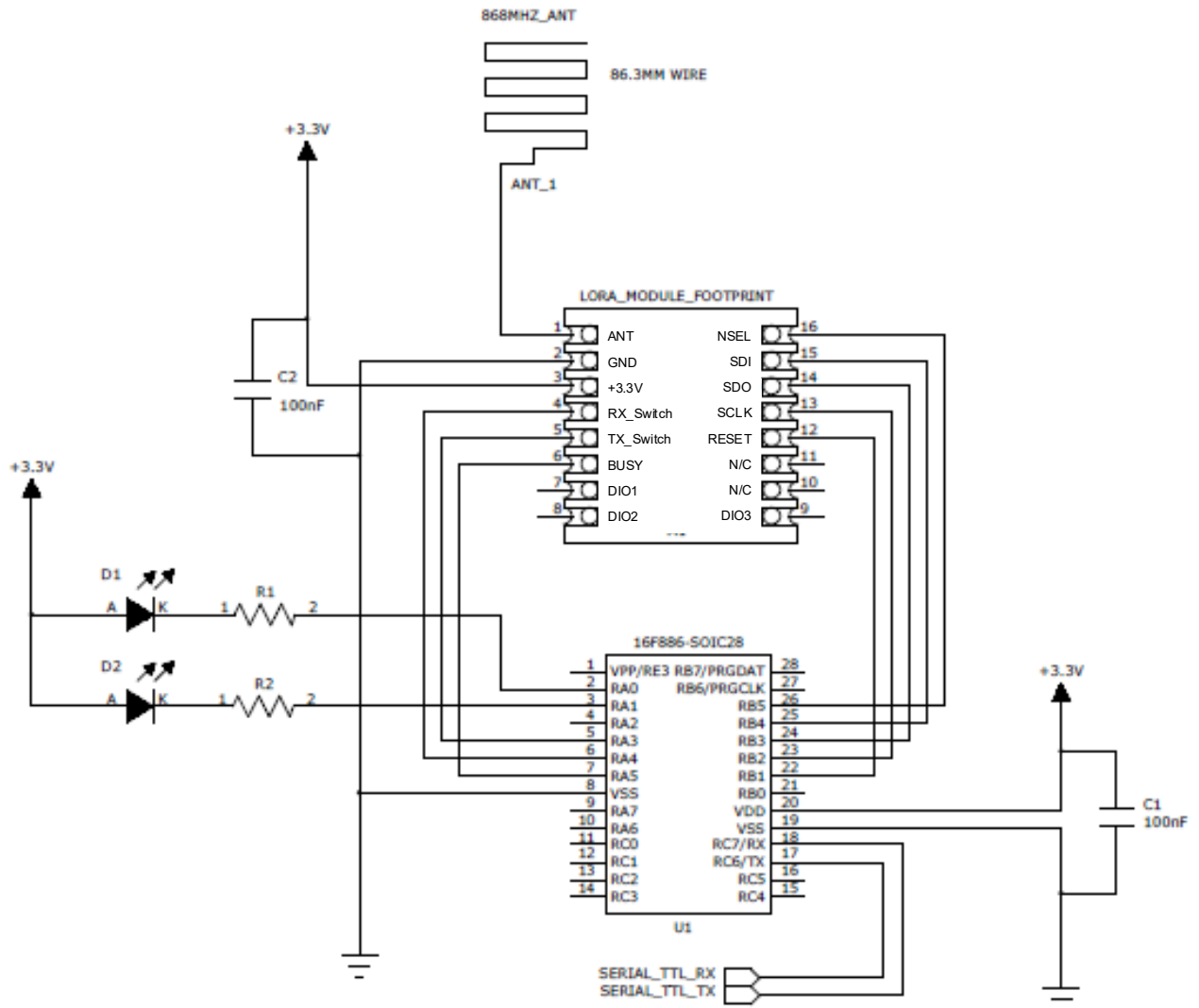
LoRa Calculator: fast evaluation of link budget, time on air and energy consumption.

Packet Error Rate Firmware User Guide.

LoRa Modem Designer's Guide is available from Semtech at the below link:

[Semtech Website](#)

Application schematic Interfacing a PIC™ Micro Controller:



The above schematic shows an easy interface to a PIC Microcontroller.

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:

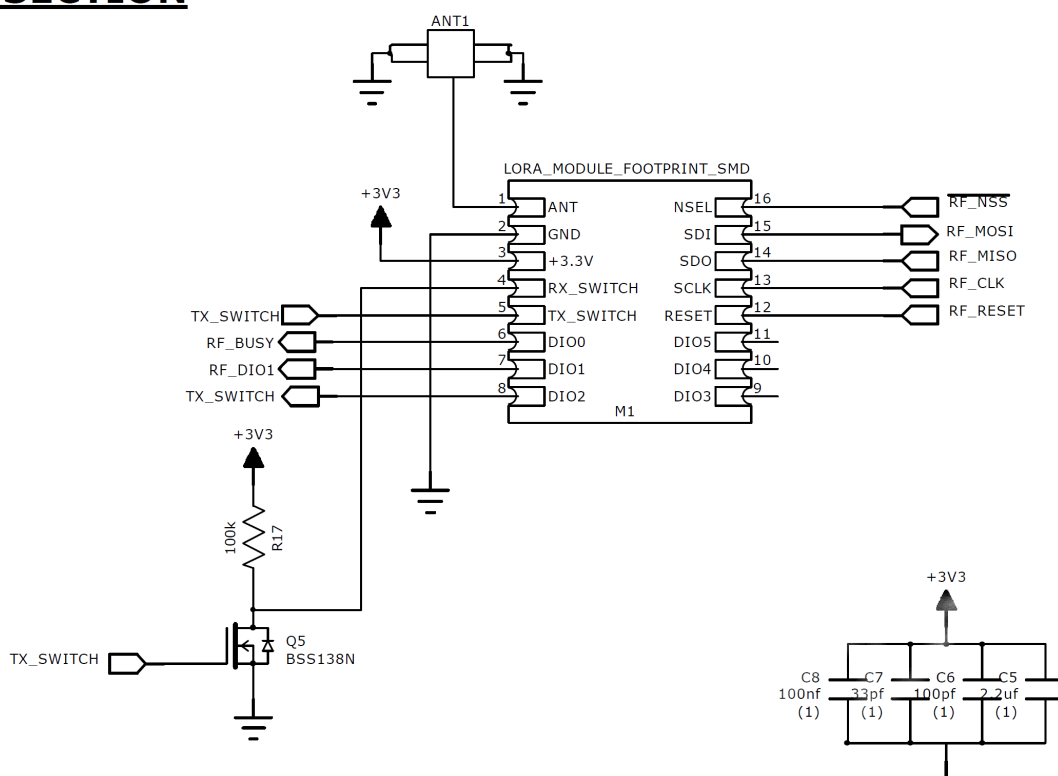
The LAMBDA68 has two inputs to control the onboard RF Switch which connects the impedance matching network / antenna to the Transmit / Receive circuit.

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.

RF SECTION



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

DC Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage Range	V_{DD}		1.8	3.3	3.7	V
Rx Mode (LDO)		FSK 4.8Kb/s		8		mA
		LoRa 125KHz		8.8		mA
Power Saving Modes	$I_{Shutdown}$	All blocks of Module 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.

Power Consumption in Transmit mode

Symbol	Frequency Band	Conditions	Power Output	Typical	Unit
IDDTX	868/918MHz	+22dBm	+22dBm	118	mA
		+20dBm	+20dBm	102	mA
		+17dBm	+17dBm	95	mA
		+14dBm	+14dBm	90	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	-125		dBm
		BR_F=1.2 kb/s FDA=5 KHz BW_F=20KHz	-123		dBm
		BR_F=4.8 kb/s FDA=5 KHz BW_F=20KHz	-118		dBm
		BR_F=38.4 kb/s FDA=40 KHz BW_F=160KHz	-109		dBm
		BR_F=250 kb/s FDA=125 KHz BW_F=500KHz	-104		dBm
RXZ_LB	Sensitivity LoRa RX boosted gain	BW_L=10.4 KHz SF=7	-134		dBm
		BW_L=10.4 KHz SF=12	-148		dBm
		BW_L=125 KHz SF=7	-124		dBm
		BW_L=125 KHz SF=12	-137		dBm
		BW_L=250 KHz SF=7	-121		dBm
		BW_L=250 KHz SF=12	-134		dBm
		BW_L=500 KHz SF=7	-117		dBm
BW_L=500 KHz SF=12	-129		dBm		
CCR_F	Co-channel Rejection FSK		133		dB
CCR_L	Co-channel Rejection LoRa	SF=7	5		dB
		SF=12	19		dB
ACR_f	Adjacent channel Rejection FSK	Offset = +/- 50KHz	45		dB
ACR_L	Adjacent channel Rejection LoRa	Offset = +/- 1.5 x BW_L	60		dB
		BW_L=125 KHz SF=7 BW_L=125 KHz SF=12	72		dB

LAMBDA68 LoRa Transceiver



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_TR M	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 $FDA + BR \cdot F/2 = < 250\text{KHz}$	0.6		200	KHz
BR_L	Bit Rate LoRa	Min for SF12 BW_L=7.8KHz Min for SF12 BW_L=500KHz	0.01 8		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
IDDCXO	Current Consumption for TCXO regulator	Quiescent current Relative to load current		1	70 2	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

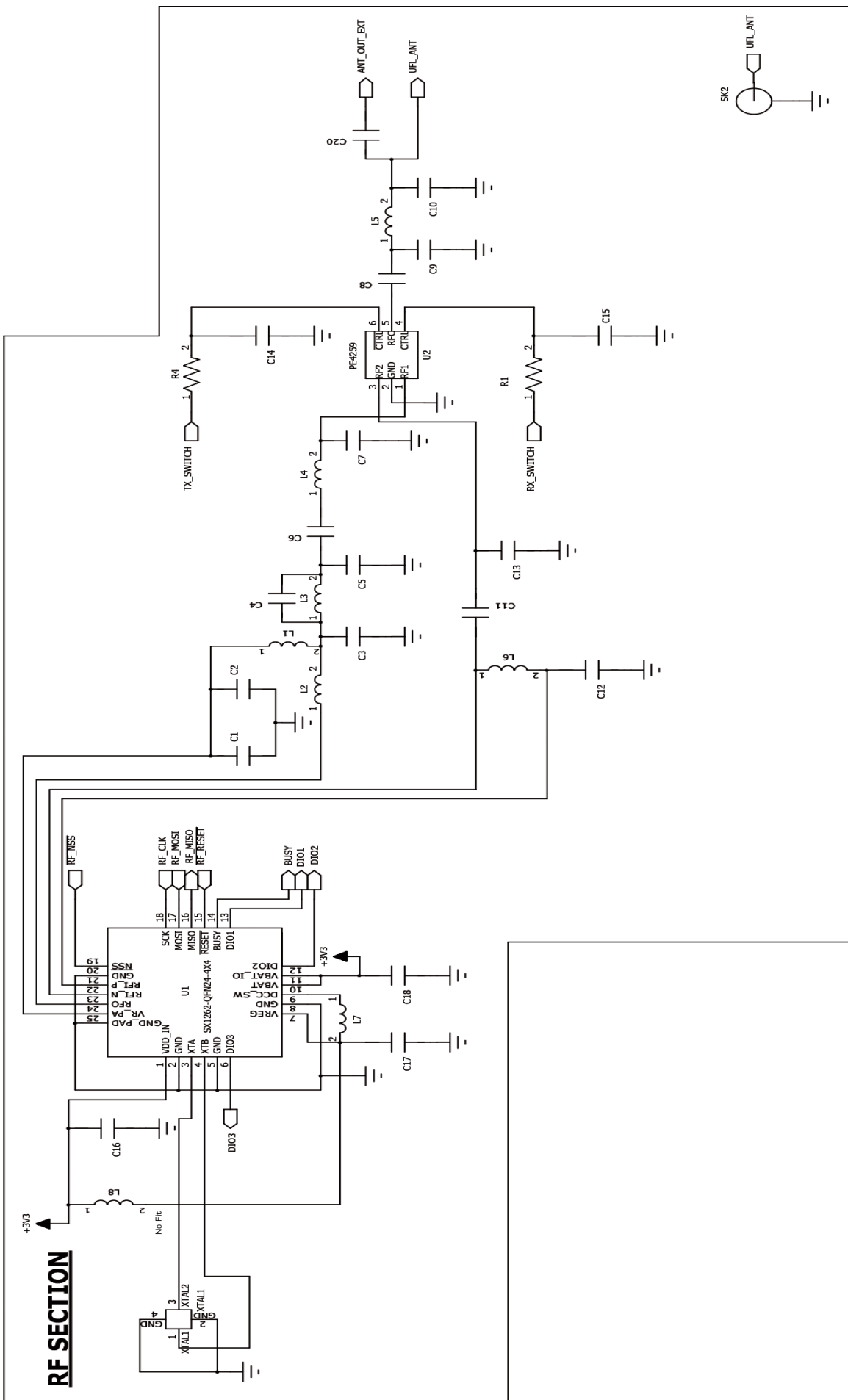
The module contains the Semtech SX1262 which is capable of these operating frequencies however the module contains an impedance matching network which is optimised for operation at 868/915, operating at other frequencies will be impractical.

LAMBDA68 LoRa Transceiver



Module Schematic

RF SECTION



LAMBDA68 Types and Device Marking:

The LAMBDA68 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:

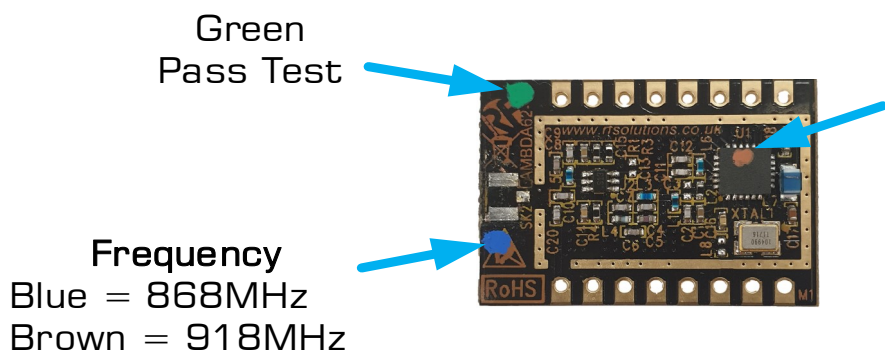
868MHz: Open module with antenna connection via pin 1 of the module. This provides the lowest cost whilst achieving CE Compliance

918MHz: With Screen Can fitted and antenna connection via ufl. This is in order to achieve FCC Certification.

Module with Screen Can & UFL



Open Module

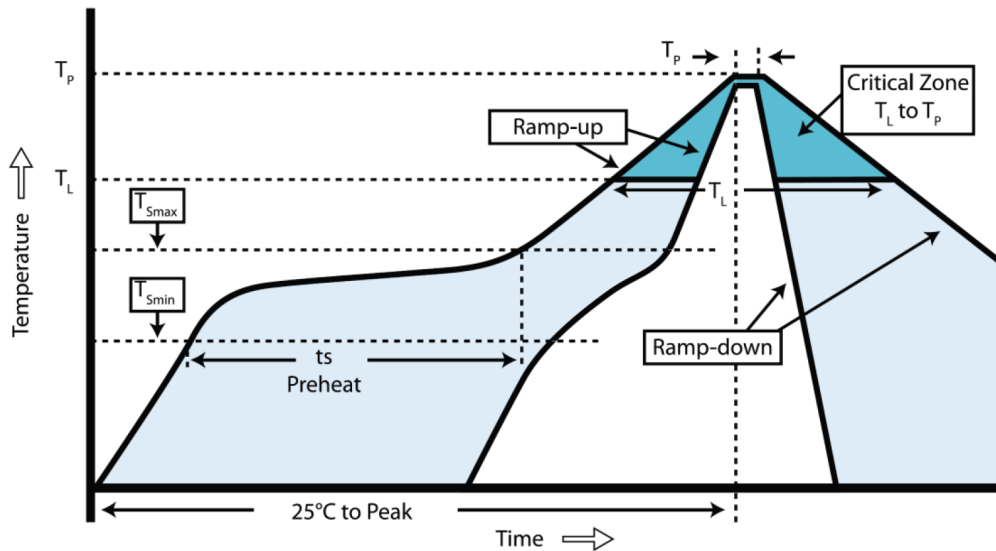


Module Revision

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

Module Re-flow Guide:

LAMBDA68 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})	150°C
- Temperature Max (T_{smax})	200°C
- Pre-heat time	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.

LAMBDA68 LoRa Transceiver



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