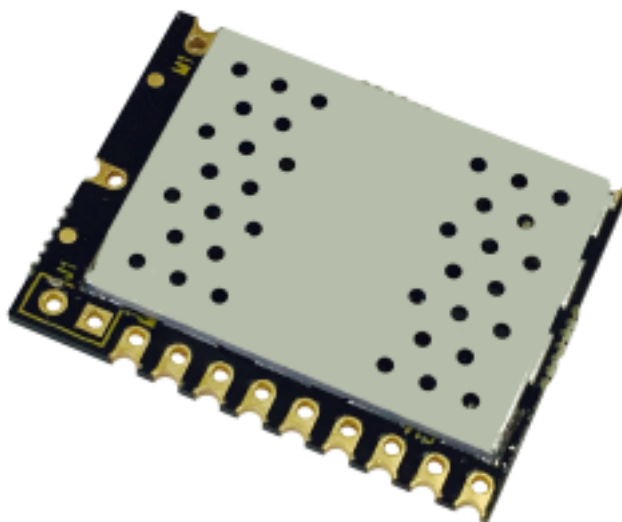


868MHz Class1 Capable RF Transceiver

Features

- 9Km range,
- Highly Tuned Narrow Band RF
- Narrow Band 12KHz Channel Spacing
- Up to 500Kbps
- **Transmit Power +20dBm**
- High sensitivity -121dBm (@ 2.4kbps)
- Small form factor: 28.5 x 22mm
- Frequency - 868MHz
- 1.8V – 3.6V power supply
- Low power consumption
 - 14-18 mA RX
 - 88mA TX @ 20dBm
- Easy SPI / UART interface
- Standby current less than 0.50nA
- TX and RX 64 byte FIFO
- Integrated battery voltage sensor
- Auto Packet handling: with Sync word detection & CRC
- 2.54mm pitch for easy prototyping



Applications

- Alarm Systems
- Fire and Security
- Home automation
- Sensor networks
- Telemetry

Description

The DELTA module is a high performance, UK designed to meet EN300-220 Category 1 “Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person)”.

The DELTA module operates over a narrow bandwidth with excellent channel selectivity and spurious noise rejection. It provides a high speed data rate over a long distance. Thus providing excellent data communications far superior to may other modules such as LORA.

Part Numbers

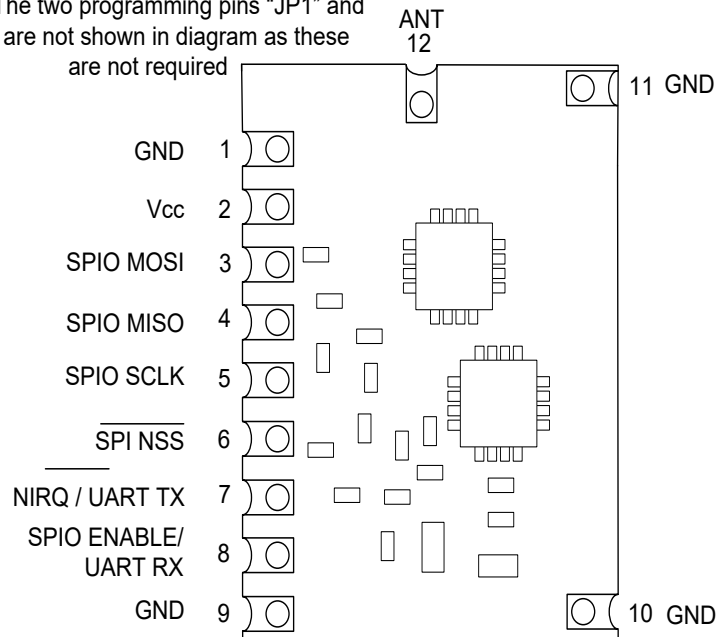
Part Number	Description
DELTA-TRX4C1	FM transceiver module, optimised for 433MHz
DELTA-TRX8C1	FM transceiver module, optimised for 868MHz
DELTA-TRX9C1	FM transceiver module, optimised for 915MHz

DELTA Class 1 Capable RF Transceiver



Pin Description

Note: The two programming pins “JP1” and GND are not shown in diagram as these are not required

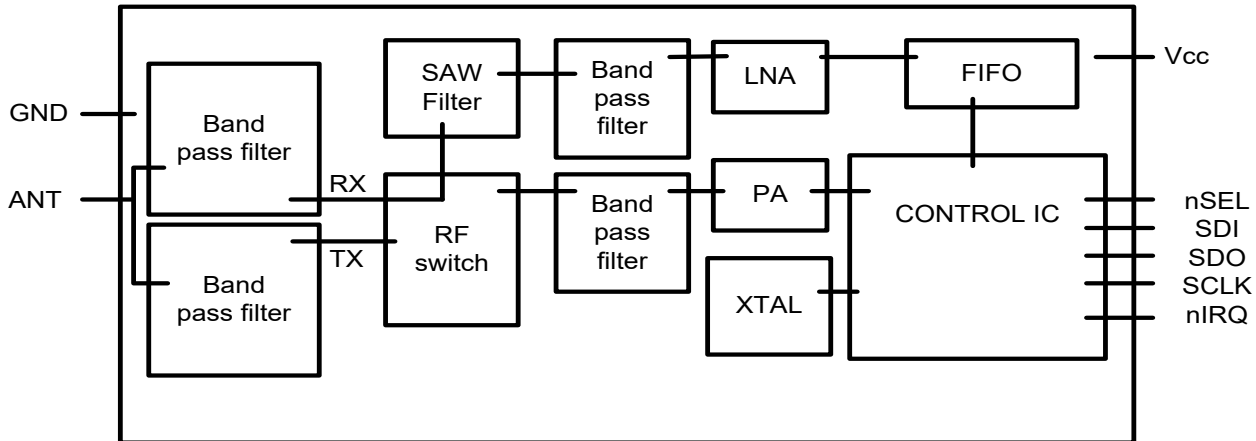


PIN	Definition	Type	Function
1, 9, 10, 11,	GND	-	Ground Connection
2	Vcc	In	Power Supply Connection 3V
3	MOSI	In	Master Output Slave Input
4	MISO	Out	Master Input Slave Output
5	SCLK	In	SPI Clock
6	SPI NSS	In	SPI Device Select (active low)
7	NIQR /TX	Out	NIQR (When using SPI (active low)) UART Data Out
8	SPI ENABLE/ RX	In	SPI Enable (active low) /UART Data In
9	GND	-	Ground Connection
12	ANT	-	Antenna pin connection. Keep short and match to 50ohms for best performance

DELTA Class 1 Capable RF Transceiver



Block Diagram



DELTA outperforms other similar modules. Because of the highly tuned RF matching network within the transmitter stage and the ultra narrow band filter within the receiver section, it achieves range far in excess of its competitors for a given power output or sensitivity.

DELTA is a SMART transceiver module and as such it handles all the RF configuration and data packetisation automatically. It provides a user with a simple to use SPI interface with straight forward commands for easy connection to a microcontroller.

What is "Category 1 or Class 1"?:

Class 1 in radio is a highly reliable SRD communication media. Within EN300-220 V2.4.1 there are specific

Rx Category	Clauses within EN300-220	Risk assessment of receiver performance
1	8.3, 8.4, 8.5 and 8.6	Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person).
2	8.4, 8.6	Medium reliable SRD communication media e.g. causing Inconvenience to persons, which cannot simply be overcome by other means.
3	8.4, 8.6	Standard reliable SRD communication media e.g. Inconvenience to persons, which can simply be overcome by other means (e.g. manual).

Please note that at the time of writing this datasheet Delta Module has not yet been certified by a Test house as Cat1 compliant, and that any end application of the Delta Module would need to be certified at an approved Test house.

Application notes

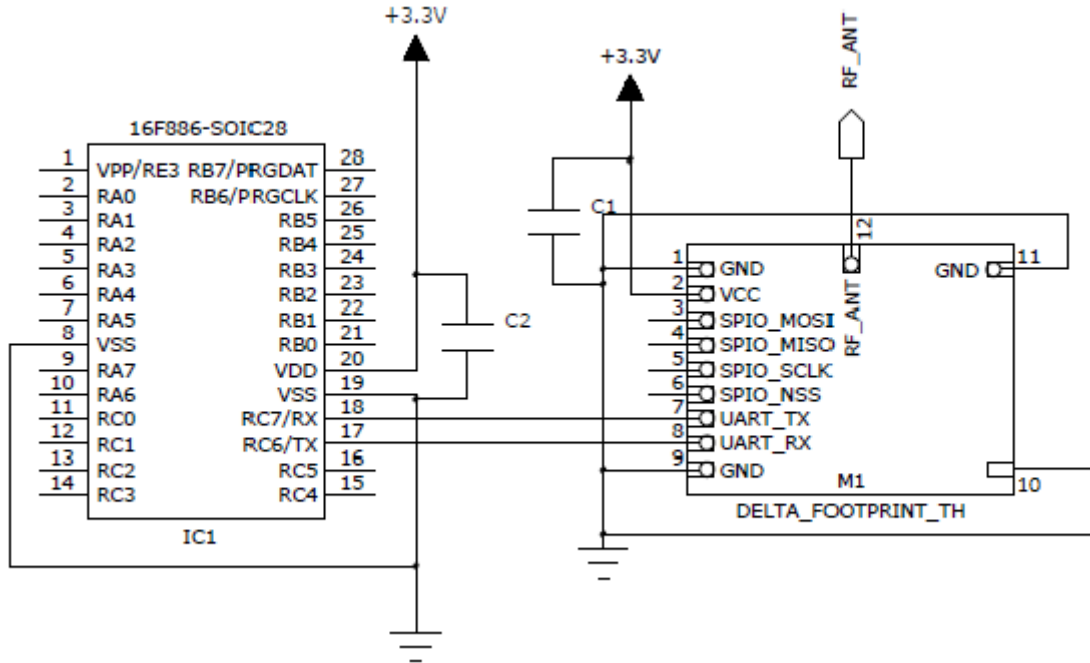
Communication with DELTA module can be via SPI interface or UART (LVTTTL). For transmission using SPI load the correct decimal byte values into the SPI TX register. When a byte is received using SPI the nIRQ line will be pulled low, this shows that data will be ready to be read from the SPI register.

Using the UART (LVTTTL) load the correct decimal byte values into the UART TX register, this will be sent to the DELTA via its RX pin. When data is received by a DELTA the module will output the data through the TX pin of the module to the RX pin of the controlling device (microprocessor) where this can be read.

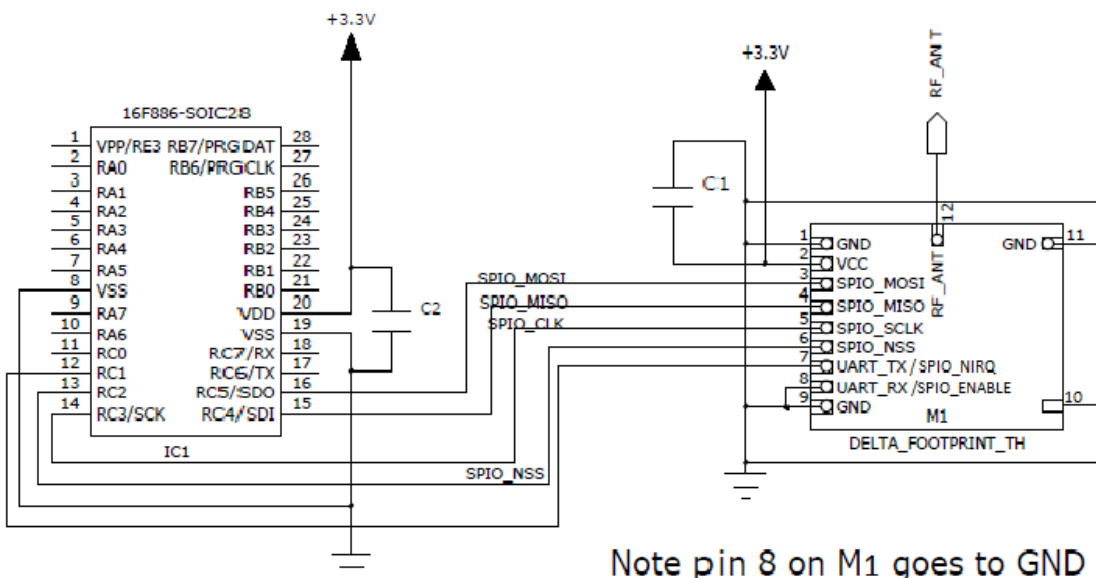
DELTA Class 1 Capable RF Transceiver



Generic Application Schematic –using UART to a PIC16F886



Generic Application Schematic – using SPI to a PIC16F886



Note pin 8 on M1 goes to GND to enable SPI mode

SPI Command Set and Interface

Mode Select

Command for ATM Mode		
Command	Name	Description
1	RX	When RX mode selected will default to last setting set using ATR command or if not set.
2	Ready	Ready is a low power wake state which can be used for fast entry to RX or switching between TX and RX. Time to RX or TX from READY <1ms
3	Sleep	Low power sleep mode with register retention.

Example: Put the module into receiver mode

Command	A	T	M	1
Decimal byte value	65	84	77	1

Receiver Mode

Command for Receiver Mode: ATR CHANNEL, PACKET LENGTH		
Command	Name	Description
1-64	Packet length	The length of the data packet to follow

Example: Enter RECEIVE mode and wait for a 10 byte packet

Command	A	T	R	10
Decimal byte value	65	84	82	10

Transmit Mode

Command for Transmit Mode: ATS CHANNEL, PACKET LENGTH, DATA		
Command	Name	Description
1-64	Packet length	The length of the data packet to follow. In 8 bit bytes.
	Data	Your data to be transmitted. (Data = Data Packet * Packet Length)

Example: Send a 10 byte data packet

Command	A	T	S	10	DATA PACKET 0-255
Decimal byte value	65	84	83	10	0-255

SPI Command Set and Interface continued

Module RF Sync Bytes:

Command for Sync Byte: ATA SYNC1, SYNC2, SYNC3, SYNC4		
Command	Name	Description
SYNCx		Reverse Order Bits i.e. 2D = B4 and D4 = 2B

Example: send SYNC BYTES to 12, 34, 56, 78

Command	A	T	A	12	34	56	78
Decimal byte value	65	84	65	12	34	56	78

Set RF TX Power

Command for ATP TX POWER		
Command	Name	Description
0-127	TX PWR	0-127 in 0.25db steps, where +20dbm is 127

Example: Sets the RF TX power to 19

Command	A	T	P	19
Decimal byte value	65	84	80	19

DATA Packet Received

IRQ GOES LOW

READ FIRST TWO BYTES FROM MODULE SHOULD BE #R
FOLLOWED BY THE PACKET LENGTH, RSSI VALUE AND DATA PACKET

NOTE: In order to be suitable for Class certification the DELTA modules Baud rates are fixed to the following values:

RF Baud Rate : 9600bps (GFSK)

Host Baud Rate: 19,200bps

DELTA Class 1 Capable RF Transceiver



Ping-Pong (Walk test)

The DELTA has a built in walk test mode that allows users to performance test via simple commands. By setting both transmitter and receiver into this mode, the transmitter will broadcast a packet to the receiver (ping) and the receiver will output #RZYXWVUTSRQ (this is simply #R and then 10 letters of the alphabet in reverse) to show that the ping command has been received.

The receiver will then send a packet back to the transmitter (pong). The transmitter will output #T followed by the RSSI value (Received Signal Strength Indication). If no reply packet is received back from the receiver with 200ms the RSSI value will be 0.

TRANSMITTER

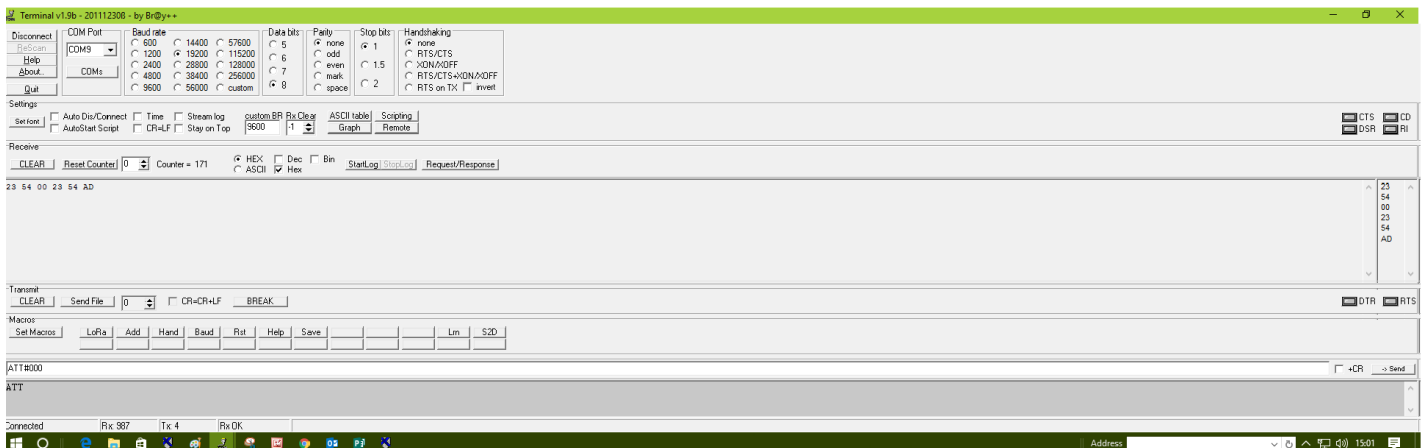
The below command will place DELTA into ping-pong mode as a transmitter. The transmitter will output every 200ms the RSSI value of a valid packet through its UART RX pin.

ATT#000



Channel number (byte value)

The screen shot below shows a terminal window and the received data on the RX pin. The image shows the data packet that is output when a successful ping-pong takes place on the transmitter.



The screen shot below shows the values output by the transmitter during the walk test when no packet is received back from the receiver.



DELTA Class 1 Capable RF Transceiver



RECEIVER

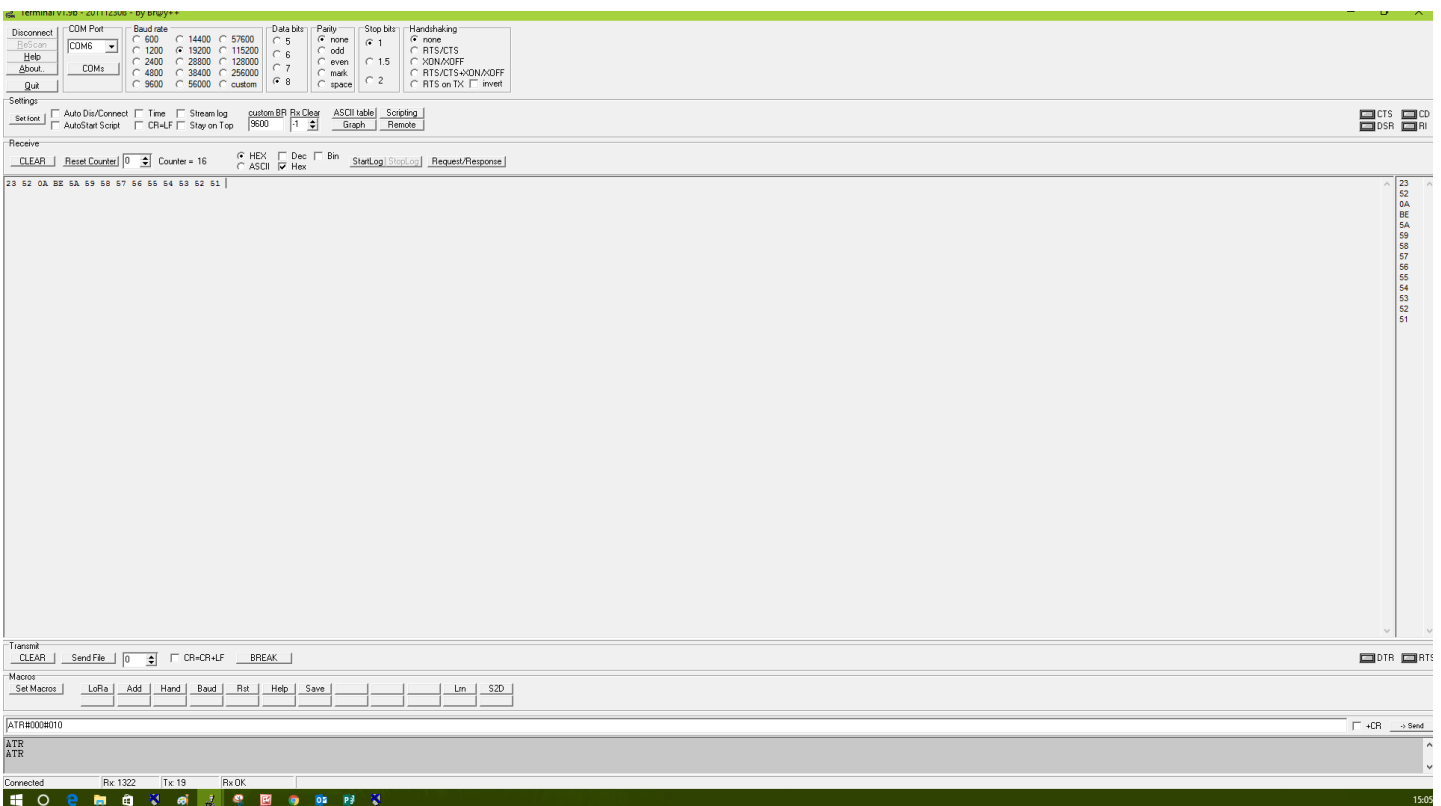
To configure the DELTA into receiver mode for the ping-pong walk test, the following string needs to be sent to the TX pin.

ATR#000#010

Channel number (byte value)

10 byte payload (this is the only byte value that will enter the device into ping-pong)

The screen shot below shows a terminal window with a successful packet received, here you can see the HEX values for #RZYXWVUTSRQ (This being the TEN BYTES and the #R showing receiver).



DELTA Class 1 Capable RF Transceiver



Electrical Parameters

Absolute Maximums

Symbol	Parameter	Minimum	Maximum	Unit
V_{dd}	Positive power supply	-0.3	+3.6	V
$V_{dd (working)}$	Positive power supply	1.8	3.3	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	125	°C

Recommended Operating Conditions

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Ambient temperature	T_A		-40	25	85	°C
Supply voltage	V_{DD}		1.8		3.6	V
I/O drive voltage	V_{GPIO}		1.8		3.6	V

DC Characteristics

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Current Ready Sleep						
RX mode current	I_{RX}		14	16.7	18	mA
TX mode current	I_{TX}		-	88	-	mA

Synthesizer AC Electrical Characteristics

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Synthesizer frequency Range	F_{SYN}		860	-	869	MHz
Synthesizer frequency Resolution	$F_{RES-868}$	850-870	-	114.4	-	Hz

Auxiliary Block Specifications

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
POR Reset Time	T_{POR}			6		ms
Startup Time				18		ms

DELTA Class 1 Capable RF Transceiver



Receiver AC electrical characteristics

Parameter	Symbol	Test condition	Min	Typ.	Max.	Unit
RX frequency range	F_{RX}		850	–	870	MHz
RX sensitivity	P_{RX_2}	(BER < 0.1%) (2.4 kbps, GFSK, BT = 0.5, DF = ±30 kHz, 114 kHz Rx BW)	–	-116	–	dBm
	P_{RX_40}	(BER < 0.1%) (40 kbps, GFSK, BT = 0.5, DF = ±25 kHz, 114 kHz Rx BW)	–	-108	–	dBm
	P_{RX_128}	(BER < 0.1%) (128 kbps, GFSK, BT = 0.5, DF = ±70 kHz, 305 kHz Rx BW)	–	-103	–	dBm
	P_{RX_00K}	(BER < 0.1%, 1 kbps, 185 kHz Rx BW, OOK, PN15 data)	–	-113	–	dBm
		(BER < 0.1%, 40 kbps, 185 kHz Rx BW, OOK, PN15 data)	–	-102	–	dBm
RX channel bandwidth	BW		40	–	850	kHz
BER variation vs power Level2	P_{RX_RES}	Up to +5 dBm Input Level	–	0	0.1	ppm
RSSI resolution	RES_{RSSI}		–	±0.5	–	dB
±1-Ch offset selectivity	C/I_{1-CH}	Desired Ref Signal 3 dB above sensitivity, BER < 0.1%. Interferer is CW and desired modulated with 1.2 kbps, DF = 5.2 kHz, GFSK with BT= 0.5, RX BW=58 kHz channel spac- ing = 100 kHz	–	-56	–	dB
±2-Ch offset selectivity	C/I_{2-CH}		–	-59	–	dB
Blocking 200 kHz–1 MHz	$200K_{BLOCK}$	Desired ref signal 3 dB above sensitiv- ity, BER < 0.1%. Interferer is CW and desired modulated with 1.2 kbps DF = 5.2 kHz GFSK with BT = 0.5, RX BW = 58 kHz	–	-58	–	dB
Blocking 1 MHz offset	$1M_{BLOCK}$		–	-61	–	dB
Blocking 8 MHz offset	$8M_{BLOCK}$		–	-79	–	dB
Image rejection	Im_{REJ}	Rejection at the image frequency IF = 468 kHz	–	-35	–	dB
Spurious emissions	P_{OB_RX1}	Measured at RX pins	–	-54	–	dBm

DELTA Class 1 Capable RF Transceiver



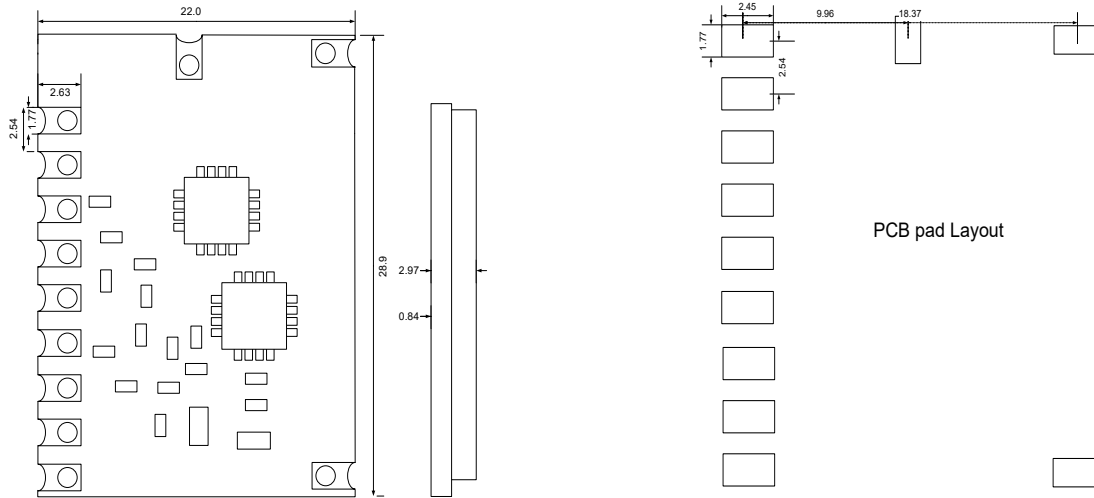
Transmitter AC electrical characteristics

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
TX frequency range	F_{TX}		850	–	870	MHz
(G)FSK data rate	DR_{FSK}		1.0	–	500	kbps
OOK data rate	DR_{OOK}		0.5	–	120	kbps
Modulation deviation range	Df_{960}	850–870 MHz	–	–	500	kHz
Modulation deviation resolution	$FRES_{960}$	850-870 MHz	–	114.4	–	Hz
Output power range	P_{TX}		-40	–	+13	dBm
TX RF output steps	DP	Using switched current match within 6 dB of max power	–	0.1	–	dB
TX RF output level variation vs. temperature	DP_{RF_TEMP}	-40 to +85 °C	–	1	–	dB
TX RF output level Variation vs. frequency	DP_{RF_FREQ}	Measured across 850-870 MHz	–	0.5	–	dB
Transmit modulation filtering	B*T	Gaussian filtering bandwidth time product	–	0.5	–	
Spurious emissions	P_{OB-TX1}	$P_{OUT} = +13$ dBm, Frequencies < 1 GHz	–	-54	–	dBm
	P_{OB-TX2}	1–12.75 GHz, excluding harmonics	–	-42	–	dBm
Harmonics	P_{2HARM}	Using reference design TX matching network and filter with max output power. Harmonics reduce linearly with output power.	–	-42	–	dBm
	P_{3HARM}		–	-42	–	dBm

DELTA Class 1 Capable RF Transceiver

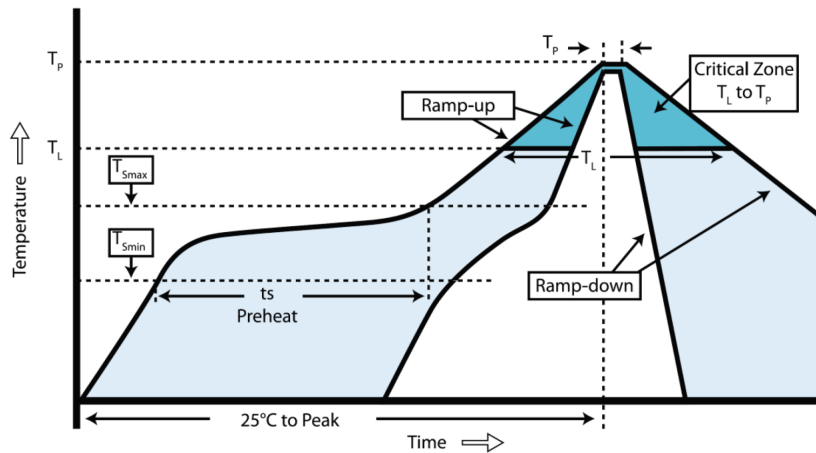


Mechanical Dimensions and SMT Layout



All dimensions in mm

DELTA module re-flow guide



DELTA is a 2 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.

DELTA Class 1 Capable RF Transceiver

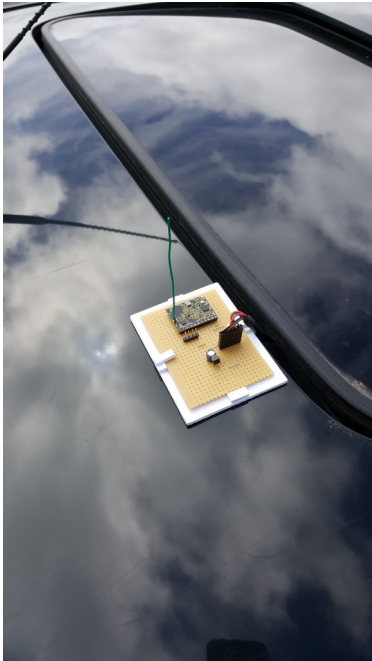


Range Test 1 In a Built up area within buildings—2KM

The range test was carried out in HOVE, East Sussex in clear atmospheric conditions.

The DELTA modules were mounted on Small prototyping boards with a simple piece of wire as antenna (not ideal!)

One DELTA module was placed on the roof of a vehicle and connected to a laptop (via LVTTTL RS232) and a packet was sent every 0.5 seconds via a terminal program. The second DELTA module was connected to a laptop and a terminal window was used to view the packet (ASCII characters)



DELTA Class 1 Capable RF Transceiver



Range Test 2 Open Line of Sight — 9KM

The second range test was carried out from Shore-by-Sea to Brighton in East Sussex. in clear atmospheric conditions. A DELTA module was connected via an LVTTT RS232 cable to a laptop to be configured via a terminal program as per our original range test. A second DELTA module was then taken to points along the coast to achieve a line of sight range (comms were lost at times when the modules were not in line of sight and then regained when line of sight was achieved). The range achieved was 9km in line of sight across water. Please see the image below that shows the exact



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