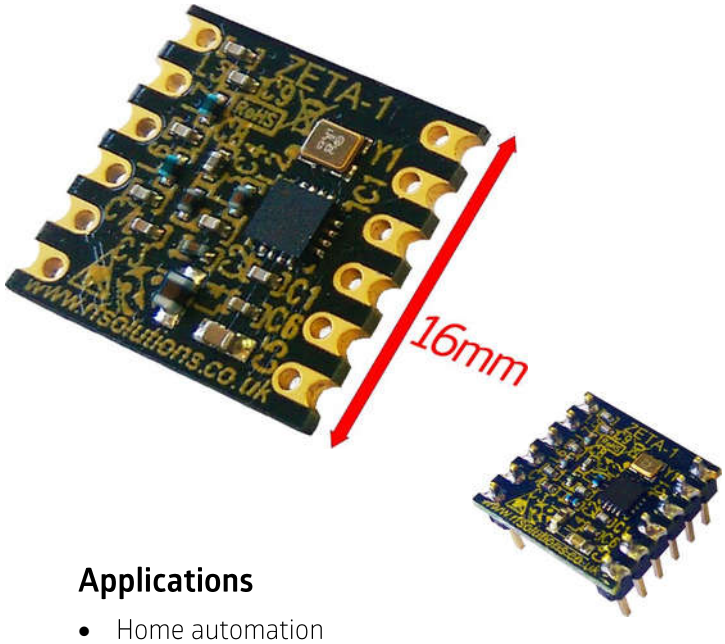
Miniature RF Transceiver

Features

- TINY form factor: 16mm x 16mm
- 2Km range, optimised RF matching
- Low cost and high performance
- Frequency - 433MHz, 868MHz, 915MHz
- 1.8V – 3.6V power supply
- Low power consumption
  - 0.5nA Standby
  - 10mA Rx
  - 18mA Tx @ 10dBm
- EZRadio™ from Silicon Laboratories
- +13dBm TX power
- High sensitivity -116dBm (@ 2.4kbps)
- Max data rate @ 500Kbps
- TX and RX 64 byte FIFO
- Integrated battery voltage sensor
- Packet handling:
  - Preamble
  - Sync word detection
  - CRC
- Based on Silicon Labs' Si4455 chipset
- 2.54mm pitch for easy prototyping
- DIP Versions Available
- Codec IC Available for plug and play RF



Applications

- Home automation
- Sensor networks
- Telemetry
- Keyless entry
- Health monitors
- Door and gate access

Introduction

The ZETA modules are extremely cost effective and high performance radio modules. Supplied in a miniature surface mount package this transceiver module can transmit/receive at up to 500kbps over a range up to 2000m.

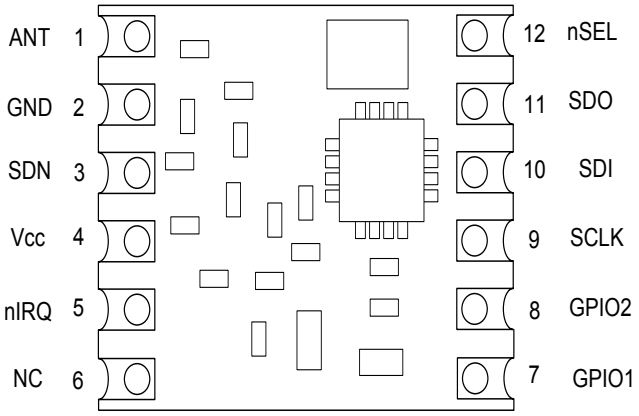
Operating between 1.8-3.6V, the module monitors its battery voltage and can sleep with very low standby current. The module can wake intermittently and provide direct control outputs to a microcontroller making it ideally suited to battery applications.

These modules will suit one-to-one or multi-node wireless links in applications including car and building security, POS and inventory tracking, remote process monitoring.

Ordering information

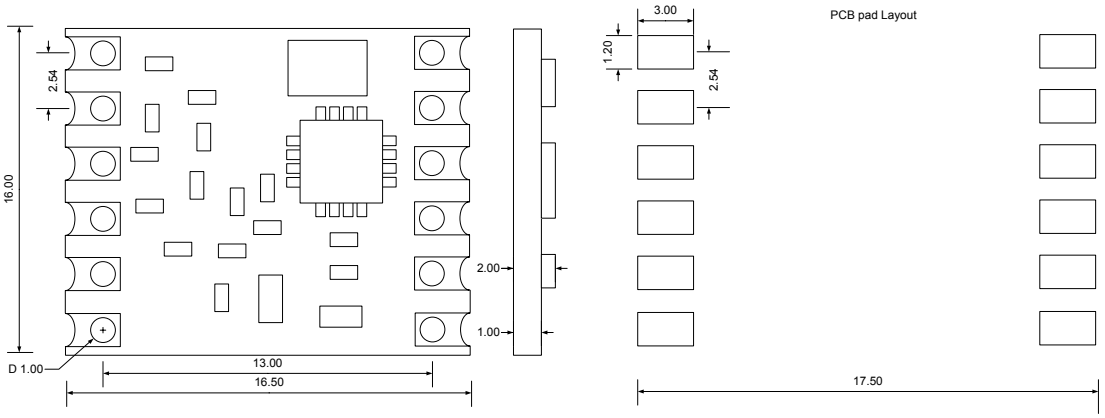
Part Number	Description
ZETA-433-SO	FM transceiver module, optimised for 433MHz (marked Red Dot)
ZETA-433-D	DIP FM transceiver module, optimised for 433MHz (marked Red Dot)
ZETA-868-SO	FM transceiver module, optimised for 868MHz (marked Blue Dot)
ZETA-868-D	DIP FM transceiver module, optimised for 868MHz (marked Blue Dot)
ZETA-915-SO	FM transceiver module, optimised for 915MHz (marked Brown Dot)
ZETA-915-D	DIP FM transceiver module, optimised for 915MHz (marked Brown Dot)

Pin Description

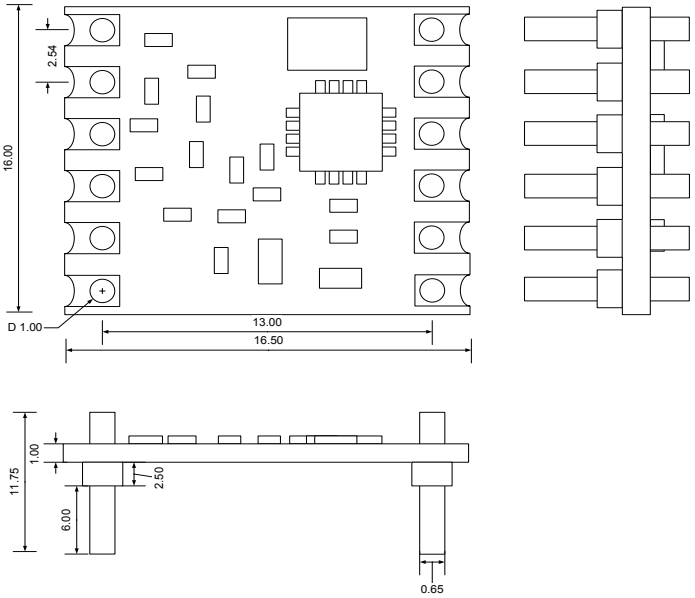


PIN	Definition	Type	Function
1	Antenna connection	In/Out	Antenna pin connection. Keep short and match to 50phms for best performance
2	GND	In	Ground connection
3	Shutdown	Active high	The shutdown state is the lowest current consumption state of the device and is entered by driving SDN high. In this state, all register contents are lost and there is no SPI access. Drive low to exit
4	Vcc	In	Power connection
5	Interrupt	Output	Active Low Interrupt Status Output – Read interrupt status for event details E.g. The FIFO on the ZETA module contains data
6	NC		Do not connect
7, 8	GPIO1, 2	In / Out	General Purpose I/O can be configured by Si4455 to provide additional function
9	Serial clock	In	Serial Clock Input (0 – VDD V): Provides serial data clock for 4-line serial data bus
10	Serial data In	In	Serial Data Input (0 – VDD V): Serial data stream input for 4-line serial data bus
11	Serial data Out	Out	Serial Data Output (0 – VDD V)
12	Serial interface select	In	Serial Interface Select Input (0 – VDD V): Provides select/enable function for 4-line serial data bus.

SO mechanical dimensions



DIP mechanical dimensions



Electrical parameters

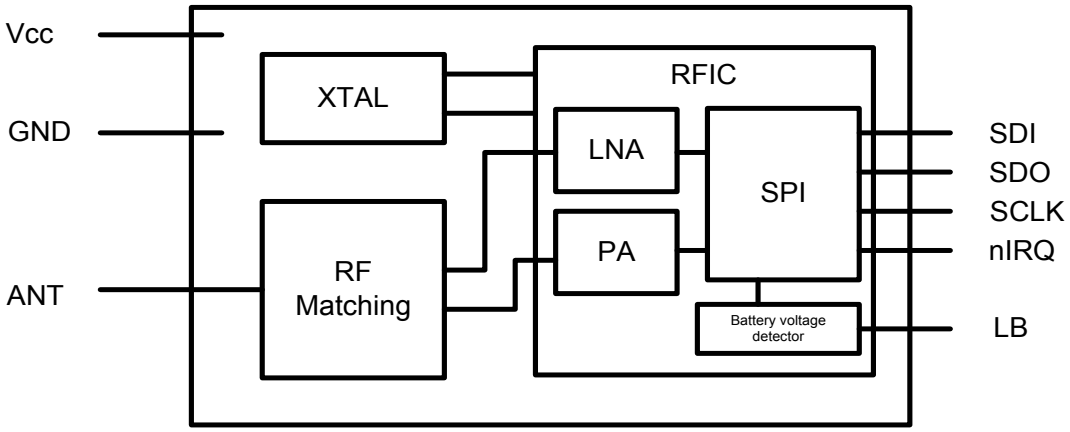
Absolute maximums

Symbol	Parameter	Minimum	Maximum	Unit
V_{dd}	Positive power supply	-0.3	+3.6	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	125	°C

Recommended working range

Symbol	Parameter	Minimum	Maximum	Unit
V_{dd}	Positive power supply	2.2	3.3	V
T_{op}	Working temperature	0	55	°C

Block diagram

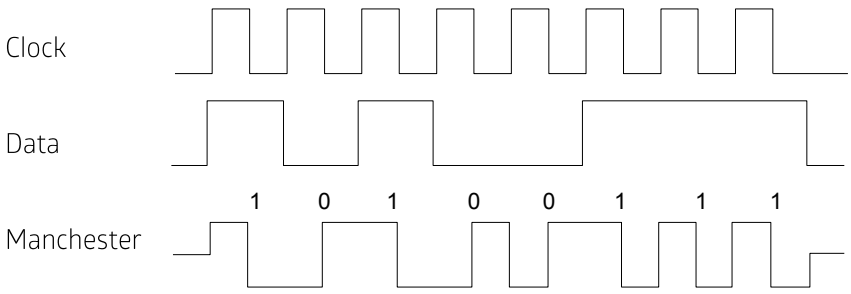


ZETA outperforms other similar modules. Because of the highly tuned RF matching on the ZETA it achieves range far in excess of its competitors for a given power output. Check out the range test results at the end of this document.

The ZETA is an easy-to-use, size efficient, low current wireless transceiver module tuned to the licence free bands.
The ZETA incorporates a high performance RFIC (Si4455) allowing high data rates and great receive sensitivity. With this powerful RFIC combined with the expert knowledge in RF matching from RF Solutions, ZETA is a module with industry leading specifications, such as size and price versus performance.

Additional module features, such as 64-byte TX/RX FIFOs, preamble detection, sync word detector, and CRC, reduce overall current consumption and allow for the use of lower-cost system MCUs. The ZETA also gives access to the integrated auxiliary 11-bit ADC used for the internal battery voltage detector making low battery detect very simple to implement on your design.

The ZETA comes enabled with Manchester Coding. This method provides a state transition at each bit and so allows for more reliable clock recovery. Manchester Code is used in conjunction with the packet handler option and will be applied to the entire packet (the preamble pattern is set to continuous "1" if therefore, the chip rate of the resulting preamble pattern is the same as for the rest of the packet).



1. Electrical Specifications

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
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 currran	I_{Tune_RX}	RX tune	–	6.5	–	mA
	I_{Tune_TX}	TX tune	–	6.9	–	mA
RX mode currran	I_{RX}		–	10	–	mA
TX mode current	I_{TX}	+10 dBm output power, 868 MHz	–	18	–	mA
		+13 dBm output power, 868 MHz	–	30	–	mA

Synthesiser 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 MHz	–	114.4	–	Hz

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-_OOK}	(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 spacing = 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 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	—	-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

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	$P2_{HARM}$	Using reference design TX matching network and filter with max output power. Harmonics erduce linearly with output power.	–	-42	–	dBm
	$P3_{HARM}$		–	-42	–	dBm

Auxiliary block specifications

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
XTAL Range	$XTAL_{RANGE}$		25	–	32	MHz
30 MHz XTAL Start-Up time	t30M	Using XTAL and board layout in reference design. Start-up time will vary with XTAL type and board layout.	–	250	–	µs
30 MHz XTAL Cap Resolution	$30M_{RES}$		–	70	–	fF
POR Reset Time	t_{POR}		–	–	5	ms
Crystal frequency tuning	Hex			52		
Tolerance	PPM			+/-10		

Absolute maximum ratings

Parameter	Value	Unit
V_{DD} to GND	−0.3, +3.6	V
Voltage on digital control inputs	−0.3, V_{DD} + 0.3	V
Voltage on analog inputs	−0.3, V_{DD} + 0.3	V
RX input power	+10	dBm
Operating ambient temperature range T_A	−0 to +55	°C
Storage temperature range T_{STG}	−40 to +125	°C

Test conditions

- T_A = +25 °C
- V_{DD}= +3.3 Vdc
- Sensitivity measured at 434 MHz using a PN15 modulated input signal and with packet handler mode enapled.
- External reference signal (XIN) = 1.0 V_{PP} at 30 MHz, centered around 0.8 Vdc
- RF input and output levels can typically be achieved at the antenna port after filtering components.

Qualification test conditions:

- TA = −40 to +85 °C (typical = 25°C)
- V_{DD} = +1.8 to +3.6 Vdc (typical = 3.3 Vdc)

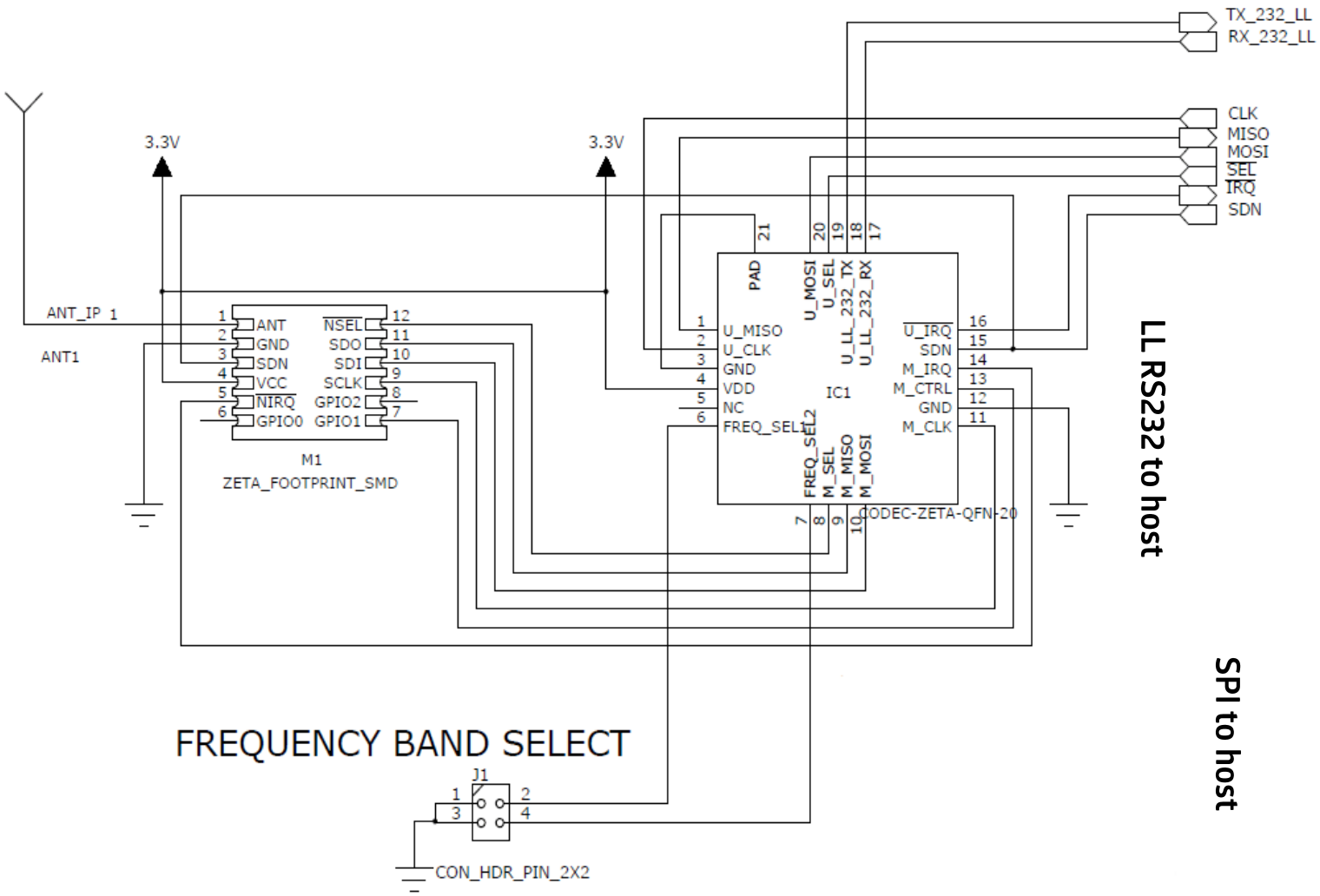
Application code and Codec Chipset.

The ZETA module requires a considerable number of register settings in order to operate efficiently.
A Codec Chipset is available which pre-configures the ZETA rf module providing a simple user SPI interface to allow the fastest route to market.
For more information see the ZETA page on our website.

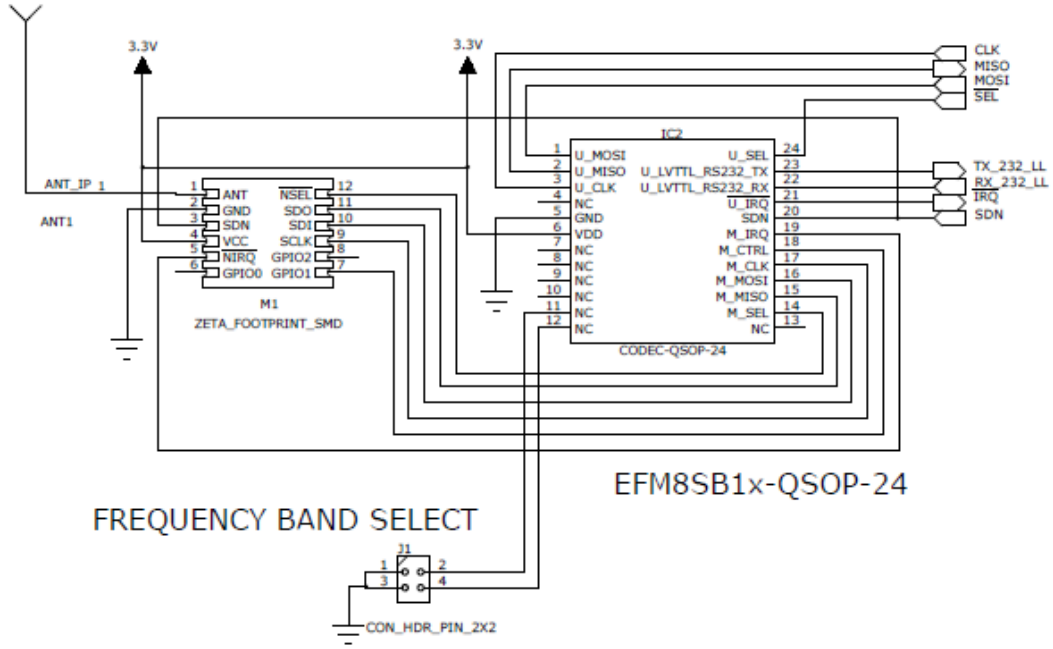
We have created some base level code to show the basic settings and register values required to get the ZETA module working: This code is created for a Microchip™ PIC 16F886 (as configured in the application schematic below) but the values should be extractable for other devices.

http://www.rfsolutions.co.uk/downloads/zeta.php

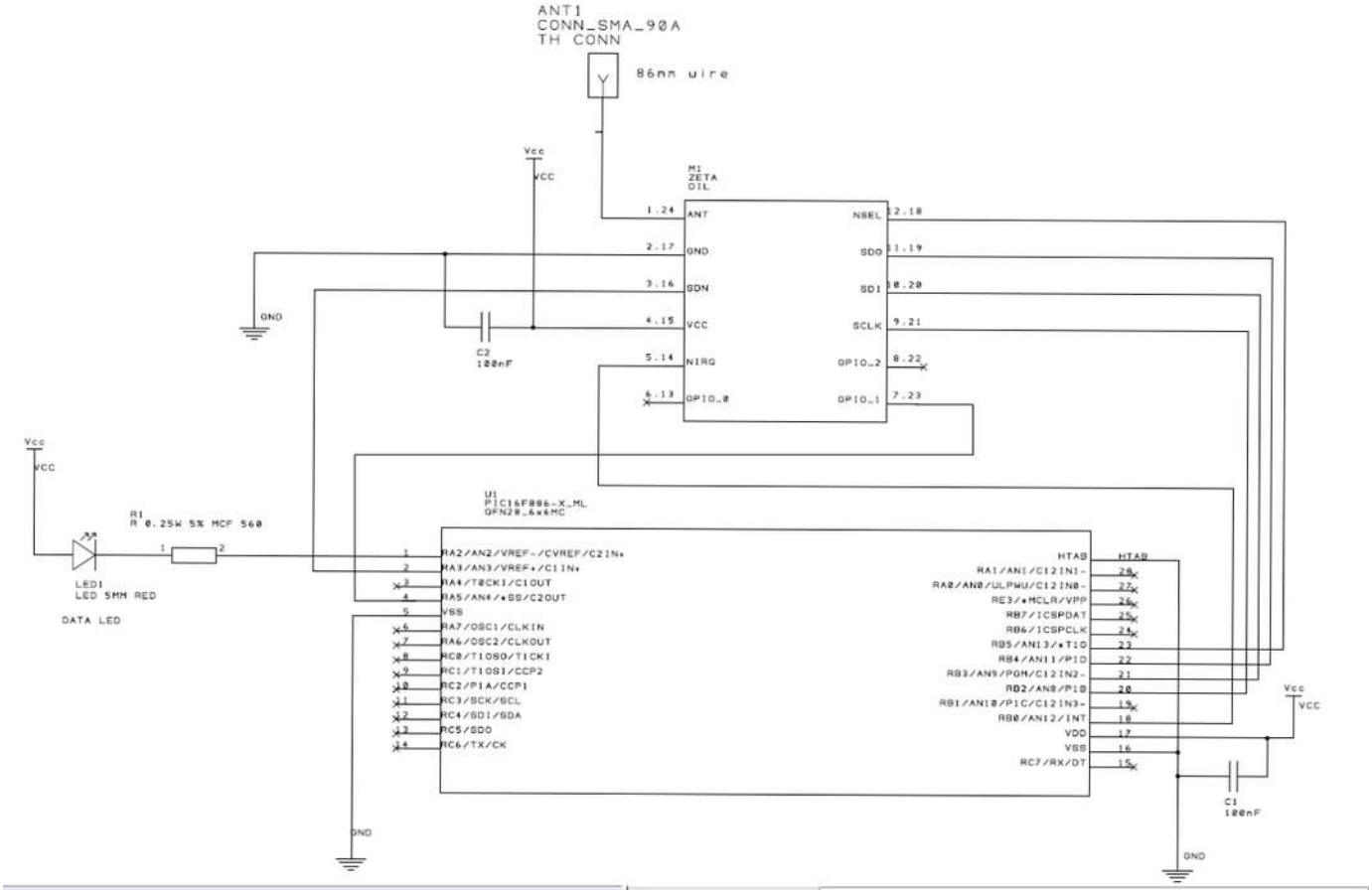
Application schematic - Using RF Solutions ZETA Codec QFN Chip



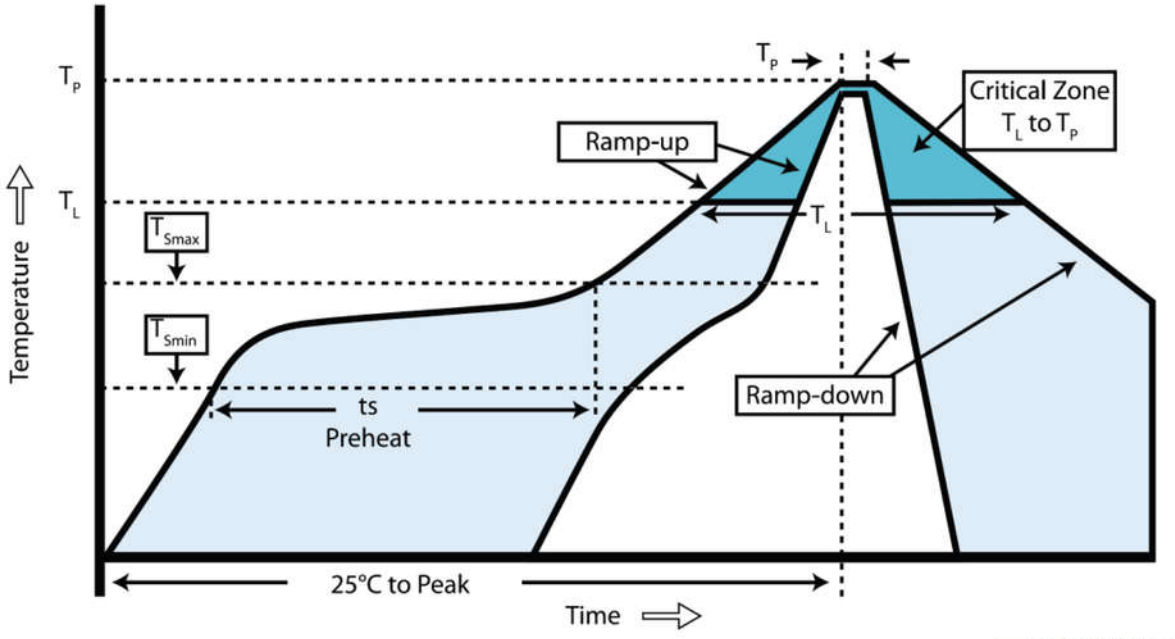
Application schematic - Using RF Solutions ZETA Codec QSOP Chip



Generic application schematic - PIC16F886 micro controller



ZETA module re-flow guide



ZETA is a 2 layer PCB, re-flow is based on IPC/JEDEC JSTD020C July 2004

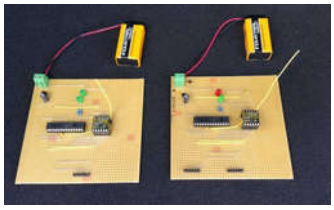
Profile feature	Value (lead free)
Ramp up rate	3°C /s
Pre-heat temperature - Temperature Min (T_{Smin}) - Temperature Max (T_{smax}) - Pre-heat time	 150°C 200°C 60-100s
Peak temperature (T_P)	240°C
Time at T_P	10-20sec
Ramp down rate	6°C/s
Time from 25°C to peak	8 mins max.

Range Test Notes

Two Transceiver boards were built using simple prototyping board and a host PIC microcontroller . One board was programmed as a transmitter to send a beacon signal at 1 second interval. The other board programmed as receiver creating a Ping test set.

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

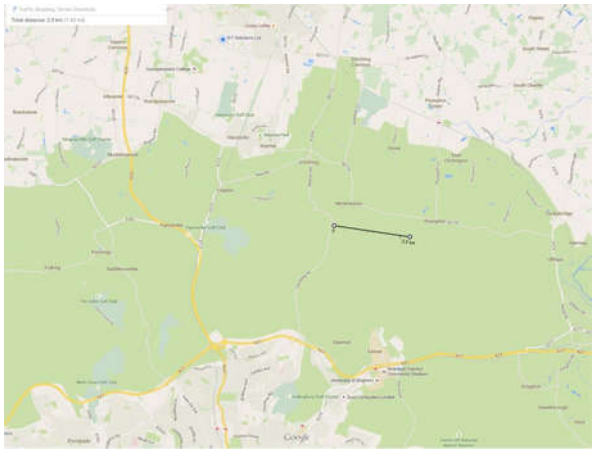
It should be noted that prototyping board and wire as antenna is not ideal, but as with many real applications it is often difficult optimise the motherboard with all features ideally suited to the RF section!



Our Range Testing was conducted from Ditchling Beacon providing an open Line of Sight Test.

1. The Transmitter was placed Receiver was mounted on the back of a pick up truck and the receiver was carried by hand ~5ft from the ground .
2. As the receiver travelled away from the transmitter Line of sight was occasionally lost when we went in the shadow of a hill, at this time the rf signal was intermittent, A Reliable signal in Line of sight was observed to 2.7K range, thereafter we couldn't go any further as the pathway stopped.. At this range in L.O.S the signal was 100% reliable.





Test conditions

- T_A = +18 °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.

Result:
The test achieve a maximum range of 2.4km after this point the terrain dropped away and a line of sight was completely lost, it is possible that the module may have achieved a longer range.

ZETA RF Transceiver

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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. This product must be disposed of through a licensed WEEE collection point. RF Solutions Ltd., fulfills its WEEE obligations by membership of an approved compliance scheme.

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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RF Solutions Ltd
William Alexander House, William Way, Burgess Hill, West Sussex, RH15 9AG
Sales: +44(0)1444 227 910 Tech Support: +44(0)1444 227909