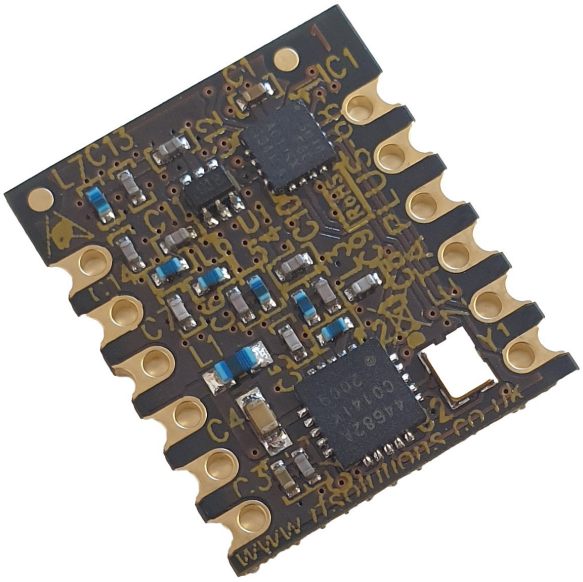
+20dBm Smart RF Transceiver

Features

- Wire replacement SMARTRADIO
- Upto 4Km range
- Specifications (from the pin of the module)
  - Transmit Power +20dBm
  - Sensitivity -132dBm
- Max data rate @ 500Kbps
- Easy UART and SPI interface
- Full CRC Error Checking Option
- User Selectable Data Payload
- Best in Class cost performance
- Available as 433/868/915MHz
- 1.8V – 3.6V Operating Voltage
- Low power consumption
  - 0.5nA Standby
  - <10mA Rx
  - 18mA Tx @ 10dBm
- 64 byte Buffer (FIFO)
- Based on Silicon Labs' Si4468 chipset
- No configuration necessary,
- No external components
- Fast Plug and Play SPI or UART RF Link
- Form factor: 16mm x 18mm SMT or DIL



Applications

- Home automation
- Sensor / mesh RF networks
- Telemetry
- Keyless entry
- Health monitors
- RF Data comms

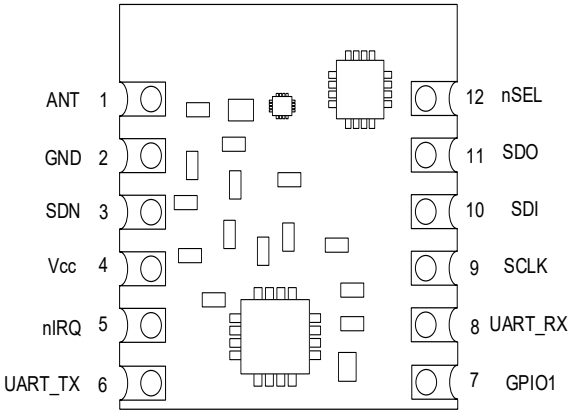
Applications

ZETAPLUS20 makes a radio data link easy. It has a simple interface using either SPI or UART (LV RS232) and provides a plug 'n' play RF comms to any application.

With connection to power, comms and antenna, the user can start sending and receiving data immediately. No other external components are required.

With a highly tuned on-board RF matching network ZETAPLUS20 outperforms other modules achieving range far in excess of its competitors for the given power output/power consumption. Specifications are stated from the module I/O (not the pin of the IC on the module).

Pin Description

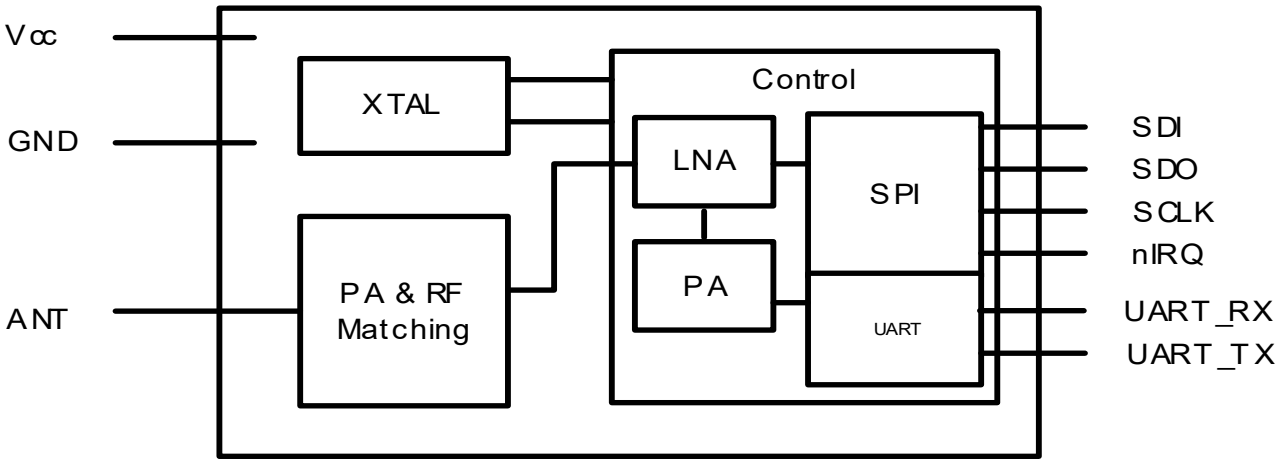


Pin	Name	Definition	Data Flow	Function
1	ANT	Antenna Pin	In/Out	Antenna pin connection. Keep short and match to 50ohms impedance for best performance
2	GND	Ground	In	Supply Ground connection
3	SDN	Shutdown	In	When asserted (active High) ZETAPLUS enters Shutdown. Shutdown state is the lowest current consumption of the device.
4	Vcc	V Supply	In	Supply Voltage Connection
5	nIRQ	Interrupt	Output	Active Low Data packet received in SPI RX mode only
6	UART_TX	UART Transmit	Out	UART (LV RS232) Data appears on this output
7	GPIO1	Gen Purpose I/O	In / Out	This is not yet implemented
8	UART_RX	UART Receive	In	UART Data Receive Pin (LV RS232)
9	SCLK	Serial clock	In	SPI Clock In
10	SDI	Serial data In	In	SPI Data In
11	SDO	Serial data Out	Out	SPI Data Out
12	nSEL	Serial interface select	In	SPI Device Select (Active Low) Only used in SPI mode. If SPI is not used pull high or leave disconnected

Ordering information

Part Number	Description
ZETAPLUS20-8S	FM Transceiver module, 868MHz (marked Blue Dot) SMT
ZETAPLUS20-8D	FM Transceiver module, 868MHz (marked Blue Dot) DIP
ZETAPLUS20-9S	FM Transceiver module 915MHz (marked Yellow Dot) SMT
ZETAPLUS20-9D	FM Transceiver module 915MHz (marked Yellow Dot) DIP

Block Diagram



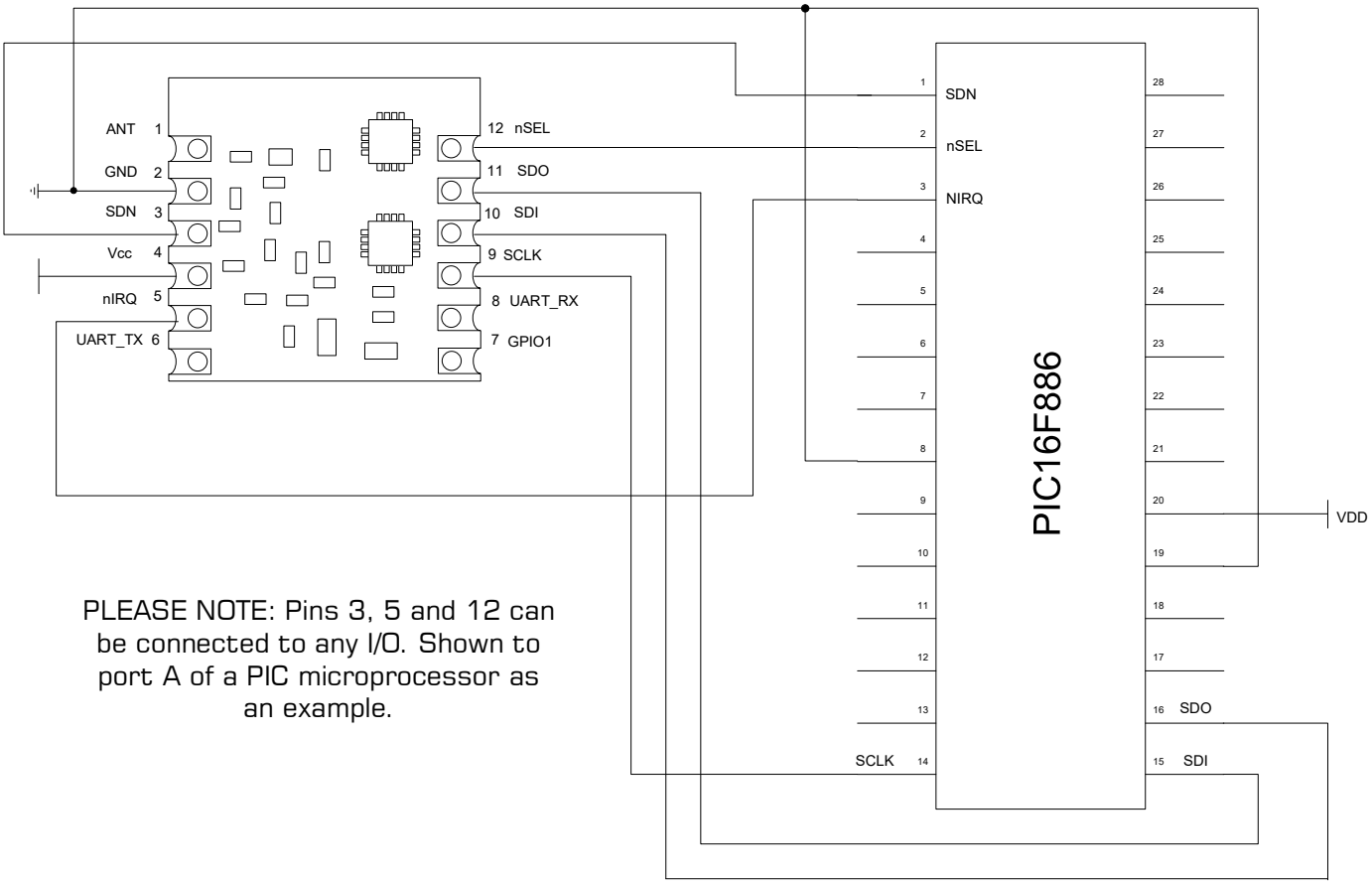
Using ZETAPLUS20

Using ZETAPLUS20 is easy, communication can be via SPI interface or UART (LVTTL).
The module will automatically communicate to its host in the same way that it was addressed, i.e. if ZETAPLUS20 receives communications on its SPI interface, then it will reply on the SPI. If comms was last received on the UART interface then it will reply on the UART interface.

Using SPI, to Transmit data simply load the correct decimal byte values into the SPI TX register. When ZETAPLUS20 receives RF data from another ZETAPLUS20 module it will output this using SPI, the nIRQ line will be pulled low, this shows that data will be ready to be read from the SPI register to the host.

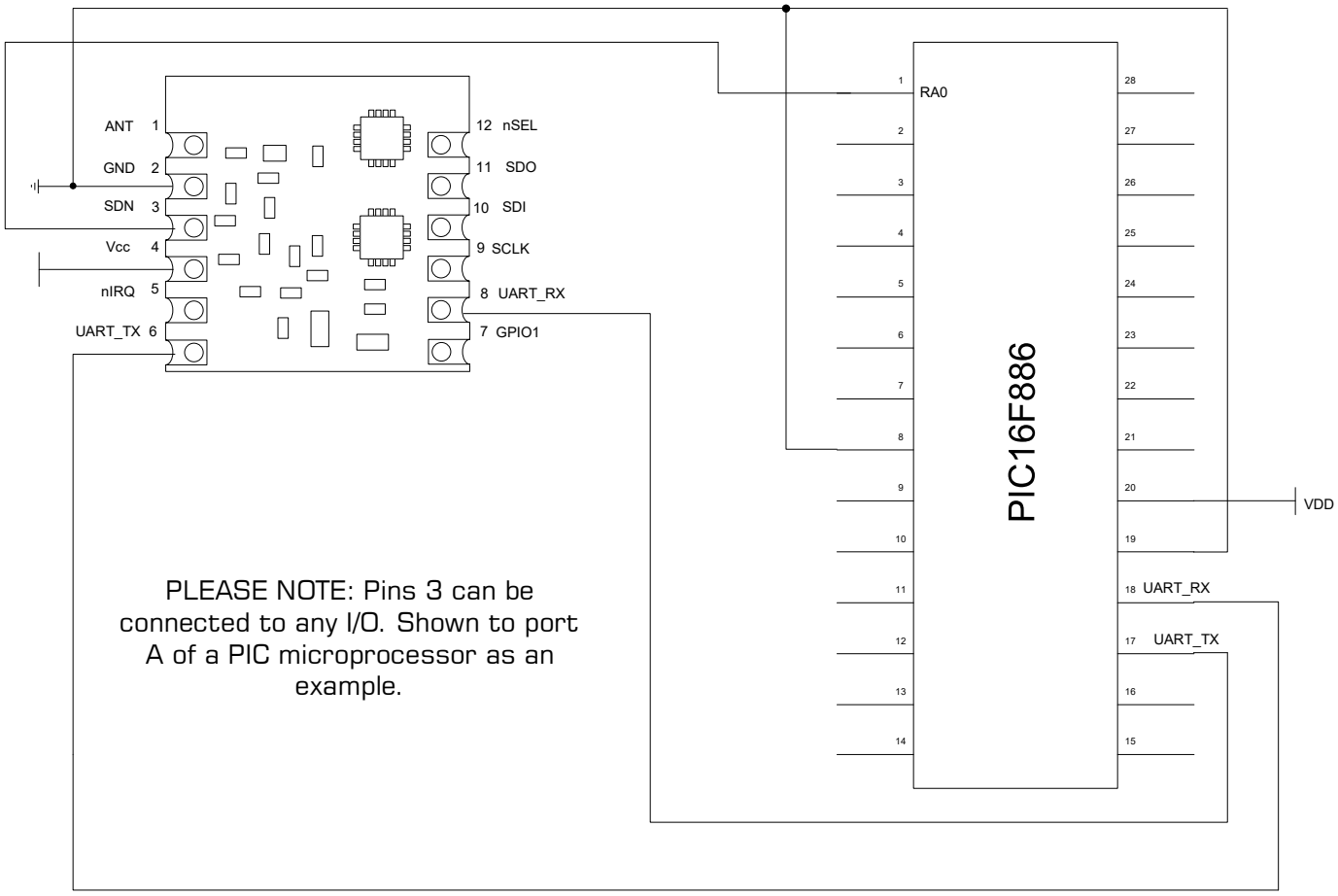
Using UART (LVTTL) to Transmit load the correct decimal byte values into the UART TX register, When ZETAPLUS20 receives RF data from another ZETAPLUS module it will output the data via the UART-TX output pin of the module to the host.

Application schematic- ZETAPLUS20 and PIC16F886 (SPI)



PLEASE NOTE: Pins 3, 5 and 12 can be connected to any I/O. Shown to port A of a PIC microprocessor as an example.

Application schematic- ZETAPLUS20 and PIC16F886 (UART)



UART Configuration

UART Configuration:
Baud rate: 19200, Data bits: 8, Parity: none, Stop bits: 1.

Note: all UART I/O are at Low level and must not exceed 5V. If used at 5V using a level shift is advised.

UART RX (in)
Data is received by ZETAPLUS20 on this pin. A 50ms timeout exists to avoid lock-up if not all required data bytes are received - in this scenario the packet would be aborted and no data sent.

UART TX (out)
Data is output from this pin ZETAPLUS20.
When in receive mode and an RF packet is received the data is automatically sent output on this pin.

SPI and UART Commands

Operating Mode (ATM)

Value	Name	Description
1	RX	ZETAPLUS enters RX mode using last RX configured settings
2	Ready	Ready is a low power awake 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: Place the ZETAPLUS20 into receive mode

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

Receive Mode Config (ATR) Channel Setting, Packet Length

Value	Name	Description
0-15	Channel	Set in 250KHz increments starting at (FREQ dependent): At 433MHz: 0=433.92 At 868MHz: 0=869.50 At 915MHz: 0=915
1-65	Packet Length	Length of data packet to be sent in 8 bit bytes

Example: Enter receiver mode on channel 2 with a packet length of 10 bytes.

Command	A	T	R	2	10
Decimal byte value	65	84	82	2	10

Note
When a valid packet is received in SPI mode the U_IRQ pin will go low indicating data is ready to be read over SPI.

Transmit Mode Config: (ATS) CHANNEL, PACKET LENGTH, DATA

Value	Name	Description
0-15	Channel	Set in 250KHz increments starting at (FREQ dependent): At 433MHz: 0=433.92 At 868MHz: 0=869.50 At 915MHz: 0=915
1-64	Packet length	This defines the data payload. In 8 bit bytes.
	Data	Your data to be transmitted. ZETAPLUS will then return to the state is was in prior to ATS command.

Example: send a 13 byte packet on channel 2

Command	A	T	S	2	13	DATA
Decimal byte value	65	84	83	2	13	Your 13 bytes

Sync bytes (ATA) SYNC1, SYNC2, SYNC3, SYNC4

Value	Name	Description
1-4	SYNC1-4	The sync bytes appear directly after the pre-amble in the transmitted RF data. They can be used as a form of addressing to discriminate between valid and spurious data. Set these bytes and the ZETAPLUS will only pass on data which contains the correct sync bytes. NOTE: the sync byte function of this module will use reverse order bytes: ie.2D will be sent as B4, D4 will be sent as 2B 2 D = B 4 , D 4 = 2 B 0010 1101 = 1011 0100, 1101 0100 = 0010 1011

Example: Set the 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

Host Interface Baud Rate (ATH)

Command	Name	Description
1-6	Host Baud rate	This controls the data rate between ZETAPLUS and the host microcontroller 0 = 9.6 kbps 1 = 19.2 kbps (default) 2 = 28.8 kbps 3 = 38.4 kbps 4 = 57.6 kbps

Example: Set the Host baud rate to 57K6:

Command	A	T	H	4
Decimal byte value	65	84	110	4

RF Baud Rate (ATB)

Value	Name	Description
1-6	RF Baud rate	Sets the data rate of the RF signal between ZETAPLUS Modules, it is recommended that this is set to at least double the Host Baud Rate. 1 = 4.8 kbps 2 = 9.6 kbps 3 = 38.4 kbps 4 = 128.0 kbps 5 = 256.0 kbps 6 = 500.0 kbps

Example: Set the RF baud rate to 500kbps GFSK:

Command	A	T	B	6
Decimal byte value	65	84	66	6

Notes:

1. Using a higher RF Baud rate increases the data Bit Error rate (BER) at longer range.

RF Output Power (ATP)

Value	Name	Description
1-127	RF TX output	Power output in increments from 1-127

Example: Set the power outputs to 32:

Command	A	T	P	15
ASCII	65	84	80	32

NOTE:
Although the RF Output power can be set at a specific value the actual output power is not a linear function, The output power can vary depending on other factors such as supply voltage, impedance miss-match from module to antenna.
The adjustment resolution of the TX output power is very fine (step size < 0.1 dB) when operating near the maximum power setting, but becomes coarser as the output power level is reduced.

Enable Data Error Checking (ATE)

Value	Name	Description
0 - 1	CRC Error Check	Enables CRC Error Checking of Received data and only passes valid data to the host. 0 =Disable Error Checking (Power on Default Value) 1 =Enable Error Checking

Example: Enable RF Error Checking

Command	A	T	E	1
Decimal byte value	65	84	69	1

RSSI (ATQ)

Value	Name	Description
0—255	RF Signal Strength	ZETAPLUS20 responds with the Received Signal Strength Value. Example reply: 35 81 56 #Q followed by one byte RSSI value (0-255)

Example: Retrieve settings

Command	A	T	Q
Decimal byte value	65	84	81

Retrieve Currant Configuration and Settings (AT?)

Value	Name	Description
N/A	Configuration and set-tings	ZETAPLUS20 Reports its current device settings Example reply: #? FOLLOWED BY 8 BYTE AS BELOW OPERATING MODE (MODE:- 1= RX 2=READY) RF BAUD RATE (1-19) RF POWER OP (1-127) SYNC BYTE 1 SYNC BYTE 2 SYNC BYTE 3 SYNC BYTE 4 CHANNEL NUMBER (0-15) EXAMPLE 35 63 1 1 127 45 210 0 0 0

Example: Retrieve settings

Command	A	T	?
Decimal byte value	65	84	63

Firmware Version (ATV)

Command	Name	Description
N/A	Firmware Version	Use this command to determine the firmware version of the ZETAPLUS20 module . Example reply: # V 1 . 0 0 EXAMPLE 35 86 31 46 30 30

Example: Check firmware version

Command	A	T	V
Decimal byte value	65	84	86

Reset to Power On Defaults (ATD)

Command	Name	Description
N/A	Firmware Version	Resets the configuration of ZETAPLUS20 Power On Status

Example:

Command	A	T	D
Decimal byte value	65	84	68

Ping-Pong (Walk test)

Using two ZETAPLUS20 module a test signal can be sent to 'Ping' 'Pong' between the two providing a site check of signal strength for a specific application.
In this mode one ZETAPLUS20 transmits a special 'Ping' signal, which is received by another ZETAPLUS20 module which outputs the message #RZYXWVUTSRQ (#R followed by the last 10 letters of the alphabet in reverse) to its host, and then automatically reply's back the 'Pong' message.
The originating ZETAPLUS20 module receives back the 'Pong' and outputs #T followed by the received Signal Strength Indication (RSSI) value.
If no 'Pong' reply packet is received back from the receiver within 200ms the RSSI value will be 0.

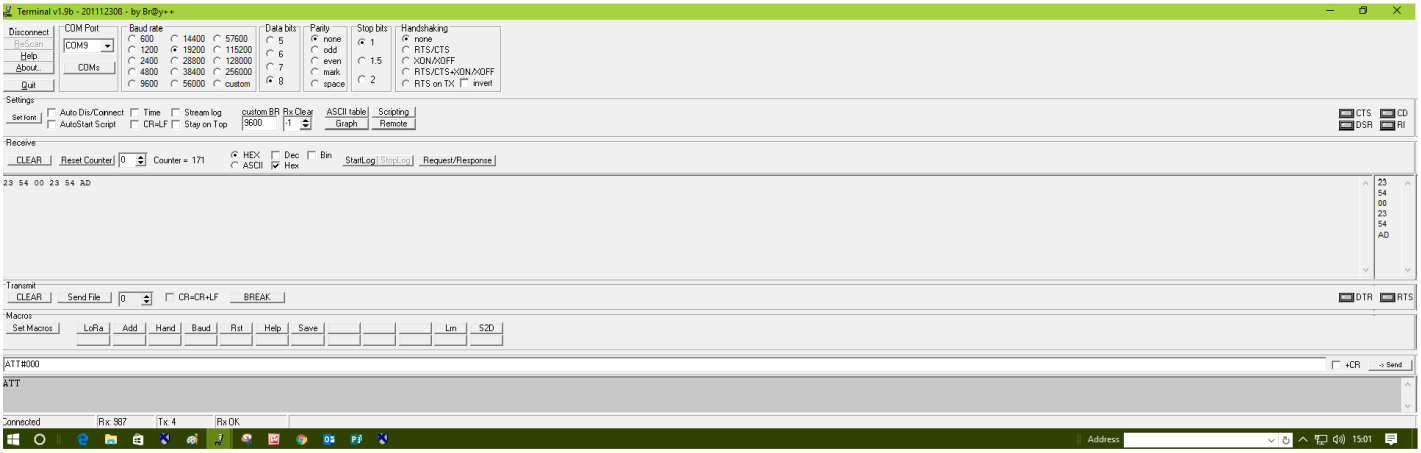
Transmitter

The example below sets the ZETAPLUS20 to transmit a ping signal.
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 below screen shots 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 below image shows the values output by the transmitter during the walk test when no packet is received back from the receiver.



Receiver

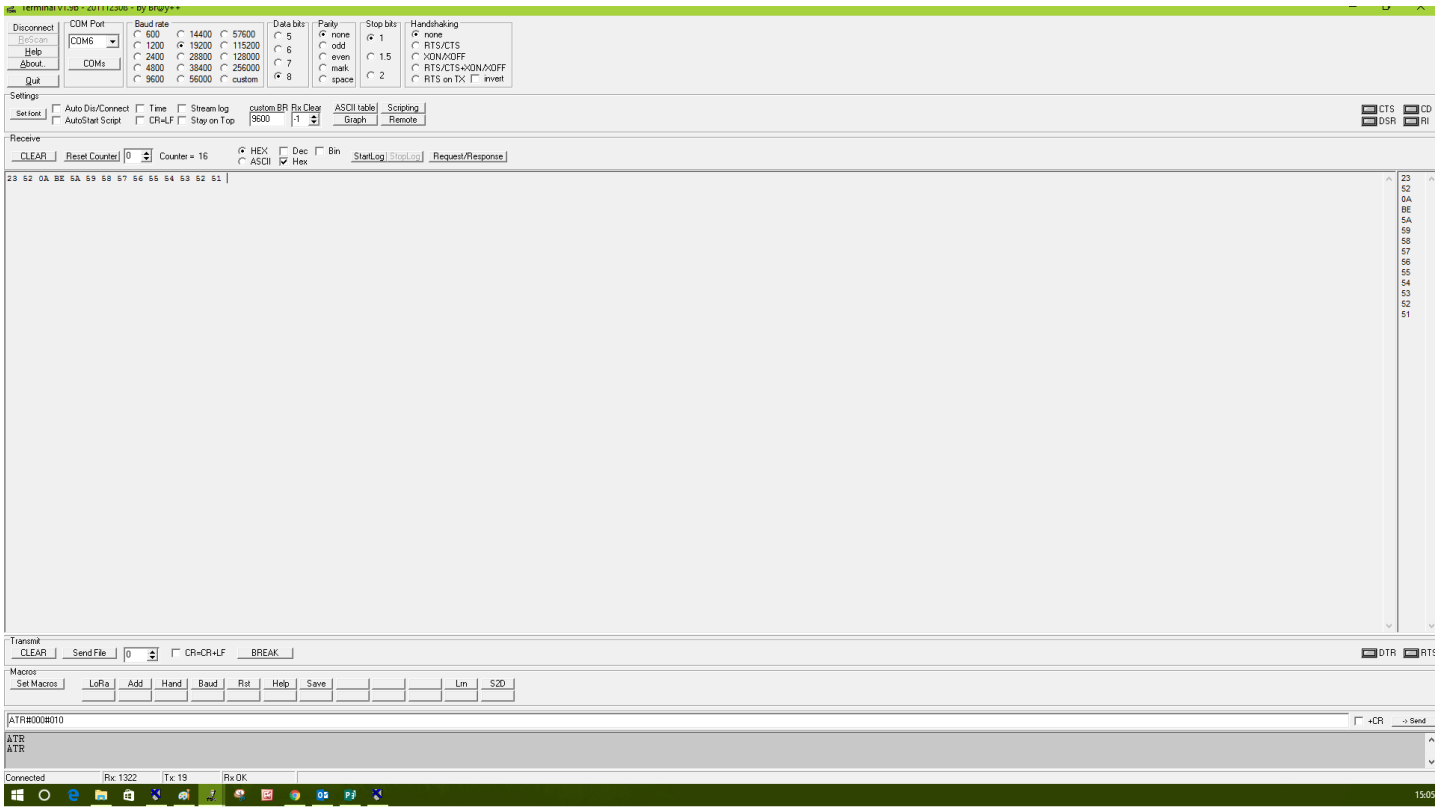
To configure the ZETAPLUS20 into receiver mode for the ping-pong walk test, the following string needs to be input on the TX pin.

ATR#000#010

Channel number (byte value)

10 byte payload (this is the only byte value that will force the ZETAPLUS20 into ping-pong)

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

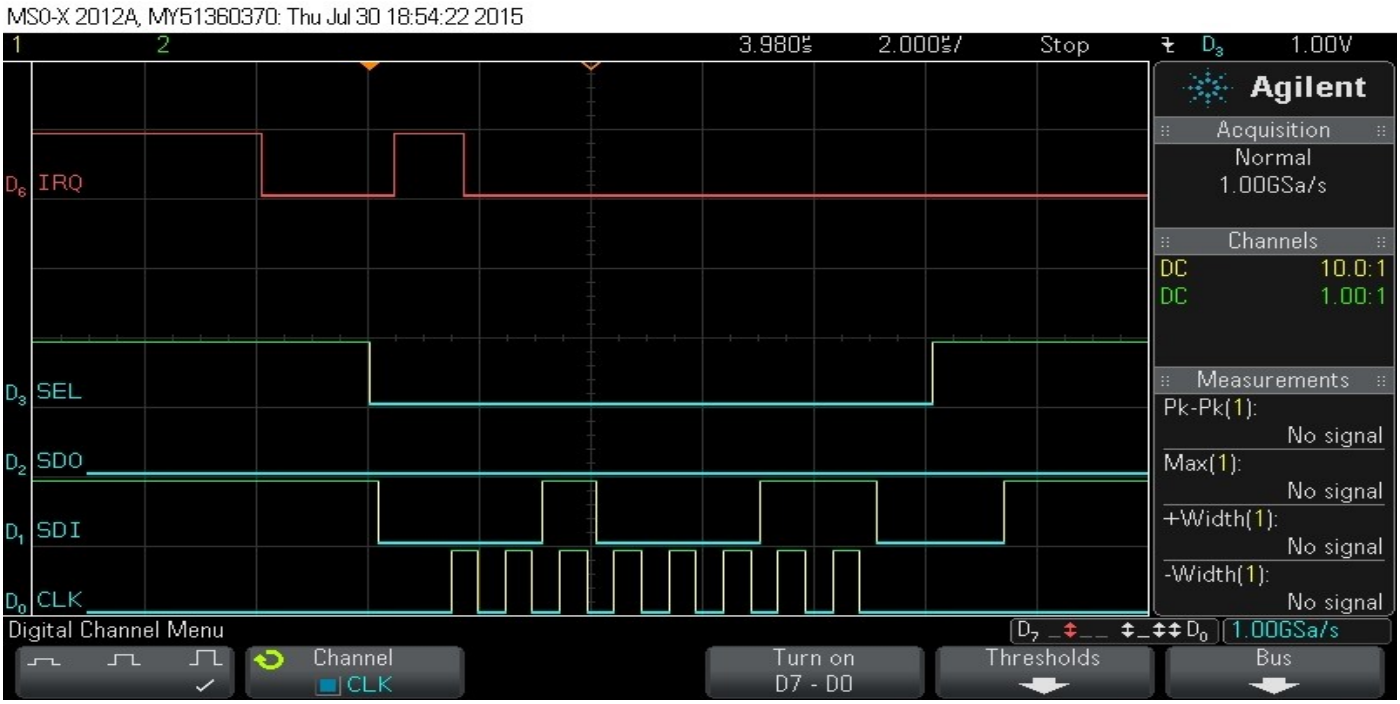


Communication with the ZETAPLUS20 via SPI interface.

Maximum SPI data rate: 1.4Mhz
Data is sent over the SPI bus on the ZETAPLUS20 codec in standard SPI format using the correct command set. A 50ms timeout exists to avoid lock-up if not all requested data bytes are sent - in this scenario the packet would be aborted and no data sent.
When in receive mode and an RF packet is received the U_IRQ pin will go low indicating SPI data is ready to be read.
The following two pages show example timing diagrams for the SPI bus communication.

Selecting preferred communication method.

Only one communication method can be used at a time. Switching from SPI to UART and vice versa is possible however please note that ZETAPLUS20 will respond using the comms that it was last addressed in.
For example if you enable receive mode via SPI ZETAPLUS20 will revert to SPI communication from there on unless you access the device via UART ZETAPLUS20 will then revert to UART communication from then on.

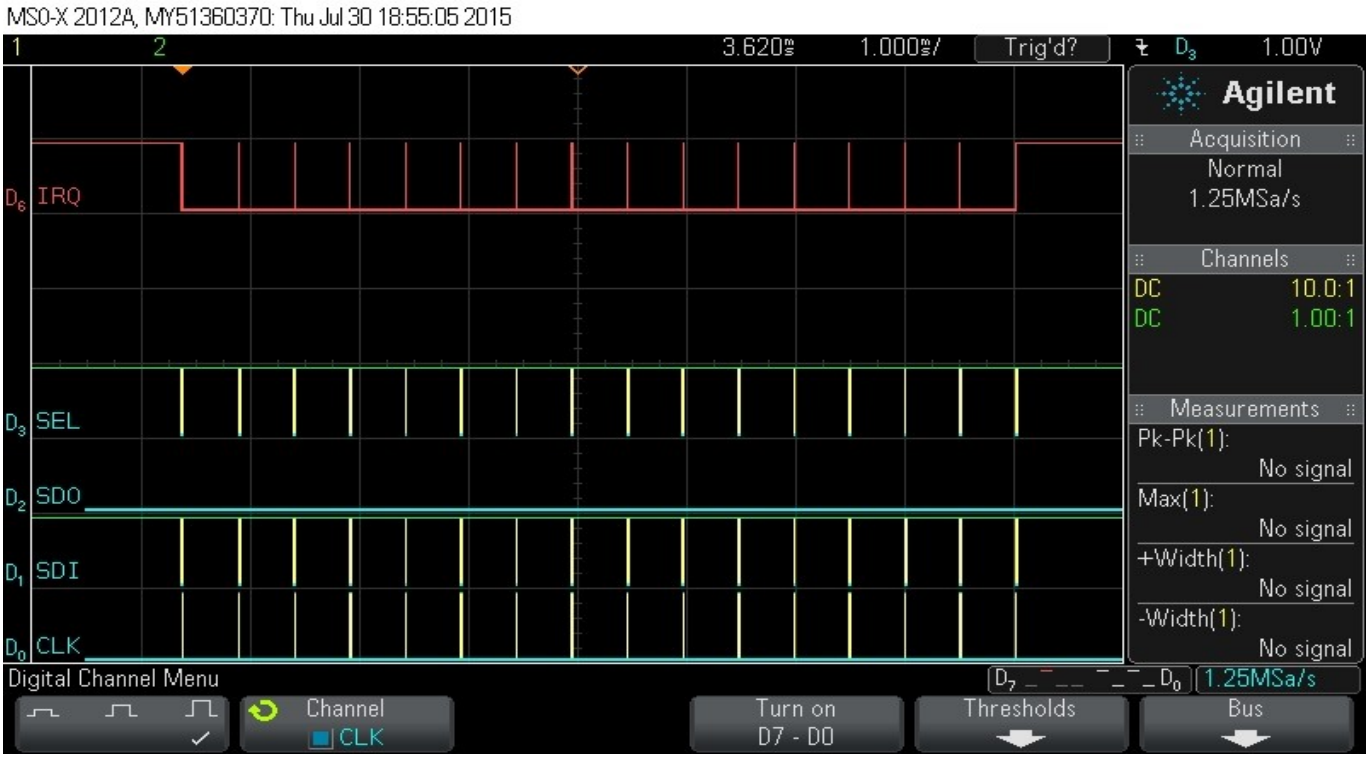


Note: SDI and SDO from the Master device not the ZETAPLUS

Above is the first byte of SPI data following U_IRQ going low after an RF packet has been received.

Sequence:-
1. IRQ goes low indicating a packet has been received.
2. Read byte over SPI bus.
3. If IRQ remains low then more data is still available to read. Repeat line 2 above.

The first two bytes read should be #R followed by the packet length & RSSI value then the packet data.

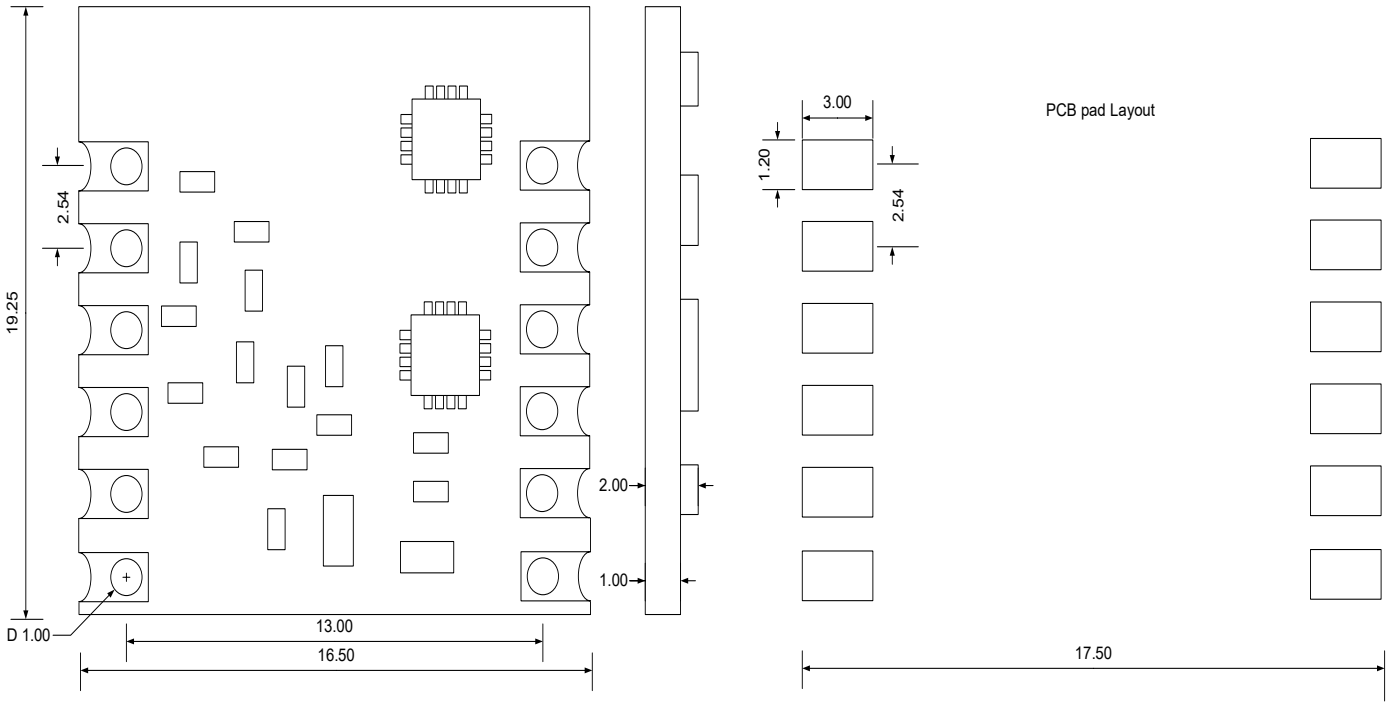


Note: SDI and SDO from the Master device not the ZETAPLUS.

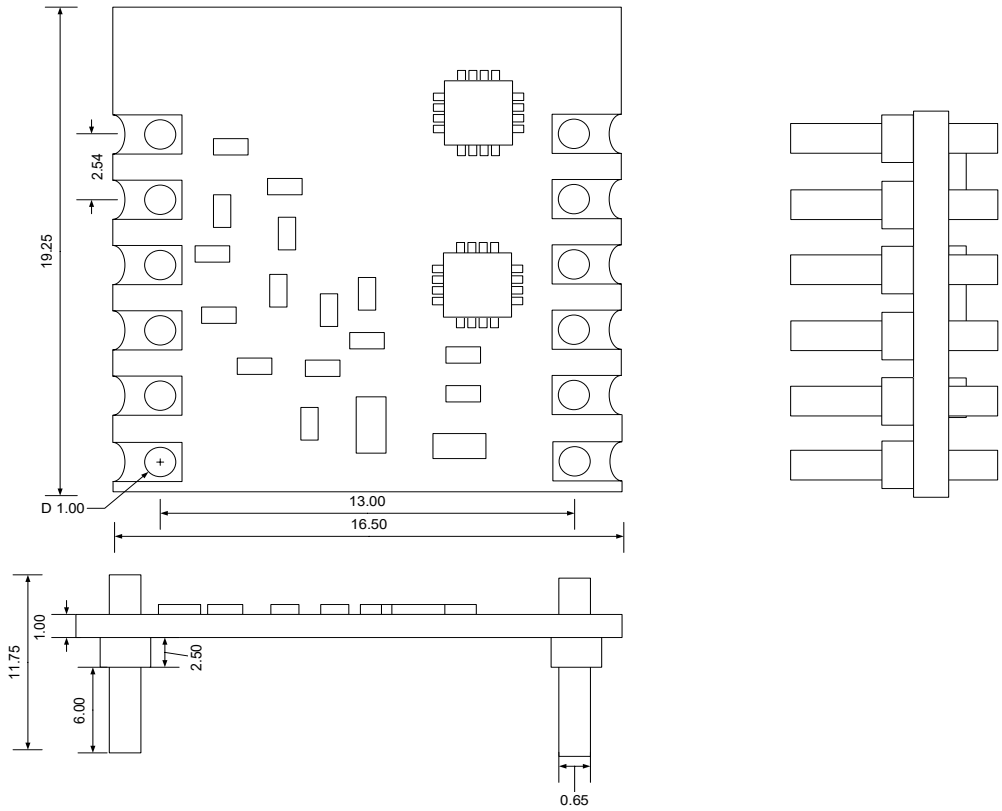
Above is the complete SPI & IRQ Timing diagram for #R<RSSI> <Packet > plus 12 byte data packet.

Mechanical dimensions

Surface Mount Package



P-DIP Package



Electrical Characteristics

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		3.8	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_{cc}		1.8	3.3	3.8	V
Power saving modes	I_{ready}	Ready to receive instruction from host	—	6	—	mA
	I_{Sleep}	Module asleep with shutdown pin active.	—		<1	uA
RX mode current	I_{RX}	Module is in RF Data receive mode	—	16	—	mA
TX mode current	I_{TX}	+20 dBm output power, 868 MHz	—	85	110	mA
		+13 dBm output power, 868 MHz	—	24	—	mA

Important European compliance information for module datasheets

This RF Solutions radio module meets the essential requirements of the European Radio Equipment Directive 2014/53/EU and has been tested to European Harmonised Standards and CE marked where space allows. A copy of the EU Declaration of Conformity can be located on the RF Solutions Website, www.rfsolutions.co.uk/certification-i59.

When using the module in an end product, continued compliance can only be assured by incorporating the module in accordance with RF Solutions specific installation instructions and in accordance with the published information on the RF Solutions product data sheet. The antenna gain specification must be adhered to at all times.

Article 3.1a and 3.1b of the EU Radio Equipment Directive 2014/53/EU should be assessed in the final product.

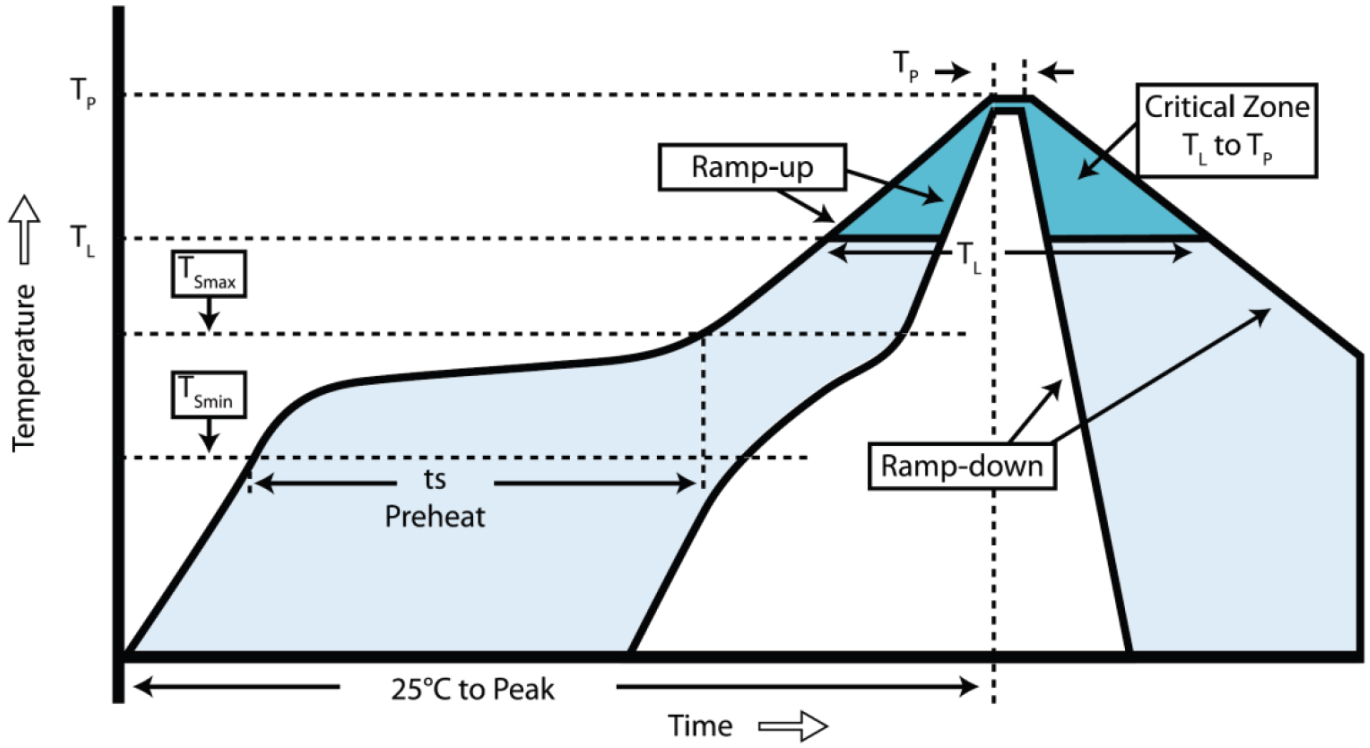
Failure to follow this guidance may result in a non-compliant product being place on the European Market, for which RF Solutions cannot accept any responsibility.

Further guidance may be obtained from RF Solutions Technical Support. Charges may apply to customer specific product evaluation.

AC Characteristics

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
TX frequency range	F_{TX}			433.92 869.5 915.0	+250 Khz (x16)	MHz
(G)FSK data rate	DR_{FSK}		0.1	—	500	kbps
TX Output power range	P_{TX}		–20	—	+20	dBm
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 & filter with max O/P power. Harmonics reduce	—	–42	—	dBm
	$P3_{HARM}$		—	–42	—	dBm
RX sensitivity	P_{RX-_2}	(BER < 0.1%) (100bps, GFSK, BT = 0.5, DF=±100Hz)	—	–132	—	dBm
	P_{RX-_40}	(BER < 0.1%) (40 kbps, GFSK, BT = 0.5, DF = ±25 kHz)	—	–109	—	dBm
	P_{RX-_128}	(BER < 0.1%) (100 kbps, GFSK, BT = 0.5, DF = ±50 kHz,)	—	–104	—	dBm
RX channel bandwidth	BW			60		kHz
BER variation vs power Level2	P_{RX_RES}	Up to +5 dBm Input Level	—	0	0.1	ppm
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	—	–79	—	dB
Blocking 1 MHz offset	$1M_{BLOCK}$		—	–68	—	dB
Blocking 8 MHz offset	$8M_{BLOCK}$		—	–86	—	dB
Image rejection	Im_{REJ}	Rejection at the image frequency IF = 868 kHz	—	–45	—	dB

ZETAPLUS20 module re-flow guide

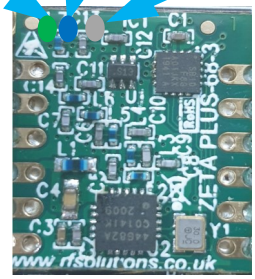


Profile feature	Value (lead free)
Ramp up rate	3°C /s
Pre-heat temperature - Temperature Min (T_{Smin}) - Temperature Max (T_{smax}) - Pre-heat time	 150°C 200°C 60-100s
Peak temperature (T_P)	240°C
Time at T_P	10-20sec
Ramp down rate	6°C/s
Time from 25°C to peak	8 mins max.

ZETAPLUS20 module Version Identification

Frequency of Operation
Red 433MHZ
Blue 868MHz
Brown 915MHz

Test
Green Pass



Firmware Version

Firmware versions 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

ZETAPLUS REVISION CHANGE HISTORY		
Part	New Revision	Change / Fix
ZETAPLUS20-8 ZETAPLUS20-9	1	Initial Version

Simplified Declaration of Conformity (RED)

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