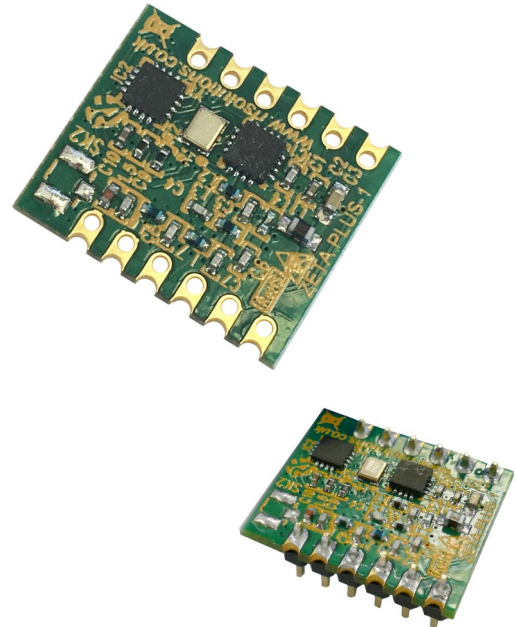


Miniature Smart RF Transceiv-

Features

- Intelligent Wire replacement SMARTRADIO
- form factor: 16mm x 18mm
- 2Km range
- Transmit Power +13dBm
- High sensitivity -116dBm (@ 2.4kbps)
- Max data rate @ 500Kbps
- Simple 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)
- Integrated battery voltage sensor
- Based on Silicon Labs' Si4455 chipset
- No configuration necessary
- No external components
- Fast and effective Plug and Play RF Comms



Applications

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

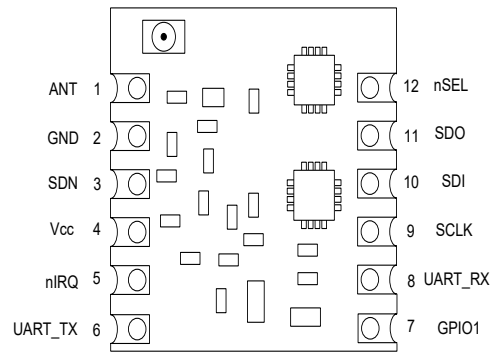
Applications

ZETAPLUS 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 ZETAPLUS outperforms other modules achieving range far in excess of its competitors for the given power output/power consumption.

Pin Description

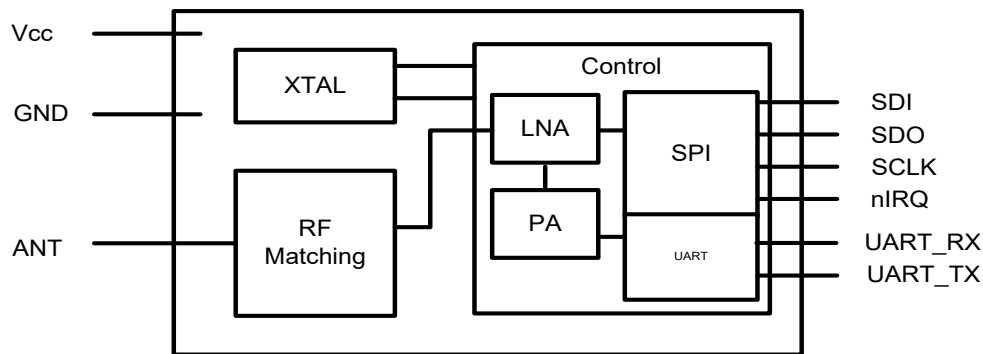


| PIN | Name | Definition | Data Flow | Function |
|-----|---------|-------------------------|-----------|---|
| 1 | ANT | Antenna Pin | In/Out | Antenna pin connection. Keep track to antenna short and impedance match to 50ohms for best performance |
| 2 | GND | Ground | In | Supply Ground connection |
| 3 | SDN | Shutdown | In | When asserted (active High) ZETAPLUS enters Shutdown. Shutdown state is the lowest current consumption of the device. Settings will be retained when SDN is asserted. When shutdown is activated no comms are possible as the device is in deep sleep mode. The time between taking the shutdown pin low and a command being excepted varies depending on supply, crystal etc and can range from 10-25ms. ZETAPLUS is ready for commands when the nIRQ pin goes high. There can be up to 2ms after the shutdown pin has gone low where the nIRQ pin is in an unknown state so always give 2ms after lowering the shutdown pin |
| 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 | RS232 Receive Pin |
| 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 is SPI not used pull high or leave disconnected |

Ordering information

| Part Number | Description |
|-----------------|--|
| ZETAPLUS-433-SO | FM transceiver module, 433MHz (marked Red Dot) SMT |
| ZETAPLUS-433-D | FM transceiver module, 433MHz (marked Red Dot) DIP |
| ZETAPLUS-868-SO | FM transceiver module, 868MHz (marked Blue Dot) SMT |
| ZETAPLUS-868-D | FM transceiver module, 868MHz (marked Blue Dot) DIP |
| ZETAPLUS-915-SO | FM transceiver module 915MHz (marked Yellow Dot) SMT |
| ZETAPLUS-915-D | FM transceiver module 915MHz (marked Yellow Dot) DIP |

Block Diagram



Using ZETAPLUS

Using ZETAPLUS is easy, communication can be via SPI interface or UART (LVTTTL).

The module will automatically communicate to its host in the same way that it was addressed, i.e. if ZETAPLUS 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 replay on the UART interface.

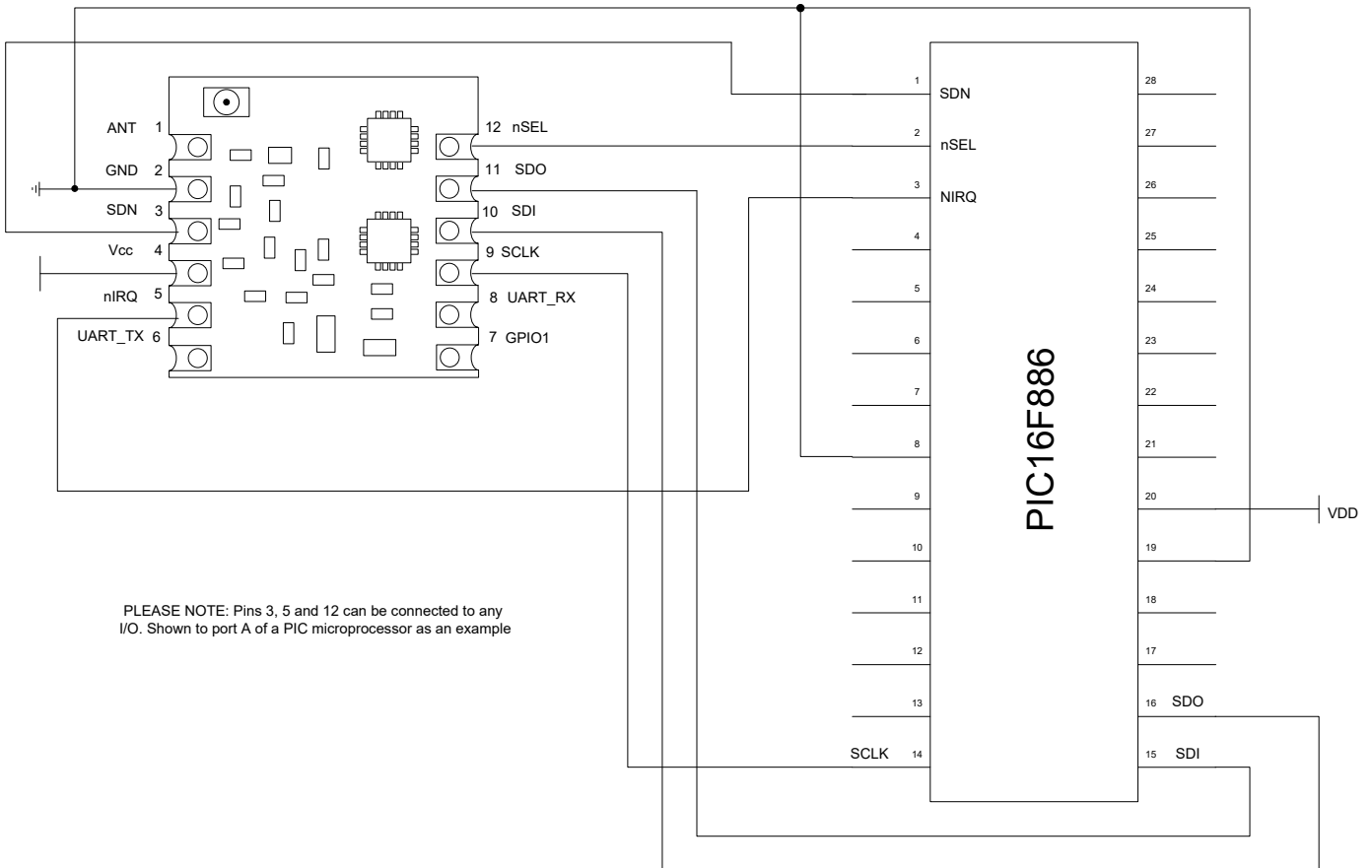
Using SPI, to Transmit data simply load the correct decimal byte values into the SPI TX register.

When ZETAPLUS receives RF data from another ZETAPLUS 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

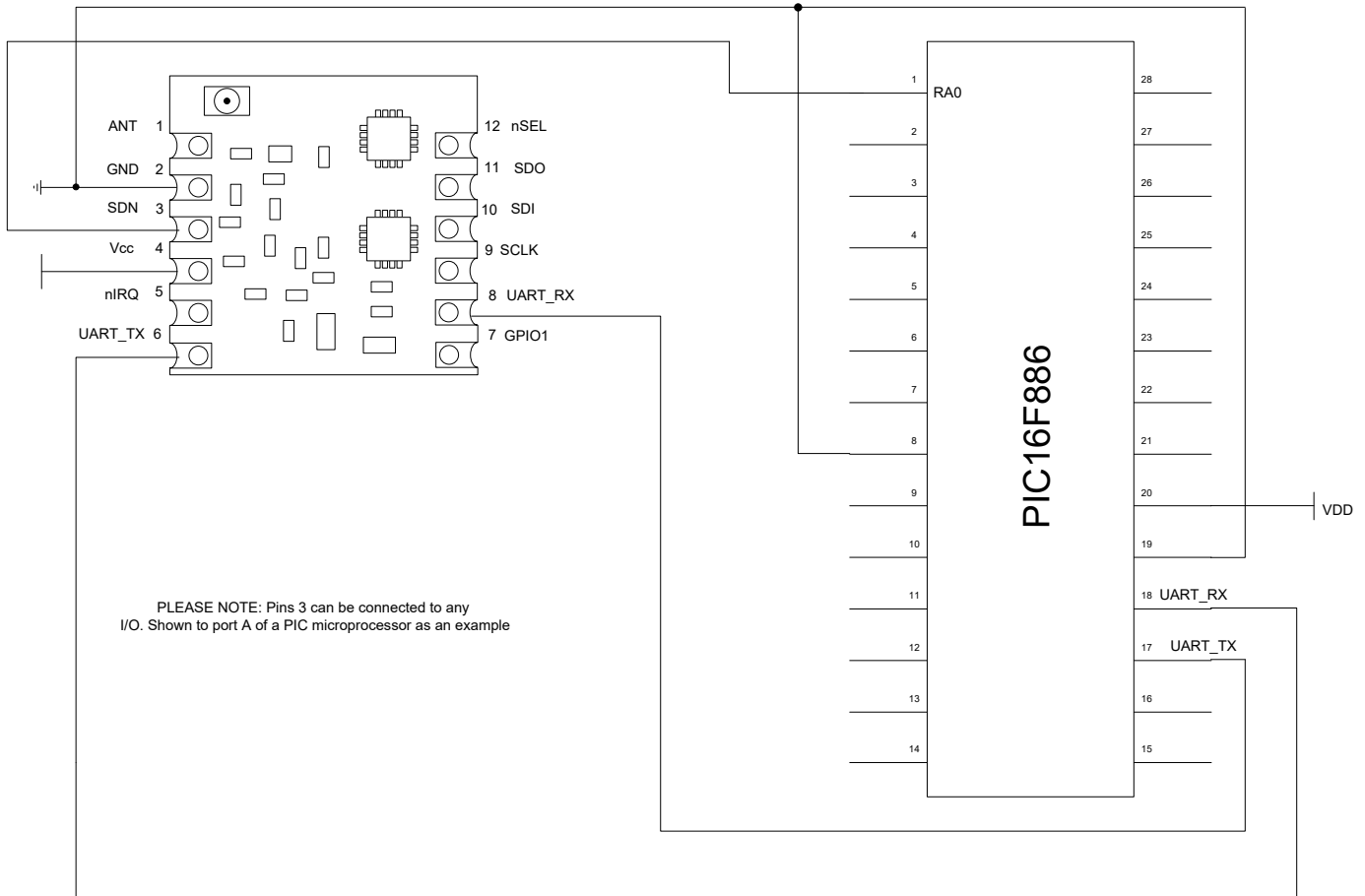
Using UART (LVTTTL) to Transmit load the correct decimal byte values into the UART TX register,

When ZETAPLUS receives RF data from another ZETAPLUS module it will output the data via the UART-TX output pin of the module to the host. (This operates as a standard UART)

Application schematic- ZETAPLUS and PIC16F886 (SPI mode)



Application schematic- ZETAPLUS 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.

UART in

Data is sent to the RX pin on the ZETAPLUS n standard UART 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.

UART out

Data is output from the TX pin on the ZETAPLUS.

When in receive mode and an RF packet is received the data packet is automatically send over the UART and output as #RnQ 'data' where n is the number of bytes.

SPI and UART Commands

Operating Mode (ATM)

Note: after SDN is pulled low this setting will need to be resent as module defaults to ready state.

| Value | Name | Description |
|--------------------|--------------|---|
| 1 | RX | ZETAPLUS enters RX mode using last RX configured settings |
| 2 (default) | 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 ZETAPLUS into receive mode

Note: alternative possible example of mode select for some terminal programs: ATM#001.

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

Receive Mode Config (ATR) Channel Setting, Packet Length

Note: after SDN is pulled low this setting will need to be resent as module defaults to ready state.

| 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.

When a valid packet is received in UART mode the data is immediately sent via the U_LVTTL TX pin.

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 it 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 |

Note: You can send a packet from any mode and after a packet has been transmitted the module will revert back to the mode it was previously in.

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. Set all to AA if not required. (the module will act as a simple pass thro and will require the user to determine their own SYNC) NOTE: Reverse order bytes: ie 2D = D4, D4 =2B |

Default :SYNC BYTE 1 : 0XB4 SYNC BYTE: 2 0X1B SYNC BYTE 3: 0X00 SYNC BYTE 4: 0X00.

Example: Set the sync bytes to 12 34 56

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

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

Enable Response (ATC)

| Value | Name | Description |
|-------|-------------|---|
| 0 - 1 | Response on | Enables Response +=good -=error 0 =Disable Response (Power on Default Value) 1 =Enable Response |

Example: Enable RESPONSE

Command A T C 1
Decimal byte value 65 84 67 1

Note: When enabled you will receive a response of either + or - after each command has completed. +=Completed successfully and ready for the next command. -=The last command didn't complete due to a syntax error but the module is ready for the next command.

RSSI (ATQ)

| Value | Name | Description |
|-------|--------------------|---|
| 0—255 | RF Signal Strength | ZETAPLUS 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 Current Configuration and Settings (AT?)

| Value | Name | Description |
|-------|----------------------------|--|
| N/A | Configuration and settings | <p>ZETAPLUS Reports its current device settings</p> <p>Example reply:</p> <pre>#? 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)</pre> <p>EXAMPLE 35 63 1 1 127 45 210 0 0 0</p> |

Example: Retrieve settings

| | | | |
|---------------------------|----|----|----|
| Command | A | T | ? |
| Decimal byte value | 65 | 84 | 63 |

Firmware Version

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

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 ZETAPLUS Power On Status |

Example:

| | | | |
|---------------------------|----|----|----|
| Command | A | T | D |
| Decimal byte value | 65 | 84 | 68 |

Ping-Pong (Walk test)

Using two ZETAPLUS 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 ZETAPLUS transmits a special 'Ping' signal, which is received by another ZETAPLUS 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 ZETAPLUS 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 ZETAPLUS to transmit a ping signal.

The transmitter will output every 200ms the RSSI value of of a valid packet through its UART RX pin.

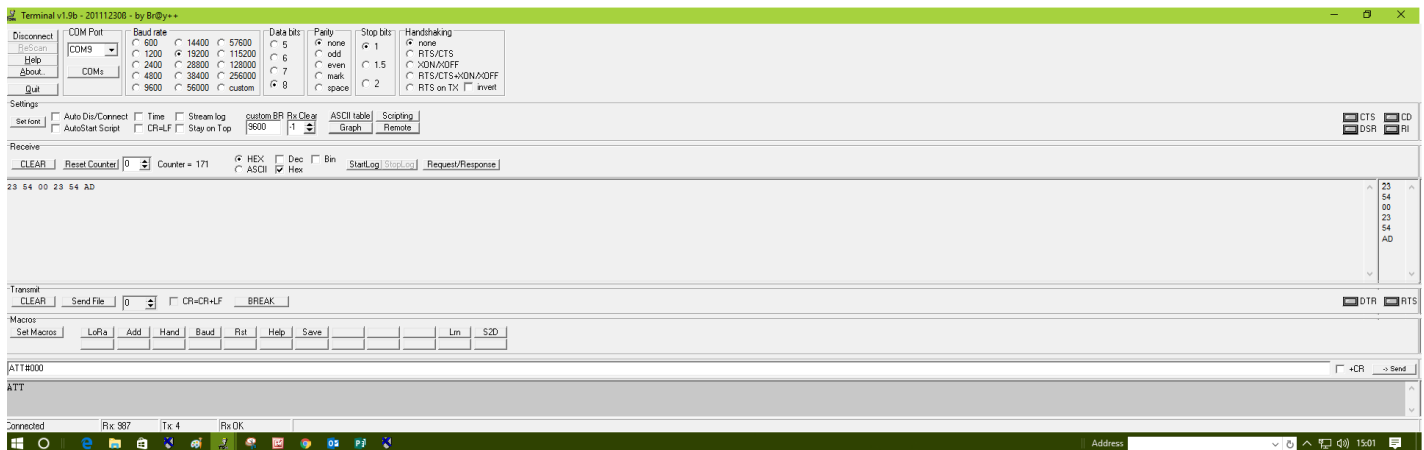
ATT#000



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 ZETAPLUS 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 ZETAPLUS into ping-pong)

The image below shows a terminal window with a successful packet received, here you can see the HEX values for #RZYXWVUTSRQ.

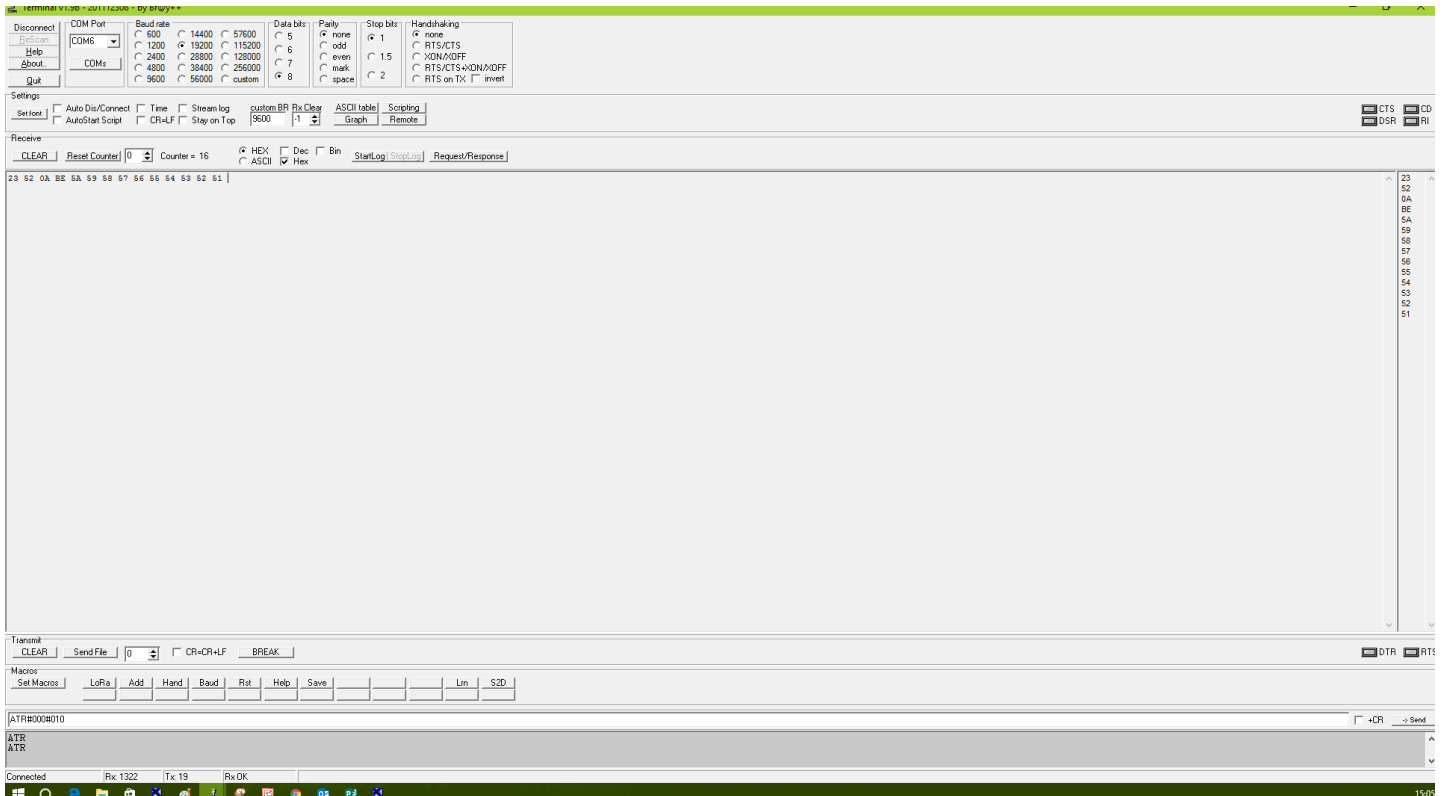
#R is the packet header which indicates the start of a new packet

Followed by the bytes received as a byte value

Followed by the received signal strength as a byte value.

Followed by the data sent from the transmitter.

For example on the TX side if ATS<0><10>ABCDEFGHIJ was issued you would receive



Communication with the ZETAPLUS via SPI interface.

Maximum SPI data rate: 1.4Mhz

Data is sent over the SPI bus on the ZETAPLUS 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 ZETAPLUS will respond using the comms that it was last addressed in.

For example if you enable receive mode via SPI ZETAPLUS will revert to SPI communication from there on unless you access the device via UART ZETAPLUS will then revert to UART communication from then on.

MSO-X 2012A, MY51360370: Thu Jul 30 18:54:22 2015



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.

ZETAPLUS Smart RF Transceiver



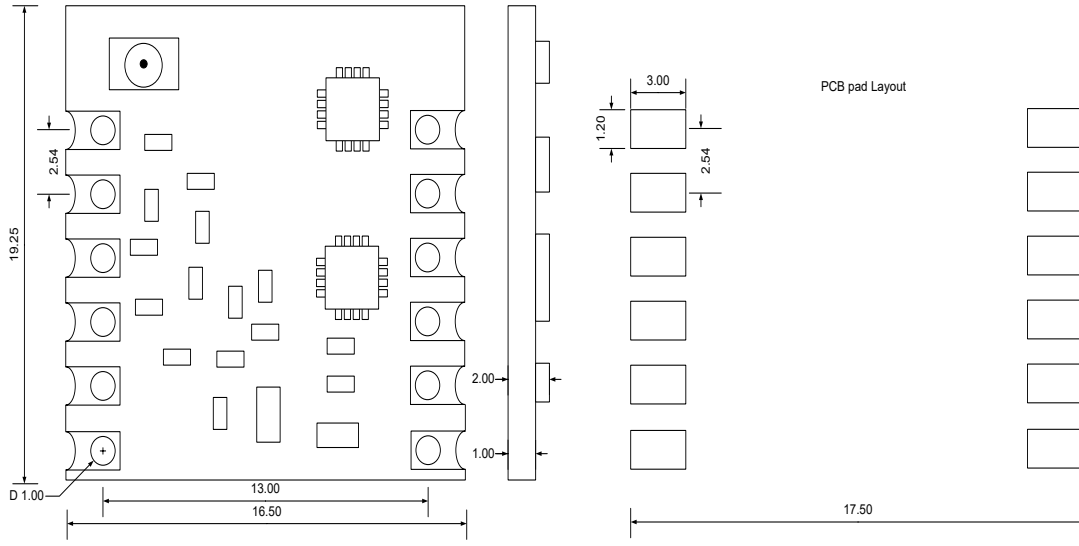
MSO-X 2012A, MY51360370: Thu Jul 30 18:55:05 2015



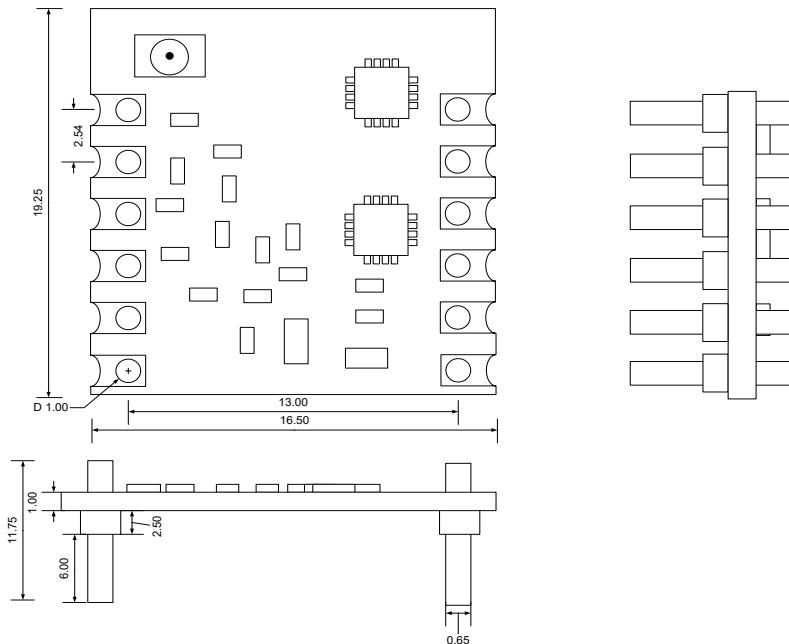
Above is the complete SPI & IRQ Timing diagram for #R<RSSI> <Packet > plus 12 byte data packet

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 | | 3.6 | V |
| I/O Drive Voltage | V_{GPIO} | | 1.8 | | 3.6 | V |

| Parameter | Symbol | Test condition | Min | Typ. | Max | Unit |
|----------------------|-------------|---|-----|------|-----|------|
| Supply voltage range | V_{CC} | | 1.8 | 3.3 | 3.6 | 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} | +10 dBm output power, 868 MHz | — | 19 | — | 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 placed 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.

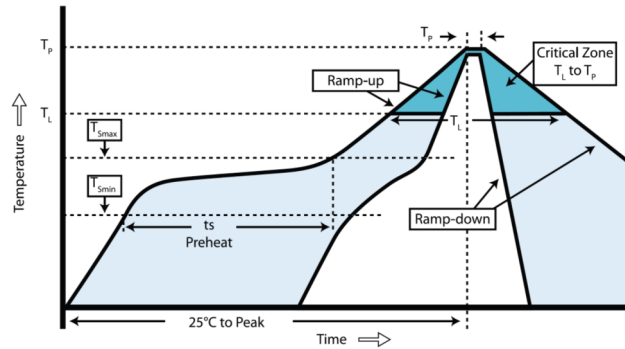
ZETAPLUS Smart RF Transceiver



AC Characteristics

| Parameter | Symbol | Test condition | Min | Typ | Max | Unit |
|--|-----------------|---|-----|--------------------------|----------------------|------|
| TX frequency range | F_{TX} | | | 433.92 869.5 915.0 | +25 0KHz (x16) | MHz |
| (G)FSK data rate | DR_{FSK} | | 4.8 | — | 500 | kbps |
| TX Output power range | P_{TX} | | -40 | — | +13 | 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 linearly with | — | -42 | — | dBm |
| | $P3_{HARM}$ | | — | -42 | — | dBm |
| 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 | | | 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 | — | -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 |

ZETAPLUS module re-flow guide



| Profile feature | Value (lead free) |
|---|-------------------|
| Ramp up rate | 3°C /s |
| Pre-heat temperature | |
| - Temperature Min (T _{smmin}) | 150°C |
| - Temperature Max (T _{smmax}) | 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. |

ZETAPLUS Smart RF Transceiver



ZETAPLUS 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 |
|---|----------------------------------|---|
| ZETAPLUS-433 ZETAPLUS-868 | 2 2 | Shut down pin fixed |
| ZETAPLUS-433 ZETAPLUS-868 ZETAPLUS-915 | 3 3 3 | Module would default to max power mode on power-up, regardless of user settings . After module was shutdown, when re-initialised the module would sometimes start in the wrong frequency . In addition the following new Commands have been added. ATD, (Reset to Defaults) ATE, (CRC Error Checking) ATH (host interface Baud Rate) |
| ZETAPLUS-433 ZETAPLUS-868 ZETAPLUS-915 | 4 4 4 | On wakeup the SPI configuration was left as 3 wire config so CS input not activated, this has been updated to 4 wire Config In addition the following new Commands have been added. ATC, (Enable Response) |
| ZETAPLUS-433 ZETAPLUS-868 ZETAPLUS-915 | 5 5 5 | To accommodate SiLabs Si4455 Silicon Revision Change from B to C |
| ZETAPLUS-433 ZETAPLUS-868 ZETAPLUS-915 | 6 6 6 | Improvement to initial power on cycle preventing the Shutdown pin from being misread |