ZULU Modem Evaluation Board Schematic
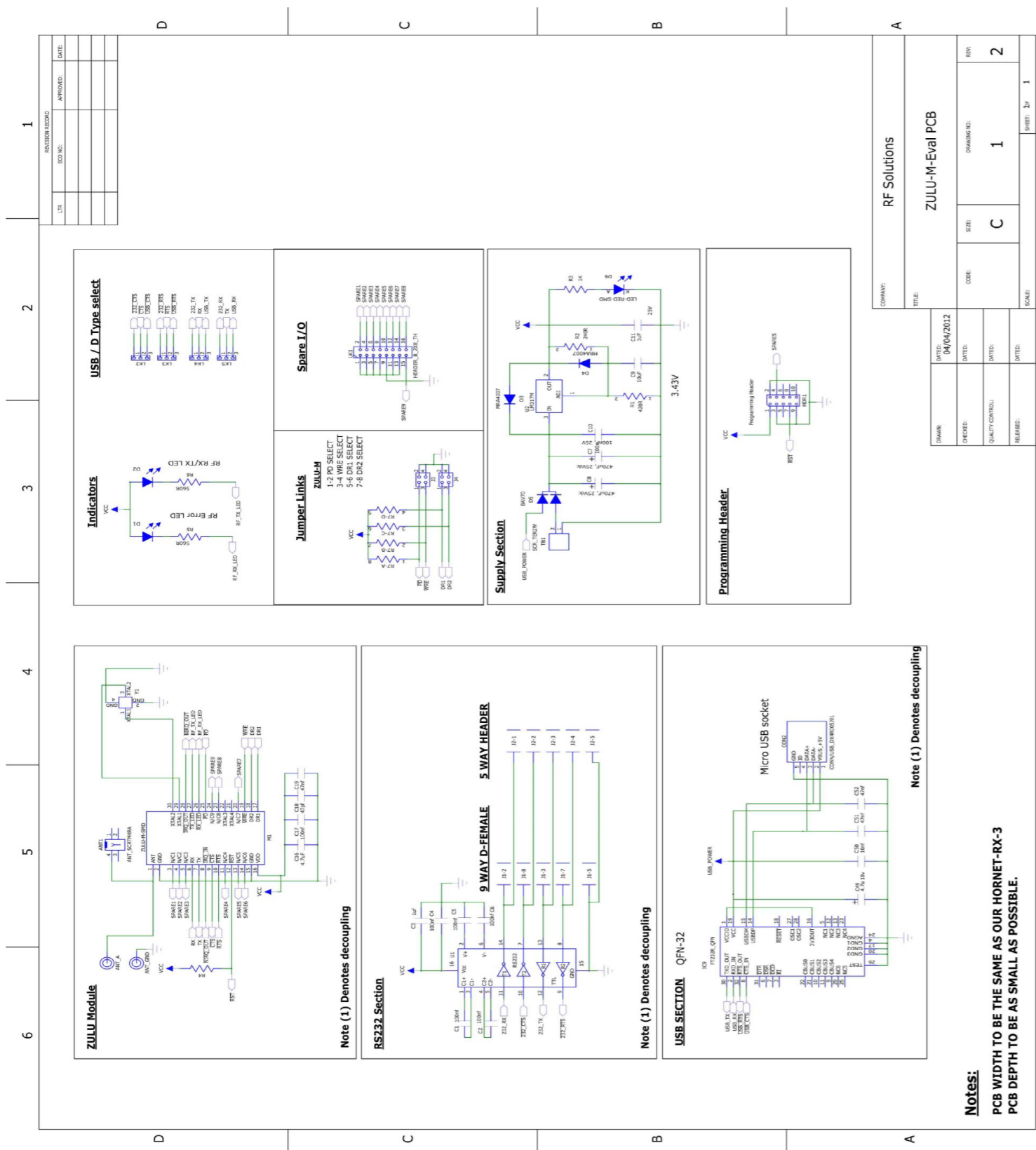
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ZULU MODEM EVALUATION BOARD

Features

- Serial Data Interface with Handshake
- Host Data Rates up to 38,400 Baud
- RF Data Rates to 115Kbps
- Range up to 2Km
- Secure Data Protocol
- CE Compliant for License Free Use
- 868MHz Multi-Channel Operation
- 100mW Transmit Power (+20dBm)
- Receiver Sensitivity –121dBm
- Direct Connection to RS232/USB
- 9-12Vdc Power in Screw Terminal
- LED Indication Transmit/Receiver
- User Configuration Links
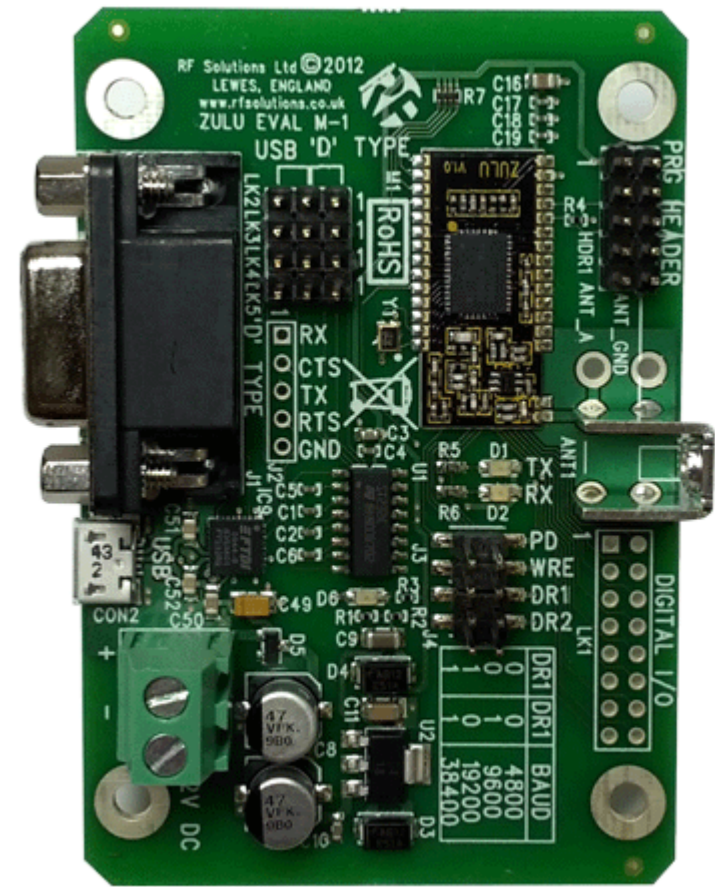
The ZULU EVAL Broad provides a ready made platform which can be used to demonstrate the capabilities of ZULU modem modules providing ready made RS232 and USB modem solutions.

The ZULU modem module is a highly integrated RF Modem and intelligent controller with simple interface. The ZULU modem can achieve a wireless serial data link up to 38Kbps over a 2Km range. Range may be further extended with suitable antenna.

The user interface is standard RS232, operating at low voltage. All RF operation is automatically controlled (with error checking etc) so the ZULU can be treated as a simple communications device. Possible applications include one-to-one and multi-node wireless links in applications including car and building security, EPOS and inventory tracking.

Ordering Information

Part Number	Description
ZULUEVAL-M	ZULU Modem Eval Board 868MHz
PSU-12V100MAUK	Plugtop Power Supply 12V 100mA

Please contact RF Solutions if any components are missing

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Operational Overview

The ZULU modem module provides a simple interface to the host controller. It handles all RF data communications automatically and without any requirement from the user (RF packetizing, preamble, encoding, CRC check etc).

With this powerful high-speed radio link, the following networks can be realised:

Networking

One-to-One: For point to point data communication

One-to-Many/Broadcast: A network consisting a master and many slaves (all receivers have the same address).

Many-to-One: Where all transmitters with different addresses send to a single receiver address.

NOTE: Because each ZULU modem module can be given a unique address, multiple ZULU networks can co-exist in the same area. This type of operation requires clear timing between transmissions or corruption of packets can occur.

Addressing Networks: Each ZULU modem module has a generic pre-configured default address (7F7F7F). This can be modified during configuration.

When sending data, the ZULU modem module has a default destination address set to 7F7F7F, this can be user configured.

By setting the two addresses appropriately the above network types can be easily achieved.

Note on compatibility with earlier ZULU modules

ZULU hardware compatible with all previous versions, however it cannot communicate with ZULU R1.1 firmware or earlier. The ZULU-2 is also 100% backward compatible with ZULU R1.4 and later when Unit ID (R7) is set to the correct value.

Check the configuration set-up for the new features and any changes to defaults.

Operating Modes

Configuration Mode: In configuration mode the ZULU modem module can receive commands to set internal registers to define its eventual operation. In this mode the ZULU modem module is 'Offline' and cannot send or receive RF data.

Normal Operation: The ZULU modem module is 'Online' automatically transmitting and receiving data from its serial interface across its RF network.

Acknowledge Secure Mode: In this mode each time a ZULU modem module transmits an RF packet, an additional 'packet ID' is added. This ID is a rolling verification counter to receiving ZULU modem modules.

Any correctly addressed receiving ZULU modem module replies with an RF acknowledgment also containing the 'packet ID'. If the transmitting ZULU fails to receive the expected acknowledgement it will transmit the packet again (up to 10 times).

Handshaking

The ZULU modem module required the handshaking (RTS/CTS) to communicate with its host interface.

NOTE: If you do not intent to use handshaking, it is possible to tie the CTS pin to GND and use the modules without. In this configuration the ZULU modem module will send all data in its buffer around a 10ms timeout. Up to 57bytes can be buffered before data is lost. A minimum of 15ms should be allowed before the new data is sent to the module after each packet. This is not a recommended method of operation.

EVAL Board Configuration

Power Requirements: 9-15Vdc

Weight: 27grams

USB / D Links (LK2,3,4,5)

For USB connect all Links from Centre to 'USB' Side.

For RS232 connect all Links from Centre to 'RS232' Side.

Link Ref	Name	When Fitted		Description
PD	Power Down	Modem is Placed in Sleep Mode		Normal Operation
DR1 DR2	Sets Host Baud	**DR1**	**DR2**	Baud Rate:
		Open	Open	4500
		Open	Fitted	9600
		Fitted	Open	19200
		Fitted	Fitted	38400

Antenna Connector:

The connector is a 4mm Screw Terminal (Part No: SCRTM4RA)

Power Connection:

Power is required for RS232 comms. USB connection provides power automatically—note that USB port cannot supply adequate power for full +20dBm transmissions! Additional power is needed for maximum range!

Host Terminal Software

Connection to Host is via the micro-USB Cable or RS232 Cable.

Any Terminal emulation program can interface the Eval Board, one we have found to be easy to use and powerful is 'Terminal'.

This can be downloaded from: https://sites.google.com/site/teminalbpp/

Notes for Optimising Range

1. Use max RF Transmit power (set Register R4 = 7)

2. Use the slowest RF comms Rate (set Register R5 = 0)

3. Power the Eval boards from 12V (don't rely on the USB power)

4. Consider upgrading the antennas to models with gain.

5. Enable data whitening.
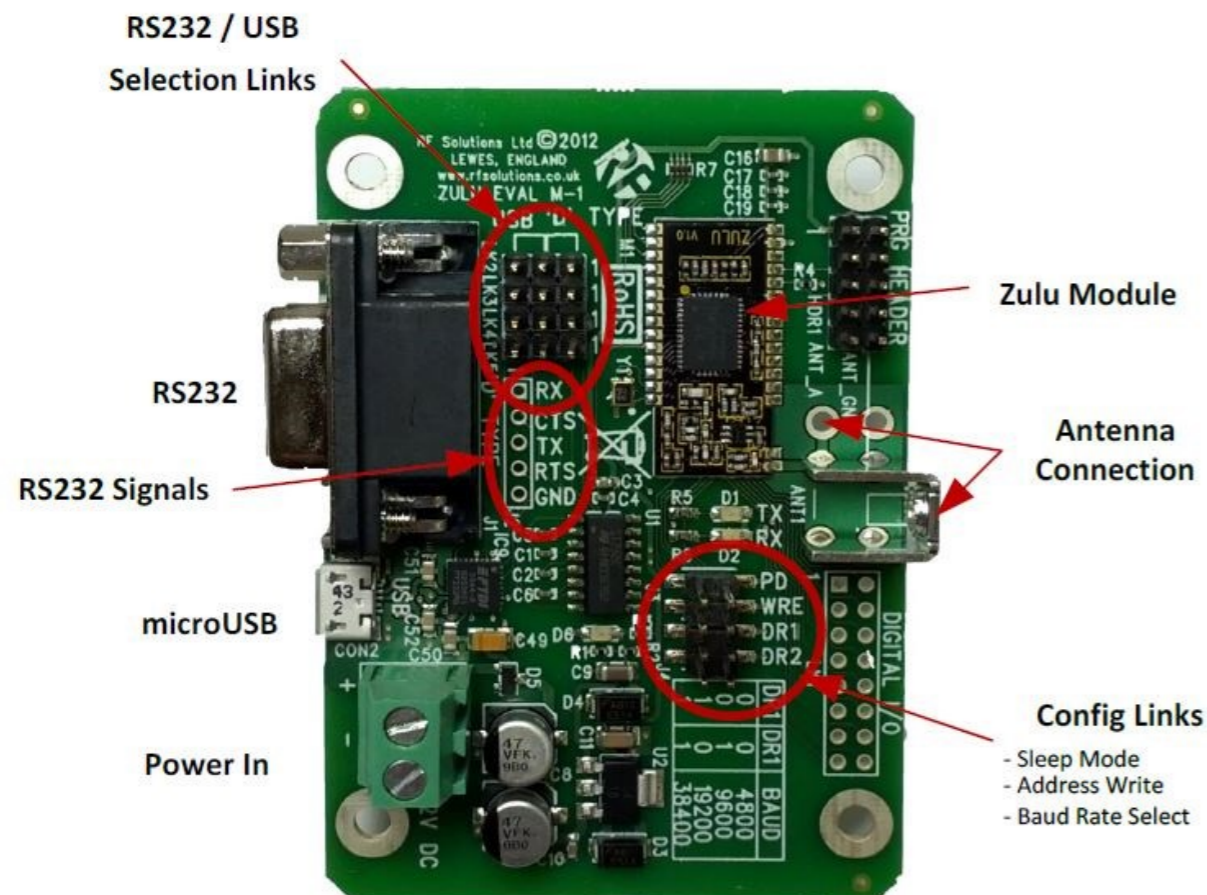
Technical Specifications

Absolute Maximums:

Temperature Range: Storage –50 to +125°C.

RF Characteristics

Parameter	Min	Typical	Max	Units
Operating frequency—see Frequency Channel Selection table	868		870	MHz
Operating temperature	-40		+85	°C
Band width per channel		100		KHz
Deviation		45		KHz
ZULU Tx MAX output power			+20	dBm
ZULU Tx-Rx FSK Raw RF data rate	9.6		115,200	Kbps
ZULU Rx sensitivity	-102 @ 115K		-109	dBm

Evaluation Board Features

RS232 / USB Selection Links

Zulu Module

RS232

RS232 Signals

microUSB

Power In

Antenna Connection

Config Links
- Sleep Mode
- Address Write
- Baud Rate Select

Configuration Mode (offline)

Commands can be set using a standard terminal program or by sending the relevant ASCII characters.

Each command must be followed by the Carriage Return <CR> or 'Enter' except '+++'

Command	Description	Response from ZULU
+++	Enter Configuration Mode **Note:** This command must be sent as a string with no characters in front or behind. This is to ensure that the +++ is not mistakenly received in mid-data (<CR> is not to be used with +++).	ZULU responds with status info.
?	Retrieve the current register values.	ZULU responds with all register values.
F	Pre-configured factory defaults: R1 = 7F7F7F R2 = 7F7F7F R3 = Ch2 (869.450MHz) R4 = 7 (+20dBm) R5 = 1 (19K2)	'OK'
H	Help	Brief description of commands available.
P	Ping Mode This sends a ping request. On receiving, the recipient ZULU Modem will respond with its address and the level of RSSI (Received Signal Strength). The Ping command is continuously repeated every 1 second until any command or character is entered.	The originating ZULU modem module will respond with the recipient ZULU modems' address. eg. Received from 7F7F7F (D5) Where 7F7F7F = the recipient address D5 = RSSI RSSI Is a hex value corresponding to the received signal strength Min = 20hex Max = E0hex
S	Save Configuration	'SAVED'
Q	Exit configuration mode and return to	No response

NOTE: All commands are entered in upper case.

Register Values (Configuration Mode)

Set a register:

To set a register, type 'R#=x' where # is the register number (1-6) and x is the value to set.

For example, to set the RF channel to 3 type : R3=3<CR>

(Where <CR> is carriage return or enter on the keyboard).

Register	Value Range	Description	Example
R1	0000 - FFFFFF (24 bit address) **Default: 7F7F7F**	Sets the recipient ZULU modem module address.	R1=000100 (Data sent to ZULU Modem module with address)
R2	0000 - FFFFFF (24 bit address) **Default: 7F7F7F**	Set ZULU modem module address	R2=F00100 (Data sent is from ZULU modem module with address F00100)
R3	CHO to CH4	Sets the RF channel selection	R3=2 (Transmit on channel 2)
R4	0 = +1dBm 1 = +2dBm 2 = +5dBm 3 = +8dBm 4 = +11dBm 5 = +14dBm 6 = +17dBm **7 = +20dBm**	Set the RF transmit power output	R4=7 (Sets transmit power to max)
R5	0 = 9,600 **1 = 19,200** 2 = 28,800 3 = 56,000 4 = 115,200	Set the RF baud rate*	R5=3 (Sets the RF data rate to 56Kbps)
R6	**0 = Off** 1 = On	(Acknowledge) Secure mode enable	R6=1 (Secure Mode on)
R7	0-FF (hex) **Default = D4**	Unique system identifier	R7=A3 Identifier set to A3
R8	0 = 4800 **1 = 9600** 2 = 14400 3 = 19200 4 = 28800 5 = 38400 6 = 56000 7 = 57600	Host baud rate—software override. FF—uses DR1 and DR1 pins.	R8=3 Baud rate set to 19K2
R9	0 or **1**	Data whitening enable	R9=1
R0	**00** or 01	OTA Enable Over the air configuration enable	R0=1 Enable

Using Configuration Mode

Baud rates:

It is possible to set both host and RF baud rate via configuration made. The RF Baud rate should always be twice the host baud rate for best operation.

Secure mode:

See *Operating Modes* section.

Unique system identifier

Adds a unique identifier at the RF stage. This allows unmatched data packets to be ignored without the need to decode—saving processor time and making a more efficient system when many nodes are present in one location. Systems with the same identifier will operate together. Use for multiple networks in one location. Do not use addresses: FF, AA or 55

RF Channel Selection

The EU standard sets maximum power transmission limits dependent on frequency, bandwidth and application. Please check the relevant standards are being met when implementing your Application. A rough guidance applicable to the ZULU channel numbers is given below:

Channel Number	Frequency Centre (MHz)	EU Power Allowance mW/dBm	Notes
0	868.400	25/14	Applicable standard—EN300-220
1	868.900	24/14	
2	**869.450**	**100/20**	
3	869.600	100/20	
4	869.800	25/14	

Range

The antenna choice and position affects and controls the system range. The best position by far, is protruding vertically from the top of the product. This is often not desirable for practical reasons and thus a compromise may be needed. Note that the space around the antenna is as important as the antenna itself. All radio systems are dependent on a radio signal being received through airspace.

The range quoted is the optimal in direct line of sight without obstacles and in good atmospheric conditions.

Range is affected by many things, for example local environmental conditions, atmospheric conditions, interference from other radio transmitters. For evaluating the local environment please see our RF meter (part number 006).

In the worse case, range quoted may be drastically reduced.