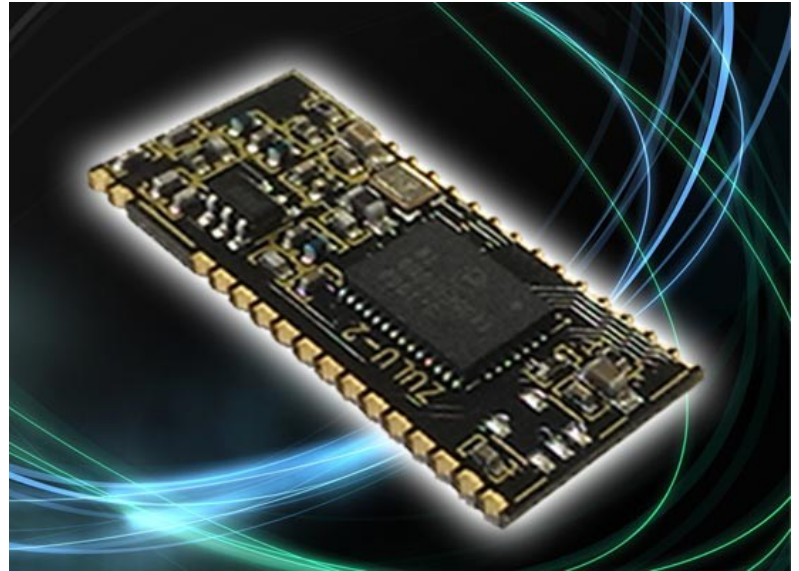


## Smart Radio Telemetry Module

### Features

- Small Form Factor
- 2 Analogue I/O (10bit)
- Data Reception LED
- Secure Data Protocol
- Easy Pairing Process
- On Board XTAL
- One to One operation
- M100mW Transmit Power
- 10 Digital Input / Outputs
- Range up to 2,000 Metres
- Minimal external components
- 868MHz Operating Frequency
- 10 Channel Transceiver Module
- 90-100KHz PWM
- CE Compliant, Licence Free Use
- Ultra Low Voltage 2.4–3.6V



### Applications

- Remote Control
- Remote Networking
- Remote Switching
- Remote Traffic Lights

### Description

The ZULU-2 Telemetry Module provides a reliable Transceiver based industrial Remote Switch with up to 2,000 metres range. Two modules are combined to provide a simple network of radio switching.

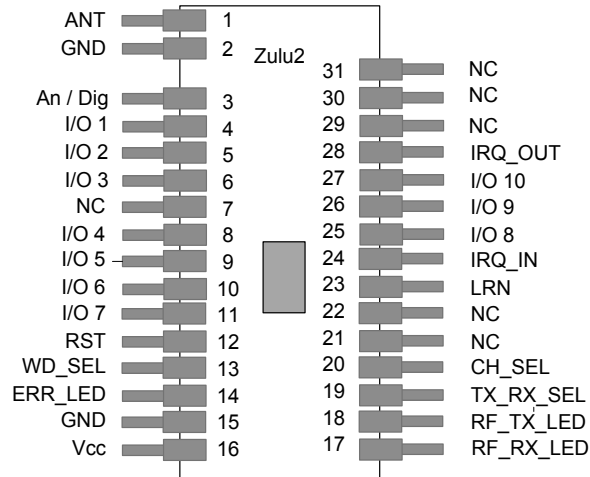
Each unit is supplied ready to operate, once paired with another Module a remote control system is created

Connections for Power, antenna and Input / Output are the only connections required

### Ordering Information

Part No	Description
ZULU-2-T868-S0	Radio Telemetry Module SMT Package

## Pin out



## Pin Description

Pin No	Name	Direction	Description
1	ANT	In	Antenna Input / Output 50ohm Impedance
2, 15	GND	In	Connect to ground
3	Analogue / Digital	In	Connect to Vcc = I/O1-2 are digital Connect to GND = I/O1-2 are Analogue
4 - 5	I/O1-2	In / Out	Analogue or digital I/Os 0–Vcc, connect to GND if unused
6, 8-11, 25-27	I/O 3-10	In / Out	When configured as transmitter: Digital inputs: high Impedance inputs When configured as receiver: Digital outputs: LVCMOS output drive
7, 21-22	NC		Leave unconnected
12	Reset	In	Resets module operation, pull high for ordinary use.
13	Watchdog	In	Connect to Vcc = Turns OFF “watchdog” Connect to GND = Turns ON “watchdog”
14	Error LED	Out	LED drive output. Flashes if Zulu Tx has not received acknowledgment or Zulu Rx not received watchdog.
16	Vcc	In	Supply voltage
17, 18	TX/RX LEDs	Out	Active LED output when module is transmitting or receiving RF data packets.
19	TX/RX	In	Connect to Vcc = Module is a Transmitter Connect to GND = Module is a Receiver
20	Ch Sel	In	Sets the channel frequency Connect to Vcc = Operates on ch A 869.500 Connect to GND = Operates on ch B 868.133
23	Learn	In	Connect to momentary switch to GND, when activated places the module into pairing mode.
24, 28	IRQ In/Out	In / Out	Connect together to enable RF interrupts on chip (mandatory).
29-30	XTAL1-2	In	These pins are provided as legacy to ensure compatibility with older ZULU modules
31	NC		Leave unconnected

## General Description of Operation

Each module can be set to act as a 'Transmitter' or 'Receiver' A remote telemetry system is achieved when two modules are paired together, as transmitter (Zulu-2 Tx) and receiver (Zulu-2 Rx).

Each time an input changes on the Zulu-2 Tx, it will transmit the status of its inputs to the paired Zulu-2 Rx(s). which will set its outputs to follow the Zulu-2 Tx Inputs and reply back with an acknowledge signal. Once completed the modules will then go into sleep mode

### Pin Descriptions:

#### Channel Select (pin 20)

This sets the operating carrier frequency of the module. This enables separate groups of modules to coexist in the same vicinity without any interference. For operation see page 2.

#### TX / RX (pin 19)

When connected to Vcc Zulu-2 is a Transmitter

When connected to GND Zulu-2 is a Receiver

#### XTAL1, XTAL2 (pins 29, 30)

The ZULU-2 module no longer requires a 30MHz drive crystal to be connected between XTAL1-2. See notes on page 2 for compatibility with older versions.

#### Learn / Erase (pin 23)

Each transmitter has a unique identity. A receiver can 'sync' with a transmitter so that the receiver outputs will respond to the transmitter inputs.

##### To Learn:

1. Briefly press the "sync" switch on the receiver
2. Briefly operate any of the transmitter inputs

##### To Erase

1. Hold pin 7 on the receiver to ground for >10seconds.
2. (For completed circuit press learn switch for 10sec)
3. Indication of the process is shown the TX/RX LED.

#### Tx / Rx LEDs (pins 17, 18)

Direct LED drive which operate whenever there is RF activity Tx or Rx

Mode	TX/Rx LED	Description
Normal operation	ON	Module is transmitting/receiving RF data
	OFF	No RF data is being transmitted/received
Learn mode	Flashing at low speed	Module is searching for another to pair with.
	Flashing at high speed 3secs	Pairing successful

The following descriptions apply to the Zulu Module in TRANSMITTER Mode

When configured as a Transmitter the ZULU2 Module will automatically default to low power sleep mode until any input state change takes place.

On receipt of an input state change the ZuluTx will transmit a packet showing the status of all inputs (multiple state changes can take place simultaneously).

The ZuluTx will remain "awake" until:

1. The paired ZULU Rx Module has acknowledged, or
2. A timeout value of 4 retry transmissions. (Pin 26 output will then be flashed)

### Analogue / Digital (pin 3)

This input configures Input 1-2 to be analogue or Digital inputs.

Note: this input is read at power up only.

### Analogue Inputs (4,5)

If enabled each input is 10bit A/D which can accept a voltage between 0 –Vcc.

Each input is sampled ten times per second, and the value is averaged before transmission. ZuluTx will transmit whenever there is a change in the detected input voltage of 0.025V

If no change of voltage is measured then the ZuluTx will not transmit. A nominal 1uF capacitor is recommended across the analogue inputs in order to prevent noise being read and transmitted.

Note: A maximum of three RF packets are sent per second.

### Digital Inputs

High Impedance Inputs, LVCMOS / LVTTTL compatible.

Can be connected directly to CMOS/TTL logic or switch inputs connected to 0V (active low)

A change on the input will cause the ZuluTx to wake, read the inputs and initiate RF transmission.

### Watchdog Input (pin 13)

The watchdog is designed to enable the ZuluRx to be aware of any potential problems with the RF link to a sync'ed ZuluTx.

When activated the ZuluTx will automatically transmit a call in packet a regular basis every 10seconds. Input statuses are not sent as part of the watchdog signal.

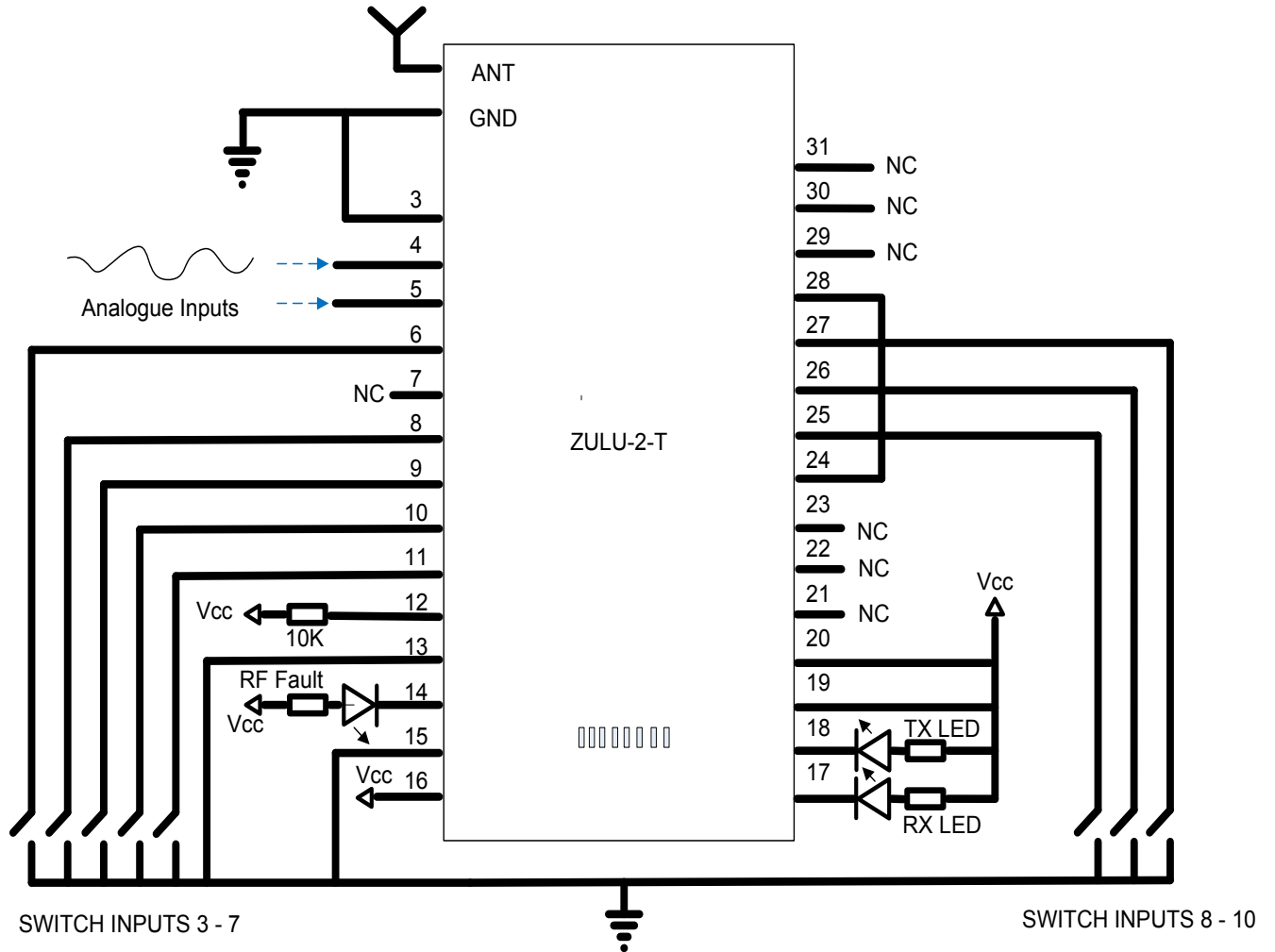
Note: This pin is only read on power up. Watchdog is only valid on a 1-1 system.

### RF Fault (pin 26)

Direct drive to LED. Each time the ZuluTx transmits the status of its inputs, it expects an acknowledgement from the paired receiver. If this is received then the RF Fault LED is not used. If no acknowledgement is received RF Fault is flashed.

RF Fault LED Status	Description
OFF	Receiver has acknowledged correctly
Flashing at 1Hz	No acknowledgment received

## Transmitter example application circuit



### Notes:

Watchdog is ON  
Channel selected is 869.500  
Analogue inputs active

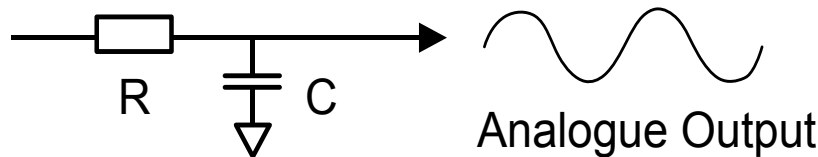
The following descriptions apply to the Zulu module in RECEIVER mode

### Analogue outputs (pin 4, 5)

If enabled the ZuluRx outputs PWM signal.  
 The PWM may be used directly (e.g. for motor control)  
 The PWM signal is a proportional digital output representing the analogue input.

If the analogue input is 0V then the PWM output will be '0'  
 If the analogue input is 1/2Vcc then the PWM output will be a square wave with 50% duty cycle, (operating at approx 90-100KHz)  
 If the analogue input is Vcc then the PWM output will be '1'

In order to re-create an analogue signal (representing the analogue input at the transmitter) the output should be fed through an RC network as above.



### Digital outputs

CMOS / TTL compatible outputs. Can be connected directly to CMOS/TTL logic or drive

### Analogue / Digital (pin 3)

This input configures output 1-2 to be analogue or digital outputs.  
 Note: this input is read at power up only.

### Watchdog Input (pin 13)

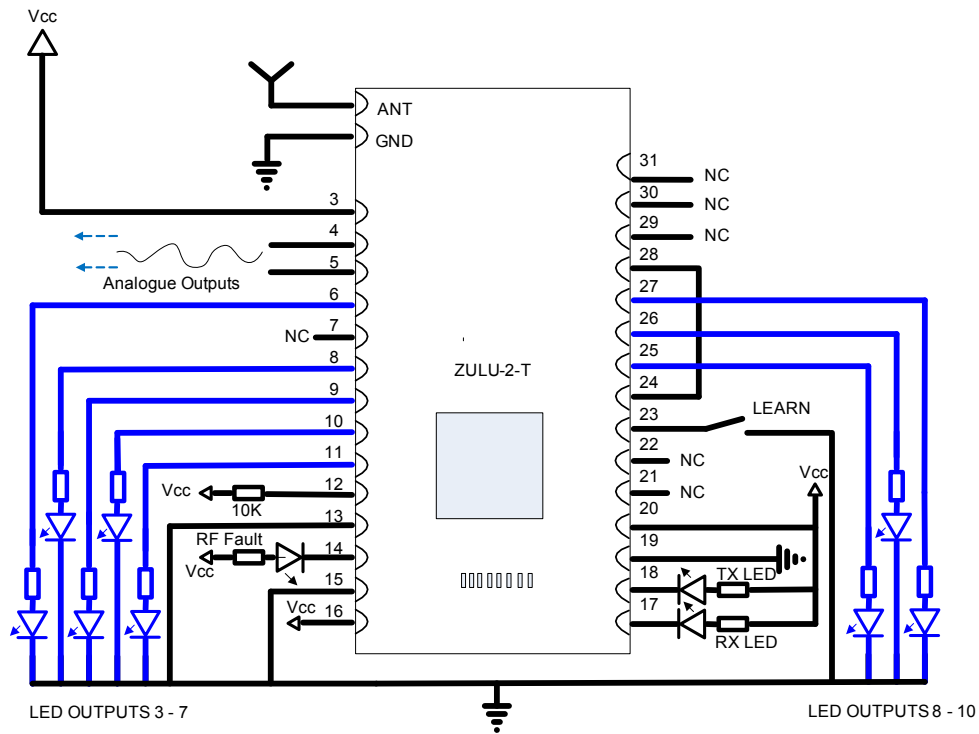
When activated the ZuluRx module will automatically expect to receive a watchdog signal from the ZuluTx on a regular basis (10seconds) If it has failed to receive this within a 30second period it will assert drop all outputs and flash the RF fault output

### RF fault

Direct drive to LED. Flashes when watchdog fails.

RF fault status	Description
OFF	ZuluRx has received watchdog correctly
Flashing at 2Hz	No watchdog received
OFF	watchdog is inactive

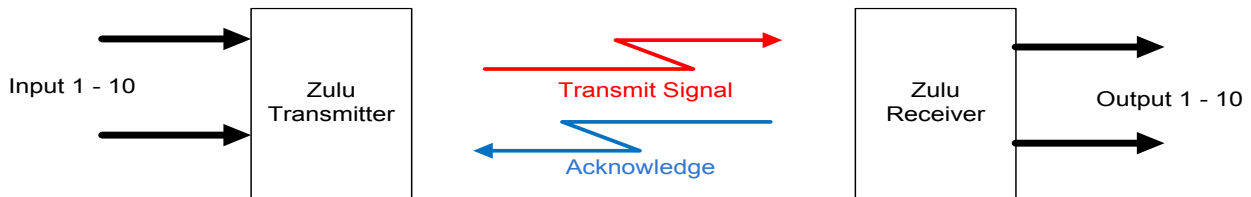
## Receiver Application Circuit



### Notes:

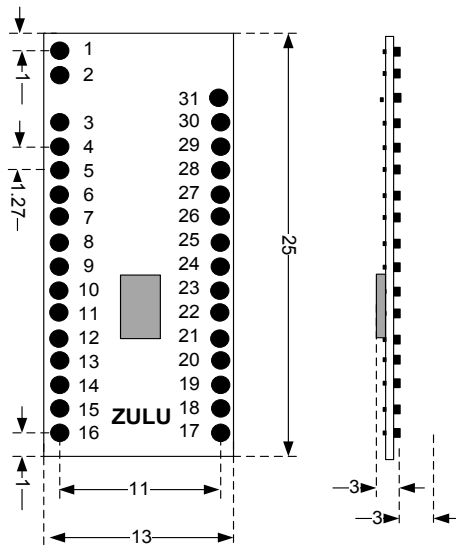
Watchdog is ON  
 Channel Selected is 869.500  
 Analogue outputs active

## Application Example ONE to ONE

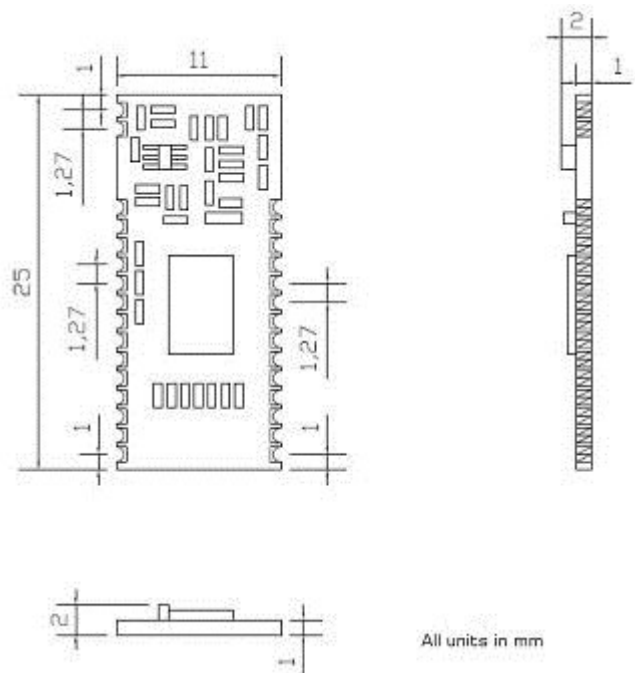


In this application the outputs at the receiver will track the inputs at the transmitter. The receiver outputs are acknowledged back to the transmitter. If required the Watchdog can be enabled to inform the user if the RF system has a fault.

## Mechanical Dimensions



- Notes
1. Pins 1.27mm pitch
  2. Pin Dims 0.4mm sq
  3. All dims in mm



All units in mm

## Range

The antenna choice and position directly controls the system range. Keep it clear of other metal in the system. 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 dependant 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 (DS006)

In very worse case applications the range quoted may be reduced dramatically below the optimal range stated.

## Recommended Antenna 868MHz

The BEAD Antenna provides a Miniature PCB mounting solution where performance is required from a small space .

Available as straight or 90 degree mount this antenna is a general purpose omni-directional. Please see Datasheet ANT-BEAD-868





## Technical Specifications

### Absolute Maximums:

**Temperature Range:** Storage -50 to +125°C.

### DC Characteristics

Parameter	Min	Max	Units
Supply Voltage		3.6	V
Voltage on any Input VDD >2.2V		5.8	V
Max Input power (thro Antenna)		+5	dBm

Parameter	Min	Typical	Max	Units
Supply Voltage	2.2		3.6	V
Operating Temperature	-40		+85	°C
Zulu Tx Supply Current:				
When Transmitting		85		mA
When sleeping		<1		uA
When used as analogue module will not sleep				
Zulu Rx Supply Current:		18.5		mA

### AC Characteristics

Parameter	Min	Typical	Max	Units
Operating Frequency 1		869.5008		MHz
Operating Frequency 2		68.133		MHz
Deviation		50		kHz
Operating Temperature	-40		+85	°C
Zulu Tx Output Power			+20	dBm
Zulu Tx–Rx FSK Raw RF Data Rate			9.6	Kbps
Zulu Rx Sensitivity		-121		dBm

### System Characteristics

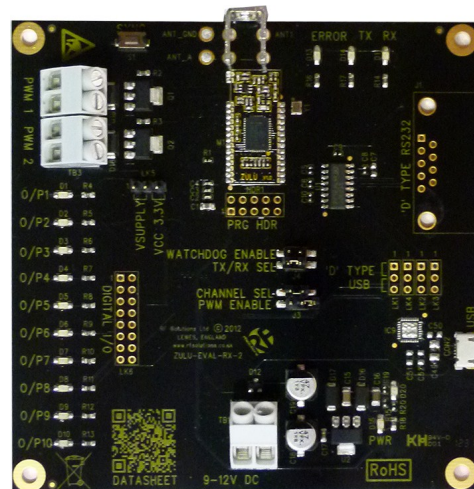
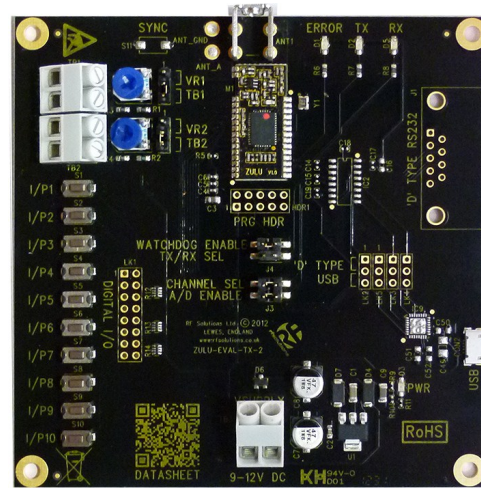
Parameter	Min	Typical	Max	Units
Time from Zulu Tx input activation time to Zulu RX output Activation		28		ms
Time from Zulu Tx input activation time to Zulu RX output Relaxing		28		ms

## ZuluT Evaluation Board

The ZULU EVAL Boards provide a ready to go platform which can be used for evaluation or complete projects. These boards demonstrate the capabilities of ZULU Modules.

### Features

- Provides a Radio Link with;
  - 10 Digital Channels
  - 2 Analogue Channels (PWM)
- Watchdog Feature
- Direct Antenna Connection
- 9-12Vdc Power in Terminal
- LED Indication of
  - Power
  - Transmit / Receiver
  - RF Error

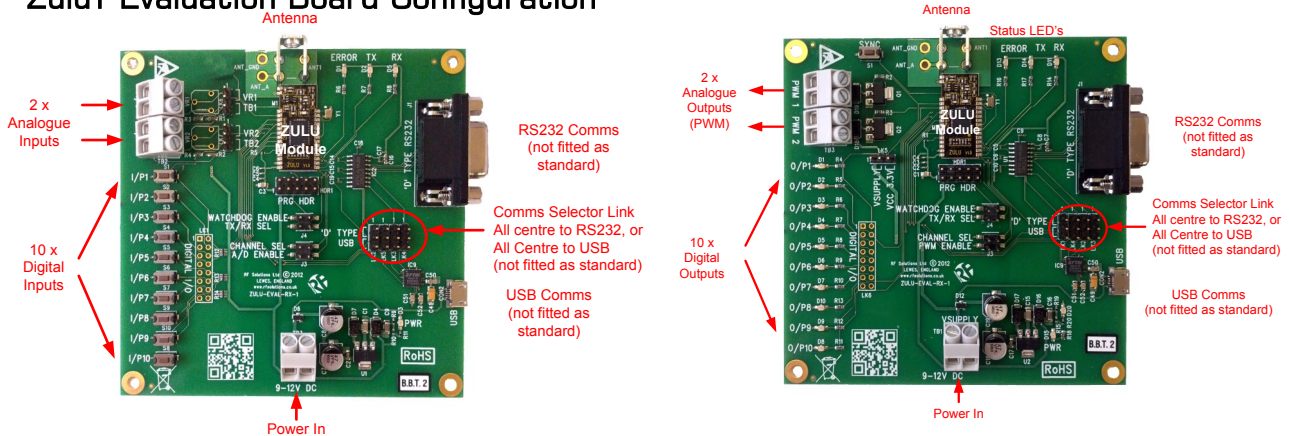


The Evaluation boards are sold as a TX and RX PCB pair, ready for component use.

### Ordering Information

Part No	Description
ZULU-EVALT	Tx and RX PCB Pair
PSU-12V1A-UK	Power Supply 12V 100mA

## ZuluT Evaluation Board Configuration



### Overview

When paired together the outputs of the receiver will follow the inputs at the transmitter  
The serial outputs also provide data from the receiver

To get up an running complete the following;

1. Set the jumper links as below
2. Screw in Antenna
3. Apply power
4. Pair together the receiver and transmitter board

Reference	Name	When Fitted	When Open
J3	A/D	I/O 1 & 2 are analogue operation	I/O 1 & 2 are set to Digital operation
J3	Channel Select	Zulu operates on Channel A	Zulu operates on Channel B
J4	TX/ RX Select	Zulu set as Transmitter	Zulu set as Receiver
J4 (Transmitter)	Watchdog Enable	Watchdog enabled	Watchdog Disabled
J4 (Receiver)	PWM Enable	Enables PWM Output	Output's 1& 2 set to Digital
LK1-LK4	Comms Select	All links from Centre to USB All links from Centre to RS232	N/A
LK5 (Receiver)	PWM Supply	Vcc: PWM is powered from Vcc VSUPPLY: PWM is powered from incoming V supply at TB1	

### Pairing Process

In order to pair together a Transmitter and receiver,

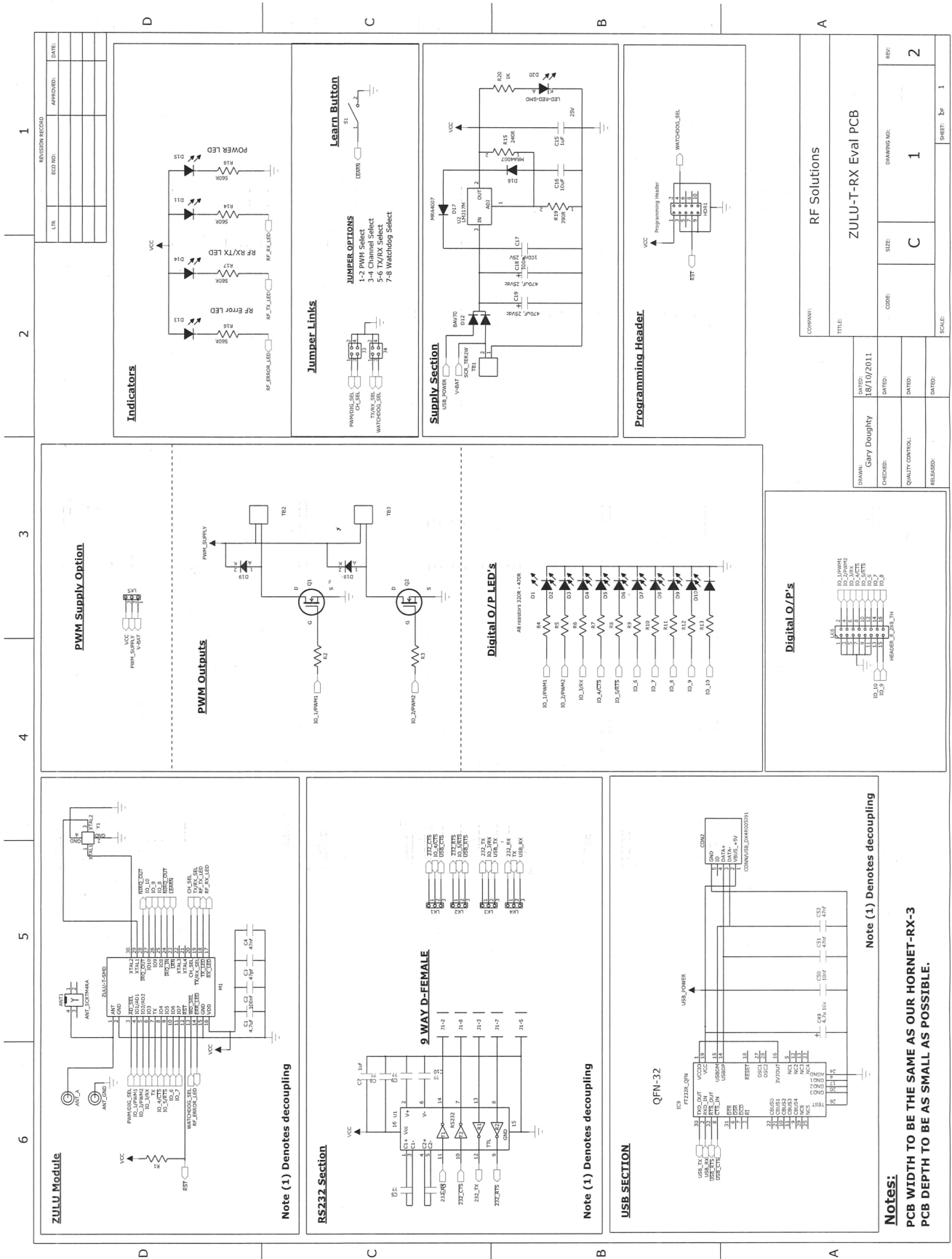
1. On the Receiver Briefly press the Receiver 'Sync Button'
2. Briefly operate any of the transmitter buttons

For all other operation please refer to the ZULU Module operation

### Analogue in / PWM Out

When using the analogue RF link, by turning the potentiometer VR1 or VR2, outputs 1 and 2 at the receiver will vary between 0 and 100% PWM, the EVAL-T board has these outputs connected to LED's 1 and 2 which will 'dim' their brightness with the adjustment of the transmitter VR1 and 2.

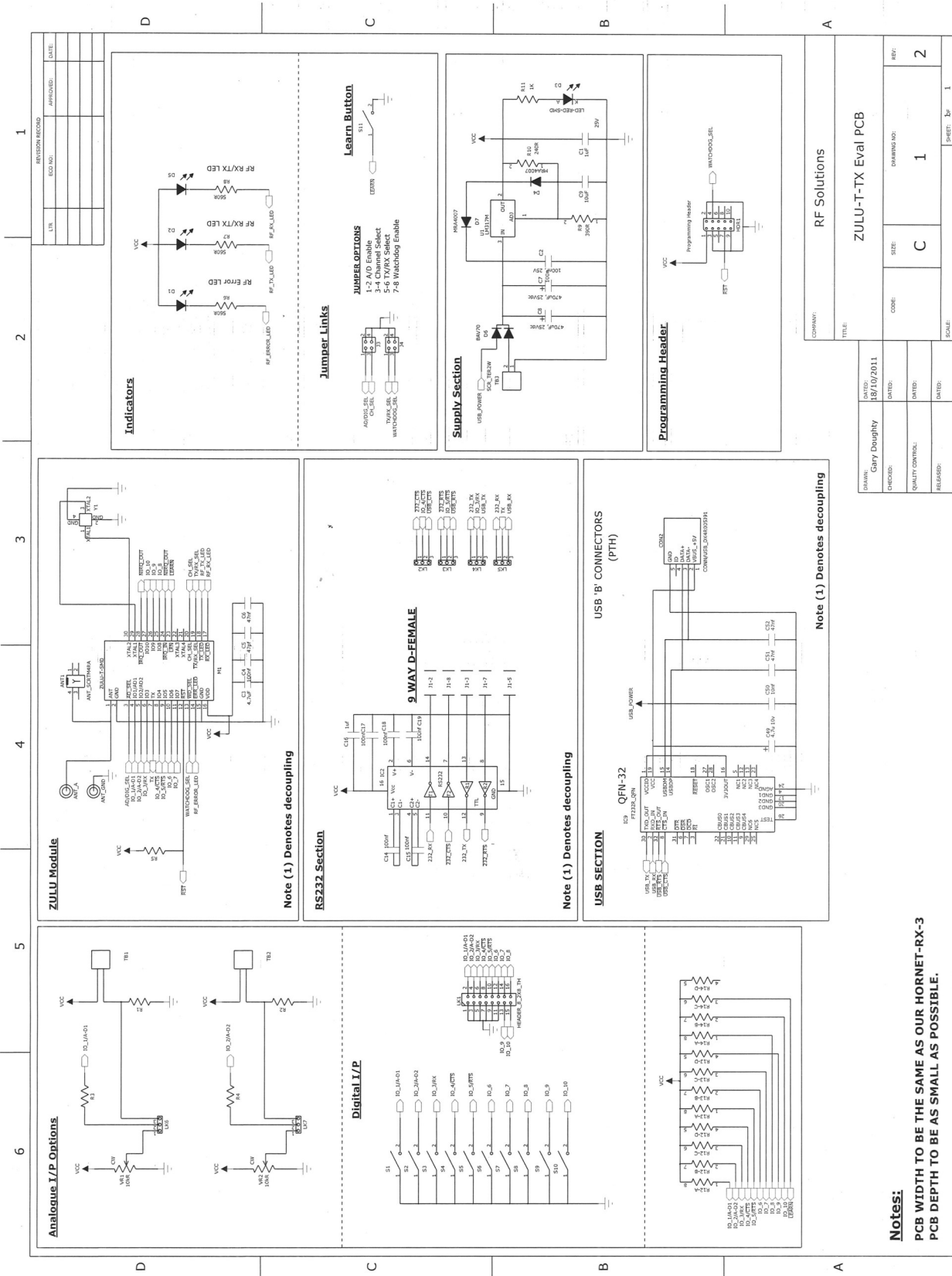
## Zulu evaluation board receiver schematic



COMPANY:	RF Solutions
TITLE:	ZULU-T-RX Eval PCB
DATE:	18/10/2011
DESIGNED:	Gary Doughty
CHECKED:	
QUALITY CONTROL:	
RELEASED:	
SCALE:	1
SHEET:	2 of 1

**Notes:**  
 PCB WIDTH TO BE THE SAME AS OUR HORNET-RX-3  
 PCB DEPTH TO BE AS SMALL AS POSSIBLE.

## Zulu evaluation board transmitter PCB layout



COMPANY:	RF Solutions
TITLE:	ZULU-TX Eval PCB
DATE:	18/10/2011
DRAWN BY:	Gary Daughtry
CHECKED:	
QUALITY CONTROL:	
RELEASED:	
CODE:	C
SIZE:	1
DRAWING NO.:	2
SCALE:	1
SHEET:	1

**Notes:**  
 PCB WIDTH TO BE THE SAME AS OUR HORNET-RX-3  
 PCB DEPTH TO BE AS SMALL AS POSSIBLE.

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Application:

Would you like a reply? Y / N

Datasheet: DS-ZULU-2-T Rev1

Questions:

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2. How does this document meet your hardware and software development needs?
3. Do you find the organization of this document easy to follow? If not, why?
4. What additions to the document do you think would enhance the structure and subject?
5. What deletions from the document could be made without affecting the usefulness?
6. Is there any incorrect or misleading information (what and where)?

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