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WT41-A / WT41-N

DATA SHEET

Wednesday, 22 January 2014

Version 1.44

VERSION HISTORY

Version	Comment
0.1	First draft
0.2	Description and product codes added
0.21	Dimensions updated, layout guide added, UART and USB chapters added
0.22	Pin descriptions, PCM, USB, UART, SPI
0.3	Physical dimensions corrected
0.31	Product codes corrected
0.32	Recommendation for a power-up reset circuitry added to chapter 10
0.4	Pins 1 and 52 (GND) removed. Dimensions updated, recommended land pattern added
0.5	Certification information added
0.6	Physical dimensions and recommended PCB land pattern updated
0.7	Figure 7 recommended land pattern corrected
1.0	Radio and antenna characteristics, layout guide for WT41-N
1.1	Japan certification info added
1.2	FCC RF radiation exposure statement updated
1.3	Layout guide updated
1.31	VDD added to table 1
1.32	FCC and IC statements updated
1.33	PIO current drive capability added. List of approved antennas added.
1.34	IC statements in French added
1.35	Information about Japan compliance updated
1.36	Absolute maximum supply voltage 3.7V
1.37	MIC Japan information updated

1.4	FCC C2PC to remove 20 cm restriction
1.41	MIC Japan ID corrected
1.42	MSL information updated
1.43	TXP vs VDD_PA figure added
1.44	Minor changes

TABLE OF CONTENTS

WT41 ***Bluetooth®*** **Module**

DESCRIPTION

WT41 is a long range class 1, Bluetooth® 2.1 + EDR module. WT41 is a highly integrated and sophisticated Bluetooth® module, containing all the necessary elements from Bluetooth® radio to antenna and a fully implemented protocol stack. Therefore WT41 provides an ideal solution for developers who want to integrate Bluetooth® wireless technology into their design with limited knowledge of Bluetooth® and RF technologies. WT41 is optimized for long range applications and since it contains a RF power amplifier, low noise amplifier and a highly efficient chip antenna. With 115 dB radio budget WT41 can reach over 1 km range in line off sight.

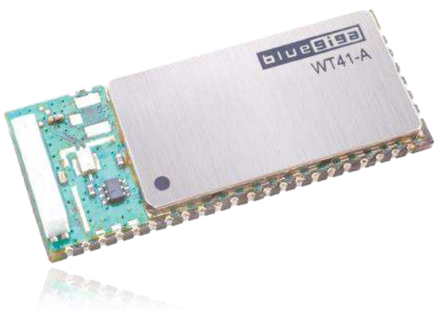
By default WT41 module is equipped with powerful and easy-to-use iWRAP firmware. iWRAP enables users to access Bluetooth® functionality with simple ASCII commands delivered to the module over serial interface - it's just like a Bluetooth® modem.

APPLICATIONS:

- Hand held terminals
- Industrial devices
- Point-of-Sale systems
- PCs
- Personal Digital Assistants (PDAs)
- Computer Accessories
- Access Points
- Automotive Diagnostics Units

FEATURES:

- Fully Qualified Bluetooth v2.1 + EDR end product,
- CE, FCC, IC and MIC Japan
- TX power : 19 dBm
- RX sensitivity : -92 dBm
- Higly efficient chip antenna, U.FL connector or RF pin
- Class 1, range up to 800 meters
- Industrial temperature range from -40°C to +85°C
- RoHS Compliant
- USB interface (USB 2.0 compatible)
- UART with bypass mode
- 6 x GPIO
- 1 x 8-bit AIO
- Support for 802.11 Coexistence
- Integrated iWRAP™ Bluetooth stack or HCI firmware



1 Ordering Information

WT41-A-HCI

Firmware

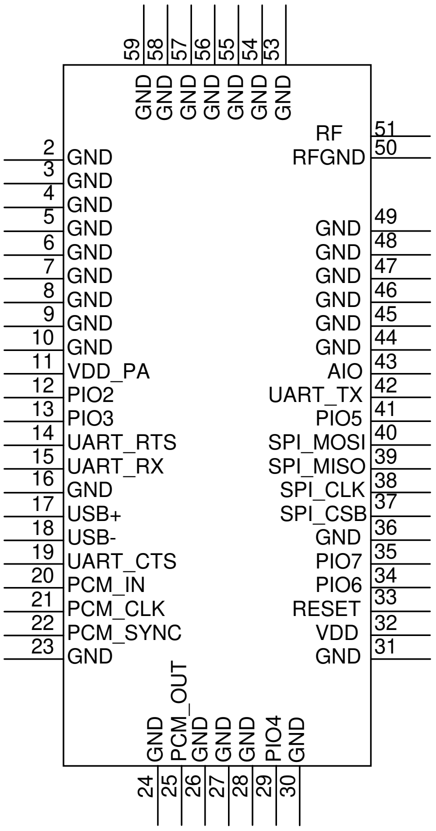
HCI21= HCI firmware (Bluetooth 2.1 + EDR)
HCI30= HCI firmware (Bluetooth 3.0)
AI4 = iWRAP 4.0.0
AI5 = iWRAP 5.0.2
C = Custom*

HW version

A = Chip antenna
N = RF pin

Product series

2 Pinout and Terminal Description



Pins 1 and 52 (GND) are not connected and have been removed

Figure 1: WT41 pin out

	PIN NUMBER	PAD TYPE	DESCRIPTION
NC	1, 52	Not connected	Pins 1 and 52 (GND) have been removed from the module.
RESET	33	Input, weak internal pull-up	Active low reset. Keep low for >5 ms to cause a reset
GND	2-10, 16, 23,24,26-28, 30, 31,36,44-49, 53-59	GND	GND
RF	51	RF output	RF output for WT41-N. For WT41-A and WT41-E this pin is not connected
RFGND	50	GND	RF ground. Connected to GND internally to the module.
VDD_PA	11	Supply voltage	Supply voltage for the RF power amplifier and the low noise amplifier of the module
VDD	32	Supply voltage	Supply voltage for BC4 and the flash memory

Table 1: Supply and RF Terminal Descriptions

PIO PORT	PIN NUMBER	PAD TYPE	DESCRIPTION
PIO[2]	12	Bi-directional, programmamble strength internal pull-down/pull-up	Programmamble input/output line
PIO[3]	13	Bi-directional, programmamble strength internal pull-down/pull-up	Programmamble input/output line
PIO[4]	29	Bi-directional, programmamble strength internal pull-down/pull-up	Programmamble input/output line
PIO[5]	41	Bi-directional, programmamble strength internal pull-down/pull-up	Programmamble input/output line
PIO[6]	34	Bi-directional, programmamble strength internal pull-down/pull-up	Programmamble input/output line
PIO[7]	35	Bi-directional, programmamble strength internal pull-down/pull-up	Programmamble input/output line
AIO[1]	43	Bi-directional	Programmamble analog input/output line

Table 2: GPIO Terminal Descriptions

SPI INTERFACE	PIN NUMBER	PAD TYPE	DESCRIPTION
PCM_OUT	25	CMOS output, tri-state, weak internal pull-down	Synchronous data output
PCM_IN	20	CMOS input, weak internal pull-down	Synchronous data input
PCM_SYNC	22	Bi-directional, weak internal pull-down	Synchronous data sync
PCM_CLK	21	Bi-directional, weak internal pull-down	Synchronous data clock

Table 3: PCM Terminal Descriptions

UART Interfaces	PIN NUMBER	PAD TYPE	DESCRIPTION
UART_TX	42	CMOS output, tri-state, with weak internal pull-up	UART data output, active high
UART_RTS#	14	CMOS output, tri-state, with weak internal pull-up	UART request to send, active low
UART_RX	15	CMOS input, tri-state, with weak internal pull-down	UART data input, active high
UART_CTS#	19	CMOS input, tri-state, with weak internal pull-down	UART clear to send, active low

Table 4: UART Terminal Descriptions

USB Interfaces	PIN NUMBER	PAD TYPE	DESCRIPTION
USB+	17	Bidirectional	USB data plus with selectable internal 1.5k pull-up resistor
USB-	18	Bidirectional	USB data minus

Table 5: USB Terminal Descriptions

SPI INTERFACE	PIN NUMBER	PAD TYPE	DESCRIPTION
SPI_MOSI	40	CMOS input with weak internal pull-down	SPI data input
SPI_CS#	37	CMOS input with weak internal pull-up	Chip select for Serial Peripheral Interface, active low
SPI_CLK	38	CMOS input with weak internal pull-down	SPI clock
SPI_MISO	39	CMOS output, tristate, with weak internal pull down	SPI data output

Table 6: Terminal Descriptions

3 Electrical Characteristics

3.1 Absolute Maximum Ratings

Rating	Min	Max	Unit
Storage Temperature	-40	85	°C
VDD_PA, VDD	-0.4	3.7	V
Other Terminal Voltages	VSS-0.4	VDD+0.4	V

Table 7: Absolute Maximum Ratings

3.2 Recommended Operating Conditions

Rating	Min	Max	Unit
Operating Temperature Range	-40	85	°C
VDD_PA, VDD *)	3.0	3.6	V

*) VDD_PA has an effect on the RF output power.

Table 8: Recommended Operating Conditions

3.3 PIO Current Sink and Source Capability

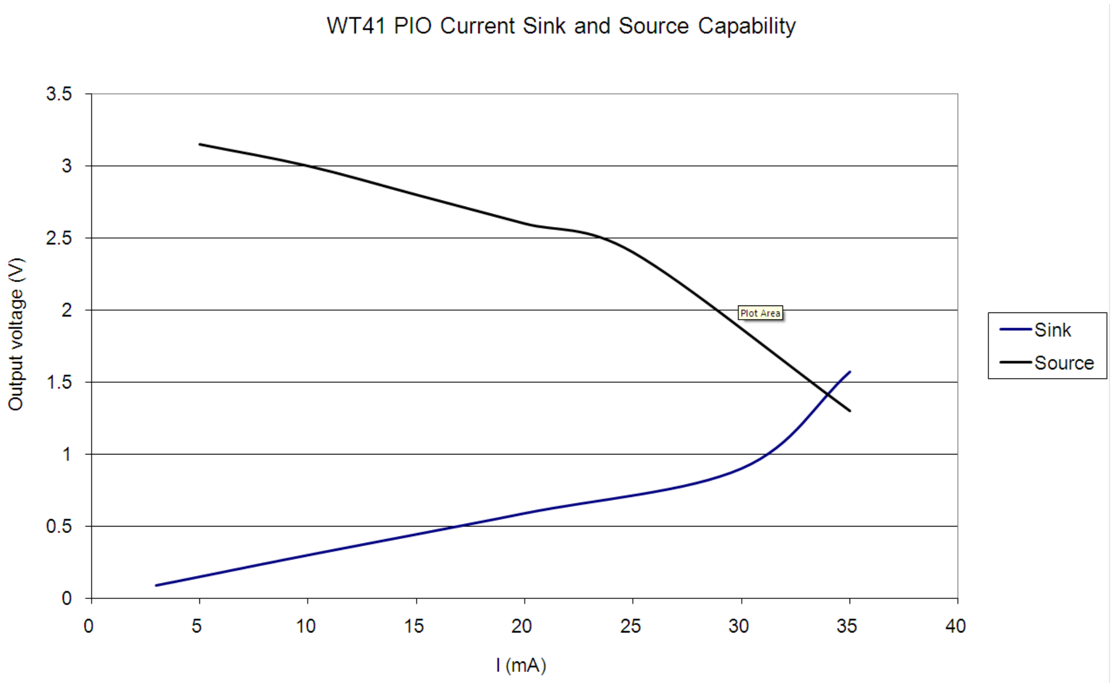


Figure 2: WT41 PIO Current Drive Capability

3.4 Transmitter Performance For BDR

Antenna gain 2.3dBi taken into account

RF Characetristics, VDD = 3.3V @ room temperature unless otherwise specified		Min	Typ	Max	Bluetooth Specification	Unit
maximum RF Transmit Power		17	19	20	20	dBm
RF power variation over temperature range				4	-	dB
RF power variation over supply voltage range (*				1.5	-	dB
RF power variation over BT band		0.1	1	2	-	dB
RF power control range (*		-10		19		
20dB band width for modulated carrier			942		1000	kHz
ACP (1	$F = F_0 \pm 2MHz$			-20	-20	
	$F = F_0 \pm 3MHz$			-40	-40	
	$F = F_0 > 3MHz$			-40	-40	
Drift rate			7		+/-25	kHz
ΔF_{1avg}			169		140<175	kHz
$\Delta F1_{max}$			161		140<175	kHz
$\Delta F_{2avg} / \Delta F_{1avg}$			1.1		>=0.8	

Table 9: Transmitter performance for BDR

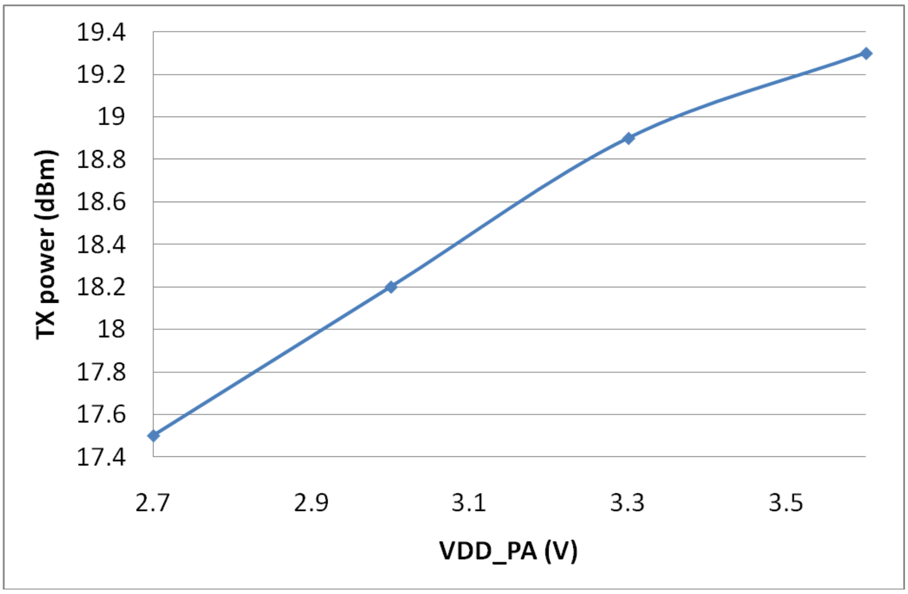


Figure 3: Typical TX power as a function of VDD_PA

3.5 Radiated Spurious Emissions

Measured from WT41 evaluation board

Standard	Band / Frequency	Min (AVG / PEAK)	Typ (AVG / PEAK)	Max (AVG / PEAK)	Limit by the Standard (AVG / PEAK)	Unit
FCC part 15 transmitter spurious emissions	2nd harmonic		52	54/58	54 / 74	dBuV/m
	3rd harmonic		51	54/58	54 / 74	dBuV/m
	Band edge 2390MHz		50/60	52/63	54 / 74	dBuV/m
	Band edge 2483.5MHz		52/65	54/67	54 / 74	dBuV/m
	Band edge 2400MHz (conducted)		-50		-20	dBc
	Band edge 2483.5MHz (conducted)		-58		-20	dBc
ETSI EN 300 328 transmitter spurious emissions	Band edge 2400MHz		-39	-36	-30	dBm
	2nd harmonic		-41		-30	dBm
	3rd harmonic		-41		-30	dBm
ETSI EN 300 328 receiver spurious	(2400 - 2479) MHz		-		-47	dBm
	(1600 - 1653) MHz		-52		-47	dBm

Table 10:Radiated spurious emission for WT41-A

Standard		Min (AVG / PEAK)	Typ (AVG / PEAK)	Max (AVG / PEAK)	Limit by the Standard (AVG / PEAK)	Unit
FCC part 15 transmitter spurious emissions	2nd harmonic		<48/55	50/56	54 / 74	dBuV/m
	3rd harmonic		<48/51	48/52	54 / 74	dBuV/m
	Band edge 2390MHz		50/60	52/63	54 / 74	dBuV/m
	Band edge 2483.5MHz		52/65	54/67	54 / 74	dBuV/m
	Band edge 2400 MHz (conducted)		-50		-20	dBc
	Band edge 3483.5MHz (conducted)		-58		-20	dBc
ETSI EN 300 328 transmitter spurious emissions	Band edge 2400MHz		-39	-36	-30	dBm
	2nd harmonic				-30	dBm
	3rd harmonic				-30	dBm
ETSI EN 300 328 receiver spurious	(2400 - 2479) MHz				-47	dBm
	(1600 - 1653) MHz				-47	dBm

Table 11: Radiated spurious emission for WT41-N

3.6 Receiver Performance

Antenna gain not taken into account

RF characteristis, VDD = 3.3V, room temperature (**	Packet type	Min	Typ	Max	Bluetooth Spefication	Unit
Sensitivity for 0.1% BER	DH1		-92		-70	dBm
	DH3		-92			dBm
	DH5		-91			dBm
	2-DH1		-94			dBm
	2-DH3		-93			dBm
	2-DH5		-93			dBm
	3-DH1		-88			dBm
	3-DH3		-85			dBm
	3-DH5		-84			dBm
Sensitivity variation over temperature range			TBD			

Table 12: Receiver sensitivity

3.7 Current Consumption

Opearation mode	Peak (mA)	AVG (mA)
Stand-by, page mode 0	-	2.1
TX 3DH5	100.5	77.6
TX 2DH5	99.3	77.6
TX 3DH3	98.1	71.1
TX 2DH3	98.1	71.2
TX 2DH1	98.7	51.6
TX DH5	164	120
TX DH1	166	67.3
RX	56.8	52.6
Deep sleep		0.36
Inquiry	169.3	58.7

Table 13: Current consumption

3.8 Antenna Performance and Radiation Patterns

Antenna performance measured from the module as a standalone and as mounted to the evaluation board.

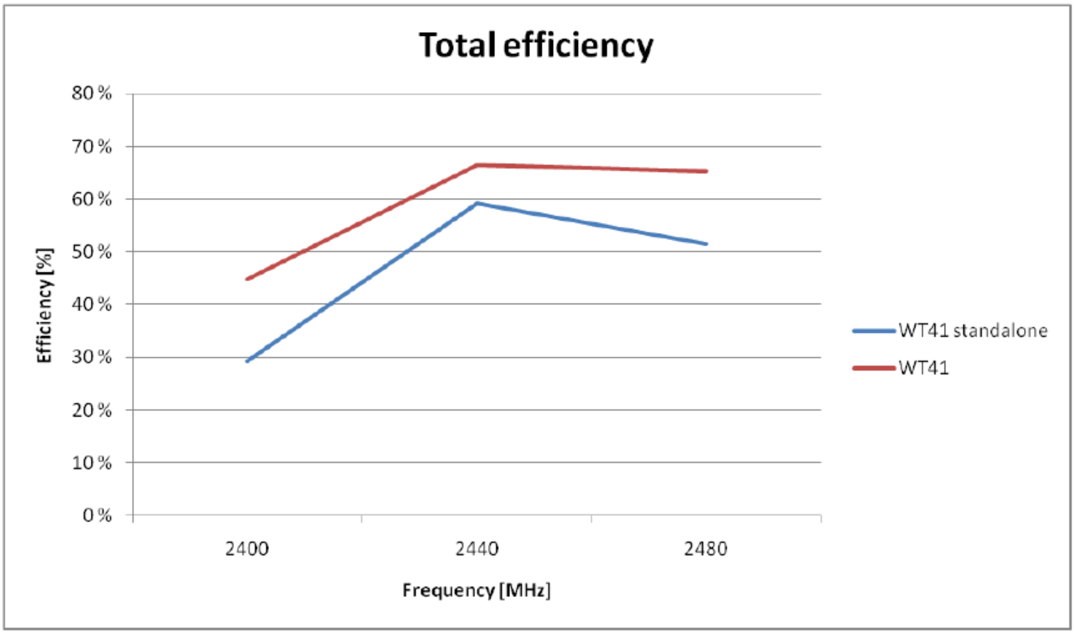


Table 14: Total efficiency of the chip antenna

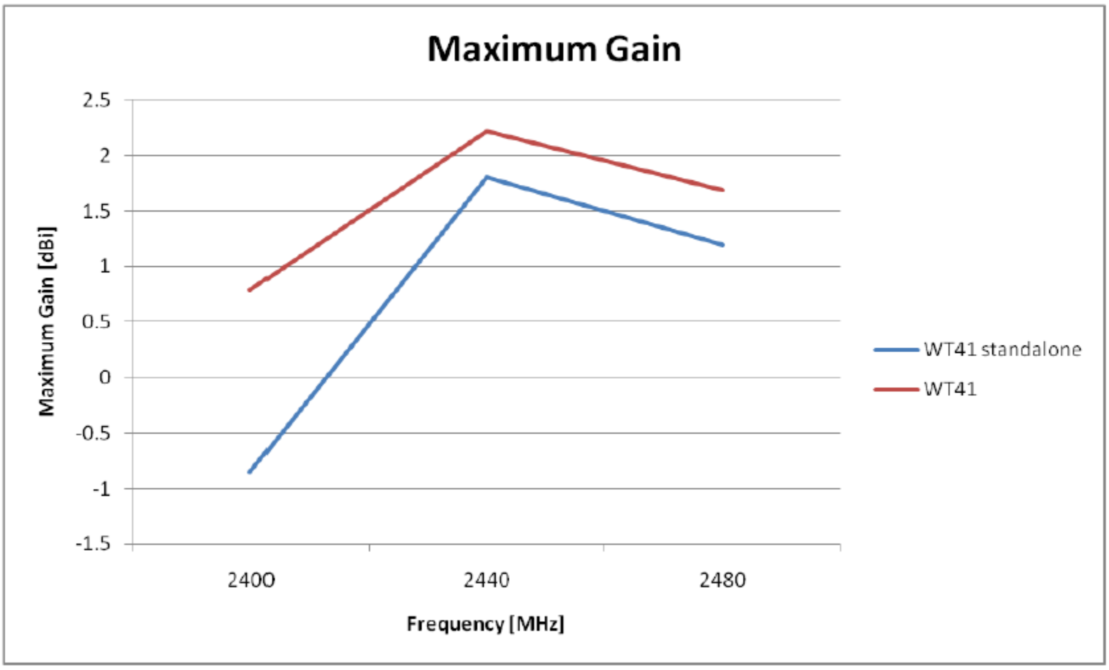
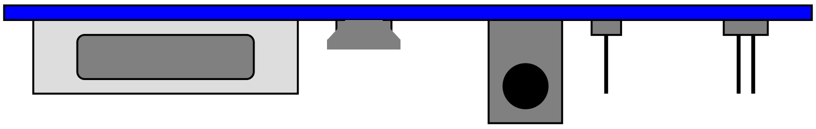
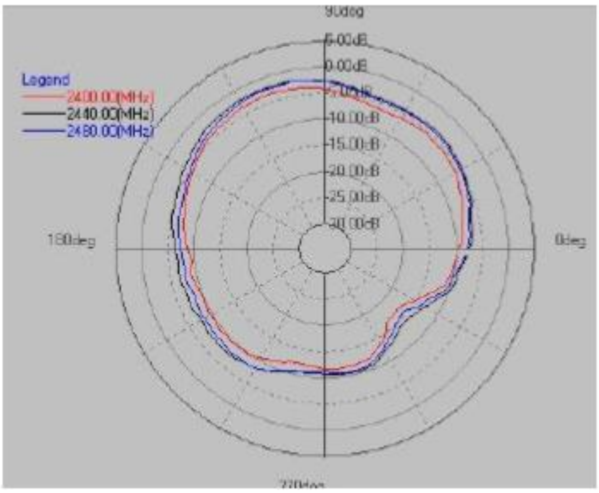
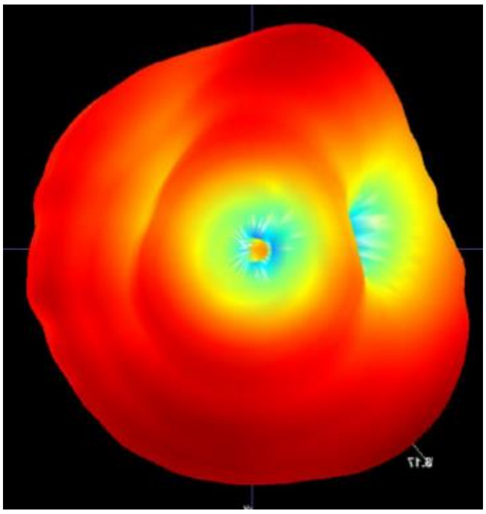


Table 15:Peak gain of the chip antenna

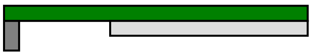
WT41 Evaluation Board

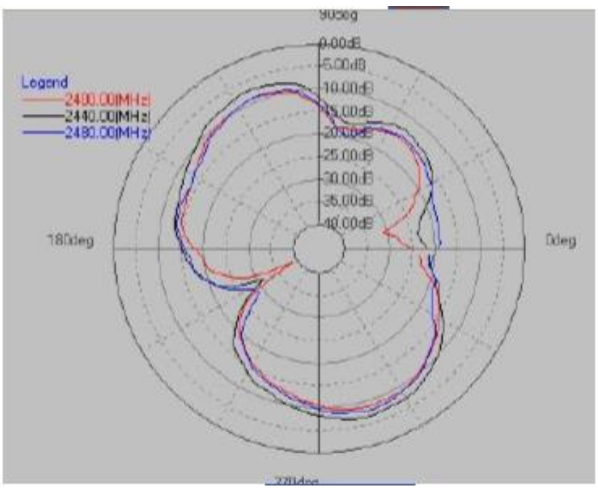


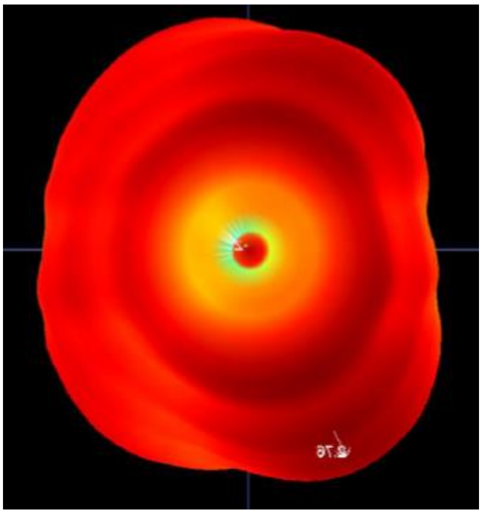




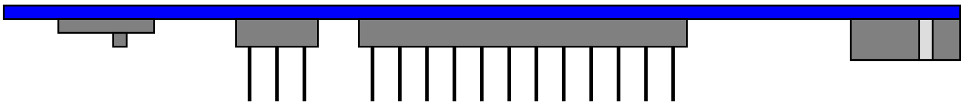
WT41 stand alone

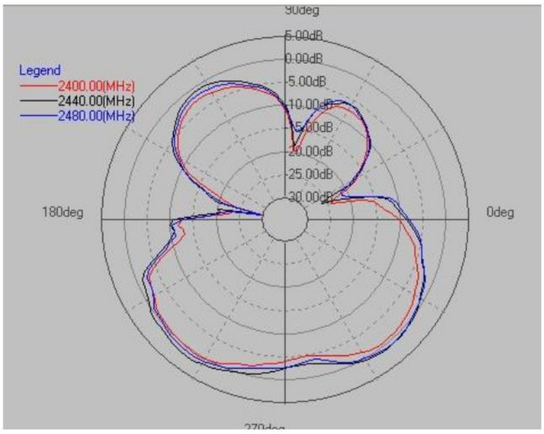


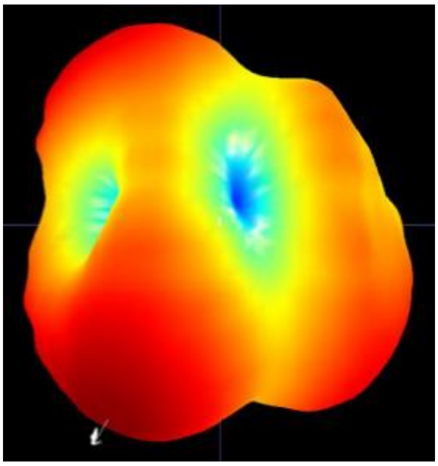




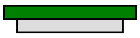
WT41 Evaluation Board

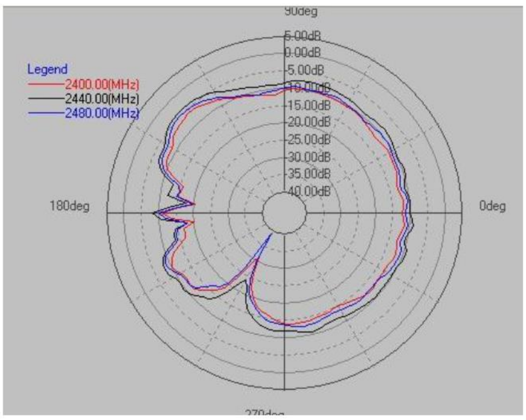


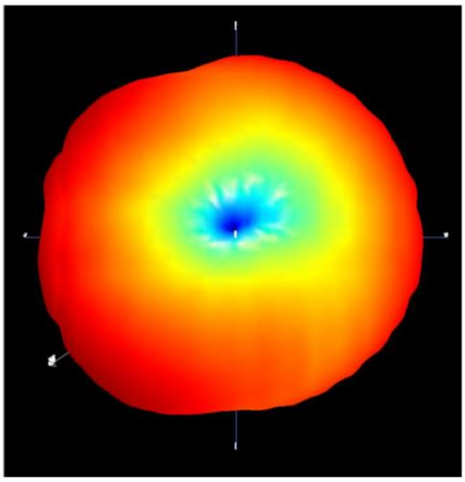


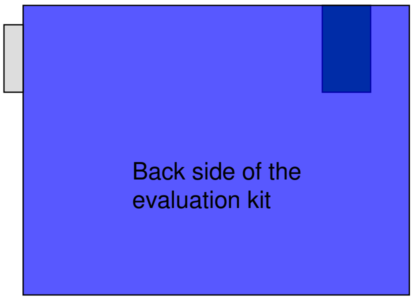


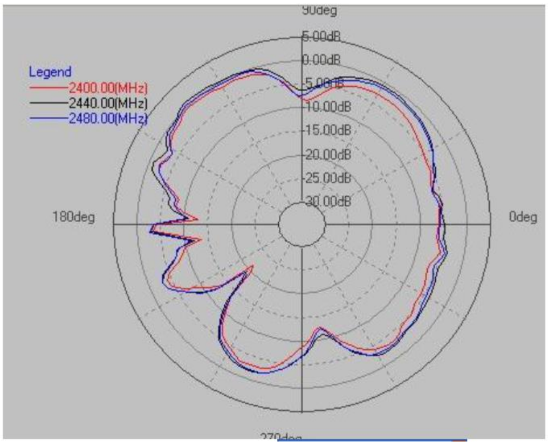
WT41 stand alone

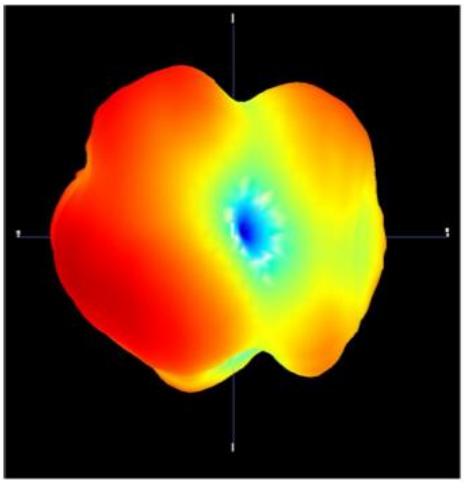


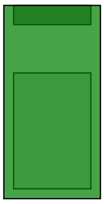




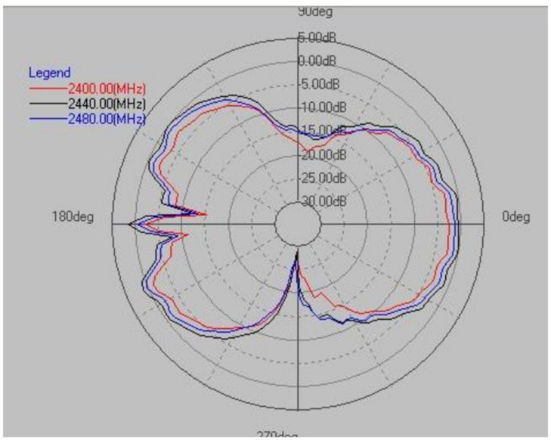


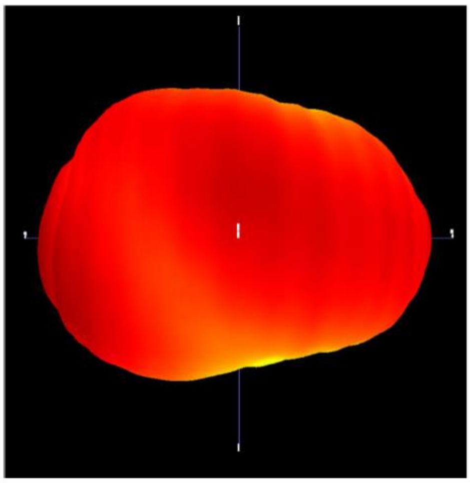






Back side of
WT41-A





4 Physical Dimensions

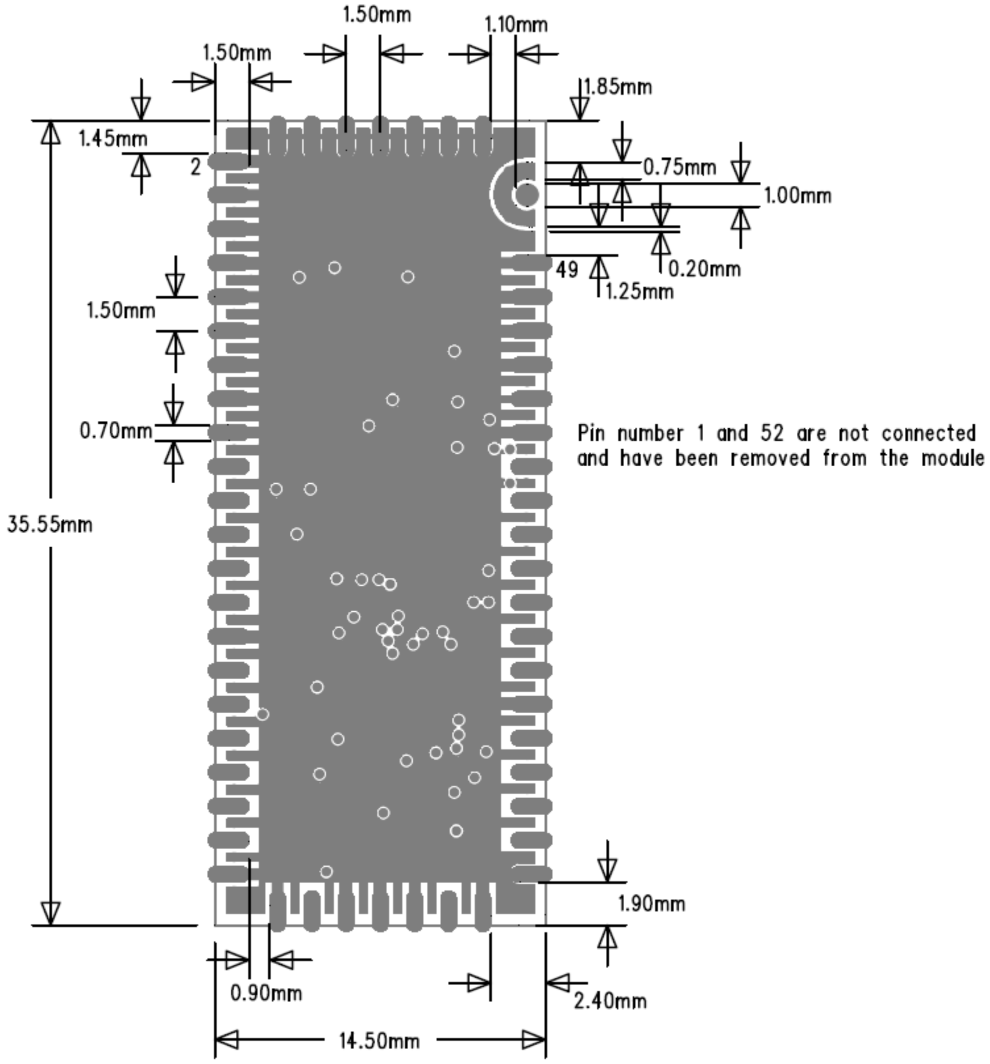


Figure 4: Physical dimensions (top view)

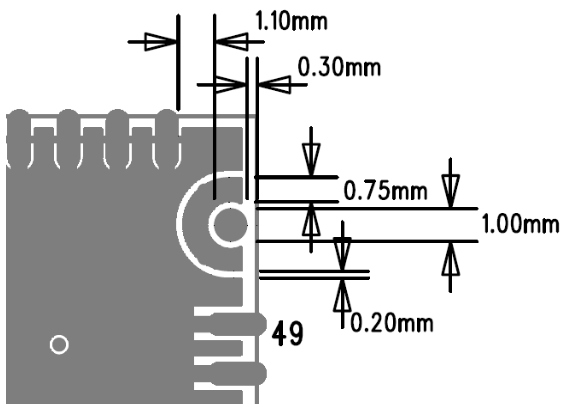


Figure 5: Dimensions for the RF pin (top view)

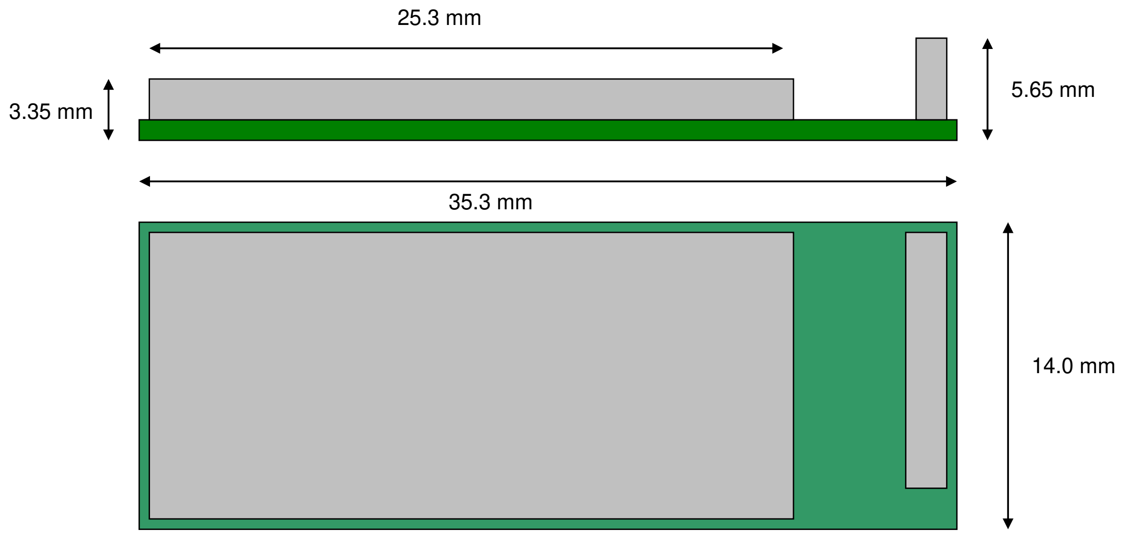


Figure 6: Dimensions of WT41

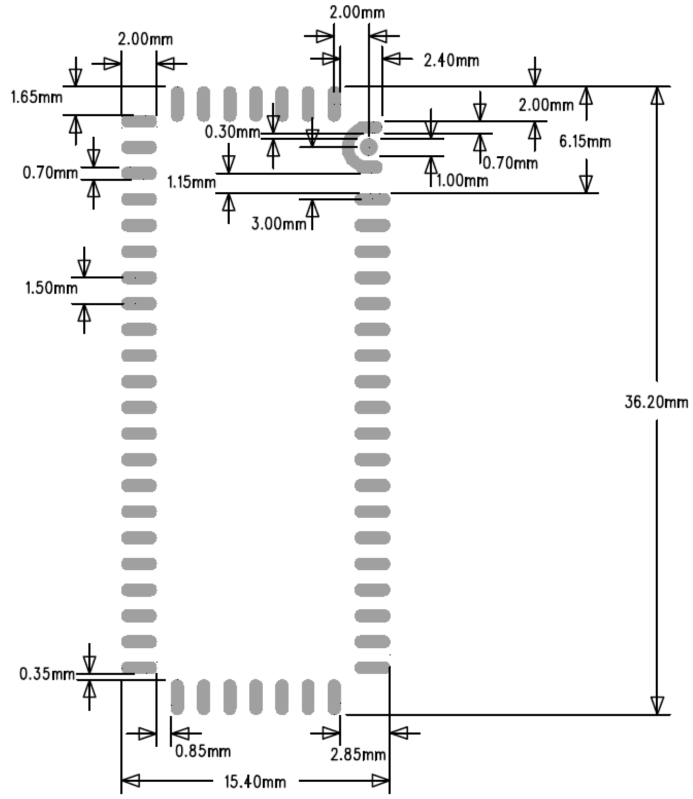


Figure 7: Recommended land pattern

5 Layout Guidelines

5.1 WT41-A

WT41-A should be mounted directly over a solid GND plane. The best performance can be achieved when placing the module to the left corner or to a middle edge of the mother board, as shown in the figure below. Components can be mounted directly under the module and the antenna. The antenna is extremely robust for environment in close proximity to the antenna. Any dielectric material has minor effect on the resonant frequency of the antenna. Metal objects with physical height less than 2 mm can be placed freely anywhere around the module within the area of the mother board without significantly effecting on the radiation characteristics. It is important to place the module to the edge of the mother board and not to place metal objects in front of the antenna.

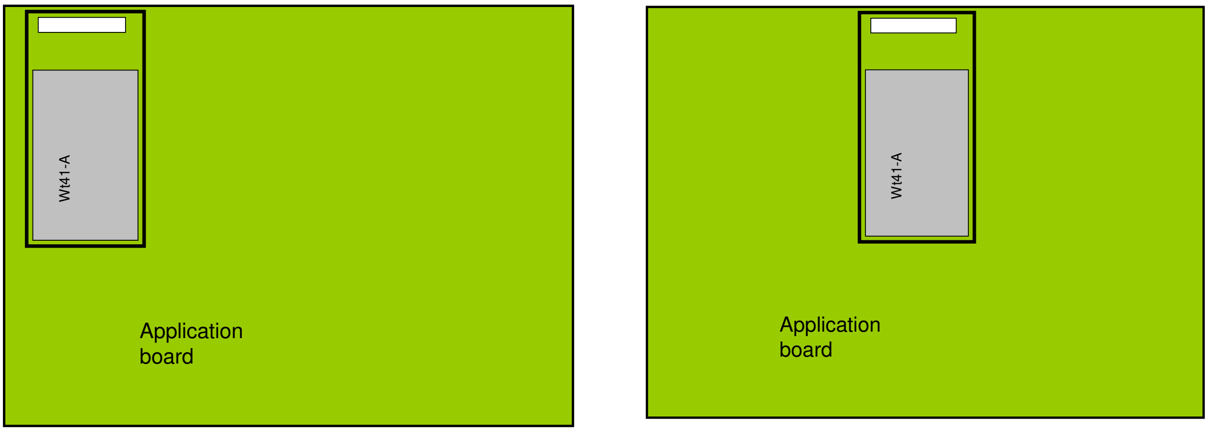


Figure 8: Recommended positions for WT41-A

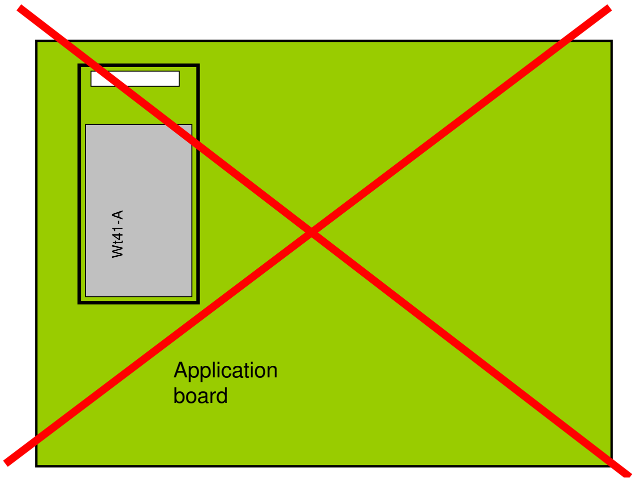


Figure 9: Do not place the module so that the GND plane reaches in front of the antenna

5.2 WT41-N

5.2.1 Layout for WT41-N with u.fl connector close to RF pin

If the trace from the RF pin to u.fl connector is very short there is no need to use impedance controlled trace. Figure 10 shows an example layout where the u.fl connector is placed right next to the RF pin.

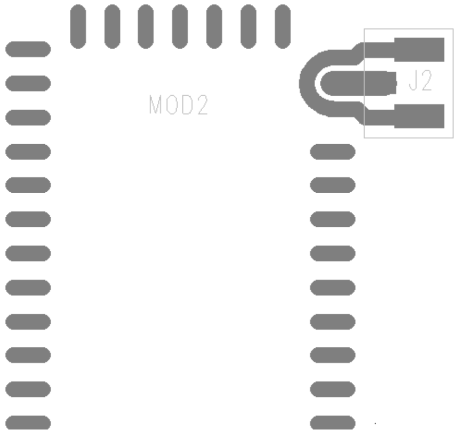


Figure 10: Layout of WT41-N with U.FL connector placed next to the RF pin

5.2.2 Layout for WT41-N with 50 ohm trace from RF pin to a SMA connector

Use 50 ohm transmission line to trace the signal from RF pin to an external RF connector. Figure 11 shows a layout example for WT41-N with an external SMA connector.

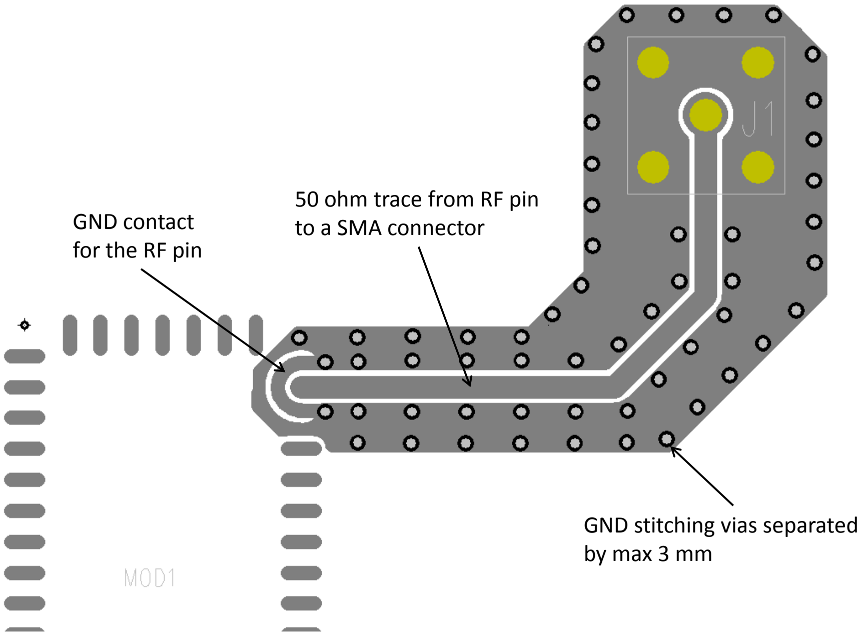


Figure 11: Example RF trace for WT41-N

A transmission line impedance calculator, such as TX-Line made by AWR, can be used to approximate the dimensions for the 50 ohm transmission line. Figure 12 shows an example for two different 50 ohm transmission lines.

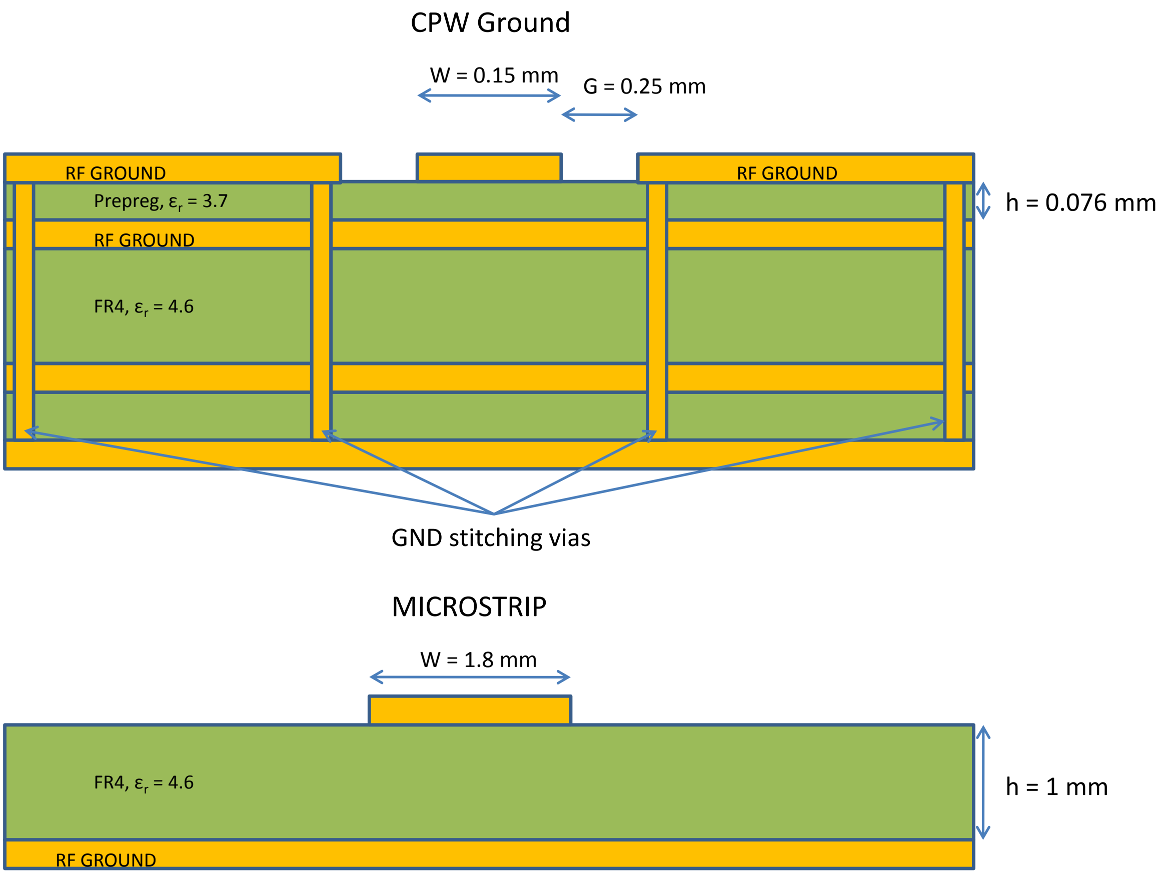


Figure 12: Example cross section of two different 50 ohm transmission line

6 UART Interface

This is a standard UART interface for communicating with other serial devices.WT41 UART interface provides a simple mechanism for communicating with other serial devices using the RS232 protocol.

Four signals are used to implement the UART function. When WT41 is connected to another digital device, UART_RX and UART_TX transfer data between the two devices. The remaining two signals, UART_CTS and UART_RTS, can be used to implement RS232 hardware flow control where both are active low indicators. All UART connections are implemented using CMOS technology and have signalling levels of 0V and VDD.

UART configuration parameters, such as data rate and packet format, are set using WT41 software.

Note:

In order to communicate with the UART at its maximum data rate using a standard PC, an accelerated serial port adapter card is required for the PC.

Parameter	Possible Values	
Data Rate	Minimum	1200 bits/s (2%Error)
		9600 bits/s (1%Error)
	Maximum	3M bit/s (1%Error)
Flow Control	RTS/CTS or None	
Parity	None, Odd or Even	
Number of Stop Bits	1 or 2	
Bits per Channel	8	

Table 16: Possible UART Settings

The UART interface is capable of resetting WT41 upon reception of a break signal. A break is identified by a continuous logic low (0V) on the UART_RX terminal, as shown in Figure 13. If tBRK is longer than the value, defined by PSKEY_HOST_IO_UART_RESET_TIMEOUT, (0x1a4), a reset will occur. This feature allows a host to initialise the system to a known state. Also, WT41 can emit a break character that may be used to wake the host.

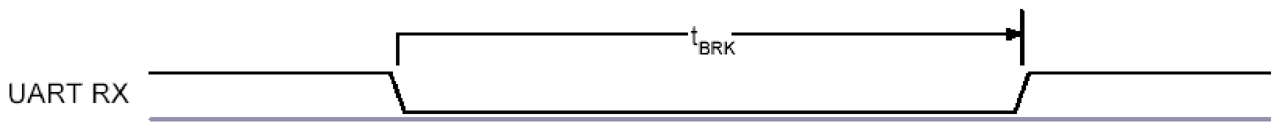


Figure 13: Break Signal

Table 17 shows a list of commonly used data rates and their associated values for PSKEY_UART_BAUD_RATE (0x204). There is no requirement to use these standard values. Any data rate within the supported range can be set in the PS Key according to the formula in Equation XXX