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# WT11i-A

DATA SHEET

Monday, 09 September 2013

Version 1.60

bluegiga

## VERSION HISTORY

| Version | Comment |
|---|---|
| 1.0 | Release |
| 1.1 | FCC radiation exposure statement updated |
| 1.2 | FCC and IC statements updated, physical dimensions added |
| 1.3 | WT11i description updated |
| 1.4 | WT11i-E removed |
| 1.41 | IC statement in French added |
| 1.42 | Table 1: reset description corrected |
| 1.43 | Contact details updated |
| 1.44 | Terminal descriptions corrected, recommended PCB land pattern added, layout recommendations updated |
| 1.45 | Current consumption, antenna characteristics |
| 1.46 | Package dimensions added |
| 1.47 | Tolerance for the external dimensions |
| 1.48 | Figure 9. Tolerances updated. |
| 1.49 | Page 38: Reset is active high |
| 1.5 | Current consumption corrected |
| 1.51 | TX power vs supply voltage and power control steps added |
| 1.52 | FCC certification notice updated |
| 1.53 | External dimensions |
| 1.54 | Pin No. 1 indicator in the PCN land pattern |
| 1.55 | Peak current consumption corrected from 170 mA to 180 mA |
| 1.56 | MIC Japan information updated |
| 1.57 | FCC/IC SAR requirement |

| | |
|---|---|
| 1.58 | MIC Japan ID corrected |
| 1.59 | Minor updates to the SPI interface description |

## TABLE OF CONTENTS

# WT11i *Bluetooth®* Module

## DESCRIPTION

WT11i is a fully integrated *Bluetooth* 2.1 + EDR, class 1 module combining antenna, *Bluetooth* radio and an on-board iWRAP Bluetooth stack. Bluegiga WT11i provides an ideal solution for developers that want to quickly integrate long range and high performance *Bluetooth* wireless technology to their design without investing several months into *Bluetooth* radio and stack development. WT11i provides a 100dB link budget ensuring long rage and robust *Bluetooth* connectivity. WT11i uses Bluegiga's iWRAP *Bluetooth* stack, which is an embedded *Bluetooth* stack implementing 13 different *Bluetooth* profiles and Apple iAP connectivity. By using WT11i combined with iWRAP *Bluetooth* stack and Bluegiga's excellent technical support designers ensure quick time to market, low development costs and risk.

## APPLICATIONS:

- Industrial and M2M
- Point-of-Sale devices
- Computer Accessories

## KEY FEATURES:

**Radio features:**

- Bluetooth v.2.1 + EDR
- Bluetooth class 1 radio
- Transmit power: +17 dBm
- Receiver sensitivity: -86 dBm
- Range: 350 meters line-of-sight
- Integrated chip antenna or U.FL connector

**Hardware features:**

- UART and USB host interfaces
- 802.11 co-existence interface
- 6 software programmable IO pins
- Operating voltage: 2.7V to 3.6V
- Temperature range: -40C to +85C
- Dimensions: 35.75 x 14.50 x 2.6 mm

**Qualifications:**

- *Bluetooth*
- CE
- FCC
- IC
- Japan

## PHYSICAL OUTLOOK

# 1 ORDERING INFORMATION

| | U.FL Connector | Internal chip antenna |
|---|---|---|
| iWRAP 5.0 firmware | WT11i-E-AI5 | WT11i-A-AI5 |
| iWRAP 4.0 firmware | WT11i-E-AI4 | WT11i-A-AI4 |
| iWRAP 3.0 firmware | WT11i-E-AI3 | WT11i-A-AI3 |
| HCI firmware, BT2.1 + EDR | WT11i-E-HCI21 | WT11i-A-HCI21 |
| Custom firmware | WT11i-E-C (* | WT11i-A-C (* |

**Table 1: Ordering information**

**) Custom firmware means any standard firmware with custom parameters (like UART baud rate), custom firmware developer by customer or custom firmware developed by Bluegiga for the customer.*

*To order custom firmware you must have a properly filled Custom Firmware Order From and unique ordering code issued by Bluegiga.*

*Contact sales@bluegiga.com for more information.*

# 2 Pinout and Terminal Description

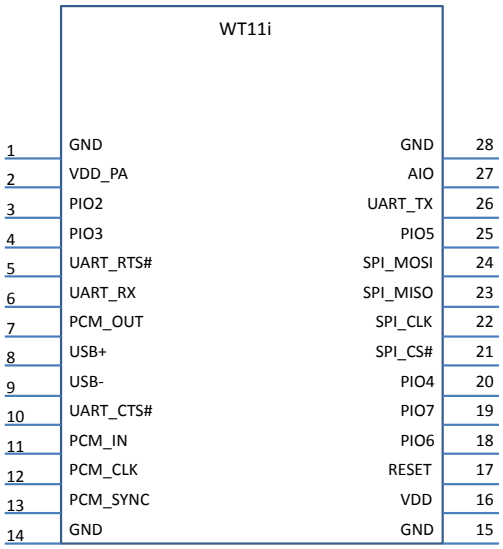



**Figure 1: WT11i connection diagram**

| | PIN NUMBER | PAD TYPE | DESCRIPTION |
|---|---|---|---|
| RESET | 17 | Input, internal 220kohm pull-down, internal start up reset circuitry | Active high reset. Keep high for >5 ms to cause a reset |
| GND | 1, 14, 15, 28 | GND | GND |
| VDD_PA | 2 | Supply voltage | Supply voltage for the RF power amplifier |
| VDD | 16 | Supply voltage | Supply voltage for BC4 and the flash memory |

**Table 2: Supply and RF Terminal Descriptions**

| PIO PORT | PIN NUMBER | PAD TYPE | DESCRIPTION |
|---|---|---|---|
| PIO[2] | 3 | Bi-directional, programmamble strength internal pull-down/pull-up | Programmamble input/output line |
| PIO[3] | 4 | Bi-directional, programmamble strength internal pull-down/pull-up | Programmamble input/output line |
| PIO[4] | 20 | Bi-directional, programmamble strength internal pull-down/pull-up | Programmamble input/output line |
| PIO[5] | 25 | Bi-directional, programmamble strength internal pull-down/pull-up | Programmamble input/output line |
| PIO[6] | 18 | Bi-directional, programmamble strength internal pull-down/pull-up | Programmamble input/output line |
| PIO[7] | 19 | Bi-directional, programmamble strength internal pull-down/pull-up | Programmamble input/output line |
| AIO[1] | 27 | Bi-directional | Programmamble analog input/output line |

**Table 3: GPIO Terminal Descriptions**

| SPI INTERFACE | PIN NUMBER | PAD TYPE | DESCRIPTION |
|---|---|---|---|
| PCM_OUT | 7 | CMOS output, tri-state, weak internal pull-down | Synchronous data output |
| PCM_IN | 11 | CMOS input, weak internal pull-down | Synchronous data input |
| PCM_SYNC | 13 | Bi-directional, weak internal pull-down | Synchronous data sync |
| PCM_CLK | 12 | Bi-directional, weak internal pull-down | Synchronous data clock |

**Table 4: PCM Terminal Descriptions**

| UART Interfaces | PIN NUMBER | PAD TYPE | DESCRIPTION |
|---|---|---|---|
| UART_TX | 26 | CMOS output, tri-state, with weak internal pull-up | UART data output, active high |
| UART_RTS# | 5 | CMOS output, tri-state, with weak internal pull-up | UART request to send, active low |
| UART_RX | 6 | CMOS input, tri-state, with weak internal pull-down | UART data input, active high |
| UART_CTS# | 10 | CMOS input, tri-state, with weak internal pull-down | UART clear to send, active low |

**Table 5: UART Terminal Descriptions**

| USB Interfaces | PIN NUMBER | PAD TYPE | DESCRIPTION |
|---|---|---|---|
| USB+ | 8 | Bidirectional | USB data plus with selectable internal 1.5k pull-up resistor |
| USB- | 9 | Bidirectional | USB data minus |

**Table 6: USB Terminal Descriptions**

| SPI INTERFACE | PIN NUMBER | PAD TYPE | DESCRIPTION |
|---|---|---|---|
| SPI_MOSI | 24 | CMOS input with weak internal pull-down | SPI data input |
| SPI_CS# | 21 | CMOS input with weak internal pull-up | Chip select for Serial Peripheral Interface, active low |
| SPI_CLK | 22 | CMOS input with weak internal pull-down | SPI clock |
| SPI_MISO | 23 | CMOS output, tristate, with weak internal pull down | SPI data output |

**Table 7: Terminal Descriptions**

# 3 Electrical Characteristics

## 3.1 Absolute Maximum Ratings

| Rating | Min | Max | Unit |
|---|---|---|---|
| Storage Temperature | -40 | 85 | °C |
| VDD_PA, VDD | -0.4 | 3.6 | V |
| Other Terminal Voltages | VSS-0.4 | VDD+0.4 | V |

**Table 8: 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 9: Recommended Operating Conditions**

## 3.3 Current Consumption

| | Packet type | Power level | MAX | AVG | Unit |
|---|---|---|---|---|---|
| TX | DH1 | 17 dBm | 180 | 72 | mA |
| | | 12 dm | 110 | 54 | |
| | DH5 | 17 dBm | 170 | 128 | |
| | | 12 dm | 110 | 84 | |
| | 2DH5 | 12 dm | 120 | 93 | |
| | 3DH5 | 12 dm | 120 | 93 | |
| RX | - | - | - | 39 | |
| Sleep | - | - | - | 50 | µA |
| Inquiry | - | 17 dBm | | 59 | mA |

**Table 10: WT11i Current Consumption**

## 3.4 PIO Current Sink and Source Capability

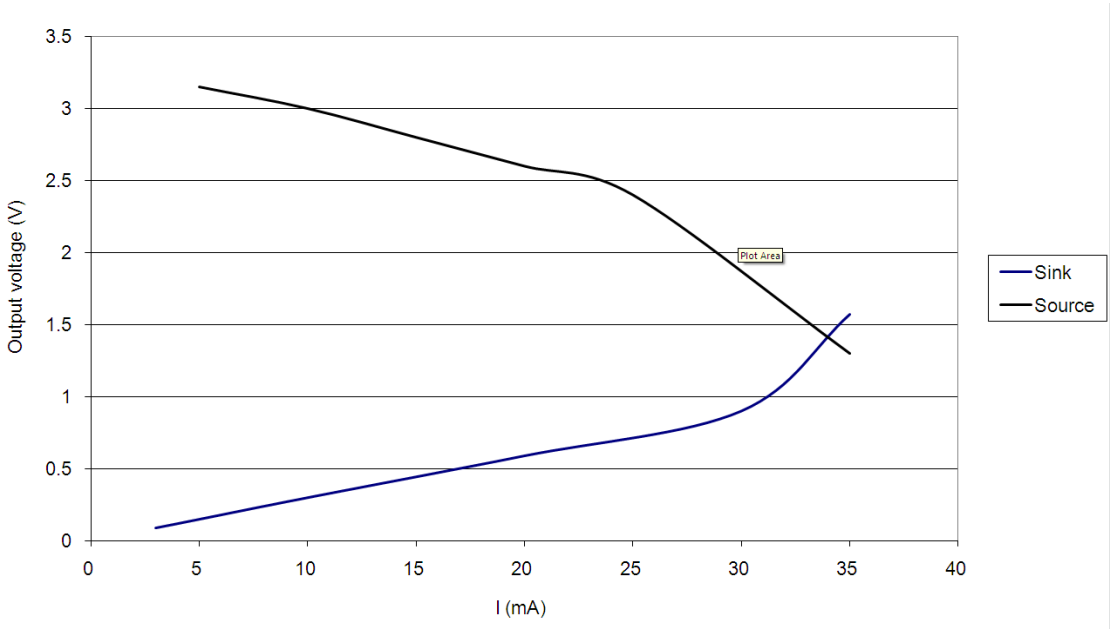



**Figure 2: WT11i PIO Current Drive Capability**

## 3.5 Radio Characteristics

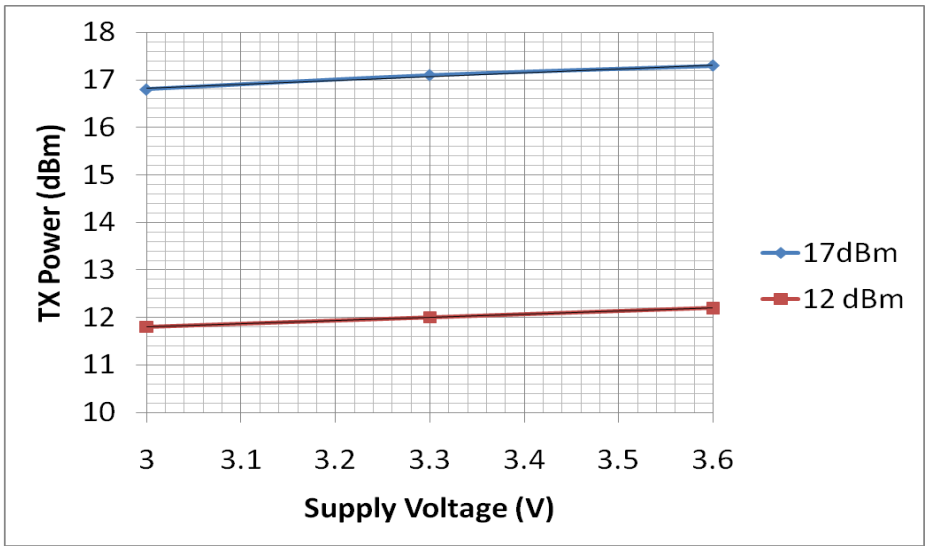



**Figure 3: WT11i-A TX Power vs VDD_PA Supply Voltage**

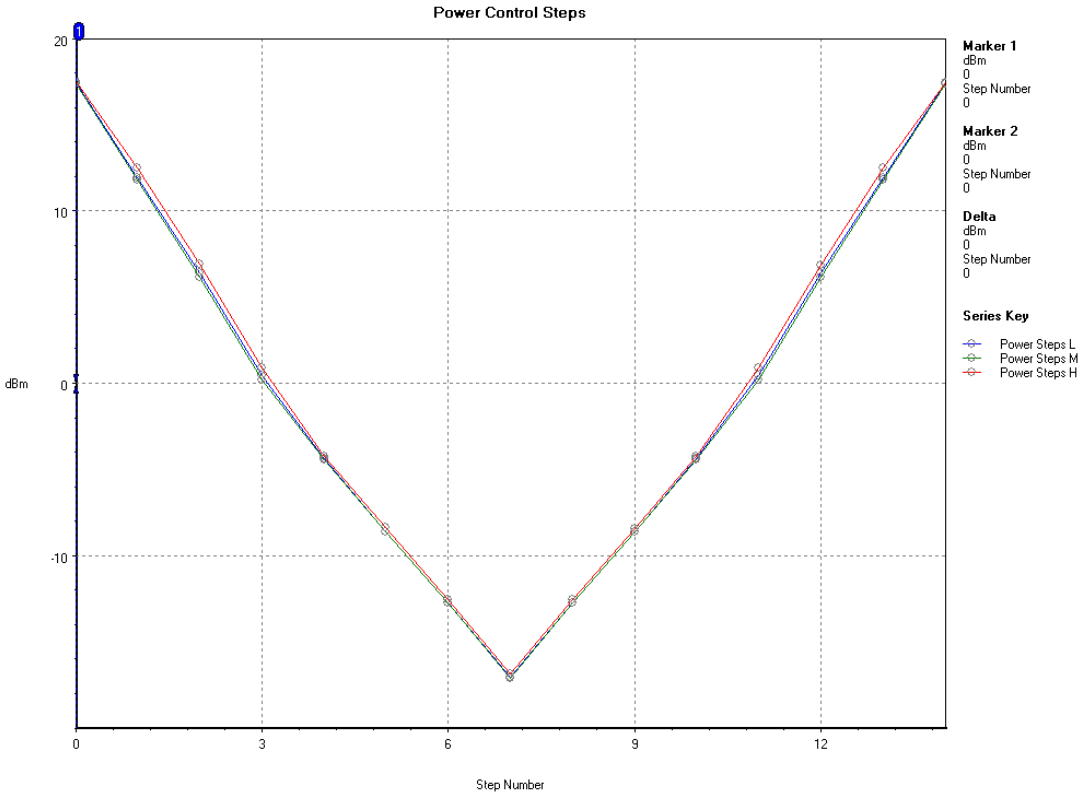



**Figure 4: Power Control Steps Of WT11i-A**

## 3.6 Antenna Specification

WT11i uses a monopole type on a chip antenna with maximum gain of 0.5 dBi. The radiation pattern and the total radiated efficiency are dependent on the layout and any metal around the antenna has an effect on the radiation characteristics. Typically the efficiency is 30 … 50%.

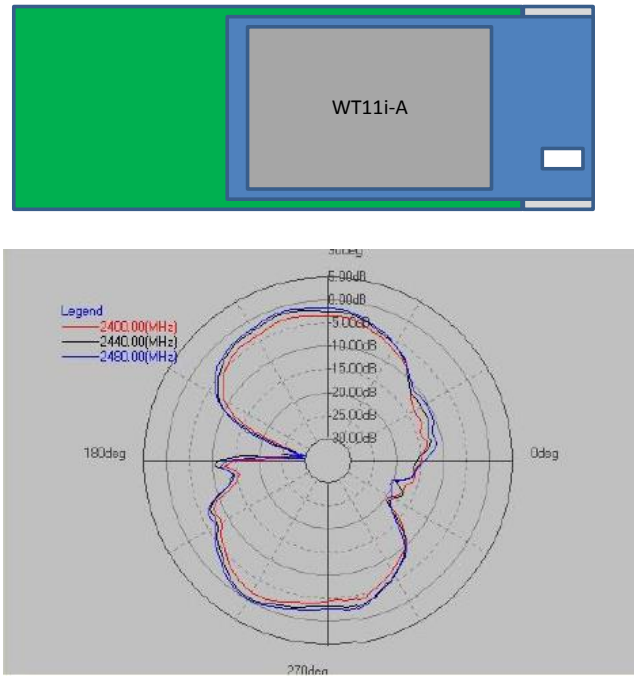



**Figure 5: Antenna radiation pattern in a USB dongle layout**

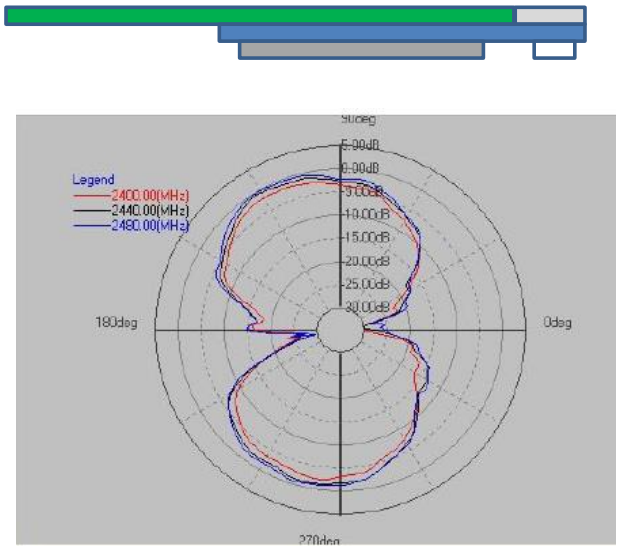



**Figure 6: Antenna radiation pattern in a USB dongle layout**

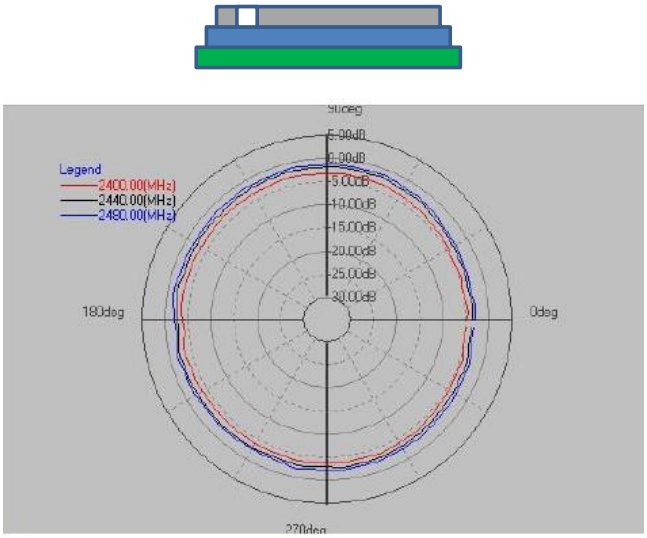



**Figure 7: Antenna radiation pattern in a USB dongle layout**

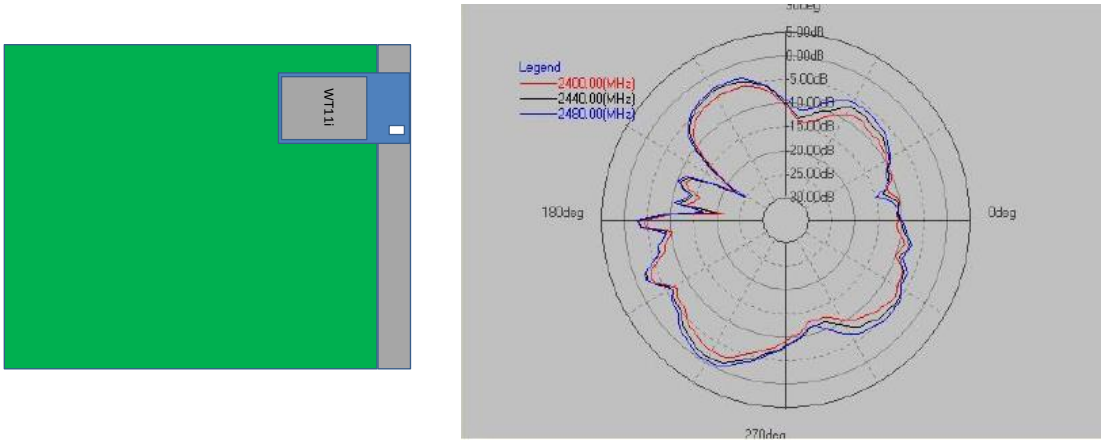



**Figure 8: Antenna radiation pattern in the WT11 evaluation kit**

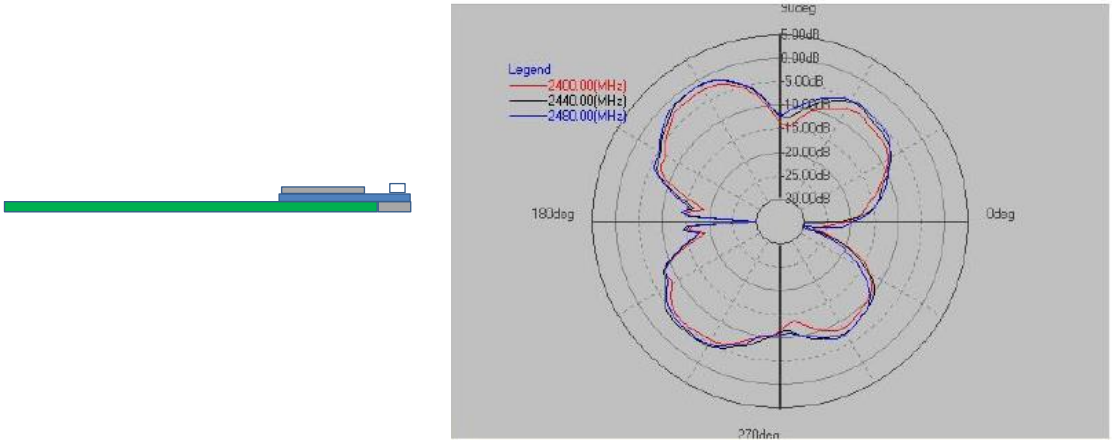



**Figure 9: Antenna radiation pattern in the WT11 evaluation kit**

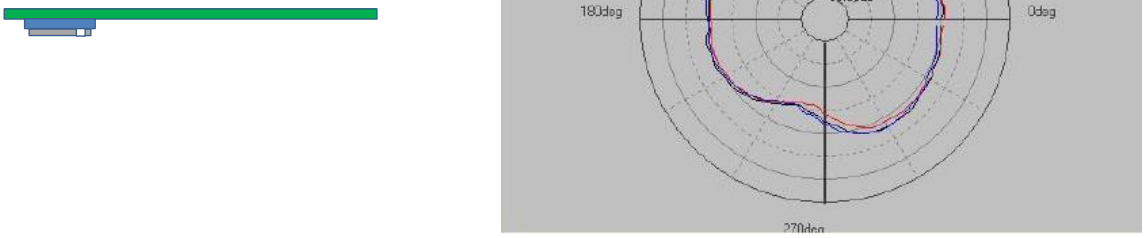



**Figure 10: Antenna radiation pattern in the WT11 evaluation kit**

# 4 Physical Dimensions

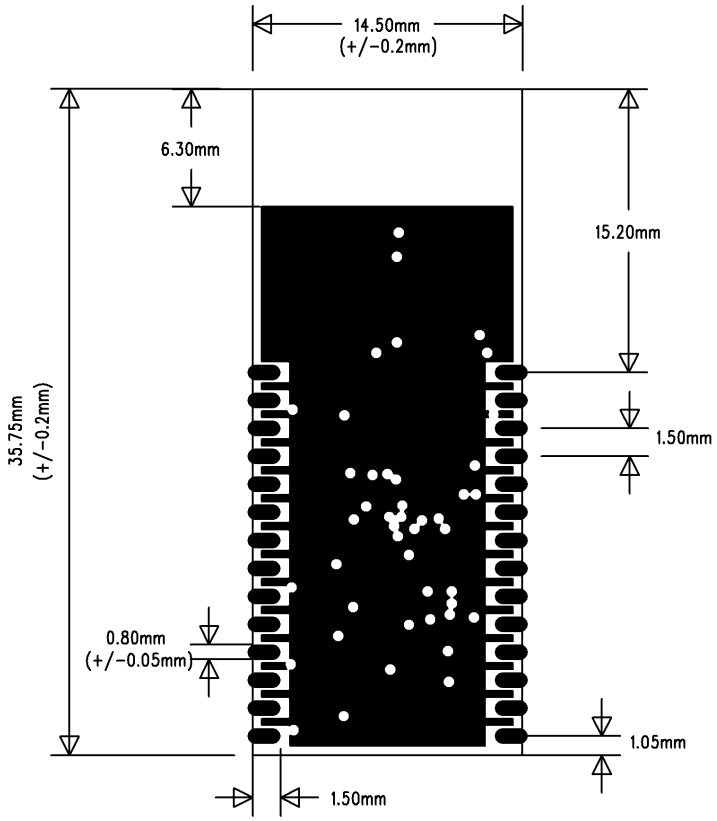
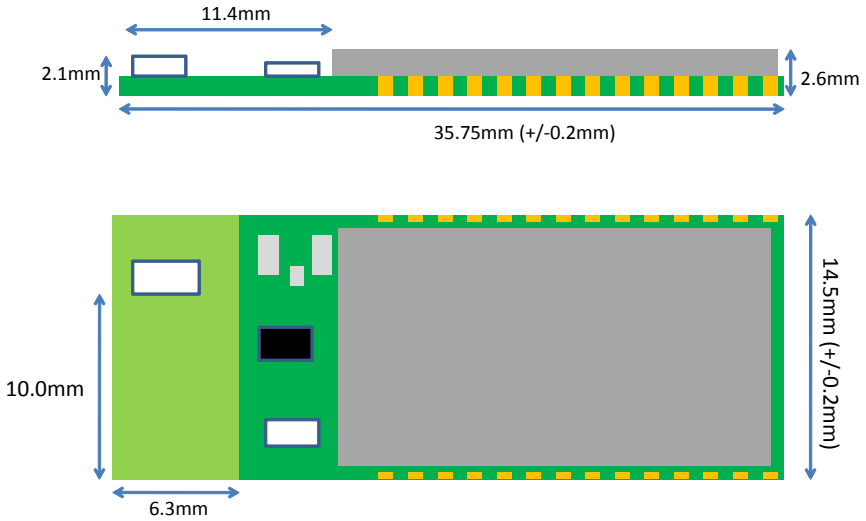



**Figure 11: Physical dimensions (top view)**




Tolerance for the thickness is +/-10%

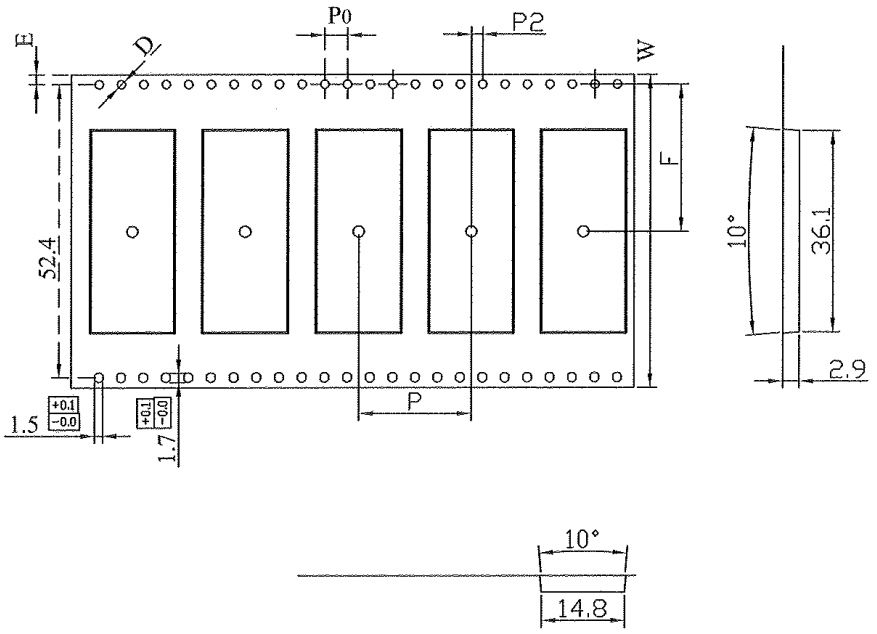
**Figure 12: Dimensions of WT11i**

## 4.1 Package Drawings

DEVICE TYPE:WT11i-A
CUSTOMER :
DWG NO :CM0

MATERIAL :P.S0.4黑色
DATE : 99.02.24

| ITEM | W | A0 | B0 | K0 | K1 | P | E | F | D | D1 | P0 | P2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DIM | 56 +0.3 -0.3 | 14.8 +0.1 -0.1 | 36.1 +0.1 -0.1 | 2.9 +0.1 -0.1 | 0 +0.1 -0.1 | 20 +0.1 -0.1 | 1.75 +0.1 -0.1 | 26.2 +0.1 -0.1 | 1.5 +0.1 -0.0 | 2.0 +0.25 -0.0 | 4.0 +0.1 -0.1 | 2.0 +0.1 -0.1 |




NOTE:

1.10 sprocket hole pitch cumulative tolerance±0.2
2.Carrier camber is 1mm in 100mm
3.A0 and B0 measured on a plance 0.3mm above the bottom of the pocket
4.K0 measured from a plane on the inside bottom of the pocket to the top surface of the carrier
5.All dimensions meet EIA-481-2 requirements
6. 22" 1R= 65M 3000PCS 13"1R= 500PCS

CUSTOMER: DESIGNER: DRAW:

**Figure 13: WT11i taping**

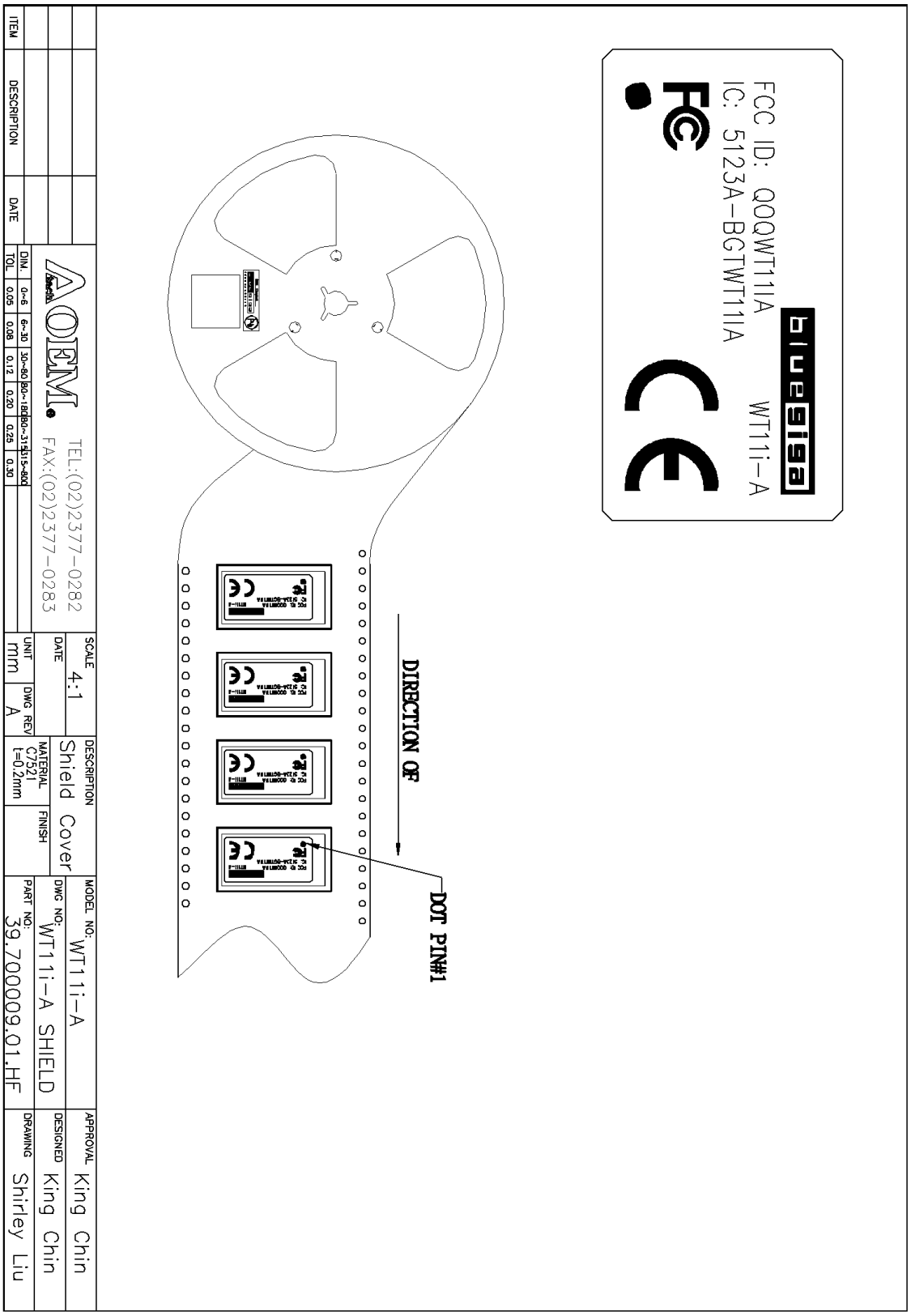



**Figure 14: WT11i orientation in the reel**

# 5 Layout Guidelines

WT11i is pin compatible with WT11 despite of slightly different external dimensions. For new design it recommended to follow the land pattern shown in the figure below.

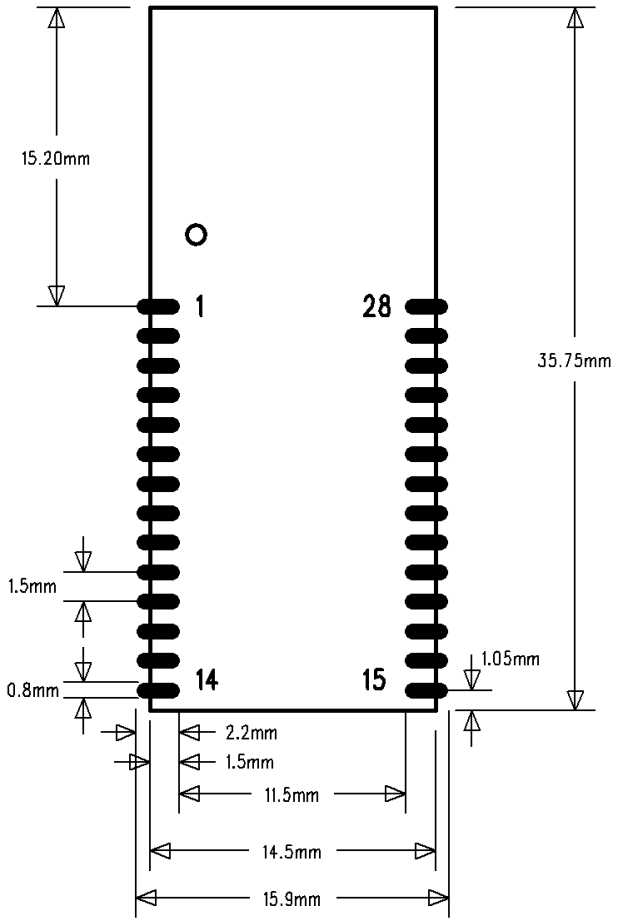



**Figure 15: Recommended PCB land pattern for WT11i**

Do not place any copper under the antenna. The minimum recommended keep out area is shown in the figure 16. Any dielectric material in close proximity to the antenna will effect on the impedance matching of the antenna by lowering the resonance frequency. Figure 17 shows how different FR4 thickness under the antenna effect on the resonance frequency. Recommended PCB thickness for the PCB is 1.6 mm – 2.8 mm. Avoid placing plastic cover closer than 3 mm from the antenna as this will also tune the resonance frequency downwards.

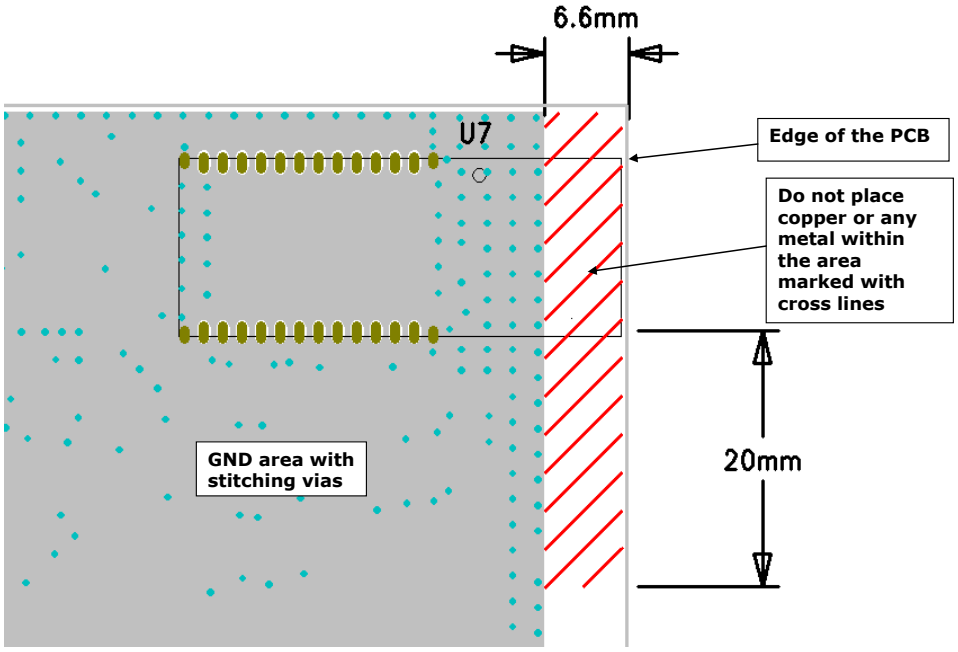



**Figure 16: Recommended metal keep put area for WT11i**

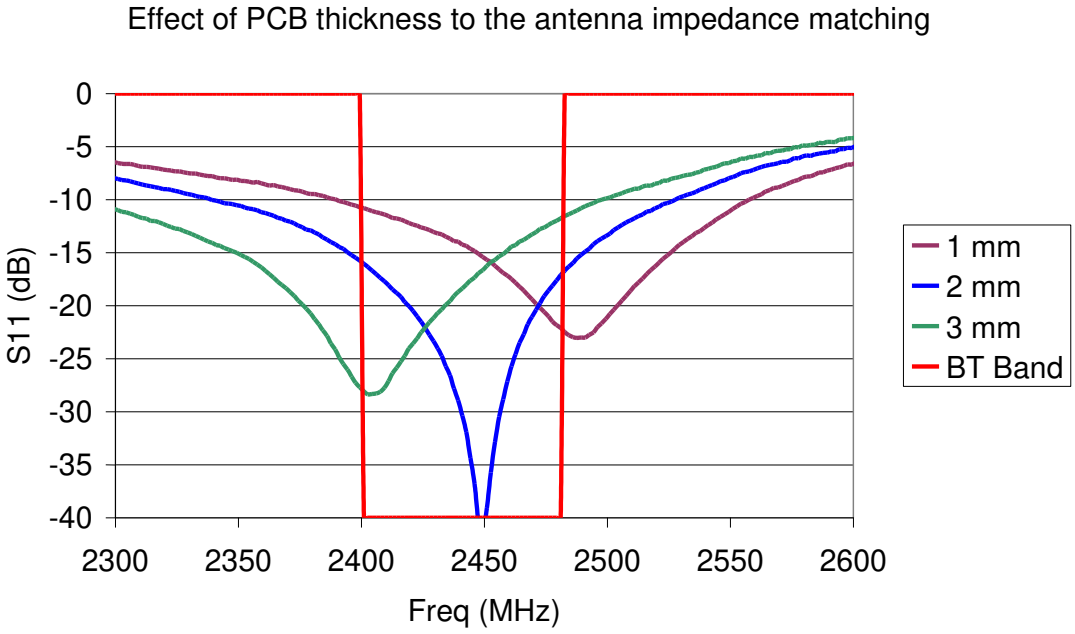



**Figure 17: Effect of FR4 under the antenna to the resonant frequency**

Use good layout practices to avoid excessive noise coupling to supply voltage traces or sensitive analog signal traces, such as analog audio signals. If using overlapping ground planes use stitching vias separated by max 3 mm to avoid emission from the edges of the PCB. Connect all the GND pins directly to a solid GND plane and make sure that there is a low impedance path for the return current following the signal and supply traces all the way from start to the end.

A good practice is to dedicate one of the inner layers to a solid GND plane and one of the inner layers to supply voltage planes and traces and route all the signals on top and bottom layers of the PCB. This arrangement will make sure that any return current follows the forward current as close as possible and any loops are minimized.


**Figure 18:** Typical 4-layer PCB construction

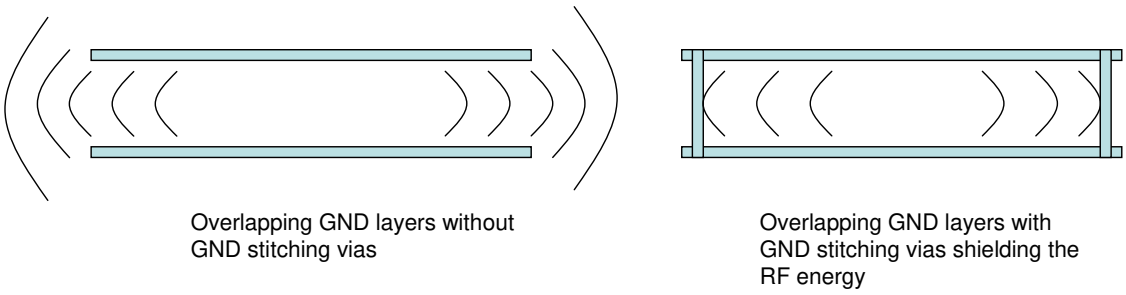



**Figure 19:** Use of stitching vias to avoid emissions from the edges of the PCB

# 6 UART Interface

This is a standard UART interface for communicating with other serial devices.WT11i 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 WT11i 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 WT11i 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 11: Possible UART Settings**

The UART interface is capable of resetting WT11i 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 9. 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, WT11i can emit a break character that may be used to wake the host.

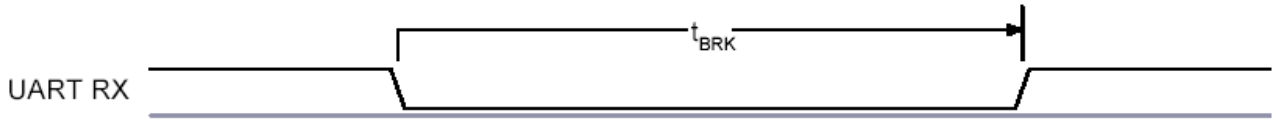



**Figure 20: Break Signal**

Table 11 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 1

$$\text{Data Rate} = \frac{\text{PSKEY\_UART\_BAUDRATE}}{0.004096}$$

**Equation 1: Data Rate**

| Data Rate (bits/s) | Persistent Store Value | Error | Dec |
|---|---|---|---|
| | Hex | | |
| 1200 | 0x0005 | 5 | 1.73% |
| 2400 | 0x000a | 10 | 1.73% |
| 4800 | 0x0014 | 20 | 1.73% |
| 9600 | 0x0027 | 39 | -0.82% |
| 19200 | 0x004f | 79 | 0.45% |
| 38400 | 0x009d | 157 | -0.18% |
| 57600 | 0x00ec | 236 | 0.03% |
| 76800 | 0x013b | 315 | 0.14% |
| 115200 | 0x01d8 | 472 | 0.03% |
| 230400 | 0x03b0 | 944 | 0.03% |
| 460800 | 0x075f | 1887 | -0.02% |
| 921600 | 0x0ebf | 3775 | 0.00% |
| 1382400 | 0x161e | 5662 | -0.01% |
| 1843200 | 0x1d7e | 7550 | 0.00% |
| 2764800 | 0x2c3d | 11325 | 0.00% |

**Table 12: Standard Data Rates**