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WT11

Data Sheet

Version 3.1

Friday, May 22, 2009

bluegiga TECHNOLOGIES

Contents:

TERMS & ABBREVIATIONS

Term or Abbreviation:	Explanation:
Bluetooth	Set of technologies providing audio and data transfer over short-range radio connections
CE	Conformité Européene
DFU	Device Firmware Upgrade
EDR	Enhanced Data Rate
FCC	Federal Communications Commission
HCI	Host Controller Interface
HID	Human Interface Device
iWRAP	Interface for WRAP
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
RoHS	The Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive (2002/95/EC)
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Transmitter Receiver
USB	Universal Serial Bus
VM	Virtual Machine
WRAP	Wireless Remote Access Platform

DESCRIPTION

WT11 is a next-generation, class 1, Bluetooth® 2.0+EDR (Enhanced Data Rates) module. It introduces three times faster data rates compared to existing Bluetooth® 1.2 modules even with lower power consumption! WT11 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 WT11 provides an ideal solution for developers who want to integrate Bluetooth® wireless technology into their design with limited knowledge of Bluetooth® and RF technologies.

By default WT11 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 luetooth® modem.

FEATURES:

- Fully Qualified Bluetooth system v2.0 + EDR, CE and FCC
- Class 1, range up to 300 meters
- Integrated chip antenna or UFL connector
- Industrial temperature range from -40°C to +85°C
- Enhanced Data Rate (EDR) compliant with v2.0.E.2 of specification for both 2Mbps and 3Mbps modulation modes
- RoHS Compliant
- Full Speed Bluetooth Operation with Full Piconet
- Scatternet Support
- USB interface (USB 2.0 compatible)
- UART with bypass mode
- Support for 802.11 Coexistence
- 8Mbits of Flash Memory

APPLICATIONS:

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

Figure 1: Physical outlook of WT11-A

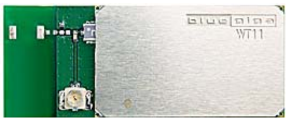

Figure 2: Physical outlook of WT11-E

ORDERING INFORMATION:

	Internal chip antenna	UFL connector
iWRAP 3.0 firmware	WT11-A-AI3	WT11-E-AI3
iWRAP 2.2.0 firmware	WT11-A-AI	WT11-E-AI
HCI firmware, BT2.1 + EDR	WT11-A-HCI21	WT11-E-HCI21
HCI firmware, BT2.0 + EDR	WT11-A-HCI	WT11-E-HCI
Custom firmware	WT11-A-C (*	WT11-E-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 support@bluegiga.com for more information.

1. BLOCK DIAGRAM AND DESCRIPTIONS

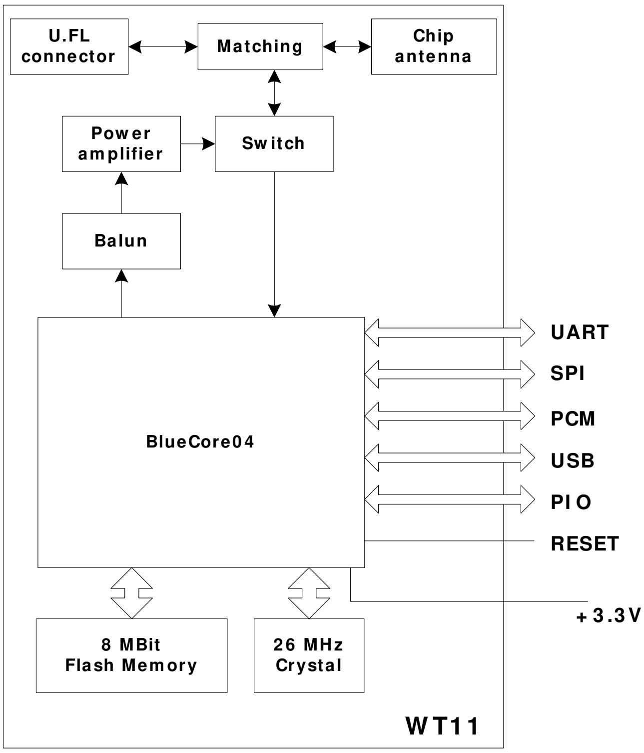

Figure 3: Block Diagram of WT11

BlueCore04

BlueCore4 is a single chip Bluetooth solution which implements the Bluetooth radio transceiver and also an on chip microcontroller. BlueCore4 implements Bluetooth® 2.0+EDR (Enhanced Data Rate) and it can deliver data rates up to 3 Mbps.

The microcontroller (MCU) on BlueCore04 acts as interrupt controller and event timer run the Bluetooth software stack and control the radio and host interfaces. A 16-bit reduced instruction set computer (RISC) microcontroller is used for low power consumption and efficient use of memory.

BlueCore04 has 48Kbytes of on-chip RAM is provided to support the RISC MCU and is shared between the ring buffers used to hold voice/data for each active connection and the general purpose memory required by the Bluetooth stack.

Crystal

The crystal oscillates at 26MHz.

Flash

Flash memory is used for storing the Bluetooth protocol stack and Virtual Machine applications. It can also be used as an optional external RAM for memory intensive applications.

Balun

Balun changes the balanced input/output signal of the module to unbalanced signal of the monopole antenna.

Power amplifier

Power amplifier is used to increase the output power to a level required by class 1 specification.

Switch

Switch is used to separate transmission and receiver modes.

Matching

Antenna matching components match the antenna to 50 Ohms and also selects between chip antenna and UFL connector.

Antenna

The antenna is ACX AT3216 chip antenna.

U.FL

This is a standard U.FL male connector for external antenna possibility.

USB

This is a full speed Universal Serial Bus (USB) interface for communicating with other compatible digital devices. WT11 acts as a USB peripheral, responding to requests from a Master host controller such as a PC.

Synchronous Serial Interface

This is a synchronous serial port interface (SPI) for interfacing with other digital devices. The SPI port can be used for system debugging. It can also be used for programming the Flash memory.

UART

This is a standard Universal Asynchronous Receiver Transmitter (UART) interface for communicating with other serial devices.

Audio PCM Interface

The audio pulse code modulation (PCM) Interface supports continuous transmission and reception of PCM encoded audio data over Bluetooth.

Programmable I/O

WT11 has a total of 6 digital programmable I/O terminals. These are controlled by firmware running on the device.

Reset

This can be used to reset WT11.

802.11 Coexistence Interface

Dedicated hardware is provided to implement a variety of coexistence schemes. Channel skipping AFH (Adaptive Frequency Hopping), priority signaling, channel signaling and host passing of channel instructions are all supported. The features are configured in firmware. Since the details of some methods are proprietary (e.g. Intel WCS) please contact Bluegiga Technologies for details.

2. ELECTRICAL CHARACTERISTICS

Absolute maximum ratings

	Min	Max	Unit
Storage temperature	-40	85	°C
Operating temperature	-40	85	°C
Supply voltage	-0,3	3,6	V
Terminal voltages	-0,4	Vdd + 0,4	V
Output current from PIOs		35	mA

The module should not continuously run under these conditions. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability and cause permanent damage to the device.

Table 2: Absolute maximum ratings

Recommended operating conditions

	Min	Max	Unit
Operating temperature	-40	85	°C
Supply voltage	3,1 (1)(2)	3.6	V
Terminal voltages	0	Vdd	V

Table 3: Recommended operating conditions

1) WT11 operates as low as 2,7 V supply voltage. However, to safely meet the USB specification for minimum voltage for USB data lines, minimum of 3,1 V supply is required.

2) The supply voltage has an effect on the output power of WT11. See figure 4.

Terminal characteristics

	Min	Typ	Max	Unit
I/O voltage levels				
V_{IL} input logic level low	-0,4	-	0,8	V
V_{IH} input logic level high	0,7Vdd	-	Vdd + 0,4	V
V_{OL} output logic level low	-	-	0,2	V
V_{OH} output logic level high	Vdd - 0,2	-	-	V
Reset terminal				
$V_{TH,res}$ threshold voltage	0,64	0,85	1,5	V
R_{IRES} input resistance		220		kΩ
C_{IRES} input capacitance		220		nF
Input and tri-state current with				
Strong pull-up	-100	-40	-10	µA
Strong pull-down	10	40	100	µA
Weak pull-up	-5	-1	-0,2	µA
Weak pull-down	0,2	1	5	µA
I/O pad leakage current	-1	0	1	µA
Vdd supply current				
TX mode	-	-	170	mA
RX mode	-	-	170	mA

Table 4: Terminal characteristics

Current consumption

Test conditions: Room temperature, Vdd = 3,3 V, iWRAP firmware

OPERATION MODE	Peak supply current	AVG supply current	Unit	Notes
Peak current at TX mode	170	-	mA	-
Peak current at RX mode	170	-	mA	-
IDLE	-	3	mA	Module is idle Default settings
IDLE, Deep Sleep ON	-	1,5	mA	Module is idle
IDLE, Deep Sleep ON NOT visible, NOT connectable	-	0,37	mA	Module is idle Minimum consumption
INQUIRY	-	54,6	mA	Device discovery with INQUIRY command
NAME	-	54,6	mA	Name resolution
CALL [channel]	-	54,6	mA	CALL addr 1 RFCOMM, Default settings
CALL [UUID]	-	54,7	mA	CALL addr 1101 RFCOMM, Default settings
CONNECT Slave	-	21,5	mA	No data was transmitted, Default settings
CONNECT Master	-	6,5	mA	No data was transmitted, Default settings
CONNECT, Slave Sniff mode ON	-	3,7	mA	No data was transmitted, Default settings, Sniff parameter 1000
CONNECT, Master Sniff mode ON	-	4,9	mA	No data was transmitted, Default settings, Sniff parameter 1000
CONNECT, Slave Park mode ON	-	3,4	mA	No data was transmitted, Default settings, Park parameter 1000
CONNECT. Master Park mode ON	-	6,3	mA	No data was transmitted, Default settings, Park parameter 1000
CONNECT + DataSlave (RX)	-	33,4	mA	UART: 115200,8n1, Full bandwidth transmission, Default settings, 2 meter distance
CONNECT + DataMaster (TX)	-	22,0	mA	UART: 115200,8n1, Full bandwidth transmission, Default settings, 2 meter distance
CONNECT + DataSlave (RX) Sniff mode ON	-	23,8	mA	UART: 115200,8n1, Sniff parameter 40, Full bandwidth transmission, 1 meter distance
CONNECT + DataMaster (TX) Sniff mode ON	-	18,3	mA	UART: 115200,8n1, Sniff parameter 40, Full bandwidth transmission, 1 meter distance

Table 5: Current consumption

Radio characteristics and general specifications

	Specification		Note
Operating frequency range	(2400 ... 2483,5) MHz		ISM Band
Lower quard band	2 MHz		
Upper quard band	3,5 MHz		
Carrier frequency	2402 MHz ... 2480 MHz		f = 2402 + k, k = 0...78
Modulation method	GFSK (1 Mbps) P/4 DQPSK (2Mbps)		
Hopping	1600 hops/s, 1 MHz channel space		
Maximum data rate	GFSK:	Asynchronous, 723.2 kbps / 57.6 kbps Synchronous: 433.9 kbps / 433.9 kbps	
	P/4 DQPSK:	Asynchronous, 1448.5 kbps / 115.2 kbps Synchronous: 869.7 kbps / 869.7 kbps	
	8DQPSK:	Asynchronous, 2178.1 kbps / 177.2 kbps Synchronous: 1306.9 kbps / 1306.9 kbps	
Receiving signal range	-82 to -20 dBm		Typical condition
Receiver IF frequency	1.5 MHz		Center frequency
Transmission power	Min	-11 ... -9 dBm	
	Max	+14 ... +18 dBm	
RF input impedance	50 Ω		
Compliance	Bluetooth specification, version 2.0 + EDR		
USB specification	USB specification, version 1.1 (USB 2.0 compliant)		

Table 6: Radio characteristics and general specifications

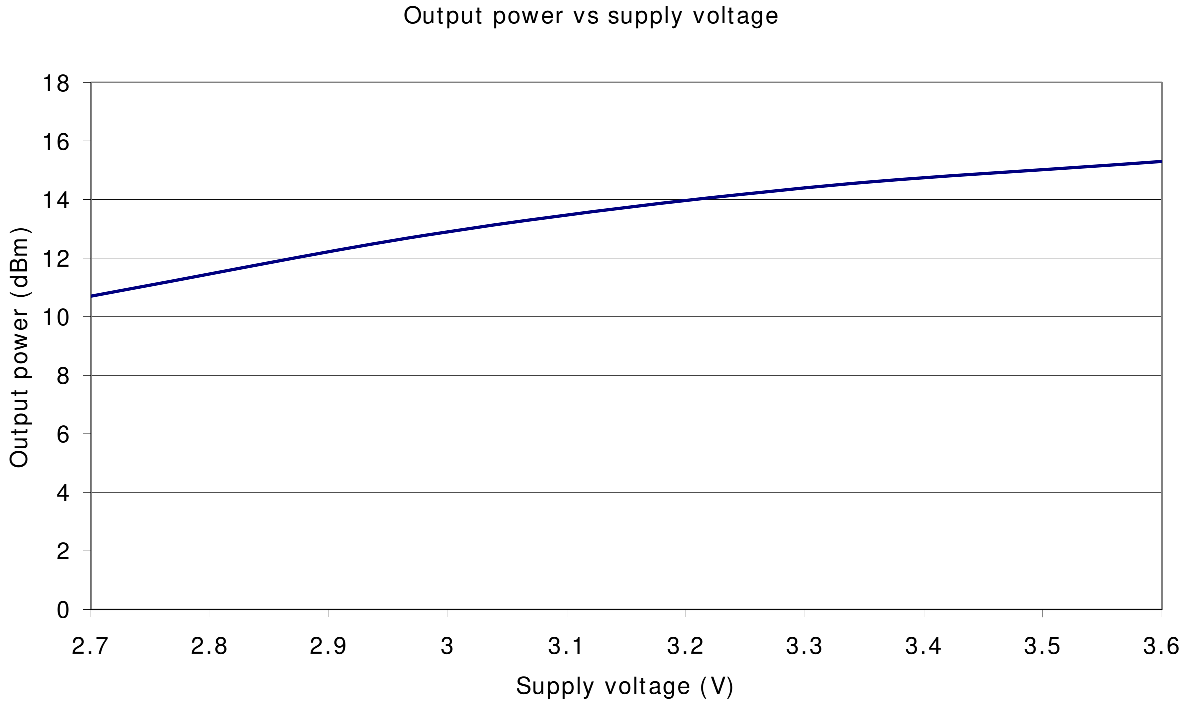

Figure 4: WT11 output power vs supply voltage

3. WT11 PIN DESCRIPTION

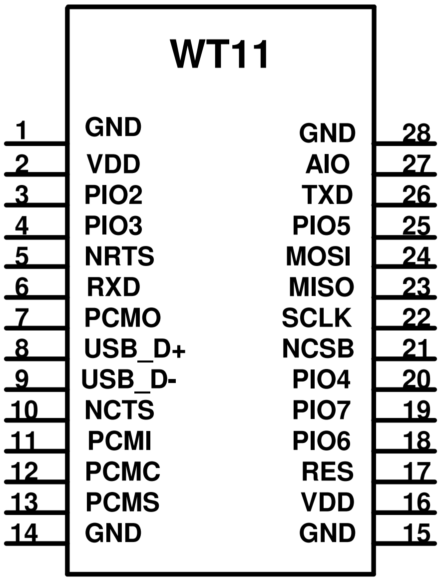

Figure 5: WT11 connection diagram

GND (pins 1, 14, 15 and 28)

Connect GND pins to the ground plane of PCB.

VDD (pins 2 and 16)

3.3 V supply voltage connection. WT11 has an internal decoupling capacitor and LC filter to block high frequency disturbances. Thus external filtering is usually not needed. It is however recommended to leave an option for an external high Q 10pF decoupling capacitor in case EMC problems arise.

RES (pin 17)

The RESET pin is an active high reset and is internally filtered using the internal low frequency clock oscillator. A reset will be performed between 1.5 and 4.0ms following RESET being active. It is recommended that RESET be applied for a period greater than 5ms.

WT11 has an internal reset circuitry, which keeps reset pin active until supply voltage has reached stability in the start up. This ensures that supply for the flash memory inside the WT11 will reach stability before BC4 chip fetches instructions from it. Schematic of the reset circuitry is shown in figure 5. Rising supply voltage charges the capacitor, which will activate the reset of WT11. The capacitor discharges through 220 kΩ resistor, which eventually deactivates the reset. Time constant of the RC circuitry is set such that the supply voltage is safely stabilized before reset deactivates. Pull-up or pull-down resistor should not be connected to the reset pin to ensure proper star up of WT11.

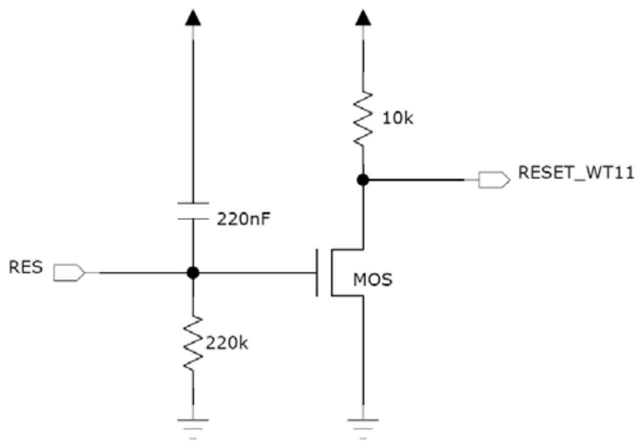

Figure 6: WT11 internal reset circuitry

PIO2 – PIO7 (pins 3, 4, 18, 19, 20 and 25)

Programmable digital I/O lines. All PIO lines can be configured through software to have either weak or strong pull-ups or pull-downs. Configuration for each PIO line depends on the application. See section 10 "I/O parallel ports" for detailed descriptions for each terminal. Default configuration for all of the PIO lines is input with weak internal pull-up.

AIO (pin 27)

General purpose analog interface. Typically used for battery voltage measurements. Can be left not connected.

NRTS (pin 5)

CMOS output with weak internal pull-up. Can be used to implement RS232 hardware flow control where RTS (request to send) is active low indicator. UART interface requires external RS232 transceiver chip.

NCTS (pin 10)

CMOS input with weak internal pull-down. Can be used to implement RS232 hardware flow control where CTS (clear to send) is active low indicator. UART interface requires external RS232 transceiver chip.

RXD (pin 6)

CMOS input with weak internal pull-down. RXD is used to implement UART data transfer from another device to WT11. UART interface requires external RS232 transceiver chip.

TXD (pin 26)

CMOS output with weak internal pull-up. TXD is used to implement UART data transfer from WT11 to another device. UART interface requires external RS232 transceiver chip.

PCMO (pin 7)

CMOS output with weak internal pull-down. Used in PCM (pulse code modulation) interface to transmit digitized audio.

PCMI (pin 11)

CMOS input with weak internal pull-down. Used in PCM interface to receive digitized audio.

PCMC (pin 12)

Bi-directional synchronous data clock signal pin with weak internal pull-down. PCMC is used in PCM interface to transmit or receive CLK signal. When configured as a master, WT11 generates clock signal for the PCM interface. When configured as a slave PCMC is an input and receives the clock signal from another device.

PCMS (pin 13)

Bi-directional synchronous data strobe with weak internal pull-down. When configured as a master, WT11 generates SYNC signal for the PCM interface. When configured as a slave PCMS is an input and receives the SYNC signal from another device.

USB_D+ (pin 8)

Bi-directional USB data line with a selectable internal 1.5 kΩ pull-up implemented as a current source (compliant with USB specification v1.2). External series resistor is required to match the connection to the characteristic impedance of the USB cable.

USB_D- (pin 9)

Bi-directional USB data line. External series resistor is required to match the connection to the characteristic impedance of the USB cable.

NCSB (pin 21)

CMOS input with weak internal pull-up. Active low chip select for SPI (serial peripheral interface).

SCLK (pin 22)

CMOS input for the SPI clock signal with weak internal pull-down. WT11 is the slave and receives the clock signal from the device operating as a master.

MISO (pin 23)

SPI data output with weak internal pull-down.

MOSI (pin 24)

SPI data input with weak internal pull-down.

4. PHYSICAL INTERFACES

4.1 UART Interface

WT11 Universal Asynchronous Receiver Transmitter (UART) interface provides a simple mechanism for communicating with other serial devices using the RS232 standard. The UART interface of WT11 uses voltage levels of 0 to Vdd and thus external transceiver IC is required to meet the voltage level specifications of UART.

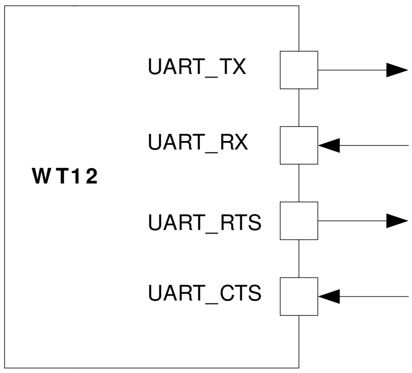

Figure 7: WT11 UART interface

Four signals are used to implement the UART function, as shown in Figure 7. When WT11 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. DTR, DSR and DCD signals can be implemented using PIO terminals of WT11. All UART connections are implemented using CMOS technology and have signaling levels of 0V and VDD.

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
Baud rate	Minimum	1200 baud (d2%Error)
		9600 baud (d1%Error)
	Maximum	3.0Mbaud (d1%Error)
Flow control		RTS/CTS, none
Parity		None, Odd, Even
Number of stop bits		1 or 2
Bits per channel		8

Table 7: Possible UART settings

The UART interface is capable of resetting WT11 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 8. If t_{BRK} is longer than the value, defined by the PS Key PSKEY_HOST_IO_UART_RESET_TIMEOUT, (0x1a4), a reset will occur. This feature allows a host to initialize the system to a known state. Also, WT11 can emit a Break character that may be used to wake the Host.

Since UART_RX terminal includes weak internal pull-down, it can't be left open unless disabling UART interface using PS_KEY settings. If UART is not disabled, a pull-up resistor has to be connected to UART_RX. UART interface requires external RS232 transceiver, which usually includes the required pull-up.

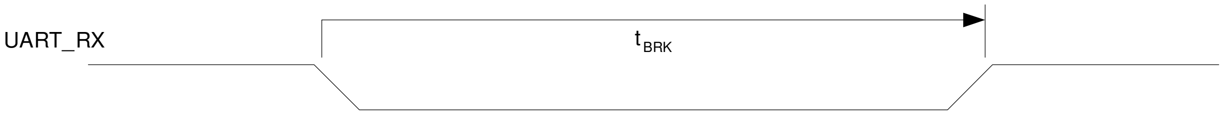

Figure 8: Break signal

Note:

Table 8 shows a list of commonly used Baud rates and their associated values for the Persistent Store Key PSKEY_UART_BAUD_RATE (0x204). There is no requirement to use these standard values. Any Baud rate within the supported range can be set in the Persistent Store Key according to the formula in Equation below.

$$\text{Baud Rate} = \frac{\text{PSKEY\_UART\_BAUD\_RATE}}{0.004096}$$

Figure 9: Baud rate calculation formula

Baud rate	Persistent store values		Error
	Hex	Dec	
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	263	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%
2765800	0x2c3d	11325	0.00%

Table 8: UART baud rates and error values

4.1.1 UART Configuration While RESET is Active

The UART interface for WT11 while the chip is being held in reset is tri-state. This will allow the user to daisy chain devices onto the physical UART bus. The constraint on this method is that any devices connected to this bus must tri-state when WT11reset is de-asserted and the firmware begins to run.

4.1.2 UART Bypass Mode

Alternatively, for devices that do not tri-state the UART bus, the UART bypass mode on WT11 can be used. The default state of WT11 after reset is de-asserted, this is for the host

UART bus to be connected to the WT11 UART, thereby allowing communication to WT11 via the UART.

In order to apply the UART bypass mode, a BCCMD command will be issued to WT11 upon this, it will switch the bypass to PIO[7:4] as shown in Figure 10. Once the bypass mode has been invoked, WT11 will enter the deep sleep state indefinitely.

In order to re-establish communication with WT11, the chip must be reset so that the default configuration takes affect.

It is important for the host to ensure a clean Bluetooth disconnection of any active links before the bypass mode is invoked. Therefore it is not possible to have active Bluetooth links while operating the bypass mode.

The current consumption for a device in UART Bypass Mode is equal to the values quoted for a device in standby mode.

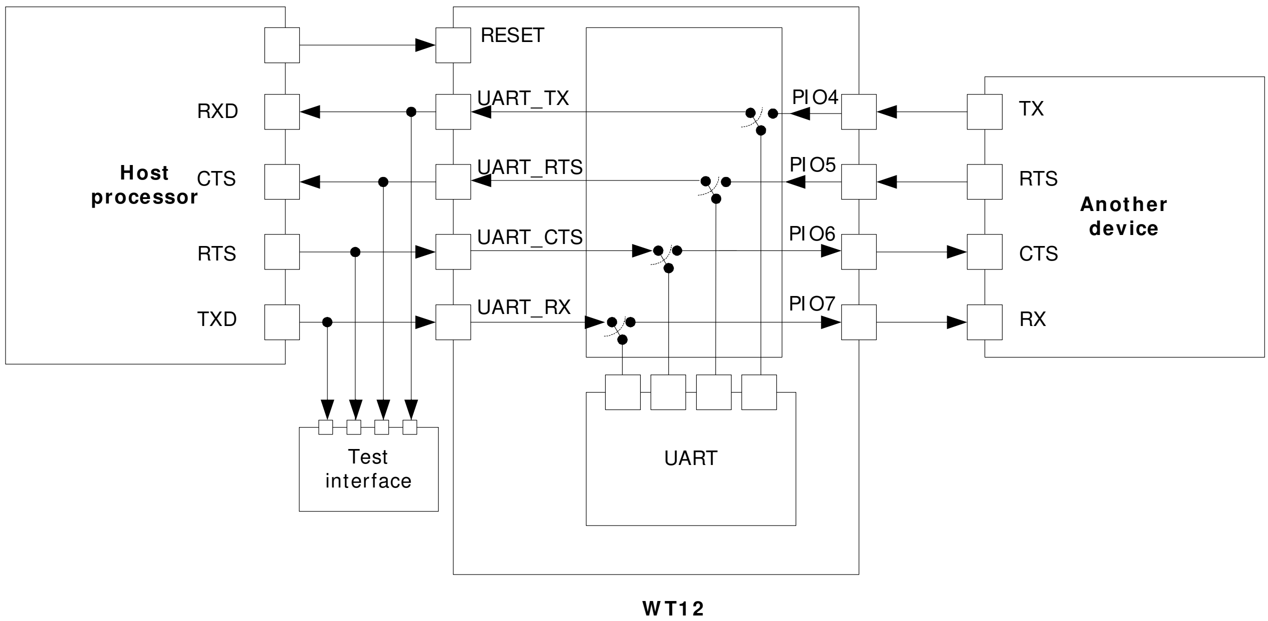

Figure 10: UART bypass mode

4.2 USB Interface

WT11 USB devices contain a full speed (12Mbits/s) USB interface that is capable of driving a USB cable directly. No external USB transceiver is required. To match the connection to the characteristic impedance of the USB cable, series resistors must be included to both of the signal lines. These should be of 1% tolerance and the value required may vary between 0 and 20 ohm with 10 ohm being nominal. The resistors should be placed close to the USB pins of the module in order to avoid reflections. The module has internally 22 ohm resistors in series. The total input impedance seen by the cable is affected by the IC characteristics, track layout and the connector. The cable impedance is approximately 40 ohm.

The device operates as a USB peripheral, responding to requests from a master host controller such as a PC. Both the OHCI and the UHCI standards are supported. The set of USB endpoints implemented can behave as specified in the USB section of the Bluetooth v2.0 + EDR specification or alternatively can appear as a set of endpoint appropriate to USB audio devices such as speakers.

As USB is a Master/Slave oriented system (in common with other USB peripherals), WT11 only supports USB Slave operation.

4.2.1 USB Pull-Up Resistor

WT11 features an internal USB pull-up resistor. This pulls the USB_DP pin weakly high when WT11 is ready to enumerate. It signals to the PC that it is a full speed (12Mbit/s) USB device.

The USB internal pull-up is implemented as a current source, and is compliant with Section 7.1.5 of the USB specification v1.2. The internal pull-up pulls USB_D+ high to at least 2.8V when loaded with a 15kΩ +/-5% pull-down resistor (in the hub/host). This presents a Therein resistance to the host of at least 900Ω. Alternatively, an external 1.5kΩ pull-up resistor can be placed between a PIO line and D+ on the USB cable. The firmware must be alerted to which mode is used by setting PS Key PSKEY_USB_PIO_PULLUP appropriately. The default setting uses the internal pull-up resistor.

4.2.2 Self Powered Mode

In self powered mode, the circuit is powered from its own power supply and not from the VBUS (5V) line of the USB cable. It draws only a small leakage current (below 0.5mA) from VBUS on the USB cable. This is the easier mode for which to design for, as the design is not limited by the power that can be drawn from the USB hub or root port. However, it requires that VBUS be connected to WT11 via a voltage devider (Rvb1 and Rvb2), so WT11 can detect when VBUS is powered up. Voltage divider is essential to drop the 5V voltage at the VBUS to 3,3V expected at the USB interface of WT11. WT11 will not pull USB_DP high when VBUS is off.

Self powered USB designs (powered from a battery or PSU) must ensure that a PIO line is allocated for USB pull-up purposes. A 1.5K 5% pull-up resistor between USB_DP and the selected PIO line should be fitted to the design. Failure to fit this resistor may result in the design failing to be USB compliant in self powered mode. The internal pull-up in WT11 is only suitable for bus powered USB devices i.e. dongles.

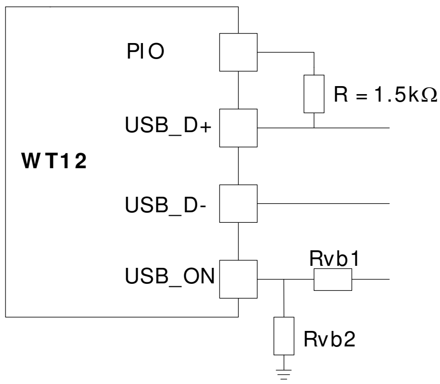

Figure 11: USB in self powered mode

The terminal marked USB_ON can be any free PIO pin. The PIO pin selected must be registered by setting PSKEY_USB_PIO_VBUS to the corresponding pin number. In self powered mode PSKEY_USB_PIO_PULLUP must be set to match with the PIO selected.

Note:

USB_ON is shared with WT11 PIO terminals (PIO2-PIO7).

4.2.3 Bus Powered Mode

In bus powered mode the application circuit draws its current from the 5V VBUS supply on the USB cable. WT11 negotiates with the PC during the USB enumeration stage about how much current it is allowed to consume.

For WT11 Bluetooth applications, it is recommended that the regulator used to derive 3.3V from VBUS is rated at 200mA average current and should be able to handle peaks of 220mA without fold back or limiting. In bus powered mode, WT11 requests 200mA during enumeration.

When selecting a regulator, be aware that VBUS may go as low as 4.4V. The inrush current (when charging reservoir and supply decoupling capacitors) is limited by the USB specification (see USB specification v1.1, Section 7.2.4.1). Some applications may require soft start circuitry to limit inrush current if more than 10pF is present between VBUS and GND.

The 5V VBUS line emerging from a PC is often electrically noisy. As well as regulation down to 3.3V, applications should include careful filtering of the 5V line to attenuate noise that is above the voltage regulator bandwidth.

In bus powered mode PSKEY_USB_PIO_PULLUP must be set to 16 for internal pull-up (default configuration in WT11).

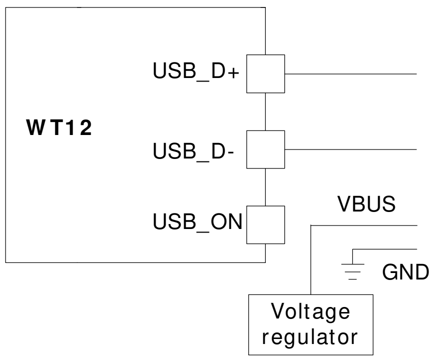

Figure 12: USB in bus powered mode

4.2.4 Suspend Current

All USB devices must permit the USB controller to place them in a USB Suspend mode. While in USB Suspend, bus powered devices must not draw more than 0.5mA from USB VBUS (self powered devices may draw more than 0.5mA from their own supply). This current draw requirement prevents operation of the radio by bus powered devices during USB Suspend.

The voltage regulator circuit itself should draw only a small quiescent current (typically less than 100uA) to ensure adherence to the suspend current requirement of the USB specification. This is not normally a problem with modern regulators. Ensure that external LEDs and/or amplifiers can be turned off by WT11. The entire circuit must be able to enter the suspend mode. (For more details on USB Suspend, see separate CSR documentation).

4.2.5 Detach and Wake-Up Signaling

WT11 can provide out-of-band signaling to a host controller by using the control lines called 'USB_DETACH' and 'USB_WAKE_UP'. These are outside the USB specification (no wires exist for them inside the USB cable), but can be useful when embedding WT11 into a circuit where no external USB is visible to the user. Both control lines are shared with PIO pins and can be assigned to any PIO pin by setting the PS Keys PSKEY_USB_PIO_DETACH and PSKEY_USB_PIO_WAKEUP to the selected PIO number.

USB_DETACH is an input which, when asserted high, causes WT11 to put USB_D- and USB_D+ in high impedance state and turned off the pull-up resistor on D+. This detaches the device from the bus and is logically equivalent to unplugging the device. When USB_DETACH is taken low, WT11 will connect back to USB and await enumeration by the USB host.

USB_WAKE_UP is an active high output (used only when USB_DETACH is active) to wake up the host and allow USB communication to recommence. It replaces the function of the software USB WAKE_UP message (which runs over the USB cable), and cannot be sent while WT11 is effectively disconnected from the bus.

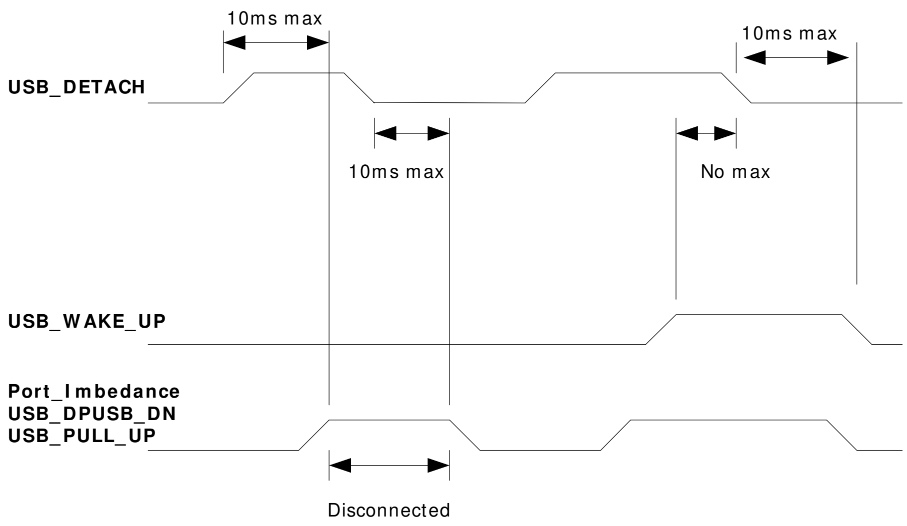

Figure 13: USB_DETACH and USB_WAKE_UP Signal

4.2.6 USB Driver

A USB Bluetooth device driver is required to provide a software interface between WT11 and Bluetooth software running on the host computer. Suitable drivers are available from www.bluegiga.com/techforum/.

4.2.7 USB 1.1 Compliance

WT11 is qualified to the USB specification v1.1, details of which are available from http://www.usb.org. The specification contains valuable information on aspects such as PCB track impedance, supply inrush current and product labeling.

Although WT11 meets the USB specification, Bluegiga Technologies cannot guarantee that an application circuit designed around the module is USB compliant. The choice of application circuit, component choice and PCB layout all affect USB signal quality and electrical characteristics. The information in this document is intended as a guide and should be read in association with the USB specification, with particular attention being given to Chapter 7. Independent USB qualification must be sought before an application is deemed USB compliant and can bear the USB logo. Such qualification can be obtained from a USB plug fest or from an independent USB test house.

Terminals USB_D+ and USB_D- adhere to the USB specification 2.0 (Chapter 7) electrical requirements.

4.2.8 USB 2.0 Compatibility

WT11 is compatible with USB v2.0 host controllers; under these circumstances the two ends agree the mutually acceptable rate of 12Mbits/s according to the USB v2.0 specification.

4.3 SPI Interface

The synchronous serial port interface (SPI) is for interfacing with other digital devices. The SPI port can be used for system debugging. It can also be used for programming the Flash memory. SPI interface is connected using the MOSI, MISO, CSB and CLK pins.

The module operates as a slave and thus MISO is an output of the module. MISO is not in high-impedance state when CSB is pulled high. Instead, the module outputs 0 if the processor is running and 1 if it is stopped. Thus WT11 should not be connected in a multi-slave arrangement by simple parallel connection of slave MISO lines.

4.4 PCM Interface

Pulse Code Modulation (PCM) is a standard method used to digitize audio (particularly voice) patterns for transmission over digital communication channels. Through its PCM interface, WT11 has hardware support for continual transmission and reception of PCM data, thus reducing processor overhead for wireless headset applications. WT11 offers a bi directional digital audio interface that routes directly into the baseband layer of the on chip firmware. It does not pass through the HCI protocol layer.

Hardware on WT11 allows the data to be sent to and received from a SCO connection. Up to three SCO connections can be supported by the PCM interface at any one time.

WT11 can operate as the PCM interface Master generating an output clock of 128, 256 or 512kHz. When configured as PCM interface slave it can operate with an input clock up to 2048kHz. WT11 is compatible with a variety of clock formats, including Long Frame Sync, Short Frame Sync and GCI timing environments.

It supports 13 or 16-bit linear, 8-bit μ-law or A-law companded sample formats at 8ksamples/s and can receive and transmit on any selection of three of the first four slots following PCM_SYNC. The PCM configuration options are enabled by setting the PS Key PS KEY_PCM_CONFIG32 (0x1b3). WT11 interfaces directly to PCM audio devices including the following:

- Qualcomm MSM 3000 series and MSM 5000 series CDMA baseband devices
- OKI MSM7705 four channel A-law and μ-law CODEC
- Motorola MC145481 8-bit A-law and μ-law CODEC
- Motorola MC145483 13-bit linear CODEC
- STW 5093 and 5094 14-bit linear CODECs
- BlueCore4-External is also compatible with the Motorola SSI™ interface
-

4.4.1 PCM Interface Master/Slave

When configured as the Master of the PCM interface, WT11 generates PCM_CLK and PCM_SYNC.

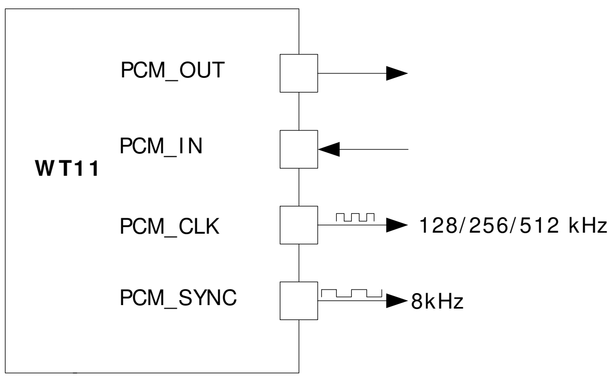

Figure 14: WT11 as PCM master

When configured as the Slave of the PCM interface, WT11 accepts PCM_CLK and PCM_SYNC. PCM_CLK rates up to 2048kHz are accepted.