Application Report
SPRA986 – December 2003

Connecting Bluetooth to the OMAP5910

Gerald Coley — *DSP/EEE Catalog, OMAP Applications*

ABSTRACT

There are numerous applications that require the addition of a Bluetooth™ wireless interface for both audio and data applications to the OMAP5910. This is a fairly straightforward effort that requires very little external logic thanks to circuitry in the OMAP5910 that is perfect for supporting a Bluetooth interface. This application note describes how, by using a Bluetooth module, the Bluetooth function can be connected to the OMAP5910 processor.

Contents

List of Figures

List of Tables

1 Wireless Basics

Before we discuss the details of how to add Bluetooth to the OMAP5910, we will briefly discuss some wireless basics. There are several different wireless technologies in use today.

- Wireless personal area networks (WPAN) for the interconnection of devices separated less than 50 meters away (PCs, PDAs, printers).

  Bluetooth: 1 Mbps over 10 to 30 meters

- Wireless LAN (WLAN) for interconnection of devices in a larger area (about 100 meters), configuring a local network like an “Ethernet without wires.”
  - HomeRF: 11 Mbps for domestic use, not very well supported by the industry anymore.
  - Wi-Fi:11 Mbps known as IEEE 802.11b and supported by the WECA. Existing extensions a/g/i…
  - HiperLAN: two types (1 and 2) supporting 20Mbps and 54Mbps. Developed by the ETSI.
  - MMAC: Japanese organization for standardization of WLAN for the 5-GHz band.

This application note will deal with Bluetooth for use in WPAN.

2 TI BRF6100

This application note uses the BRF6100 from Texas Instruments on a ready-made module from the Taiyo Yuden Corporation. This section focuses on the BRF6100 device and gives a little background on its capabilities. The Taiyo Yuden (TY) module is covered in the next section.

The BRF6100 Bluetooth chip is a highly integrated single-chip CMOS Bluetooth RF device that forms a complete standalone Bluetooth wireless communications system. This device implements an advanced solution for the Bluetooth protocol with easy interfacing to a host system. It comprises a digital radio processor (DRP), an embedded Bluetooth point-to-multipoint hardware core for highly optimized execution of the Bluetooth protocol, on-chip ROM, and on-chip RAM.

2.1 Features

The features of the BRF6100 include:

- On-chip digital radio processor (DRP)
- Integrated 2.4-GHz RF transceiver
- All-digital PLL transmitter with digitally controlled oscillator
- Near-zero intermediate frequency architecture
- Multitap direct subsampling mixer used in the receiver
- On-chip T/R RF switch
- Internal regulators
- Support for to 3.6-V power supply
- Embedded ARM7TDMI® microprocessor

- Functionality with all cellular standard frequencies for 2G, 2.5G, 3G
- High-rate UART host controller interface (HCI)
- Integrated point-to-multipoint Bluetooth core
- Up to seven active slaves, one voice channel
- Support for all Bluetooth packet types (voice and data)
- Support for Park, Sniff, Hold and M/S switch
- Law, μ-Law and linear codec Interface over PCM bus
- Support for full Bluetooth data rate (723.2 KBPS) applications
- Compliant with Bluetooth 1.1 Specification
- 32K-Byte RAM
- 180K-byte ROM included. Supports all software levels up to HCI
- Built-in self-test (BIST) capability useful for production test
- 6 x 6 mm MicroStar junior BGA

The BRF6100 provides a complete solution for the implementation of a Bluetooth interface. This is the device used in the Bluetooth module referenced in this application note.

2.2 BRF6100 Block Diagram

Figure 1 is the block diagram of the BRF6100 device.

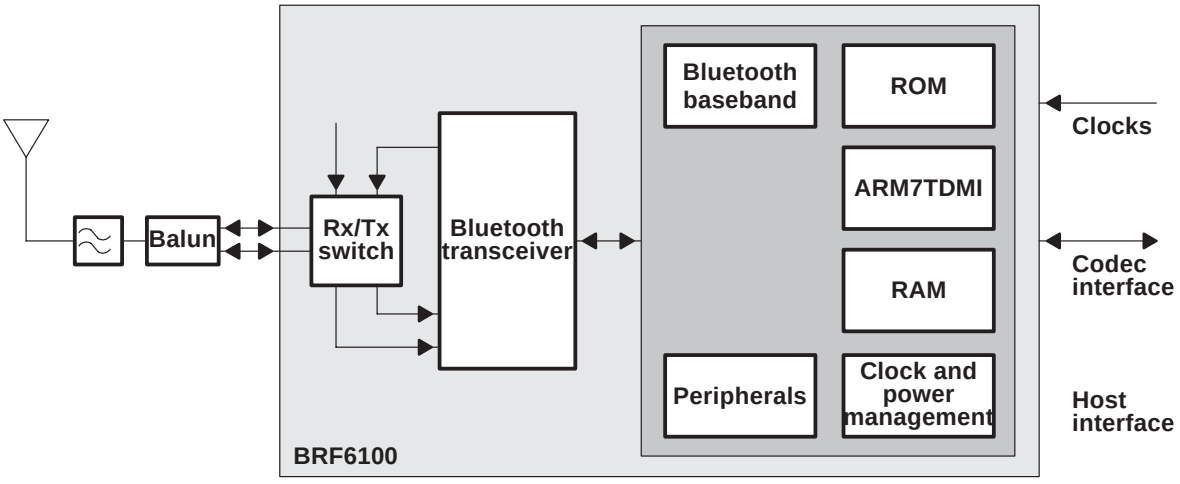


Figure 1. BRF6100 Block Diagram

3 Taiyo Yuden Bluetooth Module

This application note is based on the Taiyo Yuden Bluetooth module. All you need is to supply power, and antenna, and to hook it up to the OMAP5910 for a complete Bluetooth solution.

3.1 Features

The features of the Taiyo Yuden EYSMAYAXX module include:

- Class 2 compliant (Max .4dBm)
- Low current consumption
- Bluetooth standard Version 1.1 conformity
- HCI UART Interface
- Audio Interface
- Small Outline (9.8 x 9.6 x 1.65mm)
- Shielded case

3.2 Profile

Figure 2 provides a general profile of the Taiyo Yuden module.

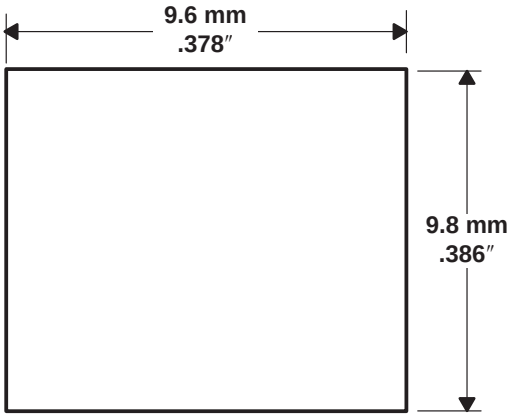


Figure 2. Taiyo Yuden Module Profile

As you can see, it takes up very little space on the board.

3.3 Taiyo Yuden Contact

Taiyo Yuden can be contacted at:

http://www.taiyo-yuden.com/

It will be up to the users of this application note to work out arrangements with Taiyo Yuden to get additional information and data sheets.

4 OMAP5910 Interface

This section describes how to connect the Taiyo Yuden Bluetooth Module to the OMAP5910 processor. Appendix A has a full schematic of the design.

This sections that follow breakdown the design to better understand what is being done.

4.1 Block Diagram

Figure 3 is the block diagram of the interconnection between the OMAP5910 and the Bluetooth Module. As you can see, the interconnection is straight forward.

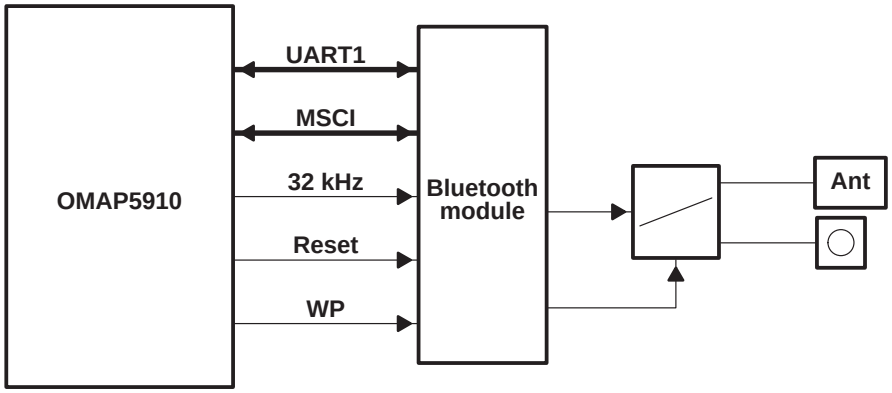


Figure 3. OMAP5910 and Bluetooth Module Block Diagram

Table 1 defines each of the signals used on the OMAP5910 and the function they perform in the interface to the Bluetooth Module.

Table 1. OMAP5910 Bluetooth Interface Signals

Module Name	I/O	OMAP5910 Signal	Description
HCI_CTS	O	RTS1	Clear to send signal from the OMAP5910.
HCI_RTS	I	CTS1	Request to send signal to the OMAP5910.
HCI_RX	I	TX1	Receive signal from the OMAP5910
HCI_TX	O	RX1	Transmit signal to the OMAP5910.
AUDIO_OUT	O	MCSI1_DIN	CODEC audio output to the OAMP5910.
AUDIO_IN	I	MCSI1_DOUT	CODEC audio input to the Bluetooth module.
AUDIO_CLK	O	MCSI1_BCLK	CODEC transmit clock to the OMAP5910.
AUDIO_FSYNC	O	MCSI1_SYNC	CODEC frame sync signal from the Bluetooth module.
SLOW_CLK	I	CLK32K_OUT	32.768-kHZ input from the OAMP5910.
WP	O	GPIOx	EEPROM write protection signal. Can be connected to a GPIO pin on the OMAP5910 or tied to VDD_I/O to set the protection.
RESET	O	GPIOx	Active Low reset from the OMAP5910. Can be tied to any available GPIO pin.

4.2 UART1

UART1 from the OMAP5910 is used as the communications channel between the processor and the Bluetooth Module. The CTS and RTS handshake leads are used for hardware based flow control as needed. The speed at which the serial port on the BRF6100 can run is shown in Table 2.

Table 2. OMAP5910 Bluetooth Interface Signals

UART Baud Rate	−2.5%	+1.5%
921.6K	898.56K	935.42K
460.8K	449.28K	467.712K
115.2K	112.32K	116.928K
57.6K	56.16K	58.464K

While UART1 is used in this application note, UART2 may be used as well. The final decision will be based on what other serial port needs are in the system.

4.3 MCSI

The Multi Channel Serial Interface (MCSI) on the OMAP5910 is used to connect to the audio port of the BRF6100. The port on the BRF6100 can operate in either a master or slave mode. When set to slave mode, AUD_FSYNC and AUD_CLK pins act as inputs. When set to master mode, AUD_FSYNC and AUD_CLK pins act as outputs.

When the BRF6100 is in master mode:

- AUD_FSYNC changes to high on the rising edge of AUD_CLK and changes to low at the next rising edge of AUD_CLK. AUD_FSYNC frequency is 8 kHz.
- The first bit of AUD_OUT is output on the rising edge of AUD_CLK immediacy after a valid AUD_FSYNC. The next bit of AUD_OUT is output on the next rising edge of AUD_CLK.
- The first bit of AUD_IN is latched on the falling edge of AUD_CLK immediately after a valid AUD_FSYNC. The next bit of AUD_IN is latched on the next falling edge of AUD_CLK.

When the BRF6100 is in slave mode:

- AUD_FSYNC is latched on the falling edge of AUD_CLK. AUD_FSYNC frequency is 8 kHz.
- The first bit of AUD_OUT is output immediately after the rising edge of AUD_CLK after a valid AUD_FSYNC is detected. The next bit of AUD_OUT is output immediately after the next rising edge of AUD_CLK.
- The first bit of AUD_IN is latched on the falling edge of AUD_CLK, immediately after a valid AUD_FSYNC. The next bit of AUD_IN is latched at the next falling edge of AUD_CLK.

Depending on the mode desired by a specific application, the configuration of the OMAP5910 MCSI mode will need to be set.

4.4 32-kHZ Clock

The 32-kHZ clock is supplied from the 32-kHZ clock output of the OMAP5910 processor. If desired, the OMAP5910 and the Bluetooth module could be supplied by a common clock. You need to insure that the level of the clock signal is compliant with both the OMAP5910 and the Bluetooth Module.

4.5 Reset

This signal from the OMAP5910 GPIO pin allows the processor to reset the Bluetooth device as needed. The signal is active low and is pulled high via a 10K ohm resistor. This signal can be tied to a system reset if desired.

4.6 Write Protect

This signal disables the ability to write to the EEPROM on the Bluetooth Module. This can be controlled by a GPIO pin for the OMAP5910 or use a GPIO pin from the Bluetooth Module. Another option would be to tie the signal to the required level via either a jumper or a resistor on the board.

4.7 Optional Output

The schematic shows an optional feature as described in Figure 4. This interface is not necessarily required, but can be useful during the test phase of the product development.

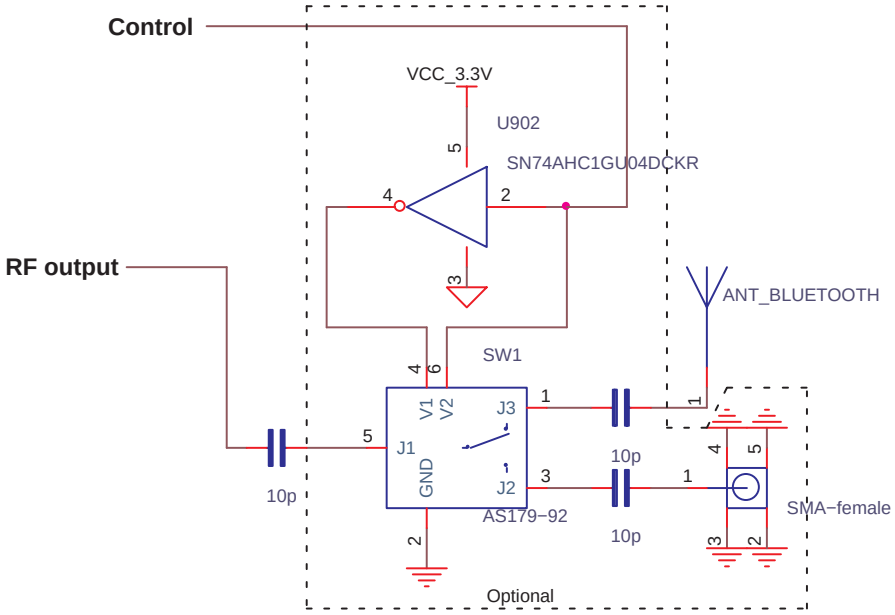


Figure 4. Optional Output Section

This circuit provides for a SMA COAX connector to allow testing of the RF interface into a piece of test equipment. By activating the control lead with a LO signal, the RF signal is routed to the SMA connector. A Hi signal routes it to the antenna.

The switch is implemented with a GaAs IC SPDT switch, AS179-92, device from Skyworks, Inc. Skyworks can be contacted at http://www.skyworksinc.com.

Care should be taken in the layout of this area to keep it isolated from devices that might be susceptible to noise.

4.8 Antenna

There are several sources on the market for the Bluetooth antenna. Depending on cost and space factors, one may be more suitable than others. The AH104F2450S1 has been used in numerous designs. Supplied by Taiyo Yuden, it is an excellent companion for the Taiyo Yuden Bluetooth Module.

Following is a short list of possible antenna sources:

- http://www.halontech.com
- http://www.centurion.com

4.9 I/O Pins

Up to five general purpose I/O pins are available on the Taiyo Yuden module. These can be used as needed by the designer.

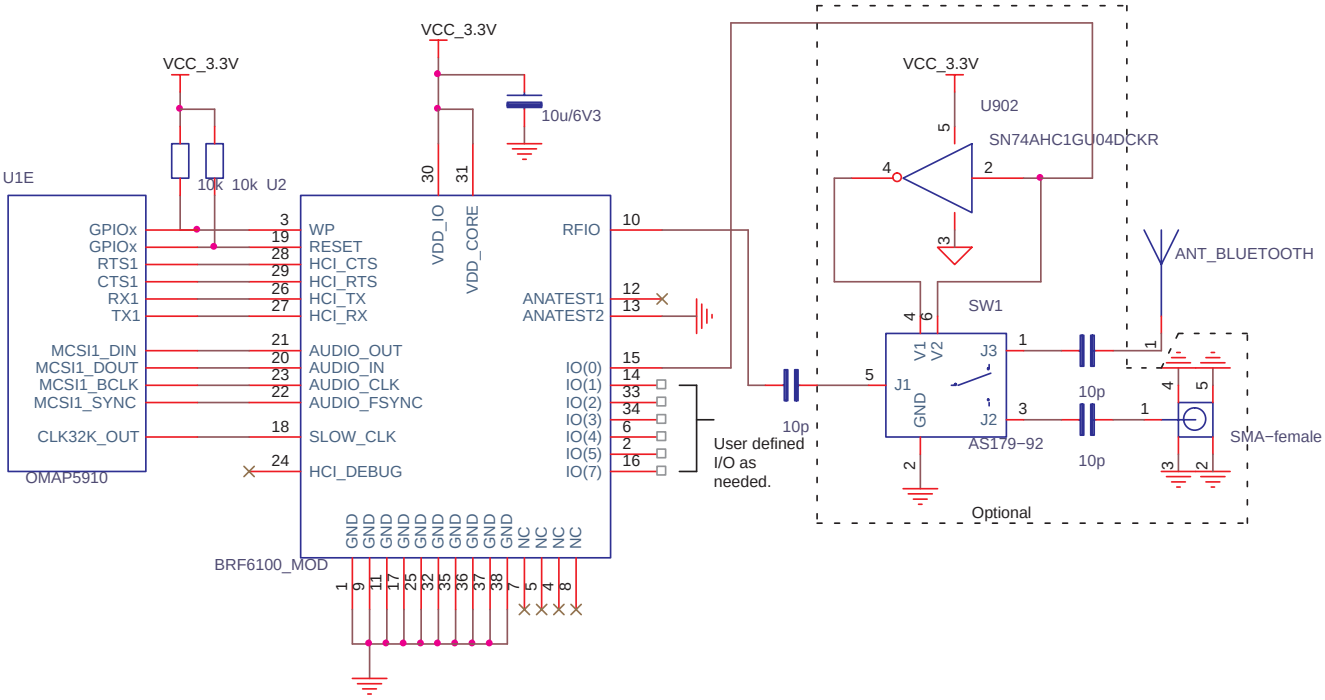
5 Summary

The BRF6100 design has been put on the OMAP1610 processor. The interfaces are the same for the BRF6100 device on the OMAP5910. Other designs have used Bluetooth on the OMAP5910. The Taiyo Yuden modules can also be found in the Wanda Reference Design from Texas Instruments.

6 References

1. *OMAP5910 Dual-Core Processor Data Manual* (SPRS197)
2. *OMAP5910 Dual-Core Processor Functional and Peripheral Overview Reference Guide* (SPRU602)
3. *BRF6100 Bluetooth Chip* data sheet (SWRS017)
4. *Taiyo Yuden EYSMAYAXX* data sheet (September, 2002)

Appendix A Schematic



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265