Basic Operation Principle of

MS-6967 Transceiving Key & MS-6968 Transceiving Module

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This description is based upon the "Block diagram of MS-6967/6968 Bluetooth Transceiving Key & Transceiving Module".(see Fig. 1)

MS-6967(Transceiving Key)/6968(Transceiving Module) Bluetooth uses CSR Bluetooth single-chip technology (BC02) via Point to Point or Point to Multi-Point to communicate with other Bluetooth device and not affected by angle or obstacle. Bluetooth operates at 2.4GHz ISM frequency band. Maximum transmission rate: 723kbps and maximum output power is 18 dBm. It can also be used as wireless intranet for transferring data, audio and video.

BC02 single-chip integrates the RF receiver, RF transmitter, RF synthesizer, microcontroller and baseband logic interface. The whole design combines external crystal, flash, balun, power amplifier (PA), Low-Noise Amplifier (LNA), switch and antenna. We make more detail description as below.
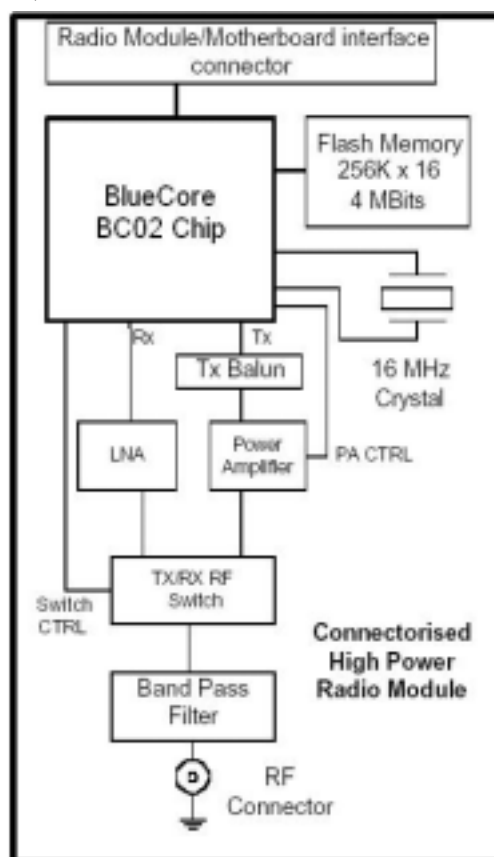

Figure. 1   Block diagram of MS-6967/6968 Bluetooth Transceiving Key & Transceiving Module

1.BlueCore02-- TX　RX　Synthesizer　Microcontroller and Baseband Logic

1.1 RF Receiver

The receiver features a near-zero Intermediate Frequency (IF) architecture that allows the channel filters to be integrated on to the die(Figure 2). Sufficient out-of-band blocking specification at the Low Noise Amplifier (LNA) input allows the radio to be used in close proximity to Global System for Mobile Communications (GSM) and Wideband Code Division Multiple Access (W-CDMA) cellular phone transmitters without being desensitized. The use of a digital Frequency Shift Keying (FSK) discriminator means that no discriminator tank is needed and its excellent performance in the presence of noise allows BlueCore2-External to exceed the Bluetooth requirements for co-channel and adjacent channel rejection.

1.1.1 Low Noise Amplifier

The LNA can be configured to operate in single-ended or differential mode. Single-ended mode is used for Class 1 Bluetooth operation; differential mode is used for Class 2 operation.

1.1.2 Analogue to Digital Converter

The Analogue to Digital Converter (ADC) is used to implement fast Automatic Gain Control (AGC). The ADC samples the Received Signal Strength Indicator (RSSI) voltage on a slot-by-slot basis. The front-end LNA gain is changed according to the measured RSSI value, keeping the first mixer input signal within a limited range. This improves the dynamic range of the receiver, improving performance in interference limited environments.

1.2 RF Transmitter

1.2.1 IQ Modulator

The transmitter features a direct IQ modulator to minimize the frequency drift during a transmit timeslot which results in a controlled modulation index. A digital baseband transmit filter provides the required spectral shaping.

1.2.2 Power Amplifier

The internal Power Amplifier (PA) has a maximum output power of +6dBm allowing BlueCore2-External to be used in Class 2 and Class 3 radios without an external RF PA. Support for transmit power control allows a simple implementation for Class 1 with an external RF PA.
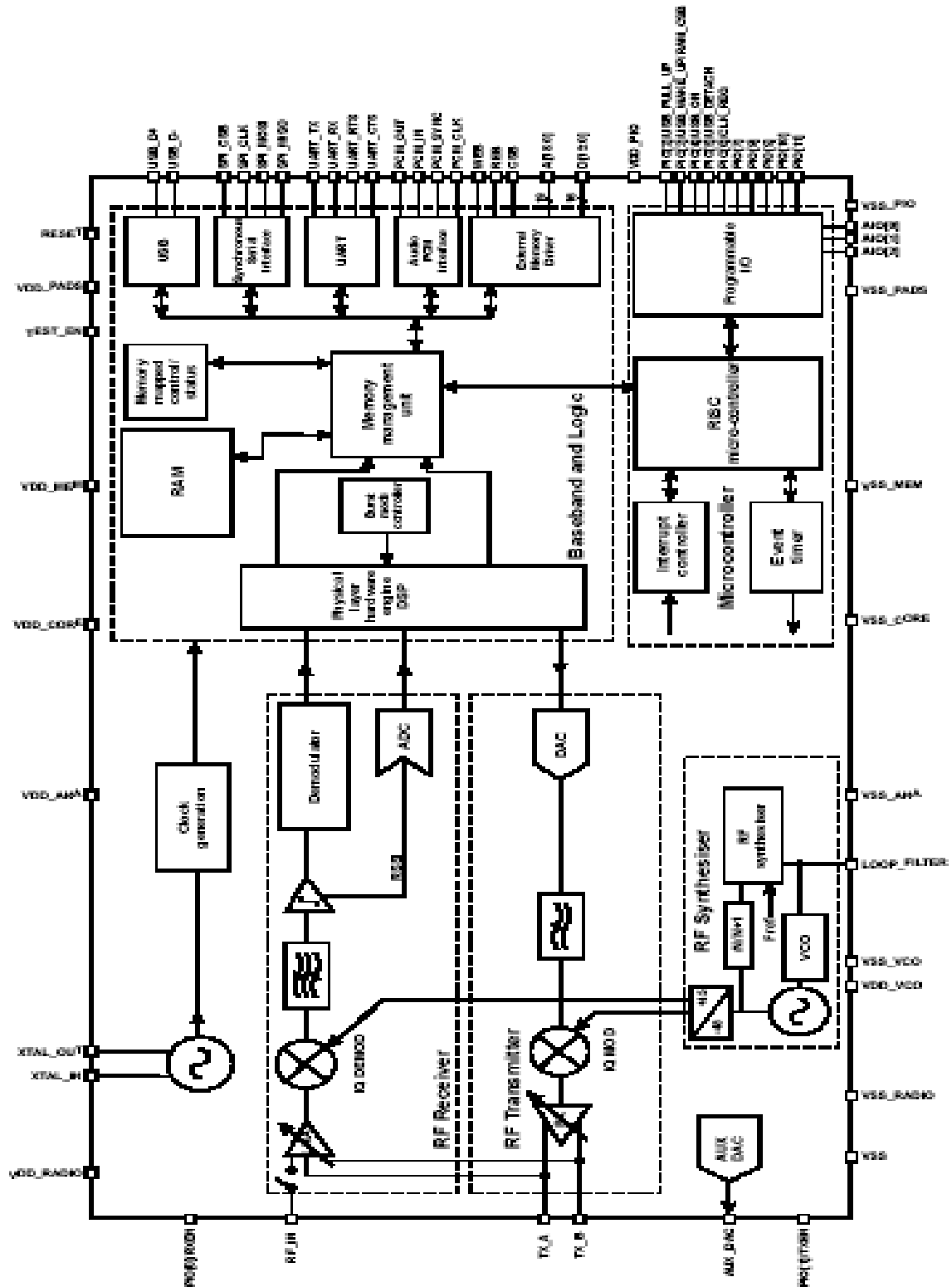
Figure 2. BC02 Device Function diagram

1.3 RF Synthesizer

The radio synthesizer is fully integrated onto the die with no requirement for an external Voltage Controlled Oscillator (VCO) screening can, varactor tuning diodes or LC resonators.

1.4 Baseband and Logic

1.4.1 Memory Management Unit

The Memory Management Unit (MMU) provides a number of dynamically allocated ring buffers that hold the data which is in transit between the host and the air or vice versa. The dynamic allocation of memory ensures efficient use of the available Random Access Memory (RAM) and is performed by a hardware MMU to minimize the overheads on the processor during data/voice transfers.

1.4.2 Burst Mode Controller

During radio transmission the Burst Mode Controller (BMC) constructs a packet from header information previously loaded into memory-mapped registers by the software and payload data/voice taken from the appropriate ring buffer in the RAM. During radio reception, the BMC stores the packet header in memory-mapped registers and the payload data in the appropriate ring buffer in RAM. This architecture minimizes the intervention required by the processor during transmission and reception.

1.4.3 Physical Layer Hardware Engine DSP
Dedicated logic is used to perform the following:
*Forward error correction
*Header error control
*Cyclic redundancy check
*Encryption
*Data whitening
*Access code correlation
*Audio transcoding
The following voice data translations and operations are performed by firmware:
*A-law/   -law/linear voice data (from host)
*A-law/   -law/Continuously Variable Slope Delta (CVSD) (over the air)
*Voice interpolation for lost packets
*Rate mismatches

1.4.4 RAM

32Kbytes of on-chip RAM is provided 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.

1.4.5 External Memory Driver

The External Memory Driver interface used to connect to the external 4M bits flash memory and to the optional external RAM for memory intensive applications.

1.4.6 USB

This is a full speed Universal Serial Bus interface for communicating with other compatible digital devices. BlueCore2-External acts as a USB peripheral, responding to requests from a Master host controller such as a PC.

1.4.7 Synchronous Serial Interface

This is a synchronous serial port interface for interfacing with other digital devices. The SPI port can be used for software debugging and for programming the external Flash memory.

1.4.8 UART

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

1.4.9 Audio PCM Interface

The Audio Pulse Code Modulation (PCM) Interface supports continuous transmission and reception of PCM encoded audio data over Bluetooth.

1.5 Microcontrollers

The microcontroller, 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.

1.5.1 Programmable I/O

BlueCore2-External has a total of 15 (12 digital and 3 analogue) programmable I/O terminals. These are controlled by firmware running on the device.

2. External Components

2.1 Principle of operation

The RF out put circuit is derived from a network where two out of phase current sources of output impedance R ohm are connected together through a ½ wavelength transmission line with a characteristic impedance of R ohm, (see Figure 3). One of the two ends of the transmission line is connected to a load of R/2 ohm. Because the line is ½ wavelength long, the out of phase signal at the far end is transformed into an in-phase signal of the same magnitude at the near end. These two combine and the power dissipated in the load is double that which a single source would deliver. The ½ wavelength line therefore performs the function of a balun, and will be termed such in the rest of this document.
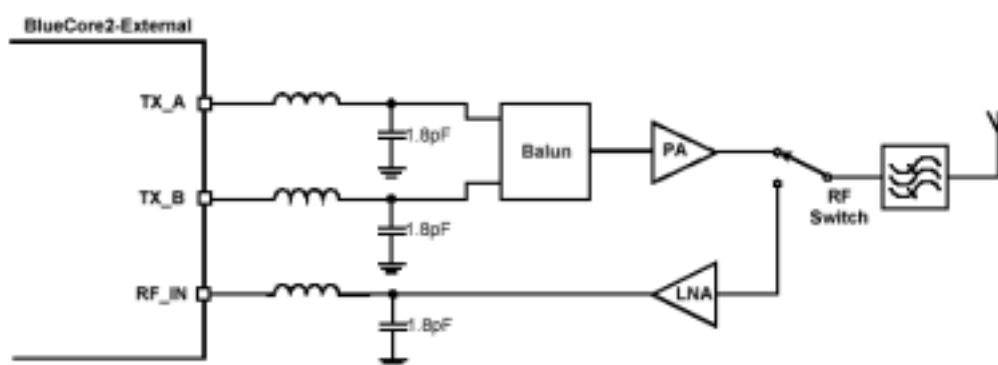

Figure 3.   Single Ended (Class 1) RF Input and output

2.2. Receiver Input (RF_IN)-- Antenna   BPF   LNA

The RF signal received from the **antenna** to 2.4GHz **BPF** which removes out of band interference and noise. The **LNA** configured to operate in single-ended for Class 1 Bluetooth operation. It provides maximum gain of 17 dB and reduces overall noise figure (NF),and the system receiving sensitivity can be guaranteed over Bluetooth RF standard.

2.3. TX_A and TX_B-- Balun   PA   Switch   Antenna

Balls TX_A and TX_B form a push-pull balanced current output. They connected to **balun** input and the **balun** output is formed with unbalanced signal. The **power amplifier** provides maximum gain of 22.5 dB and the signal from output of PA transmitted to **antenna.**

2.4. Flash

External 4Mbits Flash memory device for flexibility and low cost. The BC02 provides a Interface for accessing the external Flash.(reference section A.4.5)

2.5. Crystal(16MHz)

BlueCore2-External contains a crystal driver circuit. This operates with an external crystal and capacitors to form a Pierce oscillator.

The BlueCore2-External driver circuit is a transconductance amplifier. A voltage at XTAL_IN generates a current at XTAL_OUT. The value of transconductance is variable and may be set for optimum performance.
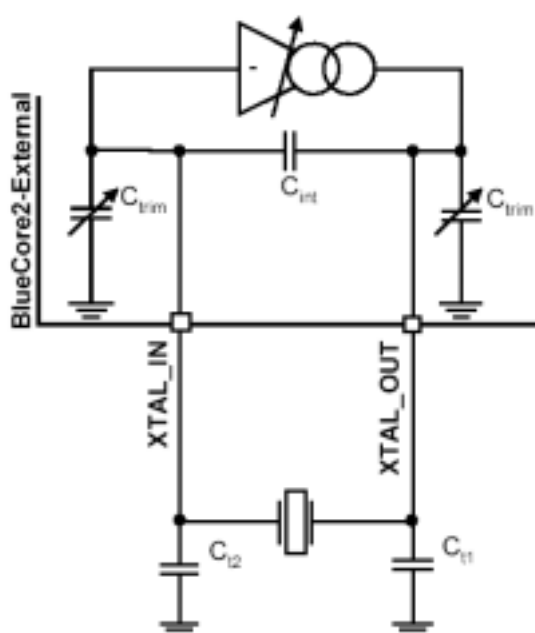

Figure 4.   BlueCore2-External Crystal Driver Circuit

Appendix A.

MS-6967 Transceiving Key & MS-6968 Transceiving Module Specification

MSI™ PC2PC Bluetooth Spec	
General	
	Bluetooth Transceiving Key Bluetooth Transceiving Module
H/W Interface	USB
Bluetooth Spec.	Ver. 1.1 Compliance
Throughput	About 723Kbps (data channels)
Operating Volt.	5V from USB interface
Operating Range	Up to 200M for open space
Regulatory Approval	FCC, CE, BQB (Bluetooth Qualified)
Temperature Storage temp	-40oC~+105oC Operating temp: -40oC~+105oC
Radio	
Spread Spectrum	Frequency Hopping Spread Spectrum (FHSS) Compliant with FCC part 15
Frequency Range	2.4~2.4835GHz (2.4GHz ISM Band)
RF Channels	79-channel system for USA, Japan, and Europe (except France, 23-channel system for France)
Modulation	GFSK, BT=0.5
Output Power Class	Bluetooth Power Class 1
Output Power	+18dBm (Max.)
Receiver Sensitivity	Better than -90dBm with BER < 0.1%
Max Input	Level -20dBm
Power Control	Yes
Base Band	
Physical Links	Support ACL link
Network Capabilities	Support piconet point-to-point and point-tomultipoint connections (Scatternet to be supported soon)
Link Manager	

3-slot Packets	Yes
5-slot Packets	Yes
Slot Offset	Yes
Timing Accuracy	Yes
Switch	Yes
Hold Mode	Yes
Sniff Mode	Yes
Test Mode	Yes
Park Mode	Yes
RSSI	Yes
Power Control	Yes
Authentication	Yes
Encryption	Yes
Software	
System Support	Windows 2000/ME/98/XP
Profile Support	Generic Access Profile/ Service Discovery Profile/ Serial Port Profile/ Dial-Up Networking Profile/ Fax Profile/ LAN Access Profile/ Generic Object Exchange Profile/ File Transfer Profile/ Object Push Profile/ Synchronization Profile