

Theory of operation; Alereon HS6618A USB Dongle.

1.0 Discussion of the Functional Architecture and chipset Functions.

The Alereon HS6618A is a UWB radio device with a USB interface to the host computer. This device is intended to provide a short-range wireless USB connection for computers and peripheral units equipped with a USB 2.0³ interface. The HS6618A is powered entirely from the USB connector of the host system to which it is attached. The HS6618A operates in the frequency band defined in the FCC rules and Regulations for UWB devices. Specifically, it operates between the frequencies of 3.168 and 8.976 GHz per the industry-defined WiMedia 1.1 specification¹.

The HS6618A is comprised of two integrated circuit devices and supporting circuitry for firmware, filtering, interface and power conditioning. The HS6618A has a permanently attached antenna internal to the product housing. The schematic diagram shows a connector, Murata MM8030-2600RK0, in the RF path. This connector, is not accessible from outside of the unit housing, it is used for factory test of the devices during production. Following the factory test connector is a Diplexer type bandpass filter having two sections; The LB section has a passband from 3.1 GHz to 4.752 GHz, the HB section has a passband from 6.336GHz to 8.976GHz. This filter provides suppression of unwanted out of band transmitter emissions and receiver interference rejection in the 2.4 GHz and 5.1 GHz bands.

The AL5100 RF Transceiver generates the system reference frequency from a 44 MHz crystal resonator. The 44 MHz reference frequency is multiplied to 16.896 GHz internally in the AL5100 by a PLL multiplier. From this frequency the local oscillator frequencies for band frequencies for both transmit and receive modes are derived internally within the AL5100 by direct synthesis. The local oscillator frequencies are as listed as F_{mid} per the following table.

BG	Channel	Ch1	Ch0	F_{low}	F_{mid}	F_{high}
N/A	N/A	0	0	-	-	-
1	1 (A)	0	1	3168 MHz	3432 MHz	3696 MHz
	2 (B)	1	0	3696 MHz	3960 MHz	4224 MHz
	3 (C)	1	1	4224 MHz	4488 MHz	4752 MHz
3	7 (A)	0	1	6336 MHz	6600 MHz	6864 MHz
	8 (B)	1	0	6864 MHz	7128 MHz	7392 MHz
	9 (C)	1	1	7392 MHz	7656 MHz	7920 MHz
6	9 (A)	0	1	7392 MHz	7656 MHz	7920 MHz
	10 (B)	1	0	7920 MHz	8184 MHz	8448 MHz
	11 (C)	1	1	8448 MHz	8712 MHz	8976 MHz

Figure 1. L.O. Frequency Table

In addition to the band frequencies, a 1056 MHz clock for ADCs and DACs within the AL6301 Baseband Processor/MAC is generated by the AL5100 RF Transceiver.

The interface between the AL5100 RF Transceiver and the AL6301 Baseband Processor/MAC consists of the analog RX-I and -Q signals and the analog TX-I and -Q signals all of which are baseband, having 2 MHz to 264 MHz frequency band. The interface also includes a 1056 MHz

clock signal and CMOS logic-level control signals which are used by the MAC within the AL6301 to control the band frequency and mode of operation; TX, RX or Idle (TX and TX powered-down).

The AL6301 design is based on the WiMedia MAC-PHY Interface Specification 2.0². The AL6301 implements the digital functionality for the UWB radio consisting of the following functions:

- RX Baseband Signal ADC.
- Receive digital signal Processing.
- Data Encryption and Decryption.
- Transmit Digital Signal Processing.
- TX Baseband Signal DAC.
- Digital interface to AL5100 for control.
- ARM processor implementation of the MAC.
- USB 2.0 PHY, interface to host system.

The AL6301 and its associated firmware memory, and power filtering and conditioning circuits perform no function other than support of the UWB radio function.

Among the radio support functions, the AL6301 MAC implements the FCC-required function of verifying that transmissions are acknowledged by the device-side unit at 10 second intervals for the entire time that the UWB link is active. If the 10-second timeout test fails, the AL6301 MAC firmware embedded within the AL6301 will cause transmissions to cease.

2.0 Discussion of Channelization.

The HS6618A implements the spectrum and channelization plan described by the WiMedia specification 1.1. While the basic AL5100 / AL6301 chipset is capable of implementing a UWB radio capable of operation on every WiMedia defined band group and channel, operation of the HS6618A is limited to those WiMedia channels which are implemented within band group 1 (3.168 – 4,752 GHz), band group 3 (6.336 – 7.920 GHz) and band group 6 (7.392 – 8.976 GHz).

Band Frequency Map			
Edges	BG	Center	
	1 3 6		
3168			
1		3432	
3696		2	3960
4224			
3		4488	
4752			
6336			
7		6600	
6864			
8		7128	
7392			
9		7656	
7920			
10		8184	
8448			
11		8712	
8976			

Figure 2. Band Group Frequency Table

Band group 2 (4.752 – 6.336 GHz) is not used because this band group coincides with IEEE 802.11 wireless LAN operations. Concerns about mutual interference between radios co-located within the same host system have driven this consideration.

The upper three sub bands of the WiMedia spectrum plan (8.976 – 10.560 GHz) which are a portion of band group 4 and band group 5 are not implemented due to technology limitations in the filter and antennas.

Within the implemented band groups, channels are enabled or disabled according to the regulatory domain for which the specific device is intended. The enabled channels are set by a channel map table embedded within the firmware of the MAC. This table is programmed with the enabled channels during manufacture by the Alereon factory test station software at the same time that the device firmware image is loaded. The channel map is not accessible to the end user.

The interface between the HS6618A USB dongle and the host system is via the industry-defined USB 2.0.

The HS6621 is powered by 5.0V DC from the host system. Power conditioners on the HS6621 generate the various voltages required by the integrated circuits.

References.

1. MultiBand OFDM Physical Layer Specification 1.1.
2. MAC-PHY Interface Specification 1.0.
3. Universal Serial Buss Specification 2.0.