AirPrime HL Series

Scalability Guide

SIERRA WIRELESS®

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Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

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Document History

Version	Date	Updates
1.0	April 03, 2014	Creation
2.0	January 07, 2015	Added information for HL75xx and HL8549x
3.0	December 07, 2015	Added information for HL6528RDx, HL7618, HL8518, HL8528 and HL8529
3.1	December 08, 2015	Updated 5.4.5.2 UIM2
4.0	March 21, 2016	Added information for HL7528, HL7538, HL7539 and HL7549
		Updated Figure 12 USB Reference Schematic
		Deleted: • UIM2 support from the HL6528RDx • HL7519
4.1	April 05, 2016	Updated Table 5 Supported Frequencies
4.2	April 28, 2016	Updated: • Figure 3 Antenna Detection Feature Reference Schematic • 5.4.1 UART1 • 5.4.3 HSIC • HSIC support for HL7548, HL7588 and HL854xx (removed) • TX_ON support for HL7548 (removed)
5.0	July 25, 2016	Added information for HL7518, HL7648, HL7688 and HL7690
		Updated 5.4.1 UART1
	August 19, 2016	Removed PCM support for the HL7528, HL7538, HL7539 and HL7549
6.0	August 17, 2017	Added HL7618RD, HL7650, HL7692 and HL8518-S
		Updated: • Table 28 PCM Features • UART support for HL7548
		Deleted HSIC
	October 16, 2018	Added HL78xx
		Deleted HL6528x (legacy), HL7618 and HL8518-S

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1. Overview

This document aims to provide a guideline for designing applications based on the HL series embedded module, which has three main product lines – the HL6528RDx, HL7xxx and HL85xxx. This document enumerates the differences between these HL series embedded modules and provides solutions to maximize scalability between products.

The following table tabulates the product naming convention used throughout this document.

Table 1. Product Naming Convention

Naming Convention Used	Applicable HL Variant
HL Series	All HL series embedded modules
HL6528RDx	HL6528RD HL6528RD-G HL6528RD-2.8V HL6528RD-G2.8V
HL7xxx	HL75xx HL76xx HL78xx
HL75xx	HL7518 HL7528 HL7538 HL7539 HL7548 HL7549 HL7588
HL76xx	HL7618RD HL7648 HL7650 HL7688 HL7690 HL7692
HL78xx	HL7800 HL7800-M
HL85xxx	HL8518 HL8528 HL8529 HL854xx
HL854xx	HL8548x HL8549x
HL8548x	HL8548 HL8548-G
HL8549x	HL8549 HL8549-G

This document does not cover all specifications and characteristics of the HL series modules. For detailed specifications, refer to the documents listed in section 2.1 Documentation, which can be downloaded from the Source.

2. References

2.1. Documentation

[1] AirPrime HL6528RDx Product Technical Specification
Reference number: 4117701

[2] AirPrime HL7518 Product Technical Specification
Reference number: 4115834

[3] AirPrime HL7528 Product Technical Specification
Reference number: 4116873

[4] AirPrime HL7538 Product Technical Specification
Reference number: 4118596

[5] AirPrime HL7539 Product Technical Specification
Reference number: 4118548

[6] AirPrime HL7548 and HL7588 Product Technical Specification
Reference number: 4116369

[7] AirPrime HL7549 Product Technical Specification
Reference number: 4117459

[8] AirPrime HL7618RD Product Technical Specification
Reference number: 4119874

[9] AirPrime HL7648 Product Technical Specification
Reference number: 4119069

[10] AirPrime HL7650 Product Technical Specification
Reference number: 41110363

[11] AirPrime HL7688 Product Technical Specification
Reference number: 4119272

[12] AirPrime HL7690 Product Technical Specification
Reference number: 4118552

[13] AirPrime HL7692 Product Technical Specification
Reference number: 4119631

[14] AirPrime HL8518, HL8528 and HL8529 Product Technical Specification
Reference number: 4117047

[15] AirPrime HL8548 and HL8548-G Product Technical Specification
Reference number: 4114663

[16] AirPrime HL8549 and HL8549-G Product Technical Specification
Reference number: 4115653

[17] AirPrime HL7800 and HL7800-M Product Technical Specification
Reference number: 41111094

[18] AirPrime HL Series Customer Process Guidelines
Reference number: 4114330

[19] AirPrime HL78xx Customer Process Guidelines
Reference number: 41112095

[20] AirPrime HL Series Antenna Detection Application Note
Reference number: 2174045

2.2. Glossary

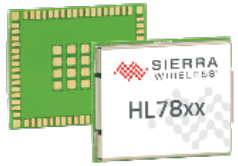
Term	Definition
GND	Ground
NC	Not Connected When a pin is marked as not connected, it means that no connection should be made from the pin to the application board.
Reserved	When a pin is marked as Reserved, it means that no connection should be made from the module pin to the application board; and that there might be a connection to the pin from within the module.

3. General Description

This section provides a general description of the features supported by the AirPrime HL series.

The following tables enumerate the main features, power domain and frequencies supported by the HL series modules; as well as specifies whether GNSS option is supported.

Table 2. AirPrime HL Series Main Feature List

HL6528RDx	HL75xx	HL76xx	HL78xx	HL8518, HL8528 and HL8529	HL8548x	HL8549x
						
CF[3] V1 form factor			CF[3] V2 form factor	CF[3] V1 form factor		
Quad band GSM GPRS	Up to Penta band LTE[1] Dual Band UMTS[1]	Up to Penta band LTE[1] Tri band UMTS[1] Dual band GSM[1]	World Wide LTE Cat-M1 World Wide Cat-NB1	Dual band UMTS[1] Dual band GSM[1]	Hexa band UMTS[1] Quad band GSM[1]	Hexa band UMTS[1] Quad band GSM[1]
GSM/GPRS Class 10	LTE Category 4 HSDPA 42.2Mbps HSUPA 5.7 Mbps	GPRS/EDGRS up to class 33 LTE Category 1 HSDPA 10.1Mbps HSUPA 5.76 Mbps	LTE Cat-M1 LTE Car-NB1	GSM/GPRS/EDGE RX Class 12 HSDPA 7.2Mbps HSUPA 5.76Mbps	GSM/GPRS/EDGE Class 12 GPRS/EDGRS up to class 33 (AT command selectable) HSDPA 7.2Mbps HSUPA 5.76Mbps	GSM/GPRS/EDGE Class 12 GPRS/EDGRS up to class 33 (AT command selectable) HSDPA 7.2Mbps HSUPA 5.76Mbps
GPS and GLONASS	No GNSS	No GNSS	GPS	No GNSS	GPS and GLONASS	GPS and GLONASS
Class A: -30°C to +70°C Class B: -40°C to +85°C Storage: -40°C to +90°C						

HL6528RDx	HL75xx	HL76xx	HL78xx	HL8518, HL8528 and HL8529	HL8548x	HL8549x
1 x Full UART interface 1 x 2-wire UART interface (for trace only) 1 x USB 2.0 interface (full speed) 1 x I²C interface (for NMEA frame only) 1 x 1.8V/3V SIM interface 1 x Differential analog audio output 1 x Differential analog audio input 1 x PCM 2 x ADCs 8 x GPIOs 2 x clocks outputs 1 x RTC	1 x Full UART interface[6] 1 x USB 2.0 interface (high speed) 1 x 5-wire trace/debug interface 1 x 1.8V/3V SIM interface 1 x PCM[4] 1 x ADC[3] 12 x GPIOs for the HL7548 and HL7588; 14 x GPIOs for the HL7518, HL7528, HL7538, HL7539 and HL7549 2 x clocks outputs 1 x RTC 1 x JTAG	1 x Full UART interface 1 x USB 2.0 interface (high speed) 1 x 5-wire trace/debug interface[5] 1 x 1.8V/3V SIM interface 1 x PCM[2] 1 x ADC; 2 x ADCs on the HL7618RD, HL7648, HL7650, HL7690 and HL7692 12 x GPIOs; 13 x GPIOs on the HL7692 2 x clocks outputs 1 x RTC 1 x JTAG	1 x Full UART interface 1 x USB 2.0 interface (full speed)[7] 1 x 4-wire UART interface (for trace only) 1 x 1.8V SIM interface 2 x ADCs[7] 1 x PCM[7] 11 x GPIOs 2 x clocks outputs 1 x RTC 2 x PWMs 2 x clocks outputs[7]	1 x Full UART interface 1 x USB 2.0 interface (high speed) 1 x 2-wire UART interface (for trace only) 1 x 1.8V/3V SIM interface 1 x PCM 2 x ADCs 12 x GPIOs 2 x clocks outputs 1 x RTC 2 x PWMs 1 x JTAG	1 x Full UART interface 1 x USB 2.0 interface (high speed) 1 x I²C interface (for NMEA frame only) 1 x 2-wire UART interface (for trace only) 1 x 1.8V/3V SIM interface 1 x PCM 2 x ADCs 12 x GPIOs 2 x clocks outputs 1 x RTC 2 x PWMs 1 x JTAG	1 x Full UART interface 1 x USB 2.0 interface (high speed) 1 x I²C interface (for NMEA frame only) 1 x 2-wire UART interface (for trace only) 1 x 1.8V/3V SIM interface 1 x PCM 2 x ADCs 12 x GPIOs 2 x clocks outputs 1 x RTC 2 x PWMs 1 x JTAG
23mm x 22 mm x 2.5mm (typical)	23mm x 22 mm x 2.5mm (typical)		15mm x 18 mm x 2.4mm (typical)	23mm x 22 mm x 2.5mm (typical)		25mm x 24 mm x 2.5mm (typical)

1 Depends on the variant; refer to Table 5 Supported Frequencies for detailed information.

2 Only available on the HL7618RD, HL7648, HL7650, HL7688 and HL7692.

3 Not available on the HL7518.

4 Not available on the HL7518 and HL7548.

5 Not available on the HL7650.

6 The HL7548 only supports 4-wire UART.

7 Will be available in a future release

Table 3. Supported Power Domains

Module Variant	1.8V Power Domain	2.8V Power Domain
HL6528RD	✓	
HL6528RD-G	✓	
HL6528RD-2.8V		✓
HL6528RD-G2.8V		✓
HL7xxx	✓	
HL85xxx	✓	

Table 4. GNSS Option Support

Module Variant	GNSS Option
HL6528RD, HL6528RD-2.8V	
HL6528RD-G, HL6528RD-G2.8V	✓
HL75xx, HL76xx	
HL78xx	✓
HL8518, HL8528, HL8529, HL8548, HL8649	
HL8548-G, HL8549-G	✓

Table 5. Supported Frequencies

Air Interface Standard	Band	Description	Frequency (MHz)	HL6528RDx	HL7518	HL7528	HL7538	HL7539	HL7548	HL7549	HL7588	HL7618RD	HL7648	HL7650	HL7688	HL7690	HL7692	HL78xx	HL8518	HL8528	HL8529	HL854xx
GSM	1900	PCS 1900	1850 – 1910 / 1930 – 1990	✓																✓		✓
	1800	DCS 1800	1710 – 1785 /1805 – 1880	✓													✓		✓			✓
	850	GSM 850	824 – 849 / 869 – 894	✓																✓		✓
	900	EGSM 900	880 – 915 / 925 – 960	✓													✓		✓			✓
WCDMA	1	IMT Core Band	1920 – 1980 / 2110 – 2170											✓					✓			✓
	2	PCS 1900	1850 – 1910 / 1930 – 1990								✓				✓					✓	✓	✓
	5	CLR 850	824 – 849 / 869 – 894								✓			✓	✓					✓	✓	✓
	6	850 MHz	830 – 840 / 875 – 885																			✓
	8	EGSM 900	880 – 915 / 925 – 960											✓					✓			✓
LTE	1	IMT 2100	1920 – 1980 / 2110 – 2170			✓	✓	✓										✓*				
	2	PCS 1900	1850 – 1910 / 1930 – 1990						✓		✓		✓		✓			✓*				
	3	DCS 1800	1710 – 1785 / 1805 – 1880			✓				✓				✓		✓	✓	✓*				
	4	AWS 1700	1710 – 1755 / 2110 – 2155		✓				✓		✓	✓	✓		✓			✓*				
	5	CLR 850	824 – 849 / 869 – 894			✓			✓		✓			✓	✓			✓*				

Air Interface Standard	Band	Description	Frequency (MHz)	HL6528RDx	HL7518	HL7528	HL7538	HL7539	HL7548	HL7549	HL7588	HL7618RD	HL7648	HL7650	HL7688	HL7690	HL7692	HL78xx	HL8518	HL8528	HL8529	HL854xx
LTE	7	IMT-E 2600	2500 – 2570 / 2620 – 2690			✓				✓												
	8	E-GSM	880 – 915 / 925 – 960											✓		✓	✓	✓*				
	9	1800+																**				
	10	Extended AWS-1	1710 – 1770 / 2110 – 2170															**				
	11	Lower PDC 1500	1427.9 – 1447.9 / 1475.9 – 1495.9				✓															
	12	Lower SMH blocks A/B/C	699 – 716 / 729 – 746										✓					✓*				
	13	700 MHz	777 – 787 / 746 – 756		✓						✓	✓						✓*				
	14	Upper SMH block C 700	788 – 798 / 758 – 768															✓*				
	17	700 MHz	704 – 716 / 734 – 746						✓		✓				✓			**				
	18	Japan Lower 800	815 – 830 / 860 – 875				✓											✓*				
	19	Japan Upper 800	830 – 845 / 875 – 890					✓										✓*				
	20	EU Digital Dividend	832 – 862 / 791 – 821													✓	✓	✓*				
	21	Upper PDC 1500	1447.9 – 1462.9 / 1495.9 – 1510.9					✓														
	25	Extended PCL 1900	1850 – 1915 / 1930 – 1995															✓*				
	26	Extended CLR 850	814 – 849 / 859 – 894															✓*				

Air Interface Standard	Band	Description	Frequency (MHz)	HL6528RDx	HL7518	HL7528	HL7538	HL7539	HL7548	HL7549	HL7588	HL7618RD	HL7648	HL7650	HL7688	HL7690	HL7692	HL78xx	HL8518	HL8528	HL8529	HL854xx
LTE	27	SMR 800	807 – 824 / 852 – 869															✓*				
	28	APT 700	703 – 788 / 718 –803							✓				✓				✓*				
	66	Extended AWS 1700	1710 – 1780 / 2110 – 2200															✓*				

* Including LTE Cat-NB1

** Will be supported in a future release.

4. Hardware Compatibility

4.1. CF³ Connector Pad Configuration

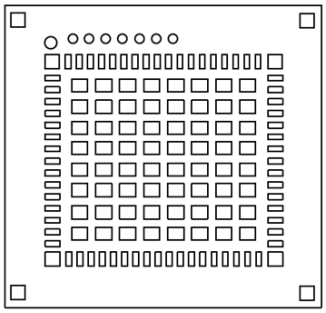


Figure 1. CF³ V1 Connector Pad

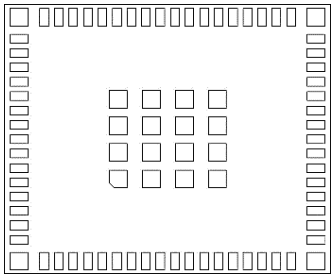


Figure 2. CF³ V2 Connector Pad

CF³ V1 modules have 146 pads that have the following distribution:

- 66 inner signal pads, 1x0.5mm, pitch 0.8mm
- 1 reference test point (Ground),1.0mm diameter
- 7 test point (JTAG), 0.8mm diameter, 1.2mm pitch
- 64 inner ground pads, 1.0x1.0mm, pitch 1.825mm/1.475mm
- 4 inner corner ground pads, 1x1mm
- 4 outer corner ground pads, 1x0.9mm

While CF³ V2 modules have 86 pads with the following distribution:

- 66 inner signal pads, 1x0.5mm, pitch 0.8mm
- 16 inner ground pads, 1.0x1.0mm, pitch 1.825mm/1.475mm
- 4 inner corner ground pads, 1x1mm

4.2. Pinout

AirPrime HL Series module pins are divided into 3 functional categories.

- **Core functions and associated pins** cover all the mandatory features for M2M connectivity and will be available by default across all CF3 family of module. These Core functions are always available and always at the same physical pin locations. A customer platform using only these functions and associated pins is guaranteed to be forward and/or backward compatible with the next generation of CF[3] modules.
- **Extension functions and associated pins** bring additional capabilities to the customer. Whenever an Extension function is available on a module, it is always at the same pin location.
- **Custom functions and associated pins** are specific to a given module, and make an opportunistic use of specific chipset functions and I/Os. Custom features should be used with caution as there is no guarantee that the custom functions available on a given module will be available on other CF[3] modules.

Pins marked as “not connected” or “reserved” should not be used.

For recommendations for unused pins, power domains and other pin-specific information, refer to the corresponding HL Series product technical specification listed in section 2.1 Documentation.

Table 6. Pad Definition

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
1	Extension	GPIO1 / I2C1_CLK[1]	General purpose input/output / I²C serial clock	GPIO1	General purpose input/output	GPIO1 / I2C_CLK[1]	General purpose input/output / I²C clock	C1	Extension	GPIO1	General purpose input/output
2	Core / Custom	UART1_RI	UART1 Ring indicator	UART1_RI[2] / TRACE_DATA3	UART1 Ring indicator / Trace data 3	UART1_RI	UART1 Ring indicator	C2	Core	UART1_RI	UART1 Ring indicator

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
3	Core	UART1_RTS	UART1 Request to send	UART1_RTS	UART1 Request to send	UART1_RTS	UART1 Request to send	C3	Core	UART1_RTS	UART1 Request to send
4	Core	UART1_CTS	UART1 Clear to send	UART1_CTS	UART1 Clear to send	UART1_CTS	UART1 Clear to send	C4	Core	UART1_CTS	UART1 Clear to send
5	Core	UART1_TX	UART1 Transmit data	UART1_TX	UART1 Transmit data	UART1_TX	UART1 Transmit data	C5	Core	UART1_TX	UART1 Transmit data
6	Core	UART1_RX	UART1 Receive data	UART1_RX	UART1 Receive data	UART1_RX	UART1 Receive data	C6	Core	UART1_RX	UART1 Receive data
7	Core	UART1_DTR	UART1 Data terminal ready	UART1_DTR[2]	UART1 Data terminal ready	UART1_DTR	UART1 Data terminal ready	C7	Core	UART1_DTR	UART1 Data terminal ready
8	Core / Custom	UART1_DCD	UART1 Data carrier detect	UART1_DCD[2] / TRACE_DATA1	UART1 Data carrier detect / Trace data 1	UART1_DCD	UART1 Data carrier detect	C8	Core	UART1_DCD	UART1 Data carrier detect
9	Core / Custom	UART1_DSR	UART1 Data set ready	UART1_DSR[2] / TRACE_DATA0	UART1 Data set ready / Trace data 0	UART1_DSR	UART1 Data set ready	C9	Core	UART1_DSR	UART1 Data set ready
10	Core / Custom	GPIO2	General purpose input/output	GPIO2 / TRACE_DATA2	General purpose input/output / Trace data 2	GPIO2	General purpose input/output	C10	Core	GPIO2	General purpose input/output
11	Core	RESET_IN_N	Input reset signal	RESET_IN_N	Input reset signal	RESET_IN_N	Input reset signal	C11	Core	RESET_IN_N	Input reset signal
12	Extension	USB_D-	USB Data Negative	USB_D-	USB Data Negative	USB_D-	USB Data Negative	C12	Extension	USB_D-	USB Data Negative
13	Extension	USB_D+	USB Data Positive	USB_D+	USB Data Positive	USB_D+	USB Data Positive	C13	Extension	USB_D+	USB Data Positive
14	Extension	NC	Not connected	NC	Not connected	NC	Not connected	C14	Not connected	NC	Not connected

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
15	Extension	NC	Not connected	NC	Not connected	NC	Not connected	C15	Not connected	NC	Not connected
16	Extension	USB_VBUS	USB VBUS	USB_VBUS	USB VBUS	USB_VBUS	USB VBUS	C16	Extension	USB_VBUS	USB VBUS
17	Extension	SPKR_N	Speaker negative output	NC	Not Connected	NC	Not Connected	C17	Not connected	NC	Not connected
18	Extension	SPKR_P	Speaker positive output	NC	Not connected	NC	Not connected	C18	Not connected	NC	Not connected
19	Extension	MIC_P	Microphone positive input	NC	Not connected	NC	Not connected	C19	Not connected	NC	Not connected
20	Extension	MIC_N	Microphone negative input	NC	Not connected	NC	Not connected	C20	Not connected	NC	Not connected
21	Extension	BAT_RTC	Power supply for RTC backup	BAT_RTC	Power supply for RTC backup	BAT_RTC	Power supply for RTC backup	C21	Extension	BAT_RTC	Power supply for RTC backup
22	Extension	26M_CLKOUT	26MHz System Clock Output	26M_CLKOUT	26MHz System Clock Output	26M_CLKOUT	26MHz System Clock Output	C22	Extension	26M_CLKOUT	26M System Clock Output
23	Extension	32K_CLKOUT	32.768kHz System Clock Output	32K_CLKOUT	32.768kHz System Clock Output	32K_CLKOUT	32.768kHz System Clock Output	C23	Extension	32K_CLKOUT	32.768kHz System Clock Output
24	Extension	ADC1	Analog to digital converter	NC / ADC1[3]	Not connected / Analog to digital converter	ADC1	Analog to digital converter	C24	Extension	ADC1	Analog to digital converter
25	Extension	ADC0	Analog to digital converter	NC / ADC0[4]	Not connected / Analog to digital converter	ADC0	Analog to digital converter	C25	Extension	ADC0	Analog to digital converter
26	Core	UIM1_VCC	1.8V/3V UIM1 Power supply	UIM1_VCC	1.8V/3V SIM1 Power supply	UIM1_VCC	1.8V/3V SIM1 Power supply	C26	Core	UIM1_VCC	1.8V USIM1 Power supply

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
27	Core	UIM1_CLK	1.8V/3V UIM1 Clock	UIM1_CLK	1.8V/3V SIM1 Clock	UIM1_CLK	1.8V/3V SIM1 Clock	C27	Core	UIM1_CLK	1.8V USIM1 Clock
28	Core	UIM1_DATA	1.8V/3V UIM1 Data	UIM1_DATA	1.8V/3V SIM1 Data	UIM1_DATA	1.8V/3V SIM1 Data	C28	Core	UIM1_DATA	1.8V USIM1 Data
29	Core	UIM1_RESET	1.8V/3V UIM1 Reset	UIM1_RESET	1.8V/3V SIM1 Reset	UIM1_RESET	1.8V/3V SIM1 Reset	C29	Core	UIM1_RESET	1.8V USIM1 Reset
30	Extension	NC	Not connected	GND	Ground	NC	Not connected	C30	Extension	GND	Ground
31	Extension	NC	Not connected	RF_DIV	RF Input - Diversity	NC	Not connected	C31	Not connected	NC	Not connected
32	Extension	NC	Not connected	GND	Ground	NC	Not connected	C32	Extension	GND	Ground
33	Extension	PCM_OUT	PCM data out	PCM_OUT[2, 3, 7]	PCM data out	PCM_OUT	PCM data out	C33	Extension	PCM_OUT	PCM data out
34	Extension	PCM_IN	PCM data in	PCM_IN[2, 3, 7]	PCM data in	PCM_IN	PCM data in	C34	Extension	PCM_IN	PCM data in
35	Extension	PCM_SYNC	PCM sync out	PCM_SYNC[2, 3, 7]	PCM sync out	PCM_SYNC	PCM sync out	C35	Extension	PCM_SYNC	PCM sync out
36	Extension	PCM_CLK	PCM clock	PCM_CLK[2, 3, 7]	PCM clock	PCM_CLK	PCM clock	C36	Extension	PCM_CLK	PCM clock
37	Core	GND	Ground	GND	Ground	GND	Ground	C37	Core	GND	Ground
38	Extension	RF_GPS[1]	RF GPS Input	NC	Not connected	RF_GPS[1] / NC	RF GNSS input / Not connected	C38	Core	RF_GPS	RF_GPS
39	Core	GND	Ground	GND	Ground	GND	Ground	C39	Core	GND	Ground
40	Core	GPIO7	General purpose input/output	GPIO7	General purpose input/output	GPIO7	General purpose input/output	C40	Core	GPIO7	General purpose input/output
41	Core	GPIO8	General purpose input/output	GPIO8 / TRACE_CLK	General purpose input/output / Trace clock	GPIO8	General purpose input/output	C41	Core	GPIO8	General purpose input/output

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
42	Extension	PPS[1]	GPS Pulse Per Second	NC	Not connected	PPS[1] / NC	GNSS Pulse Per Second / Not connected	C42	Not connected	NC	Not connected
43	Extension	EXT_LNA_GPS_EN[1]	External GPS LNA enable	NC	Not connected	EXT_LNA_ GPS_EN[1] / NC	External GNSS LNA enable / Not connected	C43	Extension	EXT_LNA_ GPS_EN	External GPS LNA enable
44	Extension	DEBUG_TX	Debug Transmit Data	GPIO13	General purpose input/output	DEBUG_TX	Debug transmit data	C44	Extension	WAKE_UP	Wake up signal
45	Core	VGPIO	GPIO voltage output	VGPIO	GPIO voltage output	VGPIO	GPIO voltage output	C45	Core	VGPIO	GPIO voltage output
46	Core	GPIO6	General purpose input/output	GPIO6	General purpose input/output	GPIO6	General purpose input/output	C46	Core	GPIO6	General purpose input/output
47	Extension	TP1	Test Point 1 0 - JTAG Enable Open - Normal Mode	NC	Not connected	TP1	Test Point 1 0-Download Mode Open-Normal Mode	C47	Not connected	NC	Not connected
48	Core	GND	Ground	GND	Ground	GND	Ground	C48	Core	GND	Ground
49	Core	RF_MAIN	RF GSM Input/output	RF_MAIN	RF Input/output	RF_MAIN	RF GSM input/output	C49	Core	RF_MAIN	RF Input/output
50	Core	GND	Ground	GND	Ground	GND	Ground	C50	Core	GND	Ground
51	Extension	DEBUG_RX	Debug Receive Data	GPIO14	General purpose input/output	DEBUG_RX	Debug receive data	C51	Extension	GPIO14	General purpose input/output
52	Extension	Reserved	Reserved	GPIO10	General purpose input/output	GPIO10	General purpose input/output	C52	Extension	GPIO10	General purpose input/output
53	Extension	Reserved	Reserved	GPIO11	General purpose input/output	GPIO11	General purpose input/output	C53	Extension	GPIO11	General purpose input/output

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
54	Extension	NC	Not connected	GPIO15	General purpose input/output	GPIO15	General purpose input/output	C54	Extension	GPIO15	General purpose input/output
55	Extension	NC	Not connected	NC	Not connected	NC	Not connected	C55	Extension	UART0_RX	Debug Receive data
56	Extension	NC	Not connected	NC	Not connected	NC	Not connected	C56	Extension	UART0_TX	Debug Transmit data
57	Extension	NC	Not connected	NC	Not connected	PWM1	Pulse Width Modulation	C57	Extension	UART0_CTS	Debug Clear to Send
58	Extension	NC	Not connected	GPIO12[5] / NC	General purpose input/output / Not connected	PWM2 / GPIO12	Pulse Width Modulation / General purpose input/output	C58	Extension	UART0_RTS	Debug Request to Send
59	Core	PWR_ON_N	Active Low Power On control signal	PWR_ON_N	Active Low Power On control signal	PWR_ON_N	Active Low Power On control signal	C59	Core	PWR_ON_N	Active Low Power On control signal
60	Extension	2G_TX_ON	2G TX burst indicator	NC / TX_ON[2, 3]	Not connected / TX indicator	2G_TX_ON	2G TX burst indicator	C60	Extension	TX_ON	TX transmission indication
61	Core	VBATT_PA	3.7V Power Amplifier Power supply	VBATT_PA	Power supply	VBATT_PA	Power supply	C61	Core	VBATT_PA	Power supply
62	Core	VBATT_PA	3.7V Power Amplifier Power supply	VBATT_PA	Power supply	VBATT_PA	Power supply	C62	Core	VBATT_PA	Power supply
63	Core	VBATT	3.7V Power supply	VBATT	Power supply	VBATT	Power supply	C63	Core	VBATT	Power supply

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
64	Core	UIM1_DET / GPIO3	UIM1 Detection / General purpose input/output	UIM1_DET / GPIO3[6]	UIM1 Detection / General purpose input/output	UIM1_DET / GPIO3	UIM1 Detection / General purpose input/output	C64	Core	UIM1_DET / GPIO3	USIM1 Detection / General purpose input/output
65	Extension	GPIO4	General purpose input/output	GPIO4	General purpose input/output	GPIO4	General purpose input/output	C65	Extension	FAST_ SHUTDOWN_ N	Fast Shutdown signal
66	Extension	GPIO5 / I2C1_DATA[1]	General purpose input/output / I²C serial data line	GPIO5	General purpose input/output	GPIO5 / I2C_SDA[1]	General purpose input/output / I²C Data	C66	Extension	GPIO5	General purpose input/output
67-70	Core	GND	Ground	GND	Ground	GND	Ground	CG1-CG4, G1-G16	Core	GND	Ground
71-166	*Note: These pads are not available.*										
167-234	Core	GND	Ground	GND	Ground	GND	Ground	-	-	-	-
236	Extension	JTAG_RESET	JTAG Reset	JTAG_RESET	JTAG Reset	JTAG_RESET	JTAG Reset	-	-	-	-
237	Extension	JTAG_TCK	JTAG Test Clock	JTAG_TCK	JTAG Test Clock	JTAG_TCK	JTAG Test Clock	-	-	-	-
238	Extension	JTAG_TDO	JTAG Test Data Output	JTAG_TDO	JTAG Test Data Output	JTAG_TDO	JTAG Test Data Output	-	-	-	-
239	Extension	JTAG_TMS	JTAG Test Mode Select	JTAG_TMS	JTAG Test Mode Select	JTAG_TMS	JTAG Test Mode Select	-	-	-	-
240	Extension	JTAG_TRST	JTAG Test Reset	JTAG_TRST	JTAG Test Reset	JTAG_TRST	JTAG Test Reset	-	-	-	-

Pin #	CF3 V1 Pin Type	HL6528RDx		HL75xx and HL76xx		HL85xx		Pin #	CF3 V2 Pin Type	HL78xx	
		Signal Name	Description	Signal Name	Description	Signal Name	Description			Signal Name	Description
241	Extension	JTAG_TDI	JTAG Test Data Input	JTAG_TDI	JTAG Test Data Input	JTAG_TDI	JTAG Test Data Input	-	-	-	-
242	Extension	JTAG_RTCK	JTAG Returned Test Clock	JTAG_RTCK	JTAG Returned Test Clock	JTAG_RTCK	JTAG Returned Test Clock	-	-	-	-

1 This signal is only available on HL6528RDx and HL854xx variants with GNSS (HL6528RD-G, HL6528RD-G2.8V, HL8548-G and HL8549-G).

2 This signal is not available on the HL7548.

3 This signal is not available on the HL7518.

4 This signal is not available on the HL75xx and HL7688.

5 This signal is not available on the HL7548, HL7588, HL7618RD, HL7648, HL7650, HL7688, HL7690 and HL7692.

6 GPIO3 is not available as an option on the HL7618RD, HL7648, HL7650, HL7688 and HL7690.

7 This signal is not available on the HL7690.

5. Application Notes for Scalability

5.1. RF Antenna Interface

5.1.1. RF_MAIN

The main antenna port of the HL series is identical throughout all series variants.

Table 7. RF_Main Pin Description

Pin #	Signal Name	Description
48 / C48	GND	Ground
49 / C49	RF_MAIN	RF GSM Input/Output
50 / C50	GND	Ground

The following figure shows a typical schematic diagram of an RF path with an antenna detection circuit.

Note: The HL7518 does not support antenna detection.

This feature will be supported by the HL78xx in the future.

This example is the same regardless of power domain (can be used for either 1.8V or 2.8V).

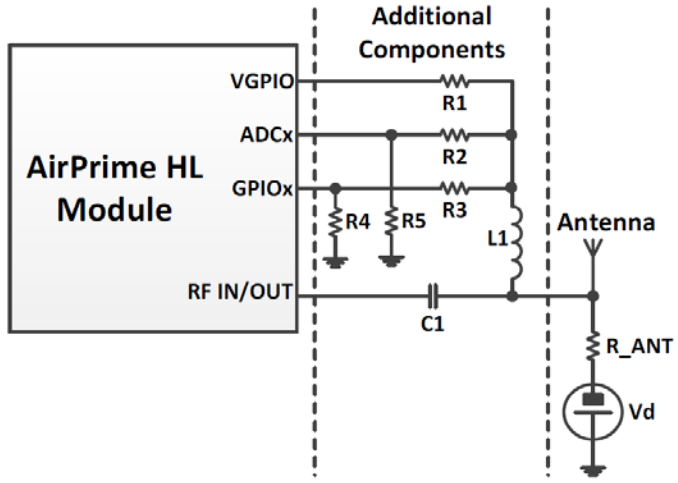


Figure 3. Antenna Detection Feature Reference Schematic

Refer to document [20] AirPrime HL Series Antenna Detection Application Note for more information.

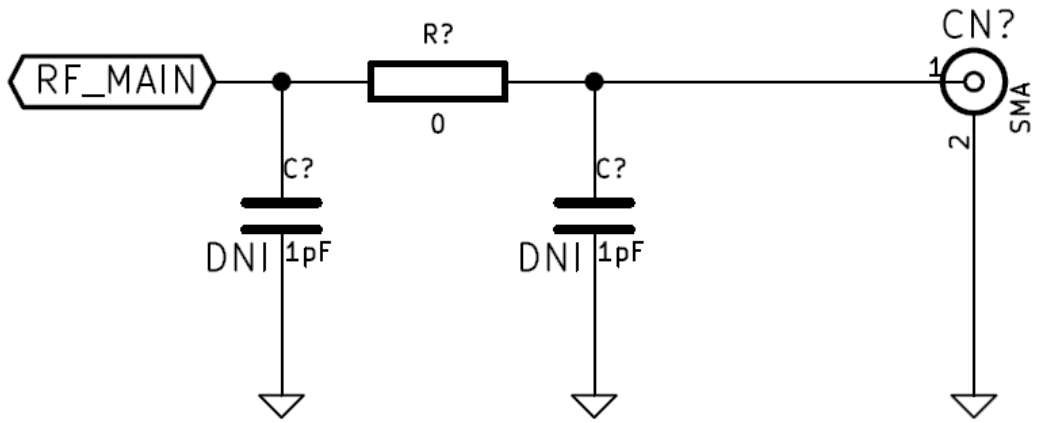


Figure 4. Direct Connection to Main Antenna Reference Schematic

Note: When using a direct connection, always ensure that the circuit matches that on the customer board. Adjustments might be needed during RF qualification.

5.1.2. RF_DIV

The RF diversity antenna port is only available on the HL75xx and HL76xx; its corresponding pin (pin 31) is not connected on the HL6528RDx, HL78xx and HL85xxx.

Table 8. RF_DIV Pin Description

Pin #	HL6528RDx, HL78xx and HL85xxx		HL75xx and HL76xx	
	Signal Name	Description	Signal Name	Description
30 / C30	NC*	Not Connected	GND	Ground
31 / C31	NC	Not Connected	RF_DIV	RF Diversity Input
32 / C32	NC*	Not Connected	GND	Ground

* Pins C30 and C32 are GND (Ground) on the HL78xx.

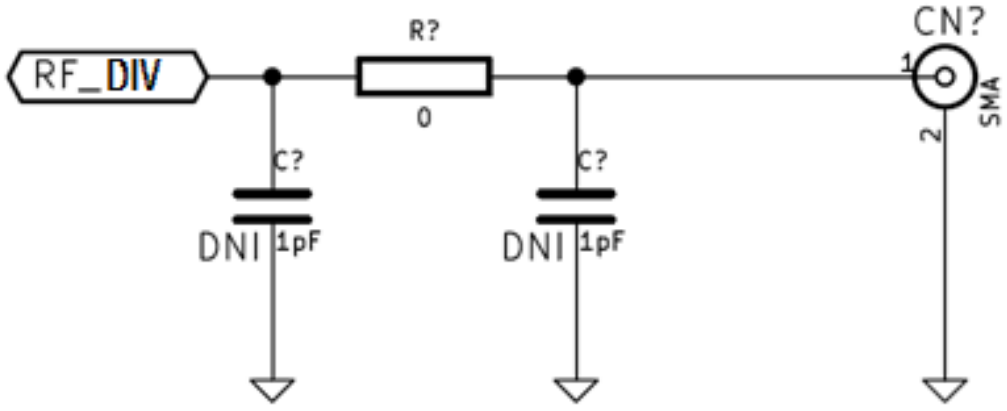


Figure 5. Direct Connection to Diversity Antenna Reference Schematic

Note: When using a direct connection, always ensure that the circuit matches that on the customer board. Adjustments might be needed during RF qualification.

5.1.3. RF_GPS

The HL6528RD-G, HL6528RD-G2.8V, HL78xx, HL8548-G and HL8549-G variants provide GNSS functionality through an embedded GNSS chip.

The HL6528RD, HL6528RD-2.8V, HL75xx, HL76xx, HL8518, HL8528 and HL8529 do not support GNSS functionality; their corresponding pin (pin 38) is not connected.

Table 9. RF_GPS Pin Description

Pin #	HL6528RD-G, HL6528RD-G2.8V, HL78xx, HL8548-G and HL8549-G		HL6528RD, HL6528RD-2.8V, HL75xx, HL76xx, HL8518, HL8528 and HL8529	
	Signal Name	Description	Signal Name	Description
37 / C37	GND	Ground	GND	Ground
38 / C38	RF_GPS	RF GPS input	NC	Not connected
39 / C39	GND	Ground	GND	Ground

The following figure shows a typical schematic diagram for a direct connection to a GPS antenna. Note that the power domain depends on the HL embedded module variant.

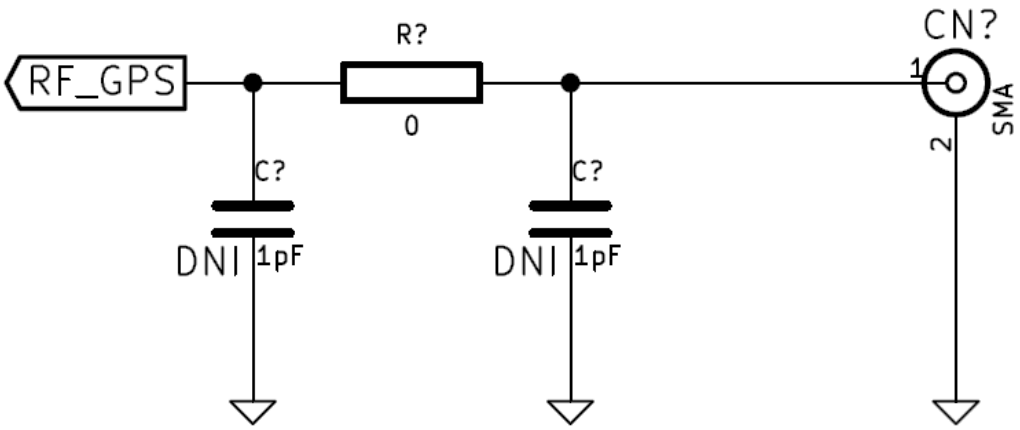


Figure 6. Direct Connection to GPS Antenna Reference Schematic

Note: When using a direct connection, always ensure that the circuit matches that on the customer board. Adjustments might be needed during RF qualification.

The GPS receiver shares the same RF resources as the 4G receiver on the HL78xx. The end-device target should allow GPS positioning for asset management applications where infrequent and no real-time position updates are required.

5.1.3.1. EXT_LNA_GPS_EN

AirPrime HL series variants that support GNSS provide a signal, EXT_LNA_GPS_EN, that indicates whether the GNSS receiver is active, and can be used to enable an external LNA (or active antenna), especially during GNSS low power mode.

This signal automatically sets the AirPrime HL6528RD-G, HL6528RD-G2.8V, HL78xx, HL8548-G, and HL8549-G modules' internal LNA to low gain when an external pull-down resistor is detected.

The HL6528RD, HL6528RD-2.8V, HL75xx, HL76xx, HL8518, HL8528 and HL8529 do not support this signal; their corresponding pin (pin 43) is not connected.

Table 10. EXT_LNA_GPS_EN Pin Description

Pin #	HL6528RD-G, HL6528RD-G2.8V, HL78xx and HL854x-G		HL6528RD, HL6528RD-2.8V, HL75xx, HL76xx, HL8518, HL8528 and HL8529	
	Signal Name	Description	Signal Name	Description
43 / C43	EXT_LNA_GPS_EN	External GPS LNA enable	NC	Not connected

Table 11. EXT_LNA_GPS_EN Power Domain

Power Domain for HL6528RD-G, HL78xx and HL854x-G	Power Domain for HL6528RD-G2.8V
1.8 V	2.8 V

Note: To ensure HL series scalability, it is recommended that the 1.8V variant be used for applications that use this signal/feature.

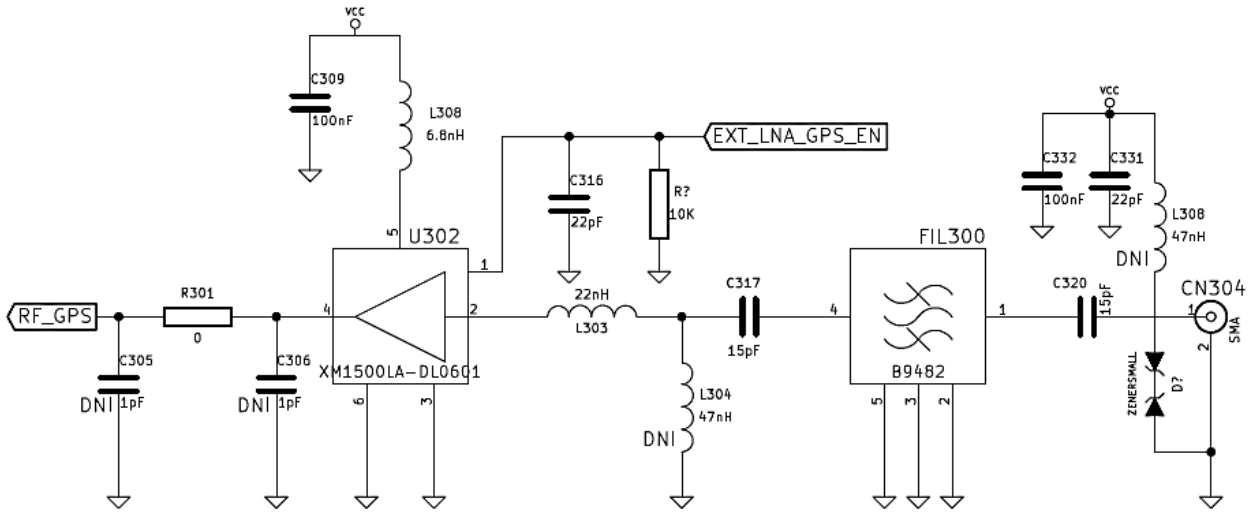


Figure 7. Active Antenna and External LNA Reference Schematic

5.1.3.2. PPS

The PPS signal is an output pulse related to GNSS receiver time available on HL6528RDx and HL854xx series variants that support GNSS.

The HL7xxx, HL8518, HL8528, HL8529 do not support this signal; their corresponding pin (pin 42 and pin C42) is not connected.

Table 12. PPS Pin Description

Pin #	HL6528RD-G, H6528RD-G2.8V and HL854x-G		HL7xxx, HL8518, HL8528 and HL8529	
	Signal Name	Description	Signal Name	Description
42 / C42	PPS	GNSS pulse per second	NC	Not connected

Table 13. PPS Power Domain

Power Domain for HL6528RD-G and HL854x-G	Power Domain forHL6528RD-G2.8V
1.8 V	2.8 V

Note: To ensure HL series scalability, it is recommended that the 1.8V variant be used for applications that use this signal/feature.

5.1.3.3. I²C Interface

AirPrime HL series variants that support GNSS, except for the HL78xx, embed an I²C interface dedicated to NMEA frames. (Note that NMEA frames can also be output from the UART1 interface, as well as the USB interface for the HL6528RD-G, HL6528RD-G2.8V and HL854x-G.)

Table 14. I²C Pin Description

Pin #	HL6528RD-G, H6528RD-G2.8V and HL854x-G		HL7xxx, HL8518, HL8528 and HL8529	
	Signal Name	Description	Signal Name	Description
1 / C1	GPIO1/I2C1_CLK	General purpose input/output / I²C Clock	GPIO1	General purpose input/output
66 / C66	GPIO5/I2C1_DATA	General purpose input/output / I²C Data	GPIO5	General purpose input/output

Table 15. I²C Power Domain

Power Domain for HL6528RD-G and HL854x-G	Power Domain forHL6528RD-G2.8V
1.8 V	2.8 V

Note: As most microprocessor customer applications do not operate at 1.8V or 2.8V, and to ensure full scalability, customers need to use an integrated dual bi-directional I²C voltage level translator (for example, PCA9306) or a bi-directional level shifter based on MOSFET (for example, BSS138).

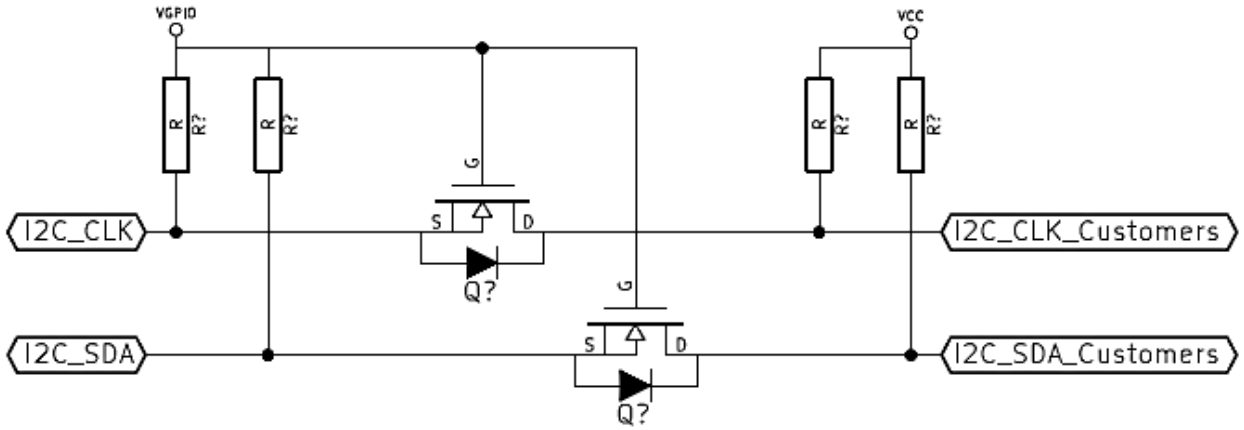


Figure 8. Bi-directional Level Shifter for I²C

For more information about this example, refer to NXP Application Note AN10441.

5.2. Power Supply

5.2.1. VBATT and VBATT_PA

For standard applications, VBATT and VBATT_PA must be tied externally to the same power supply. However, for some specific applications, the HL series modules support separate VBATT and VBATT_PA connections. For more information, refer to the specific technical specifications specified in section 2.1 Documentation.

Table 16. Power Supply Pin Description

Pin #	Signal Name	Description	Voltage
61 / C61	VBATT_PA	3.7 V Power Amplifier Power Supply	3.7 V
62 / C62	VBATT_PA	3.7 V Power Amplifier Power Supply	3.7 V
63 / C63	VBATT	3.7 V Power Supply	3.7 V

Table 17. Power Supply Electrical Characteristics

Variant	VBATT_PA (V) – Full Specification			VBATT_PA (V) – Extended Range			VBATT (V)		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
HL6528RDx	3.35	3.7	4.3	2.8	3.7	4.3	3.35	3.7	4.3
HL75xx, HL76xx and HL85xxx	3.2	3.7	4.5	2.8	3.7	4.5	3.2	3.7	4.5
HL78xx	3.2	3.7	4.35	2.8	3.7	4.35	3.2	3.7	4.35

5.2.2. BAT-RTC

The BAT-RTC voltage varies depending on the HL series variant. Customers should use a super capacitor to ensure scalability between variants. For scalability with the HL78xx, customers must use an external power loading circuit or a battery cell.

Table 18. BAT_RTC Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RDx	Voltage for HL7xxx and HL85xxx
21 / C21	BAT-RTC	Power Supply for RTC backup	2.8 V	1.8 V

Caution: *If customers want to use a non-rechargeable battery or a rechargeable battery cell, BOM modification must be anticipated.*

5.2.3. VGPIO

Although the pin number is the same, the GPIO voltage output and current capability of the HL6528RD-2.8V and HL6528RD-G2.8V is different from that of other HL variants.

Table 19. VGPIO Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RD, HL6528RD-G, HL7xxx, and HL85xx	Voltage for HL6528RD-2.8V, HL6528RD-G2.8V
45 / C45	VGPIO	GPIO voltage output	1.8 V	2.8 V

Table 20. VGPIO Electrical Characteristics

Parameter	HL6528RD, HL6528RD-G			HL6528RD-2.8V, HL6528RD-G2.8V			HL75xx and HL76xx			HL78xx			HL85xxx		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
Voltage level (V) (Both active mode and sleep mode)	1.7	1.8	1.9	2.7	2.8	2.95	1.7	1.8	1.9	1.7	1.8	1.9	1.7	1.8	1.9
Current capability active mode (mA)	-	-	50	-	-	50	-	-	50	-	-	50	-	-	50
Current capability sleep mode (mA) (32KHz system clock enable)	-	-	3	-	-	3	-	-	3	-	-	1	-	-	-
Line regulation (mV/V)	-	-	50	-	-	50	-	-	-	-	-	-	-	-	-
Rise Time (ns) (Test load capacitor = 30 pF)	-	-	6	-	-	6	-	-	1.5	-	-	TBD	-	-	1.5

5.3. Digital Control Signals

5.3.1. Power On

A low-level signal must be provided to pin 59 / C59, PWR_ON_N, to switch the AirPrime HL series module on.

Table 21. Power On Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RDx	Voltage for HL7xxx and HL85xxx
59 / C59	PWR_ON_N	Active low power on control signal	3 V	1.8 V

The PWR_ON_N pin is internally pulled up and an open collector or open drain transistor can be used for ignition. This signal will become low after the module is ready and it cannot be directly driven by a GPIO signal, so an open collector or open drain transistor should be used.

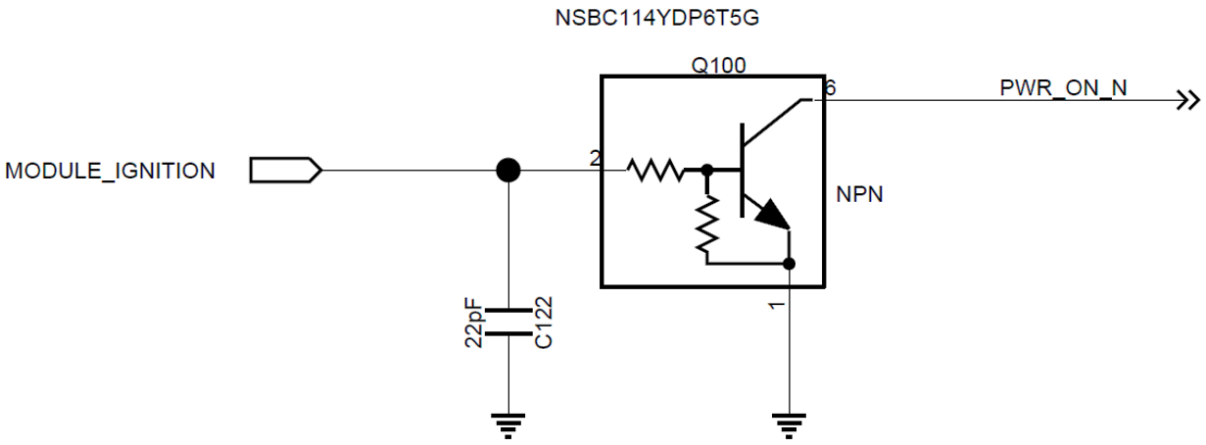


Figure 9. PWR_ON_N Reference Schematic

To start the HL series embedded module, a low-level pulse must be applied on the PWR_ON / PWR_ON_N signal for 2000 ms.

Caution: *If the PWR_ON_N pin is not configured as managed by host on the HL78xx (default configuration), the module will start regardless of PWR_ON_N state. In case the RESET_IN_N signal is maintained low, the module will not start until RESET_IN_N is released.*

5.3.2. Power Off

Different AT commands are used to switch the HL modules off.

Table 22. AT Command to Switch the HL Module Off

	HL6528RDx	HL7xxx	HL85xxx
AT Command	**AT+EPOF**	**AT+CPWROFF** for the HL7518, HL7548, HL7588, HL7618RD, HL7648, HL7650, HL7688, HL7690 and HL7692; **AT+CFUN=0** for the HL7528, HL7538, HL7539 and HL7549 **AT+CPOF** for the HL78xx	**AT+CPOF**

Note that when the AT command to switch the module off is sent to the HL6528RDx and HL85xxx:

- If a high level is applied on the PWR_ON_N signal, the module is turned OFF.
- If a low level is applied on the PWR_ON_N signal, the module is turned OFF then turned ON.

5.3.3. Reset

The AirPrime HL series modules have an input Reset pin, RESET_IN_N. This is a hardware reset and should only be used for emergency resets.

Table 23. Reset Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RD, HL6528RD-G, HL7xxx and HL85xxx	Voltage for HL6528RD-2.8V and HL6528RD-G2.8V
11 / C11	RESET_IN_N	Input reset signal	1.8 V	2.8 V

To reset the HL series embedded module, a low-level pulse must be applied on the RESET_IN_N pin for 38 ms. This pin cannot be directly driven by a GPIO signal; an open collector or open drain transistor must be used.

Additionally for the HL85xxx, if a power on is required after triggering the reset pin, then the PWR_ON_N pin must be set to logic low.

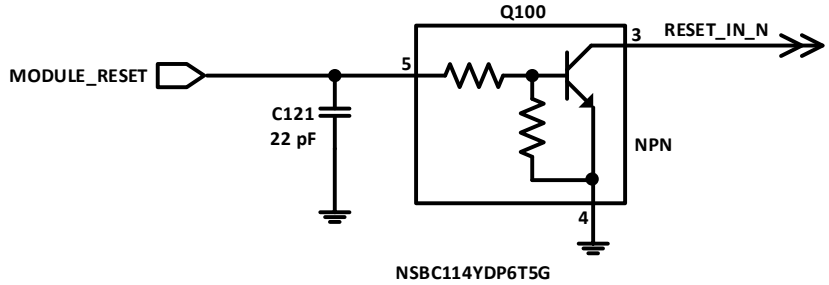


Figure 10. RESET_IN_N Reference Schematic

5.4. Interfaces

5.4.1. UART1

Except for the HL7548 which only supports 4-wire UART, all other HL series modules support a full UART interface (8-wire).

Table 24. UART1 Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RD, HL6528RD-G, HL7xxx and HL85xxx	Voltage for HL6528RD-2.8V, and HL6528RD-G2.8V
2 / C2	UART1_RI*	UART1 Ring indicator	1.8 V	2.8 V
3 / C3	UART1_RTS	UART1 Request to send	1.8 V	2.8 V
4 / C4	UART1_CTS	UART1 Clear to send	1.8 V	2.8 V
5 / C5	UART1_TX	UART1 Transmit data	1.8 V	2.8 V
6 / C6	UART1_RX	UART1 Receive data	1.8 V	2.8 V
7 / C7	UART1_DTR*	UART1 Data terminal ready	1.8 V	2.8 V

Pin #	Signal Name	Description	Voltage for HL6528RD, HL6528RD-G, HL7xxx and HL85xxx	Voltage for HL6528RD-2.8V, and HL6528RD-G2.8V
8 / C8	UART1_DCD*	UART1 Data carrier detect	1.8 V	2.8 V
9 / C9	UART1_DSR*	UART1 Data set ready	1.8 V	2.8 V

* This pin is not available on the HL7548.

As most microprocessors in customer applications do not operate at 1.8V or 2.8V, and to ensure full scalability, customers should use an 8-bit bi-directional voltage level translator.

Sierra Wireless recommends using 2.8V variants of the HL6528RDx when using a level shifter to communicate with a 3V or 3.3V microprocessor since 1.8V variants of the HL6528RDx contain an internal level shifter. Cascading level shifters (inside and outside the HL module) may cause UART driving issues.

Refer to the corresponding product technical specification listed in section 2.1 Documentation for minimum and maximum IO signal voltage when designing level shifter circuitry.

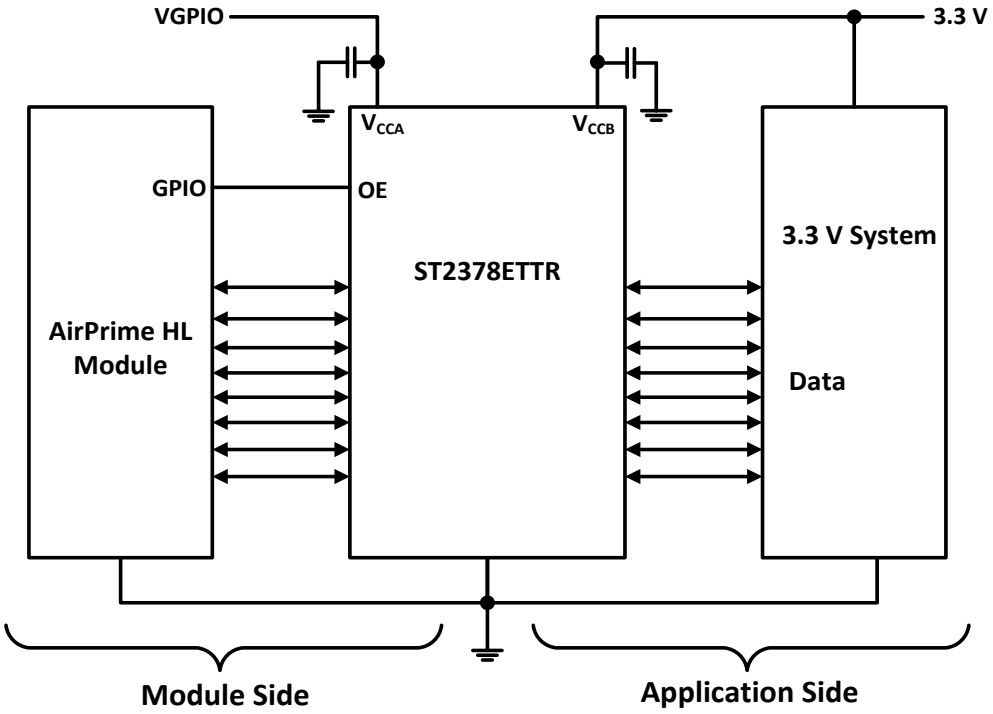


Figure 11. Level Translator Example

The module can also be connected directly to VGPIO to enable the level translator when using an HL6528RDx.

5.4.2. USB 2.0

The HL6528RDx supports a full-speed USB 2.0 interface, while both HL7xxx and HL85xxx support a high-speed USB 2.0 interface. This USB interface can be used for AT commands, NMEA traces or software traces.

Note: This interface will be available on the HL78xx in a future release.

Table 25. USB Pin Description

Pin #	Signal Name	Description	Voltage
12 / C12	USB_D-	USB Data Negative	3.3 V
13 / C13	USB_D+	USB Data Positive	3.3 V
16 / C16	USB_VBUS	USB VBUS	5 V

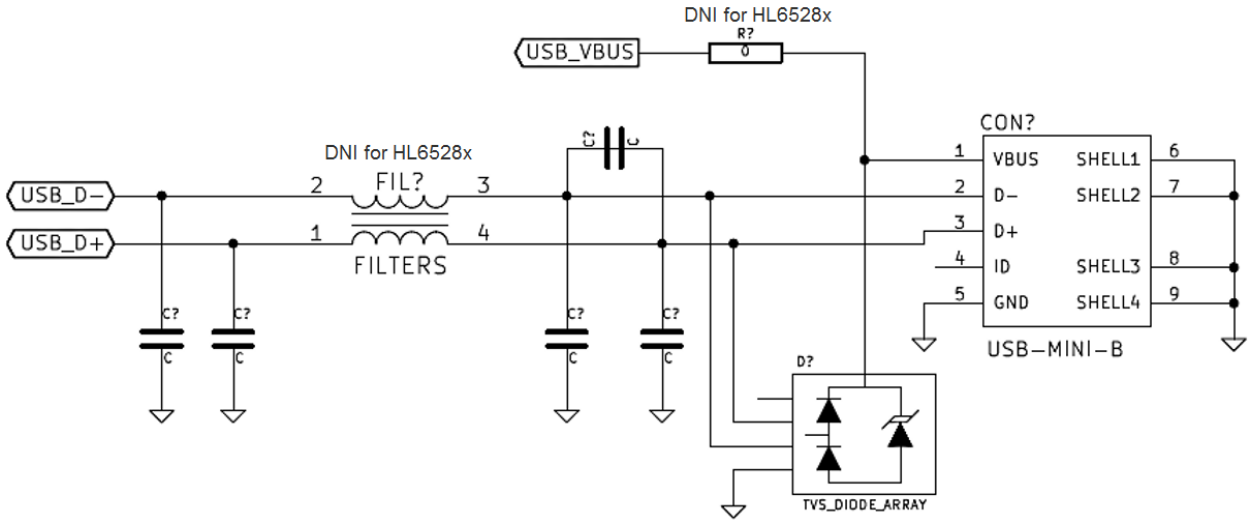


Figure 12. USB Reference Schematic

If the 5V VUSB is not available on the customer application, VBATT can be used instead (an AT command must be used to set the level of VBUS).

Caution: *USB_VBUS is used for USB detection in the HL6528RDx and must be connected to the host's 5V VUSB.*

5.4.3. Audio

5.4.3.1. Analog Audio

The HL6528RDx provides one microphone input and one speaker output, both of which supports either single ended or differential connection.

The HL7xxx and HL85xxx do not support this feature; corresponding pins are not connected.

Table 26. Analog Audio Pin Description

Pin #	HL6528RDx			HL7xxx and HL85xxx	
	Signal Name	Description	Voltage	Signal Name	Description
17 / C17	SPKR_N	Speaker negative output	2.8 V	NC	Not Connected
18 / C18	SPKR_P	Speaker positive output	2.8 V	NC	Not Connected
19 / C19	MIC_P	Microphone positive input	2.8 V	NC	Not Connected
20 / C20	MIC_N	Microphone negative input	2.8 V	NC	Not Connected

5.4.3.2. Digital Audio (PCM)

The HL6528RDx, HL7xxx (except for the HL7518, HL7548 and HL7690) and HL85xxx support a digital audio (PCM) interface.

Table 27. PCM Pin Description

Pin #	Signal Name	Description	Power Domain for HL6528RDx	Power Domain for HL7xxx and HL85xx
33 / C33	PCM_OUT	PCM data out	2.8 V	1.8 V
34 / C34	PCM_IN	PCM data in	2.8 V	1.8 V
35 / C35	PCM_SYNC	PCM sync out	2.8 V	1.8 V
36 / C36	PCM_CLK	PCM clock	2.8 V	1.8 V

Caution: *Although pins 33, 34, 35 and 36 are also marked as PCM pins in HL7518, HL7588 and HL7690, they do not support this interface.*

Note that the power domain of the HL6528RDx PCM interface is 2.8 V regardless of variant. A 4-bit level shifter is required to ensure scalability between the HL series modules.

Also, the HL series modules use different basebands which can result in varying behavior between them. The following table enumerates the PCM features of the HL series modules.

Table 28. PCM Features

Parameters	HL6528RDx	HL7xxx*	HL85xx	Compatible HW Audio Codec
Mode	Master	Master and Slave	Master and Slave	Master and Slave
Number of bits	16 significant bits	16 bits	16 significant bits	16 bits
MSB / LSB	MSB first	MSB first	MSB only	MSB only
Bit clock in master mode	256 kHz, 512 kHz, 1024 kHz, 2048 kHz	256 kHz, 384 kHz, 512 kHz	256 kHz, 384 kHz, 512 kHz	Should support continuous value in slave mode
Frame clock	8 kHz	8 kHz	8 kHz	8 kHz
Rising edge or falling edge	Rising	Both	Both	One or the other
Long / short frame	Both	Long frame sync	Long frame sync	Should support both
Law	Linear	Linear	Linear	Linear
Right / left alignment	Left	Left	Left	Left

* Except on the HL7518, HL7548 and HL7690. TBD on the HL78xx.

The Nuvoton W681360 is a hardware voice codec that is compatible with AirPrime HL7xxx and HL85xxx.

5.4.4. SIM

The AirPrime HL series modules support a SIM interface.

Table 29. UIM1 Pin Description

Pin #	Signal Name	Description*	Voltage*
26 / C26	UIM1_VCC	1.8V/3V SIM1 Power supply	1.8V/3V
27 / C27	UIM1_CLK	1.8V/3V SIM1 clock	1.8V/3V
28 / C28	UIM1_DATA	1.8V/3V SIM1 Data	1.8V/3V
29 / C29	UIM1_RESET	1.8V/3V SIM1 Reset	1.8V/3V

* The HL78xx only supports 1.8V SIM cards.

The HL6528RDx, HL7548, HL7588, HL76xx and HL85xxx support DSSS (Dual SIM Single Standby) on the UIM1 interface and require an external switch.

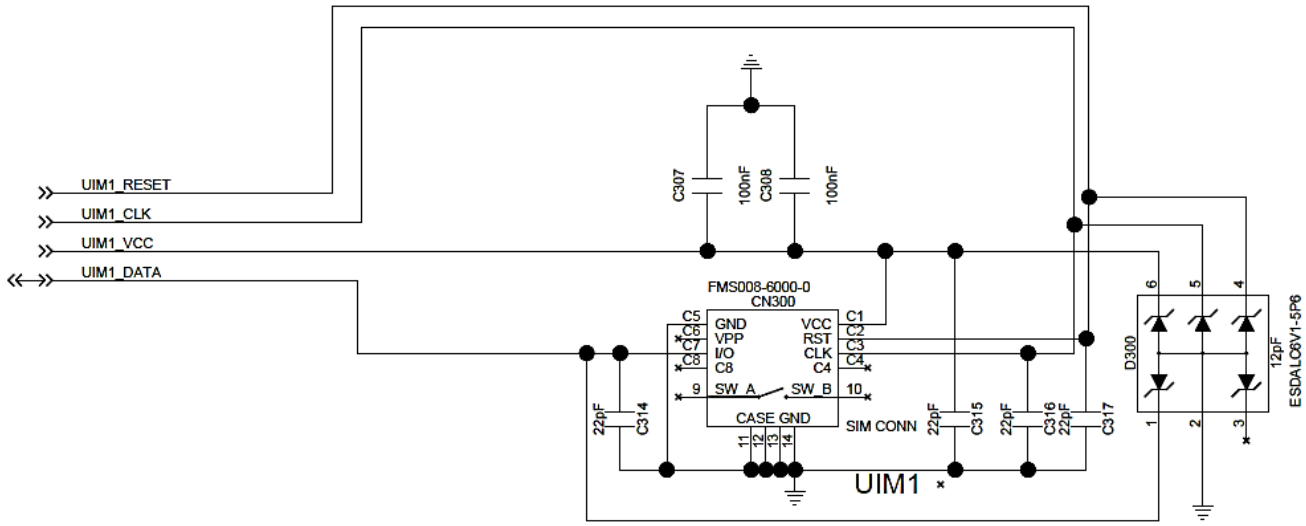


Figure 13. UIM1 Reference Schematic

5.4.4.1. UIM1 Detection

The AirPrime HL series modules support UIM1 detection through a dedicated GPIO.

Table 30. UIM1 Detection Pin Description

Pin #	Signal Name	Description
64 / C64	UIM1_DET / GPIO3*	UIM1 detection / General purpose input/output

* GPIO3 is not available as an option on the HL7618RD, HL7648, HL7650, HL7688 and HL7690.

Caution: *The HL6528RDx need a 4.7 kΩ pull-down resistor to properly set its logic low, which is used for SIM detection.*

5.4.5. ADC

The AirPrime HL6528RDx, HL76xx (except the HL7688 which has one ADC), HL78xx and HL85xxx have two ADC signals; all other HL75xx variants have one ADC signal except for the HL7518, which does not have an ADC interface (pin 24 and pin 25 are NC on the HL7518).

Table 31. ADCx Summary

Variant	ADC0	ADC1
HL6528RDx	✓	✓
HL75xx	×	×
HL7618RD, HL7648, HL7650, HL7690, HL7692	✓	✓
HL7688	×	✓
HL78xx	✓	✓
HL85xxx	✓	✓

Table 32. ADC1 Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RDx	Voltage for HL75xx, HL76xx and HL85xxx	Voltage for HL78xx
24 / C24	ADC1	Analog to digital converter	2.8 V	1.2 V	1.82 V

Table 33. ADC0 Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RDx	Voltage for HL75xx, HL76xx and HL85xxx	Voltage for HL78xx
25 / C25	ADC0*	Analog to digital converter	2.8 V	1.2 V	1.82 V

* This signal is not available on the HL75xx and HL7688.

Note: When the ADC is used for antenna detection, the embedded software compensates for the ADC resolution difference.

Table 34. ADC Electrical Characteristics

Parameter		HL6528RDx			HL7xxx and HL85xxx			Unit
		Min	Typ	Max	Min	Typ	Max	
Resolution			10			10		bits
Sampling frequency				100			125	kHz
Input signal range		0		2.8	0		1.2	V
Integral non-linearity (INL)		-1		+1	-2		+2	bit
Differential non-linearity (DNL)		-1		+1	-1		+1	bit
Input impedance	Input resistance		1000		1000			kΩ
	Input capacitance		4			1		pF

Note: To ensure HL series scalability, a resistive level shifter must be used on the HL7xxx and HL85xxx if the signals applied are greater than 1.2V.

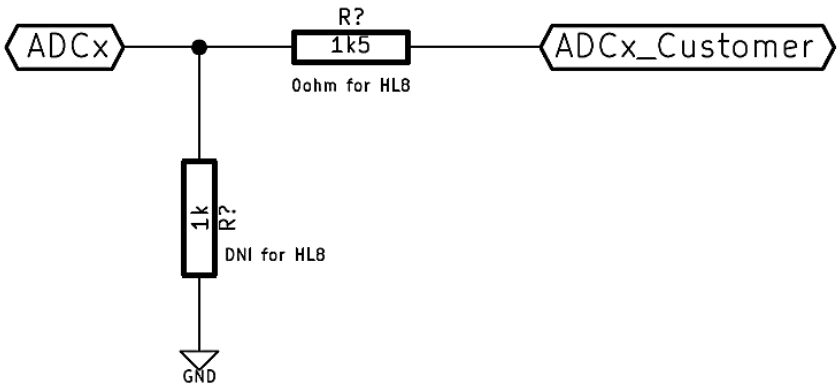


Figure 14. Resistive Level Shifter Reference Schematic

5.4.6. GPIO

The HL series modules share 6 common GPIOs. Some of these GPIOs are dedicated for specific purposes:

- GPIO3 / UIM1_DET (pin 64) is dedicated for UIM1 detection feature on the HL series modules
- GPIO6 is dedicated to switch UIM1 for DSSS feature on the HL series modules

Table 35. Common GPIO Pin Description

Pin #	Signal*	Description
1 / C1	GPIO1	General purpose input/output
10 / C10	GPIO2	General purpose input/output
40 / C40	GPIO7	General purpose input/output
41 / C41	GPIO8	General purpose input/output
46 / C46	GPIO6	General purpose input/output
66 / C66	GPIO5	General purpose input/output

* Signals may be multiplexed. Refer to the corresponding product technical specification listed in section 2.1 Documentation for details.

On top of these 6 GPIOs, the HL7xxx and HL85xxx have three more compatible GPIOs.

Table 36. Additional Common GPIOs on the HL7xxx and HL85xxx

Pin #	HL6528RDx		HL7xxx and HL85xxx	
	Signal Name	Description	Signal Name	Description
52 / C52	SPI1_MISO	SPI Master In Slave Out	GPIO10	General purpose input/output
53 / C53	SPI1_CLK	SPI Clock	GPIO11	General purpose input/output
54 / C54	SPI1_MOSI	SPI Master Out Slave In	GPIO15	General purpose input/output

Other GPIOs available are listed in the following table.

Table 37. Other Available GPIOs

Pin #	Signal Name[1]	Description	HL6528RDx	HL75xx	HL76xx	HL78xx	HL85xxx
44 / C44	GPIO13	General purpose input/output	×	✓	✓	×	×
51 / C51	GPIO14	General purpose input/output	×	✓	✓	×	×
58 / C58	GPIO12	General purpose input/output	×	✓[2]	✓	✓	✓
64 / C64	GPIO3	General purpose input/output	×	✓[2]	✓[3]	✓	✓
65 / C65	GPIO4	General purpose input/output	✓	✓	✓	×	✓

1 Signals may be multiplexed. Refer to the corresponding product technical specification listed in section 2.1 Documentation for details.

2 This is not available on the HL7548 and HL7588.

3 This is only available on the HL7692.

5.4.7. Internal Clock

The HL6528RDx, HL7xxx and HL85xxx support two digital clock interfaces – a 26MHz and a 32.768kHz digital clock output.

Table 38. Internal Clock Pin Description

Pin #	Signal Name	Description	Voltage for HL6528RDx	Voltage for HL7xxx and HL854xx
22 / C22	26M_CLKOUT	26MHz system clock output	1.2 V	1.8 V
23 / C23	32K_CLKOUT	32.768kHz system clock output	2.8 V	1.8 V

Note: Note that the 26M_CLKOUT signal is very sensitive to loading; hence a low load on this clock is required when used. A 4.7pF series capacitor is recommended.

5.4.8. TX Burst Indicator

The AirPrime HL series modules (except for the HL7518 and HL7548) provide a signal for TX burst indication.

Table 39. TX Burst Indicator Pin Description

Pin #	Signal Name*	Description	Power Domain for HL6528RDx	Power Domain for HL75xx and HL76xx	Power Domain for HL78xx and HL85xxx
60 / C60	2G_TX_ON / TX_ON	2G TX burst indicator / TX burst indicator	2.8 V	2.3 V	1.8 V

* This signal is not available on the HL7518 and HL7548.

Note: Behavior of this signal may vary depending on the variant.

5.5. Debug

The HL series modules provide debug interfaces for test purposes. These interfaces are dedicated for Sierra Wireless use and do not impact scalability.

Test points on the customer application should be anticipated in the application design.

5.5.1. SW Traces and Debug Port

The HL6528RDx and HL8548x provide a 2-wire debug port interface, and the HL7xxx provides a 5-wire trace debug interface through the UART interface; these are dedicated to internal software traces.

Note: The HL7xxx debug interface is not compatible with the HL6528RDx and HL85xxx debug interface as they are on different pins.

Table 40. SW Trace Pin Description – HL6528RDx and HL85xxx

Pin #	Signal Name	Description
44	DEBUG_TX	Debug Transmit Data
51	DEBUG_RX	Debug Receive Data

Table 41. SW Trace Pin Description – HL75xx and HL76xx

Pin #	Signal Name	Description
2	UART1_RI / TRACE_DATA3	UART1 Ring indicator / Trace data 3
8	UART1_DCD / TRACE_DATA1	UART1 Data carrier detect / Trace data 1
9	UART1_DSR / TRACE_DATA0	UART1 Data set ready / Trace data 0
10	GPIO2 / TRACE_DATA2	General purpose input/output / Trace data 2
41	GPIO8 / TRACE_CLK	General purpose input/output

Table 42. SW Trace Pin Description – HL78xx

Pin #	Signal Name	Description
C55	UART0_RX	Debug Receive Data
C56	UART0_TX	Debug Transmit Data
C57	UART0_CTS	Debug Clear to Send
C58	UART0_RTS	Debug Request to Send

5.5.2. JTAG

The AirPrime HL6528RDx, HL75xx, HL76xx and HL85xxx modules provide debug access to the module core. These JTAG signals are accessible through solderable test points which should be accessible from the customer application.

All signals listed in the table below should be outputs on the customer board to allow JTAG debugging.

Table 43. JTAG Pin Description

Pin #	Signal Name	Description
47	TP1*	Test Point 1
236	JTAG_RESET	JTAG RESET
237	JTAG_TCK	JTAG Test Clock
238	JTAG_TDO	JTAG Test Data Output
239	JTAG_TMS	JTAG Test Mode Select
240	JTAG_TRST	JTAG Test Reset
241	JTAG_TDI	JTAG Test Data Input
242	JTAG_RTCK	JTAG Returned Test Clock

* This pin is not connected on the HL75xx and HL76xx.

Note: Test points should also be reserved for pins 52 and 53 of the HL6528RDx.

5.5.3. USB for Debug Trace

Additionally on the HL75xx and HL76xx, the USB interface can also be used to collect trace for debug purposes. It is recommended to reserve test points for collecting trace when USB is not used. Refer to the USB section of each corresponding product technical specification listed in section 2.1 Documentation for details.

6. Layout Recommendations

The HL series modules share the same LGA pins, solder mask, and solder paste mask.

Note: *For customers planning to use both HL78xx (15x18mm – 16 ground pads) and larger HL modules (22x23mm – 64 ground pads), Sierra Wireless advises to use the larger HL footprint (22x23mm) and 2 stencils (one recommended for each product).*

Using larger HL modules (64 ground pads) on HL78xx copper footprint (16 ground pads) has not yet been evaluated thermally. This will be confirmed in future document revisions.

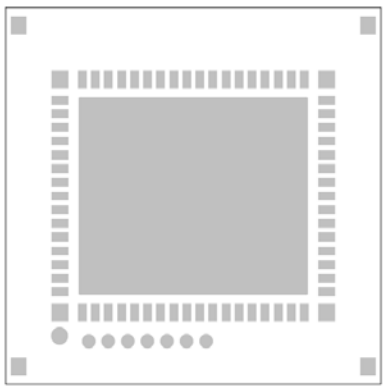


Figure 15. AirPrime HL Series Pad Layout

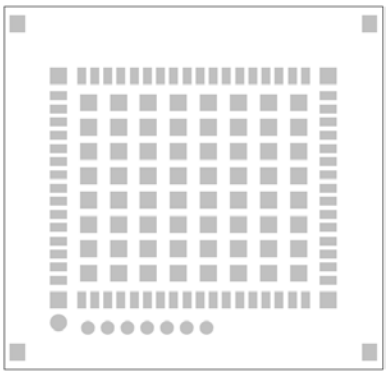


Figure 16. AirPrime HL Series Solder Mask

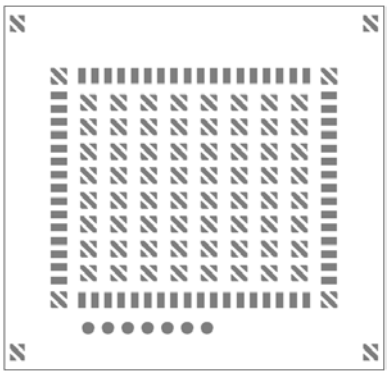


Figure 17. AirPrime HL Series Paste Mask

To ensure HL series scalability between CF[3] V1 and CF[3] V2, guidelines specified in documents [18] AirPrime HL Series Customer Process Guidelines and [19] AirPrime HL78xx Customer Process Guidelines must be followed.

Also, it is recommended to leave a component-free area of 2 mm around the HL series module.

Note: The HL8549x is 2mm bigger (25mm x 24mm) but it does not impact the AirPrime HL series pad layout, solder mask and paste mask.