Skywire® LTE CAT 1 S7618RD Embedded Cellular Modem Datasheet

NimbeLink Corp

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1. Introduction

1.1 Orderable Part Numbers

Orderable Device	Firmware Revision	Operating Temperature	Bands	Carrier	Network Type
NL-SW-LTE-S7618RD	V1.10	-40 to +85˚C	B4, B13	Verizon	LTE

**May require World Wide SIM from Verizon*

1.2 Additional Resources

The following documents or documentation resources are referenced within this document.

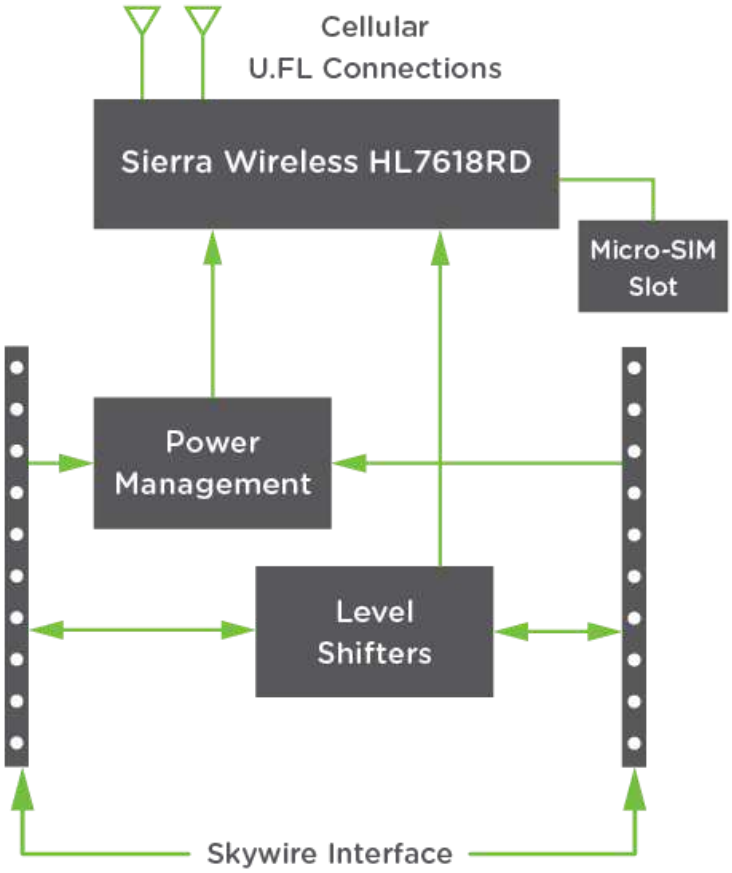
- Sending SMS
- Configuring linux 'pppd'
- Sending and Receiving Data Using Socket Dials
- Sierra's HL7681RD Product Technical Resources
- Sierra's HL76xx AT Command Manual

1.3 Product Overview

Add robust cellular connectivity to your M2M devices with scalable radio technology with the Skywire line of modems including HL7618RD based LTE solutions. Extensive experience in designing and building embedded product solutions makes the NimbeLink Skywire® embedded cellular modem the smallest on the market. It uses the popular Skywire interface and supports multiple LTE bands and fallback capability minimizing costs of hardware and network access. The module is designed for volume production and is intended for OEMs to embed into end equipment designs.

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1.4 Block Diagram



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2. Technical Specifications

2.1 Electrical Specifications

2.1.1 Absolute Maximum Ratings

Parameter	Signal	Maximum Rating
Main Power Supply	VCC	5.5V
I/O Voltage Reference	VREF	5.5V

2.1.2 Recommended Ratings & Module Pin out

2.1.2.1 Connectors J1 and J2

Pin	Name	Direction	Description	Min	Typical	Max	If not used
1	VCC	Input	Main Power supply	3.0V	3.9V	5.5V	Must be implemented
2	DOUT	Output	UART data out, I/O level tied to VREF	VOL: GND to 0.55V		VOH: VREF x 0.67 to VREF	Must be implemented if USB not used, No connection
3	DIN	Input	UART data in, I/O level tied to VREF	VIL: GND to 0.15V		VIH: VREF-0.4V to VREF	Must be implemented if USB not used, No connection
4	GND	Input	Ground Pin		0		Must be implemented
5	RESET_nIN	Input	Controls RESET input on Sierra HL7681RD, tie low for a minimum of 20mS and released to activate. Internally pulled up to 1.8V. Drive with open collector output. Assert only in an emergency as the module will not gracefully exit the cellular network when asserted.	0V		1.8V	No connection
6	VUSB	Input	Supply for USB interface	3.2V	5V	5.5V	No connection
7	USB_D+	I/O	USB differential Data + signal				No connection
8	USB_D-	I/O	USB differential Data - signal				No connection
9	DTR	Input	Modem Data Terminal Ready input	VIL: GND to 0.15V		VIH: VREF-0.4V to VREF	Tie to GND
10	GND	Input	Ground Pin		0		Must be implemented

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11	GND	Input	Ground Pin		0		Must be implemented
Pin	**Name**	**Direction**	**Description**	**Min**	**Typical**	**Max**	**If not used**
12	CTS	Output	Modem Clear to Send hardware flow control output	VOL: GND to 0.55V		VOH: VREF x 0.67 to VREF	No connection
13	VGPIO	Output	Signal drives high indicating the modem is on and ready for commands. (It can be idle, or in sleep mode) May also be used to power external level shifters to interface to DIO5 or DIO7. See HL7681RD manual for additional information.	0		1.8V	No connection
14	VREF	Input	Voltage reference for off board I/O signals. This signal drives the input voltage side of an onboard buffer which converts all external I/O voltage from VREF range to 1.8V range to drive the onboard HL7681RD modem module.	1.65V	1.8V or 3.3V	5.5V	Must be implemented
15	GND	Input	Ground Pin		0		Must be implemented
16	RTS	Input	Modem Request to Send hardware flow control input	VIL: GND to 0.15V		VIH: VREF-0.4V to VREF	Tie to GND
17	DIO5	I/O	Programmable GPIO_05 on HL7681RD module	0		1.8V	No connection
18	DIO7	I/O	Programmable GPIO_07 on HL7681RD module	0		1.8V	No connection
19	ADC1	Input	ADC1 input on HL7681RD module (10-bit resolution)	0		1.2V	No connection
20	PWR_ON	Input	Modem PWR_ON signal. Assert low for at least 25 msec and then release to activate start sequence. Drive with open collector output. Internally pulled up to internal I/O rail with resistor. Do not use any external pull ups. power down the modem.	0		1.8V	Must be implemented.

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2.1.2.2 Connectors J3, X1, X2

Connector Designator	Description	Connector Location
J3	Micro SIM Connector	Bottom Side of Module
X1	Primary Antenna Connection	Topside of Module
X2	Diversity Antenna Connection	Topside of Module

2.1.2.3 Typical Power Consumption

Mode	Attenuation (dB)	RSRQ (dB)	RSRP (dBm)	Average Current (mA)	Peak Current (mA)	Average Charge (µAh)	Measurement Notes
Active Socket Dial	0	-10	-69	176.355	301.601	44.285	**Tested at:** 3.8V **Time elapsed:** 1.82s Open socket, HTTP POST, read HTTP response
Active Socket Dial	20	-12	-91	182.808	454.347	49.859	**Tested at:** 3.8V **Time elapsed:** 1.95s Open socket, HTTP POST, read HTTP response
Active Socket Dial	40	-10.5	-110	240.428	701.573	78.031	**Tested at:** 3.8V **Time elapsed:** 2.324s Open socket, HTTP POST, read HTTP response
Off	0	-10	-69	135.415 (µA)	6.464	3.417	**Tested at:** 3.8V **Time elapsed:** 180s Modem powered off
Idle	0	-10	-69	54.389	747.101	1.384 (mAh)	**Tested at:** 3.8V **Time elapsed:** 180s Idle whilst powered on and registered on the network
Idle, Low Power Mode	0	-10	-69	24.346	196.510	1.22 (mAh)	**Tested at:** 3.8V **Time Elapsed:** 180s Registered on the network, DTR tied HIGH, AT+KSLEEP=0

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2.2 Mechanical Specifications

2.2.1 Mechanical Characteristics

Parameter	Typical	Unit
Dimensions (excluding pin height, for solder to board applications)	29.0 x 33.60 x 6.63	mm
Dimensions (including pin height, for board to board connector applications)	29.0 x 33.60 x 10.73	mm
Weight	0.4	oz
Connector Insertion/Removal	hundreds	Cycles

2.2.2 Mating Connectors

Connector Designator	Manufacture	Populated on Module	Recommended Mate	Mate Manufacture
J1, J2	3M	Pinrex 222-96-10GBE1	NPPN101BFCN-RC	Sullins Connector Solutions
			Acceptable Alternative: 950510-6102-AR	3M
J3	Molex	786463001	NL-SIM-COM	Nimbelink
X1, X2	Hirose	U.FL-R-SMT(10)	CAB.011	Taoglas

2.2.3 Device Placement

⚠ **Make sure the Skywire is installed in the correct orientation; failure to do so will damage the device and void the warranty.**

2.3 Environmental Specifications

Parameter	Min	Typical	Max	Unit	Notes
Operating Temperature	-40	25	+85	˚C	
Storage Temperature	-40	25	+85	˚C	
Operating Humidity	20		90	%	Non-condensing

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3. Important Design Considerations

3.1 PWR_ON Signal

To conserve power, the HL7681RD does not automatically startup when power is applied. The baseboard design must supply a means to assert the PWR_ON signal for the specified time (at least 25 msec) and then released to startup the module. After asserting the PWR_ON signal, software must wait for VGPIO to assert before attempting to communicate with the HL7681RD.

To power down the modem, issue AT+CPWROFF to the modem via an AT command interface.

3.2 Power Supply Requirements

The module will regularly consume high amounts of current on the main power supply (VCC) - up to 1.5A during active transmits and receives. The baseboard power supply should be designed to support peak currents up to 2 Amps. A 100 µF capacitor should be placed near the VCC pin on the module to ensure ample energy is available, with a low inductance path to the VCC pin. For example power supply designs, there are multiple references available. See the NimbeLink Skywire Development Kit schematic for a switching regulator example:

https://nimbelink.com/Documentation/Development_Kits/NL-SWDK/20002_NL-SWDK_Schematic.pdf

3.3 Serial Communications

The NL-SW-LTE_S7618RD can communicate over UART and/or USB. An ideal design must implement one or both serial interfaces in order to properly communicate with the modem.

3.4 LED

The Skywire has an on-board LED, D1, connected to the HL7681RD on GPIO10. The state of the LED can be asserted by issuing the following AT command:

```
AT+KGPIO=10,1    //Turn on LED
AT+KGPIO=10,0    //Turn off LED
```


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3.5 FOTA

LTE networks are constantly being updated, improved, and enhanced with new features. Therefore, carriers tend to make frequent network changes. Most of these changes will not negatively affect network connected devices, but occasionally an update will prevent an unprepared device from re-connecting to the network permanently.

To account for these future changes, FOTA (Firmware over the Air) capability is being added to all cellular modules by manufacturers. Accordingly, NimbeLink supports this functionality in the entire Skywire family of embedded modems. However, it is often required that designers implement support for FOTA in their device's firmware.

All Skywire users must ensure that their device firmware can accommodate FOTA updates after deployment. Failure to do so may result in network connectivity interruptions in the event of a network change.

Should a device be rendered unable to connect to the cellular network after an update, it is impossible to resolve the issue using FOTA. In this case, the only way to fix the connectivity issue would be to physically update the device over a serial connection.

FOTA Instructions are available by contacting NimbeLink's product support team at product.support@nimbelink.com.

4. Mounting Guidelines

Skywire embedded cellular modems support two connection methods: board-to-board connectors and the solder-to-board method.

4.1 Board-to-Board Connector Approach

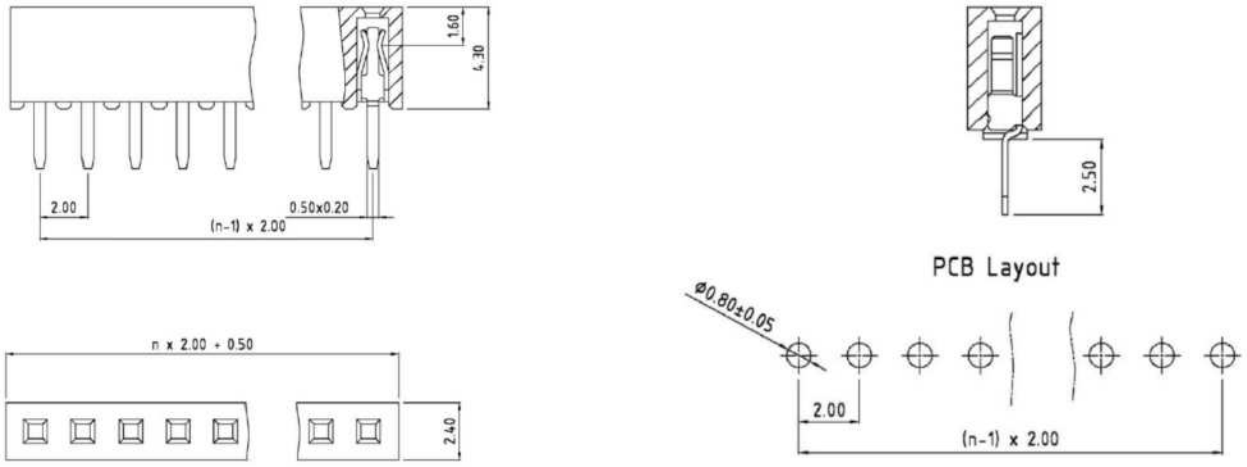
The Skywire interface utilizes two, 10 pin, 2mm pitch female receptacles. Many connector manufacturers can be used; two readily available products are listed below:

Manufacturer: Sullins Connector Solution, **Part Number**: NPPN101BFCN-RC

Manufacturer: 3M, **Part Number:** 950510-6102-AR

Please refer to the figures on the next page for diagrams of typical board-to-board connectors.

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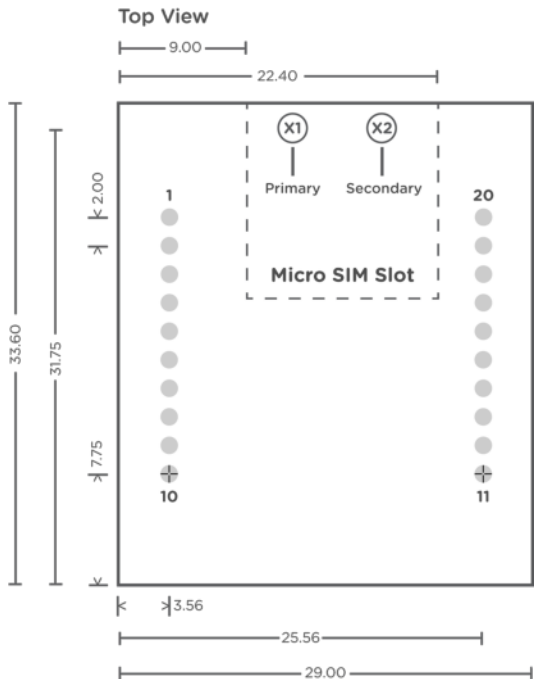


4.2 Solder-to-Board Connection Approach

The second method of connection is soldering the module directly to the main board.

The PCB should be designed with two rows of ten, 0.8 mm plated through-holes spaced 2mm apart, with each row spaced 22mm. See the drawing below for a recommended footprint.

Note: U.FL locations are marked with circles, X1 and X2 are located on the top side of board, J3 is the micro SIM card slot on bottom side of board, and all measurements are in millimeters.



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5. Antenna Considerations

Designers should review the latest HL7681RD Hardware User Guide to ensure the following information is up to date:

https://source.sierrawireless.com/resources/airprime/hardware_specs_user_guides/airprime_hl7618rd_product_technical_specification/

5.1 Primary Antenna Requirement

Primary Antenna Requirements	
Frequency Range	Depending on the frequency bands provided by the network operator, the customer shall use the most suitable antenna for those bands
Bandwidth	**LTE B4(1700):** Transmit: 1710 to 1755 MHz Receive: 2110 to 2155 MHz **LTE B13(700c):** Transmit: 777 to 787 MHz Receive: 746 to 756 MHz
Impedance	50 ohm
Input Power	>24dB
VSWR Max	1.5:1

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5.2 Diversity Antenna Requirements

RX Diversity Antenna Requirements	
Frequency Range	Depending on the frequency bands provided by the network operator, the customer shall use the most suitable antenna for those bands
Bandwidth	**LTE B4:** Transmit: 1710 to 1755 MHz Receive: 2110 to 2155 MHz **LTE B13:** Transmit: 777 to 787 MHz Receive: 746 to 756 MHz
Impedance	50 ohm
VSWR Max	1.5:1

5.3 Recommended Antennas

Type	Manufacturer	Part Number
Primary & Diversity	Taoglas[1]	TG.30.8113

Note 1: U.FL to SMA adapter required.

For applications not using the recommended antennas, developers must ensure that the selected antenna(s) meet certain requirements. In order to maintain FCC and carrier specific certifications the antennas cannot exceed the maximum gain levels listed here:

Frequency Band (MHz)	Max Gain (dBi)
LTE Band 4	5.00
LTE Band 13	9.00

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6. Certifications

6.1 Carrier Specific

NL-SW-LTE-S7618RD: Verizon ODI Certified

6.2 Geography Specific

Federal Communications Commission (FCC47) part 22, 24

Complies with FCC47 Part 15 Class B Radiated and Conducted Emissions

7. Federal Regulatory Licensing

7.1 Export Control Classification Number (ECCN)

ECCNs are five character alpha-numeric designations used on the Commerce Control List (CCL) to identify dual-use items for export control purposes. An ECCN categorizes items based on the nature of the product, i.e. type of commodity, software, or technology and its respective technical parameters.

All Skywire Modems: 5A992.c

7.2 Harmonized Tariff Schedule Code

HTS Code: 8517.62.0010

8. End Product Labeling Requirements

Device Uses Approved Radio: NL-SW-LTE-S7618RD

Contains FCC ID: N7NHL7618RD

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interferences, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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