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Skywire™ HSPA+ HE910 Embedded Cellular Modem Datasheet

NimbeLink Corp

Updated: March 2017

Table of Contents

1. Introduction

1.1 Orderable Part Numbers

Orderable Device	Telit Chipset	Operating Temperature	Bands	Fallback?	Network Type	GPS
NL-SW-HSPA	HE910-DG	-40 to +85˚C	B1, B2, B4, B5, B6, B8	Yes	GSM	Yes
NL-SW-HSPAP	HE910-NAD	-40 to +85˚C	B2, B4, B5, B6	Yes	GSM	No
NL-SW-HSPAPG	HE910-NAG	-40 to +85˚C	B2, B4, B5, B6	Yes	GSM	Yes
NL-SW-HSPAPE	HE910-EU	-40 to +85˚C	B1, B5, B6, B8	Yes	GSM	Yes

1.2 Additional Resources

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

- Telit's HE910 Hardware User Guide

1.3 Product Overview

Add robust cellular connectivity to your M2M devices with scalable radio technology with Skywire line of modems including HE910 based HSPA+ solutions. Extensive experience in designing and building embedded product solutions makes the NimbeLink Skywire™ embedded cellular modem the smallest on the market. It complies with the popular XBEE® interface standard and supports multiple GSM 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.

1.4 Block Diagram
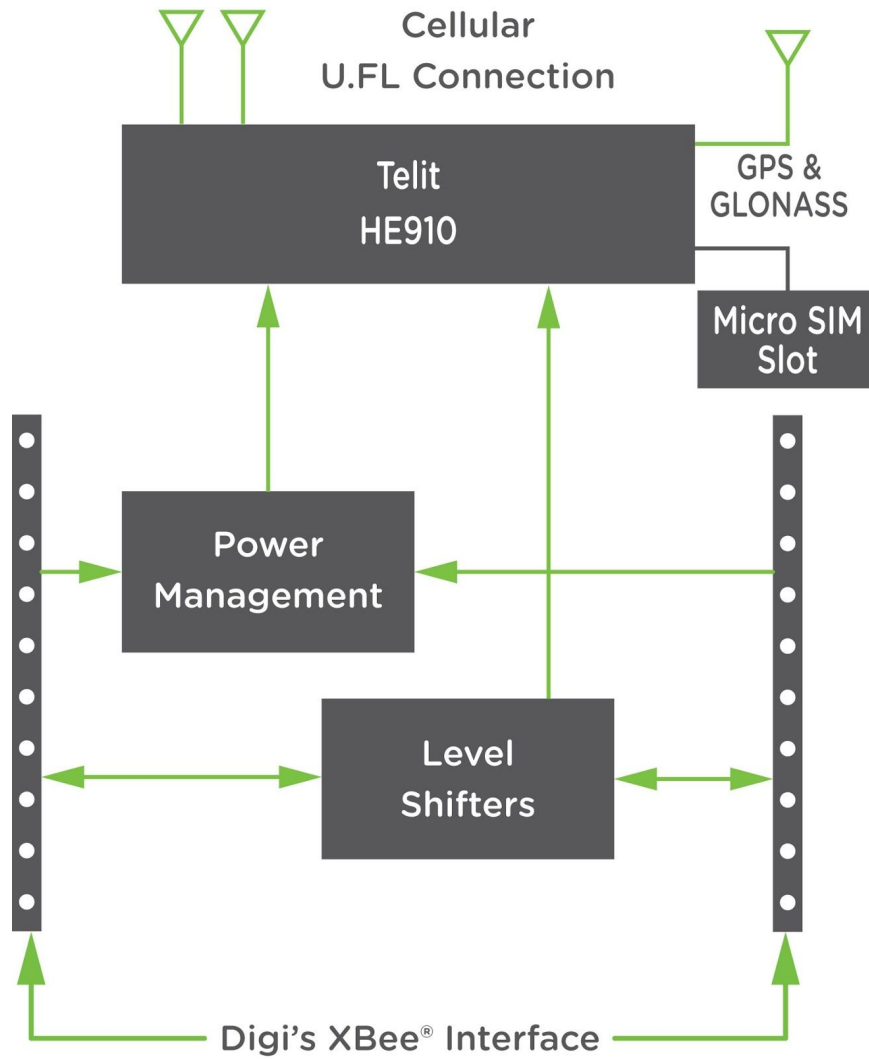
2. Technical Specifications

2.1 Electrical Specifications

2.1.1 Absolute Maximum Ratings

Parameter	Signal	Maximum Rating
Main Power Supply	VCC	4.3V
I/O Voltage Reference	VREF	5.0V

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	3.5V	3.9V	4.3V	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_n IN	Input	Controls HW_SHUTDOWN input on Telit HE910, tie low for 200mS and released to activate. Internally pulled up to VCC. Drive with open collector output. Assert only in an emergency as the module will not gracefully exit the cellular network when asserted.		VREF		No connection
6	VUSB	Input	Supply for USB interface	4.4V	5V	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
11	GND	Input	Ground Pin		0		Must be implemented
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	ON/nSLEEP	Output	Signal drives the onboard LED indicating network status. OFF = Device OFF, Fast blink = Searching for Network & Not Registered, Slow Blink = Registered with full service, Permanently on = call is active. See TelitHE910 manual for additional information.	0		1.8V	No connection
14	VREF	Input	Voltage reference for offboard 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 TelitHE910 modem module.	1.65V	1.8V or 3.3V	5.0V	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	DIO3	I/O	Programmable GPIO_03 on TelitHE910 module	0		1.8V	No connection
18	DIO2	I/O	Programmable GPIO_02 on TelitHE910 module	0		1.8V	No connection
19	ADC1	Input	ADC_IN1 input on Telit HE910module (8bit resolution, <6.6mV)	0		1.3V	No connection
20	ON_OFF	Input	Modem On/Off signal. Assert low for at least 1 second and then release to activate start sequence. Drive with open collector output. Internally pulled up to internal I/O rail with pull up. Do not use any external pull ups. **Note:** If you want modem to turn on automatically when power is applied, permanently tie this signal to GND.	0		1.8V	Must be implemented.

2.1.2.2 Connectors J3, X1, X2, X3

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
X3	GPS/GNSS Satellite Receiver	Bottom Side of Module

2.1.2.3   Typical Power Consumption - NL-SW-HSPA

Measurement	Attenuation (dB)	AT+CSQ	Average Current (mA)	Peak Current (mA)	Average Charge (µAh)	Notes
Socket Dial	0	18	106.391	228.14	386.07	Tested at 3.8V Time elapsed: 12.565s Test: Opening socket, making HTTP POST, reading HTTP response, closing socket, powering off Skywire.
Socket Dial	20	10	116.74	246.35	390.753	Tested at 3.8V Time elapsed: 12.322s Test: Opening socket, making HTTP POST, reading HTTP response, closing socket, powering off Skywire.
Socket Dial	40	1	152.03	622.075	594.341	Tested at 3.8V Time elapsed: 12.507s Test: Opening socket, making HTTP POST, reading HTTP response, closing socket, powering off Skywire.
Off	0	-	2.64	3.01	660.68	Tested at 3.8V Connected to power, not turned on. 15 minute sample.
Idle - Low Power	0	-	7.91	85.795	1990.34	Tested at 3.8V 15 minute sample period. AT+CFUN=5, DTR held HIGH.
Idle	0	-	19.3	114.60	4820.16	Tested at 3.8V Registered on network, 15 minute sample period.

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	x	Grams
Connector Insertion/Removal	hundreds	Cycles

2.2.2 Mating Connectors

Connector Designator	Manufacture	Populated on Module	Recommended Mate	Mate Manufacture
J1, J2	3M	951110-2530-AR-PR	950510-6102-AR	3M
			Acceptable alternate: NPPN101BFCN-RC	Sullins Connector Solutions
J3	Molex	786463001	Micro SIM Card	Micro SIM Card
X1, X2, X3	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	Note
Operating Temperature	-40	25	+85	˚C	
Storage Temperature	-40	25	+85	˚C	
Operating Humidity	20		90	%	Non-condensing

3. Important Design Considerations

3.1 ON_OFF Signal

To conserve power, the Telit HE910 does not automatically start up when power is applied. The baseboard design must supply a means to assert the ON_OFF signal for the specified time (at least 5 seconds) and then released to start-up the module. After asserting the ON_OFF signal, software must wait for 15 seconds before attempting to communicate with the HE910. To make module automatically start when power is applied, tie ON/OFF signal to GND permanently. See Telit Hardware User Guide for additional details regarding the ON_OFF signal.

3.2 Power Supply Requirements

The equipment must be supplied by an external limited power source in compliance with the clause 2.5 of the standard IEC-60950-1.

The module will regularly consume high amounts of current on the Main Power Supply (VCC), up to 2A during active transmits and receives. The baseboard power supply should be designed to support peak currents up to 2 Amps. A 100uF 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, or reference the Telit Hardware User Guide which has an example of both Linear and Switching regulator designs.

3.3 Serial Communications

The HE910 can communicate over UART and/or USB. Design should implement one or both serial interfaces to be able to send commands to the modem.

3.4 Network Connection Status LED

The ON/nSLEEP signal on pin 13 drives the on-board LED indicating network status. By default, the 3G EVDO module has this setting disabled. Use the following commands to enable and save this feature.

First, configure the GPIO for alternate function:

AT#GPIO = 1,0,2

The modem should respond with:

OK

Next, set the desired LED behavior with this command:

AT#SLED=2,10,10

The modem should respond with:

OK

Finally, commit the changes to non-volatile memory so the setting will persist across power down/power up:

AT#SLEDSAV

The modem should respond with:

OK

LED Status	Network Status Indication
Permanently OFF	Device OFF or setting disabled (see above)
Permanently ON	Searching for Network & Not Registered
Slow Blinking	Registered with full service
Permanently ON	Call is active (Modem has been registered)

4. Mounting Guidelines

The Skywire™ embedded cellular modem supports multiple connection methods, the two primary methods are board to board connectors and soldering directly to the baseboard.

4.1 Board to Board connectors approach

The XBEE® form factor calls for two, 10 pin, 2mm pitch female receptacles.

There are many connector manufacturers that can be used; below is one readily available product:
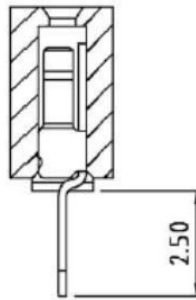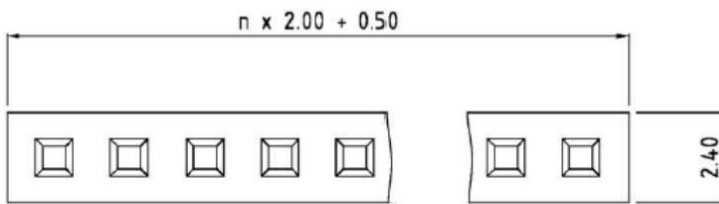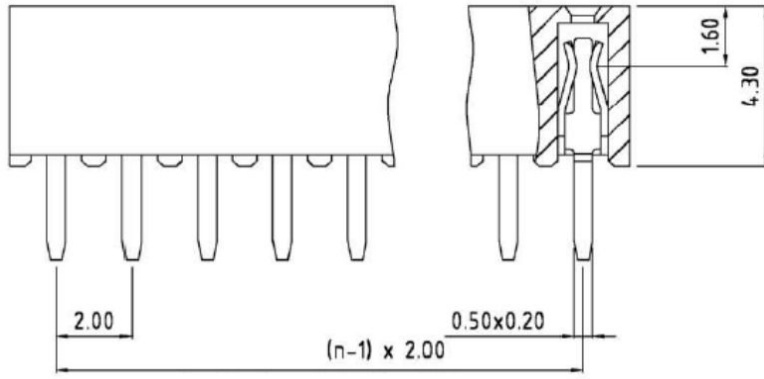
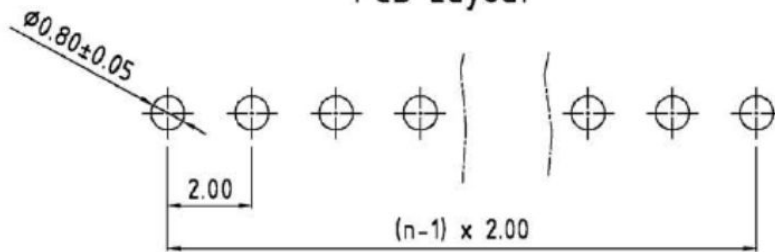Manufacturer: 3M   Alternate: Sullins Connector Solutions

Part Number: 950510-6102-AR   Alternate P/N: NPPN101BFCN-RC

Typical part drawing and footprint information:

1.60

4.30

2.00

0.50x0.20

(n-1) x 2.00

n x 2.00 + 0.50

2.40

2.50

PCB Layout

Ø0.80±0.05

2.00

(n-1) x 2.00

4.2 Solder to Board connection approach
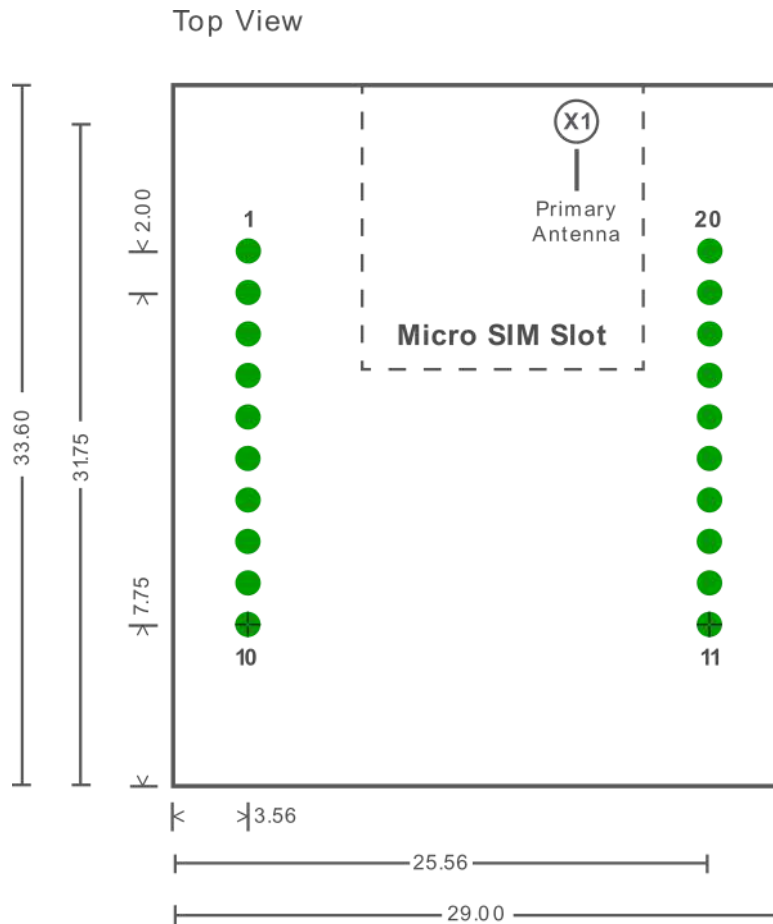
The module can be soldered directly to a PCB. The PCB should be designed with two rows of ten, 0.8mm plated thru holes spaced 2mm apart. The two rows should be 22mm apart. See drawing for recommended footprint. Measurements are in millimeters. U.FL locations are marked with circles, X1 and X2 on top side of board, J3 is Micro SIM card slot on bottom side of board.

Top View

5. Antenna Considerations

5.1 Primary Antenna Requirements

These tables are copied from Telit HE910 Hardware User Guide. Designers should review latest HE910 Hardware User Guide to ensure the information is up to date.

ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth (GSM/EDGE)	70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz PCS band
Bandwidth (WCDMA)	70 MHz in WCDMA Band V 80 MHz in WCDMA Band VIII 460 MHz in WCDMA Band IV 140 MHz in WCDMA Band II 250 MHz in WCDMA Band I
Impedance	50 ohm
Input power	> 33dBm(2 W) peak power in GSM > 24dBm Average power in WCDMA
VSWR absolute max	≤ 10:1 (limit to avoid permanent damage)
VSWR recommended	≤ 2:1 (limit to fulfil all regulatory requirements)

5.2 Diversity Antenna Requirements

These tables are copied from Telit HE910 Hardware User Guide. Designers should review latest HE910 Hardware User Guide to ensure the information is up to date.

ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth (GSM/EDGE)	70 MHz in GSM850, 80 MHz in GSM900 & 140 MHz PCS band
Bandwidth (WCDMA)	70 MHz in WCDMA Band V 80 MHz in WCDMA Band VIII 140 MHz in WCDMA Band II 250 MHz in WCDMA Band I
Impedance	50 ohm

5.3 GPS Antenna Requirements

The Skywire forwards the voltage supplied by the VREF pin to the GPS coax connection, X3. This is to provide power to active GNSS antennas. When using a passive antenna installed on the baseboard users must ensure that the coax cable connection is kept as short as possible between the Skywire and the mating PCB. Excess loss in long cables will significantly reduce GPS performance. Users must also ensure that the passive antenna does not behave like a DC short to ground since the Skywire provides voltage on the coax. When using such an antenna you must use a DC blocking capacitor, Nimbelink recommends a Samsung 56pF 0402 CL05C560FB5NNNC.

For GPS/GNSS, circularly polarized antennas are desired over linear and patch topologies because they typically have 3dB improved sensitivity.

5.4 Recommended Antennas

Type	Manufacturer	Part Number
Primary & Diversity	Taoglas[1]	TG.30.8113
Primary & GPS	Taoglas[1]	MA.301.A.AB.001

Note 1: U.FL to SMA adapter required.

6. Certifications
6.1 Carrier Specific

PTCRB, AT&T Rogers

Each carrier has different requirements for activating the HE910 modem on their networks. Many accept the Telit PTCRB & GCF certification to allow device on the network, however, recent carrier preferences may require the end product to go through PTCRB & GCF certification in the final enclosure, antenna, and software configuration.

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-HSPAP

Contains FCC ID: RI7HE910NA and IC ID: 5131A-HE910NA

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.