# 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

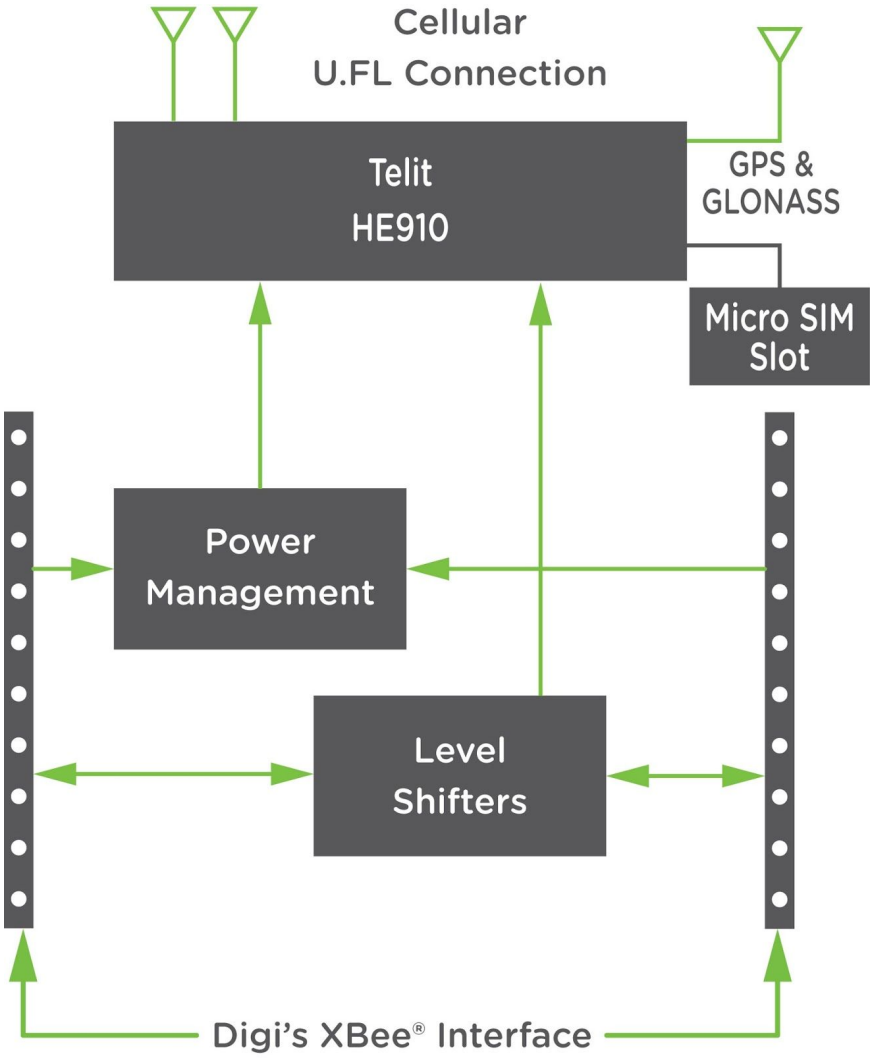
The following documents or documentation resources are referenced within this document.

- 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-0.4 V 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-0.4 V 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-0.4 V 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<br>Time elapsed: 12.565s<br>Test:<br>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<br>Time elapsed: 12.322s<br>Test:<br>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<br>Time elapsed: 12.507s<br>Test:<br>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<br>Connected to power, not turned on. 15 minute sample. |
| Idle - Low Power | 0 | - | 7.91 | 85.795 | 1990.34 | Tested at 3.8V<br>15 minute sample period.<br>AT+CFUN=5, DTR held HIGH. |
| Idle | 0 | - | 19.3 | 114.60 | 4820.16 | Tested at 3.8V<br>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

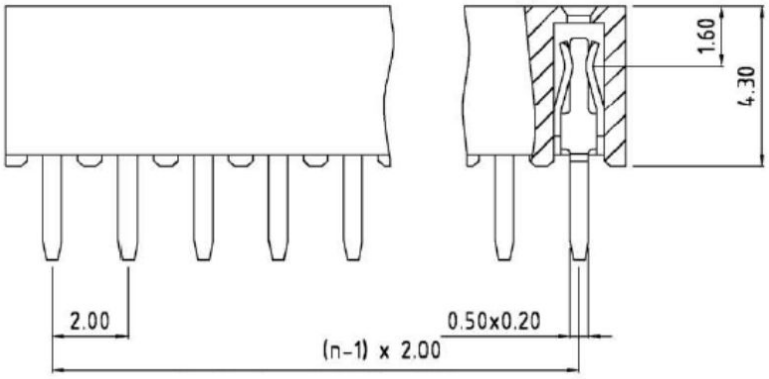
The XBEE® form factor calls for two, 10 pin, 2mm pitch female receptacles.

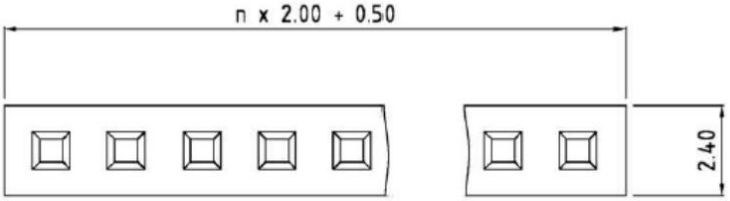
There are many connector manufacturers that can be used; below is one readily available product:

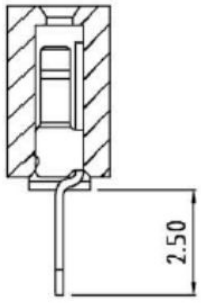
Manufacturer: 3M Alternate: Sullins Connector Solutions

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

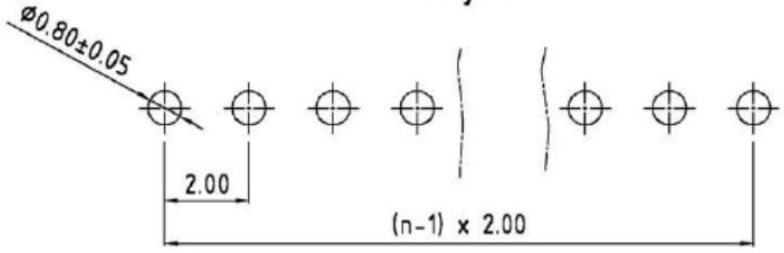
Typical part drawing and footprint information:



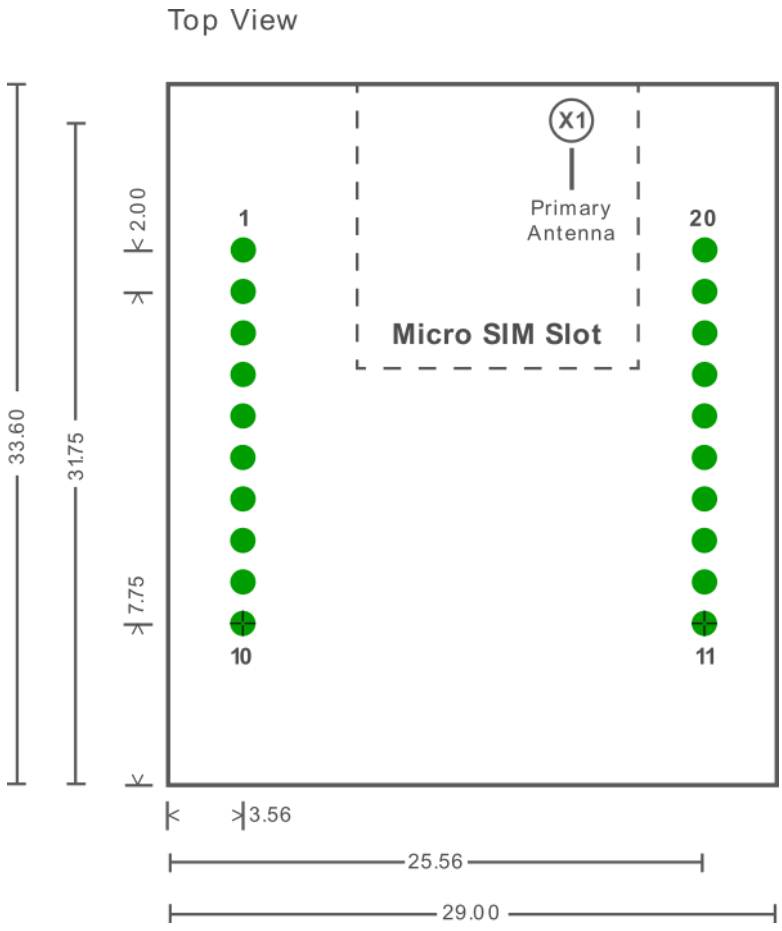




PCB Layout



## 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.



# 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<br>80 MHz in WCDMA Band VIII<br>460 MHz in WCDMA Band IV<br>140 MHz in WCDMA Band II<br>250 MHz in WCDMA Band I |
| **Impedance** | 50 ohm |
| **Input power** | > 33dBm(2 W) peak power in GSM<br>> 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<br>80 MHz in WCDMA Band VIII<br>140 MHz in WCDMA Band II<br>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.