

Skywire[®] 3G EVDO Embedded Cellular Modem Datasheet

NimbeLink Corp

Updated: March 2017



© NimbeLink Corp. 2017. All rights reserved.

NimbeLink Corp. provides this documentation in support of its products for the internal use of its current and prospective customers. The publication of this document does not create any other right or license in any party to use any content contained in or referred to in this document and any modification or redistribution of this document is not permitted.

While efforts are made to ensure accuracy, typographical and other errors may exist in this document. NimbeLink reserves the right to modify or discontinue its products and to modify this and any other product documentation at any time.

All NimbeLink products are sold subject to its published Terms and Conditions, subject to any separate terms agreed with its customers. No warranty of any type is extended by publication of this documentation, including, but not limited to, implied warranties of merchantability, fitness for a particular purpose and non-infringement.

NimbeLink is a registered trademark, and Skywire is a registered trademark, of NimbeLink Corp. All trademarks, service marks and similar designations referenced in this document are the property of their respective owners.

Table of Contents

| | |
|--|-----------|
| Table of Contents | 2 |
| Introduction | 3 |
| Orderable Part Numbers | 3 |
| Additional Resources | 3 |
| Product Overview | 3 |
| Block Diagram | 4 |
| Technical Specifications | 5 |
| Electrical Specifications | 5 |
| Absolute Maximum Ratings | 5 |
| Recommended Ratings & Module Pin out | 5 |
| Connectors J1 and J2 | 5 |
| Connector X1, X2, X3 | 6 |
| Mechanical Specifications | 7 |
| Mechanical Characteristics | 7 |
| Mating Connectors | 7 |
| Device Placement | 7 |
| Environmental Specifications | 7 |
| Important Design Considerations | 8 |
| ON_OFF Signal | 8 |
| Power Supply Requirements | 8 |
| Mounting Guidelines | 9 |
| Board to Board connectors approach | 9 |
| Solder to Board connection approach | 10 |
| Antenna Considerations | 11 |
| Primary Antenna Requirements | 11 |
| GNSS Antenna Requirements | 11 |
| Recommended Antennas | 12 |
| Certifications | 13 |
| Carrier Specific | 13 |
| Geography Specific | 13 |
| Federal Regulatory Licensing | 13 |
| End Product Labeling Requirements | 13 |

1. Introduction

1.1 Orderable Part Numbers

| Orderable Device | Operating Temperature | Carrier | Network Type |
|------------------|-----------------------|---------|-------------------|
| NL-SW-EVDO-V | -40 to +85°C | Verizon | CDMA EVDO & 1xRTT |
| NL-SW-EVDO-A | -40 to +85°C | AERIS | CDMA EVDO & 1xRTT |
| NL-SW-EVDO-S | -40 to +85°C | Sprint | CDMA EVDO & 1xRTT |

1.2 Additional Resources

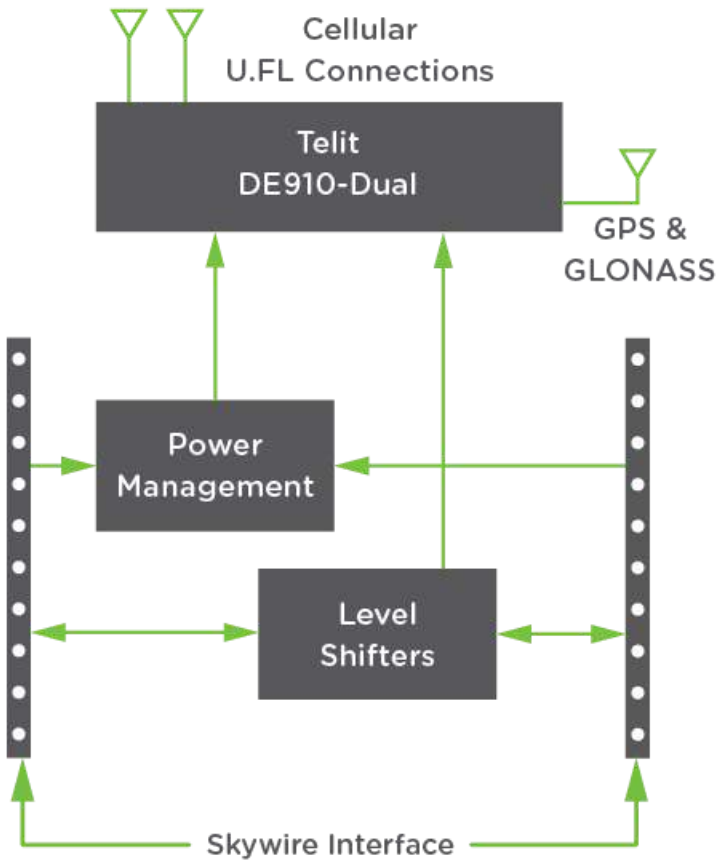
The following documents or documentation resources are referenced within this document.

- Telit's [DE910 Hardware User Guide](#)

1.3 Product Overview

Add robust cellular connectivity to your M2M devices without the cost, delay, and hassle of federal and carrier certifications. 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 CDMA EV-DO Rev. A and 1xRTT communication, 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 | 5.5V |

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 | 3.5V | 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_nIN | Input | Controls HW_SHUTDOWN input on Telit DE910-DUAL, tie low for 200ms 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 Telit DE910-DUAL 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 Telit DE910-DUAL 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-0.4 V to VREF | Tie to GND |
| 17 | DIO3 | I/O | Programmable GPIO_03 on Telit DE910-DUAL module | 0 | | 1.8V | No connection |
| 18 | DIO2 | I/O | Programmable GPIO_02 on Telit DE910-DUAL module | 0 | | 1.8V | No connection |
| 19 | ADC1 | Input | ADC_IN1 input on TelitDE910-DUAL module (12bit resolution, <1mV, input resistance 1Mohm) | 0 | | 1.2V | 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 Connector X1, X2, X3

| Connector Designator | Description | Connector Location |
|----------------------|---------------------------------|-----------------------|
| X1 | Primary Antenna Connection | Topside of Module |
| X2 | Diversity RX Antenna Connection | Topside of Module |
| X3 | GPS/GLONASS Antenna Connection | Bottom Side of Module |

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 |
| 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 DE910-DUAL 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 (1 second < hold time < 2 seconds) to start-up the module. 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 module will regularly consume high amounts of current on the Main Power Supply (VCC), up to 735mA during active transmits and receives. The baseboard power supply should be designed to support peak currents up to 1 Amp. 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 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) |
| Fast Blinking | Searching for Network & Not Registered |
| Slow Blinking | Registered with full service |
| Permanently ON | Call is active |

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 Skywire interface calls for two, 10 pin, 2mm pitch female receptacles.

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

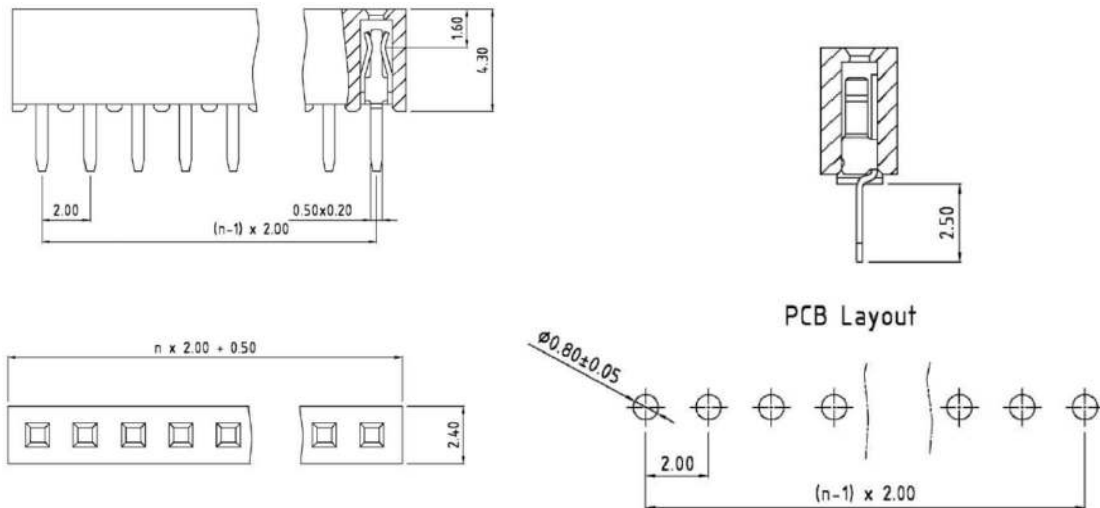
Manufacturer: 3M

Alternate: Sullins Connector Solutions

Part Number: 950510-6102-AR

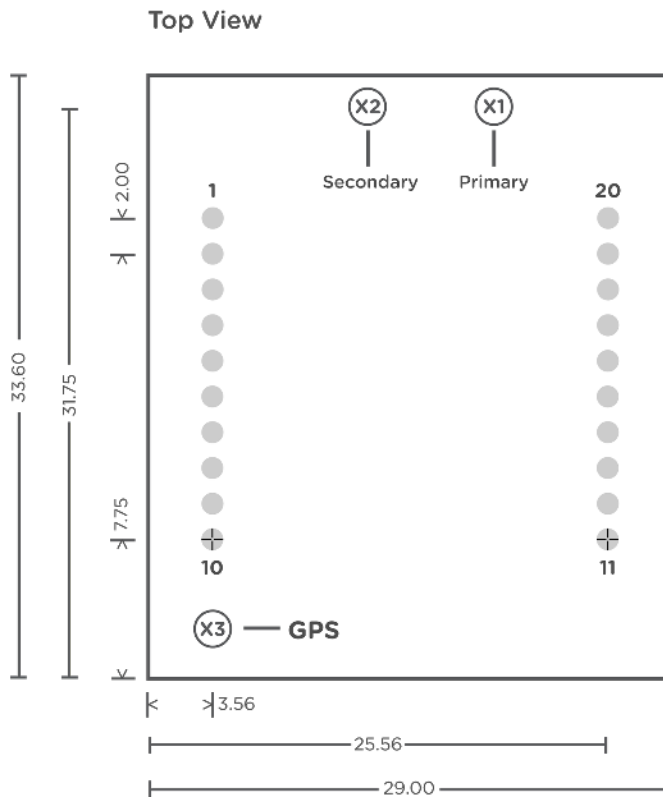
Alternate P/N: NPPN101BFCN-RC

Typical part drawing and footprint information:



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, X3 on bottom side of board.



5. Antenna Considerations

Designers should review latest DE910 Hardware User Guide to ensure the information is up to date.

5.1 Primary Antenna Requirements

| Parameter | Signal |
|-----------------------------|---------------------|
| Type | 800/1900Mhz Primary |
| Bandwidth in CDMA BC0 | 70Mhz |
| Bandwidth in CDMA BC1 | 140Mhz |
| Max Gain in CDMA BC0 | 5.12dBi |
| Max Gain in CDMA BC1 | 6.12dBi |
| Impedance | 50 Ohm |
| Input Power (Average Power) | >24.4dBm |
| VSWR recommended | <2:1 |

5.2 GNSS 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 [CL05C560FB5N](#).

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

An external GNSS LNA and GNSS pre-Filter is required for GLONASS applications. GNSS LNA requirement shall fulfill the following specifications

- Frequency = 1565 ~ 1606MHz
- Power Gain $|S_{21}|_2 = 14 \sim 17$ dB
- NF < 1dB

GNSS pre-Filter requirement shall fulfill the following requirements

- Source and Load Impedance = 50Ohm
- Insertion Loss (1575.42 ~1576.42MHz) = 1.4dB(Max)
- Insertion Loss (1565.42 ~1585.42MHz) = 2.0dB(Max)
- Insertion Loss (1597.5515 ~1605.886MHZ) = 2.0dB (Max)

An external active antenna connected to the device must fulfill the following requirements:

| Parameter | Signal |
|-----------------------------|--------------------|
| GPS Frequency | 1575.42Mhz |
| GLONASS Frequency | 1597.55-1605.89Mhz |
| GPS Bandwidth | +/-1.023Mhz |
| GLONASS Bandwidth | 8.34Mhz |
| Impedance | 50 Ohm |
| LNA Gain | 14-17dB |
| Input Power (Average Power) | >24.4dBm |
| LNA Input Voltage | 3.0 or 5.0V |

5.3 Recommended Antennas

| Type | Manufacturer | Part Number |
|---------------------|-------------------------|-----------------|
| Primary & Diversity | Taoglas ¹ | TG.30.8113 |
| Primary & Diversity | MobileMark ¹ | PSKN3-900/1900S |
| Primary & GNSS | Taoglas ¹ | MA.301.A.AB.001 |

Note 1: U.FL to SMA adapter required.

6. Certifications

6.1 Carrier Specific

NL-SW-EVDO-V: [Verizon ODI Certified](#)

NL-SW-EVDO-S: [Sprint 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-EVDO

Contains FCC ID: RI7DE910-DUAL and IC ID: 5131A-DE910DUAL

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.