Skywire™ 3G EVDO Embedded Cellular Modem Datasheet

NimbeLink Corp

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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.

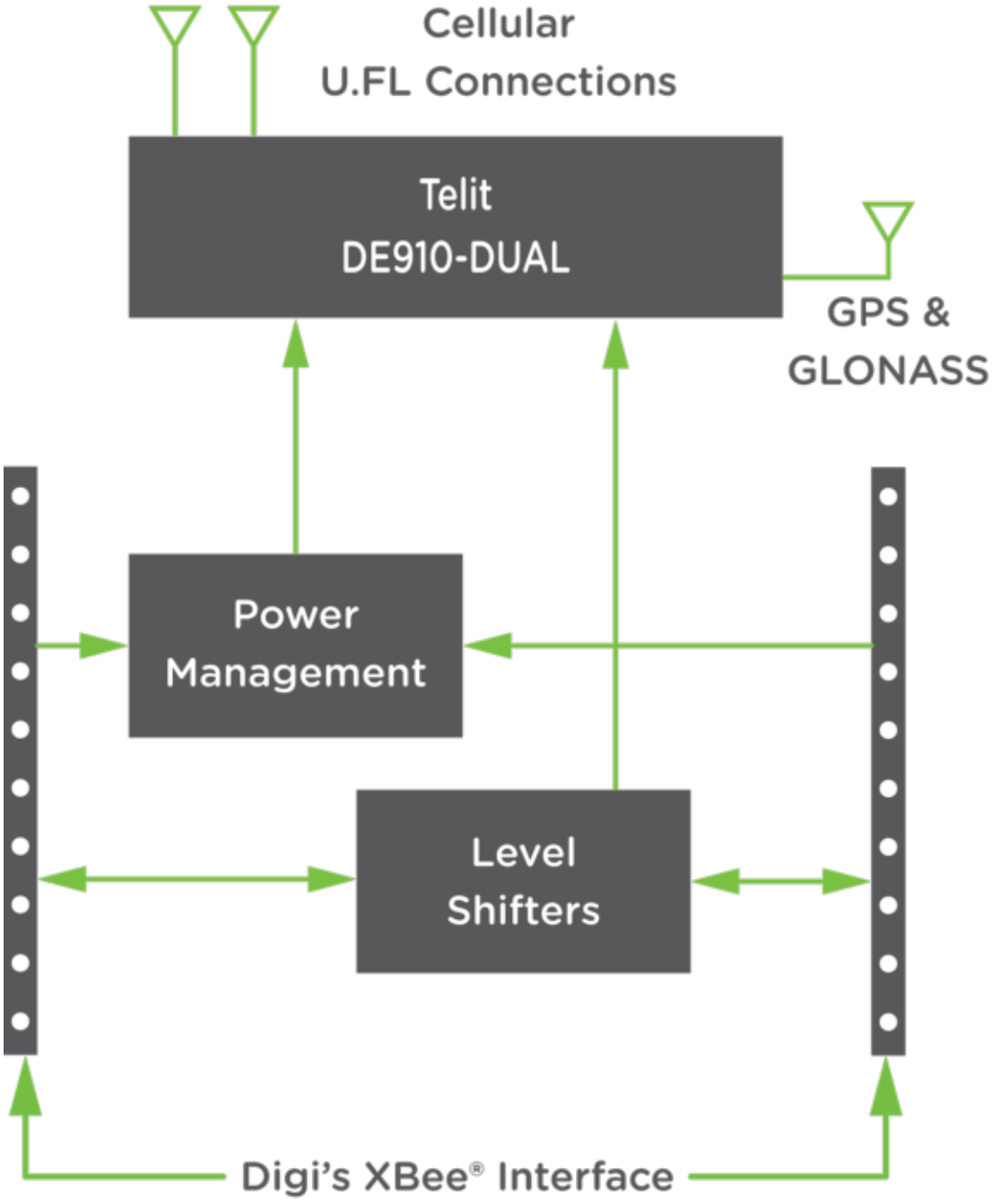
- Telit's DE910 Hardware User Guide

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 complies with the popular XBEE® interface standard 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.

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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	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

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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

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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	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

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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

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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 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:

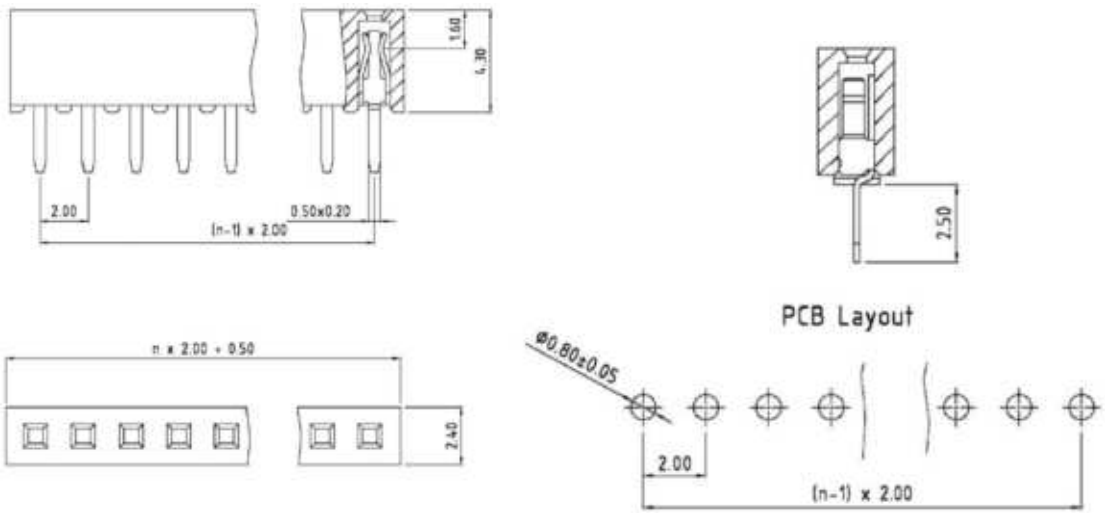
Manufacturer: 3M

Part Number: 950510-6102-AR

Alternate: Sullins Connector Solutions

Alternate P/N: NPPN101BFCN-RC

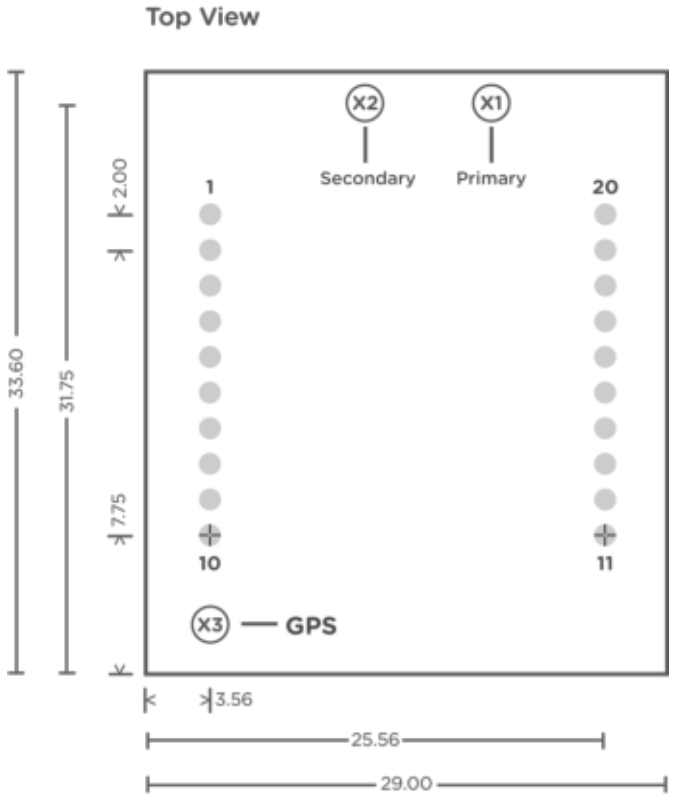
Typical part drawing and footprint information:



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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.



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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 CL05C560FB5NNNC.

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$|S21|_2$= 14 ~ 17dB
- NF < 1dB

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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.

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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.

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