Skywire® LTE CAT-M1 Embedded Cellular Modem Datasheet

NimbeLink Corp

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1. Introduction

The NL-SW-LTE-SVZM20 Skywire® modem is transitioning from Production to **Not Recommended for New Design (NRND)**. This is a production classification that the part is approaching the end of its product life cycle, but is **not EOL**. The part is still in production; however long term support is not guaranteed. End of Life and Last Time Buy dates have not been established at this time; NimbeLink will distribute a separate EOL PCN when the product moves into End of Life.

The following part numbers are now NRND:

- NL-SW-LTE-SVZM20
- NL-SW-LTE-SVZM20-B

For more information and migration details please refer to the NRND PCN notice.

- SVZM20 NRND PCN

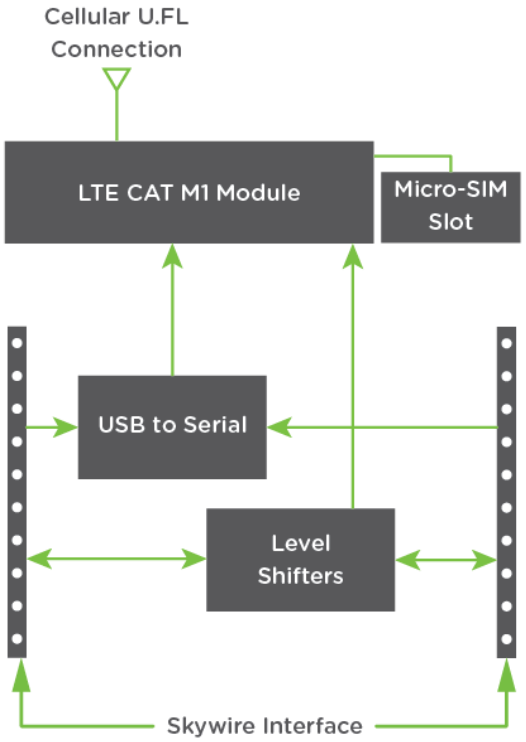
1.1 Orderable Part Numbers

Orderable Device	Firmware Revision	Operating Temp	Bands	Network Type
NL-SW-LTE-SVZM20	LR5.1.1.0-32110	-40 to +85˚C	B4, B13	Verizon
NL-SW-LTE-SVZM20-B	LR5.1.1.0-37120	-40 to +85˚C	B4, B13	Verizon

1.2 Product Overview

Add robust cellular connectivity to your M2M devices with scalable radio technology with the Skywire® line of modems, including CAT-M1 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 complies with the Skywire standard interface and supports multiple LTE bands 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.

1.3 Block Diagram



2. Technical Specifications

2.1 Electrical Specifications

2.1.1 Absolute Maximum Ratings

Parameter	Signal	Maximum Rating
Main Power Supply	VCC	4.5V
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	3.1V	3.8V	4.5V	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.
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.
4	GND	Input	Ground Pin		0		Must be implemented.
5	RESET_N	Input	Controls RESET_N input on modem, tie low for a minimum of 1uS and released to activate. Internally pulled up to 1.8V. Drive with open collector output. Assert only in an emergency as the modem will not gracefully exit the cellular network when asserted.	0		1.8V	Must be implemented.
6	VUSB	Input	Supply for USB interface	3.0V	5V	5.5V	No connection if not used.
7	USB_D+	I/O	USB differential Data + signal				No connection if not used.
8	USB_D-	I/O	USB differential Data - signal				No connection if not used.
9	WAKE	Input	Wakes up the modem from low power modes. Default configuration for wakeup is a low to high transition on this line	VIL: GND to 0.15V		VIH: VREF-0.4V to VREF	Tie to GND.
10	GND	Input	Ground Pin		0		Must be implemented.

Pin	Name	Direction	Description	Min	Typical	Max	If not used
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 if not used.
13	ON_STATUS	Output	Signal drives high indicating the modem is on and ready for commands. (It can be idle, or in sleep mode)	0		1.8V	No connection if not used.
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 cellular 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	Reserved		Reserved.				No connection if not used.
18	Reserved		Reserved.				No connection if not used.
19	RING	Output	Signal wakes up a host processor when there is incoming traffic on the network	VOL: GND to 0.55V		VOH: VREF x 0.67 to VREF	No connection if not used.
20	ON_OFF	Input	The modem will always boot up when power is applied, so this pin can be left floating. For more information, see Section 3.1.				Leave floating.

2.1.2.2 Connectors J3, X1, X2

Connector Designator	Description	Connector Location
J3	Micro SIM Connector	Bottom Side of Modem
X1	Primary Antenna Connection	Top side of Modem

2.1.2.3 Typical Power Consumption

Mode	Attenuation (dB)	RSRQ	RSRP	Average Current (mA)	Peak Current (mA)	Average Charge (µAh)	Measurement Notes
Active Socket Dial	0	21	72	183.04	196.69	291.60	**Tested at:** 3.8V **Time elapsed:** 5.74s **Test:** Open socket, HTTP POST, read HTTP response, power off
Active Socket Dial	20	14	50	183.63	404.21	297.69	**Tested at 3.8V** **Time elapsed:** 5.84s **Test:** Open socket, HTTP POST, read HTTP response, power off
Active Socket Dial	40	14	30	191.58	514.44	310.94	**Tested at 3.8V** **Time elapsed:** 5.85s **Test:** Open socket, HTTP POST, read HTTP response, power off
Off	0	12	64	5.349 (µA)	5.702 (µA)	446.940 (nAh)	**Tested at 3.8V** **Test:** Issued AT+SQNSSHDN, RTS and WAKE held HIGH, 5 minute sample
Idle	0	12	64	187.46	497.62	15.61	**Tested at 3.8V** **Test:** Powered on and registered on the network
Start PSM Countdown	0	16	62	178.62	198.94	878.11	**Tested at 3.8V** **Test:** Issue PSM commands, RTS and WAKE held HIGH, 16 second timer from network, 17.72 seconds to enter pre-PSM
Pre-PSM Mode	0	16	62	2.06	168.72	55.19	**Tested at 3.8V** **Test:** Skywire will stay in this mode for about 90 seconds in case AT interface is needed again. It is more power efficient to stay in this mode in the event of needing the interface sooner. RTS and WAKE held HIGH, elapsed time 94.01 seconds
PSM	0	16	62	6.606 (µA)	118.18 (µA)	345.85 (nAh)	**Tested at:** 3.8V **Test:** PSM state, RTS and WAKE held HIGH, 189 second sample

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	0.3	oz
Connector Insertion/Removal	hundreds	Cycles

2.2.2 Mating Connectors

Connector Designator	Manufacturer	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	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	-30	25	+60	˚C	
Extended Temperature*	-40	25	+85	˚C	
Operating Humidity	20		90	%	Non-condensing

** Transmit power limited during Extended Temperature operation*

3. Important Design Considerations

3.1 ON_OFF Signal

By default, the modem will boot up as soon as power is applied, with no way to change this behavior. Therefore, the 'ON_OFF' pin can be ignored in all designs.
Instead of asserting a signal on the 'ON_OFF' pin, follow the instructions below to start, restart, and shutdown the device:

In order to turn on the modem, simply apply power. To turn off the modem, issue the following command:

```
AT+SQNSSHDN
```

This command will gracefully shut down the device. Finally, to restart the modem after it has been shut down using the aforementioned AT command, assert a logic low state on the RESET_N pin for at least one microsecond.

3.2 Power Supply Requirements

The modem will regularly consume high amounts of current on the Main Power Supply (VCC), up to 500mA 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 modem 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.

3.3 Serial Communications

The Skywire Modem can communicate over UART for AT commands and PPP interface. The SVZM20-B firmware defaults the USB port to an AT command interface. Earlier versions of the firmware on the SVZM20 do not enable this.

3.4 Baud Rate

The default baud rate of the NL-SW-LTE-SVZM20 and NL-SW-LTE-SVZM20-B is 921600 baud 8N1. Please make sure to change the settings of your terminal program to reflect this.

3.5 FOTA

LTE networks are constantly being updated, improved, and enhanced with new features. As a result, carriers are making frequent network changes. Most will not

negatively affect devices connected to those networks, 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 each module manufacturer, and NimbeLink supports this functionality in the Skywire family of embedded modems. However, there is often a requirement to implement support for this FOTA functionality in your device firmware.

As a developer using the Skywire modem, it is required that your device firmware plan to accommodate FOTA updates after deployment. Failure to do so may result in interruption of your device's cellular connectivity if the carriers implement a network change. If the device can no longer access the network, FOTA cannot be used to resolve the situation after the fact. The only way to restore connectivity will be physical access to the device to perform the updates directly on the device.

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

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

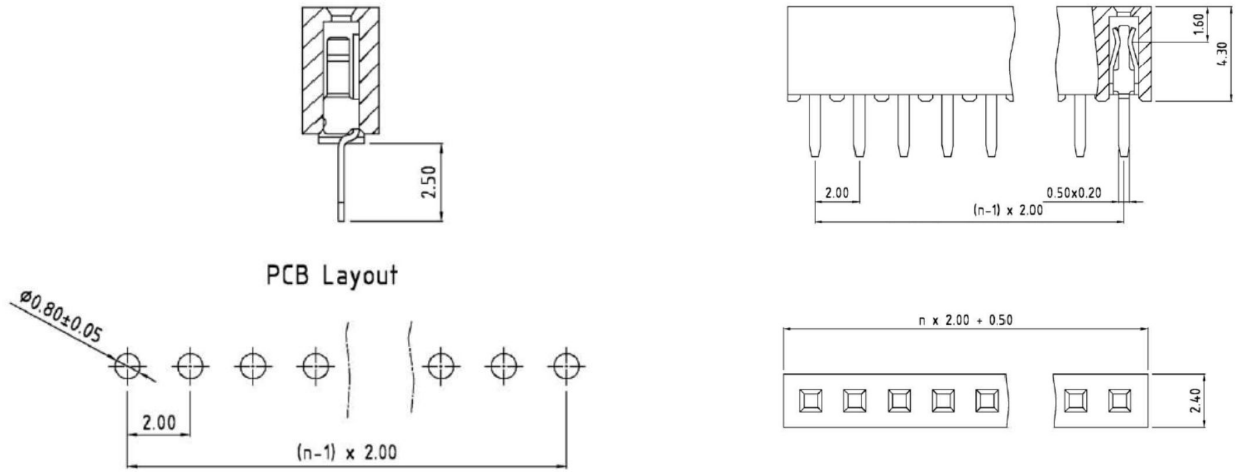
The Skywire form factor calls for two, 10 pin, 2mm pitch female receptacles.

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

Manufacturer: 3M **Alternate:** Sullins Connector Solutions

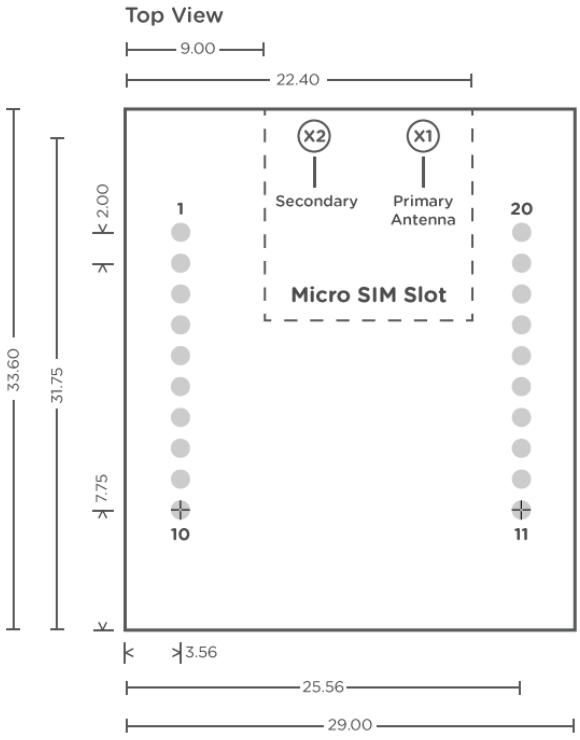
Part Number: 950510-6102-AR **Alternate P/N:** NPPN101BFCN-RC

Typical part drawing and footprint information:



4.2 Solder to Board connection approach

The modem 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

Designers should review latest VZM20Q Hardware User Guide to ensure the information is up to date.

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): 445 MHz LTE B13(700c): 41 MHz
Impedance	50 ohm
Input Power	>24dB

5.2 Recommended Antennas

Function	Antenna Type	Manufacturer	Part Number
Primary Cellular	Monopole	Taoglas[1]	TG.08.0113
Primary Cellular	Dipole	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	Max Gain (dBi)
700 MHz Band	10.0
1700 MHz Band	6.0

6. Certifications

6.1 Carrier Specific

NL-SW-LTE-SVZM: Verizon OD 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 alphanumeric 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.

NL-SW-LTE-SVZM (and 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-SVZM
Contains FCC ID: 2AAGMVZM20Q

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.