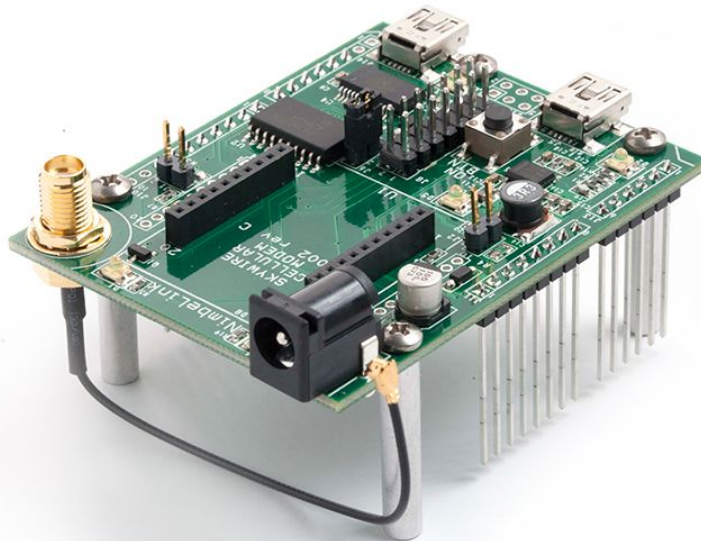


Skywire[®] Development Kit

User Manual

NimbeLink Corp

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1. Introduction

1.1. Orderable Part Numbers

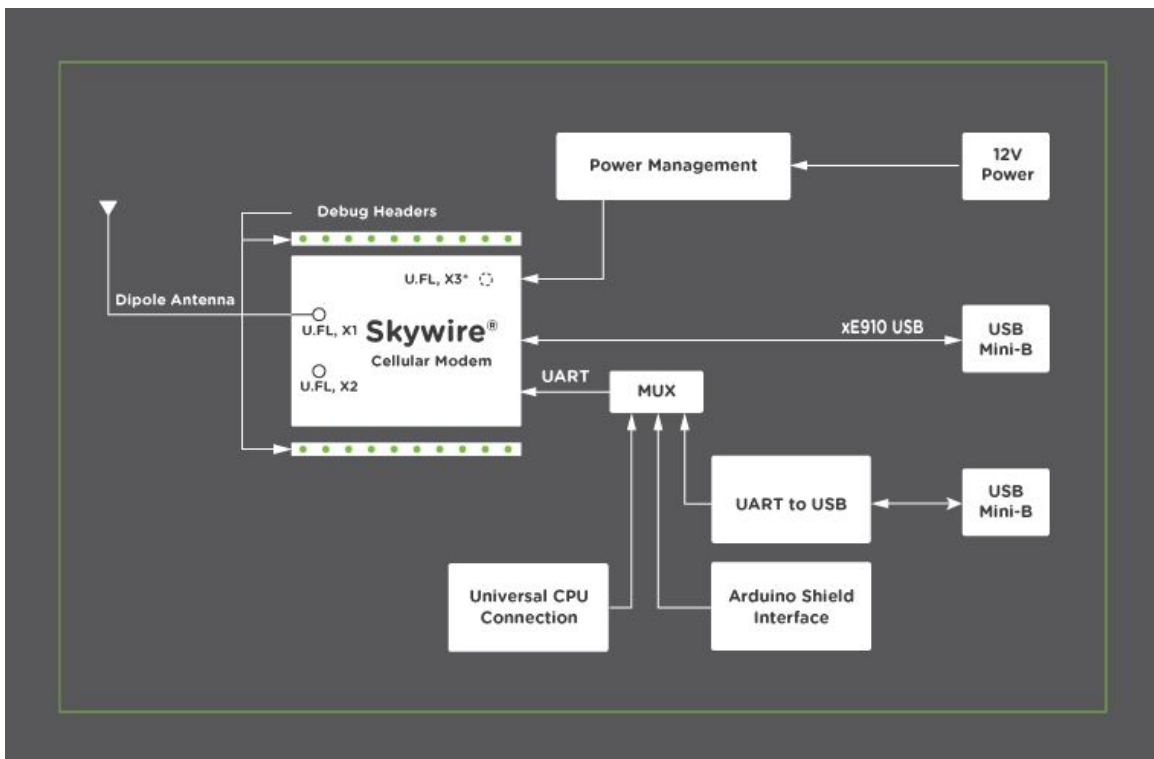
| Orderable Device | Description | Carrier | Network Type |
|-------------------|-----------------------------------|---|--------------|
| NL-SWDK | Skywire Development Kit | Any | Any |
| NL-SW-1xRTT-A | 2G 1xRTT | Aeris | CDMA |
| NL-SW-1xRTT-S | 2G 1xRTT | Sprint | CDMA |
| NL-SW-1xRTT-V | 2G 1xRTT | Verizon | CDMA |
| NL-SW-GPRS | 2G GPRS | Any GSM (AT&T, T-Mobile, etc.) | GSM |
| NL-SW-EVDO-A | 3G EVDO, GPS, GLONASS | Aeris | CDMA |
| NL-SW-EVDO-V | 3G EVDO, GPS, GLONASS | Verizon | CDMA |
| NL-SW-HSPA | 3G HSPA+, GNSS, GLOBAL BANDS | Any HSPA/GSM Carrier (AT&T, T-Mobile, etc.) | HSPA/GSM |
| NL-SW-HSPA-B | 3G HSPA+, GNSS, GLOBAL BANDS | Any HSPA/GSM Carrier (AT&T, T-Mobile, etc.) | HSPA/GSM |
| NL-SW-LTE-TSVG-B | LTE without Fallback, GNSS | Verizon | LTE |
| NL-SW-LTE-TNAG-B | LTE with HSPA+ Fallback, GNSS | Any GSM Carrier (AT&T, T-Mobile, etc.) | LTE/GSM |
| NL-SW-LTE-TEUG | LTE with HSPA+ Fallback, GNSS, EU | Any EU LTE/GSM Carrier | LTE/GSM |
| NL-SW-LTE-GELS3-C | LTE CAT1, Verizon | Verizon | LTE |
| NL-SW-LTE-GELS3-D | LTE CAT1, Verizon | Verizon | LTE |
| NL-SW-LTE-WM14-B | LTE CAT1, GSM | Any LTE Carrier (AT&T, T-Mobile, etc.) | LTE |
| NL-SW-LTE-QBG96 | LTE CAT M1, GNSS | AT&T, Orange, Telstra, Telus, T-Mobile, Verizon, Vodafone, and more | LTE |
| NL-SW-LTE-TC4EU | LTE Cat4, EU | EU Carriers | LTE |
| NL-SW-LTE-TC4NAG | LTE Cat 4 | AT&T, Verizon | LTE |

1.2. Product Overview

The Skywire® Development Kit includes one baseboard, antenna, power supply, SIM cards, and debug cables. Skywire modems must be purchased separately. The kit enables you to develop your application directly on the Skywire modem with three different ways to connect:

- Connect your PC to the Skywire modem UART port via onboard USB-to-UART converter and send AT commands directly to the modem through PC terminal applications. You can also connect over USB for access to multiple COM ports.
- The kit is an Arduino shield, so you can plug the kit directly onto an Arduino microcontroller. Please see Section 4: Common Next Steps for links to example documentation.
- To connect the kit to a different processor or development kit, a 14-pin header breaks out the necessary signals for easy connection to any device. The modem supports I/O levels from 1.65-5.5V, simplifying connection to other systems.

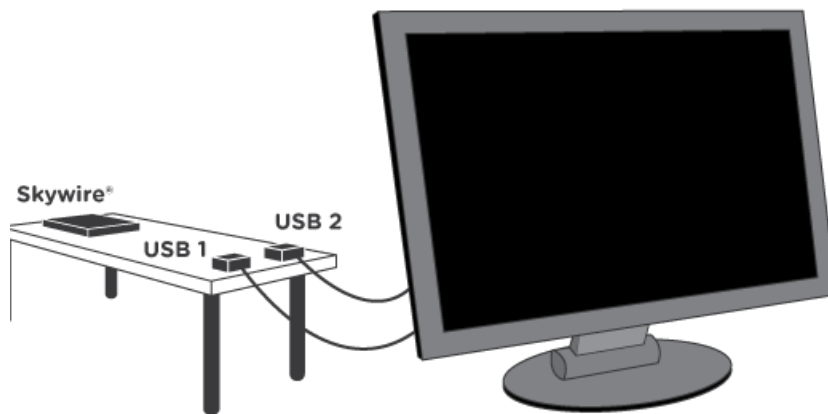
1.3. Block Diagram



*X2 and X3 U.F.L connectors not present on all modems.

2. Connect to Kit using a PC

This section covers how to connect your development kit to a PC and provision the modem with your cellular plan. It also covers how to communicate over the serial port to the Skywire modem which only requires the use of USB port and connector marked J14 or USB2 in the diagram below. USB1 (connector J5) is used for high speed data connections and firmware updates to the modem and is not used in this section.



2.1. Unpack Kit Contents



2.2. Skywire Placement

To mount your Skywire Cellular modem follow these steps:

1. Gather the following:
 - a. Skywire Development Kit board
 - b. Skywire Cellular Modem
 - c. U.FL extractor tool (Always use a U.FL extractor tool when placing or removing U.FL cables on the Skywire modem to avoid damaging the U.FL connectors).
2. Line up your Skywire's cellular U.FL connector(s) on the side of the board closest to the antenna connector. Depending on the type of Skywire Modem you have there may be one, two, or three U.FL connections.
3. To avoid damage to the U.FL connector and maximize connector life, a U.FL removal tool should be used when attaching/removing the U.FL connector. Always insert and remove the U.FL connector with a force perpendicular to the board. If your Skywire is using GPS, attach the GPS antenna to the bottom of the Skywire connector X3. If you are not using your Skywire's GPS or if your Skywire does not support GPS, continue to step 4.
4. Attach the U.FL cable to the top U.FL connector X1 on the Skywire. If you are using a Skywire with the cellular diversity antenna option attach a second antenna to connector X2.
5. Carefully seat your Skywire into the board's Skywire socket (U1). Take care to ensure that the pins are correctly aligned. Failure to properly align the pins may damage your Skywire.



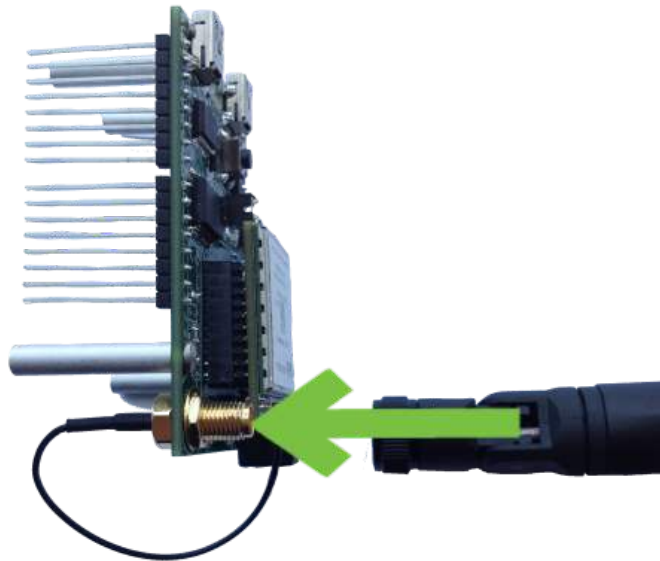
A properly mounted Skywire™ Modem with U.FL cable attached to top U.FL connector X1.



A common issue is accidentally inserting the modem with pins misaligned by one row. Check pin alignment **BEFORE** applying power to prevent modem damage.

2.3. Attach Antenna to Baseboard

Antenna screws onto SMA connector with a clockwise rotation



2.4. Short Jumper J6

Ensure header J6 is shorted with 2 pin Jumper. This enables USB to UART communication between the PC and the modem.



2.5. Attach Jumper Wires (NL-SW-LTE-WM14 only)

To power on the NL-SW-LTE-WM14 modem, you must tie the SW_ON_OFF pin to GND. Place a jumper wire to connect header J8 Pins 2 and 8 together.

Please see page 3 of the Skywire Development Kit schematic for pin locations:

http://nimbelink.com/Documentation/Development_Kits/NL-SWSDK/20002_NL-SWSDK_Schematic.pdf

2.6. Plug in 12V Power Supply to connector J15



2.7. Plug USB cable into connector J14 and PC



2.8. Power On the Modem

Press and hold button S1 to power on the modem. Please see the table below for the length of time needed to hold down button S1 for your particular modem.



| Device | Hold Time (t_h) for Button S1 To Power On the Modem | Wait Time (t_w) Before Software Communication* | LED D1 Activity |
|------------------|---|--|-----------------|
| NL-SW-1xRTT-A | 1 second < t_h < 2 seconds | t_w > 10 seconds | Blink once |
| NL-SW-1xRTT-S | 1 second < t_h < 2 seconds | t_w > 10 seconds | Blink once |
| NL-SW-1xRTT-V | 1 second < t_h < 2 seconds | t_w > 10 seconds | Blink once |
| NL-SW-GPRS | t_h > 5 seconds | t_w > 10 second | Blink once |
| NL-SW-EVDO-A | 1 second < t_h < 2 seconds | t_w > 10 seconds | Blink twice |
| NL-SW-EVDO-V | 1 second < t_h < 2 seconds | t_w > 10 seconds | Blink twice |
| NL-SW-HSPA | t_h > 5 seconds | t_w > 2 seconds | Solid on |
| NL-SW-HSPA-B | t_h > 5 seconds | t_w > 2 seconds | Solid on |
| NL-SW-LTE-TSVG | 1 second < t_h < 2 seconds | t_w > 15 seconds | No activity |
| NL-SW-LTE-TNAG | 1 second < t_h < 2 seconds | t_w > 15 seconds | No activity |
| NL-SW-LTE-TEUG | 1 second < t_h < 2 seconds | t_w > 15 seconds | No activity |
| NL-SW-LTE-GELS3 | 1 second < t_h < 2 seconds | t_w > 30 seconds | Solid on |
| NL-SW-LTE-WM14 | n/a (Done in Section 2.5) | t_w > 30 seconds | Solid on |
| NL-SW-LTE-QBG96 | t_h > 1 second | t_w > 4 seconds | Solid on |
| NL-SW-LTE-TC4EU | t_h > 5 second | t_w > 5 seconds | Solid on |
| NL-SW-LTE-TC4NAG | t_h > 1 second | t_w > 5 seconds | Solid on |

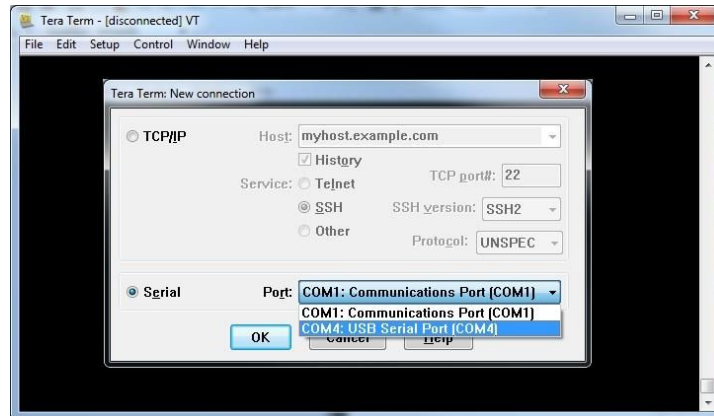
Note: Depending on your modem and depending on the setup, the modem may be available for use before t_w .

2.9. Open Terminal Emulator

Open Tera Term, Putty, or similar terminal emulator to communicate with the modem.

If you do not have a terminal emulator program, you can download Tera Term here: <https://ttssh2.osdn.jp/index.html.en>

Your PC may have multiple COM ports. Select appropriate USB COM port to communicate with the development kit.



Note: Your device may not show up on the port list due to a missing driver. Drivers can be downloaded from <https://www.ftdichip.com/Drivers/VCP.htm>. Refer to 2.9.1 for instructions on installing a driver.

You may need to adjust the Serial Settings. These can be accessed in Tera Term by going *Setup>Serial Port*. They can also be updated in Putty by navigating *Connection>Serial*. Serial Settings should be as follows (these are the default settings):

| | |
|---------------|-------------|
| Baud Rate: | 115,200 bps |
| Data: | 8bit |
| Parity: | none |
| Stop: | 1bit |
| Flow Control: | none |

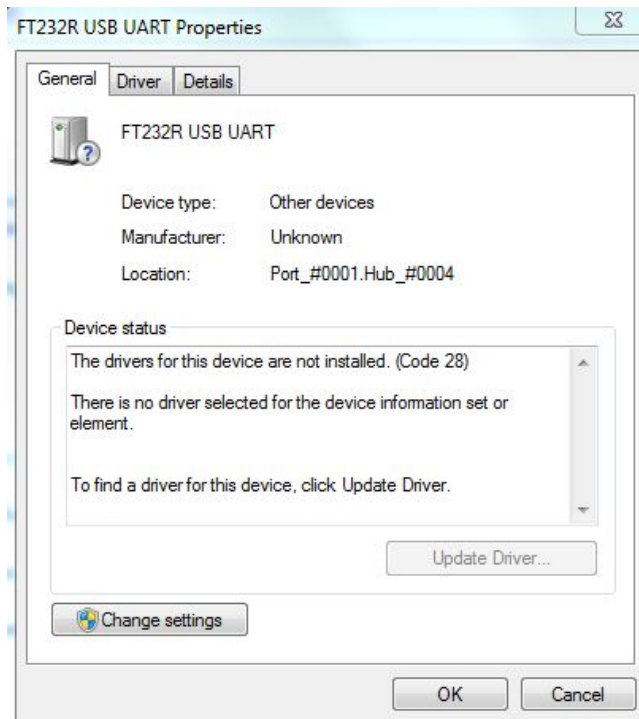
2.9.1. Install FTDI driver (Windows)

1. Download and unzip the required driver from <https://www.ftdichip.com/Drivers/VCP.htm>
2. Navigate to the device manager. *Start>Control Panel>Hardware and Sound>Device Manager*
3. *In the Device list, scroll down to the Other devices section and locate your device.*



4. *Right click on the device and choose Properties.*
5. *From the properties menu click Update Driver.*

- a. **Note:** If you don't have admin privileges on your computer you will need to first click *Change settings* and login as an admin



6. Select the *Search my computer* option and select the driver folder you downloaded in step 1.

2.10. Test Serial Communication

In the terminal program, type the command:

AT

followed by the Enter key, and the terminal should respond with:

OK

Note: For the NL-SW-LTE-WM14, you will not see the characters you have typed until hitting the enter key.

You may need to turn echo on in order to see what you are typing. If you type the command:

AT

and don't see it being typed on your screen, hit the Enter key, and type the following command:

ATE1

followed by the Enter key, and the terminal program should respond with:

OK

Type the following command:

AT

to verify you can see the command you are typing. After pressing the Enter key, the terminal program will respond with:

OK

Note: The modem will output "ERROR" when a command is entered incorrectly. To enable verbose error mode to see what error is occurring issue AT+CME=2 to the modem.

2.11. Test Signal Strength

2.11.1. For Non-LTE Modems

In the terminal program, type the command:

AT+CSQ

followed by the Enter key, and the terminal should respond with:

+CSQ: xx,yy

where xx is the signal strength of the antenna, and yy is the bit error rate in percent. Typical values are as follows:

| Values of xx | Relative Signal Strength |
|--------------|-------------------------------|
| 0 – 9 | Poor: <= -95 dBm |
| 10 – 14 | OK: -93 dBm to -85 dBm |
| 15 – 19 | Good: -83 dBm to -75 dBm |
| 20 – 30 | Excellent: -73 dBm to -53 dBm |
| 31 | Excellent: -51 dBm or greater |
| 99 | Not known or not detectable |

| Values of yy | Bit Error Rate (in percent) |
|--------------|-----------------------------|
| 0 | Less than 0.2% |
| 1 | 0.2% to 0.4% |
| 2 | 0.4% to 0.8% |
| 3 | 0.8% to 1.6% |
| 4 | 1.6% to 3.2% |
| 5 | 3.2% to 6.4% |
| 6 | 6.4% to 12.8% |
| 7 | More than 12.8% |
| 99 | Not known or not detectable |

Note: Bit Error Rate only available during active data connections.

2.11.2. For LTE Modems

To check the signal strength on an LTE modem the user should refer to the RSRP (Reference Signal Received Power) & RSRQ (Reference Signal Received Quality) values reported by the modem. These signal measurements will more accurately reflect the quality of the cellular link for LTE modems by not only

measuring **<rsrq>** is the Reference Signal Received Quality (RSRQ) and **<rsrp>** is the Reference Signal Received Power (RSRP). Typical values are as follows:

| Values of <rsrq> | RSRQ (Reference Signal Received Quality) |
|------------------|--|
| 0 | RSRQ < -19.5 dB |
| 1 | -19.5 dB ≤ RSRQ < -19 dB |
| 2 | -19 dB ≤ RSRQ < -18.5 dB |
| ... | ... |
| 32 | -4 dB ≤ RSRQ < -3.5 dB |
| 33 | -3.5 dB ≤ RSRQ < -3 dB |
| 34 | -3 dB ≤ RSRQ |
| 255 | Not known or detectable |

| Values of <rsrp> | RSRP (Reference Signal Received Power) |
|------------------|--|
| 0 | RSRP < -140 dBm |
| 1 | -140 dBm ≤ RSRP < -139 dBm |
| 2 | -139 dBm ≤ RSRP < -138 dBm |
| ... | ... |
| 95 | -46 dBm ≤ RSRP < -45 dBm |
| 96 | -45 dBm ≤ RSRP < -44 |
| 97 | -44 dBm ≤ RSRP |
| 255 | Not known or not detectable |

Here are estimated signal qualities based on the above values:

| Values of <rsrq> | RSRQ | Values of <rsrp> | RSRP | Quality |
|------------------|--------------------------|------------------|---------------------------|-----------|
| 0 | RSRQ < -19.5 dB | 0 - 40 | RSRP < -100 dBm | Marginal |
| 1 - 9 | -19.5 dB ≤ RSRQ < -15 dB | 41 - 50 | -100 dBm ≤ RSRP < -90 dBm | Fair |
| 10 - 19 | -15 dB ≤ RSRQ < -10 dB | 51 - 59 | -90 dBm ≤ RSRP < -80 dBm | Good |
| 20 - 34 | ≥ -10 dB | 60 - 97 | ≥ -80 dBm | Excellent |

For the following product models (NL-SW-LTE-GELS3, NL-SW-LTE-TC4NAG, NL-SW-LTE-TC4EU):

In the terminal program, type the command:

AT+CESQ

followed by the Enter key, and the terminal should respond with:

+CESQ: <rxlev>,<ber>,<rscp>,<ecno>,<rsrq>,<rsrp>

Where <rsrq>,<rsrp> are the RSRQ/RSRP values as defined by the modems AT command manual.

For the following product models (NL-SW-LTE-TSVG, NL-SW-LTE-TNAG, NL-SW-LTE-TEUG):

In the terminal program, type the command:

AT#MONI

followed by the Enter key, and the terminal should respond with:

**#MONI: <netmame> RSRP:<rsrp> RSRQ:<rsrq> TAC:<tac> Id:<id>
EARFCN:<earfcn> PWR:<dBm> DRX:<drx>**

Where <rsrq>,<rsrp> are the RSRQ/RSRP values as defined by the modems AT command manual.

For the following product models (NL-SW-LTE-WM14):

In the terminal program, type the command:

AT%MEAS="97"

followed by the Enter key, and the terminal should respond with:

**%MEAS: EARFCN=<earfsn>1000, CellID=<cid>, RSRP=<rsrp>,
RSRQ=<rsrq>**

Where <rsrq>,<rsrp> are the RSRQ/RSRP values as defined by the modems AT command manual.

For the following product model (NL-SW-LTE-QBG96):

In the terminal program, type the command:

AT+QCSQ

followed by the Enter key, and the terminal should respond with:

+QCSQ: <sysmode>, <rssI>, <rsrp>, <sinr>, <rsrq>

Where <sysmode> is the current cellular service mode, <rssI> is the RSSI value, <rsrp> is the RSRP value, <sinr> is the signal to interference plus noise ratio, and <rsrq> is the RSRQ value. **Note:** the values for RSRP and RSRQ are returned as raw values (dB or dBm), as opposed to encoded as per the tables on the next page.

For further information regarding the SINR ratio and the <sysmode> parameter, please refer to the QBG96 AT command manual.

2.12. Activate Modem (one-time step)



If you are using a new Skywire™ cellular modem, it does not have an active cellular plan. To activate Verizon, T-Mobile, or AT&T data plans, visit <http://go.nimbelink.com> and create an account and activate your Skywire there.

All Skywire modems have a label indicating the IMEI of the modem. An example of the IMEI location is is the photo below.



2.13. SIM Card Detection (GSM Only)

Applies to:

- NL-SW-GPRS
- NL-SW-HSPA
- NL-SW-HSPA-B

If you are using a Skywire GSM modem that uses a SIM card, you need to configure the Skywire modem to detect it.

In the terminal program, type the command:

```
AT#SIMDET=1
```

followed by the enter key. The terminal program will respond with:

```
#SIMDET: 1,1
```

This will enable the Skywire SIM detection.

2.14. Send Modem Activation String (1xRTT and EVDO only)

Applies to:

- NL-SW-1xRTT-V
- NL-SW-EVDO-V

In the terminal program, type the command:

```
ATD*22899;
```

followed by the Enter key, and the modem will begin the activation process which can take **several minutes**. The terminal should respond with:

```
OK
```

```
#OTASP: 0
```

```
#OTASP: 1
```

```
#OTASP: 2
```

```
NO CARRIER
```

For all other responses, review network status responses online.

2.15. Setup PDP Context

Before you can successfully communicate with the network using a GSM or LTE Skywire, you need to define the PDP context.

Non-Verizon LTE devices must have their APN's configured in order to connect to the network. Devices using the Verizon LTE network will automatically have the APN pushed to them after registering on the network. In the event the APN push does not occur the APN can be manually set.

Applies to:

- NL-SW-GPRS
- NL-SW-HSPA
- NL-SW-HSPA-B
- NL-SW-LTE-TSVG
- NL-SW-LTE-TNAG
- NL-SW-LTE-TEUG
- NL-SW-LTE-GELS3
- NL-SW-LTE-WM14
- NL-SW-LTE-QBG96
- NL-SW-LTE-TC4EU
- NL-SW-LTE-TC4NAG (Non-Verizon Firmware)

NOTE: The NL-SW-LTE-TC4NAG has dual firmware images for both Verizon and Non-Verizon networks. Please follow the steps outlined in the [modems datasheet](#) to select the appropriate firmware version for the desired carrier.

2.15.1. NL-SW-GPRS, -HSPA, -TNAG, -TEUG, -TC4EU, -TC4NAG (AT&T Firmware) APN Configuration:

In the terminal program, type the command:

```
AT+CGDCONT = 1,"IP","APN"
```

where **APN** is the individual APN for your network, followed by the Enter key, and the terminal program should respond with:

OK

Note: Consult Section 3: APN Setup for help with your APN.

To verify that the APN was set correctly, in the terminal program type the command:

```
AT+CGDCONT?
```

followed by the Enter key, and the terminal should respond with:

```
+CGDCONT: 1,"IP","APN"
```

as well as the other PDP context information on the device. To enable this setting, in the terminal program type the command:

AT#SGACT=1,1

followed by the enter key, and the terminal should respond with:

#SGACT: www.xxx.yyy.zzz

where **www.xxx.yyy.zzz** is the Skywire modem's IP address.

If the **AT#SGACT** command does not work, the terminal will respond with

#ERROR or +CMEE ERROR: activation failed

and further setup may be necessary. Check the signal strength with **AT+CSQ** to verify the Skywire is getting an acceptable signal. Otherwise, consult the Telit AT Command Reference Guide for your particular modem.

2.15.2. NL-SW-LTE-TC4NAG (Verizon Firmware) APN Configuration

The Verizon network will automatically push the APN to the NL-SW-LTE-TC4NAG modem the first time it registers on the network.

To manually set the APN follow these steps:

Type the command:

AT+CGDCONT?

Read the response from the terminal and see what 3rd PDP context changed to.

In the terminal program, type the command:

AT#SCFG=3,3,300,90,600,50

followed by the Enter key. The terminal should respond with:

OK

This is configuration information for setting up the context in the next step.

In the terminal program, type the command:

AT+CGDCONT=3, "IPV4V6", "Verizon APN"

where **Verizon APN** is the specific APN to connect to for your intended use, followed by the Enter key, and the terminal should respond with:

OK

Note: Consult Section 3: APN Setup for help with your Verizon APN.

To verify that the APN was set correctly, type the command:

AT+CGDCONT?

followed by the Enter key, and the terminal should respond with:

+CGDCONT: 3, "IPV4V6", "Verizon APN"

as well as the other PDP context information on the device.

To enable this setting, in the terminal program type the command:

AT#SGACT=3,1

followed by the enter key, and the terminal should respond with:

#SGACT: www.xxx.yyy.zzz

where **www.xxx.yyy.zzz** is the Skywire modem's IP address.

If the **AT#SGACT** command does not work, the terminal will respond with

#ERROR

and further setup may be necessary. Check the signal strength with **AT+CESQ** to verify the Skywire is getting an acceptable signal and the network registration with '**AT+CEREG?**' to confirm the modem has registered. Otherwise, consult the Telit AT Command Reference Guide for your particular modem.

2.15.3. NL-SW-LTE-TSVG APN Configuration

Users have two options for setting up PDP Context on the CAT3 LTE Skywire™.

Use the VZW network to pull the proper APN:

In the terminal program, type the command:

AT#OTAUIDM=0

followed by the enter key, then wait for #DRELL response from the terminal.

Next, type the command:

AT+CGDCONT?

Read the response from the terminal and see what 3rd PDP context changed to.

The second method is to manually set the APN provided by VZW.

In the terminal program, type the command:

AT#SCFG=3,3,300,90,600,50

followed by the Enter key. The terminal should respond with:

OK

This is configuration information for setting up the context in the next step.

In the terminal program, type the command:

AT+CGDCONT=3, "IP", "Verizon APN"

where **Verizon APN** is the specific APN to connect to for your intended use, followed by the Enter key, and the terminal should respond with:

OK

Note: Consult Section 3: APN Setup for help with your Verizon APN.

To verify that the APN was set correctly, type the command:

AT+CGDCONT?

followed by the Enter key, and the terminal should respond with:

+CGDCONT: 3, "IP", "Verizon APN"

as well as the other PDP context information on the device.

To enable this setting, in the terminal program type the command:

AT#SGACT=3,1

followed by the enter key, and the terminal should respond with:

#SGACT: www.xxx.yyy.zzz

where **www.xxx.yyy.zzz** is the Skywire modem's IP address.

If the **AT#SGACT** command does not work, the terminal will respond with

#ERROR

and further setup may be necessary. Check the signal strength with **AT+CSQ** to verify the Skywire is getting an acceptable signal. Otherwise, consult the Telit AT Command Reference Guide for your particular modem.

2.15.4. NL-SW-LTE-GELS3 APN Configuration

In the terminal program, type the command:

AT+CGDCONT=3, "IPV4V6", "Verizon APN"

where **Verizon APN** is the specific APN to connect to for your intended use, followed by the Enter key, and the terminal should respond with:

OK

Note: Consult Section 3: APN Setup for help with your Verizon APN.

To verify that the APN was set correctly, type the command:

AT+CGDCONT?

followed by the Enter key, and the terminal should respond with:

+CGDCONT: 3, "IPV4V6", "Verizon APN"

as well as the other PDP context information on the device.

To enable this setting, in the terminal program type the command:

AT^SICA=1,3

followed by the enter key, and the terminal should respond with:

OK

To verify that the APN is correct, type the command:

AT^SICA?

followed by the enter key, and the terminal should respond with:

^SICA: 1,1

^SICA: 2,0

^SICA: 3,1

^SICA: 4,0

^SICA: 8,0

If the **AT^SICA** command does not work, the terminal will respond with

#ERROR

or **AT^SICA?** will respond with:

^SICA: 3,0

Check the signal strength with **AT+CSQ** to verify the Skywire is getting an acceptable signal. Otherwise, consult the Nimbelinek AT Command Manual for Firmware 4.3.2.0.

2.15.5. NL-SW-LTE-WM14 APN Configuration:

In the terminal program, type the command:

AT%PDNSET=1,"APN","IP"

where **APN** is the individual APN for your network, followed by the Enter key, and the terminal program should respond with:

OK

Note: Consult Section 3: APN Setup for help with your APN.

To verify that the APN was set correctly, in the terminal program type the command:

AT%PDNSET?

followed by the Enter key, and the terminal should respond with:

%PDNSET: 1,APN,IP,,,,,0

as well as the other PDP context information on the device.

Further setup may be necessary. Check the signal strength with **AT+CSQ** to verify the Skywire is getting an acceptable signal. Otherwise, consult the Telit AT Command Reference Guide for your particular modem.

2.15.6. NL-SW-LTE-QBG96 APN Configuration:

In the terminal program, type the following command:

AT+CFUN=0

The terminal should respond with:

OK

The above command disables cellular functionality, and deactivates any previously activated PDP contexts. Next, enter the command below to configure the APN:

AT+CGDCONT=1,"IPV4V6","APN"

Where **APN** is replaced with the individual APN for your network. The terminal program should respond with:

OK

Note: Consult Section 3: APN Setup for help with your APN.

Finally, turn on cellular functionality by issuing the following command:

AT+CFUN=1

The modem should respond with:

OK

After turning on cellular functionality, the Skywire will automatically activate the specified PDP context. To confirm that the PDP context has indeed been activated, issue the following command:

AT+CGACT?

The terminal should respond with:

+CGACT: 1,1

If the modem responds with the above line, then the PDP context has been successfully activated.

2.16. Check Network Registration

The commands to check network registration differ depending on the modem technology your modem is using. 2G/3G devices will use the AT+CREG command and LTE devices will use the AT+CEREG or AT+CGREG commands.

2.16.1. 2G/3G Network Registration

To check network registration for these modems:

- NL-SW-1xRTT-A
- NL-SW-1xRTT-S
- NL-SW-1xRTT-V
- NL-SW-EVDO-A
- NL-SW-EVDO-V
- NL-SW-GPRS
- NL-SW-HSPA
- NL-SW-HSPA-B

follow this procedure:

In the terminal program, type the command:

AT+CREG?

followed by the Enter key, and the terminal should respond with:

+CREG: 0,1 or **+CREG: 0,5**

For all other responses, review network status responses online in your respective AT Commands Manual.

2.16.2. LTE Modem Network Registration

To check network registration for these modems:

- NL-SW-LTE-TSVG
- NL-SW-LTE-TNAG
- NL-SW-LTE-TEUG
- NL-SW-LTE-TC4EU
- NL-SW-LTE-TC4NAG

follow this procedure:

In the terminal program, type the command:

AT+CEREG?

followed by the Enter key, and the terminal should respond with:

+CEREG: 0,1 or **+CEREG: 0,5**

For all other responses, review network status responses online in your respective AT Commands Manual.

2.16.2.1. NL-SW-LTE-GELS3

To test NL-SW-LTE-GELS3, follow this procedure:

If you recently updated the firmware on your NL-SW-LTE-GELS3, verify that cellular functionality is enabled. To do so, type the following command into the terminal program:

AT+CFUN=1

followed by the Enter key, and the terminal should respond with:

OK

Next, in the terminal program, type the command:

AT+CEREG?

For Firmware 4.3.2.0 or newer, the terminal should respond with:

+CEREG: 0,1 or **+CEREG: 0,5**

For all other responses, review network status responses online in your respective AT Commands Manual.

2.16.2.2. NL-SW-LTE-WM14

To test NL-SW-LTE-WM14, follow this procedure:

In the terminal program, type the command:

AT+CEREG?

followed by the Enter key, and the terminal should respond with:

+CEREG: 2, 1, xxxx, yyyyyyyy, z

For all other responses, review network status responses online in your respective AT Commands Manual.

2.16.2.3. NL-SW-LTE-QBG96

For NL-SW-LTE-QBG96 Skywire Modems:

In the terminal program, issue the following command:

AT+CEREG?

The modem should respond with:

+CEREG: x,1

Where **x** indicates the state of the **+CEREG** unsolicited response code, and **1** indicates that the modem is registered to the home network. The modem may also respond with:

+CEREG: x,5

Which indicates that the modem is registered, and roaming on the cellular network.

For all other responses, review network status responses online in your respective AT Commands Manual.

For information on the **+CEREG** URC, please refer to the AT command manual on the QBG96 product page.



Reset power, and repeat steps 2.5 through 2.15 (as applicable) before moving on to Section 4.

3. APN Setup

3.1. Overview

GSM and LTE-based Skywire modems can be setup to use different APNs. APNs are used by devices and cellular networks to initialize and properly set up a cellular connection. Accordingly, in order to connect to a cellular network, it is crucial to ensure that the proper APN is set on the device.

If you activated your Skywire modem on <https://go.nimbelink.com>, use the APN's defined in Section 3.2. For data plans not activated through NimbeLink please reach out to your carrier for APN configuration details.

3.2. Common APNs and Their Respective Carriers

The table below contains a list of common APNs and their respective carriers. It is important to use the APN that corresponds to the proper carrier and the specific IP address configuration. Failure to do so will result in failed cellular network connections.

| Cellular Carrier | Common APNs | Description |
|------------------|-----------------------|--|
| Verizon | NIMBLINK.GW12.VZWENTP | APN for Verizon devices activated through Go.NimbeLink.com |
| | MW01.VZWINTERNET | APN for devices upgraded to a Public Static IP address |
| AT&T | iot0718.com.attz | AT&T Direct APN |
| T-Mobile | m2mgloba1 | T-Mobile Direct APN |

4. Common Next Steps

Once the network setup and testing is complete, you are ready to start developing with your Skywire modem. Common application examples include sending and receiving SMS messages, FTP file transfer, TCP/UDP packets, and using the modem with an external microcontroller, such as an Arduino. Please consult these application notes on the Skywire Development Kit page (<http://nimbelink.com/skywire-development-kit/>) or your Skywire-specific page for specific examples of each type of operation.