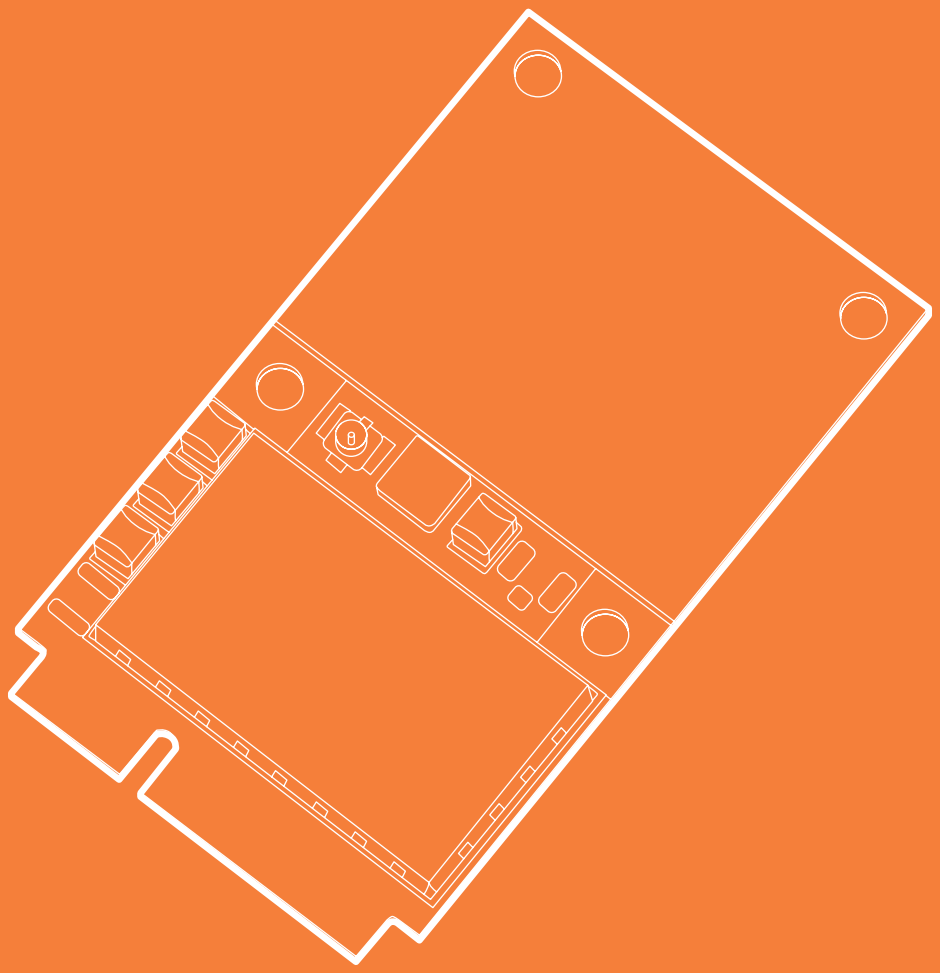
NWK030: Cat M1 / NB-IoT Modem

Revision Date 2019.01.29



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NWK030 Product Manual

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Important Notices and Warnings

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Extrovert family of products are used in a normal manner with a well constructed network, the Extrovert family of products should not be used in situations where failure to transmit or receive data could result in damage of any kind to other equipment, the user or any other party, including but not limited to personal injury, death or loss of property. Logic Supply accepts no responsibility for damages of any kind resulting from failures, delays or errors in data transmitted or received. The purchase and use of the Extrovert family of products does not come with, or constitute a wireless or data plan. A separate plan with your carrier is required.

Limitation of Liability

The information in this manual is subject to change without notice and does not represent a commitment on the part of Logic Supply. LOGIC SUPPLY AND ITS AFFILIATES SPECIFICALLY DISCLAIM LIABILITY FOR ANY AND ALL DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE OR ANTICIPATED PROFITS OR REVENUE ARISING OUT OF THE USE OR INABILITY TO USE ANY LOGIC SUPPLY PRODUCT, EVEN IF LOGIC SUPPLY AND/OR ITS AFFILIATES HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

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Safety and Hazards

CAUTION: For your own safety and to ensure continued proper operation, Extrovert products should not be used where explosive atmospheres may be present or where radio interference may cause damage to, or disruption in service from, other equipment.

IMPORTANT NOTE: Maintain at least 20 cm of separation between the LTE antenna and the user's body while in regular operation. Do not use Extrovert products in the vicinity of medical equipment as it may cause potentially disruptive interference.

Do not co-locate an Extrovert-enabled device with any other transmitting system.

To comply with FCC/IC regulations in North America that limit both maximum RF output power and human exposure to RF radiation (SAR), the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed the limits outlined in the table on the following page.

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Important Notices and Warnings (cont.)

Device	Technology	Bands	Uplink Frequencies (MHz)	Downlink Frequencies (MHz)	Maximum antenna gain (dBi)
NWK030	LTE	2	1850 - 1910	1930 - 1990	7
		4	1710 - 1755	2110 - 2155	6.75
		5	824 - 849	869 - 894	4.41
		12	698 - 716	728 - 746	3.66
		13	777 - 787	746 - 756	3.94

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Overview

Specifications

SKU	NWK030
Carriers	Verizon
Connectivity	LTE, SMS, GSM, VoLTE
Bands	**LTE:** FDD Bands Ch 2, 3, 4, 5, 8, 12, 13, 20, 28 3GPP Release 13 LTE Cat M1 3GPP Release 13 LTE Cat NB1 Coverage Enhancement Mode A Rel 12 LTE Power Save Mode, PSM Rel 13 e-DRX Cat M1 Half-duplex (375 kbit/s DL and UL) Cat NB1 Half-duplex (27.2 kbit/s DL, 62.5 UL) Cat NB1 Non-IP Data Delivery **GSM:** EGPRS Power class E2 **SMS:** MT/MO PDU / Text mode SMS over SG/NAS1 **VoLTE:** Codec: AMR-WB
Data Rate	**Cat M1 Half-duplex:** (300 kbit/s DL, 375 kbit/s UL) **NB-IoT:** (27.2 kbit/s DL, 62.5 kbit/s UL)
Interface	Mini PCIe (Half and Full Height)
SIM Card Socket Size	3FF (Micro-SIM)

Signal Type	USB 2.0 (on Mini PCIe)
Expansion Options	SIM Card Socket PCIe Mini Card (Half and Full Height)
Operating Temp. Range	-40°C ~ 85°C
Drivers Supported	Ubuntu Windows 10
Regulatory Information	GCF, PTCRB, CE Europe, FCC US, ISED Canada, RoHS
Protocols	Dual stack IPv4 and IPv6 Embedded TCP/IP, UDP/IP, FTP, HTTP Embedded MQTT, CoAP Embedded HTTPS, FTPS, TLS
Firmware Upgrade	Via UART and USB Via FOTA
Operating Voltage Power Input VCC_3V3	Minimum: 3v Maximum: 5.5v
Serial	1 UART 1 USB 2.0 (high speed, 480 Mb/s)
Features	Power Save Mode Embedded TCP/UDP stack eDRX Embedded HTTP, FTP Antenna Supervisor Dual stack IPv4 / IPv6 Embedded HTTPS, FTPS, TLS FW update over the air (FOTA)
U(SIM)	Supports 1.8 and 3 V, SIM toolkit

Product Description

The Logic Supply NWK030 is based on the PCI Express Mini Card standard with a USB 2.0 interface.

The NWK030 is an available option within Logic Supply's full range of industrial PCs. See www.logicsupply.com to select your PC platform. Add Cat M1 / NB-IoT connectivity during the system configuration stage. The NWK030 is not available for individual sale as a component.

The NWK030 is intended to use applications developed by the user to interface with the modem and do data transfers. By the nature of Cat M1 / NB-IoT operating systems will not be able use the connection directly (i.e. Network Managers).

Antenna RF Interfaces (ANT1)

NWK030 is based on the SARA-R410M module and provides a single RF interface for connecting the external antenna: "Cellular" represents the primary RF input/output for transmission and reception of LTE RF signals. The "Cellular" pin of NWK030 has a

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Overview (cont.)

Antenna RF Interfaces (ANT1) (cont.)

nominal characteristic impedance of 50 Ω and must be connected to the primary Tx / Rx antenna through a 50 Ω transmission line to allow proper RF transmission and reception.

When installed in a Logic Supply computer, “Cellular” interface is connected to an external antenna mount. The external mount uses an SMA (female) connector. Our line of compatible cellular antennas all use a standard SMA (male) connector.

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Initial Setup

A SIM inserted into the Modem will automatically configure onto the SIM's respective network. The connection can be verified by checking the APN with 'AT+CGDCONT?' The APN will be configured on Class 1 by default. Connectivity can be verified using a data test of supported protocol tests outlined in the AT command section or by using the different connectivity AT commands outlined in the AT manual.

Firmware Update

Customers can check for device Firmware updates through Logic Supply's NWK030 product page. When Firmware is available, end users can perform Firmware Over The Air (FOTA) updates to download and flash firmware. Both methods can be aided with applications or performed within a PuTTY session using the relevant AT commands.

When Firmware is available, User can perform a FOTA update via HTTP. The Firmware will be hosted at www.logicsupply.com/nwk030/

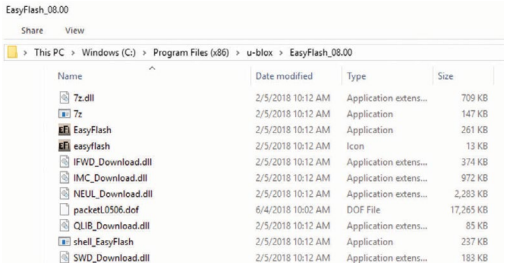
A FOTA upgrade package is delivered as two phases:

- fwA_to_fwB-Phase1.pkg
- fwA_to_fwB-Phase2.pkg

In the Phase 1 package, the FOTA Update Agent is updated from a full file to delta file Agent. In the Phase 2 package, the remaining firmware changes are executed. This two package method substantially reduces the overall package size.

USB Update Application

1. Download the Easy Flash application and Firmware Image File.
2. Make sure the Easy Flash application and the .dof Firmware Image file are in the same directory.



3. Launch the Easy Flash utility as Administrator
4. Select the following options:
   Product: SARA-R4
   Port: USB
   Baud rate: 921600

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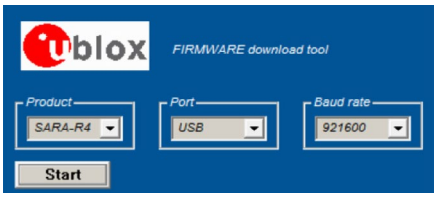
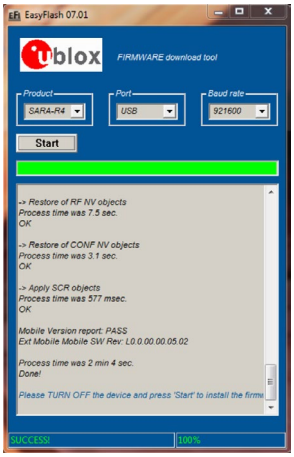
Initial Setup (cont.)

USB Update Application (cont.)



5. Hit Start and follow instructions provided



Firmware Update via AT Commands

Procedure for FOTA Over HTTP

1. Verify existing / current firmware version via ATI command
2. Set up a HTTP connection:
   AT+UHTTP=2,1,"www.websiteurl.com"
   AT+UHTTP=2,5,<port number>
3. Get from the previously set HTTP connection
   AT+UHTTPC=0,1,"/path/firmware_file.pkg"
4. After the download is finished (+UUFTPCR: 100, 1), start the FOTA update:
   AT+UFWINSTALL
   It should reboot after 15-20 minutes, do not remove the power from the device before it reboots.
5. Verify firmware version via the ATI command
   The firmware should be different from the previous ATI command output

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Initial Setup (cont.)

Procedure for FOTA Over HTTP (cont.)

For more information and details on the HTTP commands, see the U-blox manual by searching U-blox's website for SARA-R4 or following this link (https://www.u-blox.com/sites/default/files/SARA-R4-SARA-N4_ATCommands_%28UBX-17003787%29_0.pdf).

Procedure for FOTA Upgrade via UFTP Method

1. Verify existing / current firmware version via ATI command
2. Set up a FTP connection:
   AT+UFTP=0,"<ip_address>"
   AT+UFTP=7,<server_port_number>
   AT+UFTP=2,"<username>"
   AT+UFTP=3,"<password>"
   AT+UFTP=4,"<account>"
   AT+UFTP=5,<timeout_seconds>
   AT+UFTP=6,<ftp_mode: 1-passive, 0-active>
   AT+UFTPC=1
   The +UUFTPCR: 1,1 URC is issued to confirm a successful connection.
3. Download the phase-1 file from the FTP server
   AT+UFTPC=100,"<package_path>/fwA_to_fwB-Phase1.pkg"
4. After the download is finished (+UUFTPCR: 100, 1), start the FOTA update:
   AT+UFWINSTALL
   It should reboot shortly after (< 2 minutes), do not remove the power from the device before it reboots.
5. Setup a FTP connection:
   AT+UFTP=0,"<ip_address>"
   AT+UFTP=7,<server_port_number>
   AT+UFTP=2,"<username>"
   AT+UFTP=3,"<password>"
   AT+UFTP=4,"<account>"
   AT+UFTP=5,<timeout_seconds>
   AT+UFTP=6,<ftp_mode: 1-passive, 0-active>
   AT+UFTPC=1
   The +UUFTPCR: 1,1 URC is issued to confirm a successful connection.
6. Download the phase-2 file from the FTP server:
   AT+UFTPC=100,"<package_path>/fwA_to_fwB-Phase2.pkg"
7. After the download is finished (+UUFTPCR: 100, 1), start the FOTA update:
   AT+UFWINSTALL
   It should reboot after 15-20 minutes, do not remove the power from the device before it reboots.
8. Verify firmware version via the ATI command
   The firmware should be different from the previous ATI command output

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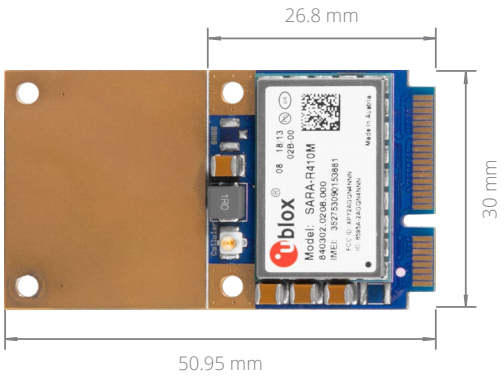
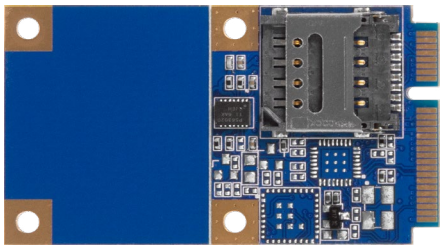
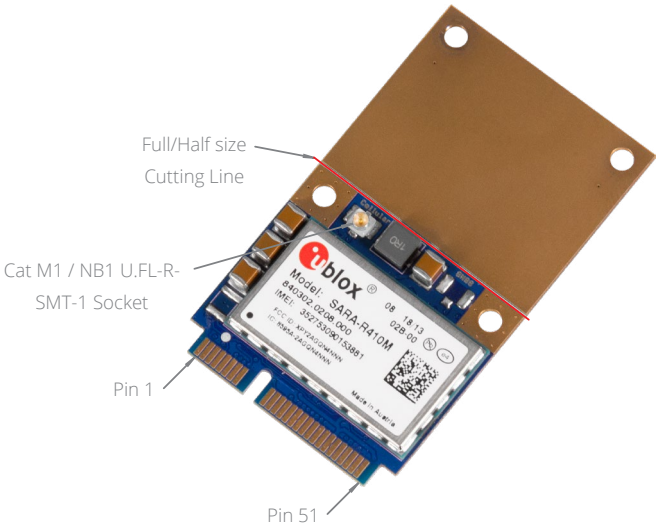
Product Information

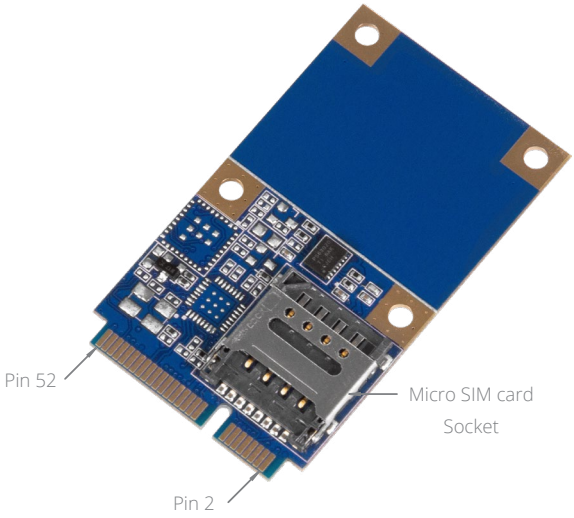
Dimensions





Pin Connectors





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Product Information (cont.)

Pin Connectors (cont.)

PIN	Name	Input/Output	Description
1	GPIO2	Output	Module status indication SARA-R4 pin23
2	VCC_3V3	Power	Power Input
3	NC		Not Connected
4	GND		Power Ground
5	NC		Not Connected
6	GNSS_TXD	Output	+1.8V UART GNSS data output EVA-M8M-0 pin16
7	PWR_ON	Input	Power-on / power-off input SARA-R4 pin15
8	SIM_VCC		External SIM signal — Power supply for the SIM
9	GND		Power Ground
10	SIM_IO	Input/Output	External SIM signal — Data I/O
11	V_INT	Output	+1.8V UART GNSS data output SARA-R4 pin4
12	SIM_CLK	Output	External SIM signal — Clock
13	UART_DSR	Output	UART data set ready SARA-R4 pin6
14	SIM_RST	Input	External SIM signal — Reset
15	GND		Power Ground
16	NC		Not Connected
17	GNSS_RXD	Input	+1.8V UART GNSS data output EVA-M8M-0 pin15
18	GND		Power Ground
19	NC		Not Connected
20	W_DISABLE_N		Hi or Open: Enable the Power Low: Disable the power
21	GND		Power Ground
22	RESET_N	Input	SARA-R4 External reset input SARA-R4 pin18
23	UART_RXD	Input	+1.8V UART data output SARA-R4 pin12
24	VCC_3V3	Power	Power Input
25	UART_RTS	Output	+1.8V UART clear to send SARA-R4 pin11
26	GND		Power Ground
27	GND		Power Ground
28	UART_CTS	Input	+1.8V UART ready to sent SARA-R4 pin10
29	GND		Power Ground
30	UART_DCD	Output	+1.8V UART data carrier detect SARA-R4 pin8
31	UART_TXD	Output	+1.8V UART data output SARA-R4 pin13
32	NC		Not Connected
33	GPIO1		RESERVED pin SARA-R4 pin16
34	GND		Power Ground
35	GND		Power Ground

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Pin Connectors (cont.)

PIN	Name	Input/Output	Description
36	USB_DN	Input/Output	USB Data Negative
37	GND		Power Ground
38	USB_DP	Input/Output	USB Data Positive
39	VCC_3V3		Power Input
40	GND		Power Ground
41	VCC_3V3		Power Input
42	LED_WWAN	Output	Default: high impedance; LED setting flash via AT command port AT+UGPIOC=16,2
43	GND		Power Ground
44	GPIO5	Input	SIM detection SARA-R4 pin42
45	NC		Not Connected
46	UART_DTR	Input	+1.8V UART data terminal ready SARA-R4 pin9
47	NC		Not Connected
48	V_BCKP	Input	Real Time Clock Backup supply EVA-M8M-0 pin21
49	NC		Not Connected
50	GND		Power Ground
51	NC		Not Connected
52	VCC_3V3	Power	Power Input

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Technical Functions

Connecting to Modem via PuTTY (Windows)

- In the Device Manager, find out which virtual COM the modem is attached to.
  - Open the 'Modems' category flyout,
  - right click the Qualcomm modem entry
  - select properties. The port number [n] is listed at the top of main page.
- Open PuTTY
  - select the Serial radio button in the main window.
  - In the <<connection>> box, replace COM1 with the COM[n] from the modem properties.
  - the baud rate to 9600
  - Click Open.
- Make the modem "echo" back the commandes. In the terminal window, type
  - *ATE1* and press Enter. It is possible that no text will be displayed until the command is executed.

Connecting to Modem via Minicom (Ubuntu)

- From Ubuntu terminal
  - *sudo minicom -s*
    - Serial port setup
      - Press a - change name to '/dev/ttyUSB1'
      - Press g to change software flow control to YES
      - Exit (this will drop you to a new shell)
    - Make the modem "echo" back the commandes. In the terminal window, type
      - *ATE1*
- User can now send any AT commands necessary

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AT Commands (partial)

The modem can be accessed through Minicom or PuTTY. The full list of AT commands and functionality of the SARA-R410M modem can be found by searching U-blox's website for SARA-R4 or following this link (https://www.u-blox.com/sites/default/files/u-blox-CEL_ATCommands_%28UBX-13002752%29.pdf).

AT+CGDCONT
Check Class, APN, and IP information

AT+CGDCONT=<1-6>, <IP,IPV4V6,IPV6>,<APN>
Set class, IP format, and APN

AT+CFUN?
Check power function

AT+CFUN=0
Set modem into airplane mode (off)

AT+CFUN=1
Turn modem on

AT+CFUN=15
Power cycle the modem

AT+CNUM
Verify Phone Number

AT+CSQ?
Signal quality (99,99 means no signal)

AT+XSIMSWITCH
Switch SIM Slot in use, 0-1 (default is 0)

AT+USOCR
Creates a socket and associates it with the specified protocol (TCP or UDP), returns a number identifying the socket. Such command corresponds to the BSD socket routine. Up to 7 sockets can be created. It is possible to specify the local port to bind within the socket in order to send data from a specific port. The bind functionality is supported for both TCP and UDP sockets.

AT+USOCO
Establishes a peer-to-peer connection of the socket to the specified remote host on the given remote port, like the BSD connect

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AT Commands (partial) (cont.)

routine. If the socket is a TCP socket, the command will actually perform the TCP negotiation (3-way handshake) to open a connection. If the socket is a UDP socket, this function will just declare the remote host address and port for later use with other socket operations (e.g. +USOWR, +USORD). This is important to note because if refers to a UDP socket, errors will not be reported prior to an attempt to write or read data on the socket.

AT+USORD

Reads the specified amount of data from the specified socket, like the BSD read routine. This command can be used to know the total amount of unread data

AT+USOCL

Closes the specified socket, like the BSD close routine. In case of remote socket closure the user is notified via the URC.

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Troubleshooting

U-blox provides a GUI (https://www.u-blox.com/en/product/m-center) program to send AT commands to the modem in case using PuTTY becomes too difficult.

For network Connectivity issues, a SIM swap using a known good SIM should suffice in troubleshooting if the SIM or Modem is at fault. When putting in a new SIM, use the AT commands above to check APN, Number, ICCID, and do a connectivity test.

If a known good SIM doesn't fix the issue, loading the default values for the card might help.

AT&V
Display the default values

AT&F
Load the default values

Using the above commands followed by a system reset should help with troubleshooting issues with the modem + SIM.

Check Internet Connectivity (TCP)

This test sends a TCP packet to u-blox's test server and then reads the return followed by closing the socket.

- TCP - Create socket and then open it
  - AT+USOCR=6
  - AT+USOCO=0,"195.34.89.241" ,7
  - AT+USORD=0,32
  - AT+USOCL=0

Known Limitations

The NWK030 will not have a cellular network connection that the Operating System's network managing application can use. This means that you can not select the "Cellular" network option from the system tray and then open a browser and begin browsing the web. An application must be developed by the customer to interface with the modem and do data transfers.

NWK030 requires SIM cards specific to Cat M1 and NB-IoT networks. Standard 4G/LTE SIM cards, even if in the same form factor, may not function in this cellular modem.

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