μMURADG
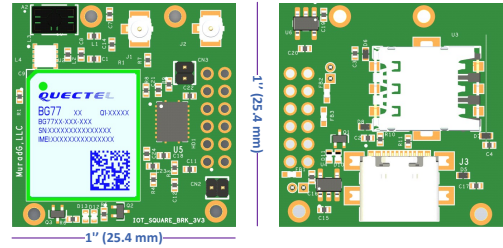
IoT²BRK3V3

BG77 LTE-M/NB2 Breakout Board

IoT²BRK3V3 is the simplest way to add cellular connectivity and GNSS to your application. It is based on the ultra-compact LTE cat M1/cat NB2 BG77 module. This 1-inch square board comes with an on-board GNSS low-noise amplifier front-end with integrated pre and post SAW filters and a GNSS ceramic antenna. External active or passive GNSS antennas can be used via the U.FL connector. The BG77 is an ultra-compact LPWA module supporting LTE Cat M1, LTE Cat NB2 and integrated GNSS. It is fully compliant with 3GPP Rel-14 specification and provides maximum data rates of 588 kbps downlink and 1119 kbps uplink. It features ultra-low power consumption by leveraging the integrated RAM/flash as well as the ARM Cortex A7 processor supporting ThreadX, achieving up to 70% reduction in PSM leakage and 85% reduction in eDRX current consumption compared to its predecessor.
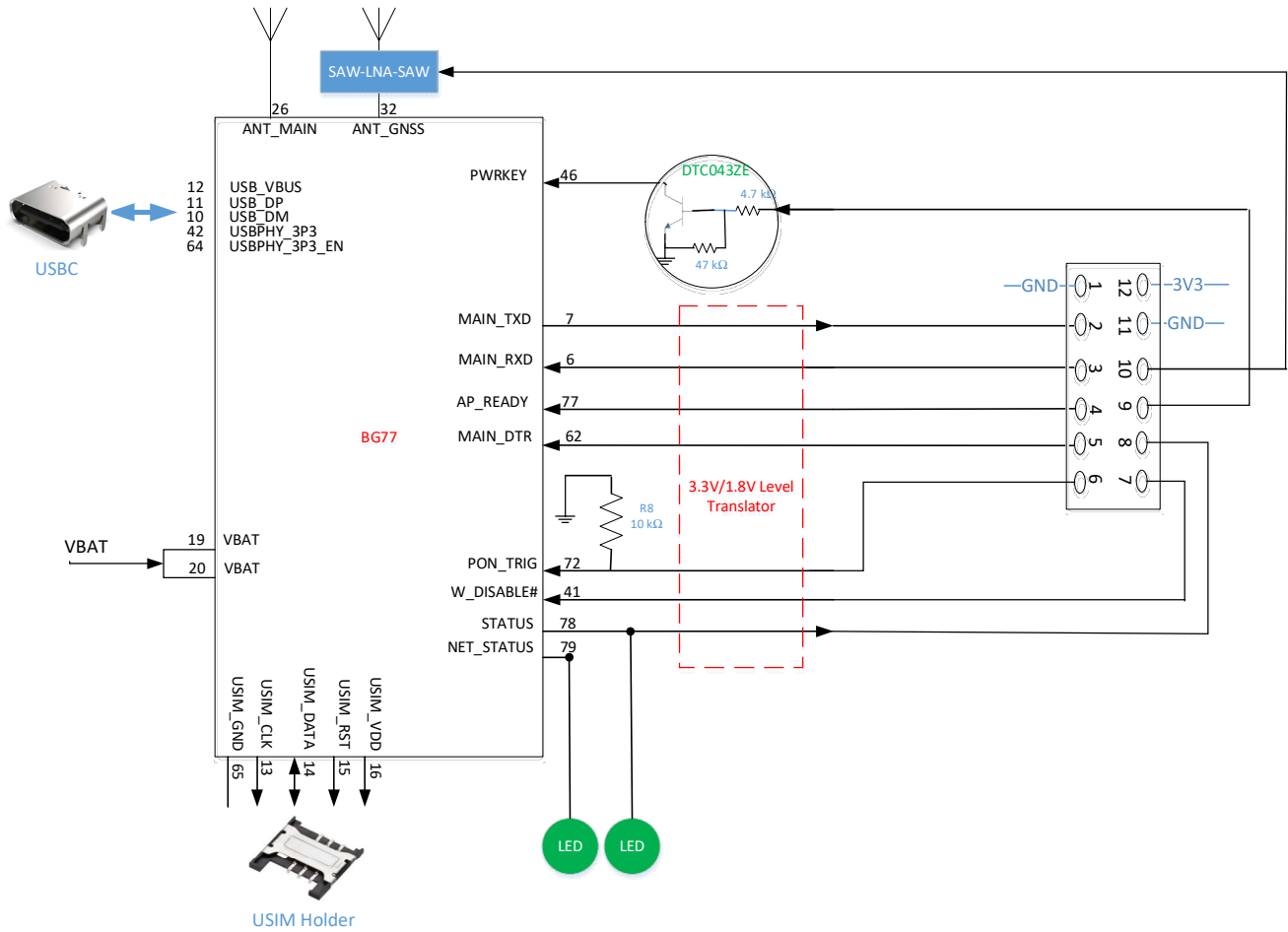
Key Benefits

- ✓ SWAP (Size, Weight, and Power) IoT solution
- ✓ Robust mounting and interface
- ✓ 3 GNSS antenna options
- ✓ On-Board uSIM Holder
- ✓ LTE antenna U.FL connector
- ✓ USB-C interface
- ✓ Module and Network status LEDs

Applications

- ✓ Asset Management
- ✓ Logistics
- ✓ Tracking
- ✓ Geo-Fence
- ✓ Wearables
- ✓ Smart Energy
- ✓ Medical Devices
- ✓ PPPoS/Hotspot

Block Diagram

Board Reference

HD1 Pin Description

Pin Number	Direction	Name	Description
1	-	GND	Ground
2	Output	MAIN_TXD_HDR	Main UART transmit
3	Input	MAIN_RXD_HDR	Main UART receive
4	Input	AP_READY_HDR	Application Ready
5	Input	MAIN_DTR_HDR	Main UART data terminal ready
6	Input	PON_TRIG_HDR	Wake up the module from PSM[1]
7	Input	W_DISABLE_HDR	Airplane mode control
8	Output	STATUS_HDR	BG77 Module operation status indication
9	Input	GPS_LNA_HDR	Enable/Disable GNSS LNA
10	Input	PWRKEY_HDR	Turn on/off the BG77 module
11	-	GND	Ground
12	Power Input/Output	3V3	Power Supply

1: BG77 Bug-Pulling PON_TRIG High will prevent the BG77 from powering off. BG77 will power On immediately after toggling the PWRKEY. R8 can be populated to have BG77 in the OFF state at Power-On.

LED Description

LED Number	Name	Description
D12	NET STATUS	Flicker slowly (200 ms High/1800 ms Low): Network searching Flicker slowly (1800 ms High/200 ms Low): Idle Flicker quickly (125 ms High/125 ms Low): Data transfer is ongoing Always high: Voice calling
D13	STATUS	High: BG77 is ON Low: BG77 is OFF

Power

Interface: The board can be powered by providing a 3.3 V at the HD1 (pin 12) or through a USB-C.

Power Supply	Jumper Position	Description
3.3 V	CN3 installed CN2 uninstalled	3.3 V **Input**: Connect Ground and 3.3 V to HDR pins 11 and 12 respectively.
USB-C	CN3 uninstalled CN2 installed	Connect Ground to pin 11 only.

USB-C	CN3 installed CN2 installed	3.3 V **Output**: pin 12 can be used to supply a 3.3 v to external circuitry.

Jumper Settings

CN2	CN3	Function
Installed	Uninstalled	USB-C is the input power
Uninstalled	Installed	3.3 V is an **input** powered
Installed	Installed	3.3 V is an **output** Power
Uninstalled	Uninstalled	System off

GNSS

Antenna: 2 options

Option 1: Connect active or passive GNSS antenna to J1 u.FL connector. C1 must be populated and C8 DNP.

Option 2: use onboard active GNSS antenna by populating C8 and C1 DNP (or leave C1 populated but don't plug an antenna to J1 u.FL). *Valid on Rev B and above.*

LTE

Antenna

J2: connect LTE CAT-M antenna to J2 u.FL connector.

BOARD

Testing

Quectel "QNavigator" tool is used to test both LTE and GNSS.

To speed up the CAT M1 registration in the US, send the following command from QNavigator (or UART if you are connected to the board through the header).

AT+QCFG="band",0,100181A,100181A,1

Screenshot 1 - QNavigator_V1.6.9 (Home)

QNavigator_V1.6.9

File Setting Tool View Help

Home

Disconnect to module

☑ Automatic initialization

Module information

Manufacturer ID:	Quectel
Device module:	BG77
Firmware version:	BG77LAR02A04

Registration information

Network registration:	Registered
GPRS network status:	... ...
Preferred operator:	ATT

SIM card information

SIM card IMSI:	901405
SIM card ICCID:	898822

QUECTEL
Build a Smarter World

```
/* Use AT+CPIN? to query the SIM card status : SIM card inserted or not, locked or unlocked */
[2023-04-27 09:21:20:406_S:] AT+CPIN?
[2023-04-27 09:21:20:459_R:] AT+CPIN?
[2023-04-27 09:21:20:459_R:] +CPIN: READY

[2023-04-27 09:21:20:459_R:] OK

/* Use AT+CIMI to query the IMSI of SIM card */
[2023-04-27 09:21:20:563_S:] AT+CIMI
[2023-04-27 09:21:20:617_R:] AT+CIMI
[2023-04-27 09:21:20:617_R:] 901

[2023-04-27 09:21:20:617_R:] OK

/* Use AT+QCCID to query ICCID number of SIM card */
[2023-04-27 09:21:20:767_S:] AT+QCCID
[2023-04-27 09:21:20:820_R:] AT+QCCID
[2023-04-27 09:21:20:820_R:] +QCCID: 8988

[2023-04-27 09:21:20:820_R:] OK

/* Use AT+CSQ to query current signal quality */
[2023-04-27 09:21:20:869_S:] AT+CSQ
[2023-04-27 09:21:20:924_R:] AT+CSQ
[2023-04-27 09:21:20:924_R:] +CSQ: 31,99

[2023-04-27 09:21:20:924_R:] OK

/* Use AT+CEREG? to query the network registration status. */
[2023-04-27 09:21:20:925_S:] AT+CEREG?
[2023-04-27 09:21:20:979_R:] AT+CEREG?
[2023-04-27 09:21:20:979_R:] +CEREG: 0,5

[2023-04-27 09:21:20:979_R:] OK

/* Use AT+COPS? to query current Network Operator */
[2023-04-27 09:21:20:982_S:] AT+COPS?
[2023-04-27 09:21:21:036_R:] AT+COPS?
[2023-04-27 09:21:21:036_R:] +COPS: 0,0,"AT&T",8

[2023-04-27 09:21:21:036_R:] OK
```

◉ Text ○ Hex ○ SpecialChars ○ File   ☑ Send With Enter

AT+QCFG="band",0,100181A,100181A,1   [Send]

DTR RTS

QNavigator_eMTC   COM44,115200,8,1,None,None DSR[0] CTS[0] RI[0] DCD[0] 2023-04-27 09:21:30

Screenshot 2 - QNavigator_V1.6.9 (GNSS)

QNavigator_V1.6.9

File Setting Tool View Help

GNSS

USB NMEA Port:	Quectel USB NMEA Port [COM46]	[Disconnect]
Port property:	115200,8,1,None,None	☑ Auto start/stop GNSS

UTC date:	270423	UTC time:	132236.0
Latitude:	28.557339N	Longitude:	81.206535W
Altitude(m):	26.9	Speed(km/h]:	0.00
Satellite_used:	8	Locating type:	3D
*DOP:	PDOP:1.2 HDOP:0.8 VDOP:0.8		

Legend: ■ GPS Tracked ■ GPS Used ■ Glonass Tracked ■ Glonass Used ■ SBAS

Signal column chart (S/N [dBHZ] vs Satellite PRN number):
25, 43, 42, 35, 40, 36, 30, 48, 42, 46, 42, 42, 36
PRN: 4, 7, 8, 9, 14, 16, 19, 27, 30, 72, 73, 74, 80

World map | Sky view | Signal column chart | Map | NMEA data

```
/* use AT+CPIN? to query the SIM card status : SIM card inserted or not, locked or unlocked */
[2023-04-27 09:21:49:593_S:] AT+CPIN?
[2023-04-27 09:21:49:647_R:] AT+CPIN?
[2023-04-27 09:21:49:647_R:] +CPIN: READY

[2023-04-27 09:21:49:647_R:] OK

/* use AT+CSQ to query current signal quality */
[2023-04-27 09:21:49:649_S:] AT+CSQ
[2023-04-27 09:21:49:702_R:] AT+CSQ
[2023-04-27 09:21:49:702_R:] +CSQ: 21,99

[2023-04-27 09:21:49:702_R:] OK

/* use AT+CREG? /AT+CGREG? to query the network registration status, if the return value is [0,1] or [0,5], it is successfully registered, other
value is fail to register */
[2023-04-27 09:21:49:705_S:] AT+CREG?
[2023-04-27 09:21:49:759_R:] AT+CREG?
[2023-04-27 09:21:49:759_R:] +CREG: 0,5

[2023-04-27 09:21:49:759_R:] OK
[2023-04-27 09:21:49:760_S:] AT+CGREG?
[2023-04-27 09:21:49:814_R:] AT+CGREG?
[2023-04-27 09:21:49:814_R:] ERROR

/* use AT+CREG? /AT+CGREG? to query the network registration status, if the return value is [0,1] or [0,5], it is successfully registered, other
value is fail to register */
[2023-04-27 09:21:50:817_S:] AT+CREG?
[2023-04-27 09:21:50:871_R:] AT+CREG?
[2023-04-27 09:21:50:871_R:] +CREG: 0,5

[2023-04-27 09:21:50:871_R:] OK
[2023-04-27 09:21:50:872_S:] AT+CGREG?
[2023-04-27 09:21:50:926_R:] AT+CGREG?
[2023-04-27 09:21:50:926_R:] ERROR

/* Make sure the Antenna is connected and the network is normal */
[2023-04-27 09:21:55:139_S:] AT+QGPS=1
[2023-04-27 09:21:55:194_R:] AT+QGPS=1
[2023-04-27 09:21:55:194_R:] OK
```
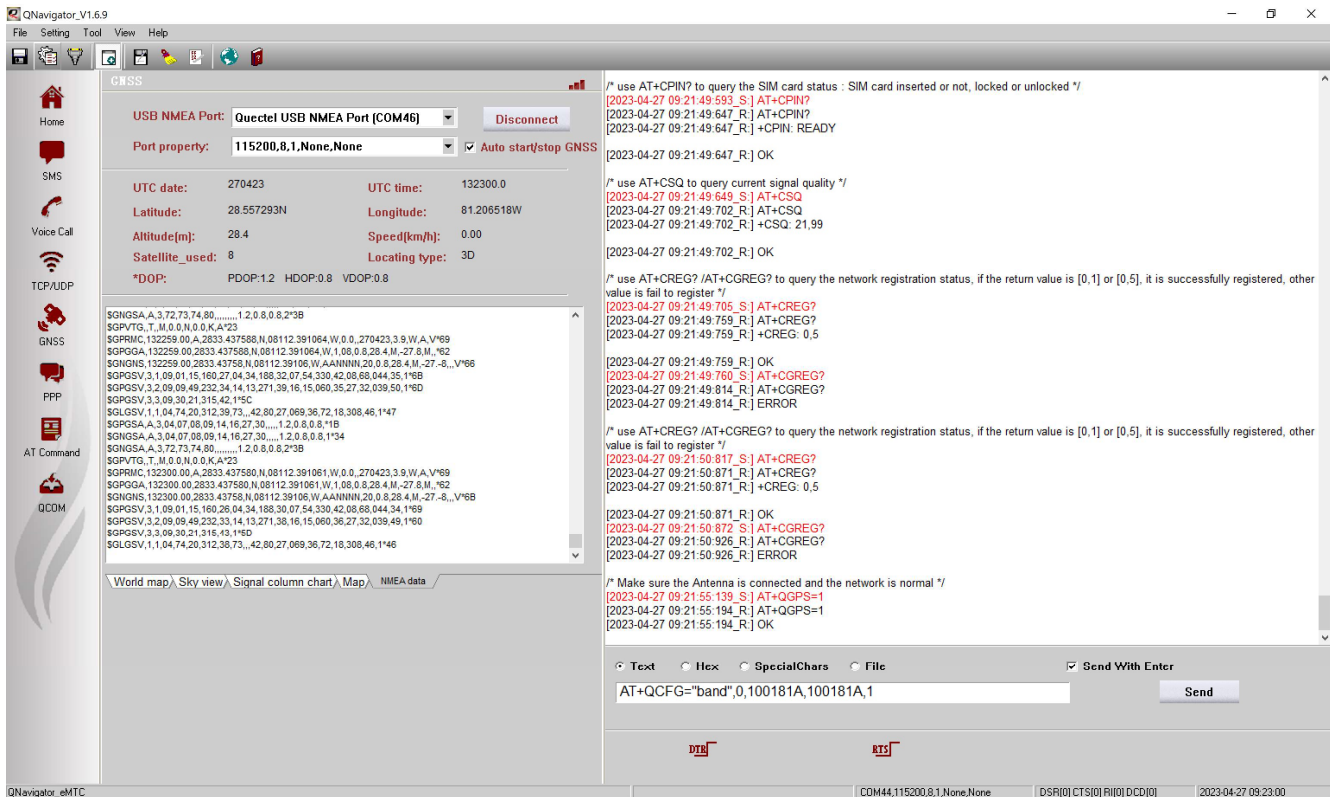
◉ Text ○ Hex ○ SpecialChars ○ File   ☑ Send With Enter

AT+QCFG="band",0,100181A,100181A,1   [Send]

DTR RTS

QNavigator_eMTC   COM44,115200,8,1,None,None DSR[0] CTS[0] RI[0] DCD[0] 2023-04-27 09:22:36

The board is shipped with a free uSIM card that includes 10 years/500 MB data plan. The Access Point Name (APN) is "iot.1nce.net":

AT+CGDCONT=1,"IP","iot.1nce.net"

Resources

1- **BG77 AT Commands Manual**

https://www.quectel.com/download/quectel_bg95bg77bg600l_series_at_commands_manual_v2-0

2- **BG77 GNSS Application Note**

https://www.quectel.com/download/quectel_bg95bg77bg600l_series_gnss_application_note_v1-2