



TRITOM Azure Sphere Guardian S100

Document Number	3.0
Created By	Tri Cascade Inc.

Chapter 1

Get to Know About Your S100

1.1. Product Overview

The **TRITOM Azure Sphere Guardian S100**, with Microsoft Azure Sphere-certified chip includes built-in Microsoft security technology, can provide connectivity and a dependable hardware-based root of trust. The **TRITOM S100** provides various interface for unconnected equipment which was designed before connectivity for non-IT devices was considered feasible or were intentionally not connected because they were deemed too mission critical to be subjected to the unsafe internet world. Connecting equipment and device to the internet representing innovative business model such as preventive maintenance, just-in-time reporting and role-based access to the equipment and data. The **TRITOM S100** can be deployed in the following indoor IoT applications and scenarios.

1.2. Appearance

Top Panel



The Front Panel/ Back Panel



Features

Item	Description
Ethernet Port	1x Ethernet 10BASE-T port with two status LEDs.
USB Port	1x Micro USB 2.0 port (Client).
RS485 Port	1x RS485 port (A/B/G/V).
Power Port	1x Connect S100 to a power socket via the provided power adapter.
Antenna	2x SMA connectors for user-install detachable LTE antenna for extended single range
LED	6x LED Status (LTE/SIM/ETH/USB/RS485/Power)

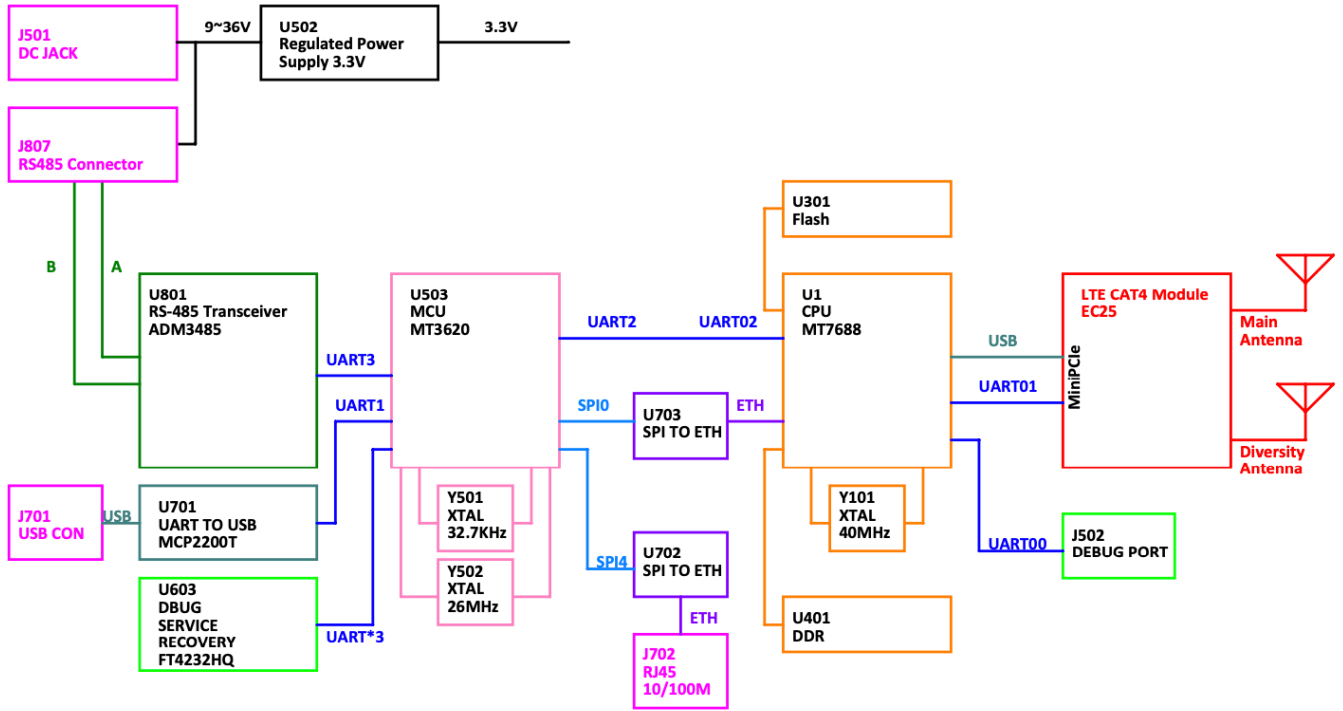
LED Status

Table 1

LED	Color	Status	Description
LTE	Off		No wireless network
	Green	On	Indicate S100 is connected with wireless network and the signal strength is good.
	Yellow	On	-110dBm <=RSRP< -100dBm
	Amber	On	RSRP< -110dBm
SIM	Off		Indicate either NO SIM card is installed or NOT being installed correctly.
	Green	On	Indicate that a SIM card is installed.
ETH	Off		Indicate that NO ETHERNET device is present.
	Green	On	Indicate that an ETHERNET device is connected.
USB	Off		Indicate that NO USB device is present.
	Green	On	Indicate that a USB device is connected.
RS485	Off		Indicate that NO RS485 device is present.
	Green	On	Indicate that a RS485 device is connected.
PWR	Off		Indicate that NO power is being applied to S100.
	Green	On	Indicate that power is being applied to S100.

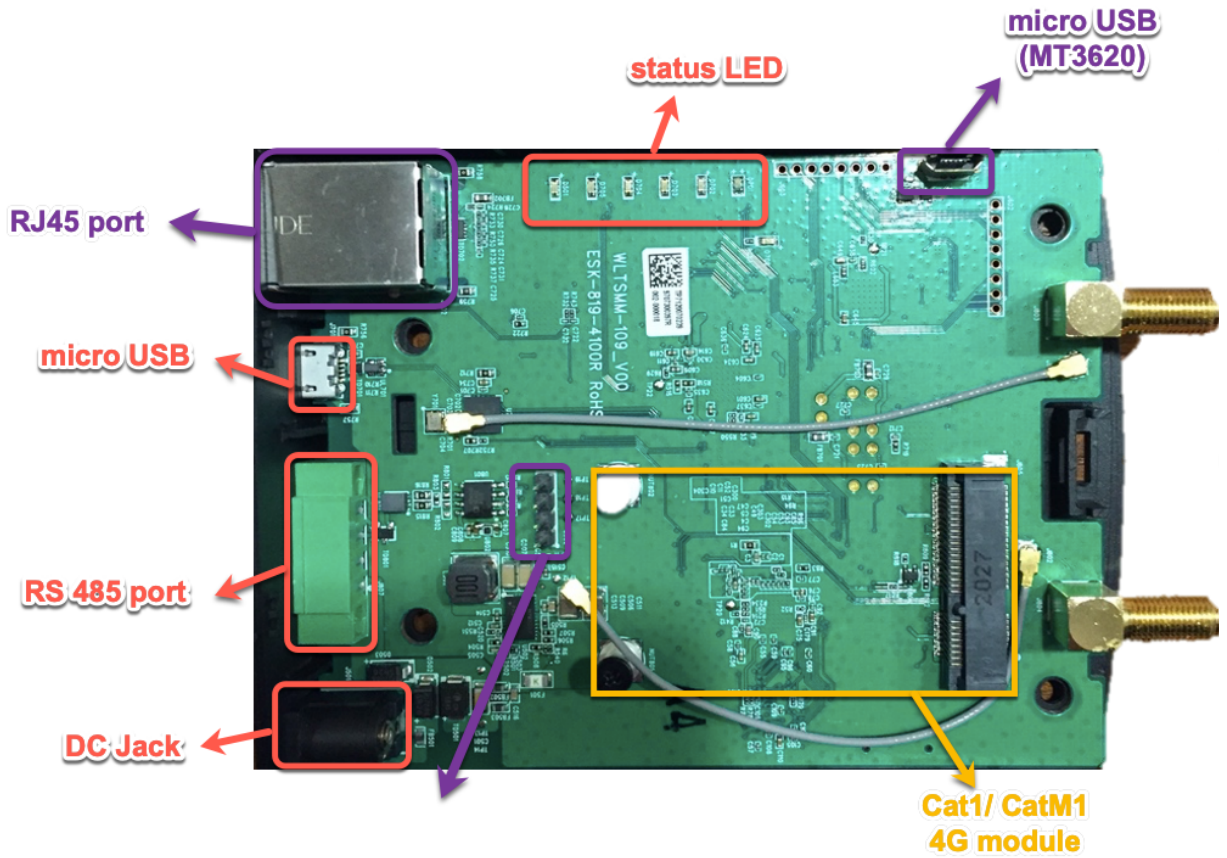
1.3. Inside the S100

Block Diagram

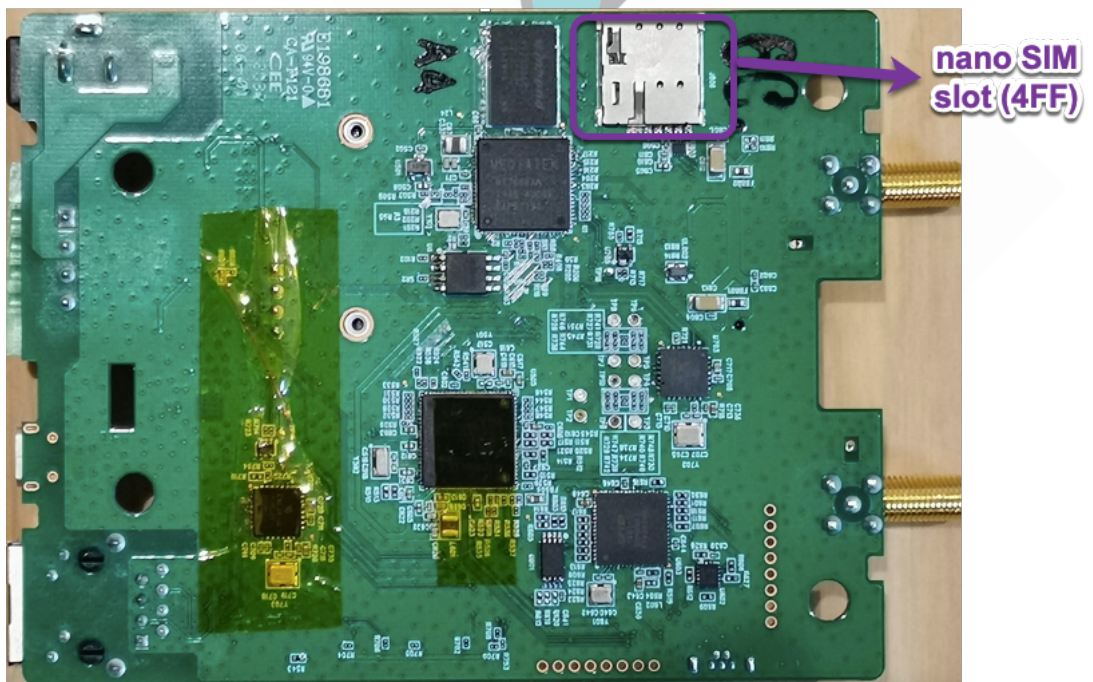


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Front Side



Back Side



Chapter 2

Get Started to Develop Your S100

2.1 Quickstarts to setup your S100

2.1.1 To develop your own TRITOM S100 application, please refer to: <https://docs.microsoft.com/en-us/azure-sphere/install/overview> for reference.

2.1.2 S100 is a LTE connectivity device, please also prepare your IoT LTE SIM which is activated with data service. Our suggestion SIMs are Cat.M, Cat.M1 or Cat.4.

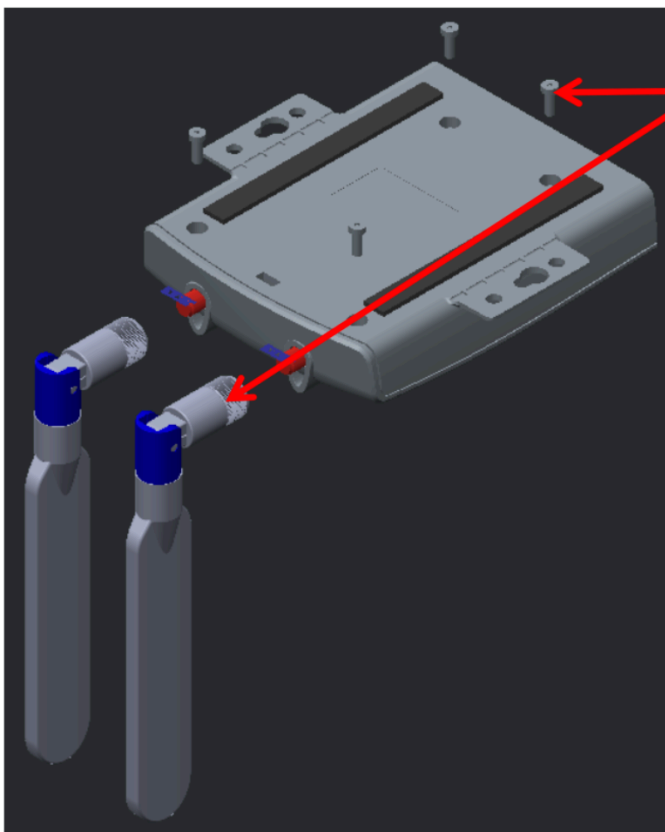
SIM corresponding to LTE module

Cat.M : Quectel BG96

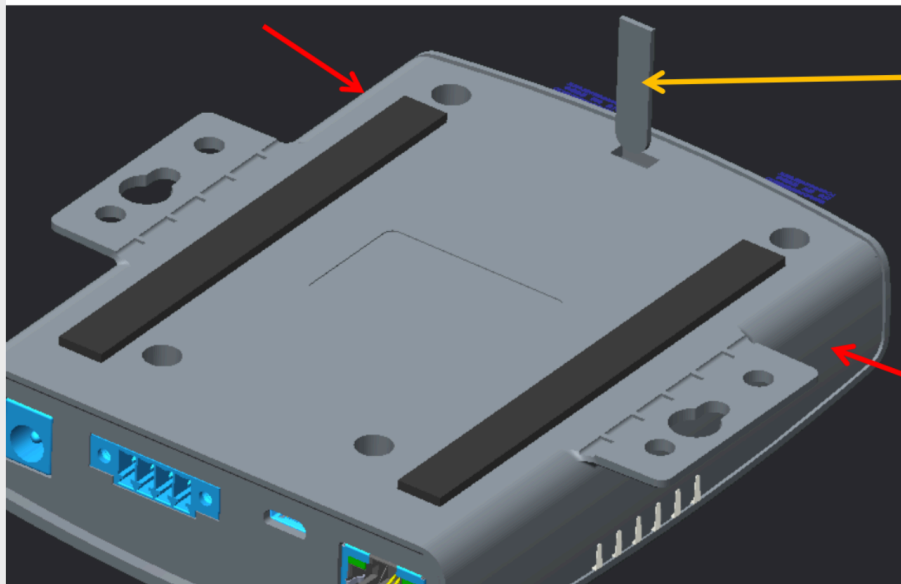
Cat. 1 : Quectel EC21-E/EU, Telit LE910C1-NF

Cat. 4 : Quectel EC25

2.1.3 Disassemble Your S100. Please follow the steps to disassembling the enclosure of S100:

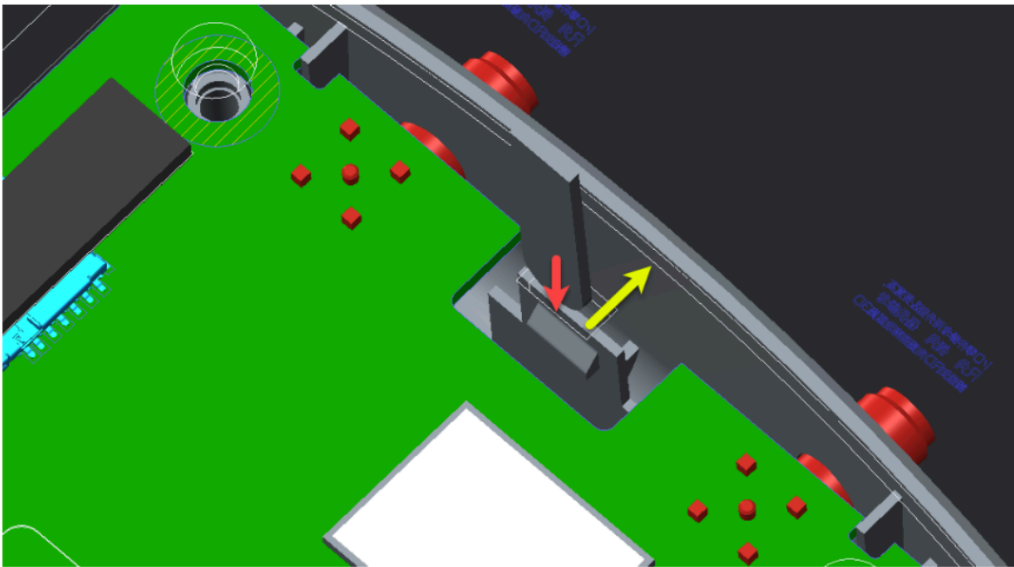


Step 1
Screw antennas and screws out.



Step 3
insert a flat stuff.

Step 2
Hold Bottom cover
(Hold position red arrow)



Step 4
When inserting (red arrow) ,
the hook will be pushed back(yellow arrow) .

Open the hook, continually insert and push the housing.
Top and bottom cover will be spilt.

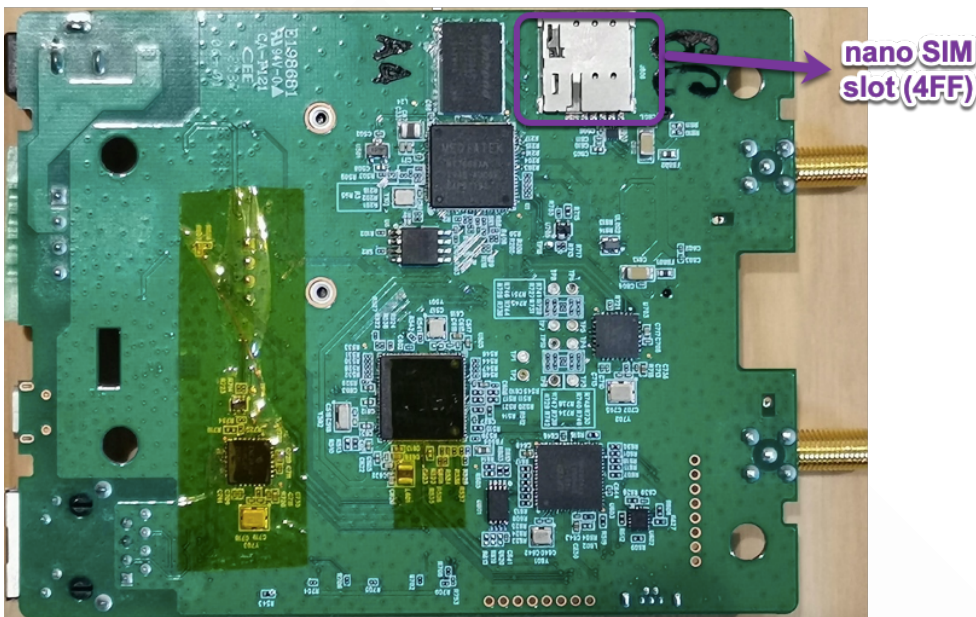
2.1.2 Insert your SIM card.

2.1.2.1 After disassembling, the SIM card slot is in the backside of the PCBA as showed below.

2.1.2.2 Insert the SIM card (4FF, nano SIM).

2.1.2.3 Power on, then check the LTE connection status by LED. Check the LTE connection, please refer to the LED table <Table 1>

<If APN setting is necessary, please refer to either way of (1) Chapter 3.2.2.19 or (2) Appendix A>



2.2 Preparation for Software Development Environment

2.2.1 Microsoft Installation Instructions. Detailed guidance is provided at:

<https://docs.microsoft.com/en-us/cli/azure/>

2.2.2 Verify Windows 10 Version

2.2.2.1 Before starting software installation, verify the version of Windows 10 Operating System meets requirements. In the Windows search box (**Windows key + R**), enter **winver** to check...

2.2.2.2 The version reported must be 1607 or later



2.2.3 Install Azure Sphere SDK

2.2.3.1 Download and unzip the latest Microsoft Azure Sphere SDK from: <https://reurl.cc/R6ljyx>

- Installing the SDK and setting up for development
- Claiming your device
- Configuring networking for app development
- Subscribing to notifications about Azure Sphere updates and services

Complete the Quickstart for each step, and then you'll be ready to run the tutorials, use the samples, and develop your own applications.

Next steps

[Install Windows SDK](#) or [Install Linux SDK](#)

2.2.3.2 Install this SDK on a Windows 10 computer, using the instructions located at: http://avnet.me/ms_sphere_docs

2.2.3.3 Once installed, launch the application and at the Azsphere command prompt, enter this command to confirm the Sphere SDK version: `azsphere show-version`. The version reported should be 19.02 or later

2.2.4 Claim your device

Detailed guidance is provided at: <https://reurl.cc/l0r0Z9>

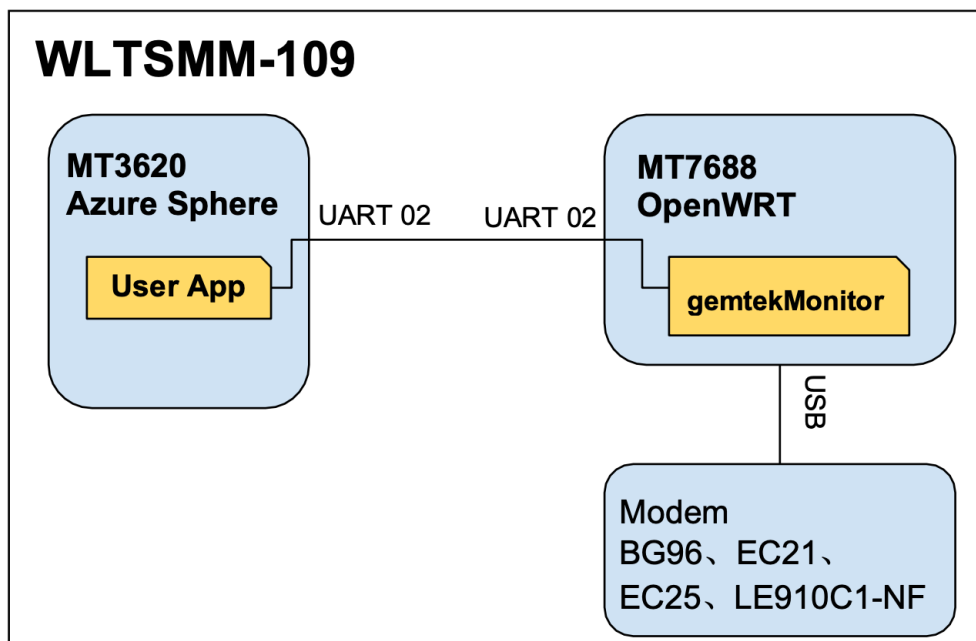
Every device must be "claimed" into an Azure Sphere tenant. Claiming the device associates its unique, immutable device ID with your Azure Sphere tenant. The Azure Sphere Security Service uses the device ID to identify and authenticate the device.

Chapter 3

Software Development Introduction

3.1 Introduction (MT3620/MT7688 AT-Command)

3.1.1 Block diagram



“User App” is an application program running on MT3620, which uses AT-command at chapter 3.2 to communicate with “gemtekMonitor”.

“gemtekMonitor” is a daemon running at MT7688, which handles AT commands from MT3620, and gives responses respectively. Please refer to chapter 3.2 to see the command details. When “gemtekMonitor” gets ready, it will send “+ROUTER_READY” to MT3620.

3.1.2 Serial Port Configuration for MT7688 UART 02

- Baud Rate: 115200
- Data bits: 8
- Parity Check: None
- Stop bit: 1
- Flow control: None

3.2 gemtekMonitor Commands

3.2.1 Command List

Command		Description
3.2.2.2	AT+VER	Get gemtekMonitor version.
3.2.2.3	AT+MGMR	Get Modem version.
3.2.2.4	AT+MGETIMEI	Get modem IMEI.
3.2.2.5	AT+MGETIMSI	Get modem IMSI.
3.2.2.6	AT+MGETICCID	Get modem ICCID.
3.2.2.7	AT+MGETTIME	Get current time from modem.
3.2.2.8	AT+MSMSFORMAT	Set modem SMS format.
3.2.2.9	AT+MSMSLIST	List modem SMS.
3.2.2.10	AT+MSMSDEL	Delete modem SMS.
3.2.2.11	AT+MGPS_ENABLE	Turn on/off modem GPS.
3.2.2.12	AT+MGPS_LOC	Get modem GPS location.
3.2.2.13	AT+MFWD	Let user input be forwarded to Modem (aka BG96, EC21, LEC910C1-NF EC25..)
3.2.2.14	AT+ROUTER_LED	Set LED controlled by MT7688
3.2.2.15	AT+MGMI	Get modem manufacturer identification.
3.2.2.16	AT+MGMM	Get modem model.
3.2.2.17	AT+MBG96IOTOP	Set/Query Modem BG96 IoT OP Mode
3.2.2.18	AT+ROUTER_REBOOT	Restart MT7688.
3.2.2.19	AT+ROUTER_APN	Config modem APN
3.2.2.20	AT+OTA_APPVER	Get gemtekMonitor version number
3.2.2.21	AT+ROUTER_OTA	Update gemtekMonitor

3.2.2 Command Description

3.2.2.1 "+ROUTER_READY"

When gemtekMonitor is ready, it will send "+ROUTER_READY" and "+APP_VER:<VER>". Please send commands after receiving "+ROUTER_READY".

3.2.2.2 AT+VER

This command returns the version of gemtekMonitor daemon.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+VER?	+VER_WLTSMM-109_ROUTER:<VERSION> (BUILD DATE)
Test/Help		ERROR
Example	AT+VER? +VER_WLTSMM-109_ROUTER:V0.90 (Oct 16th 2020 08:27:26)	

3.2.2.3 AT+MGMR

This command requests the version of modem by issuing "AT+GMR".

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGMR?	<REVISION>
Test/Help		ERROR
Example	AT+MGMR? EC25AFXGAR07A02M1G OK	

3.2.2.4 AT+MGETIMEI

This command requests the IMEI by issuing “AT+GSN”.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGETIMEI?	<IMEI>
Test/Help		ERROR
Example	AT+MGETIMEI? 864431045403906 OK	

3.2.2.5 AT+MGETIMSI

This command requests the IMSI by issuing “AT+CIMI”.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGETIMSI?	<IMSI>
Test/Help		ERROR
Example	AT+MGETIMSI? 466011300041140 OK	

3.2.2.6 AT+MGETICCID

This command requests the ICCID by issuing “AT+ICCID”.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR

Read	AT+MGETICCID?	+ICCID: <ICCID>
Test/Help		ERROR
Example	AT+MGETICCID? +ICCID: 89886013157800349895 OK	

3.2.2.7 AT+MGETTIME

Get current time from modem by issuing "AT+CCLK".

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGETTIME?	+CCLK:<Time> OK
Test/Help		ERROR
Example	AT+MGETTIME? +CCLK: "80/01/06,00:01:46+32" OK	

3.2.2.8 AT+MSMSFORMAT

This command set the modem SMS format. When establishing network connection, this setting will be cleared while OpenWRT resetting modem, please set SMS format after network connection is ready.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MSMSFORMAT=<Flag>	AT+MSMSFORMAT=<Flag> OK
Read	AT+MSMSFORMAT?	+MSMSFORMAT:<Flag> OK

Test/Help		ERROR
Example	AT+MSMSFORMAT? +CMGF: 0 OK	

3.2.2.9 AT+MSMSLIST

This command lists modem SM.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MSMSLIST=<stat>	AT+MSMSLIST=<stat> +CMGL: <SMS List> OK <i>Note: This command passes the <stat> parameter to modem, please refer to section "AT+CMGL List Messages" of "Quectel_BG96_AT_Commands_Manual" for details.</i>
Read		ERROR
Test/Help		ERROR
Example	AT+MSMSFORMAT? +CMGF: 1 OK AT+MSMSLIST="all" +CMGL: 0,"REC READ","0911111111",,"20/11/19,14:01:55+32" Test 11 +CMGL: 1,"REC READ","0911111111",,"20/11/19,14:02:03+32" Test 12 OK	

3.2.2.10 AT+MSMSDEL

This command deletes modem SMS.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MSMSDEL=<index>[,<del flag>]	AT+MSMSDEL=<index>[,<delflag>] OK <i>Note: This command passes <index>, <delflag> parameter to modem, please refer to section "AT+CMGD Delete Messages" of "Quectel_BG96_AT_Commands_Manual" for details.</i>
Read		ERROR
Test/Help		ERROR
Example	AT+MSMSDEL=1 OK	

3.2.2.11 AT+MGPS_ENABLE

This command turns on / off the modem GPS.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MGPS_ENABLE=<Flag>	AT+MGPS_ENABLE=<Flag> OK <Flag> 1 : GPS enable 0 : GPS disable
Read	AT+MGPS_ENABLE?	+MGPS_ENABLE:<Flag> OK
Test/Help		ERROR
Example	AT+MGPS_ENABLE? +MGPS_ENABLE: 0	

	OK
--	----

3.2.2.12 AT+MGPS_LOC

This command requests current GPS location.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGPS_LOC?	<GPS Location> OK +MGPS_LOC:NOT_FIXED OK <i>Note:Not fixed now.</i>
Test/Help		ERROR
Example	AT+MGPS_LOC? +MGPS_LOC: 034202.000,2452.3030,N,12100.5549,E,2.0,69.4,3,0.0,0.0,0.0,030321,04 OK AT+MGPS_LOC? +MGPS_LOC:NOT_FIXED OK	

3.2.2.13 AT+MFWD

Let user input be forwarded to Modem (aka BG96, EC21-E/EU, EC25, LE910C1-NF etc.)

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MFWD=<Flag>	+MFWD=<Flag> OK
Read	AT+MFWD?	+MFWD:<Flag> OK

Test/Help		+MFWD=<Flag> Flag : 1 for ON, 0 for <u>OFF</u>
Example	AT+MFWD? +MFWD:0 OK AT+MFWD=1 OK AT+MFWD=0 OK	

3.2.2.14 AT+ROUTER_LED

Set the LED controlled by Router (ake MT7688)

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MODEM_LED=<Mode>,<Bit Mask>	OK
Read	AT+MODEM_LED?	+MODEM_LED:<Mode>,<Bit Mask> OK
Test/Help		+MODEM_LED=<Mode>,<Bit Mask> <Mode> 1 : controlled by Modem Status (default setting) <i>#Note: Please refer to Chapter 5 LED behavior.</i> 0: controlled by Bit Mask <Bit Mask> Bit 0 : LED 1, 1 for ON, 0 for <u>OFF</u> Bit 1 : LED 2, 1 for ON, 0 for <u>OFF</u> Bit 2 : LED 3, 1 for ON, 0 for <u>OFF</u>

3.2.2.15 AT+MGMI

This command requests the manufacturer identification of modem by issuing “AT+GMI”.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGMI?	<Manufacturer Identification> OK
Test/Help		ERROR
Example	AT+MGMI? Telit OK	

3.2.2.16 AT+MGMM

This command requests the model of modem by issuing “AT+GMM”.

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+MGMM?	<Model> OK
Test/Help		ERROR
Example	AT+MGMM? +MODEM_MODEL:LE910C1-NF OK	

3.2.2.17 AT+MBG96IOTOP

Set / Query the modem BG96 IoT OP mode by issuing **AT+QCFG="IOTOPMODE"**.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+MBG96IOTOP=<Mode>	+MBG96IOTOP=<Mode> <Mode> 0 : LTE Cat M1 1 : LTE Cat NB1 OK
Read	AT+MBG96IOTOP?	+QCFG: "iotopmode",<Mode> 0 : LTE Cat M1 1 : LTE Cat NB1 2 : LTE Cat M1 or Cat NB1 OK
Test/Help		ERROR
Example	AT+MBG96IOTOP? +QCFG: "iotopmode",0 OK	

3.2.2.18 AT+ROUTER_REBOOT

This command requests MT7688 to reboot.

Type	Syntax	Response/Action
Action	AT+ROUTER_REBOOT	<after reboot> +ROUTER_READY
Set		ERROR
Read		ERROR
Test/Help		ERROR
Example	AT+ROUTER_REBOOT <after reboot> +ROUTER_READY	

3.2.2.19 AT+ROUTER_APN

This command sets the APN config of OpenWRT.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+ROUTER_APN=<APN>	AT+ROUTER_APN=<APN> +ROUTER_APN_SET: <APN> OK
Read	AT+ROUTER_APN?	+ROUTER_APN:<APN> OK
Test/Help		ERROR
Example	AT+ROUTER_APN? +ROUTER_APN: 'internet' OK AT+ROUTER_APN='internet.iot' +ROUTER_APN_SET: 'internet.iot' OK	

3.2.2.20 AT+OTA_APPVER

This command returns the **version number** of gemtekMonitor daemon.Ⓜ

Type	Syntax	Response/Action
Action		ERROR
Set		ERROR
Read	AT+OTA_APPVER?	+APP_VER:<Version Number>
Test/Help		ERROR
Example	AT+OTA_APPVER? +APP_VER:0.0.1 OK	

3.2.2.21 AT+ROUTER_OTA

Download new gemtekMonitor and restart it.

Type	Syntax	Response/Action
Action		ERROR
Set	AT+ROUTER_OTA=<URL>, [<Append IMEI>]	AT+ROUTER_OTA=<URL>, [<Append IMEI>] If OTA succeeded +OTA_RESULT: OK If OTA failed +OTA_RESULT: FAIL OK <URL> : URL to download OTA file. <Append IMEI> 1: Append IMEI to the URL. (<i>default setting</i>) 0: Do nothing to the URL.
Read	AT+ROUTER_OTA?	+ROUTER_OTA:<IMEI>,<ICCID>,<Model>,<SIM Type>,<Version> OK <IMEI> : Modem IMEI <ICCID> : SIM card ICCID <Model> : Modem model name <SIM Type> 1: LTE Cat 1 2: LTE Cat M1 3: NB-IoT 4: LTE Cat M1 or NB-IoT <Version> : version number of gemtekMonitor
Test/Help		ERROR
Example	AT+ROUTER_OTA? +ROUTER_OTA_INFO:357541090188246,89860000502000180722,LE910C1-NF,1,0.0.1 OK	

3.3 WLTSMM-109 Hardware

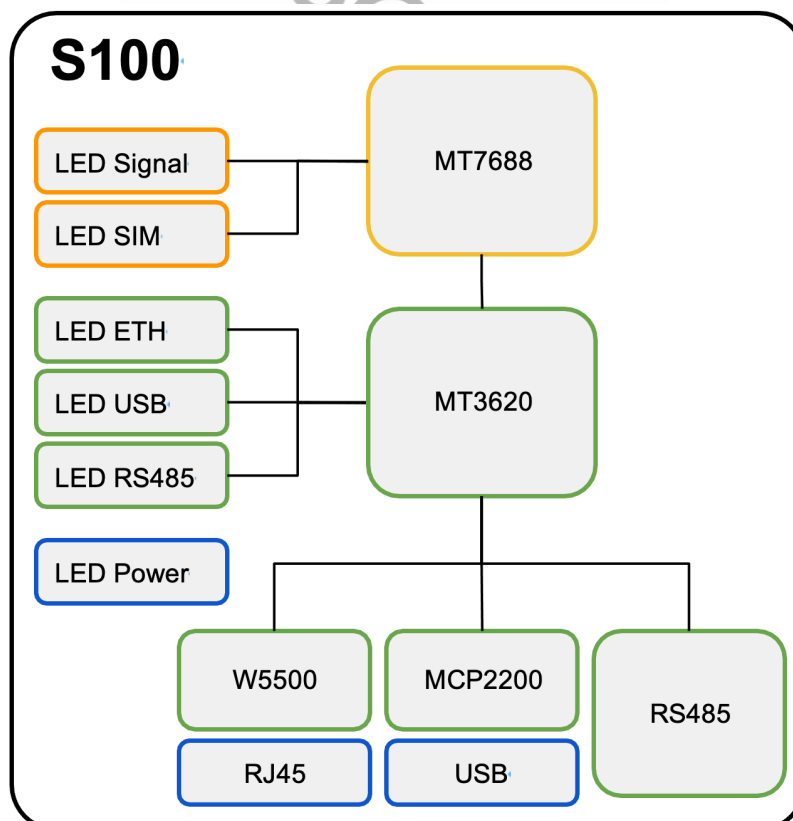
3.3.1 Hardware Version



WLTSMM-109_V01

3.3.2 WLTSMM-109_V01

3.3.2.1 Block diagram



3.3.3.2 MT3620 Peripheral Usage

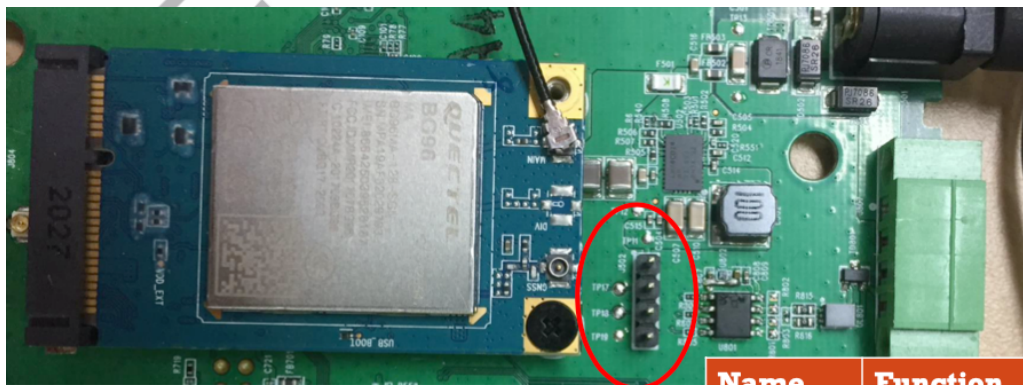
Name	MT3620 I/O	Type	Peripheral	Comment
LED	GPIO 41	Output	LED ETH	High : Turn off LED Low : Turn on LED
	GPIO 42	Output	LED USB	
	GPIO 43	Output	LED RS485	
ETH 1	ISU 0	SPI	ENC28J60	to MT7688 Ethernet
MCP2200	ISU 1	UART	USB connector	
Router	ISU 2	UART	MT7688 UART	
RS485	ISU 3	UART	to RS485	
	GPIO 59	Output	RS485 Data Direction	High : RS485 output enable Low : RS485 input enable
ETH 2 W5500	ISU 4	SPI, CSA	W5500 SPI	
	GPIO 8	Output	W5500 Reset	Low Active
	GPIO 10	Input	W5500 Interrupt	

Appendix A

S100 APN Modification Guide

1. H/W Connection
2. Teraterm config.
3. Modify config.
 - 3g.chat
 - Network config.

1. H/W Connection

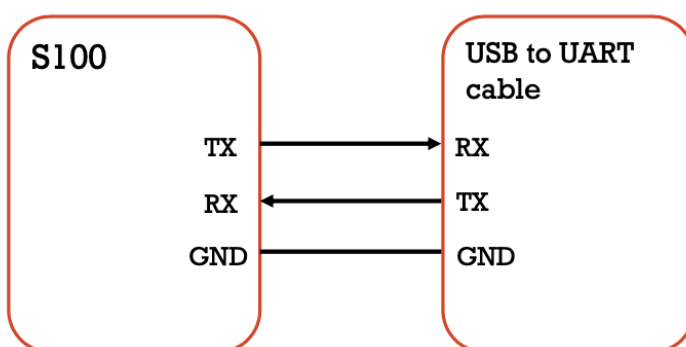


Name	Function
TP17	UART TX
TP18	UART RX
TP19	GND

UART Pin

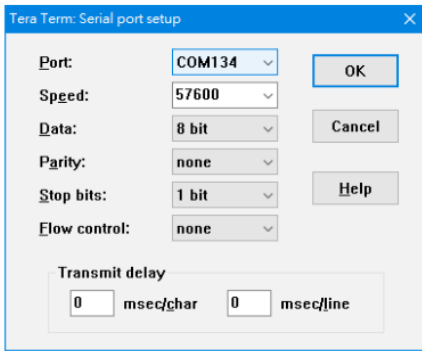
UART Connection

- Connect S100 TX to USB-UART RX
- Connect S100 RX to USB-UART TX



Teraterm config

- **Port config.**



Tera Term: Serial port setup

Port: COM134

Speed: 57600

Data: 8 bit

Parity: none

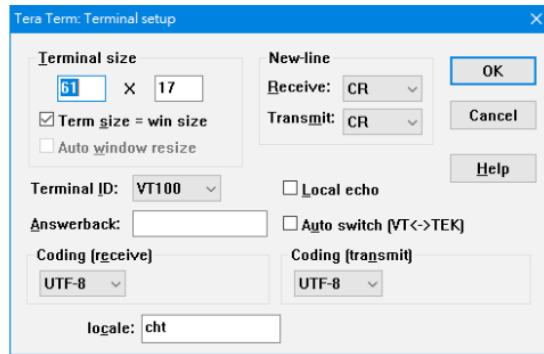
Stop bits: 1 bit

Flow control: none

Transmit delay: 0 msec/char, 0 msec/line

Buttons: OK, Cancel, Help

- **Terminal config.**



Tera Term: Terminal setup

Terminal size: 61 X 17

Receive: CR

Transmit: CR

Terminal ID: VT100

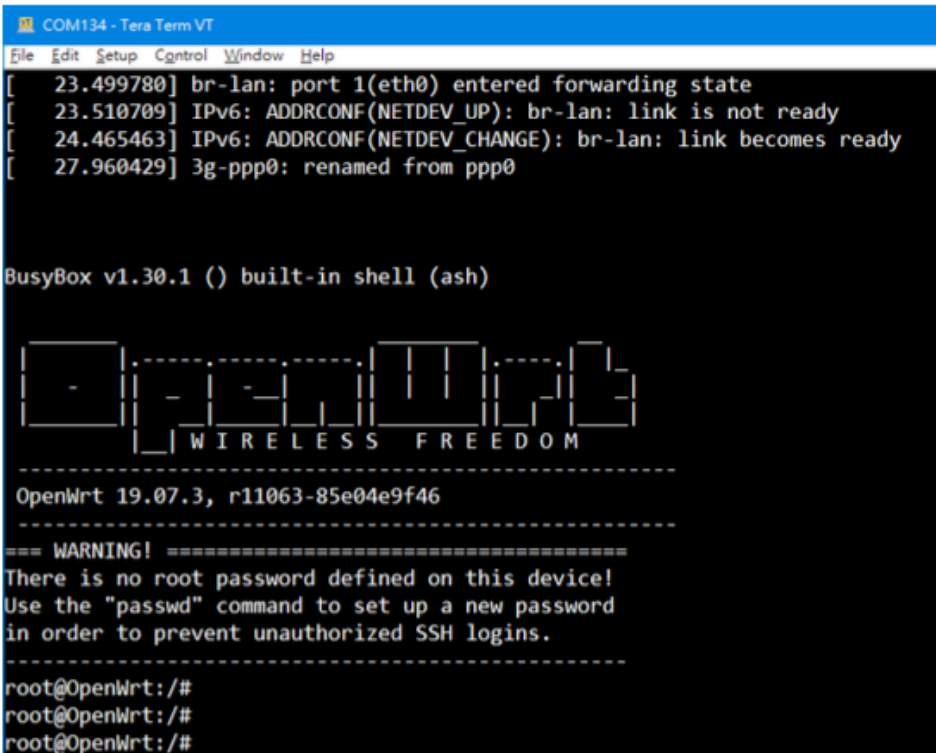
Coding (receive): UTF-8

Coding (transmit): UTF-8

logale: cht

Buttons: OK, Cancel, Help

- **OpenWRT prompt after keyin 'Enter'**



```
COM134 - Tera Term VT
File Edit Setup Control Window Help
[ 23.499780] br-lan: port 1(eth0) entered forwarding state
[ 23.510709] IPv6: ADDRCONF(NETDEV_UP): br-lan: link is not ready
[ 24.465463] IPv6: ADDRCONF(NETDEV_CHANGE): br-lan: link becomes ready
[ 27.960429] 3g-ppp0: renamed from ppp0

BusyBox v1.30.1 () built-in shell (ash)

      _ _ _ _ _
     | |_| | |_| |
     | |_| | |_| | WIRELESS FREEDOM
     |_| |_| |_| |_|

-----
OpenWrt 19.07.3, r11063-85e04e9f46
-----
=== WARNING! =====
There is no root password defined on this device!
Use the "passwd" command to set up a new password
in order to prevent unauthorized SSH logins.
-----
root@OpenWrt:/#
root@OpenWrt:/#
root@OpenWrt:/#
```

ENABLE APN CONFIG SCRIPT

- **Modify /etc/chatscripts/3g.chat**

- Remove '#' @ line 7

- From

- #OK 'AT+CGDCONT=1,"IP", "\$USE_APN"

- To

- OK 'AT+CGDCONT=1,"IP", "\$USE_APN"

Before

```
root@OpenWrt:/# cat /rom/etc/chatscripts/3g.chat
ABORT BUSY
ABORT 'NO CARRIER'
ABORT ERROR
REPORT CONNECT
TIMEOUT 10
"" "AT&F"
OK "ATE1"
#OK 'AT+CGDCONT=1, "IP", "$USE_APN'
SAY "Calling UMTS/GPRS"
TIMEOUT 30
OK "ATD$DIALNUMBER"
CONNECT ' '
```

After

```
root@OpenWrt:/# cat /etc/chatscripts/3g.chat
ABORT BUSY
ABORT 'NO CARRIER'
ABORT ERROR
REPORT CONNECT
TIMEOUT 10
"" "AT&F"
OK "ATE1"
OK 'AT+CGDCONT=1, "IP", "$USE_APN'
SAY "Calling UMTS/GPRS"
TIMEOUT 30
OK "ATD$DIALNUMBER"
CONNECT ' '
```

SET OPERATION APN

- **Command to set APN**

```
root@OpenWrt:/# uci set network.ppp0.apn='<APN to be set>'
root@OpenWrt:/# uci commit
```

- **Command to check APN**

```
root@OpenWrt:/# uci show network.ppp0.apn
network.ppp0.apn='< APN to be set >'
```