MultiConnect® Cell

MTC-LAT1 User Guide

MultiConnect® Cell Series 100 User Guide

Model: MTC-LAT1

Part Number: S000648 1.0

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Warranty

To read the warranty statement for your product, visit www.multitech.com/warranty.go. For other warranty options, visit www.multitech.com/es.go.

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Product Overview

About the MultiConnect Cell Modem

MultiConnect® Cell 100 Series MTC-LAT1 cellular modems are ready-to-deploy, standalone LTE Category 3 modems that provide wireless communication. The MTC-LAT1 is a compact communications platform that provides cellular capabilities for fixed and mobile applications. It is intended for use in energy, utility, or industrial settings. The MTC-LAT1 is available with RS-232 and optional GPS connector, or as a USB to Cellular device.

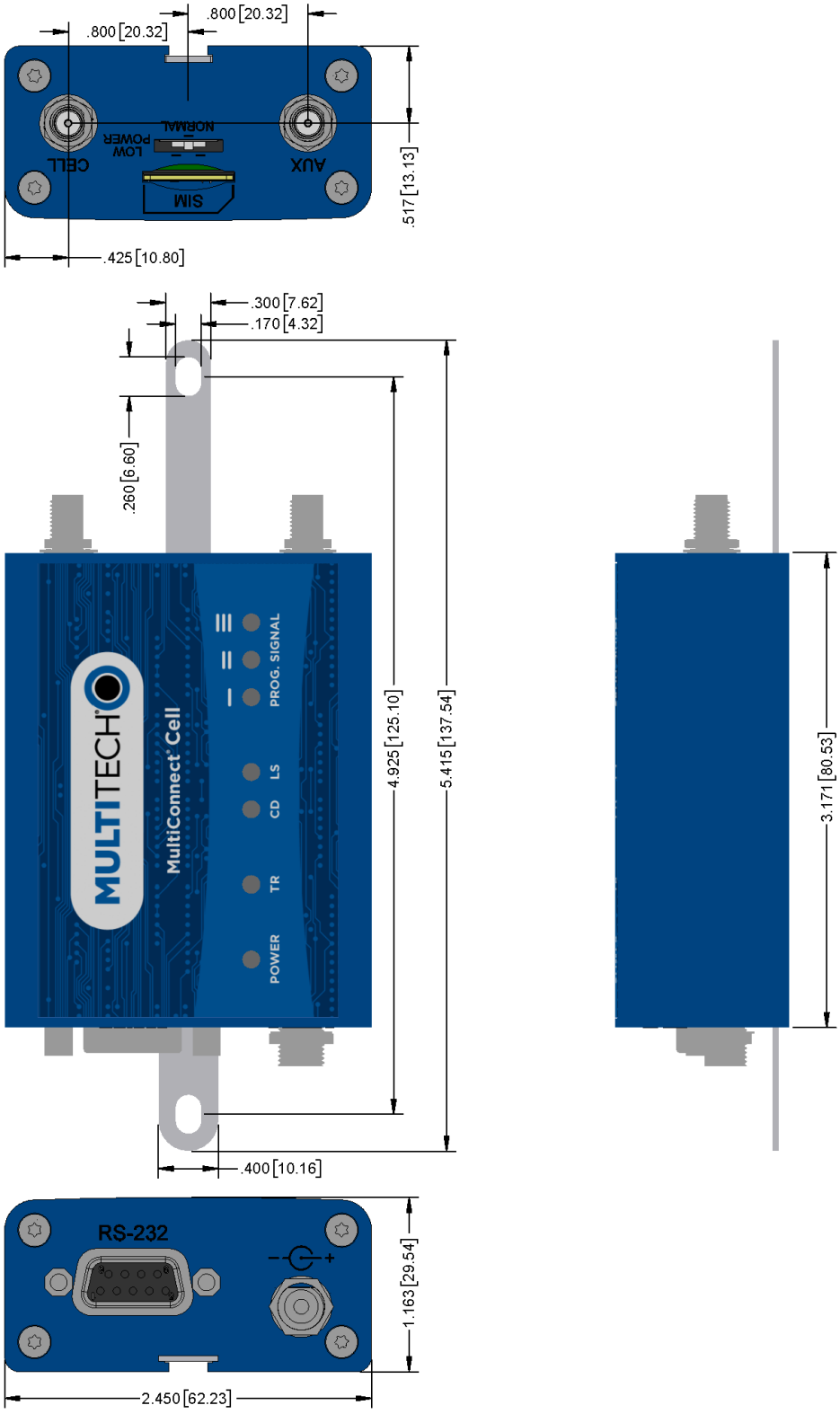
Documentation

The following documentation is available on the MultiTech Installation Resources website at www.multitech.com/setup.product.go.

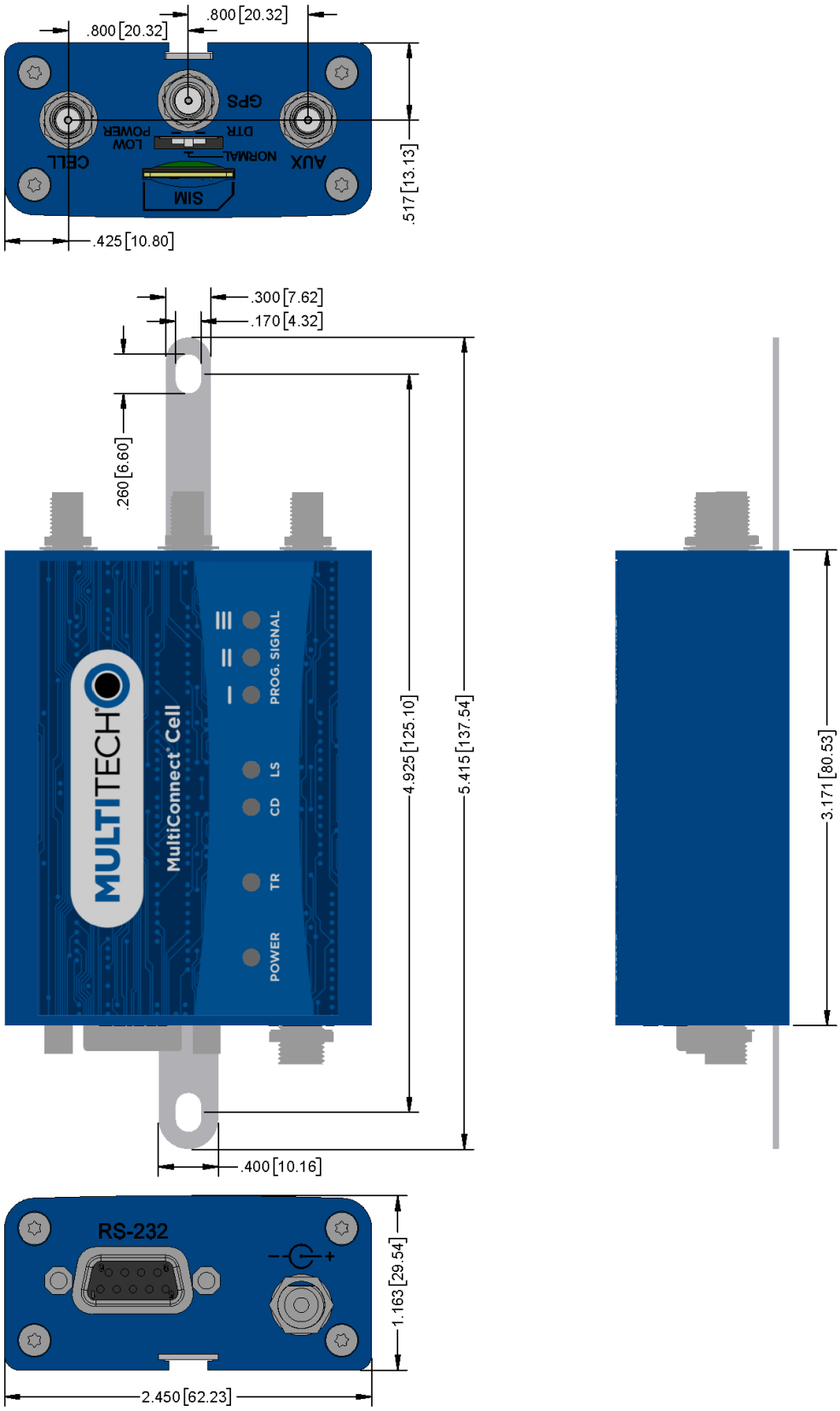
Document	Description
MultiConnect Cell User Guide	This document. Provides an overview, safety and regulatory information, schematics, and general device information.
LTE AT Commands Reference Guide	You can configure the device using the LTE AT Commands. These commands are documented in the Reference Guide part number S000617.

Dimensions

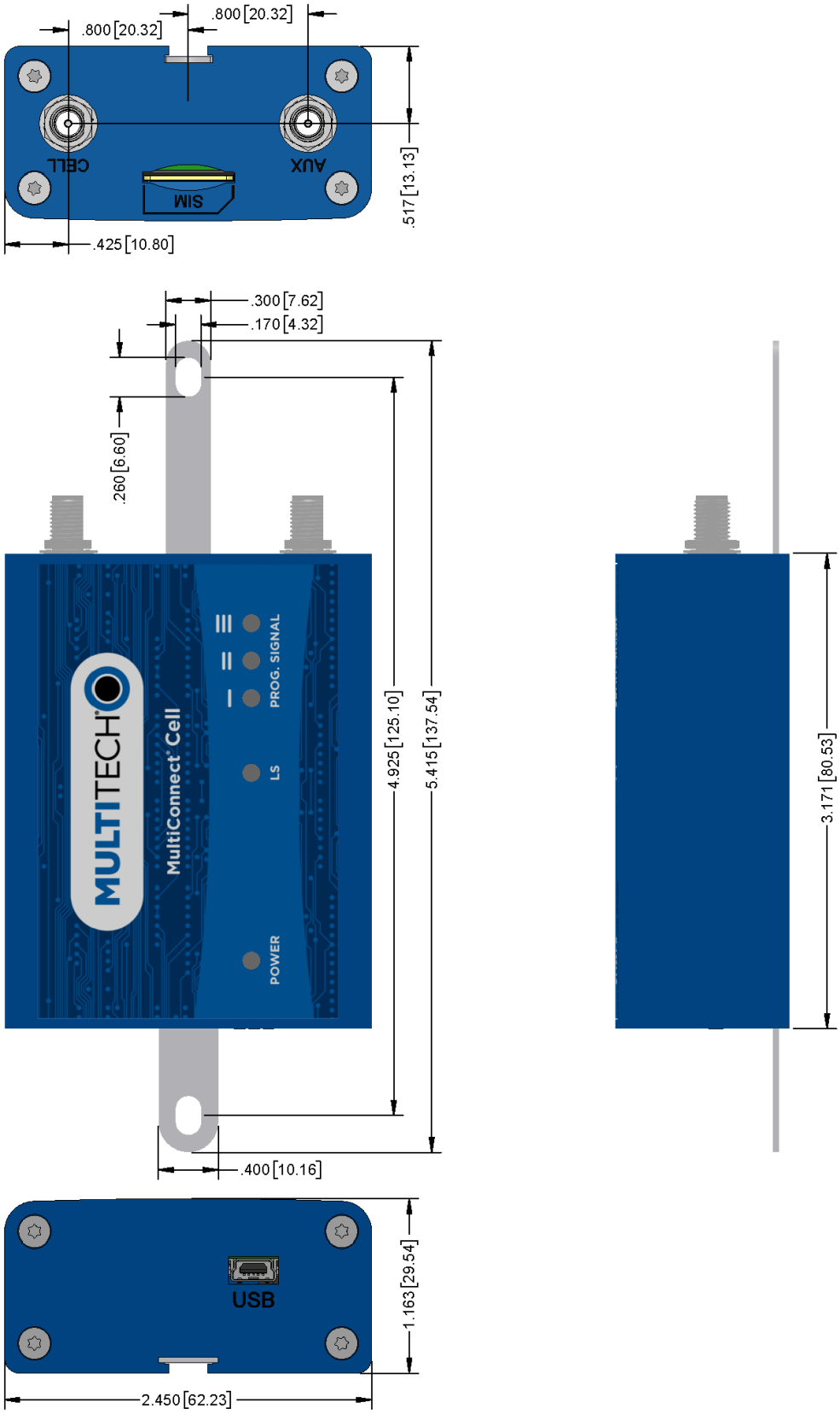
Serial



Serial with GPS



USB


.800 [20.32]
.800 [20.32]
.517 [13.13]
CELL
AUX
SIM
.425 [10.80]
.300 [7.62]
.170 [4.32]
.260 [6.60]
4.925 [125.10]
5.415 [137.54]
MULTITECH
MultiConnect® Cell
PROG. SIGNAL
LS
POWER
3.171 [80.53]
.400 [10.16]
USB
1.163 [29.54]
2.450 [62.23]

Descriptions of LEDs

The top panel contains the following LEDs:

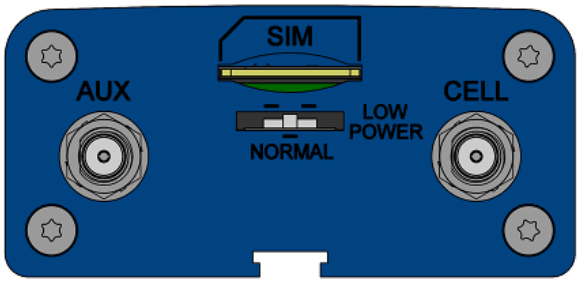
- Power and Terminal Ready LEDs—The Power LED indicates that DC power is present and the TR LED indicates when the unit is ready to receive data.
- Modem LEDs—Two modem LEDs indicate carrier detection and link status.
- Signal LEDs—Three signal LEDs display the signal strength level of the wireless connection.

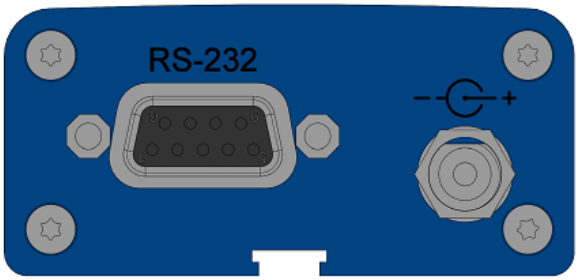
LED Indicators	
POWER	Indicates presence of DC power when lit.
TR	Terminal Ready. When lit, indicates connection to terminal emulation. When not lit, indicates no terminal is present. (for serial only)
CD	Carrier Detect. Indicates established data connection when lit. (for serial only)
LS	Link Status. ■ OFF — No power to the cellular radio ■ Continuously lit — SIM is not installed, or no signal is present ■ Slow blink — Powered and searching for a connection, or connected
PROG. SIGNAL	Signal strength. ■ ALL OFF — No power to the cellular radio ■ Bar 1 ON — Very weak signal (7 <= RSSI < 14) ■ Bars 1 and 2 ON — Weak signal (15 <= RSSI < 23) ■ Bars 1, 2, and 3 ON — Good signal (24 <= RSSI >= 31) **Note:** The three PROG. SIGNAL LEDs can be controlled as follows: ■ GPIO2: Controls the LED with a single bar above it ■ GPIO3: Controls the LED with two bars above it ■ GPIO4: Controls the LED with three bars above it For more information on using GPIO to control the LEDs, review the AT Command Guide.

Side Panels

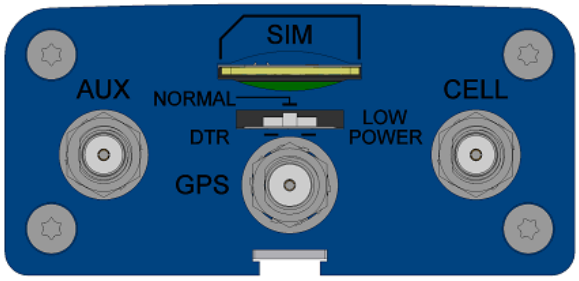
The device has connectors on either side. The figures that follow show the side panels.

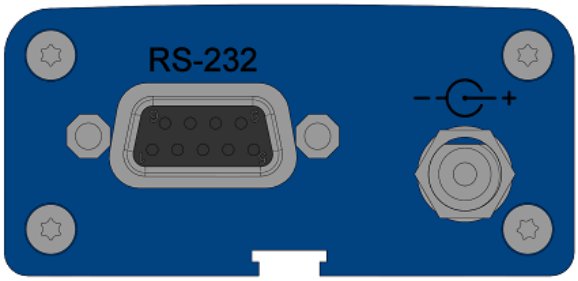
Serial



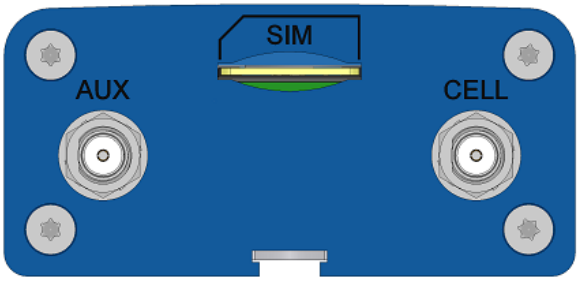


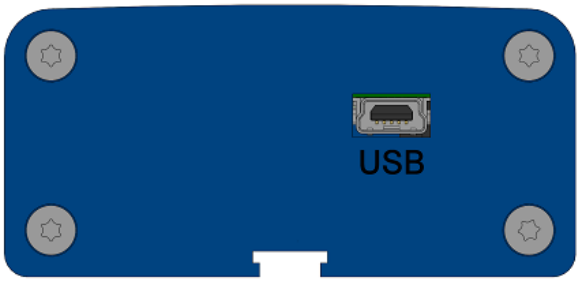
Serial with GPS





USB





Note: The power-saving switch—which appears with the NORMAL and LOW POWER labels—is included only on models that have a serial connector.

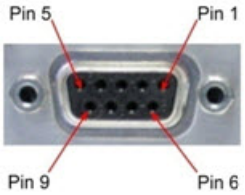
MTC-LAT1 Specifications

Category	Description
General	
Standards	LTE 3GPP Release 9
	HSPA+ 21/GPRS fallback
	USB interface is CDC-ACM compliant
TCP/IP Functions	FTP, SMTP, SSL, TCP, UDP
Frequency Bands	4G: 700 (B17)/850 (B5)/AWS 1700 (B4)/1900 (B2)
	3G: 850 (B5)/1900 (B2)
	2G: 850/1900
Speed	
Data Speed	LTE: 100 Mbps downlink/50 Mbps uplink
	HSPA+: 21 Mbps downlink/5.76 Mbps uplink
Interface	
USB Interface	USB 2.0 high speed compatible
UART Interface	RS-232 levels
Physical Description	
Weight	0.4 oz. (10 g)
Dimensions	Refer to mechanical drawing for dimensions.
Connectors	
Antenna Connectors	2 surface mount SMA connectors for cellular, Rx diversity/MIMO
	1 surface mount SMA connector for GPS (Available on the MTC-LAT1-B02 only)
SIM	1.8V and 3V SIM holder for mini-SIM card
Environment	
Operating Temperature	-40° C to +85° C
Storage Temperature	-40° C to +85° C
Humidity	20%-90% RH, non-condensing
Power Requirements	
Operating Voltage	3.1 V to 3.5 V, normal is 3.3 V
Input Voltage	3.3 - 5 VDC

Category	Description
SMS	

Category	Description
SMS	Point-to-Point messaging
	Mobile-Terminated SMS
	Mobile-Originated SMS
Certifications and Compliance	
EMC Compliance	FCC Part 15 Class B
Radio Compliance	FCC Part 22, 24, 27
Safety Compliance	UL 60950-1 2nd ED
	cUL 60950-1 2nd ED
	IEC 60950-1 2nd ED
Network Compliance	PTCRB
Carrier	AT&T

RS-232 9-Pin Female Connector



Pin	Abbreviation	Description	In/Out
1	CD	Carrier Detect	O
2	RX	Receive	O
3	TX	Transmit	I
4	DTR	Data Terminal Ready	I
5	GND	Ground	--
6	DSR	Data Set Ready	O
7	RTS	Request to Send	I
8	CTS	Clear to Send	O
9	RI	Ring Indicator	O

Power Measurements

Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

Note:

The following notes apply to the following tables.

- **Tx Pulse:** The average peak current during a GSM 850 transmission burst period or HSDPA connection. The transmission burst duration for GSM 850 can vary, depending on what transmission scheme is being deployed (GPRS Class 8, Class 10, GSM, etc.).
- **Maximum Power:** The continuous current during maximum data rate with the radio transmitter at maximum power.
- **Inrush Charge:** The input current during power up, or a reset.
- MultiTech Systems recommends a 10% buffer for the power source when determining product load.

Serial Model: MTC-LAT1-B01 Power Draw

Radio Protocol	Sleep mode current, connected to wireless (amps)	Sleep mode current, connected to live network, active SIM installed (amps)	Cellular call box connection, no data (amps)	Average measured current (amps) at maximum power	Average TX pulse amplitude current (amps)	Total inrush charge, in millicoulombs (mC)	Total inrush charge duration during power-up (ms)
9 Volts							
GSM 850 MHz	.0.020	0.010	0.028	0.152	0.837	0.956	8.87
LTE 1900 MHz	0.009	0.010	0.029	0.277	0.348	0.956	8.87
12 Volts							
GSM 850 MHz	0.018	0.007	0.026	0.120	0.567	0.681	7.01
LTE 1900 MHz	0.007	0.007	0.029	0.222	0.296	0.681	7.01
24 Volts							
GSM 850 MHz	0.010	0.005	0.016	0.073	0.286	1.210	14.2
LTE 1900 MHz	0.004	0.004	0.016	0.129	0.196	1.210	14.2

Serial Model with GPS: MTSMC-LAT1-B02 Power Draw

Radio Protocol	Sleep mode current, connected to wireless (amps)	Sleep mode current, connected to live network, active SIM installed (amps)	Cellular call box connection, no data (amps)	Average measured current (amps) at maximum power	Average TX pulse amplitude current (amps)	Total inrush charge, in millicoulombs (mC)	Total inrush charge duration during power-up (ms)
9 Volts							
GSM 850 MHz	.0.019	0.010	0.024	0.151	0.837	0.850	9.46
LTE 1900 MHz	0.008	0.008	0.026	0.275	0.368	0.850	9.46
12 Volts							
GSM 850 MHz	0.017	0.007	0.023	0.120	0.600	0.750	7.62
LTE 1900 MHz	0.007	0.006	0.024	0.233	0.300	0.750	7.62
24 Volts							
GSM 850 MHz	0.010	0.006	0.015	0.070	0.309	1.260	15.1
LTE 1900 MHz	0.004	0.004	0.016	0.132	0.200	1.260	15.1

USB Model: MTC-LAT1-B03 Power Draw

Radio Protocol	Sleep mode current (amps)	Cellular connection idle, no data (Amps)	Average measured current (amps) at maximum power	Average TX pulse amplitude current (amps)	Total inrush charge in millicoulombs (mC)
5 Volts					
GSM 850 MHz	N/A	0.0231	0.231	1.08	1.37
HSDPA 1800 MHz	N/A	0.032	0.445	0.516	1.37
LTE	N/A	0.032	0.487	0.552	1.37

Safety Warnings

Radio Frequency (RF) Safety

Due to the possibility of radio frequency (RF) interference, it is important that you follow any special regulations regarding the use of radio equipment. Follow the safety advice given below.

- Operating your device close to other electronic equipment may cause interference if the equipment is inadequately protected. Observe any warning signs and manufacturers' recommendations.
- Different industries and businesses restrict the use of cellular devices. Respect restrictions on the use of radio equipment in fuel depots, chemical plants, or where blasting operations are in process. Follow restrictions for any environment where you operate the device.
- Do not place the antenna outdoors.
- Switch OFF your wireless device when in an aircraft. Using portable electronic devices in an aircraft may endanger aircraft operation, disrupt the cellular network, and is illegal. Failing to observe this restriction may lead to suspension or denial of cellular services to the offender, legal action, or both.
- Switch OFF your wireless device when around gasoline or diesel-fuel pumps and before filling your vehicle with fuel.
- Switch OFF your wireless device in hospitals and any other place where medical equipment may be in use.

Interference with Pacemakers and Other Medical Devices

Potential interference

Radio frequency energy (RF) from cellular devices can interact with some electronic devices. This is electromagnetic interference (EMI). The FDA helped develop a detailed test method to measure EMI of implanted cardiac pacemakers and defibrillators from cellular devices. This test method is part of the Association for the Advancement of Medical Instrumentation (AAMI) standard. This standard allows manufacturers to ensure that cardiac pacemakers and defibrillators are safe from cellular device EMI.

The FDA continues to monitor cellular devices for interactions with other medical devices. If harmful interference occurs, the FDA will assess the interference and work to resolve the problem.

Precautions for pacemaker wearers

If EMI occurs, it could affect a pacemaker in one of three ways:

- Stop the pacemaker from delivering the stimulating pulses that regulate the heart's rhythm.
- Cause the pacemaker to deliver the pulses irregularly.
- Cause the pacemaker to ignore the heart's own rhythm and deliver pulses at a fixed rate.

Based on current research, cellular devices do not pose a significant health problem for most pacemaker wearers. However, people with pacemakers may want to take simple precautions to be sure that their device doesn't cause a problem.

- Keep the device on the opposite side of the body from the pacemaker to add extra distance between the pacemaker and the device.
- Avoid placing a turned-on device next to the pacemaker (for example, don't carry the device in a shirt or jacket pocket directly over the pacemaker).

Antenna

The antenna intended for use with this unit meets the requirements for mobile operating configurations and for fixed mounted operations, as defined in 2.1091 and 1.1307 of the FCC rules for satisfying RF exposure compliance. If an alternate antenna is used, consult user documentation for required antenna specifications.

Installing and Using the Device

Installing the Device

1. Connect a suitable antenna to the antenna connector.
2. If you are using the serial version of this device:

   Connect the DB9 male connector (9-pin) of the RS-232 cable to the RS-232 connector on the device, then connect the other end to the serial port on the other desired device.

   Screw-on the power lead from the power supply module into the power connection on the device.

   Plug the power supply into your power source.
3. If you are using the USB version of this device:

   For information about the USB cable that helps power your device, see the section "USB Cable Recommendations."

   The USB cable uses power from the USB power line. Connect one end of the USB cable to your computer or other USB high power device, such as a hub.

   Connect the other end to the device's USB connector.
4. The POWER LED lights after the device powers up.

Placing Serial Devices in Power Save Mode

You can place devices that have a serial connector in low power mode. When the device is in low power mode—which is also sometimes called sleep mode or power save mode—the device's radio is operating with little power. A power save switch on the device determines if the device's radio can operate in normal or low power mode.

You might want your device to go into low power mode if batteries are used to power the device. For example, you might want to use your device outdoors, and have it powered by a solar charged battery. By using low power, you can save time and money by not having to replace batteries on devices operating in the field.

You can use many techniques to place the device into low power (sleep) mode. This example uses data terminal ready (DTR) and the AT command +CFUN=5. For other techniques, review the AT command guide for your device, as described in the Documentation topic in this guide.

You can make the device "wake up" from sleep mode by using the wake-on-ring feature: In the example that follows, the ring indicator line wakes the host processor when the radio receives an incoming call or SMS message. Your application then needs to act on the ring indication and wake up the device by asserting DTR.

Using Low Power Mode

To set up the device so it can be placed into low power mode:

1. Set the power-save switch to LOW.
2. On the RS-232 interface, ensure your application controls DTR and makes it active (on). To configure the device for DTR control, issue either AT&D1 or AT&D2 for DTR control. The &D0 command does not allow low power to operate.
3. To configure the device to enter low power (sleep) mode, issue AT+CFUN=5 to the radio.
4. To configure the device to wake from low power mode by using the wake-on-ring feature, issue AT#E2SMSRI=1000. This configures the ring indicator to go active for 1000 ms when an SMS message is received.

5. To have the device enter sleep mode, set DTR to inactive (off) on the RS-232 interface. The clear to send (CTS) signal is off when the device is in sleep mode.

USB Cable Recommendations

If your device has a USB connector, to avoid enumeration or power issues:

- Use a high speed USB cable that is as short as possible.
- Use a well shielded cable with at least 24 AWG wire pair for power/ground and 28 AWG wire pair for data lines.
- If possible, use a USB port that connects directly to the motherboard rather than a USB port with added cabling inside the computer chassis.
- Use USB 3.0 ports if available. These ports are typically rated for more current.
- You can order the USB cable through MultiTech. The part number is CA-USB-A-MINI-B-3

Powering Down Your Device

CAUTION: Failing to properly shutdown the device before removing power may corrupt your device's file system.

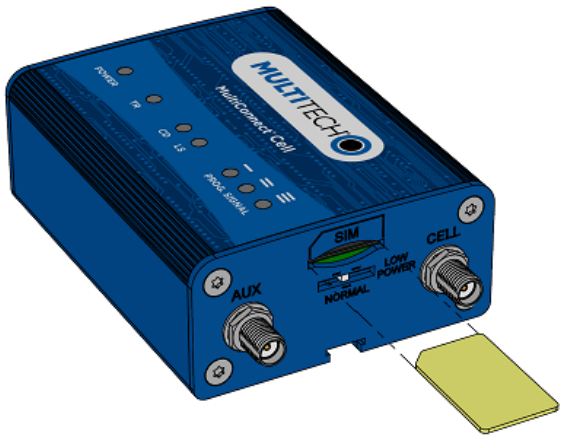
To properly power down your device, use the following sequence :

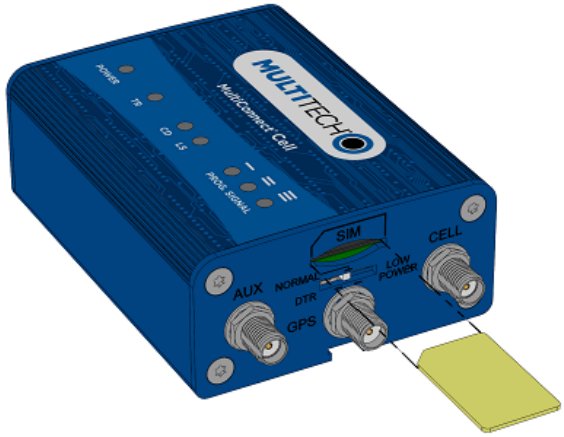
1. Issue the AT#SHDN command.
2. Wait 30 seconds.
3. Power off or disconnect power.

Installing a SIM Card

This model requires a SIM card, which is supplied by your service provider. To install the SIM card:

1. Locate the SIM card slot on the side of the modem. The slot is labeled SIM.
2. Slide the SIM card into the SIM card slot with the contact side facing down as shown. When the SIM card is installed, it locks into place.





Removing a SIM Card

To remove the SIM card, push the SIM card in. It ejects itself from the device.

Mounting Device to Flat Surface

1. Locate the groove on the bottom of the device.
2. Slide the mounting rod through the groove.
3. To secure the rod to the desired surface, place and tighten two screws in the holes on either end of the mounting rod. The dimensions illustration in this guide shows the mounting rod, as well as the dimensions for placement of the screws.

LTE Antenna Diversity

Antenna diversity uses two receive antennas to improve the downlink connection (cell tower to mobile). It has no effect on the uplink (mobile to cell tower).

Antenna diversity is useful in environments where the signal arrives at the device after bouncing off or around buildings or other objects. The bounced signal may be attenuated by going through semi-transparent (to the signal) objects. Each signal alteration can change its magnitude, phase, orientation, or polarization. This complex environment can exist in cities, inside buildings or in traffic. In this environment, signal paths from the cell tower form an interference pattern of peaks and nulls. These peaks and nulls can be very close together.

Antenna diversity provides an advantage in complex environments because if one receive antenna has a poor signal due to an interference null pattern, the other antenna is likely not in the null and has better reception. The radio compares the reception from both receive antennas and uses the one with the strongest signal.

Important: You must deploy with two antennas, unless your carrier has authorized you to deploy with one antenna.

Selecting Antennas

Select an antenna based on your product and application. Typically, both antennas are the same and either can be the main receive antenna.

Placing External Antennas

Antennas are usually a quarter wavelength apart from each other. With multiband radios where the quarter wavelengths in each band are diverse from each other, this rule may not be practical. Choose spacing based on the band used most often or the band with connection difficulty. Some environments are harsher on particular bands. MultiTech products have antenna connectors at the best spacing for the product size.

Placing antennas in close proximity to each other is not optimal, but you can do it if necessary. It depends on the signal strength to and from each antenna.

If the antennas are too close together for your application, use a similar antenna on a short cable for the second receive only antenna.

Placing GPS Antennas

GPS antennas need a clear view of the sky. Position the GPS antenna so the diversity antennas do not block its view of the sky.

Antenna Approvals and Safety Considerations

Note the following:

- PTCRB and the carriers conduct antenna diversity tests.
- There are no EMC concerns about antenna diversity.
- All antennas need to have a minimum flammability rating.
- Safety requirements depend on your final product.
- Unless otherwise noted, antennas certified by MultiTech are not approved for outdoor use. Do not extend these antennas outside of any building.

Diversity and Power Draw

There are no significant power draw differences.

Antenna and Activation Information

Antenna

The antenna intended for use with this unit meets the requirements for mobile operating configurations and for fixed mounted operations, as defined in 2.1091 and 1.1307 of the FCC rules for satisfying RF exposure compliance. If an alternate antenna is used, consult user documentation for required antenna specifications.

Antenna System Cellular Devices

The cellular/wireless performance depends on the implementation and antenna design. The integration of the antenna system into the product is a critical part of the design process; therefore, it is essential to consider it early so the performance is not compromised. If changes are made to the device's certified antenna system, then recertification will be required by specific network carriers.

LTE Antenna Included with This Device

The cellular radio portion of the device is approved with the following antenna or for alternate antennas meeting the given specifications.

Manufacturer:	EAD Ltd.
Description:	LTE Antenna with SMA-Male Connector
Model Number:	WTR7270
MultiTech Part Number:	45009760L

MultiTech ordering information:

Model	Quantity
ANLTE3-2HRA	2
ANLTE3-10HRA	10
ANLTE3-50HRA	50

Antenna Specifications

Category	Description
Frequency Range	690-960 MHz
	1710-2700 MHz
Power Rating	10W
VSWR	< 2.0:1
Gain	1 dBi
Radiating Element	1/2 wave element
Polarization	Linear

GPS Antenna Specifications

Category	Description
Frequency Range	1575.24 MHz
Impedance	50 Ohms
VSWR	2.0:1 max
Gain	10-30 dBi
LNA Current Consumption	40 mA max
Noise Figure	< 2dB
Polarization	RHCP
Input voltage	3.0V ± 0.2V

Account Activation for Cellular Devices

Some MultiTech devices are pre-configured to operate on a specific cellular network. To use the device, you must set up a cellular data account with your service provider. Each service provider has its own process for adding devices to their network. To find activation steps for your device:

1. Go to **http://www.multitech.com/support**.
2. Select your device.
3. Scroll to **Activation** and click **Download**.

Device Phone Number

Every device has a unique phone number. Your service provider supplies a phone number when you activate your account. Wireless service provider implementation may vary. Consult with your service provider to get the phone number for your device.

Device Driver Installation

Installing on Linux

The Linux OS includes a generic USB driver for modems supporting CDC/ACM.

To install the device on Linux Kernel 2.6.x and newer with CDC/ACM support, connect USB cable from the device to a USB port on your computer. For most recent Linux distributions, there are no drivers to install.

Beginning with Linux Kernel 3.18, an LTE driver named option was included in Linux. If using an older version of Linux, build an updated option driver.

If the operating system recognizes the modem, seven devices are created (assuming no other ACM values have been assigned):

- /dev/ttyACM0
- /dev/ttyACM1
- /dev/ttyACM2
- /dev/ttyACM3
- /dev/ttyACM4
- /dev/ttyACM5
- /dev/ttyACM6

Only the following devices can be used for AT commands:

- /dev/ttyACM0 (data port for PPP connections and AT commands)
- /dev/ttyACM3 (generic port for AT commands)

If the operating system recognizes the modem, devices named /dev/ttyUSBx are created, for example:

- /dev/ttyUSB0
- /dev/ttyUSB1
- /dev/ttyUSB2
- /dev/ttyUSB3
- /dev/ttyUSB4

Only the following devices can be used for AT commands:

- /dev/ttyUSB2 (data port for PPP connections and AT commands)
- /dev/ttyUSB3 (generic port for AT commands)

Troubleshooting Linux

If Linux does not create devices, check for the kernel module:

```
# lsmod | grep option
```

If entries aren't found, load the kernel module with root privileges:

```
# modprobe option
```

Check dmesg output to see that the radio was detected:

```
# dmesg | grep option

usbcore: registered new interface driver option
option 1-2.3:1.0: GSM modem (1-port) converter detected
option 1-2.3:1.2: GSM modem (1-port) converter detected
option 1-2.3:1.3: GSM modem (1-port) converter detected
option 1-2.3:1.4: GSM modem (1-port) converter detected
option 1-2.3:1.5: GSM modem (1-port) converter detected
option 1-2.3:1.6: GSM modem (1-port) converter detected
```

If this returns an error response, the kernel module is not on your system. You will need to build the driver.

Building a Linux Driver

If using the device with the Linux operating system:

1. Download latest stable kernel. Check http://www.kernel.org for the latest stable kernel. In the terminal window, enter the following:
   a. **sudo su** and then the password to put it into root mode.
   b. **cd /usr/src**
   c. **wget https://www.kernel.org/pub/linux/kernel/v3.x/linux-x.x.x.tar.xz**, where X.X.X equals the version number for the latest stable kernel
2. Untar the kernel. To do this, enter: **tar –xvJf linu-x.x.x.x.tar.xz**.
3. Edit option.c source file for the LE910 module:
   a. **gedit linux-x.x.x/drivers/usb/serial/option.c**
   b. Verify if the following #define statement exists:
      LE910 module: **#define TELIT_PRODUCT_LE910 0x1201**
   c. If the #define statement does not exist, add the statement.
   d. Add the following struct:

```
static const struct
        option_blacklist_info telit_le910_blacklist = {
.sendsetup = BIT(0),  .reserved = BIT(1) | BIT(2)
};
```

   e. Add the following line to **usb_device_id option_ids[]** structure:

```
{ USB_DEVICE(TELIT_VENDOR_ID,
        TELIT_PRODUCT_LE910),.driver_info =
        (kernel_ulong_t)&telit_le910_blacklist},
```

4. Edit qmi_wwan.c source file for the LE910 module:
   gedit linux-x.x.x/drivers/net/usb/qmi_wwan.c
5. Add the following line to u**sb_device_id products[]** structure:
   {QMI_FIXED_INTF(0x1bc7, 0x1201,2)], /*Telit LE910*/
6. Compile the drivers.
   a. **cd linux-x.x.x**

b. **make menuconfig**

If a menu window was not made. Install ncurses library.

- **apt-get install libncurses5**
- **apt-get install libncurses5-dev**

c. Go to **Device Drivers/USB Support/USB Serial Converter Support**.

To go to the menu configuration page, highlight your selection, highlight Select on the bottom of the page, and press Enter.

d. Choose **USB driver for GSM and CDMA modems** and press the **M** key to make as a module.

e. Go to **Device Drivers/Network Device Support/USB Network Adapters**.

f. Choose the appropriate driver and press **M**.

g. Exit out of the menus until prompted, **Do you wish to save your new configuration?** Select **Yes**.

To exit a menu, highlight Exit on the bottom of the page, and press Enter.

7. Start building the kernel. This process may take several hours.

a. **make**

b. **make modules**

c. **make modules_install**

8. Install the new kernel: **make install**
9. Reboot the system: **reboot**
10. Verify that the installed kernel version matches the version you downloaded: **uname –r**

Configuring and Communicating with Your Device

Interacting with Your Device Overview

This section describes how to use AT commands to interact with your device. Using terminal software such as Kermit, you can issue AT commands to communicate with and configure your modem. The AT commands let you establish, read and modify device parameters and help you control how the device operates. This section documents basic interactions with your device, such as verifying signal strength and network registrations, sending and reading SMS text messages, and sending and receiving data.

Generally, USB modems are used as unintelligent bit pipes. In Windows, this means you create a dial-up network connection that uses the Windows IP stack to use the modem to create a PPP connection to the cellular network. The modem is assigned an IP address from the cellular carrier. This connection provides Internet access and is the basis for TCP/IP communication for sending and receiving email, creating TCP/UDP Sockets, or putting and getting files from an FTP server.

In Linux, PPPD is used to dial the modem and create the connection to the cellular TCP/IP network. This provides Internet access for sending and receiving email, creating TCP/UDP Sockets, or putting and getting files from an FTP server.

Before You Begin

Before you begin:

- If you have not done so, install any drivers. Refer to the separate driver installation guide for your device.
- Power up your device and ensure it is connected to the computer that you use to issue AT commands.
- Install terminal software that can communicate with the device, such as HyperTerminal, Tera Term, Kermit, or Putty.

Using Command Mode and Online Data Mode

Modems have two operation modes, command and online data. When you power up the modem it is in command mode and ready to accept AT commands.

Use AT commands to communicate with and configure your modem. They allow you to establish, read, and modify device parameters and control how the modem works. The device can also generate responses to AT commands that help determine the modem's current state.

If the modem is in online data mode, it only accepts the Escape command (+++).

To send the modem AT Commands from terminal emulation software, set the software to match the modem's default data format, which is:

- Speed: 115,200 bps
- Data bits: 8
- Parity: none
- Stop bit: 1
- Flow control: hardware

To confirm you are communicating with the device:

- Type **AT** and press **Enter**.

If the device responds with OK, you are communicating with the device.

Verifying Signal Strength

To verify the device signal strength, enter:

AT+CSQ

The command indicates signal quality, in the form:

+CSQ: <rssi>,<ber>

Where:

<rssi>	Received signal strength indication.
0	(-113) dBm or less
1	(-111) dBm
2-30	(-109) dBm - (-53) dBm / 2 dBm per step
31	(-51) dBm or greater
99	Not known or not detectable
<ber>	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: Signal strength of 10 or higher is needed for successful packet data sessions.

Example

A example response to AT+CSQ:

+CSQ: 15,1

Checking Network Registration

Before establishing a packet data connection, verify the is device registered on the network. To do this enter the network registration report read command:

AT+CREG?

If the device returns:

+CREG: 0,1

or

+CREG: 0,5

The device is registered.

If the device returns:

+CREG: 0,2

The device is in a network searching state.

Sending and Receiving Data

Connecting Device to TCP Server as TCP Client

1. **Bring up Data Connection Using Internal IP stack**

   Enter:

   AT#SGACT=1,1

   The device responds with the IP Address the cellular provider assigned to the device on connection, followed by OK. For example:

   #SGACT: 25.194.185.116
   OK

2. **Create Client Connection to TCP Server on Port 500**

   Enter:

   AT#SD=1,0,500,"###.##.###.##" where ###.##.###.## is the TCP server IP Address.

   The device responds with OK. You can now send or receive data without entering additional commands.

Closing the Socket and the Connection

To close the socket:

- Enter the escape sequence:+++
- To close Socket 1, enter: AT#SH=1

The device responds with OK.

To close the data connection:

- Enter: AT#SGACT=1,0

The device responds with OK.

Configuring Device as UDP Listener to Accept UDP Client Connections

To configure the device as a UDP client:

1. **Check signal strength.**
   Enter:
   AT+CSQ
2. **Verify device is registered on the cellular network.**
   Enter:
   Should return:
   +CREG 0,1
   OK
3. **Configure socket parameters**
   Enter:
   AT#SCFG=1,1,300,240,600,50
4. **Activate context one**
   Enter:
   AT#SGACT=1,1
5. **Set firewall rule to accept connections:**
   AT#FRWL=1,"###.##.###.#","###.##.###.#" where ###.##.###.# represents the IP range. For example:
   AT#FRWL=1,"204.26.122.1","204.26.122.255"
6. **Set connection ID 1 for UDP listening mode on port 7000.**
   Enter:
   AT#SLUDP=1,1,7000
   The device responds with and unsolicited indication that a host is trying to connect to connection ID 1 on port 7000.
   SRING: 1
7. **Accept incoming connection ID 1**
   Enter:
   AT#SA=1
   The device indicates a client successfully established a listener connection.
   CONNECT
   You can send and receive data.

Exit Data Mode and Close Connection

To exit data mode and close the socket:

- Enter the escape sequence: +++
- To close Socket 1, enter: AT#SH=1

The device responds with OK.

- To close the data connection, enter:AT#SGACT=1,0

The device responds with OK.

Configuring Device as UDP Client to Connect to UDP Server

Configure and Connect the Device

To configure the device as a UDP client:

1. **Check signal strength.**
   Enter:
   AT+CSQ
2. **Verify device is registered on the cellular network.**
   Enter:
   Should return:
   +CREG: 0,1
   OK
3. **Configure socket parameters**
   Enter:
   AT#SCFG=1,1,300,240,600,50
4. **Activate context one**
   Enter:
   AT#SGACT=1,1
5. **Create UDP connection to Server port**
   Enter:
   AT#SD=1,1,####,"###.##.###.##" where #### is the server port and ###.##.###.## is the IP number.

The device responds with OK, which indicates a successful connection. You can send and receive data through the socket connection.

Exit Data Mode and Close Connection

To exit data mode and close the socket:

- Enter the escape sequence: +++
- To close Socket 1, enter: AT#SH=1

The device responds with OK.

- To close the data connection, enter:AT#SGACT=1,0

The device responds with OK.

Transferring FTP File to FTP Server

To connect to FTP server and upload files:

1. **Check signal strength.**
   Enter:
   AT+CSQ
2. **Activate context one**
   Enter:
   AT#SGACT=1,1

3. **Set FTP operations timeout to 10 seconds**
   Enter:
   AT#FTPTO=1000
4. **Configure FTP server IP address with username and password.**
   Enter:
   AT#FTPOPEN="###.##.###.#","username","password",0 where ###.##.###.# is the IP address and the username and password for the FTP server.
5. **Configure file transfer type.**
   Enter:
   AT#FTPTYPE=# where # is 0 for binary or 1 for ASCII.
6. **Enter the file name to be sent to the FTP server and initiate connection.**
   Enter:
   AT#FTPPUT="file.txt"
   The device responds with:
   CONNECT
7. Send the file through the device.

Closing the FTP Data Connection

When you finish sending the file:

1. **Enter the escape sequence.**
   Enter:
   +++
   The device responds with:
   NO CARRIER
2. **Close the FTP connection.**
   Enter:
   AT#FTPCLOSE
3. **Close the PPP data connection.**
   Enter:
   AT#SGACT=1,0
   The device responds with OK.

Downloading File from FTP Server

To connect to an FTP server and download files:

1. **Check signal strength.**
   Enter:
   AT+CSQ
2. **Activate context one**
   Enter:
   AT#SGACT=1,1
3. **Set FTP operations timeout to 10 seconds**

Enter:

AT#FTPTO=1000

4. **Configure FTP server IP address with username and password.**

   Enter:

   AT#FTPOPEN="###.##.###.#","username","password",0 where ###.##.###.# is the IP address and the username and password for the FTP server.

5. **Configure file transfer type.**

   Enter:

   AT#FTPTYPE=# where # is 0 for binary or 1 for ASCII.

6. **If required, change the working directory to "folder1".**

   Enter:

   AT#FTPCWD="folder1"

7. **Enter the file name.**

   Enter:

   AT#FTPGET="filename.txt" where filename.txt is the file you want to download.

   The device responds with:

   CONNECT

   The file is received through the device. The device responds with:

   NO CARRIER

   The data connection closes automatically when the file sending ends.

Closing the FTP Data Connection

When you finish sending the file:

1. **Close the FTP connection.**

   Enter:

   AT#FTPCLOSE

2. **Close the PPP data connection.**

   Enter:

   AT#SGACT=1,0

   The device responds with OK.

Reading, Writing and Deleting Messages

Reading Text Messages

To read a text message in text mode:

1. **Put the device in text mode.**

   Enter: AT+CMGF=1

2. **Read message.**

   Enter: AT+CMGR=1

Example response:

+CMGR: "REC UNREAD","+10001112222z`z","","13/09/05,13:39:40-20"

How are you?
OK

Where 0001112222 is the phone number.

Writing Text Messages

To send a text message in text mode:

1. **Put the device in text mode.**
   Enter:
   AT+CMGF=1
   The device responds.
   OK
2. **Enter the recipient's number and your message.**
   Enter:
   AT+CMGS="##########"
   >Your message here
   where ########## is the recipient's number.
3. **Send the message.**
   Enter CTRL+Z.
   The device responds:
   +CMGS: #
   OK
   where # is the reference number of the sent message.

For example:

AT+CMGF=1
OK
AT+CMGS="0001112222"
> How are you? <CTRL+Z to send>
+CMGS: 255
OK

Where 0001112222 is the phone number.

Deleting Messages

To delete one text message, enter:

AT+CMGD=I,#

where I is the index in the select storage and # is the delflag option. Enter:

0	Deletes message in the specified index.
1	Deletes all read messages. Leaves unread messages and stored device-originated messages.
2	Deletes all read and sent device-originated messages. Leaves unread messages and unsent device-originated messages.

3	Deletes all read messages and sent and unsent device-orginated messages. Leaves unread messages.
4	Deletes all messages.

For example:

AT+CMGD=1 (delete message at index 1)
AT+CMGD=2 (delete message at index 2)
AT+CMGD=1,0
AT+CMGD=1,1
AT+CMGD=1,2
AT+CMGD=1,3
AT+CMGD=1,4

Regulatory Information

Industry Canada Class B Notice

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Reglement Canadien sur le matériel brouilleur.

This device complies with Industry Canada license-exempt RSS standard(s). The operation is permitted for the following two conditions:

1. the device may not cause harmful interference, and
2. the user of the device must accept any interference suffered, even if the interference is likely to jeopardize the operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Industry Canada and FCC

This device complies with Industry Canada licence-exempt RSS standard(s) and part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme avec Industrie Canada RSS exemptes de licence standard (s) et la partie 15 des règles de la FCC. Son fonctionnement est soumis aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et

2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

47 CFR Part 15 Regulation Class B Devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Notice

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 interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

Restriction of the Use of Hazardous Substances (RoHS)

Multi-Tech Systems, Inc.

Certificate of Compliance

2011/65/EU

Multi-Tech Systems, Inc. confirms that its embedded products comply with the chemical concentration limitations set forth in the directive 2011/65/EU of the European Parliament (Restriction of the use of certain Hazardous Substances in electrical and electronic equipment - RoHS).

These MultiTech products do not contain the following banned chemicals[1]:

- Lead, [Pb] < 1000 PPM
- Mercury, [Hg] < 1000 PPM
- Hexavalent Chromium, [Cr+6] < 1000 PPM
- Cadmium, [Cd] < 100 PPM
- Polybrominated Biphenyl, [PBB] < 1000 PPM
- Polybrominated Diphenyl Ether, [PBDE] < 1000 PPM

Environmental considerations:

- Moisture Sensitivity Level (MSL) =1
- Maximum Soldering temperature = 260C (in SMT reflow oven)

[1]Lead usage in some components is exempted by the following RoHS annex, therefore higher lead concentration would be found in some modules (>1000 PPM);

- Resistors containing lead in a glass or ceramic matrix compound.

Information on HS/TS Substances According to Chinese Standards

In accordance with China's Administrative Measures on the Control of Pollution Caused by Electronic Information Products (EIP) # 39, also known as China RoHS, the following information is provided regarding the names and concentration levels of Toxic Substances (TS) or Hazardous Substances (HS) which may be contained in Multi-Tech Systems Inc. products relative to the EIP standards set by China's Ministry of Information Industry (MII).

Hazardous/Toxic Substance/Elements

Name of the Component	Lead (PB)	Mercury (Hg)	Cadmium (CD)	Hexavalent Chromium (CR6+)	Polybrominated Biphenyl (PBB)	Polybrominated Diphenyl Ether (PBDE)
Printed Circuit Boards	O	O	O	O	O	O
Resistors	X	O	O	O	O	O
Capacitors	X	O	O	O	O	O
Ferrite Beads	O	O	O	O	O	O
Relays/Opticals	O	O	O	O	O	O
ICs	O	O	O	O	O	O
Diodes/ Transistors	O	O	O	O	O	O
Oscillators and Crystals	X	O	O	O	O	O
Regulator	O	O	O	O	O	O
Voltage Sensor	O	O	O	O	O	O
Transformer	O	O	O	O	O	O
Speaker	O	O	O	O	O	O
Connectors	O	O	O	O	O	O
LEDs	O	O	O	O	O	O
Screws, Nuts, and other Hardware	X	O	O	O	O	O
AC-DC Power Supplies	O	O	O	O	O	O
Software /Documentation CDs	O	O	O	O	O	O
Booklets and Paperwork	O	O	O	O	O	O
Chassis	O	O	O	O	O	O

X Represents that the concentration of such hazardous/toxic substance in all the units of homogeneous material of such component is higher than the SJ/Txxx-2006 Requirements for Concentration Limits.
O Represents that no such substances are used or that the concentration is within the aforementioned limits.

Information on HS/TS Substances According to Chinese Standards (in Chinese)

依照中国标准的有毒有害物质信息

根据中华人民共和国信息产业部 (MII) 制定的电子信息产品 (EIP) 标准－中华人民共和国《电子信息产品污染控制管理办法》（第 39 号），也称作中国 RoHS, 下表列出了 Multi-Tech Systems, Inc. 产品中可能含有的有毒物质 (TS) 或有害物质 (HS) 的名称及含量水平方面的信息。

有害/有毒物质/元素

成分名称	铅 (PB)	汞 (Hg)	镉 (CD)	六价铬 (CR6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷电路板	O	O	O	O	O	O
电阻器	X	O	O	O	O	O
电容器	X	O	O	O	O	O
铁氧体磁环	O	O	O	O	O	O
继电器/光学部件	O	O	O	O	O	O
ICs	O	O	O	O	O	O
二极管/晶体管	O	O	O	O	O	O
振荡器和晶振	X	O	O	O	O	O
调节器	O	O	O	O	O	O
电压传感器	O	O	O	O	O	O
变压器	O	O	O	O	O	O
扬声器	O	O	O	O	O	O
连接器	O	O	O	O	O	O
LEDs	O	O	O	O	O	O
螺丝、螺母以及其它五金件	X	O	O	O	O	O
交流-直流电源	O	O	O	O	O	O
软件/文档 CD	O	O	O	O	O	O
手册和纸页	O	O	O	O	O	O
底盘	O	O	O	O	O	O

X 表示所有使用类似材料的设备中有害/有毒物质的含量水平高于 SJ/Txxx-2006 限量要求。
O 表示不含该物质或者该物质的含量水平在上述限量要求之内。