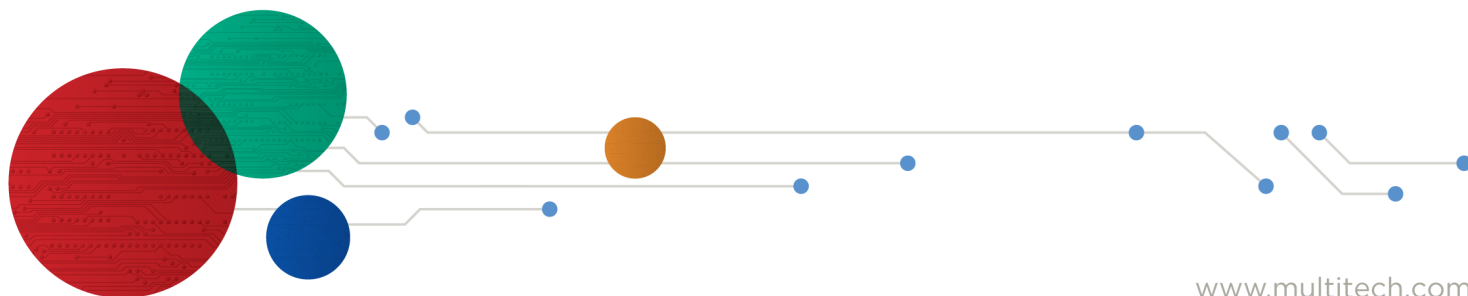




MultiConnect[®] Conduit[™] Base Station IP67

Getting Started Guide for Versions 1.5 and 2.1



MultiConnect Conduit IP67 Base Station Getting Started Guide

Models: MTCDTIP-xxx-266x-xxx, MTCDTIP-xxx-267x-xxx, MTCDTIP-xxx-270x-xxx, MTCDTIP-xxx-275x-xxx

Part Number: S000665, Version 2.2

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Contents

Chapter 1 – MultiConnect® Conduit™ IP67 Base Station	5
Installation	5
Advanced Information	5
V2.1 Features	5
Chapter 2 – Getting Started with mLinux Models	7
Accessing the Terminal Interface	7
Setting Time Zone, Time, and Date	7
Setting the Custom IP Address, Network Information, and Ethernet Internet Access	8
Configuring the Cellular Connection	8
Starting Cellular Connection on Boot	10
Configuring the LoRa Network Server for mLinux	10
Configuring the LoRa Packet Forwarder	11
Additional LoRa and mLinux Information	11
Chapter 3 – Getting Started with AEP Models	12
Logging in to AEP	12
Setting the Password	12
Setting Date and Time	12
Configuring PPP	12
Setting Up PPP Authentication	13
Entering IP Address and Network Information	13
Configuring Access	13
Finishing Configuration	14
Using DeviceHQ for Device Management	14
Chapter 4 – Specifications and Related Information	15
MultiConnect Conduit IP67 Base Station Specifications	15
All Models	15
LoRa Specifications	15
-LAT1 Models	16
-LEU1 Models	17
-LEU1 Frequency Bands	18
-LVW2 Models	18
-LAT3 Models	19
-LVW3 Models	19
Dimensions	21
V1.5 Power Draw	22
V2.1 Power Draw	22
LE910 Telit Transmission Output Power	23

LoRa Transmission Output Power	24
868 Models	24
915 Models	24
I2C Addresses	24
IO Exp V2.1 Board	25
Chapter 5 – Regulatory Information	26
47 CFR Part 15 Regulation Class B Devices	26
FCC Notice	26
Industry Canada Class B Notice	26
Chapter 6 – Safety Notices	28
EMC, Safety, and R&TTE Directive (RED) Compliance	28
Installation Safety	28
Warnings and Cautions	28
Lithium Battery	29
User Responsibility	30
Device Maintenance	30
Vehicle Safety	30
Notice regarding Compliance with FCC, EU, and Industry Canada Requirements for RF Exposure	31
Radio Frequency (RF) Safety	31
Sécurité relative aux appareils à radiofréquence (RF)	31
Interference with Pacemakers and Other Medical Devices	32
Potential interference	32
Precautions for pacemaker wearers	32
Chapter 7 – Environmental Notices	33
Waste Electrical and Electronic Equipment Statement	33
WEEE Directive	33
Instructions for Disposal of WEEE by Users in the European Union	33
Restriction of the Use of Hazardous Substances (RoHS)	33
REACH Statement	34
Registration of Substances	34
Substances of Very High Concern (SVHC)	34
Information on HS/TS Substances According to Chinese Standards (in Chinese)	35
Information on HS/TS Substances According to Chinese Standards	36

Chapter 1 – MultiConnect® Conduit™ IP67 Base Station

The MultiConnect Conduit IP67 Base Station (MTCDTIP) is a LoRa IoT gateway device designed for outdoor deployments.

Installation

An installation guide ships with the MCDTIP and is also available at www.multitech.com and www.multitech.net.

Advanced Information

- For additional information on the mLinux platform, go to <http://www.multitech.net/developer/software/mlinux/>
- For additional information on the AEP platform, go to <http://www.multitech.net/developer/software/aep/>

V2.1 Features

V2.1 refers to the Semtech reference design; the previous reference design was V1.5.

Models MTCDTIP **xxx266x-xxx** and **xxx-267x-xxx** are **V1.5**.

Models MTCDTIP **xxx270x-xxx** and **xxx-275x-xxx** are **V2.1**.

The V2.1 hardware design differs from the previous V1.5 design in the following ways:

- The custom, single purpose Semtech RF front-end ASIC was replaced by a popular wideband general purpose single-chip RF front-end from Analog Devices – the AD9361. This change transitioned Semtech's LoRa offering from a purely custom chipset to an SDR (Software-Defined Radio) architecture.
- The Semtech SX1301 baseband processor chips were retained in the design, but now provide much more limited functionality, essentially becoming hardware accelerator blocks whose purpose is to detect and synchronize the preamble (fixed symbol sequence present at the start of every LoRa packet) for incoming packets on multiple frequency slots with multiple spreading factors. This necessary functionality (essentially multiple concurrent FFTs) was more economical in the original ASICs than in an FPGA or a set of general-purpose DSPs.
- Following a popular pattern for SDR architectures, a large FPGA (a lower-end, but still relatively large Altera / Intel part) is at the center of the system, with all the other system components, including the Analog Devices RF front-end, the Semtech SX1301 ASICs, and a set of TI OMAP-L138 ARM/DSP SoC chips connected to it.
- The DSP core of the TI SoCs are used for packet symbol detection, decoding, etc.
- At system startup, the FPGA must first be configured from its associated SPI Flash memory device. The same SPI flash device also contains code which will run on the TI DSPs. After the FPGA is configured, a state machine within the FPGA reads this code from the Flash memory, loads it into the DSP memory space, and starts the DSP.
- The V2.1 design includes provisions to connect a 48-Channel Extension Board, which increases the number of simultaneous receive channels from 16 to the US maximum of 64. Note that the current LoRa V2.1 reference design allows only simultaneous transmit channels, provided by the two SX1301s on the main V2.1 board only.

- The V2.1 design includes a GPS receiver module to provide timing synchronization between geographically-dispersed gateways. The high-accuracy one-pulse-per-second (PPS) output from this receiver module maintains an accurate internal 250 MHz (4 ns period) timing counter within the FPGA. The GPS receiver and the associated high-speed counter were added specifically to enable a server-layer application to estimate the physical location of a node based on the Time Difference-of-Arrival (TDOA) of the same packet transmitted by the node at multiple (at least three) gateways. This TDOA geolocation scheme works successfully, but accuracy is limited by topography and the number of gateways providing timing information. Multi-path (reflected) signals constitute the primary challenge for this scheme since they arrive at different times based on the different path lengths.
- For this initial V2.1 release:
 - V2.1 hardware supports geolocation.
 - To get the fine timestamp for geolocation, you will need the AES keys. These can be obtained from Semtech, which has licensed the geolocation resolver software.
 - Multitech supplies the chip ID that can be used by the network service providers for obtaining the AES keys.

The packet format of the LoRa V2.1 is not backward-compatible with the LoRa V1.5 packet format. Therefore, packet processing at the server layer (which sends/receive packets to/from LoRa gateways) fails for V2.1 packets if the code has not been upgraded to handle them. Our MultiTech server code has not been upgraded yet, and therefore cannot be used to process LoRa V2.1 packets. Therefore, if the customer does not have additional server-layer support, the MultiTech LoRa V2.1 gateway can only be used as a packet forwarder. Also, unlike the previous LoRa V1.5 packet format (and packet processing source code), this information is not publicly available. Only LoRa operators or service providers having NDA agreements with Semtech currently have the information required for processing V2.1 packets.

Chapter 2 – Getting Started with mLinux Models

Accessing the Terminal Interface

After connecting Ethernet and power, access the terminal interface:

1. On your PC, configure a static IP address for the network interface that is connected to the device within the following range:

192.168.2.2 – 192.168.2.254

2. Open an SSH connection and log in.

Default IP address: (DHCP is disabled)

192.168.2.1

Default credentials for mLinux version 3: username:

root

and password:

root

Default credentials for mLinux version 4: username:

mtadm

and password:

root

Note: The above credentials do **NOT** have root privileges. As a result, many commands may not work unless you use **sudo** (for super user permissions).

To use sudo, either execute :

sudo [command]

or start the root shell:

sudo -s

Then enter the mtadm password. The prompt changes to mtcapmtcdtmtcdtip:/home/mtadm#

For tips on using sudo, go to <http://www.multitech.net/developer/software/mlinux/using-mlinux/log-in-as-an-admin-post-production/>.

The following commands require sudo:

ln -sf /usr/share ...

hwclock

ifdown

ifup

mlinux-set-apn

pppd

killall

/etc/init.d/lora-packet-forwarder

Setting Time Zone, Time, and Date

To set the time zone, date, and time:

1. Create a symbolic link from the zone info file for your location to /etc/localtime:

```
ln -fs /usr/share/zoneinfo/Europe/Zurich /etc/localtime
```

2. Update the date and time to the current time:

```
date "2016-12-11 14:58:01"
```

3. Update the hardware clock:

```
hwclock -u -w
```

Setting the Custom IP Address, Network Information, and Ethernet Internet Access

Network configuration is defined in `/etc/network/interfaces`.

1. To change the static IP, change the **address** and **netmask** fields in `/etc/network/interfaces`, (use `vi` or `nano`).
2. To apply changes, either reboot the device or issue:

```
ifdown eth0 && ifup eth0
```

Note: You will lose your SSH session by doing this.

3. To enable DHCP with default settings, edit `/etc/udhcpd.conf` (using `vi` or `nano`) by entering, starting, and ending IP addresses for DHCP range.

```
mlinux-dhcpd start
```

4. Issue this command to start DHCP:

```
mlinux-dhcpd start
```

Note: To stop or restart, issue:

```
mlinux-dhcpd stop
```

or

```
mlinux-dhcpd restart
```

5. To configure Internet access via the Ethernet port, modify `/etc/network/interfaces` as follows:

- a. Add **gateway 192.168.2.254** beneath the **netmask** line, where **192.168.2.254** is the IP address of your network router.

- b. To apply changes, either reboot the device or issue:

```
ifdown eth0 && ifup eth0
```

Note: You will lose your SSH session by doing this.

- c. Test Internet access with **ping 8.8.8.8**.

Configuring the Cellular Connection

To establish a cellular data link, you must configure and initiate a PPP connection. Sample options, files, and chat scripts are provided in the `ppp peers` directory `/etc/ppp/peers`. Anything specific to the network or connection should be placed in one of these files. Global options should be placed in `/etc/ppp/options`.

1. Set up a cellular data connection.

Note: With a Sprint SIM, your device uses Sprint's OTA activation to register the SIM to their network. Sprint automatically sets the correct APN values automatically. For more information, go to [Sprint Device Activation](#).

```
Set "APN" to the APN for your cellular provider. (Not necessary for
Verizon SIMs)
# mlinux-set-apn APN

# Before establishing PPP connection, modify the file, /etc/ppp/options
sudo -s
echo -e '+ipv6\nip6cp-use-ipaddr' >>/etc/ppp/options

# Dial the connection (using /etc/ppp/peers/xxx# config)
# pppd call xxx#
(where xxx# is your radio, LSP3 for Sprint or LEU1 for EuropeLSP3 for
SprintLEU1 for Europe)
```

2. Use the Linux `route` utility to verify ppp0 is up.

```
# route
Kernel IP routing table
```

Destination	Gateway	Genmask	Flags	Metri c	Ref	Use	Iface
default	33.140.12.1 8	0.0.0.0	UG	0	0	0	ppp0
33.140.12.1 8	*	255.255.255.25 5	UH	0	0	0	ppp0
192.168.2.0	*	255.255.255.0	U	0	0	0	ethp0

The Linux `ifconfig` utility can be used to inspect the ppp0 interface details.

```
# ifconfig ppp0
ppp0      Link encap:Point-to-Point Protocol
          inet addr:33.140.12.18  P-t-
P:33.140.12.18  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:7 errors:0 dropped:0 overruns:0 frame:0
          TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:106 (106.0 B)  TX bytes:145 (145.0 B)
```

Additionally, you can view the `pppd` logs in `/var/log/messages` to see the modem dialing and assigned IP address or errors if the connection was unsuccessful.

To Stop a PPP Connection

```
# send SIGTERM to pppd, which causes it to hang up and exit cleanly
# killall pppd
```

Starting Cellular Connection on Boot

Automatically starting pppd on boot requires (1) setting the peer file to use and (2) telling the system to run the ppp init script on boot.

1. To see the available peers files (leu1) to set the peer file, issue:

```
ls /etc/ppp/peers
```
2. Edit **/etc/ppp/ppp_on_boot** (with vi or sudo) and change:

```
#PPPD call provider
```

to your desired provider (where xxx# is your radio, LSP3 for Sprint or LEU1 for EuropeLSP3 for SprintLEU1 for EuropeLNA3 for North America.)

```
#PPPD call xxx#
```
3. Manually start the init script and check your Internet connection to test your change.

```
ppp_on_boot
# /etc/init.d/ppp start
```
4. To set init script to auto start, issue:

```
# update-rc.d ppp defaults
```
5. Restart and test your connection.

Stop Automatic Start Up

To stop ppp from automatically starting, issue:

```
# update-rc.d -f ppp remove
```

Configuring the LoRa Network Server for mLinux

Note: This section applies to LoRaWAN V1.5 devices only.

To configure the LoRa Network Server:

1. Install the LoRa mCard. Refer to <http://www.multitech.net/developer/products/multiconnect-conduit-platform/accessory-cards/installing-an-accessory-card/>.
2. Attach the LoRa antenna to the LoRa mCard.
3. Use the power cable to connect power to the Conduit and wait for the Conduit to boot up.
4. Log in to the console. Refer to <http://www.multitech.net/developer/software/mlinux/getting-started-with-conduit-mlinux/> if needed.
5. Issue these commands:

```
# cp /opt/lora/lora-network-server.conf.sample /var/config/lora/lora-network-server.conf
```
6. Edit **/var/config/lora/lora-network-server.conf** and modify these settings as needed (use vi or nano).

Field	LoRa-915 (NA, AU, AS, KR)	LoRa-868 (EU, IN)
lora["frequencyBand"]:	"915"	"868"
lora["channelplan"]:	"US915", "AU915", "AS923", or "KR920"	"EU868" or "IN865"
lora["frequencySubBand"]:	(integer. 1 to 8)	Not applicable

Field	LoRa-915 (NA, AU, AS, KR)	LoRa-868 (EU, IN)
lora["frequencyEU"]:	Not Applicable	default 869500000 range: [863500000 - 867500000] and [869100000 - 869500000]
network["name"]	Name of your LoRa network (string, 8-character minimum, case-sensitive).	
network["passphrase"]	Security passphrase for your LoRa network (string, 8-character minimum, case-sensitive).	
network["public"]	Choose from 0: Private MTS, 1: Public LoRaWAN or 2: Private LoRaWAN, Private Options use SyncWord 0x12 vs Public SyncWord 0x34.	
network["joinDelay"]:	Set to desired Join Delay, default 5 seconds	

- Restart the network server.

```
# /etc/init.d/lora-network-server restart
```

- Start mosquito client.

```
# mosquitto_sub -t lora/+/+ -v
```

For advanced LoRa settings, go to <http://www.multitech.net/developer/software/lora/conduit-mlinux-lora-communication/conduit-mlinux-advance-lora-configuration/>.

Configuring the LoRa Packet Forwarder

- Log in to the console, if you are not logged in.
- Establish an Internet connection via Ethernet or cellular.
- Edit the packet forwarder configuration as necessary by modifying **/opt/lora/globallocal_conf.json** (version 2.1) or **/opt/lora/local_conf.json** (version 1.5) with vi or nano.

gateway_conf["server_address"]	Set your LoRa network server address
gateway_conf["serv_port_up"]	Set the up port used by your LoRa network server
gateway_conf["serv_port_down"]	Set the down port used by your LoRa network server

- Start the packet forwarder:

```
# /etc/init.d/lora-packet-forwarder start
```

Additional LoRa and mLinux Information

For additional information, including how to configure LoRa devices to communicate with your gateway, visit <http://www.multitech.net>.

- For help using LoRa, go to: <http://www.multitech.net/developer/software/lora/>
- For an introduction to Lora, go to : <http://www.multitech.net/developer/software/lora/introduction-to-lora/>
- For getting started with LoRa, go to <http://www.multitech.net/developer/software/lora/getting-started-with-lora-conduit-mlinux/>
- For help using mLinux, go to: <http://www.multitech.net/developer/software/mlinux/>.
- For additional packet forwarder information, go to:
<http://www.multitech.net/developer/software/lora/conduit-mlinux-convert-to-basic-packet-forwarder/>

Chapter 3 – Getting Started with AEP Models

Logging in to AEP

After connecting and powering up your device, log in to AEP:

1. Open an Internet browser. In the browser's address field, enter the device's default address for the device:

`http://192.168.2.1`

The login page appears.

2. Type the default user name: **admin**.
3. Type the default password: **admin**.
4. Click **Login** to start the First Time Setup Wizard.

NOTE: For AEP firmware, the DHCP client is enabled by default. If no address is acquired within 20 seconds, then the device switches to static IP address 192.168.2.1 for 20 seconds. If no access to the Web UI Initial Setup Wizard is made, then the device tries the DHCP client again for 20 seconds and alternates back and forth like this until either an address is acquired through DHCP or the Web UI is accessed.

Setting the Password

Note: For security reasons, we recommend changing the default password.

To set a new password:

1. Click **Next** on the Welcome panel.
2. In the **Current Password** field, enter the default password, **admin**.
3. In the **New Password** field, enter a new password.
4. Re-type the new password in the **Confirm Password** field.
5. Click **Next**.

Setting Date and Time

To set date and time:

1. Type today's **Date** in the format shown or use the calendar (data picker).
2. Type the current **Time** (24-hour format).
3. Select the **Time Zone** in which the Conduit operates.
4. Click **Next**.

Configuring PPP

Note: For models with cellular radios only.

To configure the Cellular PPP:

1. To use PPP, check **Enable**. When enabled, your device functions as a cellular device.
2. If using two cellular antennas, check **Diversity**. Do not check this option if using one antenna.

3. To enable dial-on-demand, check **Dial-on-Demand**. This tells the device to only make a PPP connection when there is outgoing IP traffic, and it brings the PPP connection down after a given idle timeout.
4. The default **Idle timeout** is **180 seconds**. If desired, you can enter a different value.
5. Type the **APN** (Access Point Name). The APN is assigned by your wireless service provider.
6. Leave the APN, the radio gets the APN from the carrier when the device registers.
Note: When the LSP3 radio registers, the APN is usually set on dial context #2, but it can be set on context #3. To use the correct context, you need to know which context Sprint set the APN on. By default, the LSP3 script uses context #2.
7. Click **Next**.

Setting Up PPP Authentication

To set up cellular PPP authentication:

1. Select an authentication protocol **Type** used to negotiate with the remote peer: **pap, chap, or pap-chap**. The default is **None**.
2. Type the **Username** for the remote peer to use for authentication. Optional. Username is limited to 60 characters.
3. Type the **Password** for the remote peer to use for authentication. Optional. Password is limited to 60 characters.
4. Click **Next** to exit the wizard.

Entering IP Address and Network Information

Set the IP address and network information for the Ethernet port:

Note: Leave the interface static unless using a DHCP server on the network that the device is connecting to. If you select DHCP client, you need to know which address is assigned to the Conduit. For information on DHCP settings, refer to DHCP in the AEP Help.

1. Type the device's **IP Address**
2. Enter the network **Mask**.
3. Enter the **Gateway** address (optional and not displayed when **Cellular** is enabled).
4. Enter the **Primary DNS** server address (optional and not displayed when **Cellular** is enabled).
5. Enter the **Secondary DNS** server address (optional and not displayed when **Cellular** is enabled).
6. Click **Next**.

Configuring Access

When Cellular is disabled, the default settings enable HTTPRedirect to HTTPs via LAN.

Note: Enabling **HTTPs via WAN** can increase security risk including allowing web users to access the WAN interface.

1. Under **HTTP Redirect to HTTPs**, check **Enabled** to turn on or uncheck to turn off.
2. Enter **Port** or use default value.
3. Check either **Via LAN** or **Via WAN**.
4. Under **HTTPs**, enter **Port** or use default value.

5. Click **Finish**.

Finishing Configuration

Complete the following steps after you have finished entering the basic settings.

1. To save and apply the settings, click **Save and Restart** near the top of the left sidebar. The device restarts.
2. After restart, log back into the AEP interface. On the Dashboard under **Cellular**, the PPP state displays **Link is Up**. You may have to wait for short time.
3. To configure a LoRa Network, refer to [Getting Started with LoRa](#)

Using DeviceHQ for Device Management

DeviceHQ is a cloud-based device management tool for remote monitoring, upgrades, and configuration AEP devices. For information on creating and using a DeviceHQ account, go to the <http://www.multitech.net/developer/software/devicehq/>.

Chapter 4 – Specifications and Related Information

MultiConnect Conduit IP67 Base Station Specifications

MultiConnect Conduit IP67 Base Station specifications depend on the hardware configuration for your model.

All Models

Category	Description
General	
USB	USB Port with Type A Receptacle, USB Interface is CDC-ACM compliant
SIM	Micro-SIM Holder
Physical Description	
Weight	V1.5: 5.15 lbs (2.34 kg)
	V2.1: 5.65 lbs (2.56 kg)
Dimensions	Refer to Dimension Drawing.
Environment	
*Operating Temperature	-30° C to +70° C
Humidity	20%-90% RH, non-condensing
Power Requirements	
Input Power	Power over Ethernet 37-57 Volts DC.

*Please consult with MultiTech if interested in extended temperatures.

LoRa Specifications

Depending on the model, your device has one or two LoRa radios. If the model number includes -868/2 or -915/2, the device has two LoRa radios.

Category	Description
General	
Standards	LoRaWAN 1.0.2 specifications
Radio Frequency	915 MHz ISM band for US, AU, and Canada, 868 MHz for Europe, 865 MHz for India, 923 MHz for Japan, and 920 MHz for Korea
Certifications and Compliance	

Category	Description
EMC and Radio Compliance	EN 55032:2012
	RSS-210
	FCC 15.247
	FCC 15.109
	FCC 15.109(g)
	FCC 15.107
	ICES-003
	EN 61000-3-3:2013
	EN 61000-3-2:2006 (Amended by A1:2009 and A2:2009)
	EN 55022:2010
	EN 300 220-1 v3.1.1
	EN 300 220-2 v3.1.1
	EN 301 489-1 v2.2.0
	EN301 489-3 V2.1.1 (2017-3)
Safety Compliance	UL 60950-1 2nd ED
	cUL 60950-1 2nd ED
	IEC 60950-1 2nd Ed. Am.1 and Am.2

-LAT1 Models

Category	Description
General	
Standards	LTE 3GPP Release 9
	HSPA+ 21/GPRS fallback
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
SMS	
SMS	Point-to-Point messaging
	Mobile-Terminated SMS
	Mobile-Originated SMS

Category	Description
Certifications and Compliance	
EMC and Radio Compliance	FCC Part 15 Class B
	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
Environment	IEC/CSA/UL60950-22 and IP67

-LEU1 Models

Category	Description
General	
Standards	LTE 3GPP Release 9
	HSPA+ 21/GPRS fallback
TCP/IP Functions	FTP, SMTP, SSL, TCP, UDP
Frequency Bands	Refer to the following Frequency Bands table for details.
Speed	
Data Speed	LTE: 100 Mbps downlink/50 Mbps uplink
	HSPA+: 42 Mbps downlink/5.76 Mbps uplink
Interface	
SMS	
SMS	Point-to-Point messaging
	Mobile-Terminated SMS
	Mobile-Originated SMS
Certifications and Compliance	
EMC and Radio Compliance	EN55032:2012
	EN 301 511 v12.5.1
	EN 301 908-1 v11.1.1
	EN 301 908-2 v11.1.1
	EN 301 489-1 v2.1.1
	EN 301 489-52 v1.1.0
	CE RED Radio/SAR

Category	Description
Safety Compliance	IEC 60950-1 2nd ED
	AS/NZS 60950.1
Environment	IEC/CSA/UL60950-22 and IP67

-LEU1 Frequency Bands

Mode	Freq. TX (MHz)	Freq. RX (MHz)	Channels	TX - RX offset (MHz)
EGSM900	890 - 915	935 - 960	0 - 124	45
	880 - 890	925 - 935	975 - 1023	45
DCS1800	1710 - 1785	1805 - 1880	512 - 885	95
WCDMA850 (band V)	824 - 849	869 - 894	Tx: 4132 - 4233	45
			Rx: 4357 - 4458	
WCDMA900 (band VIII)	880 - 915	925 - 960	Tx: 2712 - 2863	45
			Rx: 2937 - 3088	
WCDMA2100 (band I)	1920 - 1980	2110 - 2170	Tx: 9612 - 9888	190
			Rx: 10562 - 10838	
LTE800 (band XX)	832 - 862	791 - 821	Tx: 24150 - 24449	-41
			Rx: 6150 - 6449	
>LTE1800 (band III)	1710 - 1785	1805 - 1880	Tx: 19200 - 19949	95
			Rx: 1200 - 1949	
>LTE2600 (band VII)	2500 - 2570	2620 - 2690	Tx: 20750 - 21449	120
			Rx: 2750 - 3449	

-LVW2 Models

Category	Description
General	
Standards	LTE 3GPP Release 9
	USB Interface is CDC-ACM compliant
TCP/IP Functions	FTP, SMTP, SSL, TCP, UDP
Frequency Bands	4G: 700 (B13) / AWS 1700 (B4)
Speed	
Data Speed	LTE: 100 Mbps downlink/50 Mbps uplink
SMS	

Category	Description
SMS	Point-to-Point messaging
	Mobile-Terminated SMS
	Mobile-Originated SMS
Certifications and Compliance	
EMC and Radio Compliance	FCC Part 15 Class B
	FCC Part 27
Safety Compliance	UL 60950-1 2nd ED
	cUL 60950-1 2nd ED
	IEC 60950-1 2nd ED
Carrier	Verizon
Environment	IEC/CSA/UL60950-22 and IP67

-LAT3 Models

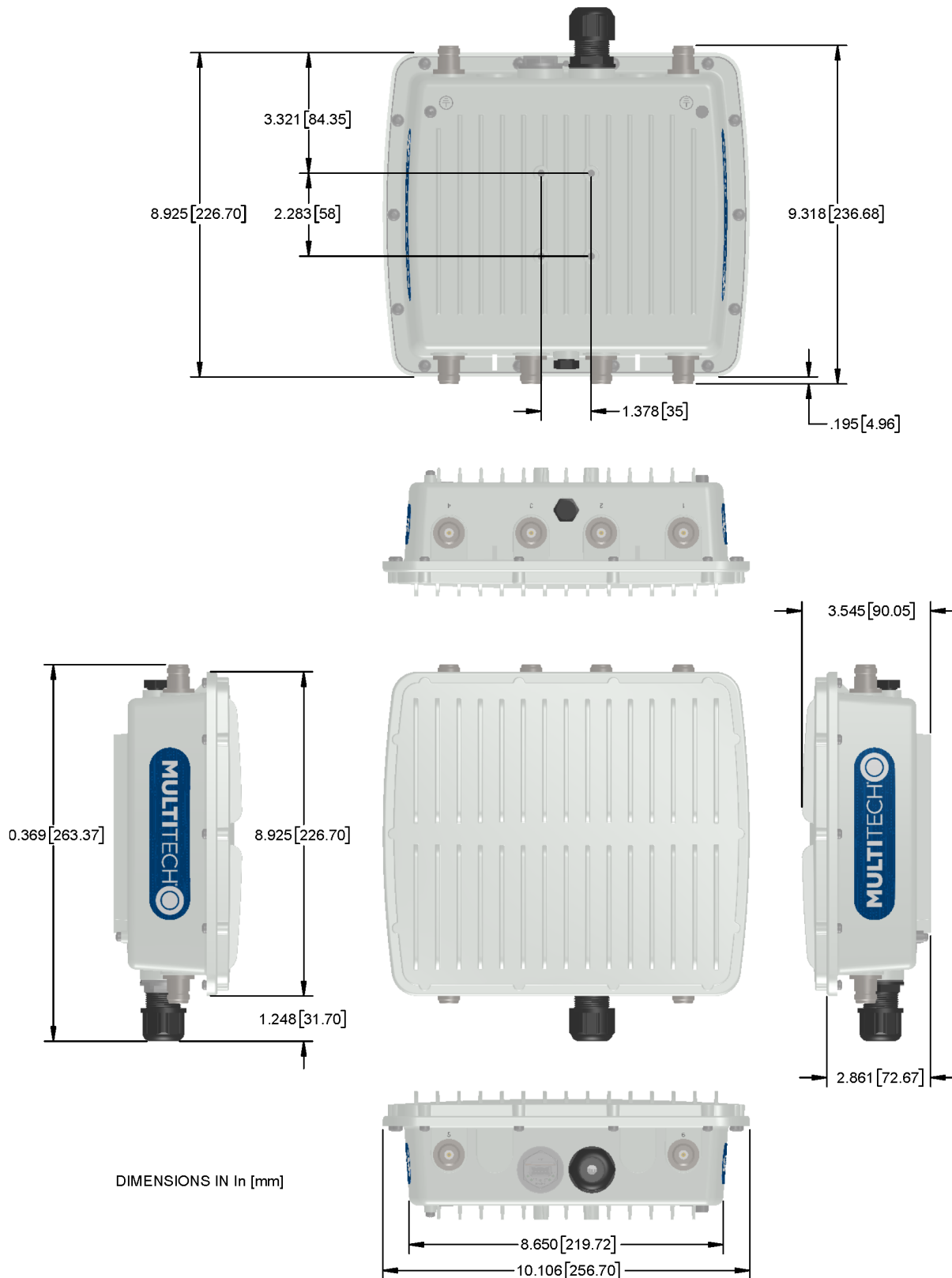
Category	Description
General	
Standards	LTE FDD Cat 1, 3GPP release 9 compliant
	HSPA+ 21/GPRS fallback
	SMS is based on CS/Packet-Switched (PS) domain of GSM and WCDMA
TCP/IP Functions	FTP, SMTP, SSL, TCP, UDP
Frequency Bands	4G: 700 (B12/B13)/850 (B5)/AWS 1700 (B4)/1900 (B2)
	3G: 850 (B5)/1900 (B2)
Speed	
Data Speed	LTE: 10 Mbps downlink/5 Mbps uplink
	HSPA+: Up to 21 Mbps downlink/5.76 Mbps uplink
Certifications and Compliance	
EMC and Radio Compliance	FCC Part 15 Class B
	FCC Part 22, 24, 27
Safety Compliance	UL 60950-1 2nd ED
	cUL 60950-1 2nd ED
Environment	IEC/CSA/UL60950-22 and IP67

-LVW3 Models

Category	Description
General	

Category	Description
Standards	LTE FDD Cat 1, 3GPP release 9 compliant
Frequency Bands	4G: 1900 (B2) / 700 (B13) / AWS 1700 (B4)
Speed	
Data Speed	LTE: 10 Mbps downlink / 5 Mbps uplink
Certifications and Compliance	
EMC and Radio Compliance	FCC Part 15 Class B
	FCC Part 22
	FCC Part 24
Safety Compliance	UL 60950-1 2nd Edition
	cUL 60950-1 2nd Edition Am. 1 and Am. 2
Environment	IEC/CSA/UL60950-22 and IP67

Dimensions



V1.5 Power Draw

Power draw for model MTCDTIP-LAT3-267A-915/2 with two LoRa cards and an LTE radio with power over Ethernet:

Voltage	Cellular Call Box Connection No Data	Measured Current at Maximum Power ¹	TX Pulse ² (AVG) Amplitude Current for GSM850 or Peak Current for HSDPA	Total Inrush Charge ³ Measured in MilliCoulombs
56.0	68 mA	187 mA	256 mA	213 mC
42.0 (Safety testing limit)	88 mA	246 mA	316 mA	230 mC

Note:

¹Maximum Power: The continuous current during maximum data rate with the radio transmitter at maximum power.

²TX Pulse: The average peak current during a GSM850 transmission burst period or HSDPA connection. The transmission burst duration for GSM850 can vary, depending on what transmission scheme is being deployed.

³Inrush Charge: The total inrush charge at power on.

V2.1 Power Draw

Power draw for model MTCDTIP-LAT1-275L-915:

Voltage	Radio Protocol	Sleep Mode Current (If Applicable)	Cellular Call Box Connection No Data	IP Connection to Cellular Call Box with Data: (AVG) Measure Current at Max Power	TX Pulse (AVG) Amplitude Current for GSM850 or Peak Current for HSDPA	Total Inrush Charge Measured in Millicoulombs
56.0 Volts	LTE	NA	154 mA	246 mA	312 mA	4.93 mC
42.0 Volts (Safety Testing Limit)	LTE	NA	207 mA	332 mA	404 mA	4.4 mC

Tx Pulse: The average peak current during a GSM850 transmission burst period or HSDPA connection. The transmission burst duration for GSM850 can vary depending on what transmission scheme is being deployed (GPRS Class 8, Class 10, GSM, etc.).

Max Power: The continuous current during maximum data rate with the radio transmitter at maximum power.

Inrush Charge: The total inrush charge at power on.

LE910 Telit Transmission Output Power

Band	Power Class
GSM 850/900 MHz	4 (2W)
DCS 1800, PCS 1900 MHz	1 (1W)
EDGE, 850/900 MHz	E2 (0.5W)
EDGE, 1800/1900 MHz	Class E2 (0.4W)
WCDMA/FDD 800/850/900, 1900/2100 MHz	Class 3 (0.25W)
LTE FDD 700/800/850/900, 1800/1900/2100/2600 MHz	Class 3 (0.2W)

LoRa Transmission Output Power

868 Models

Max output 25 dBm

Power	Frequency	On Power-up (dBm)	18 Hours After Power-up (dBm)	Bandwidth
27	869.525 MHz	24.18	25	125 kHz
27	869.525 MHz	24.18	24.83	250 kHz

915 Models

Max output 27 dBm

Power	Frequency	On Power-up (dBm)	18 Hours After Power-up (dBm)	Bandwidth
26	923.3 MHz	26.58	25.88	500 kHz
26	925.1 MHz	26.76	26.34	500 kHz
26	927.5 MHz	27.22	26.8	500 kHz

I2C Addresses

Component	I2C Address (V2.1 Board)	I2C Address (48-Channel Extension Board)	I2C Address (Processor Board)	Comments
TCA9535 I/O Expander	0100000	0100001		
LM 75AIM Temp Sensor	1001001	1001011		
LPS25HB Pressure Sensor	1011100	1011101		
24C04 EEPROM			101011x	LSB is A8 memory address bit
TMP102A Temp Sensor (U2)			1001000	
TMP102A Temp Sensor (U94)			1001001	Not populated
TMP102A Temp Sensor (U95)			1001010	Not populated
TMP102A Temp Sensor (U96)			1001011	Not populated
GPS Receiver			1000010 (default)	Can be changed by software

IO Exp V2.1 Board

Pin Name	Signal Name	Direction	Comments	Where Used
P00	FPGA_nCE	Output	FPGA configuration chip enable (active low)	V2.1 board
P01	FPGA_nCONFIG	Output	Pull low to begin FPGA configuration	
P02	FPGA_RSTn	Output	Input to FPGA	
P03	GPS_RSTn	Output	Input to FPGA	
P04				
P05	FPGA_CONF_DONE	Input	Goes high to indicate the FPGA configuration is complete (V2.1 board)	
P06				
P07				
		Output		
P10	CPU_EPCS_EN	Output	Enables SPI programming data to V2.1 band	
P11	EXT_EPCS_EN		Enables SPI programming data to 48-channel extension board	48-Channel extension board
P12				
P13				
P14	FPGA_EXT_RSTn	Output	Input to FPGA on 48-channel extension board	
P15	EXT_SPI_PROG	NA	Not used (test point on 48-channel extension board only)	
P16	EXT_CONF_DONE	Input	Goes high to indicate the FPGA configuration is complete (48-channel extension board)	
P17				

Outputs are active-low.

Chapter 5 – Regulatory Information

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 Notice

Per FCC 15.19(a)(3) and (a)(4) 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.

This device is open development based product that contains a sub GHz radio technology. MultiTech has certified for compliance with US and Foreign compliance bodies including FCC, R&TTE and others. (e.g. FCC 15.247:2015 & IC RSS-210:2010)

MultiTech provides software code meant to operate the radio to a level that maintains compliance with the operating modes under which these radio devices were certified. To ensure this level of compliance, the software code is provided in binary form only. Users are prohibited from making any changes that affect the operation of the radio performance. Accessing or controlling the radio through any means other than the provided binary software will require the user to obtain their own intentional radiator license from the certification body governing their locality, as all pre-certification provided with Conduit Base Station IP67 mDot will have been made invalid.

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

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

Chapter 6 – Safety Notices

EMC, Safety, and R&TTE Directive (RED) Compliance



The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

- Council Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment;
- and
- Council Directive 2014/53/EU on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.
- and
- Council Directive 2014/35/EU on the harmonization of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits.

MultiTech declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be requested at <https://support.multitech.com>.

Installation Safety

This information is also available in the Installation Guide.



Warnings and



Cautions

Warning and Caution symbols mean potential danger. You are in a situation that could cause bodily injury. Before working on any equipment, be aware of hazards in the installation area and be knowledgeable about electrical circuitry. Be familiar with standard practices for preventing accidents.

For translations of key cautions and warnings, refer Appendix A.



Warning: Only trained and qualified personnel should install, replace, or service this equipment. Installation must comply with local and national electrical codes.

- When installing or replacing the unit, the ground connection must always be made first and disconnected last.
- Disconnect POE power (Ethernet POE port) before servicing IP67 Base Station.
- Do not work on the system or connect or disconnect cables during periods of lightning activity.
- This device is not designed or approved to be used in any Hazardous Locations. Do not install or operate device if area is known to be an explosive environment.
- Externally ground this equipment using a customer-supplied ground wire before applying power. Contact an electrician if you are uncertain that suitable grounding is available. Refer to Installing the Ground Wire instructions. < All wall mounting installations are subject to the acceptance of local jurisdiction.
- Do not locate antenna near overhead power lines or other electric light or power circuits, or where it can come into contact with such circuits. When installing the antenna, take extreme

care not to come into contact with such circuits, because they may cause serious injury or death. For proper installation and grounding of the antenna, please refer to national and local codes.



CAUTION:

Power over Ethernet (PoE) Certification does not apply or extend to voltages outside of standard PoE range. Any PoE voltages beyond 0vdc to 60Vdc have not been evaluated by UL or MULTITECH. Nominal PoE voltage is 48Vdc to 57 VDC. The end user supplies the PoE cable. If the cable is to be used outdoors, the cable must be certified for outdoor or burial use.

For models:

MTCDTIP-270x-xxx, MTCDTIP-275x-xxx

- Recommended PoE: 802.3bt-compliant Type 4 Class 7 Power-over-Ethernet (PoE) Powered Devices (PDs) and require PoE Power Supply Equipment (PSE) that is 802.3bt-compliant with minimum 60W output power capability.

For models:

MTCDTIP-266x-xxx, MTCDTIP-xxx-266x-xxx, MTCDTIP-267x-xxx, MTCDTIP-xxx-267x-xxx

- Recommended PoE: 802.3at-compliant Type 2 Class 4 Power-over-Ethernet (PoE) Powered Devices (PDs) and require PoE Power Supply Equipment (PSE) that is 802.3at-compliant with minimum 25.5W output power capability.

Ethernet port is not designed to be connected to a public Telecommunication (PSTN) or any other connection other than IEEE 802.3-2012 power over Ethernet devices.

Do not remove product labels.



Warning:

HOT SURFACE DO NOT TOUCH

Note: This symbol is included on the serial label. UL evaluated this device to a safety and outdoor certification temperature of -30c to +70c.

Lithium Battery

- A lithium battery (3V, coin cell, CR1632) located within the product provides backup power for the timekeeping. This battery has an estimated life expectancy of ten years.
- When this battery starts to weaken, the date and time may be incorrect.
- Battery is not user replaceable. If the battery fails, the device must be sent back to MultiTech Systems for battery replacement.
- Lithium cells and batteries are subject to the Provisions for International Transportation. Multi-Tech Systems, Inc. confirms that the Lithium batteries used in the MultiTech product(s) referenced in this manual comply with Special Provision 188 of the UN Model Regulations, Special Provision A45 of the ICAO-TI/IATA-DGR (Air), Special Provision 310 of the IMDG Code, and Special Provision 188 of the ADR and RID (Road and Rail Europe).

CAUTION: Risk of explosion if this battery is replaced by an incorrect type. Dispose of batteries according to instructions.

Attention: Risque d'explosion si vous remplacez la batterie par un modèle incompatible. Jetez les piles usagées selon les instructions.

User Responsibility

Respect all local regulations for operating your wireless device. Use the security features to block unauthorized use and theft.

Device Maintenance

Do not attempt to disassemble the device. There are no user serviceable parts inside.

When maintaining your device:

- Do not misuse the device. Follow instructions on proper operation and only use as intended. Misuse could make the device inoperable, damage the device and/or other equipment, or harm users.
- Do not apply excessive pressure or place unnecessary weight on the device. This could result in damage to the device or harm to users.
- Do not use this device in explosive or hazardous environments unless the model is specifically approved for such use. The device may cause sparks. Sparks in explosive areas could cause explosion or fire and may result in property damage, severe injury, and/or death.
- Do not expose your device to any extreme environment where the temperature or humidity is high. Such exposure could result in damage to the device or fire. Refer to the device specifications regarding recommended operating temperature and humidity.
- Do not expose the device to water, rain, or spilled beverages. Unless the device is IP67 rated, it is not waterproof. Exposure to liquids could result in damage to the device.
- Do not place the device alongside computer discs, credit or travel cards, or other magnetic media. The information contained on discs or cards may be affected by the device.
- Using accessories, such as antennas, that MultiTech has not authorized or that are not compliant with MultiTech's accessory specifications may invalidate the warranty.

If the device is not working properly, contact MultiTech Technical Support.

Vehicle Safety

When using your device in a vehicle:

- Do not use this device while driving.
- Respect national regulations on the use of cellular devices in vehicles.
- If incorrectly installed in a vehicle, operating the wireless device could interfere with the vehicle's electronics. To avoid such problems, use qualified personnel to install the device. The installer should verify the vehicle electronics are protected from interference.
- Using an alert device to operate a vehicle's lights or horn is not permitted on public roads.
- UL evaluated this device for use in ordinary locations only. UL did NOT evaluate this device for installation in a vehicle or other outdoor locations. UL Certification does not apply or extend to use in vehicles or outdoor applications.

Notice regarding Compliance with FCC, EU, and Industry Canada Requirements for RF Exposure

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 of the FCC rules for satisfying RF exposure compliance. This device also meets the European RF exposure requirements of EN 62311. If an alternate antenna is used, consult user documentation for required antenna specifications.

Compliance of the device with the FCC, EU and IC rules regarding RF Exposure was established and is given with the maximum antenna gain as specified above for a minimum distance of 35 cm between the devices radiating structures (the antenna) and the body of users. Qualification for distances closer than 35 cm (portable operation) would require re-certification.

Wireless devices could generate radiation. Other nearby electronic devices, like microwave ovens, may also generate additional radiation to the user causing a higher level of RF exposure.

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.

Sécurité relative aux appareils à radiofréquence (RF)

À cause du risque d'interférences de radiofréquence (RF), il est important de respecter toutes les réglementations spéciales relatives aux équipements radio. Suivez les conseils de sécurité ci-dessous.

- Utiliser l'appareil à proximité d'autres équipements électroniques peut causer des interférences si les équipements ne sont pas bien protégés. Respectez tous les panneaux d'avertissement et les recommandations du fabricant.
- Certains secteurs industriels et certaines entreprises limitent l'utilisation des appareils cellulaires. Respectez ces restrictions relatives aux équipements radio dans les dépôts de carburant, dans les usines de produits chimiques, ou dans les zones où des dynamitages sont en cours. Suivez les restrictions relatives à chaque type d'environnement où vous utiliserez l'appareil.
- Ne placez pas l'antenne en extérieur.
- Éteignez votre appareil sans fil dans les avions. L'utilisation d'appareils électroniques portables en avion est illégale: elle peut fortement perturber le fonctionnement de l'appareil et désactiver le réseau cellulaire. S'il

ne respecte pas cette consigne, le responsable peut voir son accès aux services cellulaires suspendu ou interdit, peut être poursuivi en justice, ou les deux.

- Éteignez votre appareil sans fil à proximité des pompes à essence ou de diesel avant de remplir le réservoir de votre véhicule de carburant.
- Éteignez votre appareil sans fil dans les hôpitaux ou dans toutes les zones où des appareils médicaux sont susceptibles d'être utilisés.

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).

Chapter 7 – Environmental Notices

Waste Electrical and Electronic Equipment Statement

Note: This statement may be used in documentation for your final product applications.

WEEE Directive

The WEEE Directive places an obligation on EU-based manufacturers, distributors, retailers, and importers to take-back electronics products at the end of their useful life. A sister directive, ROHS (Restriction of Hazardous Substances) complements the WEEE Directive by banning the presence of specific hazardous substances in the products at the design phase. The WEEE Directive covers all MultiTech products imported into the EU as of August 13, 2005. EU-based manufacturers, distributors, retailers and importers are obliged to finance the costs of recovery from municipal collection points, reuse, and recycling of specified percentages per the WEEE requirements.

Instructions for Disposal of WEEE by Users in the European Union

The symbol shown below is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or where you purchased the product.

July, 2005



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 chemicals¹:

- 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)

¹Lead 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.

REACH Statement

Registration of Substances

After careful review of the legislation and specifically the definition of an “article” as defined in EC Regulation 1907/2006, Title II, Chapter 1, Article 7.1(a)(b), it is our current view that Multi-Tech Systems, Inc. products would be considered as “articles.” In light of the definition in § 7.1(b) which requires registration of an article only if it contains a regulated substance that “is intended to be released under normal or reasonably foreseeable conditions of use,” our analysis is that Multi-Tech Systems, Inc. products constitute nonregisterable articles for their intended and anticipated use.

Substances of Very High Concern (SVHC)

Per the candidate list of Substances of Very High Concern (SVHC) published October 28, 2008 we have reviewed these substances and certify the Multi-Tech Systems, Inc. products are compliant per the EU “REACH” requirements of less than 0.1% (w/w) for each substance. If new SVHC candidates are published by the European Chemicals Agency, and relevant substances have been confirmed to be greater than 0.1% (w/w), Multi-Tech Systems, Inc. will provide updated compliance status.

Multi-Tech Systems, Inc. also declares it has been duly diligent in ensuring that the products supplied are compliant through a formalized process which includes collection and validation of materials declarations and selective materials analysis where appropriate. This data is controlled as part of a formal quality system and will be made available upon request.

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。

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.