Dragonfly™

MTQ-LSP3-B03 Device Guide

Dragonfly Device Guide

Models: MTQ-LSP3-B03

Part Number: S000722, Version 1.0

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Chapter 1 – Product Overview

Overview

The Dragonfly™ (MTQ) cellular system-on-module (SoM) is a ready-to-integrate processing and communications device that offers developers the functionality of a SoM with the convenience of an onboard cellular radio all in one compact design. Models with the integrated ARM® Cortex®-M4 processor allow developers to host their application and have access to a full suite of interfaces for connecting sensors or other remote assets. Dragonfly features an ARM mbed™ compatible software library for faster development. All Dragonfly software is Open Source.

Documentation

The following documentation is available at
http://www.multitech.comhttps://www.multitech.com/brands/multiconnect-dragonfly.

Document	Description	Part Number
Device Guide	This document. Provides model specifications and developer information.	S000722
Universal Developer Kit 2.0 Developer Guide	Provides information on using the developer board with the MTQ.	S000610
USB Driver Installation Guide	Provides steps for installing USB drivers on Linux and Windows Systems.	S000616
Telit LE920x4/LE910Cx Series AT Commands Reference Guide	For LSP3 devices, lists AT Commands and parameters used to communicate with your device.	80490ST10778A

Note: Additional documentation is available on the mbed site and at www.multitech.net. See Developing with an MTQ in Mbed for details.

Product Build Options

Product	Description	Region
MTQ-LSP3-B03	LTE Cat 1 SoM with GNSS	North America
Developer Kit		
MTUDK2-ST-CELL	Developer Kit for Dragonfly devices.	Global

Note:

These units ship without network activation. To connect them to the cellular network, you need SIM cards from your service provider.

The complete product code may end in .Rx. For example, MTQ-LSP3-B03.Rx, where R is revision and x is the revision number.

All builds can be ordered individually or in 50-packs.

Chapter 2 – MTQ-LSP3 Mechanical Drawing

MTQ-LSP3-B03

DIMENSIONS IN In [mm]
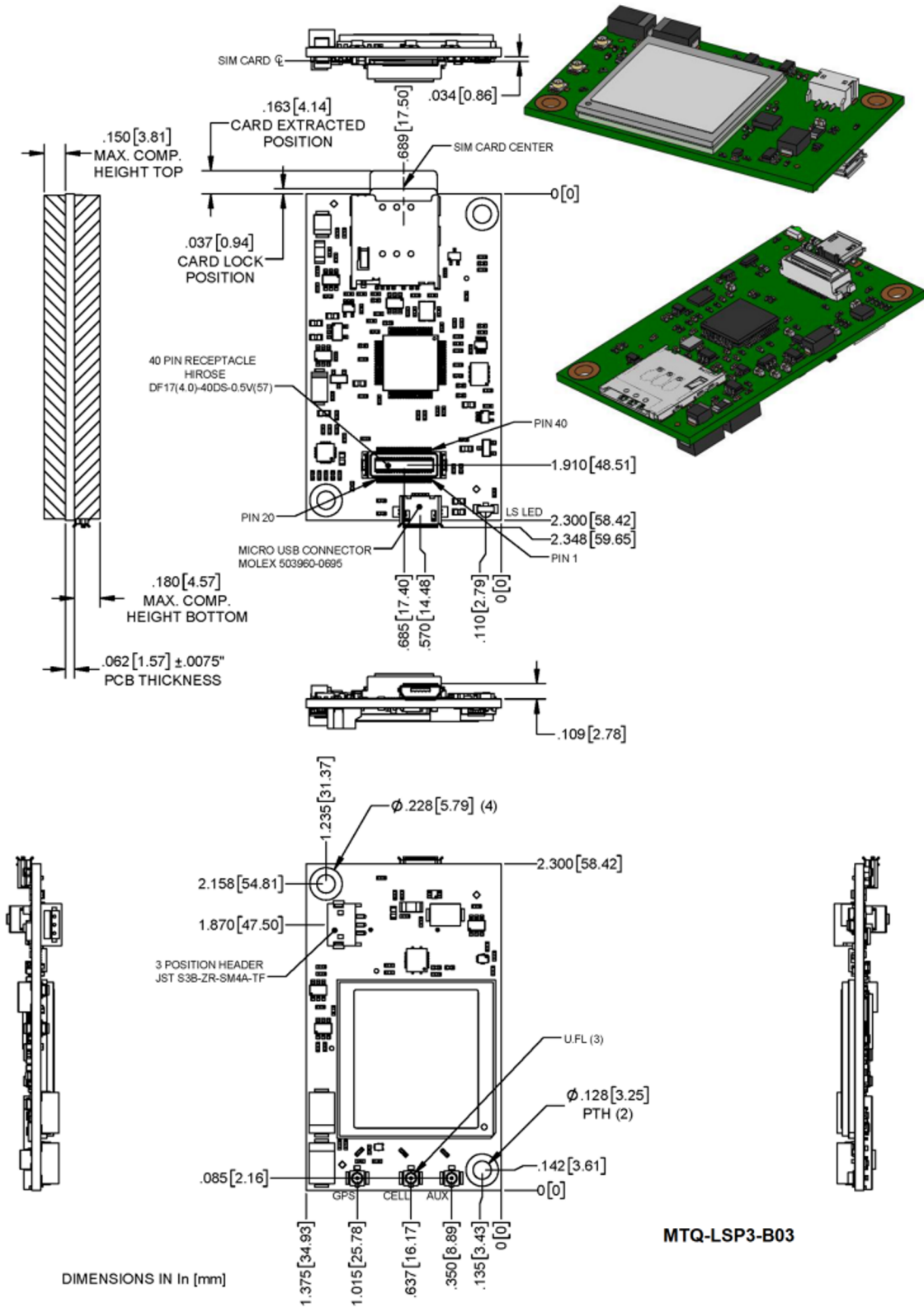
Chapter 3 – Hardware and Specifications

Specifications

Category	Description
General	
Standards	LTE FDD Cat 1, 3GPP release 9 compliant
	USB Interface is CDC-ACM compliant
Frequency Bands	4G: B2, B4, B5/B26, B12, B25, B26
LED	One, link status
Speed	
Data Speed	LTE: 10 Mbps downlink/ 5 Mbps uplink
Interface	
USB Interface	USB 2.0 high speed
UART	Full UART to processor, then RX, TX, RTS, CTS only between the processor and radio
Serial Modem Interface	Up to 921.6 Kbps
Storage	
Serial Flash	SPI bus compatible serial 16Mb flash memory
Physical Description	
Weight	0.6 oz (17g)
Dimensions	Refer to Mechanical Drawings for details.
Connectors	
Antenna	3 surface mount U.FL: cellular, auxiliary, GPS
SIM Holder	1.8 V and 3 V Micro (3FF)
Pin header	40-pin female for USB or UART
Environment	
Operating Temperature[3]	-40° C to +85° C
Storage Temperature	-40° C to +85° C
Humidity	20%-90% RH, non-condensing

Category	Description
Certifications and Compliance	
EMC and Radio Compliance	FCC Part 15 Class B
	FCC Part 22H
	FCC Part 24E
	FCC Part 27
	FCC Part 90
Safety Compliance	UL/cUL 60950-1 2nd Edition
Carrier	Sprint

Note:

- Mbed has limited USB support for the processor. Software controls routing to processor or directly to radio.
- The battery management circuit is designed for single cell Li-Ion/Li-Poly technology. Acceptability of the battery charge circuit for charging specific batteries/cells is to be determined in the end product.
- Acceptability of the battery charge circuit for charging specific batteries/cells is to be determined in the end product.
- Radio performance may be affected by temperature extremes. This is normal.
- Device has been tested up to +85° C. UL Recognized @ 85° C.

40-Pin Connector Definitions
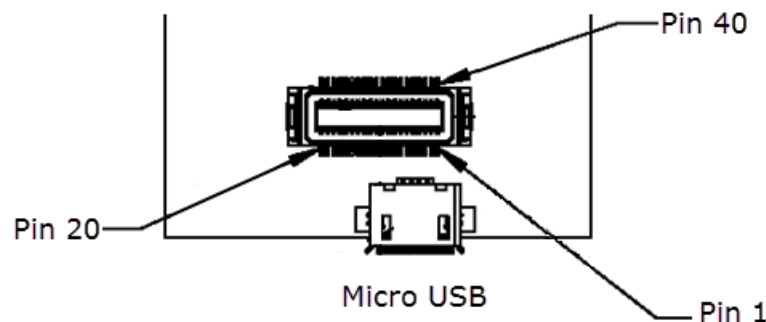
MTQ-xx-B03

Pin	Signal Name	Logic Level Voltage[1]	In/Out	Description
1	DBX_TX	3V	O	ST Micro UART debug Tx output
2	SWCLK	3V	I	See ST Microcontroller Guide
3	CHARGE_MON	0 - VCC-IN	O	Open-drain charging status indication output
4	PWR_GOOD	0 - VCC-IN	O	Open-drain power good status indication output

Pin	Signal Name	Logic Level Voltage[1]	In/Out	Description
5	GND	GND	GND	Ground
6	USB-DATA+	0 - 3V[2]		
7	USB-DATA-			
8	VCC-IN	4.35 - 5.25	Power Input	Main Power
9	IO_00	I = 0 - 7V, O = 0 - 3V	I/O	General Purpose I/O from ST Microcontroller (STM32F413RH)
10	IO_01			
11	IO_02			
12	IO_03			
13	GND	GND	GND	Ground
14	IO_04	I = 0 - 7V, O = 0 - 3V	I/O	General Purpose I/O from ST Microcontroller (STM32F413RH)
15	IO_05			
16	IO_06			
17	IO_07			
18	IO_08			
19	IO_09			
20	IO_10			
21	IO_11			
22	IO_12			
23	IO_13			
24	IO_14			
25	IO_15			
26	IO_16			
27	IO_17			
28	GND	GND	GND	Ground
29	IO_18	I = 0 - 7V, O = 0 - 3V	I/O	General Purpose I/O from ST Microcontroller (STM32F413RH)
30	IO_19			
31	IO_20			
32	IO_21			
33	VCC-IN	4.35 - 5.25	Power Input	Main Power
34	LINK_STATUS	3V	O	Radio link status LED
35	RESET	0 - 3V	I	NRST pin of ST micro
36	GND	GND	GND	Ground
37	GND			

Pin	Signal Name	Logic Level Voltage[1]	In/Out	Description
38	SWO	3V	O	See ST Microcontroller Guide
39	SWDIO	3V	I	
40	DBG_RX	3V	I	ST Micro UART debug Tx input

[1] A hyphen (-) indicates a range of acceptable logic levels.

[2]USB D+D-: 5V tolerant inputs / 3V drive-level output

40-Pin Connector

Manufacturer:	Hirose Electric Co LTD
Description:	.5MM 40 PN B>B RECEPTACLE
Model Number:	DF17(4.0)-40DP-0.5V(57)

Use with:

Manufacturer:	Hirose Electric Co LTD
Description:	.5mm 40 pin B.B header MALE
Model Number:	DF17(2.0)-40DP-0.5V(57)

Processor Pin Information
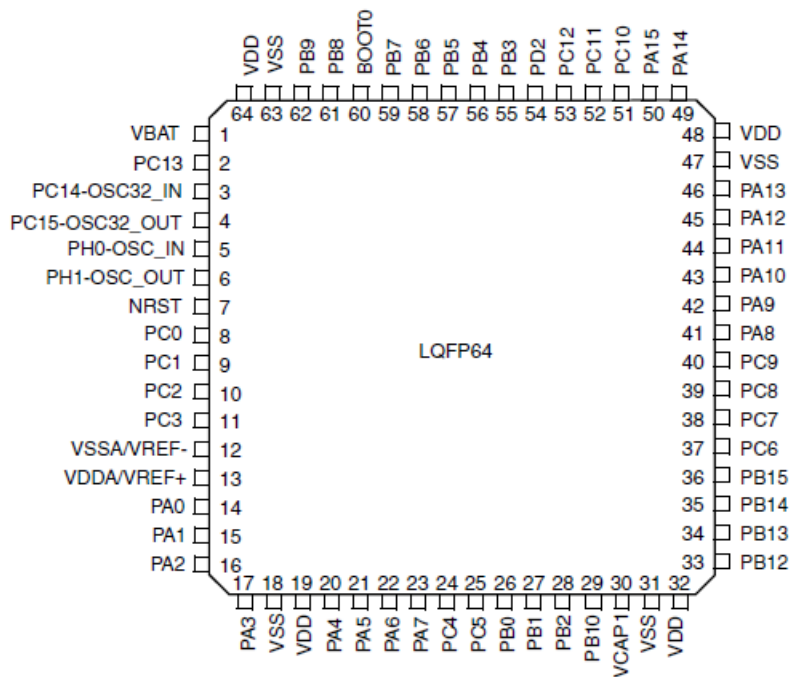
Note: Diagram from the STM32F413RH datasheet.

The following table lists the processor pins and how the MTQ uses them.

Net Name	Number	Pin Name	Details
VDD3_3	1	VBAT	Power
3G_ONOFF	2	PC13	Enable line to the Radio
32K_XTAL_	3	PC14	RTC Clock
32K_XTAL	4	PC15	RTC Clock
26MHZ_CLK_IN	5	PH0-OSC_IN	Main Clock
26MHZ_CLK_DRIVE	6	PH1-OSC_OUT	Main Clock
N_RESET	7	NRST	External Reset in
IO_10	8	PC0	GPIO/Analog capable pin
IO_11	9	PC1	GPIO/Analog capable pin
IO_8	10	PC2	GPIO
RADIO_PWR	11	PC3	Voltage enable for Telit
GND	12	VSSA	Power
VDD3_3	13	VDDA	Power
IO_18/RTS	14	PA0	GPIO/Analog capable pin/USART2_CTS
IO_03/CTS	15	PA1	GPIO/Analog capable pin/USART2_RTS
IO_00/RXD	16	PA2	GPIO/USART2_TX
IO_21/TXD	17	PA3	GPIO/USART2_RX
GND	18	VSS_4	Power
VDD3_3	19	VDD_4	Power
SPI-SS1	20	PA4	Connects to serial flash pin 1
IO_05/SCK	21	PA5	SPI1 Clock/GPIO
IO_16/MISO/SDIO_CMD	22	PA6	SPI1 MSIO/SDIO_CMD /GPIO
IO_01/DCD	23	PA7	GPIO
IO_12	24	PC4	GPIO/Analog capable pin
VDD1_8_MON	25	PC5	Power
IO_9	26	PB0	GPIO/Analog capable pin
IO_02/RI	27	PB1	GPIO
BOOT1/BC_NCE	28	PB2	Battery charge enabled. Pulled down by default.
RADIO_RTS	29	PB10	Serial comm with the radio
VCAP	30	PB11/VCAP_1	Power
N16612690	31	VCAP_1/VSS	Power
VDD3_3	32	VDD_1	Power

Net Name	Number	Pin Name	Details
RADIO_CTS	33	PB12	Serial comm with the radio
IO_13	34	PB13	GPIO
SPI-SS2	35	PB14	GPIO for use with external SPI
IO_7	36	PB15	GPIO/SDIO_CK
RADIO_TXD	37	PC6	Serial comm with the radio
RADIO_RXD	38	PC7	Serial comm with the radio
IO_17/SS2/SDIO_D0	39	PC8	GPIO/SDIO_D0
IO_14/SDIO_D1	40	PC9	GPIO/SDIO_D1
IO_20/DTR	41	PA8	GPIO
IO_19/DSR	42	PA9	GPIO/SDIO_D2
USB_DIR/VBUS	43	A10	USB Switch control, 0=Telit, 1=STM32F413
FS_DM	44	PA11	USB
FS_DP	45	PA12	USB
J_TMS /SWDIO	46	PA13	JTAG
	47	VCAP_2/VSS	Power
VDD3_3	48	VDD_2	Power
J_TCK/SWCLK	49	PA14	JTAG
J_TDI/C_MON	50	PA15	JTAG
SPI-SCK	51	PC10	Connects to serial flash pin 6. Connects to Telit radio pin F15.
SPI-MISO	52	PC11	Connects to serial flash pin 2. Connects to Telit radio pin D15.
SPI-MOSI	53	PC12	Connects to serial flash pin 5. Connects to Telit radio pin E15.
SPI-SRDY	54	PD2	Connects to Telit radio pin J15.
J_TDO/SWO	55	PB3	JTAG
J_RST/P_GOOD	56	PB4	JTAG
IO_4/MOSI/SDIO_D3	57	PB5	GPIO/SPI1_MOSI/SDIO_D3
DBG_TX	58	PB6	JTAG
DBG_RX	59	PB7	JTAG
BOOT	60	BOOT0	Reserved.
IO_6/SCL/SS1	61	B8	GPIO/I2C1_SCL
IO_15/SDA/SRDY	62	PB9	GPIO/I2C1_SDA
GND	63	VSS_3	Power

Net Name	Number	Pin Name	Details
VDD3_3	64	VDD_3	Power

Serial Flash Embedded Memory

This product uses the GigaDevice GD25Q16C serial flash memory device.

For information on features, refer to the serial flash datasheet: https://www.gigadevice.com/flash-memory/gd25q16c

For information on processor connections to serial flash, refer to the table in *Processor Pin Information*.

Electrical Characteristics

Operating Conditions

Parameter	Minimum Volts	Maximum Volts
Supply Range - Vcc	4.35	5

Absolute Maximum Rating

Parameter	Minimum Volts	Maximum Volts
Voltage at any signal pin	-0.3	5.5

DC Electrical Characteristics

Parameter	Conditions	Minimum Volts	Maximum Volts
Digital signal input low level	CMOS port I_{IO}=+8 mA	-0.3	0.9
Digital signal input high level	CMOS port I_{IO}=+8 mA	2.1	5.5
Output low level voltage for an I/O pin	CMOS port	-	0.4
Output high level voltage for an I/O pin	I_{IO}=+8 mA	V_{DD}-0.4	-
Output low level voltage for an I/O pin	TTL port	-	0.4
Output high level voltage for an I/O pin	I_{IO}=+8 mA	2.4	-
Output low level voltage for an I/O pin	I_{IO}=+20 mA	-	1.3[1]
Output high level voltage for an I/O pin		V_{DD}-1.3[1]	-
Output low level voltage for an I/O pin	I_{IO}=+6 mA	-	0.4[1]
Output high level voltage for an I/O pin		V_{DD}-0.4[1]	-
Output low level voltage for an I/O pin	I_{IO}=+4 mA	-	0.4[2]
Output high level voltage for an I/O pin		V_{DD}-0.4[2]	-

Parameter	Conditions	Minimum Volts	Maximum Volts
RESET (low active) input low	CMOS port I_{IO}=+8 mA	-	0.99
RESET (low active) input high	CMOS port I_{IO}=+8 mA	2.31	-

(1) Guaranteed by characterization results, not tested in production.

(2) Guaranteed by design, not tested in production.

> **Note:**
>
> See the ST Microcontroller data sheet (STM32F413RH) and the Pin Connector Definitions table in Chapter 3 of this guide.
>
> Use V_{DD} = 3.0V when referencing the STM32F413RH data sheet.

Input/Output Current Ratings

Output current draw PWR_GOOD, CHG_MON	5 mA
Output current draw all other output pins	25 mA

MTQ-LSP3-B03 Power Draw

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

Radio Protocol	Radio On/Off Mode Current (If Applicable) or Sleep Mode	PSM (Power Saving Mode)	Live Connection Idle (No Data)	(AVG) Measured Current at Max Power[1]	TX Pulse[2] (AVG) Amplitude Current for Peak Current for HSDPA/LTE	Total Inrush Charge[3] Measured in Millicoulombs	Total Inrush Charge Duration during Powerup (INRUSH Duration)
5 Volts, Test developer card							
LTE Only Band 4 1732.5 Mhz	8 mA	NA	55 mA	658 mA	788 mA	2.04 mC	1.05 mS
5 Volts, USB Only							
LTE Only Band 4 1732.5 Mhz	8 mA	NA	56 mA	697 mA	900 mA	2.1 mC	2.68 mS

[1]**Maximum Power:** The continuous current during maximum data rate with the radio transmitter at maximum power.
[2]**Tx Pulse:** The average peak current during an LTE connection.
[3]**Inrush Charge:** The total inrush charge at power on.

Chapter 4 – Antennas

External Antenna Option

Antenna

Devices were approved with the following antenna or for alternate antennas meeting the given specifications:

Manufacturer:	Wieson
Description:	LTE Antenna with SMA-Male Connector
Model Number	GY115IE002-001

MultiTech ordering information:

Model	Quantity
ANLTE4-1HRA	1
ANLTE4-2HRA	2
ANLTE4-10HRA	10
ANLTE4-50HRA	50

Antenna Specifications

Category	Description
Frequency Range	0.698 - 0.96 GHz
	1.710 - 2.170 GHz
	2.30 - 2.69 GHz
VSWR	3:1 maximum
Gain	2.06 dBi
Impedance	50Ω nominal
Radiation	Omni-directional
Polarization	Linear, vertical

SMA to U.FL Cables

The developer kit includes three 4.5" SMA to U.FL cables which are preinstalled on the developer board. Consult the mechanical drawings for your device to determine which antenna to connect to which U.FL connector on the device.

Connecting an Antenna through the Developer Board Connectors

To connect an antenna to the device through the developer board:

1. Determine which SMA connector you want to use for the antenna.
2. Finger tighten the antenna to the SMA connector.
3. Attach the U.FL connector from the cable to the connector on the device.

    G = GPS (may not apply to your device)

    M = Main

    D = Diversity

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.

Antenna diversity is unnecessary when the device has an unobstructed signal path from the cell tower, such as in a flat area away from buildings. In good reception environments, the product application might prohibit using two receive antennas.

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. Multi-Tech 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.

Placing GPS Antennas

GPS antennas need access to the sky. Position the GPS antenna so the diversity antennas do not block its access to the sky.

Selecting Antennas

Select an antenna based on your product and application. Typically, both antennas are the same because either can be the main receive antenna. However, if the antenna connectors are too close together, use a similar antenna on a short cable for the second receive only antenna.

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.
- Antennas are not approved for outdoor use. Do not extend antennas outside of any building.

Diversity and Power Draw

There are no significant power draw differences.

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

OEM Integration

FCC & IC Information to Consumers

The user manual for the consumer must contain the statements required by the following FCC and IC regulations: 47 C.F.R. 15.19(a)(3), 15.21, 15.105 and RSS-Gen Issue 3, Dec 2010; 7.1.2 and 7.1.3

FCC Grant Notes

The OEM should follow all the grant notes listed below. Otherwise, further testing and device approvals may be necessary.

FCC Definitions

Portable: (§2.1093) — A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

Mobile: (§2.1091) — A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

Actual content pending Grant: *This device is a mobile device with respect to RF exposure compliance. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons, and must not be collocated or operate in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product guidelines. Installers and end-users must be provided with specific information required to satisfy RF exposure compliance for installations and final host devices. (See note under Grant Limitations.) Compliance of this device in all final host configurations is the responsibility of the Grantee.*

> **Note:** Host design configurations constituting a device for portable use (<20 cm from human body) require separate FCC/IC approval.
> **Note:** Only use antennas approved respectively as listed for the unlicensed radios (Bluetooth/Wi-Fi)

Host Labeling

The following statements are required to be on the host label:

> This device contains FCC ID: {Add the FCC ID of the specific device}
> This device contains equipment certified under IC ID: {Add the IC ID of the specific device}

For additional labeling requirements, see the product's Labeling Requirements. For the FCC and IC IDs, see specific certificate information in the Regulatory Statement chapter.

Chapter 5 – Safety Information

Handling Precautions

To avoid damage due to the accumulation of static charge, use proper precautions when handling any cellular device. Although input protection circuitry has been incorporated into the devices to minimize the effect of static build-up, use proper precautions to avoid exposure to electronic discharge during handling and mounting the device.

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.

General Safety

The device is designed for and intended to be used in fixed and mobile applications. Fixed means the device is physically secured at one location and cannot be easily moved to another location. Mobile means the device is used in other than fixed locations.

> **CAUTION:** Maintain a separation distance of at least 20 cm (8 inches) between the transmitter's antenna and the body of the user or nearby persons. The device is not designed for or intended to be used in portable applications within 20 cm (8 inches) of the user's body.
> **Attention:** Maintenir une distance d'au moins 20 cm (8 po) entre l'antenne du récepteur et le corps de l'utilisateur ou à proximité de personnes. Le modem n'est pas conçu pour, ou destinés à être utilisés dans les applications portables, moins de 20 cm du corps de l'utilisateur.

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).

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.

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. 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.

User Responsibility

Respect all local regulations for operating your wireless device. Use the security features to block unauthorized use and theft.
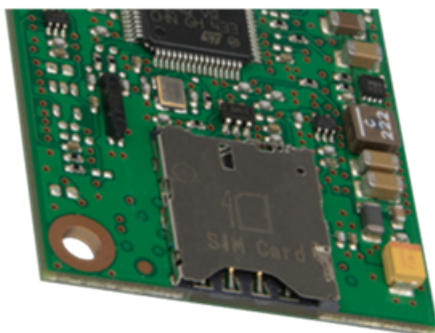
Chapter 6 – Getting Started

Installing a SIM Card on a DragonFly

Note: When using the Dragonfly with a developer board, install the SIM card before mounting the Dragonfly on the developer board.

To install the SIM card:

- With the contact side facing down, align the notched edge as shown on the Dragonfly's SIM holder and slide the SIM card completely into the SIM holder.


USB Cable Recommendations

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-MICRO-B-3.

Communications Flow

Processor Model (B03)
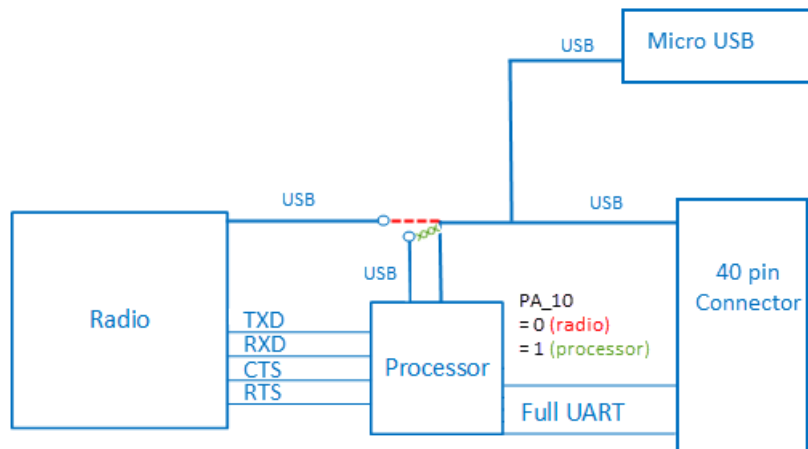
Note:

- The device has a UART subset as well as GPIO (4 pin UART (tx/rx/rts/cts)
- If needed, use the GPIOs for additional UART signaling.
- The USB port can switch between a connection to the radio (red dotted line) or a connection to the processor (green x line). The USB selection is controlled via programming on the processor. There is no USB between the radio and the processor.

Communicating with the Device

Following are three options for communicating with the device.

- *Recommended:* Establish serial communication using MultiTech developer board MTUDK2. See the *Universal Developer Kit 2.0 Developer Guide* (PN S000610) for more information.
- Install cellular radio USB drivers and plug into the micro USB connector. No need for a host board.
- Install cellular radio USB drivers. Access the device's USB interface via pins 6 and 7 of the 40-pin connector. Data pins 6 and 7 are in parallel with the micro USB connector on the device. There is no connection to pins 6 and 7 on the developer board.

Device Drivers

Note: Install drivers on your computer before connecting the device.

For the UDK2 Developer Board, download the driver through the developer kit page Downloads tab at https://www.multitech.com/brands/socketmodem-dragonfly-dev-kit. The installation instructions are included in the driver zip file.

For the MTQ, the cellular radio USB device driver is available on your model's page.
- Go to https://www.multitech.com/brands/multiconnect-dragonfly and click on your model. Download the driver from Downloads.
- The USB Driver Installation Guide (S000616) is included in the driver download and is also available under Manuals on your model's page.

Powering Down Your Device

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

To properly power down your device, do one of the following options:

Option 1: :

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

Note: If you send AT#SHDN and do not remove power AND the ONOFF line is high, the radio restarts after 60 seconds.

Option 2:

1. Hold signal ONOFF (processor pin PC13) low.
2. Monitor signal VDD1_8_MON (processor pin PC5). When it goes low, the radio is powered off and it is safe to remove power.

Device Reset (NRESET Pin 35)

NRESET pin 35 of the 40 pin connector is routed directly to NRST on the STM32F413RH processor.

There are two components to reset:

1. **Processor Reset**

   Multiple reset methods are available. Refer to STM32F413RH documentation for details.
2. **Radio Reset**

   The STM32F413RH processor pin PC_13 is routed to a tiny9 supervisory processor that controls the radio.
   - If PC_13 is driven low for >50ms and <1s, the radio is reset.
   - If PC_13 is driven low for >1s, the radio is powered down.

Resetting the Processor

- To reset the processor, the minimum recommended reset pulse is 200 µs. The maximum reset pulse is less than 1 second.
- Refer to STM32F413RH documentation for additional reset options available within the on-board microcontroller.

  - Reset is controlled via PC13 on the on-board microcontroller.

  - Refer to 3G_ONOFF Signal for instructions on managing radio module reset.

Sleep Mode

Control radio sleep mode with the GPIO pin PC13 (3G_ONOFF) on the onboard processor. See also *3G_ONOFF Signal*.

- Setting PC13 to Low and holding it low turns the radio off, causing it to draw minimal power.
- Setting PC13 to High resets and wakes up the device.

- Refer to +CFUN in the *AT Command Reference Guide* for other sleep options.
  Note: If using +CFUN commands, then reset the device via the PC13 (3G_ONOFF) toggle low to high to bring the radio out of +CFUN sleep mode.

Developing with an MTQ in Mbed

Build applications written for the MTQ are built on top of the Arm®MbedTM library and can include the MTSAS library for easy cellular radio use.

The MTQ ships with AT pass-through firmware, which directly connects the cellular radio to the external serial port on the MTUDK2-ST-CELL developer board. The firmware:

- Runs at 115200 baud by default to match with the cellular radio's default baud rate.
- Prints debug messages from the debug port at 115200 baud.
- Allows users to increase or decrease the application's baud rate by entering a plus (+) or minus (-) character on the USB debug port. Issuing a plus or minus character on the USB debug port changes the external serial port speed as well as the speed of the link between the processor and the radio. The speed of the USB debug port on reset is always 115200 to match the radio's default regardless of the baud rate used at the time of reset.
- Uses RTS/CTS flow control on the serial connection to the radio and on the external serial connection. Enables RTS/CTS flow control on terminal emulators used with the AT pass-through firmware.

MbedTM Documentation

Arm Mbed is a free, open-source platform and operating system for embedded devices using the Arm Cortex-M microcontrollers. The Mbed website provides free software libraries, hardware designs, and online tools for rapid prototyping of products. The platform includes a standards-based C/C++ SDK, a microcontroller HDK, and supported development boards, an online compiler and online developer collaboration tools.

Programming the MTQ Microcontroller

With the MTQ and the MTUDK2-ST-CELL developer board, use the Arm Mbed ecosystem to program the microcontroller. Compile in the cloud or locally, copy the resulting binary file to the Mbed USB drive, and reset the MTQ.

All MTQ software is open source.

Mbed Links

- Explore Mbed: http://developer.mbed.org/explore
- Getting Started with Mbed: http://developer.mbed.org/getting-started
- Mbed Handbook: http://developer.mbed.org/handbook/Homepage
- Additional Information: http://www.multitech.net/developer/products/multiconnect-dragonfly/

MTQ-LSP3-B03 Platform Page

Use the MTQ Mbed page with Mbed's Pelion IoT platform. For details, refer to
https://os.mbed.com/platforms/MTS-Dragonfly-f413rh.

STMicroelectronics STM32F413RH

For information on the STM32F413RH microcontroller, refer to:

- **Reference Manual:**
  https://www.st.com/content/ccc/resource/technical/document/reference_manual/group0/81/ea/88/1f/97/9e/4a/d0/DM00305666/files/DM00305666.pdf/jcr:content/translations/en.DM00305666.pdf

- **Datasheet:** https://www.st.com/resource/en/datasheet/stm32f413cg.pdf

Chapter 7 – Labels

Approvals and Certifications

This device is an industry and/or carrier approved modem. In most cases, when integrated and used with an antenna system that was part of the MultiTech modem certification, additional approvals or certifications are not required for the device that you develop as long as the following requirements are met:

- **PTCRB Requirements:** The antenna system cannot be altered. The antenna system must be the same type with similar in-band and out-of-band radiation patterns and maintain the same specifications. Refer to the FCC grant information for details.

- **Model Identification:** The MultiTech model identification allows the carrier to verify the modem as one of its approved models. This information is located on the modem's label below the bar code.

Example Labels

> **Note:** Actual labels vary depending on the regulatory approval markings and content.

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.

The label shown is not the actual size.

1 - MultiTech Model Identification
2 - MultiTech Ordering Part Number
3 - IMEI

Device Label	Package Label
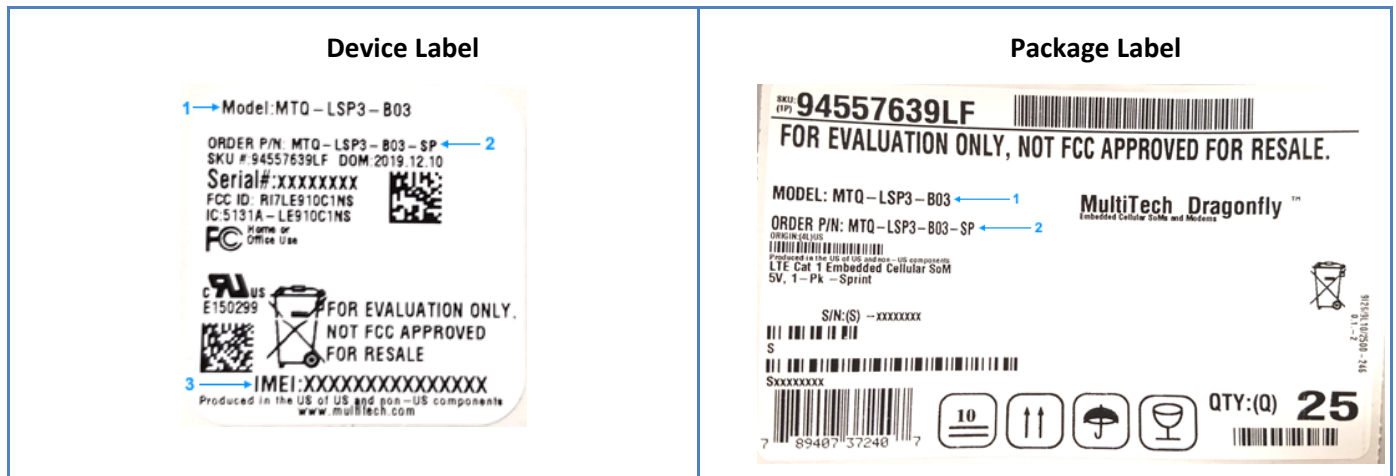
Chapter 8 – Regulatory Information

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 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.

FCC Grant Information

FCC Part 15

FCC Identifier:	RI7LE910C1NS
Equipment Class:	PCS Licensed Transmitter
Notes:	Wireless Module
Approval:	Single Modular

FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designators
24E	1850.7 -1909.3	0.271	2.5 PM	1M08G
24E	1850.7 -1909.3	0.211	2.5 PM	2M69G
24E	1851.5 -1908.5	0.213	2.5 PM	2M69W
24E	1852.5 -1907.5	0.261	2.5 PM	4M48G
24E	1852.5 -1907.5	0.209	2.5 PM	4M48W
24E	1855.0 -1905.0	0.265	2.5 PM	8M93G
24E	1855.0 -1905.0	0.231	2.5 PM	4M91W
24E	1857.5 - 1902.5	0.264	2.5 PM	13M4G
24E	1857.5 - 1902.5	0.229	2.5 PM	5M07W
24E	1860.0 - 1900.0	0.241	2.5 PM	17M9G
24E	1860.0 - 1900.0	0.183	2.5 PM	5M13W
27	1710.7 - 1754.3	0.234	2.5 PM	1M08G
27	1710.7 - 1754.3	0.184	2.5 PM	1M08W
27	1711.5 - 1753.5	0.227	2.5 PM	2M69G
27	1711.5 - 1753.5	0.195	2.5 PM	2M69W
27	1712.5 - 1752.5	0.222	2.5 PM	4M48G
27	1712.5 - 1752.5	0.17	2.5 PM	4M49W
27	1715.0 - 1750.0	0.245	2.5 PM	8M93G
27	1715.0 - 1750.0	0.209	2.5 PM	4M93W
27	1717.5 - 1747.5	0.252	2.5 PM	13M4G
27	1717.5 - 1747.5	0.218	2.5 PM	5M04W
27	1720.0 - 1745.0	0.2355	2.5 PM	17M8G
27	1720.0 - 1745.0	0.172	2.5 PM	5M15W
22H	824.7 - 848.3	0.212	2.5 PM	1M08G
22H	824.7 - 848.3	0.159	2.5 PM	1M08W

FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designators
22H	825.5 - 847.5	0.218	2.5 PM	2M69G
22H	825.5 - 847.5	0.168	2.5 PM	2M69W
22H	826.5 - 846.5	0.217	2.5 PM	4M49G
22H	826.5 - 846.5	0.167	2.5 PM	4M49W
22H	829.0 - 844.0	0.224	2.5 PM	8M94G
22H	829.0 - 844.0	0.187	2.5 PM	4M93W
27	699.7 - 715.3	0.186	2.5 PM	1M08G
27	699.7 - 715.3	0.155	2.5 PM	1M09W
27	700.5 - 714.5	0.186	2.5 PM	2M69G
27	700.5 - 714.5	0.151	2.5 PM	2M69W
27	701.5 - 713.5	0.182	2.5 PM	4M48G
27	701.5 - 713.5	0.146	2.5 PM	4M48W
27	704.0 - 711.0	0.193	2.5 PM	8M96G
27	704.0 - 711.0	0.176	2.5 PM	4M95W
24E	1850.7 - 1914.3	0.242	2.5 PM	1M08G
24E	1850.7 - 1914.3	0.193	2.5 PM	1M08W
24E	1851.5 - 1913.5	0.244	2.5 PM	2M69G
24E	1851.5 - 1913.5	0.204	2.5 PM	2M69W
24E	1852.5 - 1912.5	0.244	2.5 PM	4M48G
24E	1852.5 - 1912.5	0.192	2.5 PM	4M48W

Ouput power is conducted. Single Modular Approval. This device is approved for mobile and fixed use with respect to RF exposure compliance. The antenna of this transmitter must provide a separation distance of at least 20 cm from all persons. Installers and end-users must be provided with antenna installation instructions and transmitter operating conditions and instructions for satisfying RF exposure compliance. The final product operating with this transmitter must include operating instructions and antenna installation instructions, for end-users and installers to satisfy RF exposure compliance requirements. Multi-transmitter, supporting simultaneous transmission configurations, have not been evaluated and shall be evaluated according to KDB Publication 447498 and §15.31(h) and §15.31(k) composite system and § 2.1 end product terms and concepts. Compliance of this device in all final product configurations is the responsibility of the Grantee. Installation of this device into specific final products may require the submission of a Class II permissive change application containing data pertinent to RF Exposure, emissions and host/module authentication, or new application if appropriate.

Maximum Antenna Gain

The following table shows maximum antenna gain for the radio. For more detailed information, consult the FCC website for FCC Identifier: RI7LE910C1NS,

Band	Maximum Antenna Gain
FDD 5	6.08
FDD 26	6.08
FDD 4	5.0
FDD 2	8.01
FDD 25	8.01
FDD 12	5.63

Chapter 9 – 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

REACH Statement

Registration of Substances

Multi-Tech Systems, Inc. confirms that none of its products or packaging contain any of the Substances of Very High Concern (SVHC) on the REACH Candidate List, in a concentration above the 0.1% by weight allowable limit

The latest **197** substances restricted per the REACH Regulation were **last updated January 2019**. Refer to the following for the most current candidate list of substances: http://echa.europa.eu/candidate-list-table.

Restriction of the Use of Hazardous Substances (RoHS)

Multi-Tech Systems, Inc.

Certificate of Compliance

2015/863

Multi-Tech Systems, Inc. confirms that its embedded products comply with the chemical concentration limitations set forth in the directive 2015/863 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] < 100 PPM
- Cadmium, [Cd] < 100 PPM
- Hexavalent Chromium, [Cr+6] < 1000 PPM
- Polybrominated Biphenyl, [PBB] < 1000 PPM
- Polybrominated Diphenyl Ethers, [PBDE] < 1000 PPM
- Bis(2-Ethylhexyl) phthalate (DEHP): < 1000 ppm
- Benzyl butyl phthalate (BBP): < 1000 ppm
- Dibutyl phthalate (DBP): < 1000 ppm
- Diisobutyl phthalate (DIBP): < 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.

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