

MultiConnect[®] Dragonfly[™]

MTQ-H5 Device Guide

MultiConnect® Dragonfly™ Developer Guide

Models: MTQ-H5-B01, MTQ-H5-B02

Part Number: S000628, Version 1.0

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World Headquarters

Multi-Tech Systems, Inc.
 2205 Woodale Drive, Mounds View, MN 55112
 Phone: (800) 328-9717 or (763) 785-3500
 Fax (763) 785-9874

Contents

Chapter 1 Product Overview	6
Overview	6
Documentation	6
Product Build Options	6
Chapter 2 Mechanical Drawings	7
MTQ-H5 Models	7
Processor Model (-B01)	7
No Processor Model (-B02)	8
Chapter 3 Specifications and Related Information	9
Specifications	9
Powering Down Your Device	10
40-Pin Connector Definitions	11
MTQ-xx-B01	11
MTQ-xx-B02	12
40-Pin Connector	12
MTQ-B01 External Pin Alternate Function Mapping	12
MTQ-B01 Processor Pin Information	16
Communications Flow.....	19
MTQ-xx-B01 (Processor Model).....	19
MTQ-xx-B02 (No Processor Model)	19
Electrical Characteristics	19
Operating Conditions	19
Absolute Maximum Rating.....	19
DC Electrical Characteristics.....	20
Power Draw.....	20
MTQ-H5-B01 (Processor)	20
MTQ-H5-B02 (No Processor).....	22
USB Cable Recommendations.....	23
Chapter 4 Antennas	24
External Antenna Option	24
Wieson LTE Antennas	24
Internal Antenna Option	24
Ethertronics Prestta Standard Octa-Band Antenna	24
SMA to U.FL Cables	25
Connecting an Antenna through the Developer Board Connectors.....	25
Antenna Diversity.....	26
Using Antenna Diversity.....	26

Placing External Antennas	26
Placing GPS Antennas	27
Selecting Antennas	27
Antenna Approvals and Safety Considerations	27
Diversity and Power Draw	27
OEM Integration	27
FCC & IC Information to Consumers	27
FCC Grant Notes.....	27
Host Labeling.....	28
Chapter 5 Safety Information.....	29
Handling Precautions	29
Radio Frequency (RF) Safety	29
Sécurité relative aux appareils à radiofréquence (RF).....	29
General Safety.....	30
Interference with Pacemakers and Other Medical Devices	30
Potential interference.....	30
Precautions for pacemaker wearers	30
Vehicle Safety.....	30
Device Maintenance	31
User Responsibility.....	31
Underwriters Laboratories, Inc. Required Global Positioning System (GPS) Statement	31
Chapter 6 Getting Started with the MTQ-H5-B01	32
Developing with an MTQ in mbed	32
MTSAS Library	32
mbed Documentation	32
Programming the MTQ Microcontroller	32
mbed Links	33
MTQ Platform	33
ST Microelectronics STM32F411xC/E	33
Chapter 7 Labels	34
Approvals and Certification.....	34
Example Labels.....	34
Chapter 8 Regulatory Information	35
EMC, Safety, and R&TTE Directive Compliance	35
Additional CE Mark Information	35
47 CFR Part 15 Regulation Class B Devices	35
FCC Interference Notice.....	36
FCC Grant	36
Industry Canada Class B Notice.....	37
Canadian Limitations.....	37
Industry Canada	39

Chapter 9 Environmental Notices	40
Waste Electrical and Electronic Equipment Statement	40
WEEE Directive.....	40
Instructions for Disposal of WEEE by Users in the European Union	40
REACH Statement	41
Registration of Substances.....	41
Substances of Very High Concern (SVHC)	41
Restriction of the Use of Hazardous Substances (RoHS)	42
Information on HS/TS Substances According to Chinese Standards	43
Information on HS/TS Substances According to Chinese Standards (in Chinese)	44
Index	45

Chapter 1 Product Overview

Overview

The MultiConnect® 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 www.multitech.com.

Document	Description	Part Number
Device Guide	This document. Provides model-specific specifications and developer information.	S000627
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 H5 and G3 USB drivers.	S000553
AT Command Addendum and Getting Started Guide	AT Command release notes and basic operations.	S000638 (pending)
Telit 3G Modules AT Commands Guide	Provides AT commands for H5 modems using Telit 12.00.006 firmware.	80378ST10091A Rev 9

Note: If using the MTQ-H5-B01 model, additional documentation is available on the mbed site. See *Chapter 6, Getting Started with the MTQ-H5-B01* for details.

Product Build Options

Product	Description	Region
MTQ-H5-B01	HSPA+ SoM with GNSS	Global
MTQ-H5-B02	HSPA+ embedded modem with GNSS	Global
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.

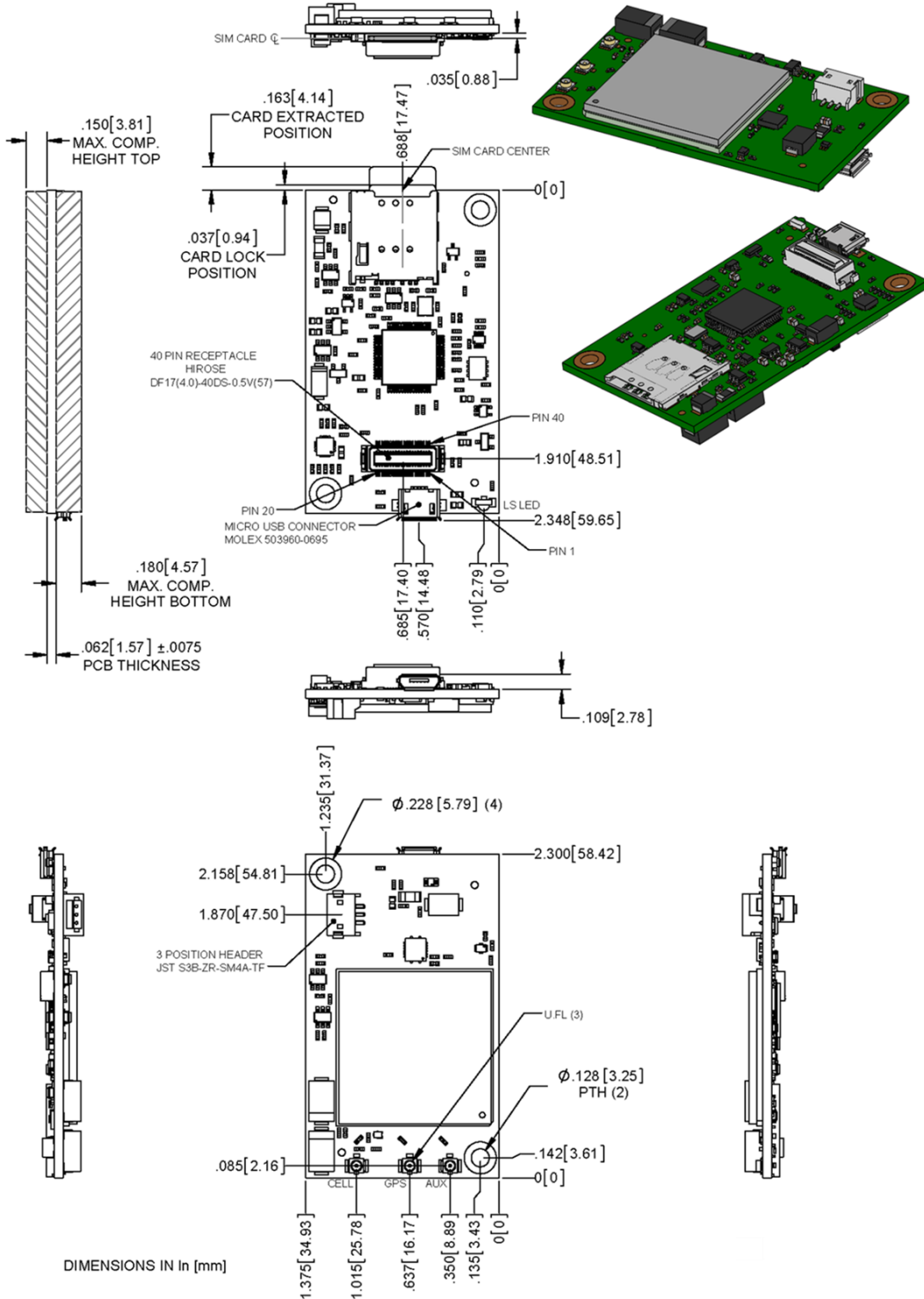
The complete product code may end in .Rx. For example, MTQ-H5-B01.Rx, where R is revision and x is the revision number.

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

Chapter 2 Mechanical Drawings

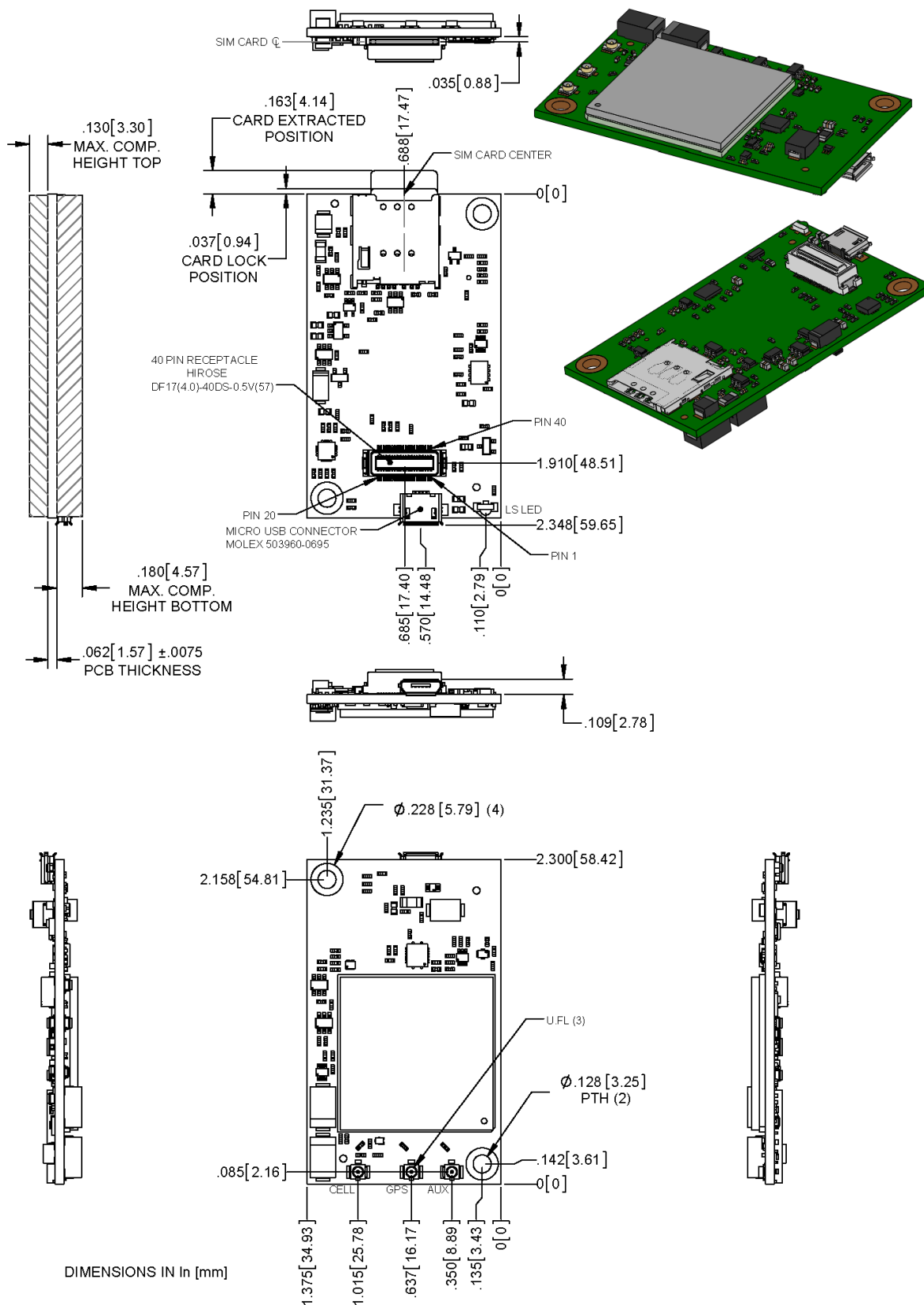
MTQ-H5 Models

Processor Model (-B01)



DIMENSIONS IN In [mm]

No Processor Model (-B02)



Chapter 3 Specifications and Related Information

Specifications

Category	Description
General	
Standards	Penta-band HSPA +21
	Quad-band GSM/GPRS/EDGE
	SMS is based on CS/Packet-Switched (PS) domain of GSM and WCDMA
	USB Interface is CDC-ACM compliant
Frequency Bands	Penta-band HSPA+: 850/900/1700/1900/2100 MHz
	Quad-band GSM/GPRS/EDGE: 850/900/1800/1900 MHz
LED	One, link status
Speed	
Data Speed	HSPA+: Up to 21.0 Mbps downlink/5.76 Mbps uplink
	EDGE: Up to 296 Kbps downlink/236.8 Kbps uplink
	GPRS: Up to 107 Kbps downlink/85.6 Kbps uplink
Interface	
USB Interface	Micro USB 2.0 high speed ¹
UART	B01 models: Full UART to processor, then RX, TX, RTS, CTS only between the processor and radio.
	B02 Models: Full UART
Serial Modem Interface	Up to 921.6 Kbps
Physical Description	
Weight	0.6 oz (17g)
Dimensions	Refer to Mechanical Drawings for details.
Connectors	
Connector	3 surface mount U.FL: cellular, GPS, auxiliary
SIM Holder	1.8 V and 3 V micro
Pin header	40-pin female for USB or UART
Environment²	
Operating Temperature	-40° C to +85° C ³
Storage Temperature	-40° C to +85° C
Humidity	20%-90% RH, non-condensing

Category	Description
Power Requirements	
Operating Voltage	5 V +/- 5%; Max 0.75 Amps
Input Current	3.75 Watts Max
Certifications and Compliance	
EMC and Radio Compliance	FCC Part 15 Class B
	FCC Part 22
	FCC Part 24
	FCC Part 27
	EN 55022 Class B
	EN 55024
	EN 301 489-1
	EN 301 489-3
	EN 301 489-7
	EN 301 489-24
	EN 301 511
EN 301 908-1 V 7.1.1	
Safety Compliance	UL/cUL 60950-1 2nd Edition Am2
	IEC 60950-12nd Edition Am.1 and Am.2
	AS/NZS 60950.1

¹mbed has limited USB support for the processor. Software controls routing to processor or directly to radio.

²Radio performance may be affected by temperature extremes. This is normal.

³Device has been tested up to +85° C. UL Recognized @ 85° C.

Note: Acceptability of the battery charge circuit for charging specific batteries/cells is to be determined in the end product.

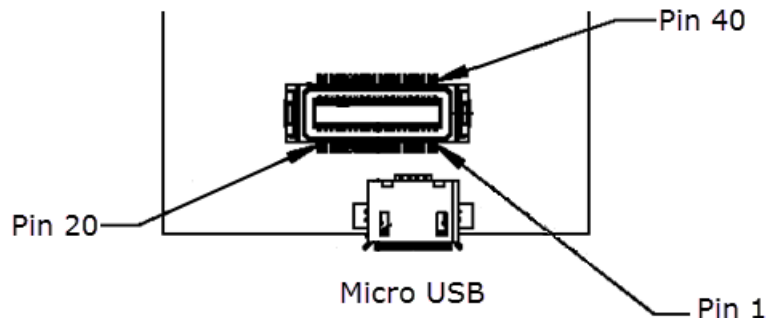
Powering Down Your Device

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

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

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

40-Pin Connector Definitions



MTQ-xx-B01

Signal Name	Pin	Pin	Signal Name
DBG_TX	1	40	DBG_RX
SWCLK	2	39	SWDIO
CHARGE_MON	3	38	SWO
PWR_GOOD	4	37	GND
GND	5	36	GND
USB-DATA+	6	35	RESET
USB-DATA-	7	34	LINK_STATUS
VCC-IN	8	33	VCC-IN
IO_00	9	32	IO_21
IO_01	10	31	IO_20
IO_02	11	30	IO_19
IO_03	12	29	IO_18
GND	13	28	GND
IO_04	14	27	IO_17
IO_05	15	26	IO_16
IO_06	16	25	IO_15
IO_07	17	24	IO_14
IO_08	18	23	IO_13
IO_09	19	22	IO_12
IO_10	20	21	IO_11

MTQ-xx-B02

Signal Name	Pin	Pin	Signal Name
N/C	1	40	N/C
N/C	2	39	N/C
CHARGE_MON	3	38	N/C
PWR_GOOD	4	37	GND
GND	5	36	GND
USB-DATA+	6	35	RESET
USB-DATA-	7	34	LINK_STATUS
VCC-IN	8	33	VCC-IN
RADIO_RXD	9	32	RADIO_TXD
RADIO_DCD	10	31	RADIO_DTR
RADIO_RI	11	30	RADIO_DSR
RADIO_CTS	12	29	RADIO_RTS
GND	13	28	GND
SPI_MOSI	14	27	SPI_CS2
SPI_SCLK	15	26	SPI_MISO
SPI_CS1	16	25	SPI_SRDY
BC_EN1	17	24	N/C
BC_EN2	18	23	N/C
BC__CHARGE_EN	19	22	N/C
N/C	20	21	N/C

40-Pin Connector

Manufacturer:	Hirose Electric Co LTD
Description:	Plug
Model Number:	DF17(2.0)-40DP-0.5V(57)

MTQ-B01 External Pin Alternate Function Mapping

This table shows alternate functions available on the external pins of the MTQ B01 models. These functions are available in mbed and can be redefined by the user. This table also shows which I/O pins are mapped to specific Arduino shield pins on the MultiTech UDK 2.0.

Note: For readability, this table has been split into two parts.

MTQ Pin	MTQ Name	UDK 2.0 Arduino Pin	mbed GPIO ¹	Programming Interface
1	DBG_TX (mbed dbgTX)		PB_6	

MTQ Pin	MTQ Name	UDK 2.0 Arduino Pin	mbed GPIO ¹	Programming Interface
2	J_TCK/SWCLK		PA_14	JTCK-SWCLK
3	J_TDI/C_MON		PA_15	JTDI
4	J_RST/P_GOOD		PB_4	JTRST
9	IO_00/RXD	D1	PA_2	
10	IO_01/DCD	D4	PA_7	
11	IO_02/RI	D8	PB_1	
12	IO_03/CTS	D6	PA_1	
14	IO_04/MOSI	D11	PB_5	
15	IO_05/SCK	D13	PA_5	
16	IO_06/SCL/SS1	D15	PB_8	
17	IO_07	D2	PB_15	
18	IO_08	A0	PC_2	
19	IO_09	A3	PB_0	
20	IO_10	A1	PC_0	
21	IO_11	A4	PC_1	
22	IO_12	A2	PC_4	
23	IO_13	D9	PB_13	
24	IO_14	A5	PC_9	
25	IO_15/SDA/SRDY	D14	PB_9	
26	IO_16/MISO	D12	PA_6	
27	IO_17/SS2	D10	PC_8	
29	IO_18/RTS	D3	PA_0-WKUP	
30	IO_19/DSR	D5	PA_9	
31	IO_20/DTR	D7	PA_8	
32	IO_21/TXD	D0	PA_3	
38	J_TDO/SWO		PB_3	JTDO-SWO
39	J_TMS/SWDIO		PA_13	JTMS-SWDIO
40	DBG_RX (mbed dbgRX)		PB_7	

¹For the ST microprocessor, the pin names are the same, but the underscore is removed.

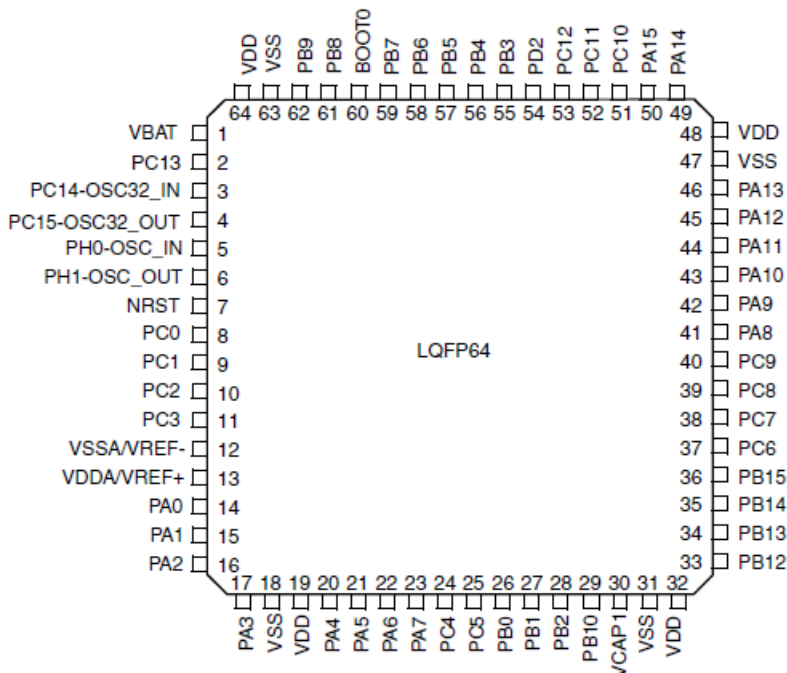
MTQ Pin	SPI Interface	I2C Interface	USARTs	Timer Functions	SDIO Functions	Event Trigger Output	ADC Channels
1		I2C1_SCL	USART1_TX	TIM4_CH1		EVENTOUT	
2						EVENTOUT	

MTQ Pin	SPI Interface	I2C Interface	USARTs	Timer Functions	SDIO Functions	Event Trigger Output	ADC Channels
3	SPI1_NSS		USART1_TX	TIM2_CH1/ TIM2_ETR		EVENTOUT	
4	SPI1_MISO	I2C3_SDA		TIM3_CH1	SDIO_D0	EVENTOUT	
9			USART2_TX	TIM2_CH3, TIM5_CH3, TIM9_CH1		EVENTOUT	ADC1_2
10	SPI1_MOSI			TIM1_CH1N, TIM3_CH2		EVENTOUT	ADC1_7
11				TIM1_CH3N TIM3_CH4,		EVENTOUT	ADC1_9
12			USART2_RTS	TIM2_CH2, TIM5_CH2		EVENTOUT	ADC1_1
14	SPI1_MOSI	I2C1_SMBA		TIM3_CH2	SDIO_D3	EVENTOUT	
15	SPI1_SCK			TIM2_CH1/ TIM2_ET		EVENTOUT	ADC1_5
16		I2C1_SCL, I2C3_SDA		TIM4_CH3, TIM10_CH1		EVENTOUT	
17	SPI2_MOSI			TIM1_CH3N	SDIO_CK	EVENTOUT	
18	SPI2_MISO					EVENTOUT	ADC1_12
19				TIM1_CH2N, TIM3_CH3		EVENTOUT	ADC1_8
20						EVENTOUT	ADC1_10
21						EVENTOUT	ADC1_11
22						EVENTOUT	ADC1_14
23	SPI2_SCK			TIM1_CH1N		EVENTOUT	
24		I2C3_SDA		MCO_2, TIM3_CH4	SDIO_D1	EVENTOUT	
25	SPI2_NSS	I2C1_SDA		TIM4_CH4, TIM11_CH1		EVENTOUT	
26	SPI1_MISO			TIM1_BKIN, TIM3_CH1	SDIO_CMD	EVENTOUT	ADC1_6
27				TIM3_CH3	SDIO_D0	EVENTOUT	
29			USART2_CTS	TIM2_CH1/ TIM2_ET, TIM5_CH1,		EVENTOUT	ADC1_0
30		I2C3_SMBA	USART1_TX	TIM1_CH2	SDIO_D2	EVENTOUT	

MTQ Pin	SPI Interface	I2C Interface	USARTs	Timer Functions	SDIO Functions	Event Trigger Output	ADC Channels
31		I2C3_SCL		MCO_1, TIM1_CH1	SDIO_D1	EVENTOUT	
32			USART2_RX	TIM2_CH4, TIM5_CH4, TIM9_CH2		EVENTOUT	ADC1_3
38	SPI1_SCK		USART1_RX	TIM2_CH2		EVENTOUT	
39						EVENTOUT	
40		I2C1_SDA	USART1_RX	TIM4_CH2	SDIO_D0	EVENTOUT	
3	SPI1_NSS		USART1_TX	TIM2_CH1/ TIM2_ETR		EVENTOUT	
4	SPI1_MISO	I2C3_SDA		TIM3_CH1	SDIO_D0	EVENTOUT	
9			USART2_TX	TIM2_CH3, TIM5_CH3, TIM9_CH1		EVENTOUT	ADC1_2
10	SPI1_MOSI			TIM1_CH1N, TIM3_CH2		EVENTOUT	ADC1_7
11				TIM1_CH3N TIM3_CH4,		EVENTOUT	ADC1_9
12			USART2_RTS	TIM2_CH2, TIM5_CH2		EVENTOUT	ADC1_1
14	SPI1_MOSI	I2C1_SMBA		TIM3_CH2	SDIO_D3	EVENTOUT	
15	SPI1_SCK			TIM2_CH1/ TIM2_ET		EVENTOUT	ADC1_5
16		I2C1_SCL, I2C3_SDA		TIM4_CH3, TIM10_CH1		EVENTOUT	
17	SPI2_MOSI			TIM1_CH3N	SDIO_CK	EVENTOUT	
18	SPI2_MISO					EVENTOUT	ADC1_12
19				TIM1_CH2N, TIM3_CH3		EVENTOUT	ADC1_8
20						EVENTOUT	ADC1_10
21						EVENTOUT	ADC1_11
22						EVENTOUT	ADC1_14
23	SPI2_SCK			TIM1_CH1N		EVENTOUT	
24		I2C3_SDA		MCO_2, TIM3_CH4	SDIO_D1	EVENTOUT	
25	SPI2_NSS	I2C1_SDA		TIM4_CH4, TIM11_CH1		EVENTOUT	

MTQ Pin	SPI Interface	I2C Interface	USARTs	Timer Functions	SDIO Functions	Event Trigger Output	ADC Channels
26	SPI1_MISO			TIM1_BKIN, TIM3_CH1	SDIO_CMD	EVENTOUT	ADC1_6
27				TIM3_CH3	SDIO_D0	EVENTOUT	
29			USART2_CTS	TIM2_CH1/ TIM2_ET, TIM5_CH1,		EVENTOUT	ADC1_0
30		I2C3_SMBA	USART1_TX	TIM1_CH2	SDIO_D2	EVENTOUT	
31		I2C3_SCL		MCO_1, TIM1_CH1	SDIO_D1	EVENTOUT	
32			USART2_RX	TIM2_CH4, TIM5_CH4, TIM9_CH2		EVENTOUT	ADC1_3
38	SPI1_SCK		USART1_RX	TIM2_CH2		EVENTOUT	
39						EVENTOUT	
40		I2C1_SDA	USART1_RX	TIM4_CH2	SDIO_D0	EVENTOUT	

MTQ-B01 Processor Pin Information



Note: Diagram from the STMicro32F411 datasheet.

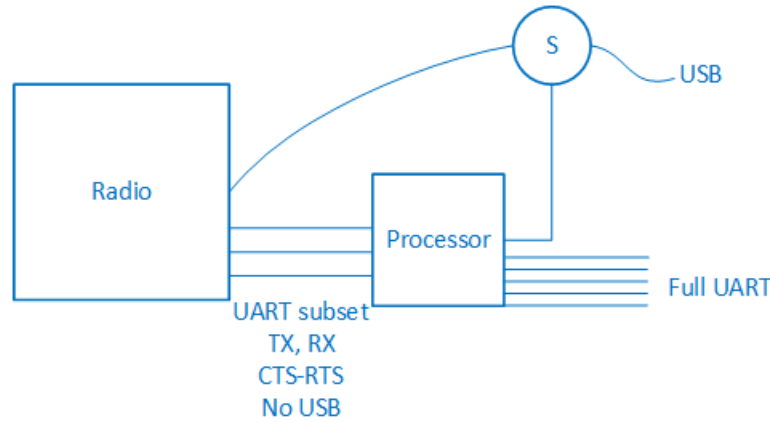
This table show STMicro pins and how the MTQ uses them.

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	SPI1 Select
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	Not used, reserved for interoperability
RADIO_RTS	29	PB10	erial 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=STM
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	EPROM/SPI3_SCK
SPI-MISO	52	PC11	EPROM/SPI3_MISO
SPI-MOSI	53	PC12	EPROM/SPI3_MOSI
SPI-SRDY	54	PD2	EPROM/SPI3_SRDY
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
VDD3_3	64 V	DD_3	Power

Communications Flow

MTQ-xx-B01 (Processor Model)



Note:

- The B01 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 or a connection to the processor. The USB selection is controlled via programming on the processor. There is no USB between the radio and the processor.

MTQ-xx-B02 (No Processor Model)



Note: B02 provides a full UART interface as well as a USB interface.

Electrical Characteristics

Operating Conditions

Parameter	Minimum Volts	Maximum Volts
Supply Range - Vcc	4.35	10.2

Absolute Maximum Rating

Parameter	Minimum Volts	Maximum Volts
Voltage at any signal pin	-0.3	5

DC Electrical Characteristics

Parameter	Minimum Volts	Maximum Volts
Digital signal input low level	-0.3	0.45
Digital signal input high level	1.4	5
Digital signal output low level 8 mA draw ¹	--	0.4
Digital signal output high level 8 mA draw ¹	2.6	--
Reset (low active) input low	--	0.99
Reset (low active) input high	2.31	--

¹All signals except PWR_GOOD and CHG_MON.

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

Digital input capacitance	5 pF
---------------------------	------

Power Draw

MTQ-H5-B01 (Processor)

Radio Protocol	Sleep Mode Current (Amps)	Cellular Call Box Connection No Data (Amps)	(AVG) Measured Current (Amps) at Max Power ¹	TX Pulse ² (AVG) Amplitude Current (Amps) for GSM850 or Peak Current for HSDPA	Total Inrush Charge ³ Measured in Millicoulombs (mC)
5 Volts, USB					
GSM 850Mhz	0.025	0.063	0.334	0.955	3.63
HSDPA 1800Mhz	0.025	0.064	0.635	0.684	3.63

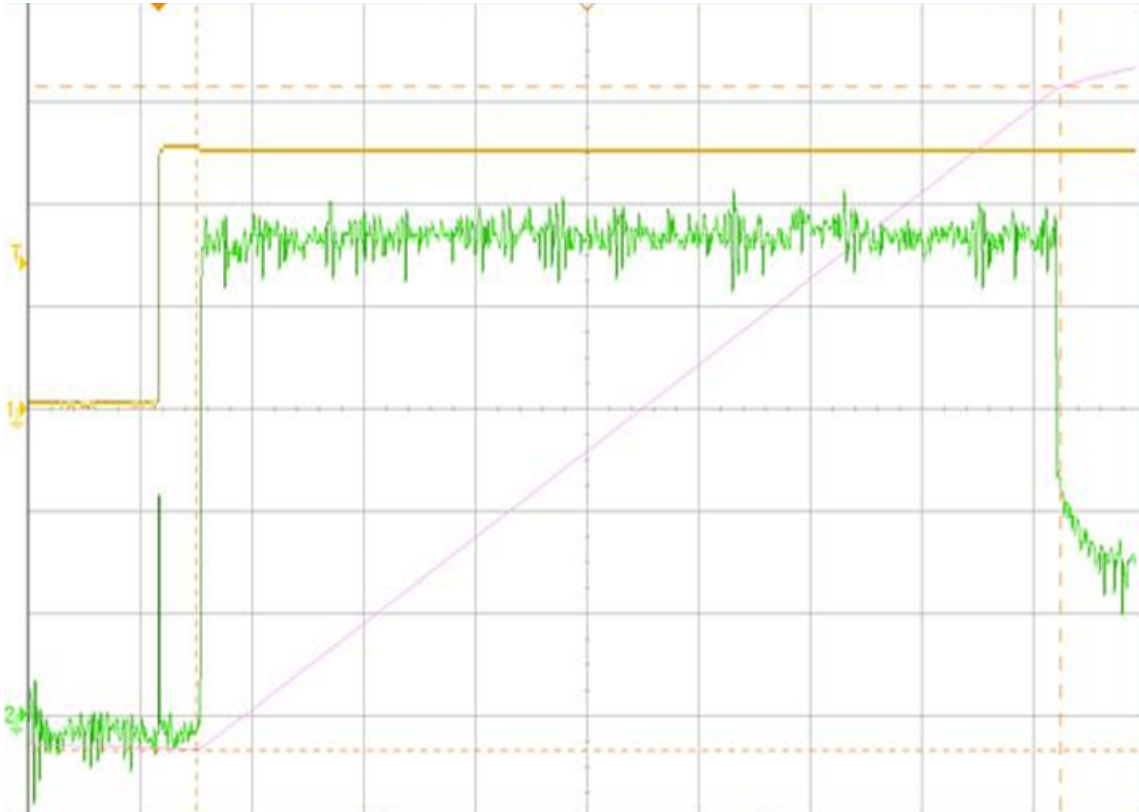
¹**Maximum Power:** The continuous current during maximum data rate with the radio transmitter at maximum power.

²**Tx Pulse:** The average peak current during 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.).

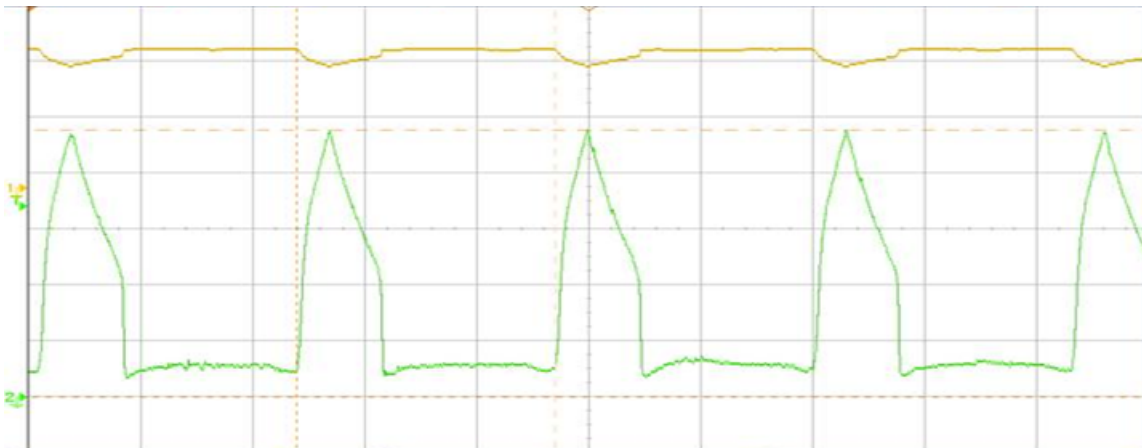
³**Inrush Charge:** The total inrush charge at power on.

Waveforms

USB only, inrush current of 3.63mC with 38.7mS duration



USB only GSM850 Burst Current of .955 Amps



MTQ-H5-B02 (No Processor)

Radio Protocol	Sleep Mode Current (Amps)	Cellular Call Box Connection No Data (Amps)	(AVG) Measured Current (Amps) at Max Power ¹	TX Pulse ² (AVG) Amplitude Current (Amps) for GSM850 or Peak Current for HSDPA)	Total Inrush Charge ³ Measured in Millicoulombs (mC)
5 Volts, USB only, no developer board					
GSM 850Mhz	0.035	0.041	0.316	0.965	3.28
HSDPA 1800Mhz	0.036	0.042	0.676	0.692	3.28

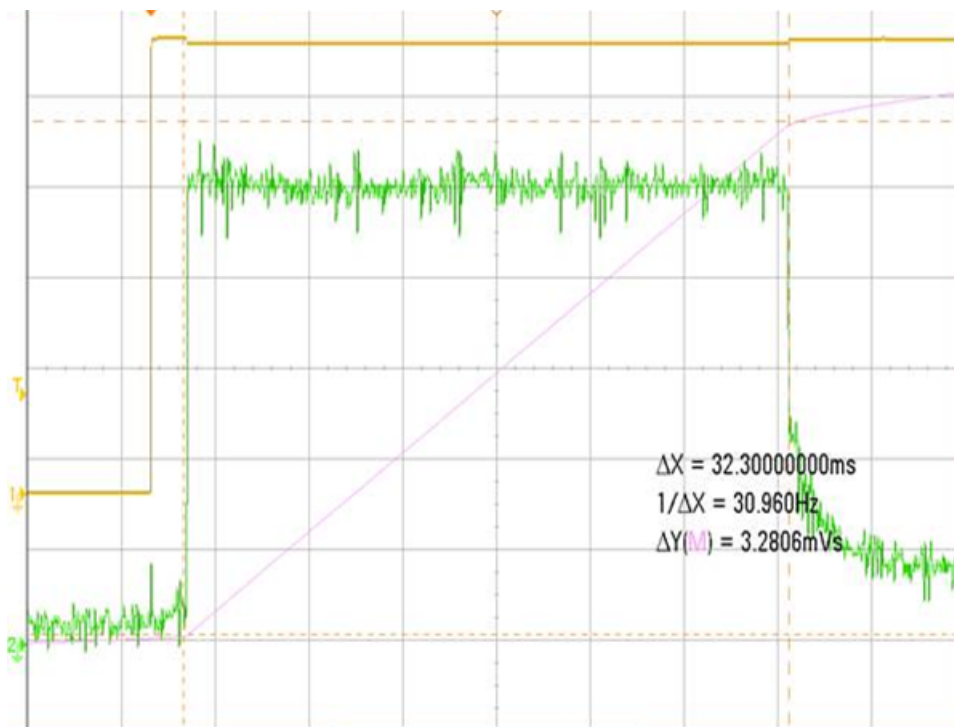
¹**Maximum Power:** The continuous current during maximum data rate with the radio transmitter at maximum power.

²**Tx Pulse:** The average peak current during 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.).

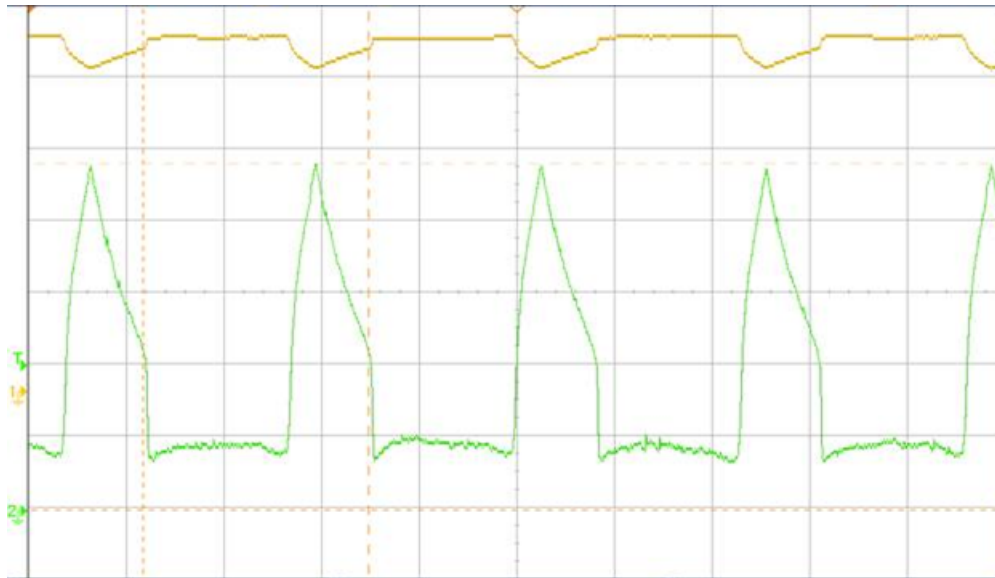
³**Inrush Charge:** The total inrush charge at power on.

Waveforms

USB only, inrush current of 3.28mC with 32.3mS duration



USB only GSM850 Burst Current of .965 Amps



USB Cable Recommendations

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

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

Chapter 4 Antennas

External Antenna Option

Wieson LTE Antennas

Devices were approved with the following antenna:

Manufacturer:	Wieson
Description:	LTE GY115HT467-017
Model Number:	11320Y11194A1
Multi-Tech Part Number:	45009890L

MultiTech ordering information:

Model	Quantity
ANLTE2-1HRA	1
ANLTE2-10HRA	10
ANLTE2-50HRA	50

Antenna Specifications

Category	Description
Frequency Range	.069~0.96GHz, 1.71~2.17GHz, 2.3GHz~2.69GHz
Impedance	50 Ohms
VSWR	VSWR should not exceed 3:1 at any point across the bands of operation
Peak Gain	3.53 dBi
Radiation	Omni-directional
Polarization	Linear Vertical

Internal Antenna Option

Ethertronics Prestta Standard Octa-Band Antenna

Manufacturer:	Ethertronics
Description:	Octo-Band Embedded Antenna, 100mm Cable
Model Number:	1002292
MultiTech Part Number:	45009583L

MultiTech ordering information:

Ordering Part Number	Quantity
ANOB-1EMB	1
ANOB-10EMB	10
ANOB-50EMB	50

Antenna Specifications

Category	Low Band	High Band
Frequency Range	704-960 MHz	1710-2200 MHz
Gain	3.0 dBi	5.0 dBi
VSWR	3:1 max, 5:1 max (LTE B13/B17)	
Impedance	50 ohms unbalanced	
Radiation	Omni-directional	
Polarization	Linear	

SMA to U.FL Cables

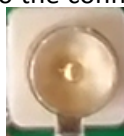
The developer kit includes three 4.5" SMA to U.FL cables which are preinstalled on the developer board. Consult the mechanical drawings for your device to determine which antenna to connect to which U.FL connector on the device.

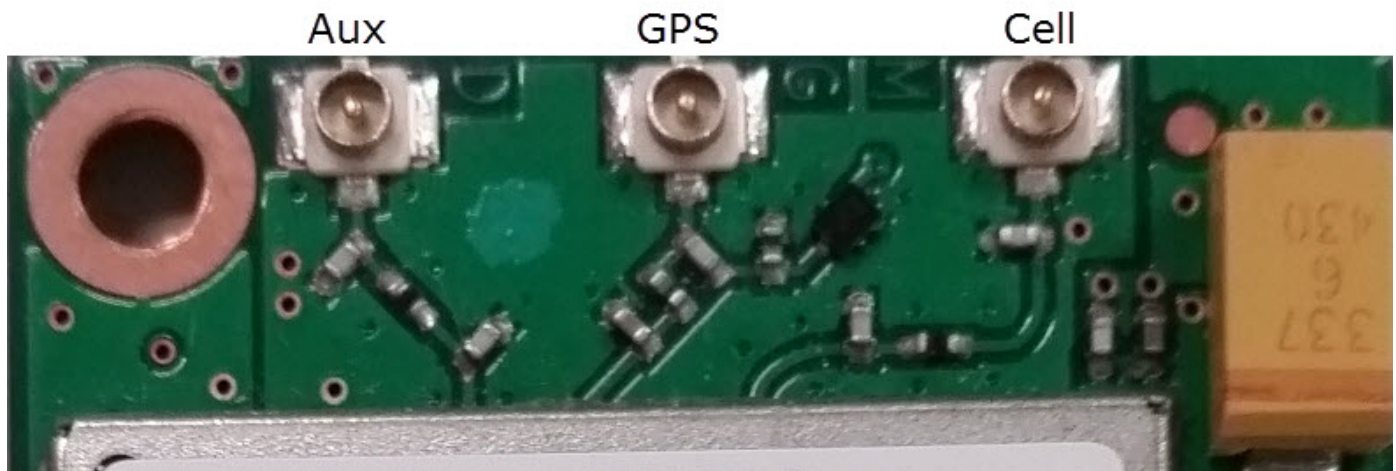


Connecting an Antenna through the Developer Board Connectors

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.





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.

Using Antenna Diversity

You can use an AT command to turn antenna diversity on and off. When antenna diversity is on and a like or similar antenna is installed on both radio connectors, the radio automatically chooses the antenna with the best reception. To learn about the AT command used to control diversity, see the AT Command Reference guide for your device.

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

Selecting Antennas

Select an antenna based on your product and application. Typically, both diversity 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.

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 modem 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

Radiofrequency 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 the 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 vehicles or outdoor applications or in ambient temperatures above 40° C.

Device Maintenance

When maintaining your device:

- Do not attempt to disassemble the device. There are no user serviceable parts inside.
- Do not expose your device to any extreme environment where the temperature or humidity is high.
- Do not expose the device to water, rain, or spilled beverages. It is not waterproof.
- 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.

Underwriters Laboratories, Inc. Required Global Positioning System (GPS) Statement

Note the following information required by Underwriters Laboratories: Underwriters Laboratories, Inc.

Underwriters Laboratories Inc. ("UL") has not tested the performance or reliability of the Global Positioning System ("GPS") hardware, operating software or other aspects of this product. UL has only tested for fire, shock or casualties as outlined in UL's Standard(s) for Safety. UL60950-1 Certification does not cover the performance or reliability of the GPS hardware and GPS operating software. UL MAKES NO REPRESENTATIONS, WARRANTIES OR CERTIFICATIONS WHATSOEVER REGARDING THE PERFORMANCE OR RELIABILITY OF ANY GPS RELATED FUNCTIONS OF THIS PRODUCT.

Chapter 6 Getting Started with the MTQ-H5-B01

Developing with an MTQ in mbed

Build applications written for the MTQ on top of the mbed 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 UKD2 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. Enable RTS/CTS flow control on terminal emulators used with the AT pass-through firmware.

MTSAS Library

The MTSAS software library on mbed provides a consistent interface to the cellular radio on each MTQ module. The interface includes:

- TCP sockets.
- UDP sockets.
- HTTP/HTTPS requests.
- SMS messaging.
- GPS if supported by the radio.
- Access to common radio information like signal strength, registration, etc .

The library provides an easy-to-use API for interacting with the cellular radio. It identifies the radio and uses proper AT commands for that radio type, which allows the same application to run on multiple MTQ models with no software changes. The library and example programs are available at:

<https://developer.mbed.org/platforms/MTS-Dragonfly/>

mbed 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>

MTQ Platform

The MTQ mbed page includes the MTSAS library and example programs.

<https://developer.mbed.org/platforms/MTS-Dragonfly>

ST Microelectronics STM32F411xC/E

For information on the STM32F411xC/E microcontroller, refer to:

- **Reference Manual:** http://www.st.com/st-web-ui/static/active/en/resource/technical/document/reference_manual/DM00119316.pdf
- **Datasheet:** <http://www.st.com/web/en/resource/technical/document/datasheet/DM00115249.pdf>

Chapter 7 Labels

Approvals and Certification

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

- **PTCRB Requirements:** The antenna system cannot be altered.
- **Model Identification:** The Multi-Tech 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.

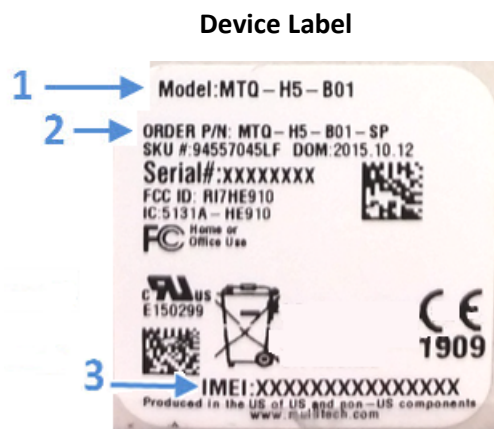
Example Labels

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



Chapter 8 Regulatory Information

EMC, Safety, and R&TTE Directive Compliance



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

Council Directive 2004/108/EC of 15 December 2004 on the approximation of the laws of Member States relating to electromagnetic compatibility;

and

Council Directive 2006/95/EC of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;

and

Council Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment;

and

Council Directive 1999/5/EC of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

Additional CE Mark Information

RF spectrum use (R&TTE art. 3.2)	EN 301 511 V9.0.2 EN 301 908-1 V5.2.1 EN 301 908-2 V5.2.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.9.2 EN 301 489-7 V1.3.1 EN 301 489-24 V1.5.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + AC:2011 EN 62311:2008

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

FCC Grant Part 15

FCC Identifier	RI7HE910
Equipment Class	Part 15 Class Computing Device Peripheral
Notes	WWAN Module
FCC Rule Parts	15B
Approval	Single Modular

FCC Grant Part 22 and 24

FCC Identifier	RI7HE910
Equipment Class	PCS Licensed Transmitter
Notes	WWAN Module
FCC Rule Parts	22H, 24E
Approval	Single Modular

FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designators
22H	824.2 - 824.2	1.995	1.0 PM	300KGXW
22H	824.2 - 848.8	0.997	1.0 PM	1M29F9W
22H	826.4 - 846.4	0.446	1.0 PM	4M20F9W
27	1712.4 - 1752.6	0.226	1.0 PM	4M20F9W
24E	1850.2 - 1909.8	0.993	1.0 PM	300KGXW
24E	1850.2 - 1909.8	0.38	1.0 PM	300KG7W
24E	1852.4 - 1907.6	0.243	1.0 PM	4M20F9W

Power listed is conducted. The maximum antenna gain including cable loss for compliance with radiated power limits, RF exposure requirements and the categorical exclusion requirements of 2.1091 is 5.22 dBi for part 22H, 3.31 dBi for part 24E and 6.45 dBi for part 27. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operated in conjunction with any antenna or transmitter not described under this FCC id, except in accordance with FCC multi-transmitter

product procedures. 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. 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, spurious emissions, ERP/EIRP, and host/module authentication, or new application if appropriate.

This device contains GSM functions that are not operational in the U.S. Territories. This filing is only applicable for U.S. operations..

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 RSS Appliance radio exempt from licensing. The operation is permitted for the following two conditions:

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

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

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

Canadian Limitations

Notice: This equipment meets the applicable Industry Canada Terminal Equipment Technical Specifications. This is confirmed by the registration number. The abbreviation, IC, before the registration number signifies that registration was performed based on a Declaration of Conformity indicating that Industry Canada technical specifications were met. It does not imply that Industry Canada approved the equipment.

Notice: The REN assigned to each terminal equipment provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed five.

Limitations canadiennes

Avis: Cet équipement respecte les spécifications techniques des équipements terminaux d'Industrie Canada. Cette conformité est confirmée par le numéro d'enregistrement. L'abréviation IC précédant le numéro d'enregistrement signifie que l'enregistrement a été effectué conformément à une Déclaration de Conformité indiquant que les spécifications techniques d'Industrie Canada ont été respectées. Ceci n'indique pas que cet équipement a été approuvé par Industrie Canada.

Avis: L'IES (indice d'équivalence de la sonnerie) attribué à chaque terminal fournit une indication du nombre maximal de terminaux pouvant être connectés à une interface téléphonique. La terminaison d'une interface peut

être constituée de n'importe quelle combinaison d'appareils à la seule condition que la somme des indices d'équivalence de sonnerie de l'ensemble des appareils ne dépasse pas cinq.

Industry Canada

Certification Number/No. de Certification	5131A-HE910
Type of Radio Equipment/Genre de Matériel	Modular Approval
	Advanced Wireless Services Equipment/Matériel des services sans fil évolués (1710-1755 MHz and 2110-2155 MHz)
	Cellular Mobile GSM/ Téléphone cellulaire mobile GSM (824-849 MHz)
	Cellular Mobile New Technologies/Téléphone cellulaire mobile - Nouvelles technologies (824-849 MHz)
	PCS Mobile/Téléphone mobile SCP (1850-1910 MHz)
Model/Modèle	HE910

Specification/Chargier des Charges	Issue/Édition	From Frequency/D e Fréquences	To Frequency/À Fréquences	Emission Designation/Designation D'émission	Minimum Power	Maximum Power
RSS133	5.0	1.85 G	1.91 G	241KGXW	993 mW	993 mW
RSS133	5.0	1.852 G	1.908 G	4M09F9W	243 mW	243 mW
RSS132	2.0	824.2 M	848.8 M	248KG7W	997 mW	997 mW
RSS139	2.0	1.712 G	1.753 G	4M06F9W	226 mW	226 mW
RSS133	5.0	1.85 G	1.91 G	252KG7W	380 mW	380 mW
RSS132	2.0	826.4 M	846.4 M	4M07F9W 446	446 mW	446 mW
RSS132	2.0	824.2 M	848.8 M	240KGXW	1.995 mW	1.995 mW

Certification of equipment means only that the equipment has met the requirements of the above noted specification. License applications, where applicable to use certified equipment, are acted on accordingly by the Industry Canada issuing office and will depend on the existing radio environment, service and location of operation. This certificate is issued on condition that the holder complies and will continue to comply with the requirements and procedures issued by Industry Canada. The equipment for which this certificate is issued shall not be manufactured, imported distributed, leased, offered for sale or sold unless the equipment complies with the applicable technical specifications and procedures issued by Industry Canada.

La certification du matériel signifie seulement que le matériel a satisfait aux exigences de la norme indiquée ci-dessus. Les demandes de licences nécessaires pour l'utilisation du matériel certifié sont traitées en conséquence par le bureau de délivrance d'Industrie Canada et dépendent des conditions radio ambiantes, du service et de l'emplacement d'exploitation. Le présent certificat est délivré à la condition que le titulaire satisfasse et continue de satisfaire aux exigences et aux procédures d'Industrie Canada. Le matériel à l'égard duquel le présent certificat est délivré ne doit pas être fabriqué, importé, distribué, loué, mis en vente ou vendu à moins d'être conforme aux procédures et aux spécifications techniques applicable publiées par Industrie Canada.

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

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 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, that exceeds 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.

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.

Information on HS/TS Substances According to Chinese Standards

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

Hazardous/Toxic Substance/Elements

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

X Represents that the concentration of such hazardous/toxic substance in all the units of homogeneous material of such component is higher than the SJ/Txxx-2006 Requirements for Concentration Limits.

O Represents that no such substances are used or that the concentration is within the aforementioned limits.

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

依照中国标准的有毒有害物质信息

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

有害/有毒物质/元素

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

X 表示所有使用类似材料的设备中有害/有毒物质的含量水平高于 SJ/Txxx-2006 限量要求。

O 表示不含该物质或者该物质的含量水平在上述限量要求之内。

Index

#IMPLIED

40-pin connector.....12

A

absolute maximum rating.....19

antenna

connecting25

diversity.....26

internal.....24

LTE.....24

AT passthrough32

AT#SHDN10

B

build options6

C

cable.....25

certification

Industry Canada39

Chinese hazardous substances

Chinese version.....44

English version43

Class B35

Industry Canada37

D

device

maintenance31

diversity.....26

documentation.....6

E

electrical characteristics.....19

F

FCC

grant notes.....27

FCC Notice

Class B35

firmware.....32

G

GPS31

H

hazardous substances42

host labeling.....27

I

IMEI location34

Industrie Canada37

Industry Canada37 39

Class B37

interférence des radiofréquences.....29

K

KDB 447498 Section 827

L

labeling

host27

labels34

library32

LTE

antenna.....24

M

maintenance31

mbed32

mechanical drawings.....7

modem

safety30

O

operating conditions19

P	
pin	
assignment.....	12
connector definitions.....	11
processor	16
power down	10
power draw	
MTQ-H5-B01	20
MTQ-H5-B02	22
processor pins	16
R	
radio frequency interference.....	29
RoHS.....	42
S	
safety	
modem.....	30
RF interference	29
vehicle	30
shutdown	10
SMA to U.FL.....	25
SMA to U.FL cable	25
specifications.....	9
static.....	29
sécurité	
interférences RF.....	29
U	
U.FL	25
UL	31
user responsibility.....	31
V	
vehicle safety	30