

MultiConnect™ PCIe

MTPCIE-H5/MTPCIE-BW Developer Guide

MultiConnect PCIe Developer Guide

Models: MTPCIE-H5-xx, MTPCIE-BW

Part Number: S000538, Version 1.2 USA and Canada Edition

Copyright

This publication may not be reproduced, in whole or in part, without the specific and express prior written permission signed by an executive officer of Multi-Tech Systems, Inc. All rights reserved. **Copyright © 2013 by Multi-Tech Systems, Inc.**

Multi-Tech Systems, Inc. makes no representations or warranties, whether express, implied or by estoppels, with respect to the content, information, material and recommendations herein and specifically disclaims any implied warranties of merchantability, fitness for any particular purpose and non-infringement.

Multi-Tech Systems, Inc. reserves the right to revise this publication and to make changes from time to time in the content hereof without obligation of Multi-Tech Systems, Inc. to notify any person or organization of such revisions or changes.

Trademarks

Multi-Tech, SocketModem, and the Multi-Tech logo are registered trademarks of Multi-Tech Systems, Inc. MultiConnect is a trademark of Multi-Tech System. All other brand and product names are trademarks or registered trademarks of their respective companies.

Legal Notices

The Multi-Tech products are not designed, manufactured or intended for use, and should not be used, or sold or re-sold for use, in connection with applications requiring fail-safe performance or in applications where the failure of the products would reasonably be expected to result in personal injury or death, significant property damage, or serious physical or environmental damage. Examples of such use include life support machines or other life preserving medical devices or systems, air traffic control or aircraft navigation or communications systems, control equipment for nuclear facilities, or missile, nuclear, biological or chemical weapons or other military applications ("Restricted Applications"). Use of the products in such Restricted Applications is at the user's sole risk and liability.

MULTI-TECH DOES NOT WARRANT THAT THE TRANSMISSION OF DATA BY A PRODUCT OVER A CELLULAR COMMUNICATIONS NETWORK WILL BE UNINTERRUPTED, TIMELY, SECURE OR ERROR FREE, NOR DOES MULTI-TECH WARRANT ANY CONNECTION OR ACCESSIBILITY TO ANY CELLULAR COMMUNICATIONS NETWORK. MULTI-TECH WILL HAVE NO LIABILITY FOR ANY LOSSES, DAMAGES, OBLIGATIONS, PENALTIES, DEFICIENCIES, LIABILITIES, COSTS OR EXPENSES (INCLUDING WITHOUT LIMITATION REASONABLE ATTORNEYS FEES) RELATED TO TEMPORARY INABILITY TO ACCESS A CELLULAR COMMUNICATIONS NETWORK USING THE PRODUCTS.

The Multi-Tech products and the final application of the Multi-Tech products should be thoroughly tested to ensure the functionality of the Multi-Tech products as used in the final application. The designer, manufacturer and reseller has the sole responsibility of ensuring that any end user product into which the Multi-Tech product is integrated operates as intended and meets its requirements or the requirements of its direct or indirect customers. Multi-Tech has no responsibility whatsoever for the integration, configuration, testing, validation, verification, installation, upgrade, support or maintenance of such end user product, or for any liabilities, damages, costs or expenses associated therewith, except to the extent agreed upon in a signed written document. To the extent Multi-Tech provides any comments or suggested changes related to the application of its products, such comments or suggested changes is performed only as a courtesy and without any representation or warranty whatsoever.

Contacting Multi-Tech

Knowledge Base

The Knowledge Base provides immediate access to support information and resolutions for all Multi-Tech products. Visit <http://www.multitech.com/kb.go>.

Support Portal

To create an account and submit a support case directly to our technical support team, visit: <https://support.multitech.com>.

Support

Business Hours: M-F, 9am to 5pm CT

Country	By Email	By Phone
Europe, Middle East, Africa:	support@multitech.co.uk	+(44) 118 959 7774
U.S., Canada, all others:	support@multitech.com	(800) 972-2439 or (763) 717-5863

Warranty

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

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

Product Overview	6
About MultiConnect PCIe.....	6
Documentation	6
Developer Kit Contents	6
Attaching Power Supply Blades	6
Power Supply and Blades.....	6
Attaching the Blades	7
Pinout	8
Multi-Tech Mini PCIe Pinout	8
Standard Mini-PCI Express Pinout	11
Pinout for Cellular USB Only	13
Design Considerations.....	14
Design Consideration	14
Noise Suppression Design	14
PC Board Layout Guideline	14
Electromagnetic Interference	14
Electrostatic Discharge Control.....	15
USB Design	15
Developer Board and Schematics.....	16
Developer Board	16
Assembly Diagram.....	18
Top	18
Bottom	19
Developer Board Block Diagram	20
Developer Board Schematics	21
Board Components	30
Installing a Communications Device onto the Board.....	31
Installing a SIM Card	31
Safety Notices and Warnings	32
Radio Frequency (RF) Safety	32
Sécurité des fréquences radio	32
Vehicle Safety.....	32
User Responsibility.....	33
Device Maintenance	33
Notice regarding Compliance with FCC and Industry Canada Requirements for RF Exposure	33
Labeling Requirements	34
Approvals and Certification.....	34

Example HSPA+ H5 Labels.....	34
Host Labeling.....	35
Regulatory Statements	36
R&TTE Directive Compliance	36
Restriction of the Use of Hazardous Substances (RoHS)	37
International Modem Restrictions	37
Industry Canada and FCC	37
Requirements for Cellular Antennas with regard to FCC/IC Compliance	38
Industry Canada and FCC Identification Numbers	38
Environmental Notices.....	39
Waste Electrical and Electronic Equipment Statement	39
WEEE Directive.....	39
Instructions for Disposal of WEEE by Users in the European Union	39
Information on HS/TS Substances According to Chinese Standards	40
Information on HS/TS Substances According to Chinese Standards (in Chinese)	41
Antennas, Cables, GPS	42
Antenna System Cellular Devices.....	42
FCC and IC Antenna Requirements Toward License Exempt Radio Transmitters (Bluetooth/Wlan).....	42
Notice regarding Compliance with FCC and Industry Canada Requirements for RF Exposure	42
Cellular Antenna Information	42
Antenna Cable Information	43
GPS Antennas.....	44
Bluetooth and Wi-Fi Antenna Specifications	44
OEM Integration	45
Device Overview	47
Description	47
Product Build Options	47
Account Activation for Cellular Devices	47
Bluetooth/Wi-Fi	47
Mechanical Drawing	49
MTPCIE-H5-xx.....	49
MTPCIE-BW	50
Specifications.....	51
MTPCIE-H5 Specifications	51
MTPCIE-H5 DC Electrical Characteristics.....	53
Absolute Maximum Rating.....	53
PCIE Connector Leads	53
Typical Power Flow	59
Power Measurements.....	60
MTPCIE-H5	60

MTPCIE-H5-V-BW	60
MTPCIE-BW	60
Application Notes	61
RF Performances	61
Receiver Features for Cellular Devices	61
Frequency Bands	62
Installing Drivers for Non-UIP HSPA+ Devices.....	63
HSPA+ Device Driver Installation	63
Installing on Linux	63
Windows Release Notes	64
Downloading the Windows USB Driver	64
Windows Notes	64
Installing on Windows 8, 7 or Vista	65
Installing on Windows XP	66
Uninstalling Windows Drivers	67
Remove Microsoft Installed Drivers.....	67
Developer Note	68
Using Linux with H5 Devices	69
Shell Commands.....	69
Testing Serial Ports.....	69
Create a PPP Connection	69
Example.....	69
C Programming.....	70
open().....	70
read().....	71
write().....	72
close().....	72
Test Program()	73
Index.....	75

Product Overview

About MultiConnect PCIe

The MultiConnect™ PCIe embedded cellular modem is a complete, ready-to-integrate communications device that offers standard-based penta-band HSPA+ 21, dual-band EV-DO Rev A, or CDMA performance. This quick-to-market communications device allows developers to add wireless communication and GPS tracking to products with a minimum of development time and expense. The MultiConnect PCIe embedded cellular modem is based on industry-standard open interfaces and utilizes a PCI Express Mini Card form factor.

Documentation

The following documentation is available by email to oemsales@multitech.com or by using the Developer Guide Request Form at www.multitech.com.

- **MultiConnect PCIe Developer Guide** – This document. Provides an overview, safety and regulatory information, design considerations, schematics, and device information for developers.
- **AT Command Guide** – Device specific AT command reference guide.

Developer Kit Contents

Your Developer Kit (MTPCIE-DK1) includes the following:

Developer Board	1 - MTPCIE-DK Developer Board
Power Supply	1 - 100-240V 9V-1.7A power supply with removable blades, 1 - US blade/plug, 1 - EURO blade/plug, 1 - UK blade/plug
Cables	1 - RS-232 DB9F-DB9M serial cable, 1 - RJ-45 Ethernet cable, 2 -USB cable 2 - SMA-to-UFL antenna cables (1 - for cellular, 1 - for GPS) 1 - RSMA-to-UFL antenna cable for Bluetooth/Wi-Fi
Antennas	1 - 3.3V magnetic GPS antenna , 1 - HEPTA band SMA antenna, 1 - 2.4GHz, dipole Wi-Fi antenna
Customer Notices	Modem activation notice
Additional	One promotional screwdriver

Attaching Power Supply Blades

Power Supply and Blades

If your device shipped with a power cord, attach the blades for your region.



Power Supply No
Blades



Power Supply with
EU blad



Power Supply with
NAM blade

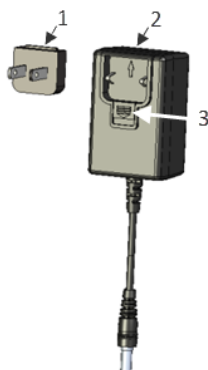


Power Supply with
UK blade

Attaching the Blades

To attach a power supply blade:

1. Remove the power supply cover (not shown). To do this, slide the lock down and hold it while you lift off the cover.
2. Insert the latch on the blade into the notch on the power supply.
3. Slide the lock down and hold it while you press the blade in place. Then, release it.



- 1 - Latch
2 - Notch
3 - Sliding lock

Pinout

Multi-Tech Mini PCIe Pinout

Note:

Some modems do not include all the pins shown above. Refer to your model's Device Guide for model specific pinout information.

SDIO can operate up to 25Mhz. Treat the SDIO traces to Host like a bus and keep the bus length as short as possible. Multi-Tech recommends adding series termination resistors on all the SDIO traces.

Pin #	Name	I/O	Function	MTPCIE-H5	MTPCIE-H5-V-BW	MTPCIE-BW
1	SDIO_D0	I/O	Wi-Fi SDIO_D0		X	X
2	3.3Vaux	I	3.3Vaux	X	X	X
3	SDIO_D1	I/O	Wi-Fi SDIO_D1		X	X
4	GND		Ground	X	X	X
5	SDIO_D2	I/O	Wi-Fi SDIO_D2		X	X
6	BT_TXD	I	Bluetooth Transmit data		X	X
7	SDIO_D3	I/O	Wi-Fi SDIO_D3		X	X
8	BT_RTS	I	Bluetooth RTS		X	X
9	GND		Ground	X	X	X
10	BT_CTS	O	Bluetooth CTS		X	X
11	SDIO_CMD	I/O	Wi-Fi SDIO_CMD		X	X
12	BT_RXD	O	Bluetooth Receive data		X	X
13	SDIO_CLK	I	Wi-Fi SDIO_CLK		X	X
14	BT_EN	I	Bluetooth enable (low disable)		X	X
15	GND		Ground	X	X	X
16	GPIO_2	I/O	3G Cellular General purpose I/O		X	
17	WLAN_EN	I	Wi-Fi enable (low disable)		X	X
18	GND		Ground	X	X	X
19	WLAN_IRQ	O	Wi-Fi interrupt (low active)		X	X
20	3G_ONOFF	I	3G Cellular On/Off (low active)	X	X	

Pin #	Name	I/O	Function	MTPCIE-H5	MTPCIE-H5-V-BW	MTPCIE-BW
21	GND		Ground	X	X	X
22	3G_RST	I	3G Cellular Reset line (low active)	X	X	
23	1.8V	O	1.8V output		X	X
24	3.3Vaux	I	3.3Vaux	X	X	X
25	GPIO_1	I/O	Bluetooth General purpose I/O		X	X
26	GND		Ground	X	X	X
27	GND		Ground	X	X	X
28	3G_DVI_WA0	I/O	3G Cellular digital voice control line		X	
29	GND		Ground	X	X	X
30	3G_DVI_CLK	I/O	3G Cellular digital voice clock		X	
31	3G_DVI_RX	I	3G Cellular digital voice receive		X	
32	RI	O	3G Cellular UART RI		X	
33	3G_DVI_TX	O	3G Cellular digital voice transmit		X	
34	GND		Ground	X	X	X
35	GND		Ground	X	X	X
36	USB_D-	I/O	3G USB Negative Data	X	X	
37	GND		Ground	X	X	X
38	USB_D+	I/O	3G USB Positive Data	X	X	
39	3.3Vaux	I	3.3Vaux	X	X	X
40	GND		Ground	X	X	X
41	3.3Vaux	I	3.3Vaux	X	X	X
42	LED_WWAN#	O	3G Cellular STAT LED Output	X	X	
43	GND		Ground	X	X	X
44	DCD	O	3G Cellular UART DCD		X	
45	CTS	O	3G Cellular UART CTS		X	
46	GPIO_3	I/O	3G Cellular General purpose I/O		X	
47	RTS	I	3G Cellular UART RTS		X	

Pin #	Name	I/O	Function	MTPCIE-H5	MTPCIE-H5-V-BW	MTPCIE-BW
48	DTR	I	3G Cellular UART DTR		X	
49	RXD	O	3G Cellular UART Receive data		X	
50	GND		Ground	X	X	X
51	TXD	I	3G Cellular UART transmit data		X	
52	3.3Vaux	I	3.3Vaux	X	X	X

Standard Mini-PCI Express Pinout

Pin #	Function	I/O	Description
1	WAKE#	O	WAKE
2	3.3Vaux	I	3.3Vaux
3	COEX1	I	Co-existence pin, not defined
4	GND		GND
5	COEX2	I	Co-existence pin, not defined
6	1.5V	I	1.5V
7	CLKREQ#	O	CLKREQ#
8	UIM_PWR	I	UIM_PWR
9	GND		GND
10	UIM_DATA	I/O	UIM_DATA
11	REFCLK+	I	PCI Express reference clock
12	UIM_CLK	I	UIM_CLK
13	REFCLK-	I	PCI Express reference clock
14	UIM_RESET	I	UIM_RESET
15	GND		GND
16	UIM_VPP	O	UIM_VPP
17	Reserved		Reserved
18	GND		GND
19	Reserved		Reserved
20	W_DISABLE#	I	W_DISABLE#
21	GND		GND
22	PERST#	I	PERST#
23	PERn0	O	PCI Express receiver differential pair signal
24	3.3Vaux	I	3.3Vaux
25	PERp0	O	PCI Express receiver differential pair signal
26	GND		GND
27	GND		GND
28	1.5V	I	1.5V
29	GND		GND
30	SMB_CLK	I	SMB_CLK
31	PETn0	I	PCI Express transmitter differential pair signal
32	SMB_DATA	I/O	SMB_DATA

Pin #	Function	I/O	Description
33	PETp0	I	PCI Express transmitter differential pair signal
34	GND		GND
35	GND		GND
36	USB_D-	I/O	USB Negative Data
37	GND		GND
38	USB_D+	I/O	USB Positive Data
39	3.3Vaux	I	3.3Vaux
40	GND		GND
41	3.3Vaux	I	3.3Vaux
42	LED_WWAN#	O	LED Output
43	GND		GND
44	LED_WLAN#	O	LED Output
45	Reserved		Reserved
46	LED_WPAN#	O	LED Output
47	Reserved		Reserved
48	1.5V	I	1.5V
49	Reserved		Reserved
50	GND		GND
51	Reserved		Reserved
52	3.3Vaux	I	3.3Vaux

Pinout for Cellular USB Only

Pin #	Name	I/O	Description
2	3.3 Vaux	I	3.3 Vaux
4	GND		Ground
9	GND		Ground
15	GND		Ground
18	GND		Ground
20	3G_ONOFF	I	3G cellular on/off
21	GND		Ground
22	3G_RST	I	3G cellular reset line
24	3.3 Vaux	I	3.3 Vaux
26	GND		Ground
27	GND		Ground
29	GND		Ground
35	GND		Ground
36	USB_D-	I/O	3G USB Negative Data
37	GND		Ground
38	USB_D+	I/O	3G USB Positive Data
39	3.3 Vaux	I	3.3 Vaux
40	GND		Ground
41	3.3 Vaux	I	3.3 Vaux
42	LED_WWAN	O	3G Cellular STAT LED Output
43	GND		Ground
50	GND		Ground
52	3.3 Vaux	I	3.3 Vaux

Design Considerations

Design Consideration

When using the Multi-Tech MiniPCIe form factor:

- Consult your modem's device guide for device dimensions. With the modem, the Multi-Tech Mini PCIe form factor exceeds the standard Mini PCIe maximum component height for top and bottom.
- If you need to install components under the module, use taller connectors to avoid conflict. Multi-Tech recommends not installing components under the module.
- Check the Pinout table for pins that differ from the MiniPCIe spec.

Noise Suppression Design

Adhere to engineering noise-suppression practices when designing a printed circuit board (PCB) containing the MultiConnect PCIe. Noise suppression is essential to the proper operation and performance of the modem and surrounding equipment.

Any OEM board design that contains the MultiConnect PCIe must consider both on-board and off-board generated noise that can affect digital signal processing. Both on-board and off-board generated noise that is coupled on-board can affect interface signal levels and quality. Noise in frequency ranges that affect modem performance is of particular concern.

On-board generated electromagnetic interference (EMI) noise that can be radiated or conducted off-board is equally important. This type of noise can affect the operation of surrounding equipment. Most local government agencies have certification requirements that must be met for use in specific environments.

Proper PC board layout (component placement, signal routing, trace thickness and geometry, and so on) component selection (composition, value, and tolerance), interface connections, and shielding are required for the board design to achieve desired modem performance and to attain EMI certification.

Other aspects of proper noise-suppression engineering practices are beyond the scope of this guide. Consult noise suppression techniques described in technical publications and journals, electronics and electrical engineering text books, and component supplier application notes.

PC Board Layout Guideline

In a 4-layer design, provide adequate ground plane covering the entire board. In 4-layer designs, power and ground are typically on the inner layers. Ensure that all power and ground traces are 0.05 inches wide.

Electromagnetic Interference

The following guidelines are offered specifically to help minimize EMI generation. Some of these guidelines are the same as, or similar to, the general guidelines. To minimize the contribution of device-based design to EMI, you must understand the major sources of EMI and how to reduce them to acceptable levels.

- Keep traces carrying high frequency signals as short as possible.
- Provide a good ground plane or grid. In some cases, a multilayer board may be required with full layers for ground and power distribution.
- Decouple power from ground with decoupling capacitors as close to the device's power pins as possible.

- Eliminate ground loops, which are unexpected current return paths to the power source and ground.
- Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.
- Locate high frequency circuits in a separate area to minimize capacitive coupling to other circuits.
- Locate cables and connectors to avoid coupling from high frequency circuits.
- Lay out the highest frequency signal traces next to the ground grid.
- If using a multilayer board design, make no cuts in the ground or power planes and be sure the ground plane covers all traces.
- Minimize the number of through-hole connections on traces carrying high frequency signals.
- Avoid right angle turns on high frequency traces. Forty-five degree corners are good; however, radius turns are better.
- On 2-layer boards with no ground grid, provide a shadow ground trace on the opposite side of the board to traces carrying high frequency signals. This will be effective as a high frequency ground return if it is three times the width of the signal traces.
- Distribute high frequency signals continuously on a single trace rather than several traces radiating from one point.

Electrostatic Discharge Control

Handle all electronic devices with precautions to avoid damage due to the static charge accumulation.

See the ANSI/ESD Association Standard (ANSI/ESD S20.20-1999) – a document “for the Development of an Electrostatic Discharge Control for Protection of Electrical and Electronic Parts, Assemblies and Equipment.” This document covers ESD Control Program Administrative Requirements, ESD Training, ESD Control Program Plan Technical Requirements (grounding/bonding systems, personnel grooming, protected areas, packaging, marking, equipment, and handling), and Sensitivity Testing.

Multi-Tech strives to follow these recommendations. Input protection circuitry is incorporated in Multi-Tech devices to minimize the effect of static buildup. Take precautions to avoid exposure to electrostatic discharge during handling.

Multi-Tech uses and recommends that others use anti-static boxes that create a faraday cage (packaging designed to exclude electromagnetic fields). Multi-Tech recommends that you use our packaging when returning a product and when you ship your products to your customers.

USB Design

Multi-Tech recommends that you review Intel's High Speed USB Platform Design Guidelines for information about USB signal routing, impedance, and layer stacking. Also:

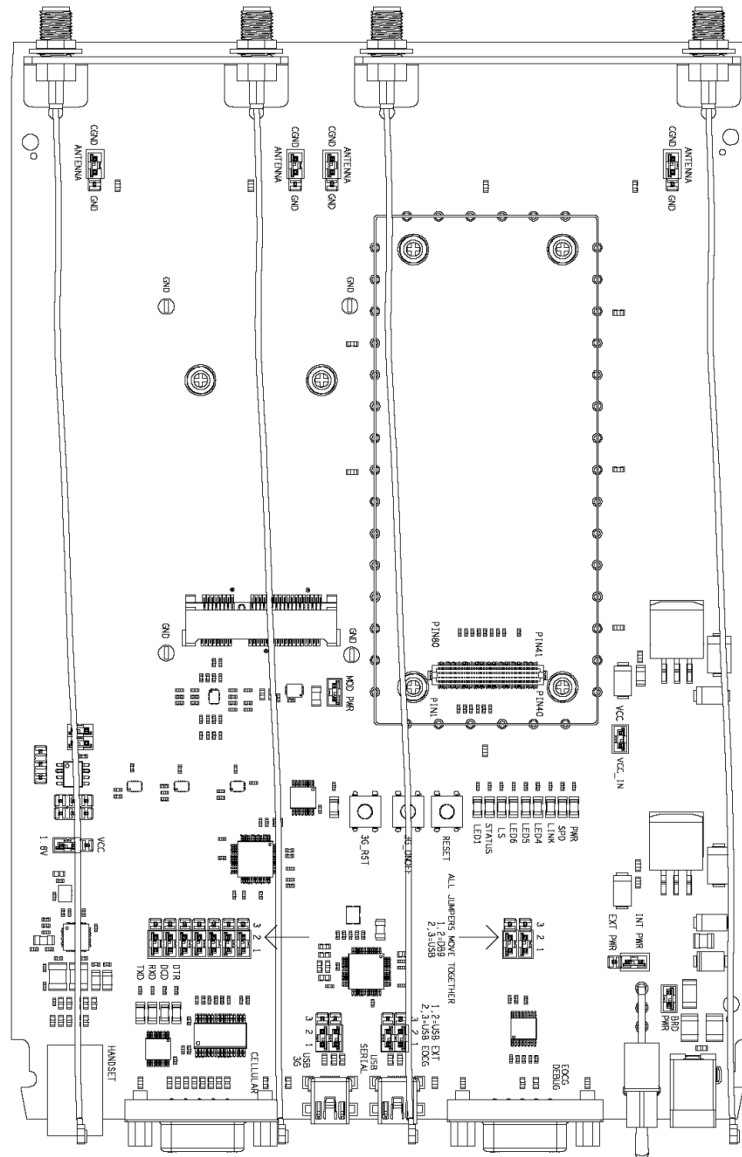
- Shield USB cables with twisted pairs (especially those containing D+/D-).
- Use a single 5V power supply for USB devices. See the Power Draw section in your model's Device Guide for current (ampere) requirements.
- Route D+/D- together in parallel with the trace spacing needed to achieve 90 ohms differential impedance for the USB pair and to maintain a 20 mil space from the USB pair and all other signals.
- If power is provided externally, use a common ground between the carrier board and the device.

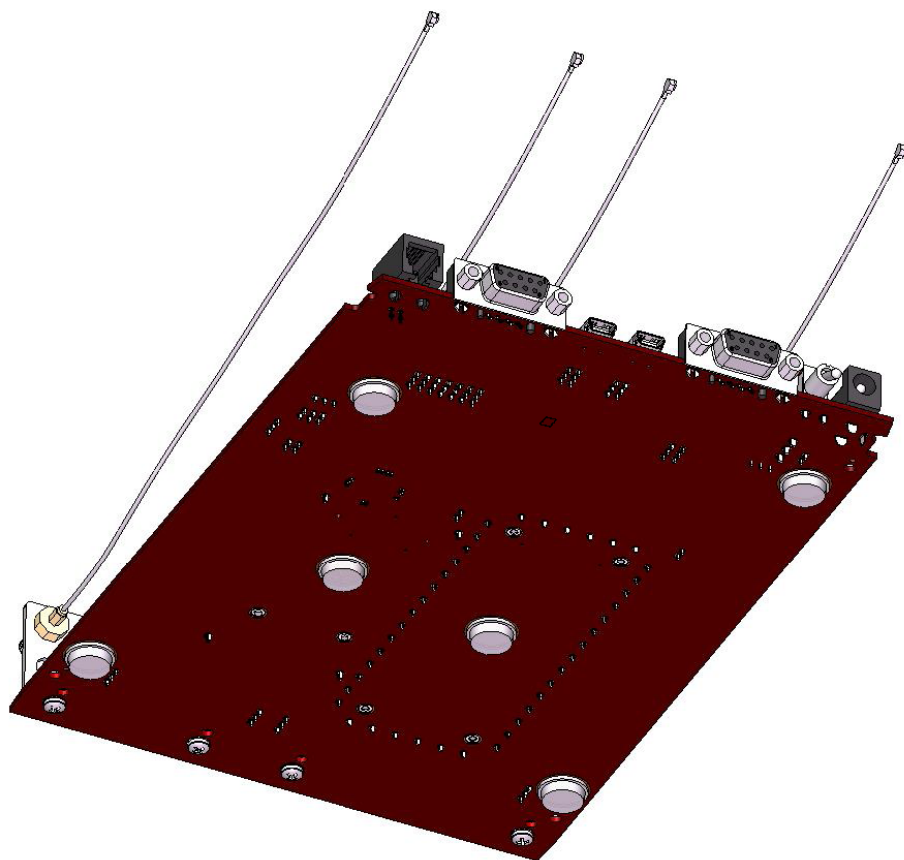
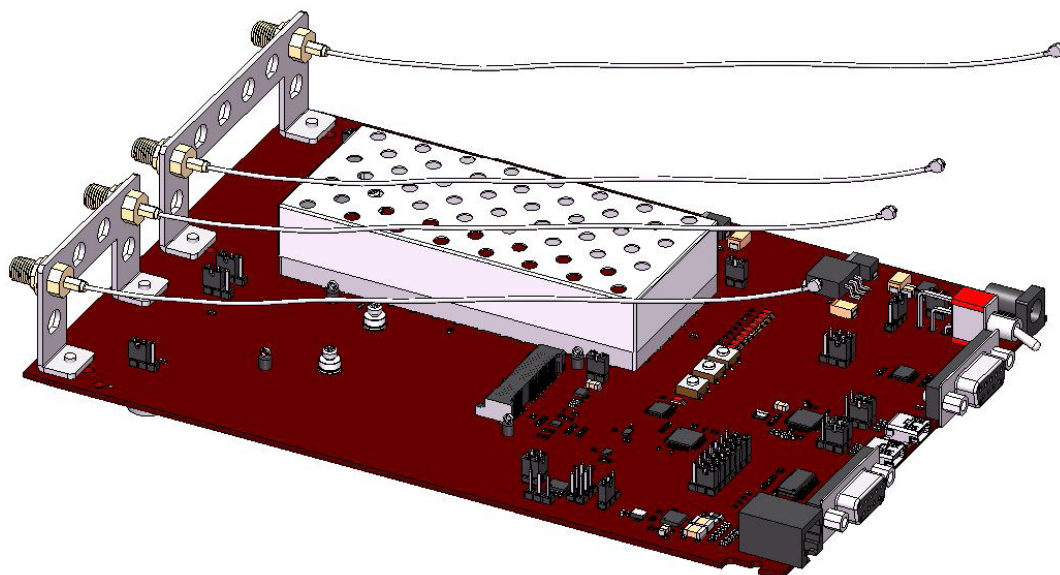
Developer Board and Schematics

Note: Third-party components shown in the following drawings are included as examples only.

Developer Board

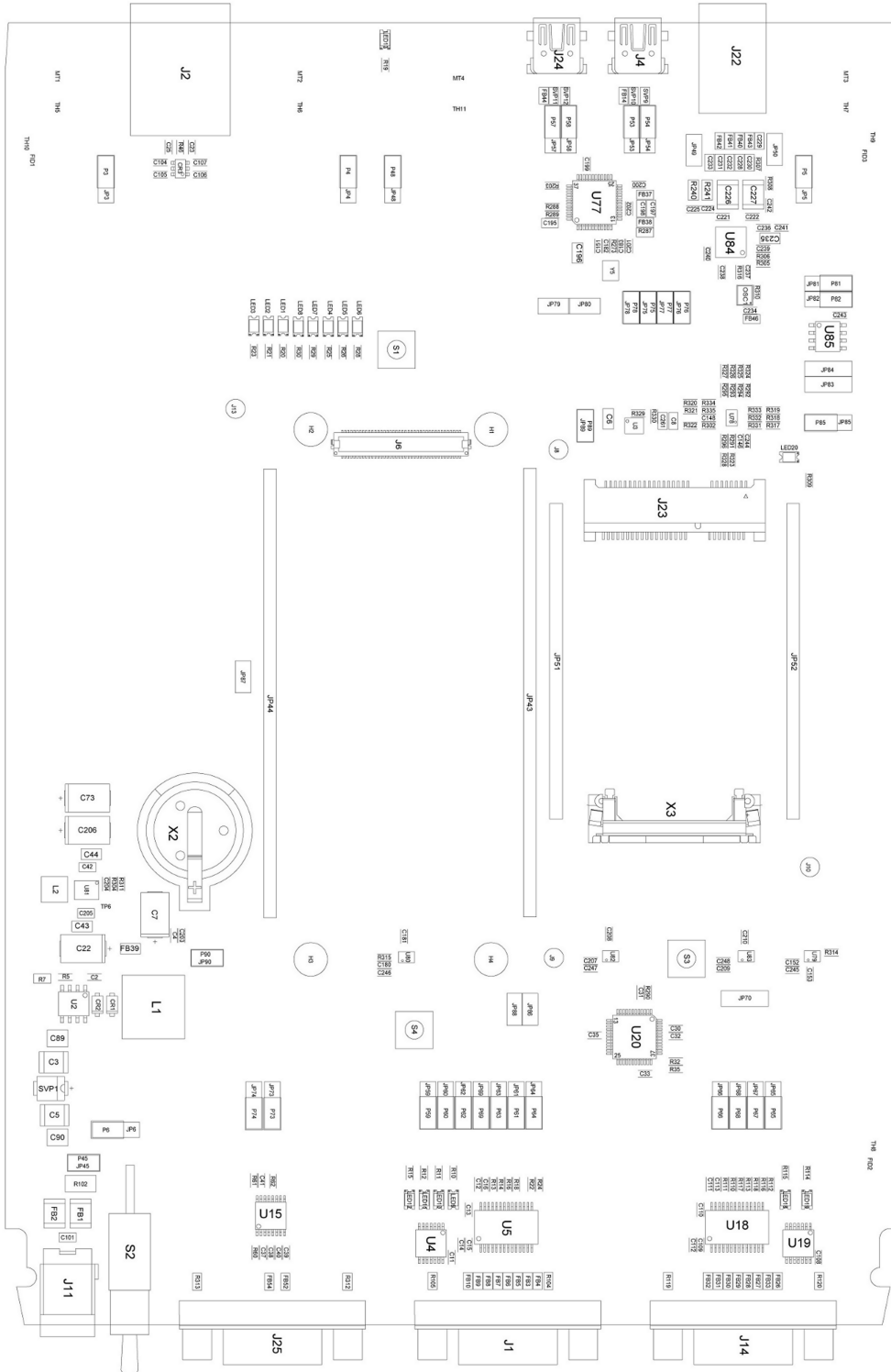
This developer board drawing shows the major board components.



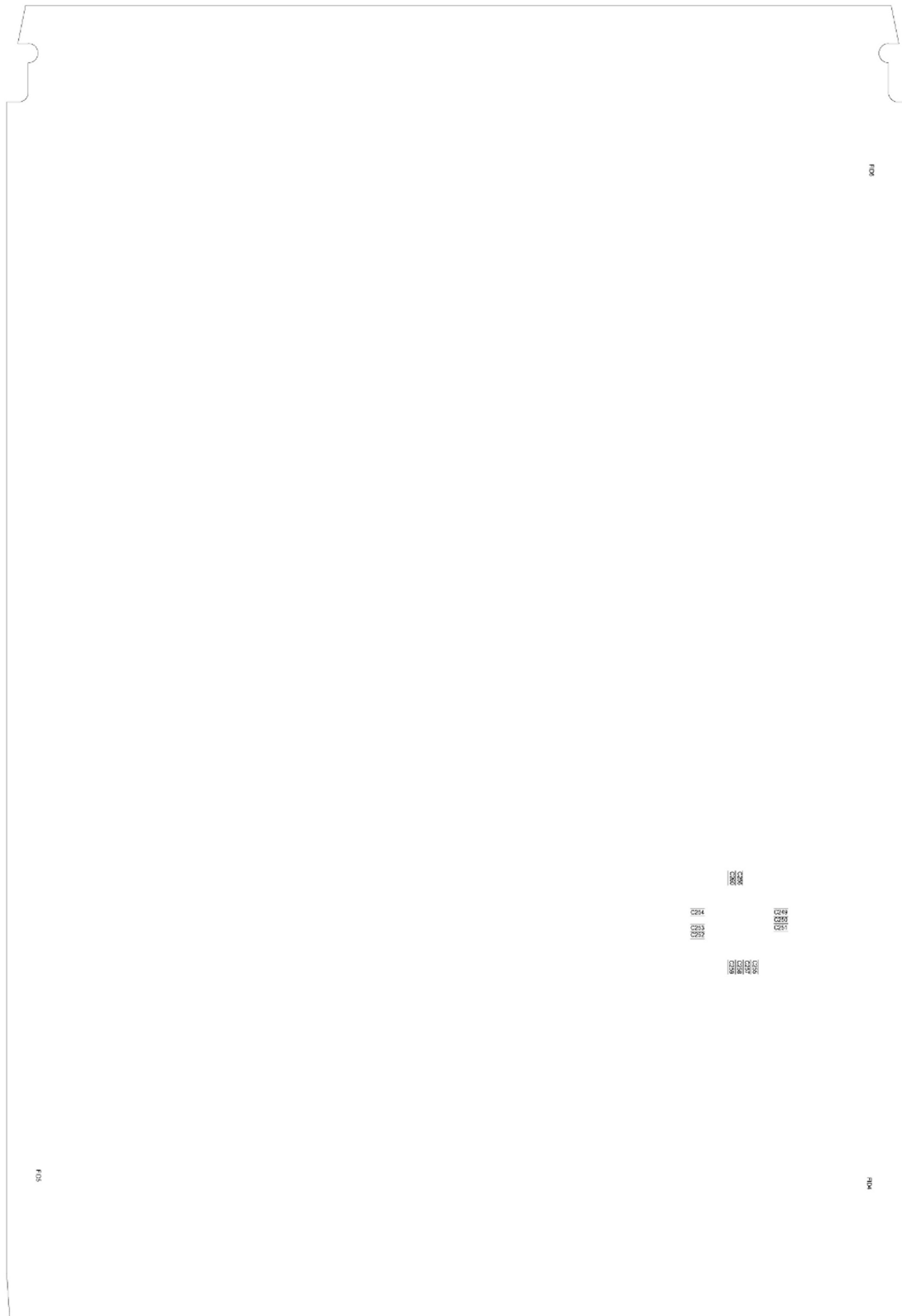


Assembly Diagram

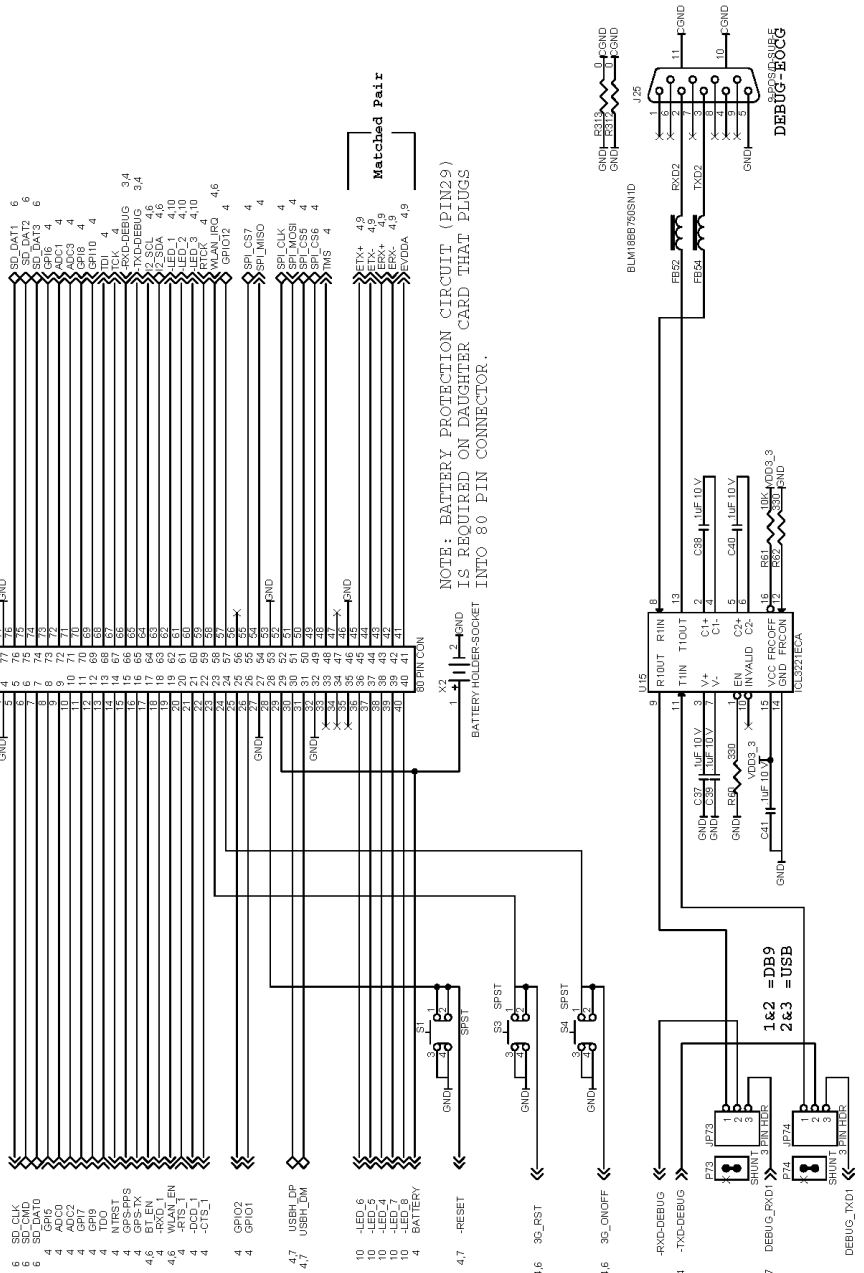
Top



Bottom

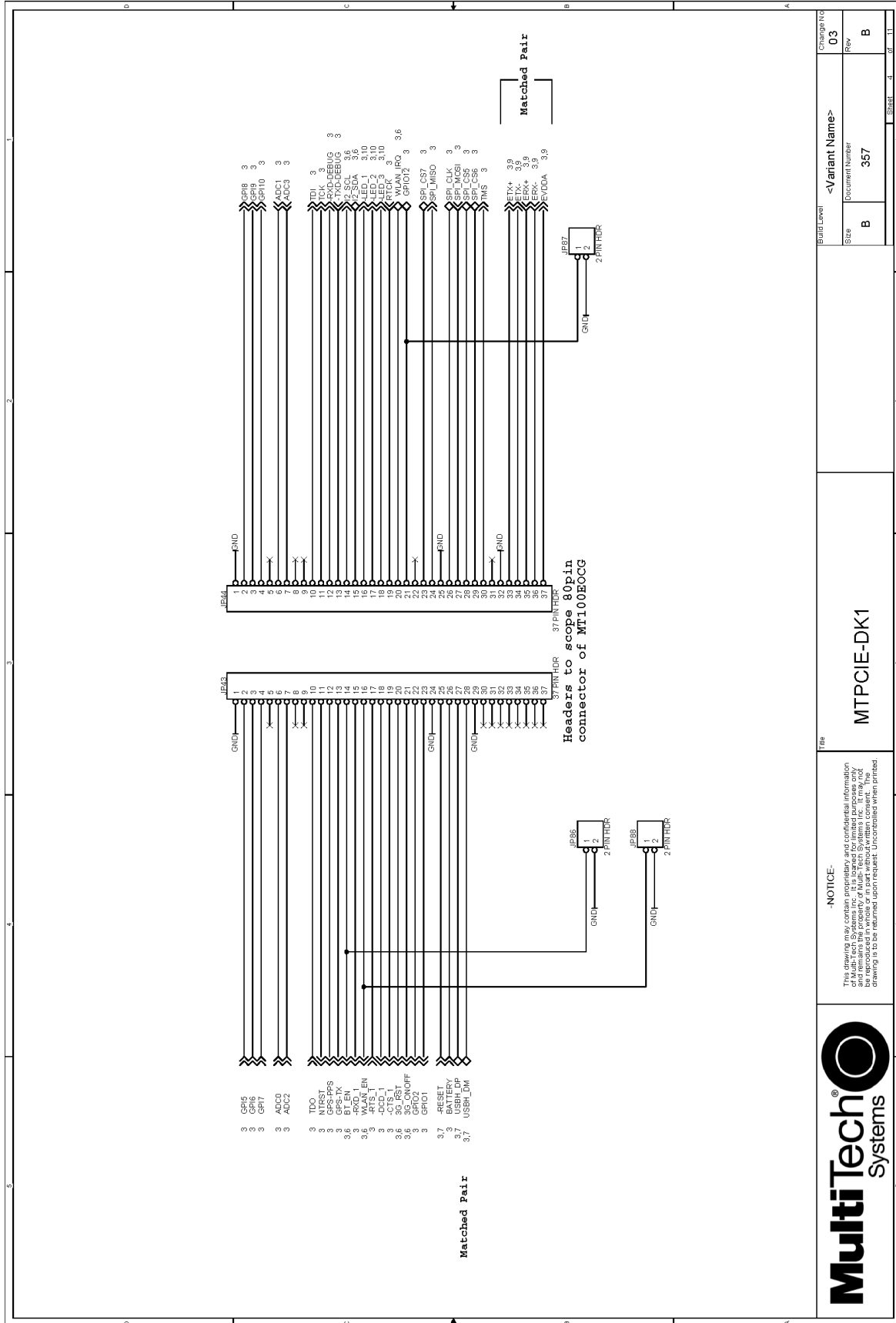


Place J6 as near as possible to J23 to keep SDIO lines short

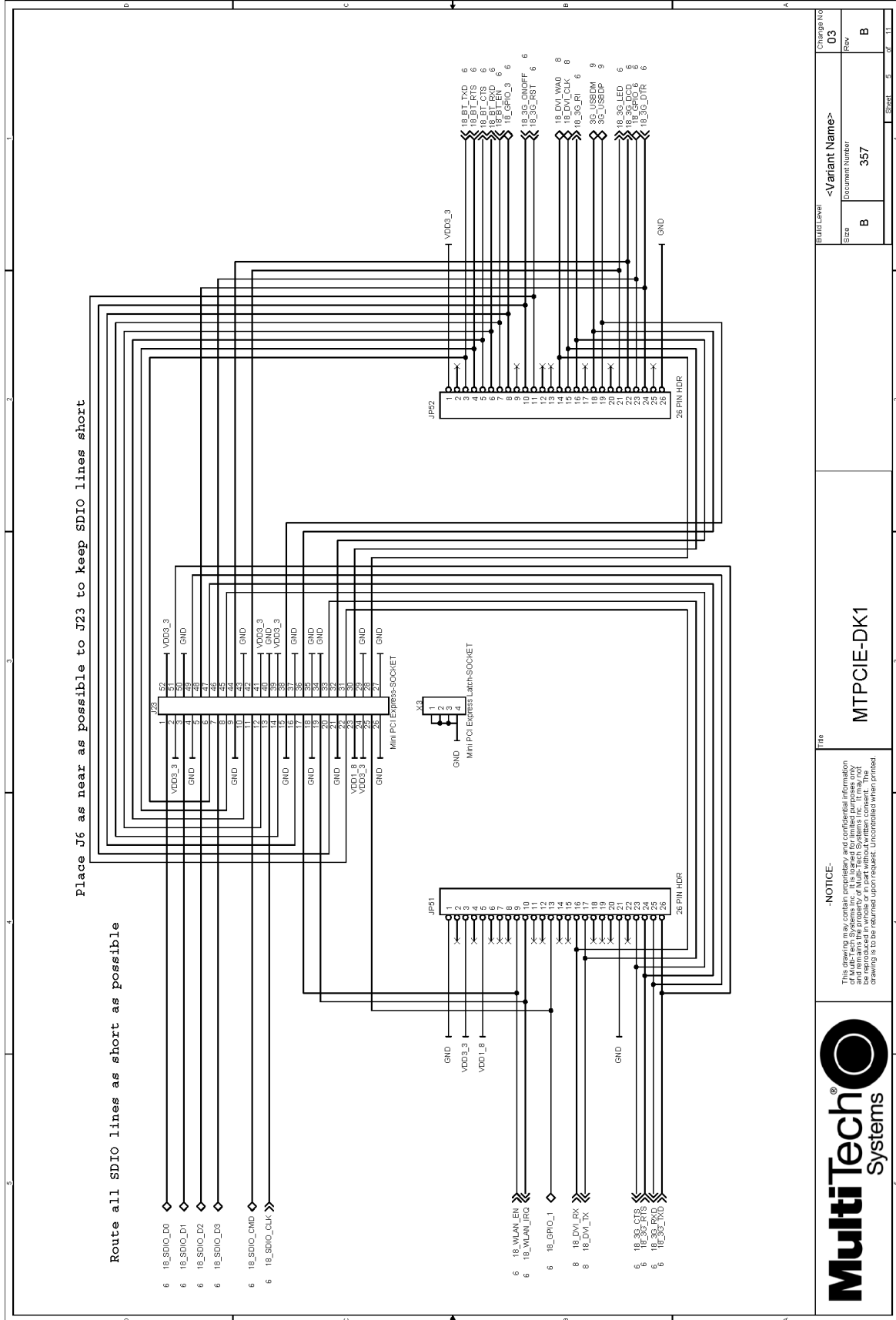


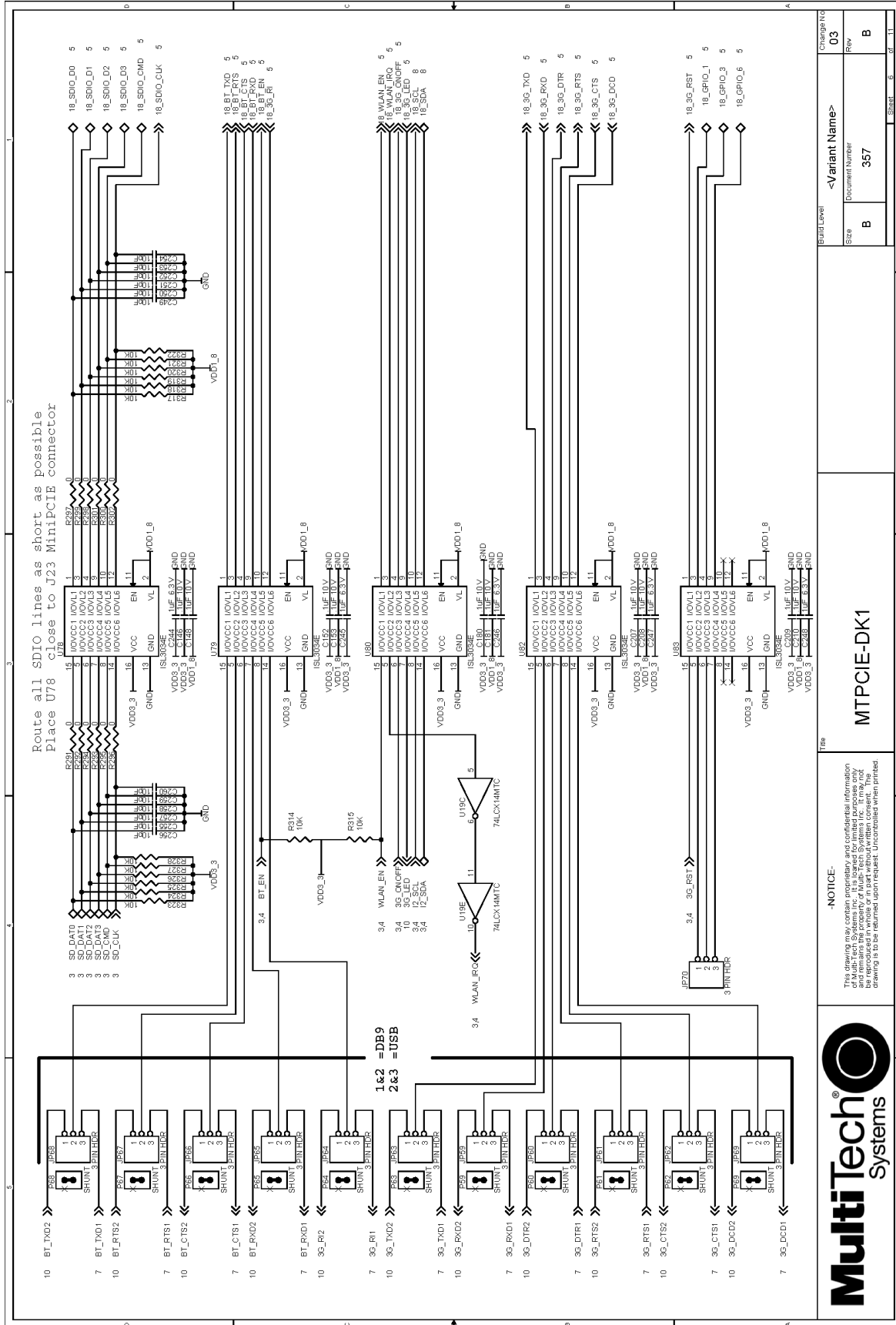
		<p>MTPCIE-DK1</p>		Title		Build Level		Change #	
				This		03			
<p>MultiTech Systems</p>		<p>MTPCIE-DK1</p>		Part Name		Variant Name		Rev	
				MTPCIE-DK1		B		B	
<p>MultiTech Systems</p>		<p>MTPCIE-DK1</p>		Description		Decrement Number		Rev	
				MTPCIE-DK1		357		B	
<p>MultiTech Systems</p>		<p>MTPCIE-DK1</p>		Size		B		Sheet	
				B		3		of	
<p>MultiTech Systems</p>		<p>MTPCIE-DK1</p>		Part Number		357		Rev	
				357		B		B	

NOTICE:
This drawing may contain proprietary and confidential information and may be used for design or manufacturing purposes only and may be reproduced or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written consent of MultiTech Systems. The drawing is to be returned upon request. Unclassified when printed.

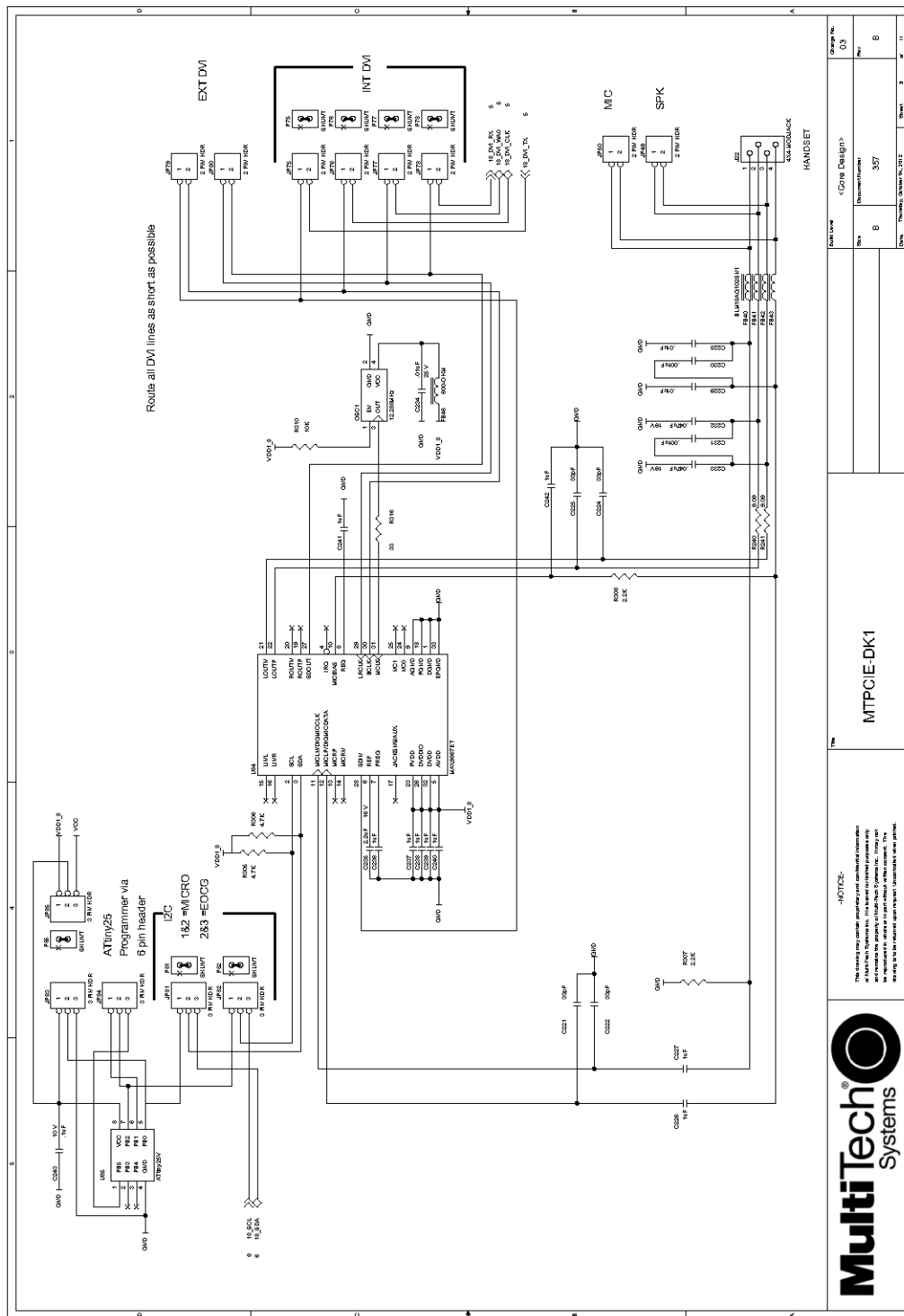


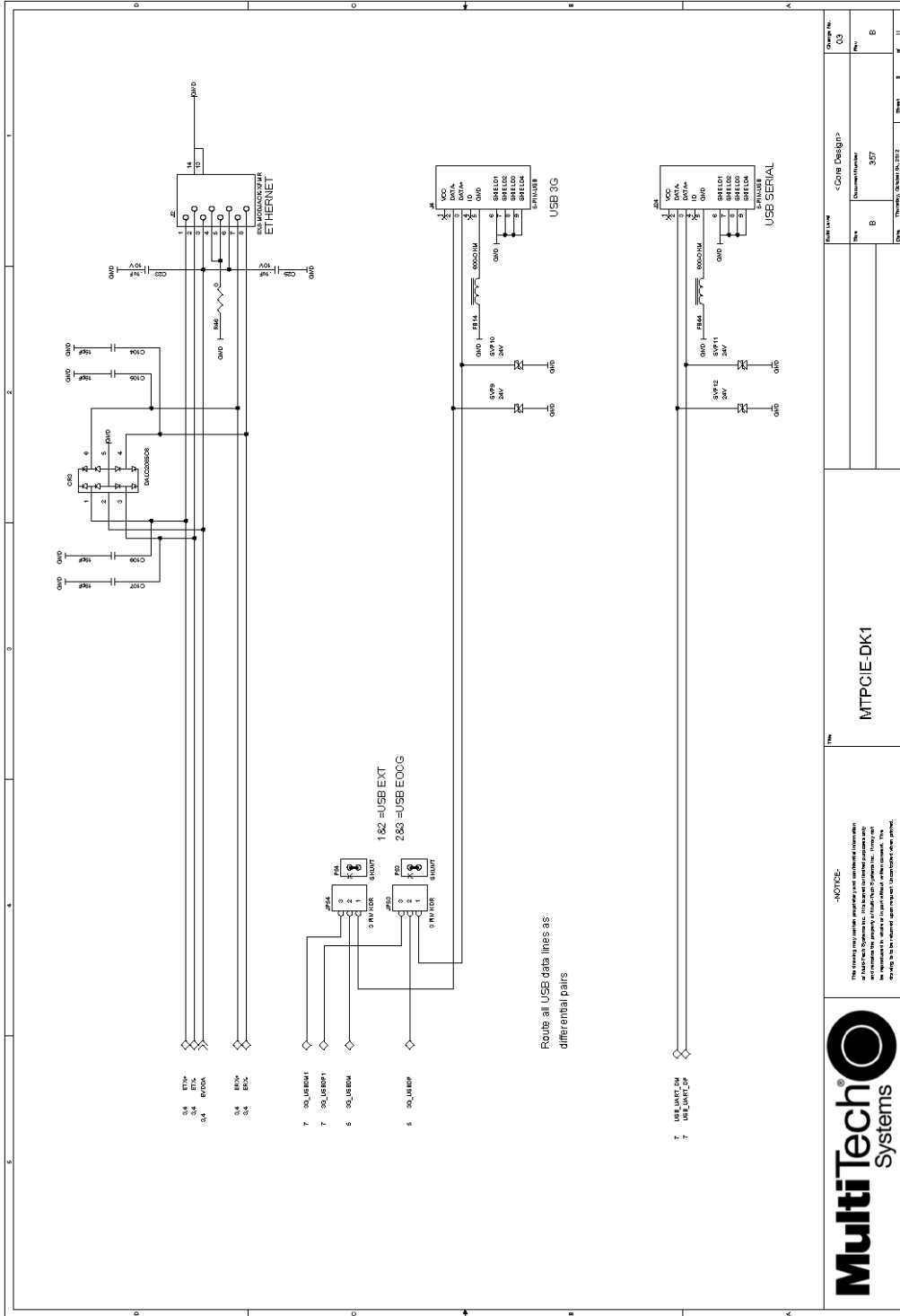
<p>MultiTech Systems</p>		<p>MTPCIE-DK1</p>		<p>Build Level</p>		<p><Variant Name></p>		<p>Change No</p>	
<p>-NOTICE- This drawing may contain proprietary and confidential information and is the property of Multi-Tech Systems, Inc. It may not be reproduced in whole or in part without written consent. The drawing is to be retained confidential. Circulate when printed.</p>		<p>Size</p>		<p>Discom Number</p>		<p>Rev</p>		<p>Sheet</p>	
		<p>B</p>		<p>357</p>		<p>B</p>		<p>of 11</p>	





MTPCIE-DK1		Build Level	03
		Variant Name	<Variant Name>
Size	B	Docuement Number	357
Rev	B	Sheet	6 of 11

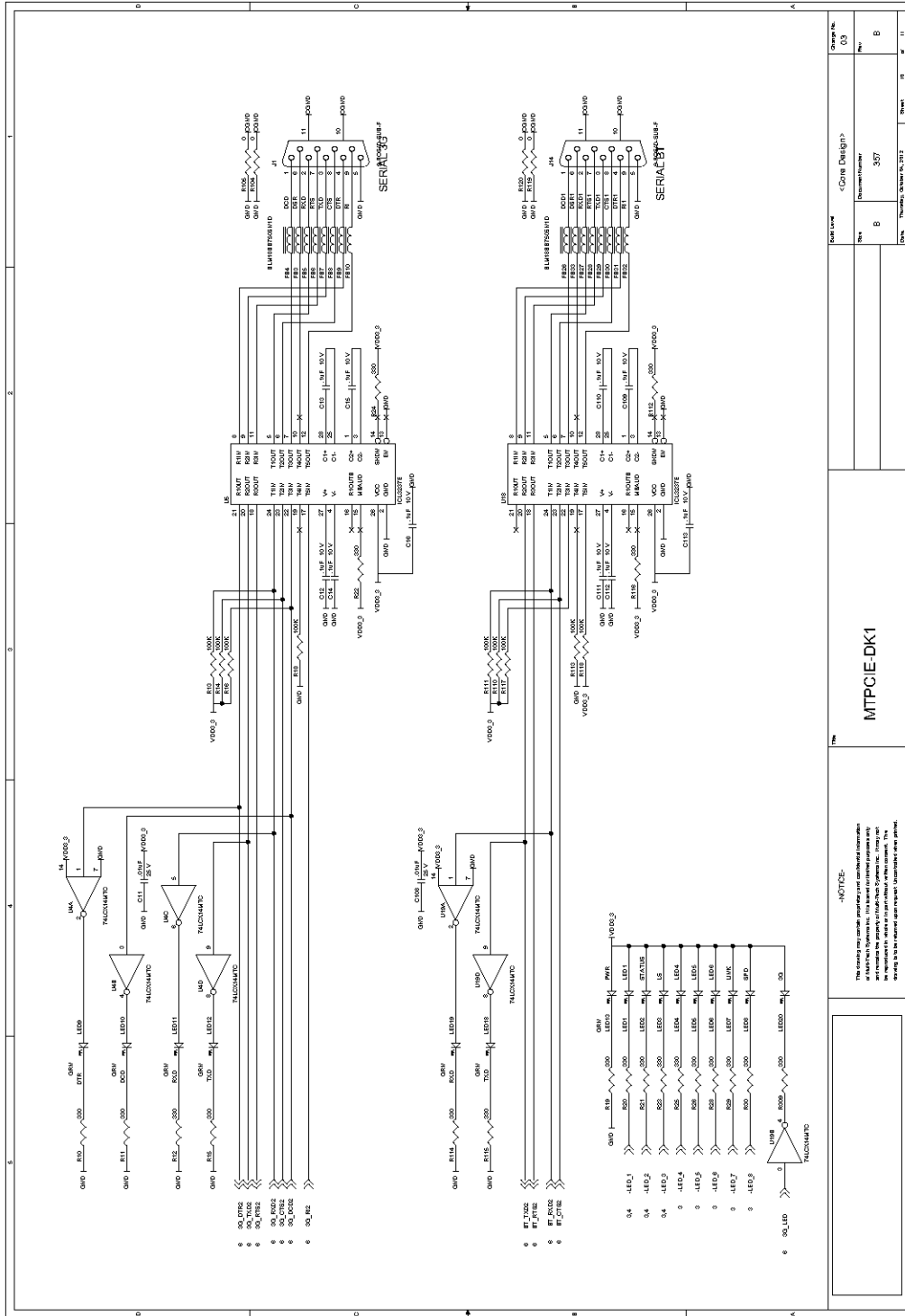




NOTICE:
 This design may contain proprietary and confidential information of MultiTech Systems Inc. This document and its contents are the property of MultiTech Systems Inc. and are not to be distributed, copied, or used for any other purpose without the prior written consent of MultiTech Systems Inc.

MTPCIE-DK1

Design No.	03
Rev	B
Quantity	507
Drawn	
Checked	
Approved	



Part Name		MTPCIE-DK1	
Rev	B	Document Number	307
Doc. No.	03	Rev. No.	B
Doc. Name	<One Design>	Doc. Date	November, October 04, 2012

NOTICE:
 This device may contain proprietary and confidential information. It is intended for use only in the development of products and is not to be distributed outside of the development team. This device is not to be used in any other manner without the express written consent of the manufacturer.

Board Components

Jumper	Description
JP3, JP4, JP5, JP48	Selects CGND or GND for antenna holder grounding. Default is CGND.
JP6	JP6 allows you to select either the internal 5V regulator (INT PWR) or to choose EXT 5V (EXT PWR). For the EXT PWR, you can use your own external 5V power source and plug it into J11.
JP43, JP44	Not used by PCIe devices.
JP45	Board Power. Default is installed.
JP49	Probes for connecting speaker.
JP50	Probes for connecting microphone.
JP51, JP52	Debugging probes for PCIe connector J23.
JP53, JP54	Selects USB host connected to PCIe device. Pins 1 & 2 jumpered selects external USB host connected to J4.
JP57, JP58	Selects USB host connected to quad serial UART U20. Pins 1 & 2 jumpered selects external USB host connected to J24.
JP59, JP60, JP61, JP63, JP64, JP69	Selects serial connection for PCIe device. Pins 1 & 2 jumpered selects DB9 connector J1 connected to PCIe device. Pins 2 & 3 jumpered selects quad UART U20 connected to PCIe device. All jumpers must be moved to the same position.
JP65, JP66, JP67, JP68	Selects serial connection for PCIe Bluetooth device. Pins 1 & 2 jumpered selects DB9 connector J14 connected to PCIe Bluetooth device. Pins 2 & 3 jumpered selects quad UART U20 connected to PCIe Bluetooth device. All jumpers must be moved to the same position.
JP70	Probes for PCIe GPIO2 & GPIO3. The pin next to the text "GPIO_3.3V" is GPIO3. The center pin is GPIO2.
JP73, JP74	Not used by PCIe devices.
JP75, JP76, JP77, JP78	When these jumpers are installed, DVI interface of audio codec U84 is connected to DVI interface of PCIe device. By removing these jumpers when connecting an external DVI device.
JP79, JP80	Use these jumper pins to connect an external DVI device.
JP81, J82	Selects source for programming audio codec U84. Pins 1 & 2 jumpered selects MICRO U84 as source. Default is MICRO.
JP83, JP84	These pins can be used for programming MICRO U84.
JP85	Selects power source for MICRO U85. Default is 1.8v
JP86	May be used to manually reset PCIe Bluetooth device by briefly installing and then removing a jumper. Default is no jumper installed.
JP87	Not applicable for this device.
JP88	May be used to manually reset PCIe Wi-Fi device by briefly installing and then removing a jumper. Default is no jumper installed.
JP89	This jumper, when installed, connects power to PCIe device.

Jumper	Description
JP90	Not used by PCIe device. This jumper, when installed, connects power to OCG-E device. (When using Developer Kit with OCG-E devices).
J6	Not used by PCIe device.
J23	Socket for installing PCIe device.
J8, J9, J10, J13	Oscilloscope probe ground connections
S1	Not used by PCIe device.
S3	Reset button for PCIe device.
S4	Button for on/off of PCIe.

Installing a Communications Device onto the Board

To install a device on the board:

1. Align the device pin with Pin 1 of the socket connector on the board and press firmly.
2. Use the optional antenna lead to connect to the device's antenna connector.

Installing a SIM Card

To install a SIM card:

- Install the SIM card into the SIM card holder on the radio.

Safety Notices and Warnings

The following safety statements may be relevant and required in the host product literature.

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 des fréquences radio

En raison de la possibilité d'interférences de radiofréquence (RF), il est important que vous suiviez une quelconque réglementation concernant l'utilisation du matériel radio. Suivez les conseils de sécurité ci-dessous.

- Fonctionnement de votre appareil à proximité d'autres appareils électroniques peuvent causer des interférences si l'équipement est insuffisamment protégé. Respectez les panneaux d'avertissement et les recommandations du fabricant.
- Différentes industries et les entreprises limitent l'utilisation des appareils cellulaires. Respectez les règlements sur l'utilisation des équipements radio dans les dépôts de carburant, les usines chimiques, ou lorsque des opérations de dynamitage sont en cours. Suivez restrictions pour n'importe quel environnement où vous utilisez l'appareil.
- Ne pas placer l'antenne à l'extérieur.
- Éteignez votre appareil sans fil dans un avion. Utilisant des dispositifs électroniques portables dans un avion peut mettre en danger le fonctionnement de l'avion, peut perturber le réseau cellulaire, et est illégal. Le non-respect de cette restriction peut entraîner la suspension ou le refus des services cellulaires au contrevenant, une action en justice, ou les deux.
- Éteignez votre appareil sans fil lorsque autour de l'essence ou pompes diesel-carburant et avant de remplir votre véhicule avec du carburant.
- Éteignez votre appareil sans fil dans les hôpitaux et tout autre endroit où l'équipement médical peut être utilisé.

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.

User Responsibility

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

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 Multi-Tech has not authorized or that are not compliant with Multi-Tech's accessory specifications may invalidate the warranty.

If the device is not working properly, contact Multi-Tech Technical Support.

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

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

Compliance of the device with the FCC and IC rules regarding RF Exposure was established and is given with the maximum antenna gain as specified above for a minimum distance of 20 cm between the devices radiating structures (the antenna) and the body of users. Qualification for distances closer than 20 cm (portable operation) would require re-certification.

Labeling Requirements

Approvals and Certification

Your Multi-Tech device is an industry and/or carrier approved modem.

- **PTCRB Requirements (GPRS and HSPA/HSDPA only).**
The antenna system cannot be altered. If altered, additional PTCRB testing may be required.
- **For HSPA+, HSPA, HSDPA and GPRS Devices**
The modem's 15-character IMEI (International Mobile Equipment Identity) number is printed on the modem's label.

Example HSPA+ H5 Labels

Note: Actual labels will 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 larger than actual size.



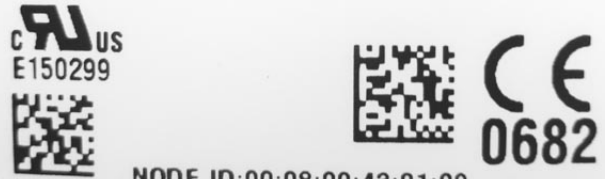
- 1 - Multi-Tech Model Identification.
- 2 - Multi-Tech Ordering Part Number.
- 3 - IMEI (International Mobile Equipment Identity).

1 → Model: MTPCIE – H5 – V
 2 → ORDER P/N: MTPCIE – H5 – V – SP
 SKU #: 92503318LF DOM: 2013.12.18
 Serial #: XXXXXXXX
 FCC ID: AU792U12616852
 IC: 125A – 0047



3 → IMEI: XXXXXXXXXXXXXXXX
 Produced in the US of US and non-US components
 www.multitech.com

1 → Model: MTPCIE – H5 – V – BW
 2 → ORDER P/N: MTPCIE – H5 – V – BW – SP
 SKU #: 92503310LF DOM: 2013.03.26
 Serial #: XXXXXXXX
 FCC ID: AU792U12616836
 IC: 125A – 0048



3 → IMEI: XXXXXXXXXXXXXXXX
 Produced in the US of US and non-US components
 www.multitech.com

Labels are positioned on the device as follows:



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}

Regulatory Statements

R&TTE Directive Compliance

CE 0682

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

RF spectrum use (R&TTE art. 3.2)	EN 301 511 V9.0.2 EN 300 440-2 V1.4.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.9.2 EN 301 489-3 V1.4.1 EN 301 489-7 V1.3.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + AC:2011 EN 62311:2008

Restriction of the Use of Hazardous Substances (RoHS)



Multi-Tech Systems, Inc

Certificate of Compliance

2011/65/EU

Multi-Tech Systems 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 Multi-Tech 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.

International Modem Restrictions

Some dialing and answering defaults and restrictions may vary for international modems. Changing settings may cause a modem to become non-compliant with national regulatory requirements in specific countries. Also note that some software packages may have features or lack restrictions that may cause the modem to become non-compliant.

Industry Canada and FCC

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

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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

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

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

Note: In Wi-Fi operation, the modem cannot operate on Channels 12, 13, or 14 due to FCC regulations.

Requirements for Cellular Antennas with regard to FCC/IC Compliance

Alterations to the antenna system may require additional testing at a certified lab. The antenna system must maintain the same specifications. The antenna must be the same type, with similar in-band and out-of-band radiation patterns.

This device has been designed to operate with the antennas listed below and having a maximum gain for 850 Mhz of ≤ 6.4 dBi , for 1700 Mhz of ≤ 6.5 dBi, and for 1900 Mhz of ≤ 3 dBi. Antennas not included in this list or that have a gain greater than specified are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Industry Canada and FCC Identification Numbers

Additional device information is available on the Industry Canada and FCC websites.

Model	Canada ID	FCC ID
MTPCIE-H5	125A-0047	AU792U12616852
MTPCIE-H5-V	125A-0047	AU792U12616852
MTPCIE-H5-V-BW	125A-0048	AU792U12616836

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 Multi-Tech 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



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。

Antennas, Cables, GPS

Antenna System Cellular Devices

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

FCC and IC Antenna Requirements Toward License Exempt Radio Transmitters (Bluetooth/Wlan)

The license-exempt Bluetooth/WLAN radio transmitter contained in this equipment may only be operated with an antenna of a type, a maximum gain and the required antenna impedance as approved and specified below. To reduce potential radio interference to other users, choose the antenna type and its gain so that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

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

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

Compliance of the device with the FCC and IC rules regarding RF Exposure was established and is given with the maximum antenna gain as specified above for a minimum distance of 20 cm between the devices radiating structures (the antenna) and the body of users. Qualification for distances closer than 20 cm (portable operation) would require re-certification.

Cellular Antenna Information

3G Authorized Antennas

The cellular radio portion was approved with the following antenna:

Manufacturer:	Laird Technologies.
Description:	HEPTA-SM
Model Number:	MAF94300

Multi-Tech ordering information:

Model	Quantity
ANHB-1HRA	1
ANHB-10HRA	10
ANHB-50HRA	50

3G Antenna Requirements/Specifications

Category	Description	
Frequency Range	824 – 960 MHz / 1710 – 1990 MHz / 1920 – 2170 MHz	
Impedance	50 Ohms	
VSWR	VSWR should not exceed 2.0:1 at any point across the bands of operation	
Typical Radiated Gain	850 MHz	3.17 dBi
	950 MHz	3.51 dBi
	1800 MHz	3.55 dBi
	1900 MHz	3.0 dBi
	2100 MHz	3.93 dBi
Radiation	Omni-directional	
Polarization	Linear Vertical	

Antenna Cable Information

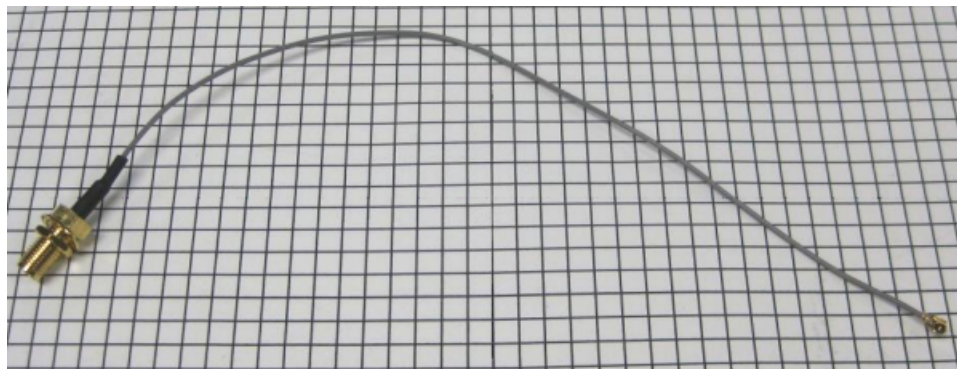
Use the following UFL to SMA RF cable to connect the device to the antenna.

Description: Coax SMA to UFL 8.5inch (216mm)

Multi-Tech Part Number: 45009575L

Multi-Tech ordering information:

Model	Quantity
CASMA-UFL-1	1
CASMA-UFL-10	10
CASMA-UFL-50	50



Average Cable Loss

The table shows the average cable loss for each cell band.

Band	Loss
800	0.37

Band	Loss
900	0.40
1800	0.70
1900	0.63
2100	0.70

GPS Antennas

GPS Antenna Specifications

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

Bluetooth and Wi-Fi Antenna Specifications

Manufacturer: Taoglas Antenna Solutions

Manufacturer's Model Number: GW.11.A153

Category	Description
Frequency Range	2.4000 to 2.4835 GHz
Impedance	50 Ohms
VSWR	VSWR should not exceed 2.0:1 at any point across the bands of operation
Peak Radiated Gain	2.3 dBi on azimuth plane
Radiation	Omni-directional
Polarization	Linear Vertical
Connector	RP-SMA(M)

Multi-Tech Ordering Information

Model Number	Quantity
ANWF-1HRA	1
ANWF-10HRA	10
ANWF-50HRA	50

Bluetooth and Wi-Fi Antenna Cable Information

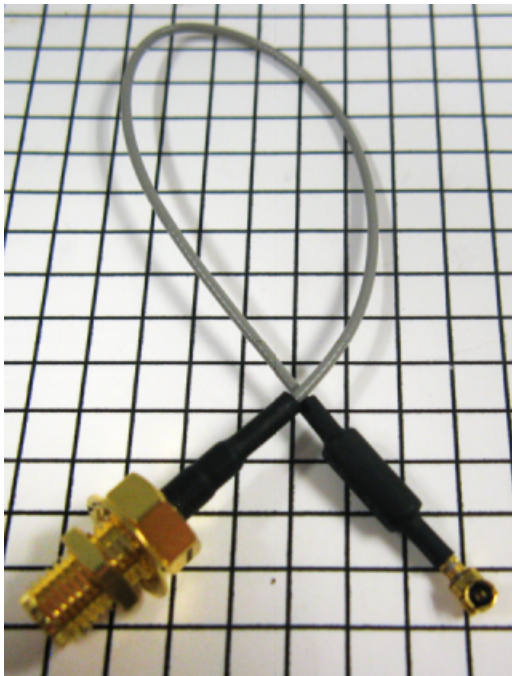
Use the following UFL to R-SMA RF cable to connect the device to the antenna.

Description: Coax R-SMA to UFL 6 inch (152.4mm)

Multi-Tech Part Number: 45009628L

Multi-Tech ordering information:

Model	Quantity
CARSMA-UFL-1	1
CARSMA-UFL-10	10
CARSMA-UFL-50	50



Average Cable Loss

The table shows the average cable loss for each cell band.

Band	Loss
2.4MHz	0.63

OEM Integration

Note: This device is for OEM integration only.

FCC and Industry Canada Information to End-users

FCC & IC Information to End-users The user manual for the end-users 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.

Installing in Portable Equipment

The available scientific evidence does not show that any health problems are associated with using low power wireless devices. There is no proof, however, that these low power wireless devices are absolutely safe. Low power wireless devices emit low levels of radio frequency energy (RF) in the microwave range while being used. Whereas high levels of RF can produce health effects (by heating tissue), exposure of low-level RF that does not produce heating effects causes no known adverse health effects. Many studies of low-level RF exposures have not found any biological effects. Some studies have suggested that some biological effects might occur, but such findings have not been confirmed by additional research. MTPCIE-H5 has been tested and found to comply with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65.

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.

Grant Limitations

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: Host devices incorporating unlicensed radio transmitters must be provided with the related antenna fixed mounted or, if coming with an external antenna connector, this connector must be of a non-standard type. In any case must an antenna be provided with the unlicensed transmitter.

Note: Only use antennas approved respectively as listed for the unlicensed radios (Bluetooth/Wi-Fi)

Device Overview

Description

The MultiConnect PCIe embedded cellular modem is a complete, ready-to-integrate communications device that offers standards-based penta-band HSPA+ 21 performance. This quick-to-market communications device allows developers to add wireless communication and GPS tracking to products with a minimum of development time and expense. The MultiConnect PCIe embedded cellular modem is based on industry-standard open interfaces and uses a PCI Express Mini Card form factor.

Product Build Options

Product	Description	Region
MTPCIE-H5	HSPA+ Embedded Cellular Modem	US/Canada
MTPCIE-H5-V	HSPA+ Embedded Cellular Modem with digital voice.	US/Canada
MTPCIE-H5-V-BW	HSPA+ Embedded Cellular Modem with digital voice, GPS, Wi-Fi and Bluetooth	US/Canada
MTPCIE-BW	Wi-Fi and Bluetooth	US/Canada/Europe
Developer Kit		
MTPCIE-DK	Developer Kit	Global

Note:

- These units ship without network activation.
- To connect them to the cellular network, you need a cellular account. For more information, refer to Account Activation.
- GP devices have a dedicated GPS receiver.
- The complete product code may end in .Rx. For example, MTPCIE-H5.Rx, where R is revision and x is the revision number.
- All builds can be ordered individually or in 50-packs.

Account Activation for Cellular Devices

Some Multi-Tech cellular modems are pre-configured to operate on a specific cellular network, such as Sprint or Verizon Wireless. Before you can use the modem, you must set up a cellular data account with your service provider. Each service provider has its own process for adding devices to their network. Refer to Multi-Tech's Cellular Activation site <http://www.multitech.com/activation.go> for step-by-step instructions on activating your cellular modem with your service provider.

Bluetooth/Wi-Fi

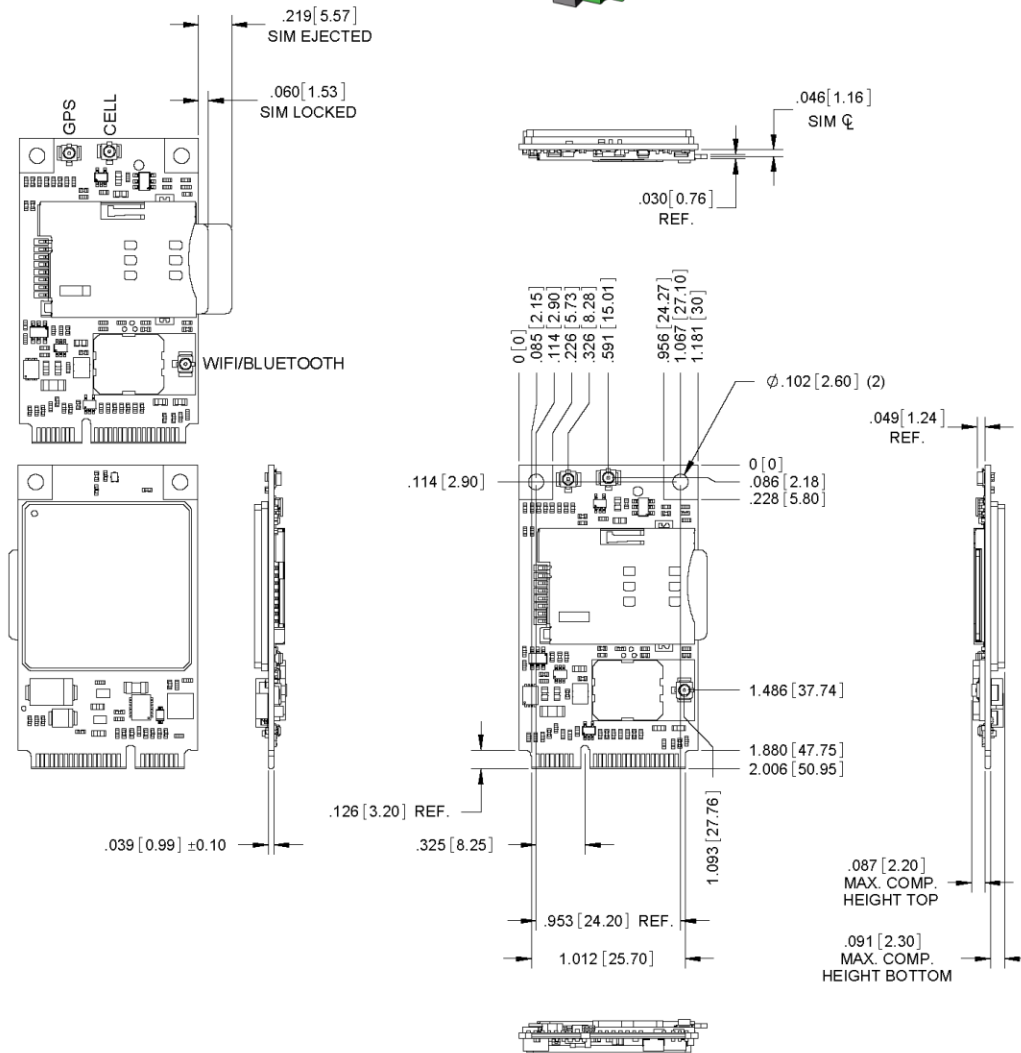
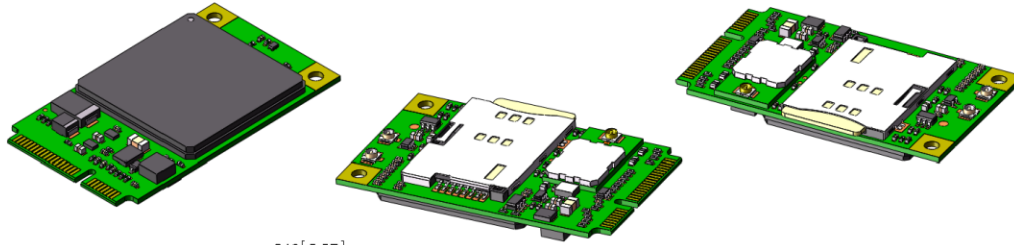
All Wi-Fi and Bluetooth drivers and stacks are based on Linux open source.

- For Wi-Fi, use the Linux calibrator tool. The WiFi drivers are compat-wireless drivers for TI WL12XX build under Linux kernel 2.6.39.4. For more information see <http://linuxwireless.org/en/users/Drivers/wl12xx/calibrator>.
- For BlueTooth, use the Linux hcitool.

Both tools are currently available inside our embedded Linux systems. These tools do not run on PCs. To invoke the tools, secure shell into the device using putty or another tool from your Windows computer. Once you secure shell and login, you can invoke the tools and test. You will need Ethernet connectivity to the development board for the secure shell and login.

Mechanical Drawing

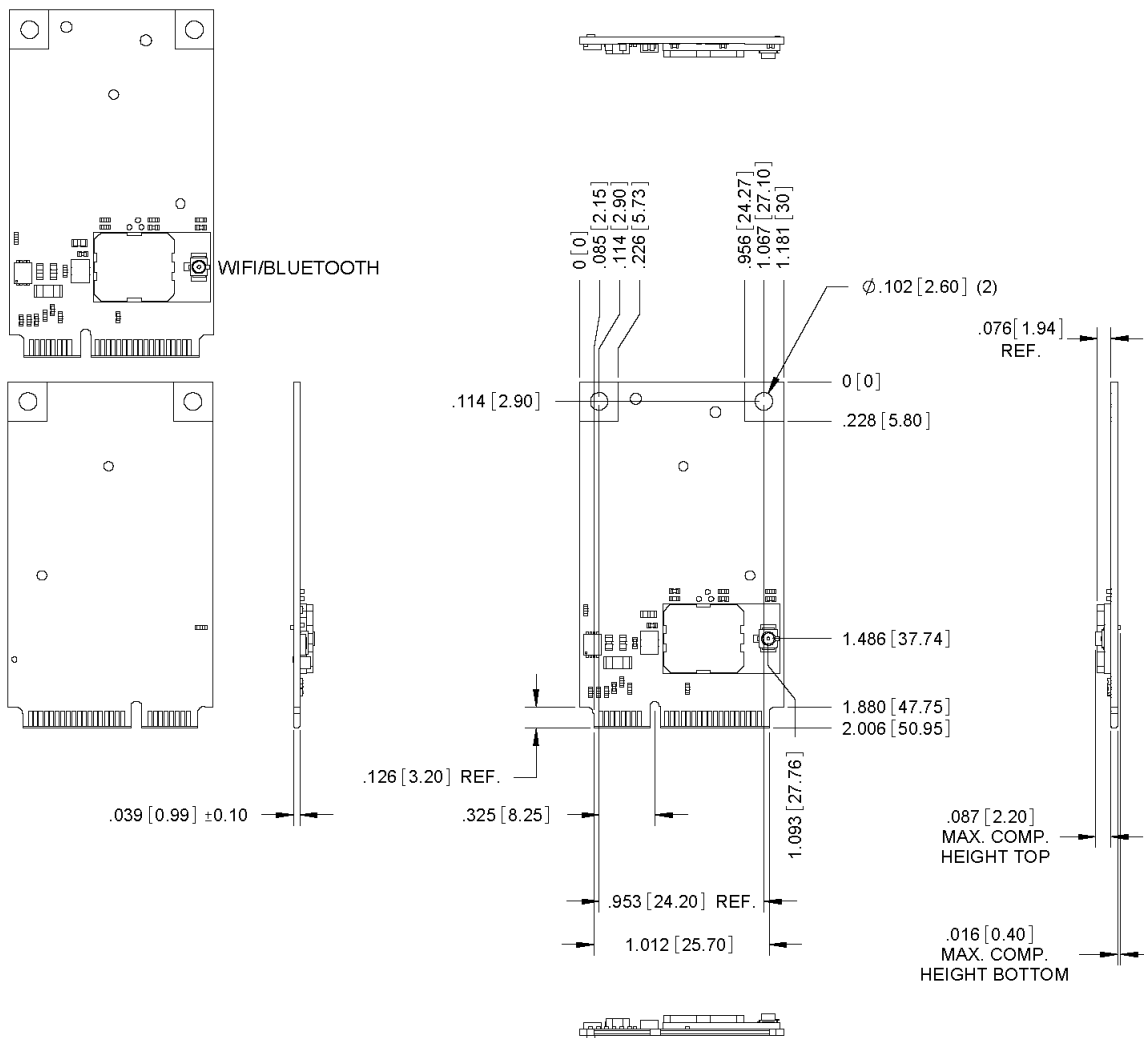
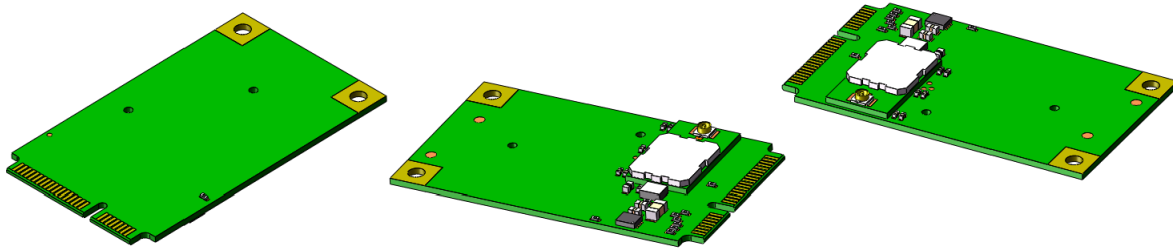
MTPCIE-H5-xx



MTPCIE-H5-xx

DIMENSION IN INCHES [mm]

MTPCIE-BW



MTPCIE-BW

DIMENSION IN INCHES [mm]

Specifications

MTPCIE-H5 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
Speed	
Data Speed	HSDPA data service of up to 21.0 Mbps downlink/5.76 Mbps uplink
Interface	
USB Interface	USB 2.0 high speed compatible
UART Interface	0-1.8V
Physical Description	
Weight	0.4 oz. (10 g)
Dimensions	1.892" x 1.181" (48.057 mm x 29.997 mm) Note: With the form factor, dimensions exceed the standard MiniPCIe maximum component height for top and bottom. Consult the Design Consideration chapter in the MultiConnect PCIe Developer Guide for more information.
Connectors	
Antenna Connector	2 surface mount UFL connectors for cellular (main and rx diversity);
	1 surface mount UFL connector for GPS;
	Bluetooth and Wi-Fi: share 1 UFL connector
SIM Holder	Standard 1.8V and 3V
Environment	
Operating Temperature	-35° C to +85° C
Storage Temperature	-35° C to +85° C
Humidity	20%-90% RH, non-condensing
Power Requirements	
Operating Voltage	
Input Power	3.3VDC
SMS, Wi-Fi, Bluetooth	

Category	Description
SMS	Point-to-Point messaging
	Mobile-Terminated SMS
	Mobile-Originated SMS
Wi-Fi	IEEE 802.11 b,g, n, compliant
	SDIO host interface (0-1.8V)
Bluetooth	Serial Port Protocol (SPP)
	UART Interface 1.8V
GPS	High-sensitivity of indoor reception, better than -165
	Cold start autonomous -147 dBm
	Hot start autonomous -161 dBm
	Tracking mode -166 dBm
	Accuracy 3 m
	TTF from cold start 42 s
	TTF from warm start 30 s
	TTF from hot start 1.8 s
	Multi-channel GPS
	L1 1575.42 MHz
	GPS NMEA 0183 output format
	Datum WGS-84
Certifications and Compliance	
EMC Compliance	FCC Part 15 Class B
	EN55022 Class B
	EN55024
Radio Compliance	FCC Part 22
	FCC Part 24
	FCC Part 15C (BT & Wi-Fi intentional radiators)
	RSS 132
	RSS 133
	Part 27 resp. RSS-139
	EN 301 511 complete by EN301908-1 & -2
	EN 301 489-1
	EN 301 489-7
	EN 301 489-24 and by EN301489-3

Category	Description
Safety Compliance	UL 60950-1
	cUL 60950-16t
	EN 60950-1
Network Compliance	GCF Certified Module

MTPCIE-H5 DC Electrical Characteristics

Units: Volts

Parameter	Minimum	Maximum
3.3 Volt Powered	3.0	3.6
Input Low Level	0	0.35
Input High Level	1.5	1.9
Output Low Level	0	0.2
Output High Level	1.6	1.9

Absolute Maximum Rating

Voltage at any signal pin: 0.0V to +1.9V

PCIE Connector Leads

PIN #	Name	I/O	Function	Type	Notes	MTPCIE-H5-V-BW	MTPCIE-H5	MTPCIE-H5-V
1	SDIO_D0	I/O	Wi-Fi SDIO_D0	1.8V	SDIO can operate up to 25Mhz. The SDIO traces to Host must be treated like a bus and the bus length shall be as short as possible. Recommend adding series termination resistors on all the SDIO traces.		no function	no function
2	3.3Vaux	I	3.3Vaux					
3	SDIO_D1	I/O	Wi-Fi SDIO_D1	1.8V			no function	no function
4	GND		Ground					

PIN #	Name	I/O	Function	Type	Notes	MTPCIE-H5-V-BW	MTPCIE-H5	MTPCIE-H5-V
5	SDIO_D2	I/O	Wi-Fi SDIO_D2	1.8V			no function	no function
6	BT_TXD	I	Bluetooth Transmit data	1.8V			no function	no function
7	SDIO_D3	I/O	Wi-Fi SDIO_D3	1.8V			no function	no function
8	BT_RTS	I	Bluetooth RTS	1.8V			no function	no function
9	GND		Ground					
10	BT_CTS	O	Bluetooth CTS	1.8V			no function	no function
11	SDIO_CMD	I/O	Wi-Fi SDIO_CMD	1.8V			no function	no function
12	BT_RXD	O	Bluetooth Receive data	1.8V			no function	no function
13	SDIO_CLK	I	Wi-Fi SDIO_CLK	1.8V	Upto 25mhz		no function	no function
14	BT_EN	I	Bluetooth enable (low disable)	1.8V	low disable		no function	no function
15	GND		Ground					
16	GPIO_2	I/O	3G Cellular General purpose I/O	1.8V	AT#GPIO=2,x,x		no function	
17	WLAN_EN	I	Wi-Fi enable (low disable)	1.8V	Low disable		no function	no function
18	GND		Ground					
19	WLAN_IRQ	O	Wi-Fi interrupt (low active)	1.8V	Low active		no function	no function

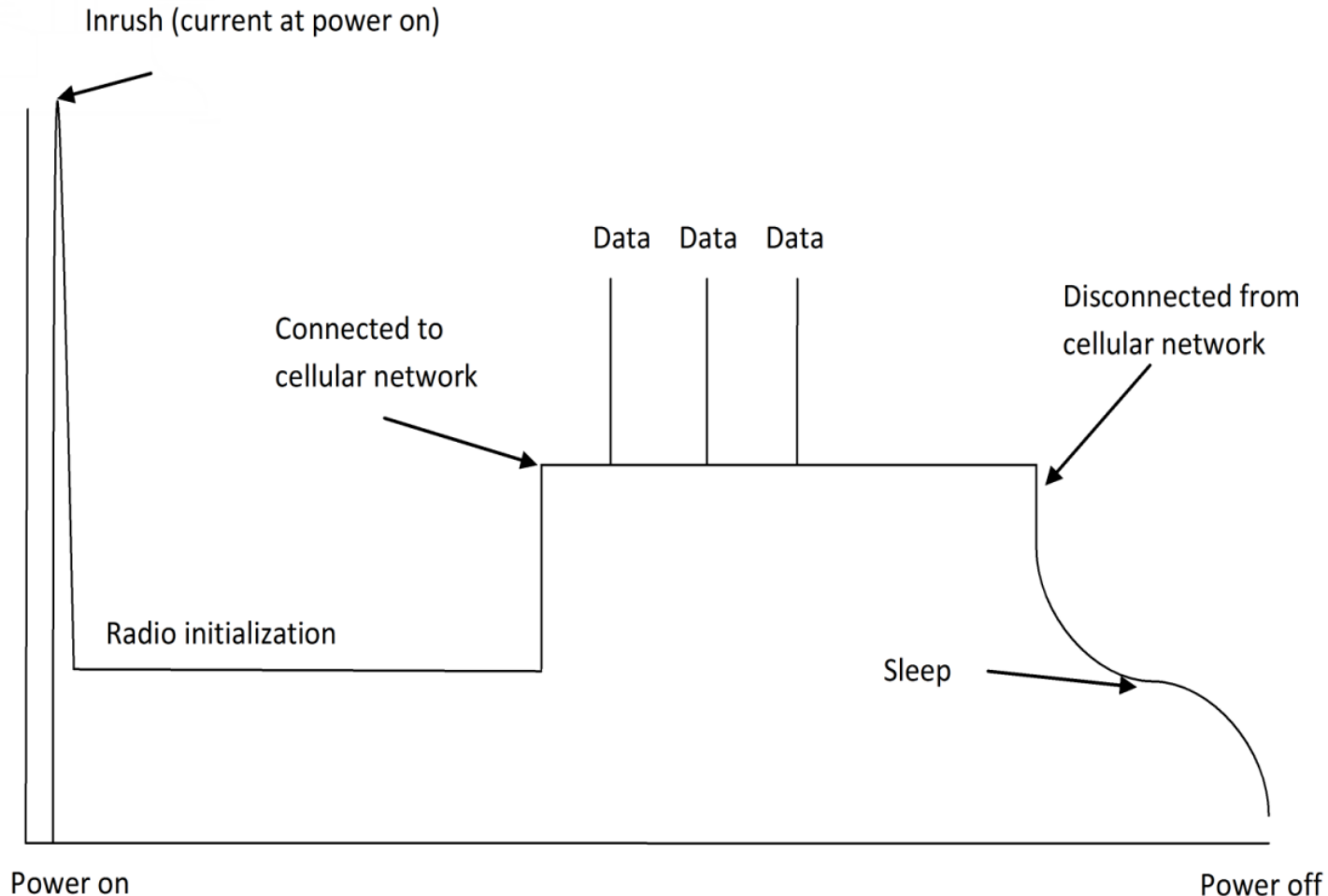
PIN #	Name	I/O	Function	Type	Notes	MTPCIE-H5-V-BW	MTPCIE-H5	MTPCIE-H5-V
20	3G_ONOFF	I	3G Cellular On/Off (low active)	1.8V	Active Low: Properly turn off and detach from the carrier network. Initial power on needs at least 5.5 seconds before AT command are issued. Low for at least 1 second turns off the 3G radio. It can take at least 8 seconds to turn off 3G radio. High turns on the 3G radio and it needs at least 13 seconds before AT command are issued.. No connect if not used.			
21	GND		Ground					
22	3G_RST	I	3G Cellular Reset line (low active)	1.8V	Active Low: Emergency reset without proper shutdown and without detach from the network. Low for at least 50 ms resets the 3G radio. It takes at least 2.5 seconds to reset and turn the 3G radio off. High turns on the 3G radio and needs at least 7.5 seconds before AT command are issued. No connect if not used			
23	1.8V	O	1.8V output	100mA output current at 1.8V			no function	no function

PIN #	Name	I/O	Function	Type	Notes	MTPCIE-H5-V-BW	MTPCIE-H5	MTPCIE-H5-V
24	3.3Vaux	I	3.3Vaux					
25	GPIO_1	I/O	Bluetooth General purpose I/O	1.8V	No connect		no function	no function
26	GND		Ground					
27	GND		Ground					
28	3G_DVI_WA0	I/O	3G Cellular digital voice control line	1.8V			no function	
29	GND		Ground					
30	3G_DVI_CLK	I/O	3G Cellular digital voice clock	1.8V			no function	
31	3G_DVI_RX	I	3G Cellular digital voice receive	1.8V			no function	
32	RI	O	3G Cellular UART RI	1.8V			no function	
33	3G_DVI_TX	O	3G Cellular digital voice transmit	1.8V			no function	
34	GND		Ground					
35	GND		Ground					
36	USB_D-	I/O	3G USB Negative Data	3.3V				
37	GND		Ground					
38	USB_D+	I/O	3G USB Positive Data	3.3V				
39	3.3Vaux	I	3.3Vaux					
40	GND		Ground					
41	3.3Vaux	I	3.3Vaux					

PIN #	Name	I/O	Function	Type	Notes	MTPCIE-H5-V-BW	MTPCIE-H5	MTPCIE-H5-V
42	LED_WWAN#	O	3G Cellular STAT LED Output	1.8V	<p>Command to enable LED function, AT#GPIO=1,0,2. This pin needs an external transistor to drive an external LED. Therefore, status indicated is reversed with respect to the pin status:</p> <p>Permanently off = Device off</p> <p>Fast blinking (Period 1s, Ton 0.5s) = Net search / Not registered / turning off</p> <p>Slow blinking (Period 3s, Ton 0.3s) = Registered full service</p> <p>Permanently on = a voice call is active</p>			
43	GND		Ground					
44	DCD	O	3G Cellular UART DCD	1.8V			no function	
45	CTS	O	3G Cellular UART CTS	1.8V			no function	
46	GPIO_3	I/O	3G Cellular General purpose I/O	1.8V	AT#GPIO=3,x,x		no function	
47	RTS	I	3G Cellular UART RTS	1.8V	Avoid having any HIGH logic level signal applied to any 3G input digital pins when the 3G module is powered off or during an ON/OFF transition.		no function	

PIN #	Name	I/O	Function	Type	Notes	MTPCIE-H5-V-BW	MTPCIE-H5	MTPCIE-H5-V
48	DTR	I	3G Cellular UART DTR	1.8V	Avoid having any HIGH logic level signal applied to any 3G input digital pins when the 3G module is powered off or during an ON/OFF transition.		no function	
49	RXD	O	3G Cellular UART Receive data	1.8V			no function	
50	GND		Ground					
51	TXD	I	3G Cellular UART transmit data	1.8V	Avoid having any HIGH logic level signal applied to any 3G input digital pins when the 3G module is powered off or during an ON/OFF transition.		no function	
52	3.3Vaux	I	3.3Vaux					

Typical Power Flow



- Peak inrush current is a fast rising pulse at power start up on board supplies or modem cap charging. It is influenced by the design and limits of the power supply providing power to the device.
- Radio initialization is a lower value steady current phase that occurs while the radio gets initialized and ready to talk to the cell network.
- Once connected to the network, there is a steady idle current state.
- When data is transmitted to the network, power peaks from this idle state. Peak data values are influenced by the distance from the towers and decided by the carrier network.
- Power starts dropping when the device is disconnected.
- After it is disconnected, power draw lowers if the device is told to enter sleep mode. Sleep mode keeps the receiver active and the device periodically wakes up long enough to tell the network it is still available.

Power Measurements

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

MTPCIE-H5

Radio Protocol	Cellular Call Box Connection No Data (Amps)	Average Measured Current (Amps) at Maximum Power	TX Pulse (Avg) Amplitude Current (Amps) for GSM850 or Peak Current for HSDPA	Total Inrush Charge Measured in Millicoulomb
3.3 Volts				
GSM850	0.056	0.629	2.5	5.27
HSDPA	0.057	0.727	0.804	5.27

Note: Inrush Current:The input current during power up, or a reset.

MTPCIE-H5-V-BW

Radio Protocol	Cellular Call Box Connection No Data (Amps)	Average Measured Current (Amps) at Maximum Power	TX Pulse (Avg) Amplitude Current (Amps) for GSM850 or Peak Current for HSDPA	Total Inrush Charge Measured in Millicoulomb
3.3 Volts				
GSM850	0.062	1.058	2.9	2.51
HSDPA	0.062	0.970	1.052	2.51

Note: Inrush Current:The input current during power up, or a reset.

MTPCIE-BW

Voltage	Inrush Current (Amps)	Idle Mode after MT100EOCG Boots Up (Amps)	Max Power with Bluetooth and Wi-Fi in Broadcast Mode (Amps)
3.3 Volts	0.056	0.0064	0.326

Note: Inrush Current:The input current during power up, or a reset.

Application Notes

RF Performances

RF performances are compliant with the ETSI recommendation 05.05 and 11.10. The module's radio transceiver meets the requirements of 3GPP Release 5 & 6. All values indicated are conducted.

Receiver Features for Cellular Devices

Category	Description
GSM 850 Sensitivity	< -109 dBm
E-GSM 900 Sensitivity	< -106 dBm
DCS 1800 Sensitivity	< -105 dBm
PCS 1900 Sensitivity	< -105 dBm
UMTS Band I 2100 Sensitivity	< -109 dBm
UMTS Band II 1900 Sensitivity	< -108 dBm
UMTS Band V 850 Sensitivity	< -110 dBm
UMTS Band VI 800 Sensitivity	< -110 dBm

Frequency Bands

Mode	Freq. TX (MHz)	Freq. RX (MHz)	Channels	TX-RX offset
GSM850	824.2 - 848.8	869.2 - 893.8	128 - 251	45 MHz
EGSM900	890.0 - 914.8	935.0 - 959.8	0 - 124	45 MHz
	880.2 - 889.8	925.2 - 934.8	975 - 1023	45 MHz
DCS1800	1710.2 - 1784.8	1805.2 - 1879.8	512 - 885	95 MHz
PCS1900	1850.2 - 1909.8	1930.2 - 1989.8	512 - 810	80 MHz
WCDMA850 (band V)	826.4 - 846.6	871.4 - 891.6	Tx: 4132 - 4233 Rx: 4357 - 4458	45 MHz
WCDMA900 (band VIII)	882.4 - 912.6	927.4 - 957.6	Tx: 2712 - 2863 Rx: 2937 - 3088	45 MHz
WCDMA1700 (band IV)	1710.4 - 1755.6	2112.4 - 2167.6	Tx: 1312 - 1513 Rx: 9662 - 9938	400MHz
WCDMA1900 (band II)	1852.4 - 1907.6	1932.4 - 1987.6	Tx: 9262 - 9538 Rx: 9662 - 9938	80MHz
WCDMA2100 (band I)	1922.4 - 1977.6	2112.4 - 2167.6	Tx: 9612 - 9888 Rx: 10562 - 10838	190MHz

Installing Drivers for Non-UIP HSPA+ Devices

HSPA+ Device Driver Installation

Installing on Linux

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

Multi-Tech tested the following Linux operating systems and all used port ttyACM0. If your system has another device using this port, your port numbers may be different.

- Ubuntu 13.04
- Debian 6.0.6
- Fedora 15
- openSUSE 11.4
- CentOS 6.0

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

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

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

Only the following devices can be used for AT commands:

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

Troubleshooting Linux

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

```
# lsmod | grep cdc_acm
```

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

```
# modprobe cdc-acm
```

If this returns an error response, such as # FATAL: Module cdc-acm not found, the kernel module is not on your system. You will need to build the driver.

Building a Linux Driver

If your system is missing the Linux driver:

1. Retrieve the appropriate kernel source code version for your system. This should be in your OS distribution package. Unpack it.
2. In its root directory type: **# make menuconfig**
3. Configure the kernel according to your system configuration,
4. Browse to menu **Device Driver > USB Support** and select **USB Modem (CDC ACM) support**.
5. To start the build once configured, type **# make**

The kernel module `cdc-acm.ko` is in the directory `drivers/usb/class`. If the kernel was built previously, compile the module by typing:

```
# make M=drivers/usb/class
```

To load the module use `modprobe` or `insmod`.

Windows Release Notes

We tested `h5-u-windriver_8.00.04.zip` `ev3-u_windriver_8.00.04.zip` driver on the following Windows operating systems.

- **Windows 8 x86 and x64, Windows 7 x86 and x64, Vista x86 and x64, XP x86 and x64, Windows Server 2012, Windows Server 2008 x86 and x64, and Windows Server 2003 x86**
 - Drivers install correctly, but may require .NET Framework version 3.5 or older.
 - After installing the driver for this device, the device may not be available when Windows comes out of a sleep/hibernate state. To correct this issue, unplug the device from the USB port and then plug it back in to the same port.
- **Windows Server 2003 x64**
 - Not supported with version 8.00.04.

Downloading the Windows USB Driver

If you haven't downloaded the driver:

1. Go to the Multi-Tech Support page, www.multitech.com/support.go and select your product from the Product Families drop down list.
2. Click **Drivers**.
3. Select **h5-u_windriver_8.00.04.zip** and **Save** the driver to your computer.
4. Extract the files to your computer.

Windows Notes

Installing on USB Host Powered Devices

When you connect a USB host powered device to a computer through a USB cable, the Windows **Add New Hardware Wizard** may display **Cannot Install this Hardware**. If this occurs, click **Finish**. Windows detects additional devices and prompts you to install them.

Installing on Non-USB Powered Devices

Turn on the device and wait 15 seconds before connecting the USB cable. If you connect the USB cable before supplying power to the device, the Windows **Add New Hardware Wizard** may appear and show **Cannot Install this Hardware**. If this occurs, click Finish. Windows detects additional devices and prompts you to install the additional devices. If Windows does not detect new device, unplug the USB cable, turn the device off and on, wait 15 seconds, insert the USB cable, and install devices when prompted.

Installing on Windows 8, 7 or Vista

This process installs multiple drivers and ports.

Note: If you previously installed USB drivers for this device, uninstall them before installing or re-installing this driver. Uninstall all existing drivers for this device. Refer to Uninstall Windows Drivers for details.

Before you connect the device (disconnect the device if you connected it):

CAUTION: If you connected the device before installing the drivers, Windows may install drivers automatically. Your device may not operate correctly with these drivers. Uninstall the drivers before proceeding. See Remove Microsoft Installed Drivers for details.

1. Go to the location where you extracted the driver and open the **H5-USB\Driver** folder.
2. Right-click on **TelitUSBInstaller_In_U8.00.04.exe** and select **Run as Administrator**.
3. Click **Yes** or **Allow** to allow the installer to make changes to your computer.
4. Click **Next** and follow the instructions in the installation wizard.
5. Click the **Install** option when prompted, for example, Install this driver software anyway.
6. Click **Finish**.
7. Connect USB cable from the device to a USB port on your computer. Windows indicates when the device is ready to use.
8. Signal strength LEDs require a device reboot after installing software. Disconnect the device from the computer's USB port for a few seconds and reconnect the device to the same USB port.

Installing on Windows XP

This process installs four drivers.

Note: If you previously installed USB drivers for this device, uninstall them before installing or re-installing this driver. Uninstall all existing drivers for this device. Refer to Uninstall Windows Drivers for details.

Before you connect the device (disconnect the device if you connected it):

1. Go to the location where you extracted the driver and open the **H5-USB\Driver** folder.
2. Right-click on **TelitUSBInstaller_In_U8.00.04.exe** and select **Run**.
3. Click **Next** and follow the instructions in the installation wizard.
4. Click **Continue Anyway** each time this screen appears.



5. Click **Finish**.
6. Connect USB cable from the device to a USB port on your computer. After it detects the hardware, Windows opens the New Hardware Wizard.
7. Select **No, not this time** and click **Next**.
8. Select **Install the software automatically (Recommended)** and click **Next**.
9. Select **Finish**.
10. Repeat Steps 7-9 for each additional New Hardware Wizard. Windows indicates when the device is ready to use.
11. Signal strength LEDs require a device reboot after installing software. Disconnect the device from the computer's USB port for a few seconds and reconnect the device to the same USB port.

Uninstalling Windows Drivers

Note: Disconnect the device before uninstalling drivers.

Windows 8

To uninstall drivers from Windows 8:

1. Open Windows **Programs and Features**.
2. Uninstall **Windows Driver Package – Intel Mobile Communications (flashusb) USB**.
3. Uninstall all **Telit modems, ports, and USB drivers**.

Windows 7 or Vista

To uninstall drivers from Windows 7 or Vista:

1. Open **Programs and Features** from the Windows Control Panel.
2. Uninstall the **Windows Driver Package – Telit Wireless Solutions (telitusbser) Modem**.
3. Uninstall all **Telit modems, ports, and USB**.

Windows XP

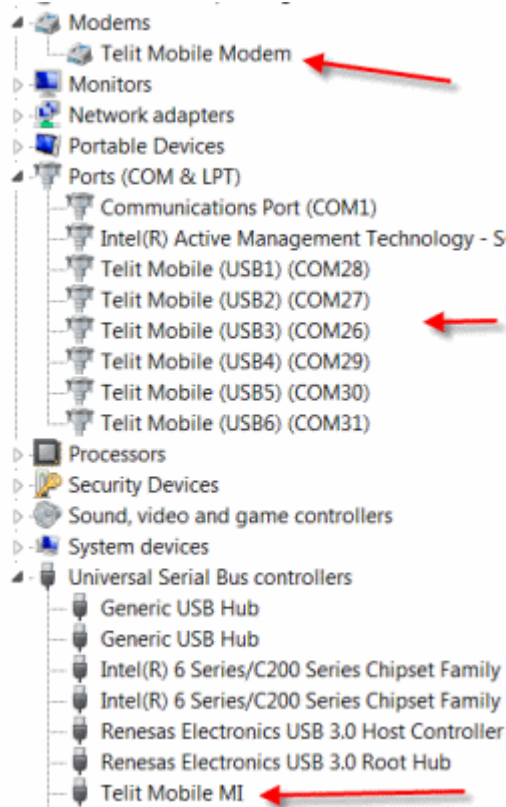
To uninstall drivers from Windows XP:

1. Open the **Control Panel** and go to **Add or Remove Programs**.
2. Uninstall **Windows Driver Package – Telit Wireless Solutions (telitusbser) Modem**.
3. Uninstall all other **Telit modems, Ports and USB**.

Remove Microsoft Installed Drivers

If using Windows 7 and connect the device before installing drivers, Windows Update automatically installs drivers. Your device may not operate correctly with these drivers. To remove these drivers:

1. With the device plugged in, open the **Device Manager**.



2. Right-click on the Telit Mobile Modem and select **Uninstall**.
3. Select **Delete the driver software for this device** and click **OK**.
4. Repeat the removal steps to uninstall each Telit port and the Telit Universal Serial Bus Control.

Developer Note

By default each time an H5 device with a different IMEI value is connected using this USB driver, the operating system will not require searching for the drivers again and uses the same ports created in a previous installation. To prevent this, use the utility included with the driver download to manage port creation as follows.

To enable USB IMEI identification, where the operating system creates a new set of ports with different COM enumeration for each H5 device with a different IMEI value:

1. Uninstall the driver if already installed.
2. Double-click **H5_enable_USB_IMEI_identification.reg** in the folder where you extracted the driver files.
3. Install the driver as normal.

To disable USB IMEI identification (driver default setting):

1. Uninstall the driver if already installed.
2. Double-click **H5_disable_USB_IMEI_identification.reg** in the folder where you extracted the driver files.
3. Install the driver as normal.

Using Linux with H5 Devices

Shell Commands

Testing Serial Ports

To test the serial ports created by the driver, type in a shell:

```
# cat /dev/ttyACM0 &
# echo -en "ATE0\r" > /dev/ttyACM03
# echo -en "AT\r" > /dev/ttyACM0
```

Note: Sending ATE0 is required, to avoid issues in the terminal output. It prevents the sending/receiving spurious characters to/from the modem when used with the Linux commands “echo” and “cat”

You can perform the same test using the other interface (ttyACM1 ttyACM3).

Create a PPP Connection

Most recent Linux distributions have GUI tools for creating PPP connections; the following instructions are for creating a PPP connection through command line interface.

PPP support must be compiled into the kernel; pppd and chat programs are also required.

pppd needs two scripts: the first script performs the environment setting and calls the second script, which is used by the chat program. For creating a PPP connection type:

```
# pppd file /etc/pppd_script &
```

Example

```
# Debug info from pppd
debug
#kdebug 4
# Most phones don't reply to LCP echos
lcp-echo-failure 3
lcp-echo-interval 3
# Keep pppd attached to the terminal
# Comment this to get daemon mode pppd
nodetach
# The chat script (be sure to edit that file, too!)
connect "/usr/sbin/chat -v -f /etc/chatscripts/hsdpa_connect"
# Serial Device to which the modem is connected
/dev/ttyACM3
# Serial port line speed
115200
dump
# The phone is not required to authenticate
#noauth
user <insert here the correct username for authentication>
name <insert here the name of the connection>
password <insert here the correct password for authentication>
```

```
# If you want to use the HSDPA link as your gateway
defaultroute
# pppd must not propose any IP address to the peer
#noipdefault
ipcp-accept-local
ipcp-accept-remote
# Keep modem up even if connection fails
#persist
# Hardware flow control
crtscts
# Ask the peer for up to 2 DNS server addresses
usepeerdns
# No ppp compression
novj
nobsdcomp
novjcomp
nopcomp
noaccomp
# For sanity, keep a lock on the serial line
lock
# Show password in debug messages
show-password
```

This script calls the option *connect* using the script *hsdpa_connect*, for example: `#!/bin/sh`

```
# Connection to the network
" AT+CGDCONT=1,"IP","<insert here the correct APN provided by
your network operator>"
# Dial the number.
OK ATD*99***1#
# The modem is waiting for the following answer
CONNECT "
```

After launching a PPP connection is possible to use ftp protocol or other utilities that allow the access to the Internet.

C Programming

The following topics show all the functions that can be used from C source code to perform read/write operations on the serial devices.

open()

The *open()* function shall establish the connection between a file and a file descriptor. The file descriptor is used by other I/O functions to refer to that file.

Header File

fcntl.h

Prototype:

```
int open(const char *pathname, int flags)
```

Parameters:

pathname – file name with its own path.

flags – is an *int* specifying file opening mode: is one of O_RDONLY, O_WRONLY or O_RDWR which request opening the file read-only, write-only or read/write, respectively.

Returns:

The new file descriptor *filides* if successful, -1 otherwise.

Example

```
Open the /dev/ttyACM0.
int fd; // file descriptor for the /dev/ttyACM0 entry
if((fd = open("/dev/ttyACM0", O_RDONLY) < 0)
{
/* Error Management Routine */
} else {
/* ttyACM0 Device Opened */
}
```

read()

The *read()* function reads *nbyte* bytes from the file associated with the open file descriptor, *filides*, and copies them in the buffer that is pointed to by *buf*.

Header File

unistd.h

Prototype:

```
ssize_t read(int fildes, void *buf, size_t nbyte)
```

Parameters:

fildes - file descriptor

buf - destination buffer pointer

nbyte - number of bytes that read() attempts to read

Returns:

The number of bytes actually read if the operation is completed successfully, otherwise it is -1.

Example

Read *sizeof(read_buff)* bytes from the file associated with *fd* and stores them into *read_buff*.

```
char read_buff[BUFF_LEN];
if(read(fd, read_buff, sizeof(read_buff)) < 0)
{
/* Error Management Routine */
} else {
/* Value Read */
}
```

write()

The *write()* function writes *nbyte* bytes from the buffer that are pointed by *buf* to the file associated with the open file descriptor. *filides*.

Header File

unistd.h

Prototype:

```
ssize_t write(int fildes, const void *buf, size_t nbyte)
```

Parameters:

fildes – file descriptor

buf – destination buffer pointer

nbyte – number of bytes that *write()* attempts to write

Returns:

The number of bytes actually written if the operation is completed successfully, otherwise it is -1.

Example

Write *strlen(value_to_be_written)* bytes from the buffer pointed by *value_to_be_written* to the file associated with the open file descriptor, *fd*.

```
char value_to_be_written[] = "dummy_write";
if (write(fd, value_to_be_written, strlen(value_to_be_written)) < 0)
{
/* Error Management Routine */
} else {
/* Value Written */
}
```

close()

The *close()* function shall deallocate the file descriptor indicated by *fildes*. To deallocate means to make the file descriptor available for return by subsequent calls to *open()* or other functions that allocate file descriptors.

Header File

unistd.h

Prototype:

```
int close(int fildes);
```

Parameters:

fildes - file descriptor

Returns:

0 if successful, otherwise it is -1.

Example

Close the ttyACMx file.

```

if(close(fd) < 0)
{
/* Error Management Routine */
} else {
/* File Closed */
}

```

Test Program()

The following simple C program is useful to test the modem issuing an AT command. The program opens the /dev/ttyACM0 interface and calls the write() and the read() function to send an AT command and receive the subsequent output.

```

#include <stdio.h> /* Standard input/output definitions */
#include <string.h> /* String function definitions */
#include <unistd.h> /* UNIX standard function definitions */
#include <fcntl.h> /* File control definitions */
#include <errno.h> /* Error number definitions */
#include <termios.h> /* POSIX terminal control definitions */
#define USB "/dev/ttyACM0"
#define BUFSIZE 1000
#define BAUDRATE B115200
int open_port(char *port)
{
struct termios options;
int fd;
fd = open(port, O_RDWR | O_NOCTTY | O_NDELAY);
if (fd == -1)
{
printf("open_port: Unable to open the port - ");
}
else
{
printf ( "Port %s with file descriptor=%i",port, fd);
fcntl(fd, F_SETFL, FNDELAY);
tcgetattr( fd, &options );
cfsetispeed( &options, BAUDRATE );
cfsetospeed( &options, BAUDRATE );
options.c_cflag |= ( CLOCAL | CREAD);
options.c_cflag &= ~(CSIZE | PARENB | CSTOPB | CSIZE);
options.c_cflag |= CS8;
options.c_cflag &= ~CRTSCTS;
options.c_lflag &= ~(ICANON | ECHO | ECHOE | ISIG);
options.c_iflag &= ~(IXON | IXOFF | IXANY | ICRNL | INLCR |
IGNCR);
options.c_oflag &= ~OPOST;
if ( tcsetattr( fd, TCSANOW, &options ) == -1 )
printf ("Error with tcsetattr = %s\n", strerror ( errno )
);
}
}

```

```
else
printf ( "%s\n", "succeed" );
}
return (fd);
}
int main()
{
int serialFD = open_port(USB);
char buf[BUFSIZE];
memset(buf,0,BUFSIZE);
write(serialFD, "AT\r" , strlen("AT\r"));
sleep(1);
read( serialFD, buf, BUFSIZE );
printf("The string is: %s\n", buf);
close(serialFD);
return 0;
}
```

The sleep instruction is required because the modem response after issuing the AT command is not immediate, so you need to wait a bit before reading. There are more efficient ways to do this, for example, you can put the read call in a while loop and exit when the read buffer contains a certain string.

Index

A	
account activation.....	47
activation	
cellular devices.....	47
antenna	42
cable.....	43 45
cellular devices.....	42
GPS.....	44
Wi-Fi RF.....	44
assembly diagram	18
B	
Bluetooth	47
build options	47
C	
cable.....	43 45
CAD drawing.....	49 50
CE mark	36
Chinese hazardous substances	
Chinese version.....	41
English version	40
C programming	
close.....	72
open	70
read.....	71
test program	73
write.....	72
D	
developer board.....	16
device	
maintenance	33
dialing restrictions.....	37
drawing	49 50
E	
electrical	
characteristics	53
electromagnetic interference	14
electrostatic discharge	15
EMI	14
ESD	15
European Community Directives	36
F	
FCC	
grant notes.....	45
frequency bands	62
G	
GPS	
antenna.....	44
ground plane	14
H	
handling precautions due to ESD.....	15
hazardous substances	37
host labeling.....	45
HSPA+.....	34
HSPA+21.....	47
I	
IMEI	34
install	
SIM card	31
installing	
device on board	31
J	
jumpers	30
L	
labeling	
host	45
labels	34
Linux	
building driver.....	64
C programming	70
driver.....	47
install.....	63
PPP connection	69

shell commands	69		
troubleshoot driver	63		
M			
maintenance	33		
mechanical drawing	49 50		
N			
noise suppression.....	14		
P			
PC board layout.....	14		
pinout.....	53		
USB.....	13		
pinout table.....	8		
standard	11		
power draw	60		
PTCRB	34		
R			
radio frequency interference	32		
receiver features	61		
RoHS.....	37		
S			
safety			
RF interference	32		
vehicle	32		
safety standards.....	14		
SIM card	31		
specifications.....	51		
		T	
		transmitter features.....	61
		U	
		uninstall.....	67
		USB.....	13 67
		design consideration.....	15
		driver download.....	64
		notes	64
		USB driver	
		install.....	63 65 66
		uninstall	67
		user responsibility	33
		V	
		vehicle safety	32
		Vista	65 67
		W	
		Wi-Fi	47
		Wi-Fi RF specifications	44
		Windows	
		release notes.....	64
		USB driver download	64
		USB driver release notes.....	64
		Windows 7	65 67
		Windows 8	65
		uninstall	67
		Windows XP	66 67
		X	
		XP	66