MULTITECH

Universal Developer Kit 2.0

MTUDK-ST-Cell Developer Guide

Universal Developer Kit 2.0 Developer Guide

Models: MTUDK-ST-Cell

Part Number: S000610, Version 2.6

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 © 2018 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 and Registered Trademarks

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

Legal Notices

The MultiTech 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.

MULTITECH 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 MULTITECH WARRANT ANY CONNECTION OR ACCESSIBILITY TO ANY CELLULAR COMMUNICATIONS NETWORK. MULTITECH 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 MultiTech products and the final application of the MultiTech products should be thoroughly tested to ensure the functionality of the MultiTech 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 MultiTech product is integrated operates as intended and meets its requirements or the requirements of its direct or indirect customers. MultiTech 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 MultiTech 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 MultiTech

Knowledge Base

The Knowledge Base provides immediate access to support information and resolutions for all MultiTech 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, 8am 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

Chapter 1 – Developer Kit Introduction 4
Overview 4
Features 4
Device Specific Documentation 4
MTUDK2-ST-CELL Developer Kit Contents 4
Chapter 2 – Board Components 6
Developer Board 6
Developer Board Connectors 7
Board Components 7
LED Indicators 8
Chapter 3 – Installation and Operation 9
Installing a SIM Card 9
Installing a SIM Card on a SocketModem 9
Installing a SIM Card on a DragonFly 9
Installing a SocketModem on the Developer Board 10
Installing a Dragonfly on the Developer Board 11
Arduino Shield 12
Installing an Arduino Shield with a Dragonfly 12
Dragonfly Arduino Pins 13
mDot Arduino Pins 15
Installing an Arduino Shield with a SocketModem 16
Attaching Power Supply Blades 17
Power Supply and Blades 17
Attaching the Blades 17
SMA to U.FL Cables 18
Connecting an Antenna through the Developer Board Connectors 18
Chapter 4 – Block Diagram and Schematics 19
Block Diagram 20
Schematics 21
Chapter 5 – Design Considerations 28
Noise Suppression Design 28
PC Board Layout Guideline 28
Electromagnetic Interference 28
Electrostatic Discharge Control 29
USB Design 29

Chapter 1 – Developer Kit Introduction

Overview

The MTUDK2-ST-Cell Universal Developer Kit supports development with cellular SocketModem, Dragonfly (including Dragonfly Nano), and mDot devices. Use the developer board to streamline your development efforts and evaluate your products and applications. Easily plug in your communications device and use the developer kit for testing, programming and evaluation.

Note: Use this Developer Guide for developing with all SocketModem or Dragonfly models. If developing with an mDot, use the MultiConnect® mDot™ Developer Guide, which includes device and developer board information specific to mDots. Go to the mDot Developer Kit page at http://www.multitech.com/models/94558010LF.
Warning: Do not use an mDot and a Dragonfly or Socketmodem on this board at the same time. Doing to may damage both devices.

Features

- 5V-9V power input
- Selectable 3.3V or 5V on board power supply for mDot and SocketModem and 5V only for Dragonfly models
- USB and serial interfaces
- USB port for mbed development environment
- Arduino shield socket

Device Specific Documentation

Refer to the Device Guide for your SocketModem or Dragonfly model for specifications, pin information, mechanical drawings, labeling, regulatory information, and other model specific details.

MTUDK2-ST-CELL Developer Kit Contents

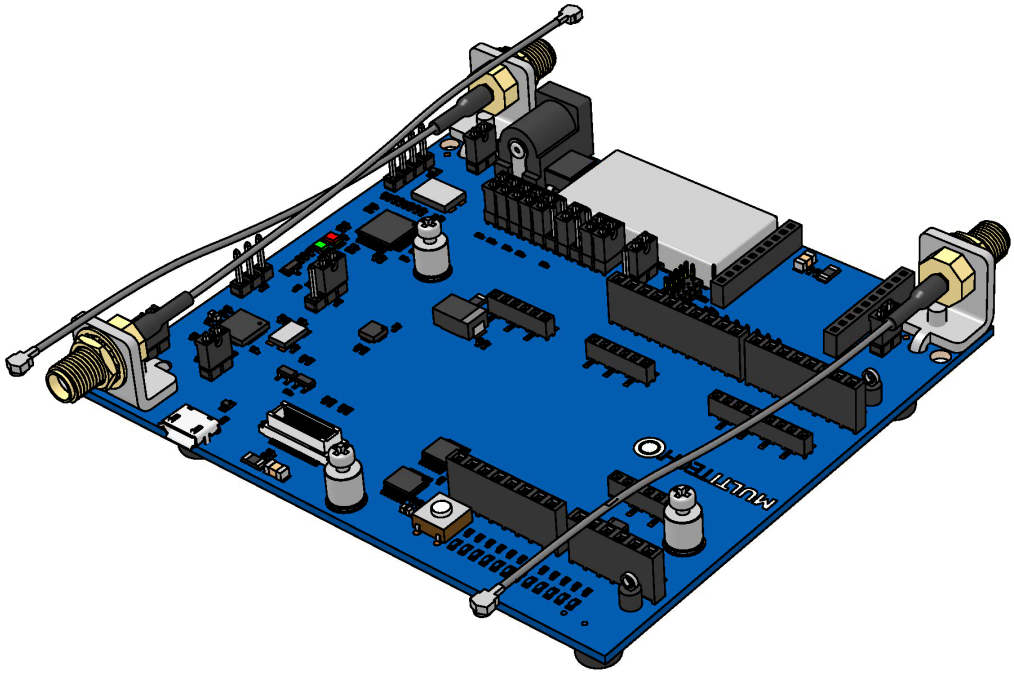
The MTUDK2-ST-CELL Developer Kit includes the following:

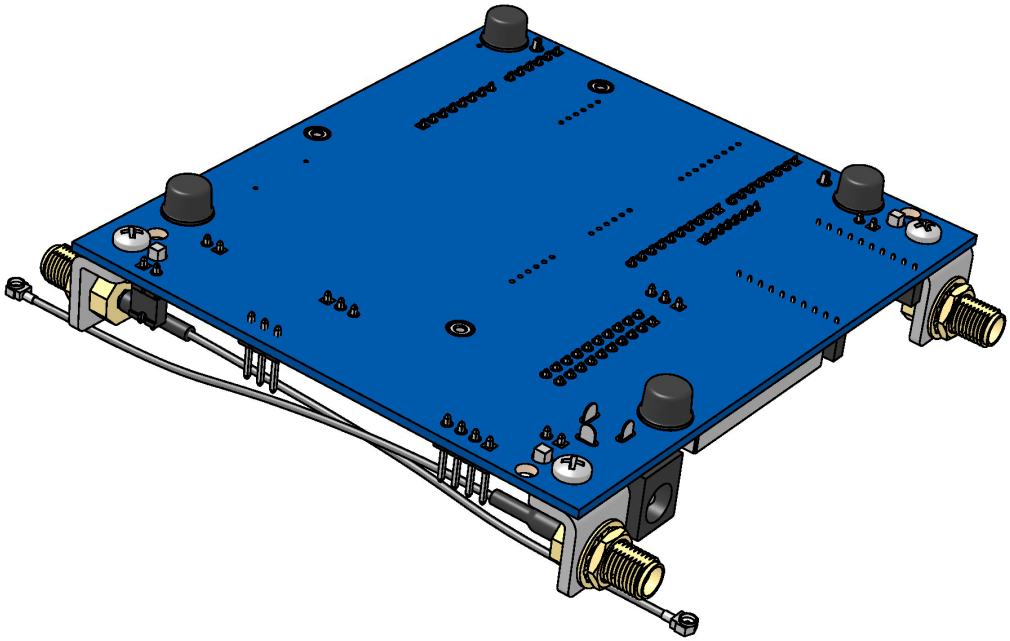
Developer Board	1 - MTUDK 2.0 Cell Developer Board
Power Supply	1 - 100-240V 9V-1.7A power supply with removable blades
	1 - NAM blade/plug,
	1 - EURO blade/plug
	1 - UK blade/plug
	1 - AU/NZ blade/plug
Cables	1 - Micro USB Cable
	3 - SMA-U.FL Antenna Cables (attached to developer board)
Antennas	1 - 3.3V magnetic GPS Antenna
	2 - 700-2600 MHz Antennas
Customer Notices	Quick Start

Additional	One promotional screwdriver

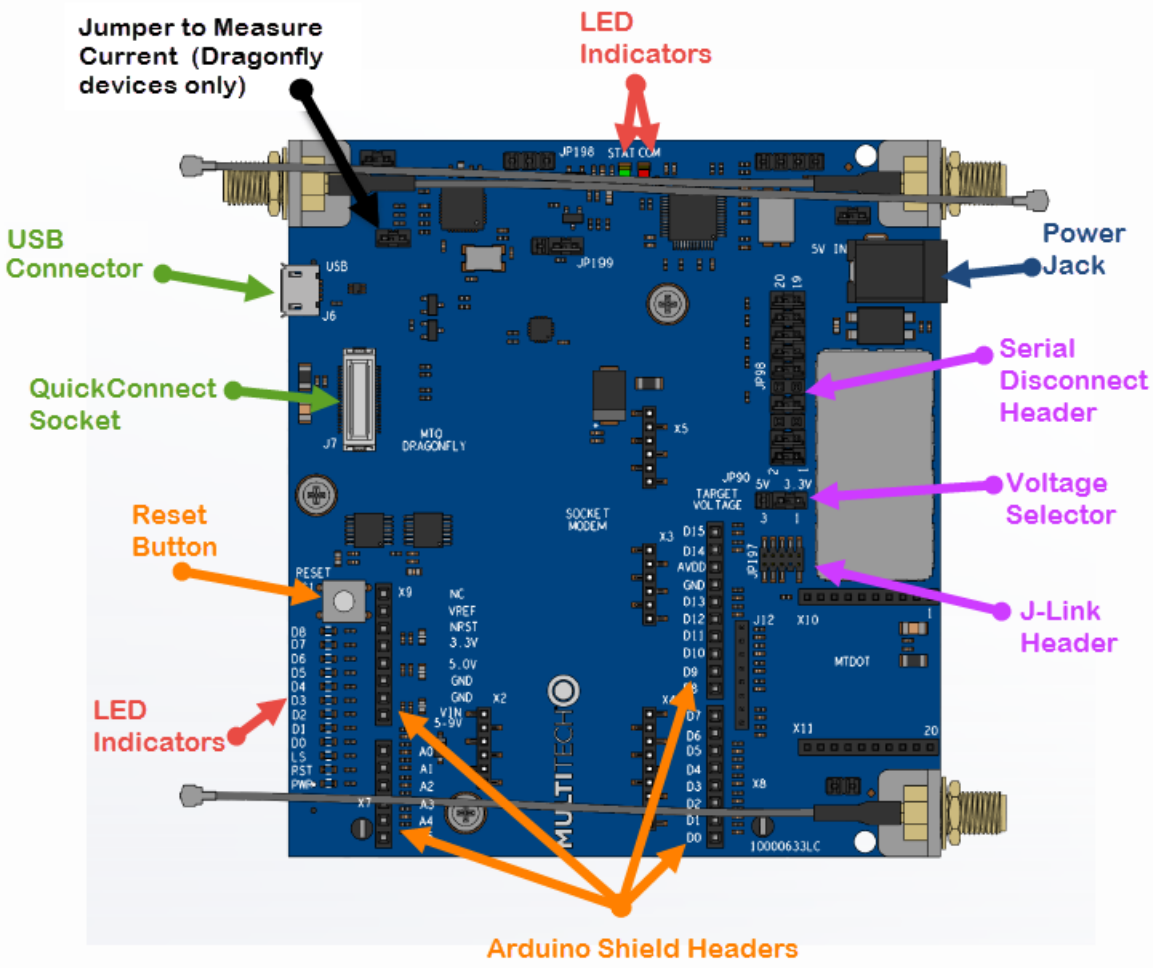
Chapter 2 – Board Components

Developer Board





Developer Board Connectors



Board Components

Label	Description
Voltage Selector	Selects between the on-board 3.3V or 5V regulator for powering a SocketModem, or mDot. Factory default operating voltage is 5V. (Note: Does not apply to Dragonfly devices which use the QuickConnect Socket that is 5V only.)
J6	USB connection for mbed, serial, and SocketModem. For the Dragonfly, use USB connector on the Dragonfly. For information on connecting to and using mbed, refer to the device guide for your Dragonfly model. (Not available for SocketModems.)
J7	QuickConnect Socket (for Dragonfly devices).
JP98	Serial Disconnect Header.
JP197	J-Link Header.
S1	Reset Button. Use to reset the processor of the device attached to the board.

Label	Description
X2	SocketModem, USB Connector.
X3	SocketModem, GPIO (not connected).
X4	SocketModem Serial Connector.
X5	SocketModem Power Connector.
X6	Arduino Shield Connector.
X7	Arduino Shield Connector.
X8	Arduino Shield Connector.
X9	Arduino Shield Connector.
X10	MTDOT Connector.
X11	MTDOT Connector.
J12	MTDOT Programming Header.

CAUTION: Take care when connecting or disconnecting USB cables to avoid detaching the connector from the board.

LED Indicators

Label	LED	Location
STAT	LED1	Near JP198
COM	LED2	Near JP198
D7	LED3	Above the SMC-USB connector
D4	LED4	Above the SMC-USB connector
D5	LED5	Above the SMC-USB connector
D8	LED6	Above the SMC-USB connector
D6	LED7	Above the SMC-USB connector
D3	LED8	Above the SMC-USB connector
D0	LED9	Above the SMC-USB connector
D1	LED10	Above the SMC-USB connector
LS	LED11	Above the SMC-USB connector
RST	LED12	Above the SMC-USB connector
PWR	LED13	Above the SMC-USB connector
D2	LED14	Above the SMC-USB connector

Chapter 3 – Installation and Operation

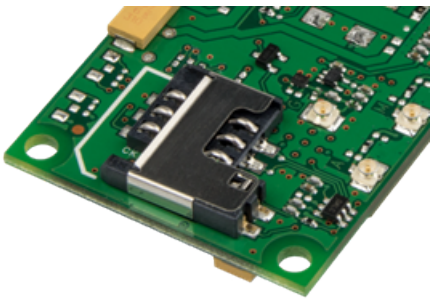
Installing a SIM Card

Installing a SIM Card on a SocketModem

Note: When using the SocketModem with a developer board, mount the SocketModem on the developer board before installing the SIM card.

To install the SIM Card:

- With the contact side facing down, align the notched edge as outlined on the SocketModem and slide the SIM card completely into the SIM holder.

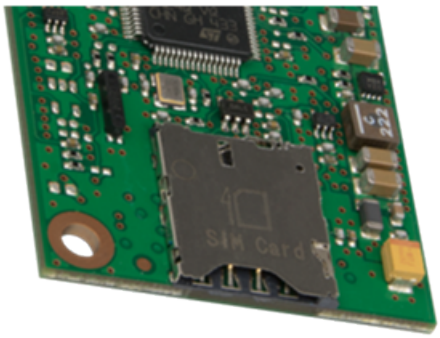


Installing a SIM Card on a DragonFly

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

To install the SIM card:

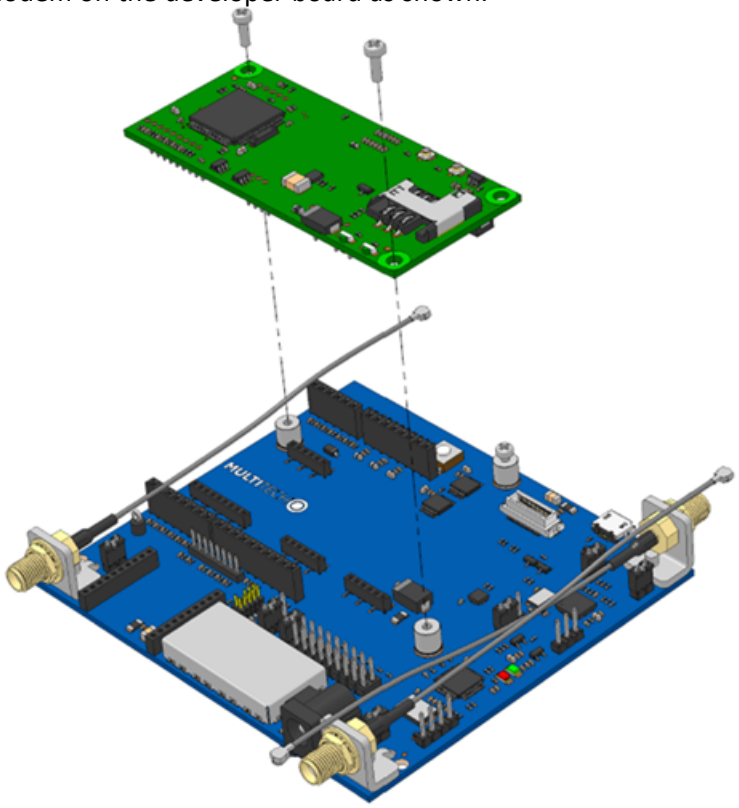
- With the contact side facing down, align the notched edge as shown on the Dragonfly's SIM holder and slide the SIM card completely into the SIM holder.



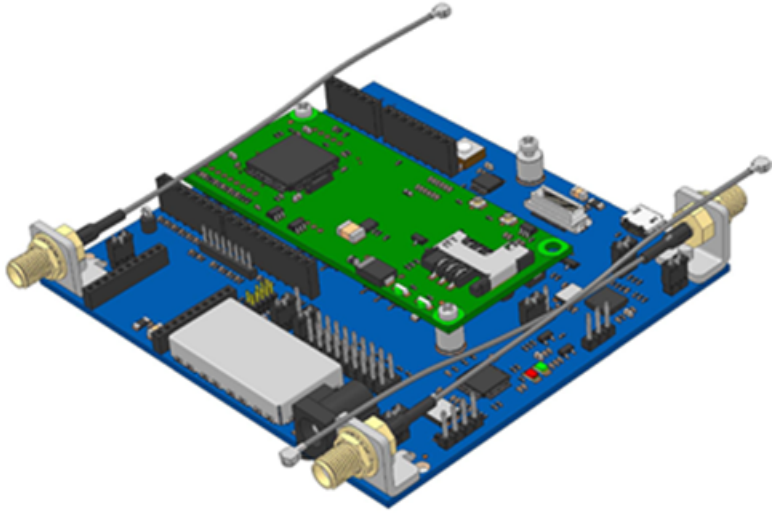
Installing a SocketModem on the Developer Board

To install a SocketModem:

1. Remove the screws from the developer board.
2. Align the SocketModem on the developer board as shown.



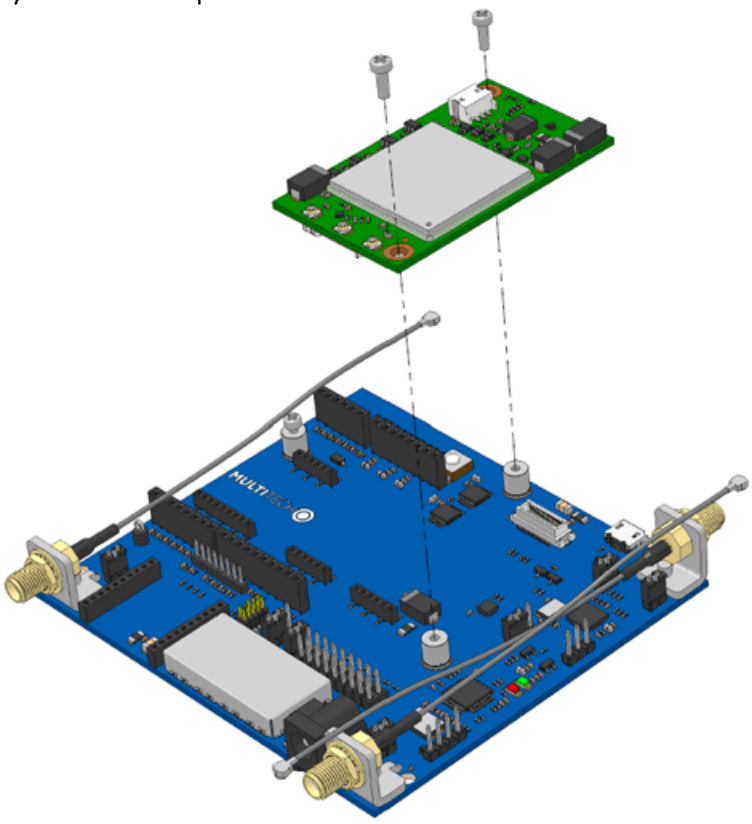
3. Secure the SocketModem with the screws you removed in Step 1.



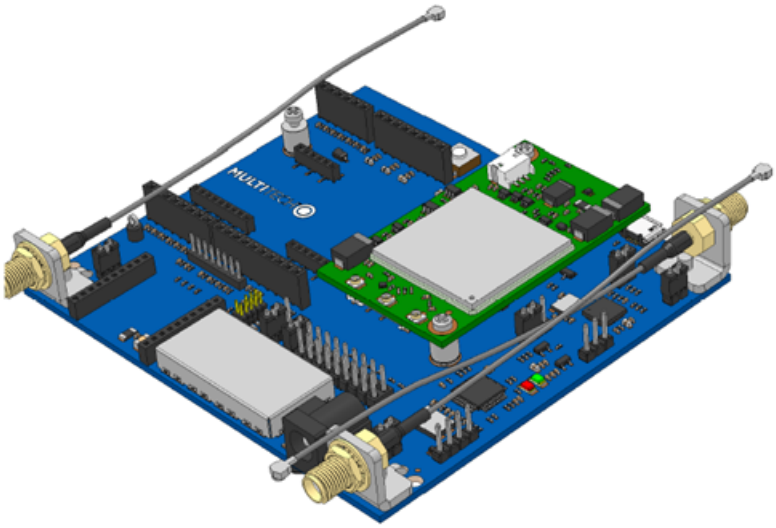
Installing a Dragonfly on the Developer Board

To install a Dragonfly:

1. Remove the screws from the developer board.
2. Align the Dragonfly on the developer board as shown.



3. Secure the Dragonfly with the screws you removed in Step 1.



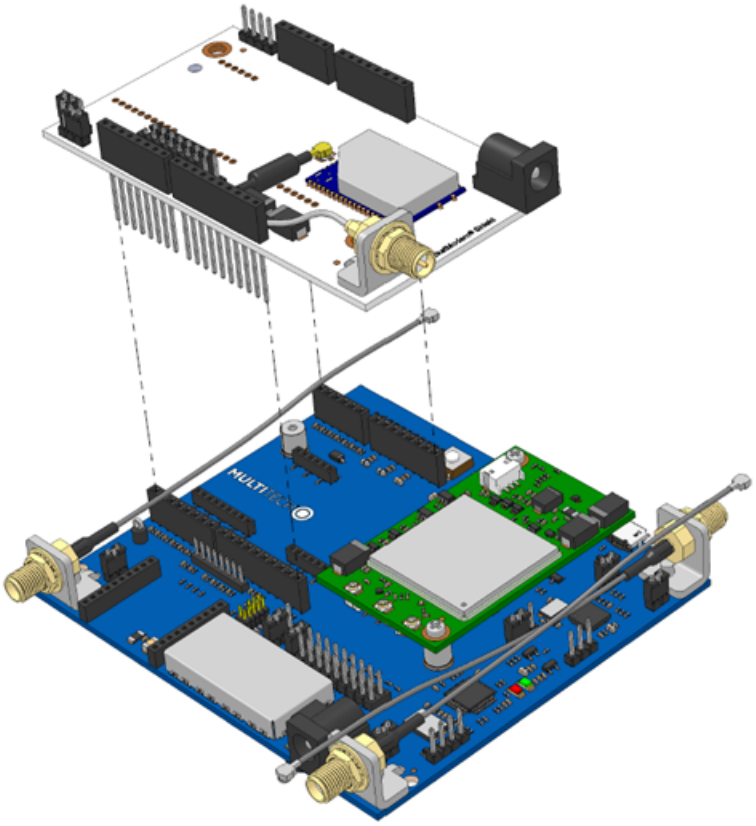
Arduino Shield

Installing an Arduino Shield with a Dragonfly

Note: When using an Arduino Shield with a Dragonfly, install the SIM card in the Dragonfly and then install the Dragonfly on the developer board before installing the Arduino shield.

To use an Arduino Shield with a Dragonfly

1. Disable the developer card's serial port.
2. Align the Arduino Shield on the developer board as shown. It will overlap the Dragonfly



Dragonfly Arduino Pins

Signals (B01 & B02)	Arduino Shield				Signals (STM32F411RE processor- B01 only)
			D15		D15 (PB8)
			D14		D14 (PB9)
			AVDD		NC
			GND		Ground
		NC	D13	X6	D13 (PA5)
NC		VREF	D12		D12(PA6)
nReset, from pushbutton		nRST	D11		D11 (PB5)
NC	X9	3.3V	D10		D10 (PC8)
5.0V		5.0V	D9		D9 (PB13)
Ground		GND	D8		D8 (PB1)
Ground		GND			
NC		VIN	D7		D7 (PA8)
			D6		D6 (PA1)
A0 (PC2)		A0	D5		D5 (PA9)
A1 (PC0)		A1	D4	X8	D4 (PA7)
A2 (PC4)	X7	A2	D3		D3 (PA0)
A3 (PB0)		A3	D2		D2 (PB15)
A4 (PC1)		A4	D1		D1 (PA2)
A5 (PC9)		A5	D0		D0 (PA3)

Dragonfly Nano Arduino Pins

Signals (B01 & B02)		Arduino Shield			Signals (STM32L471QG processor- B01 only)
			D15		D15 (PB8)
			D14		D14 (PB9)
			AVDD		NC
			GND		Ground
	X9	NC	D13	X6	D13 (PG2)
NC		VREF	D12		D12(PG3)
nReset, from pushbutton		nRST	D11		D11 (PB5)
NC		3.3V	D10		D10 (PC8)
5.0V		5.0V	D9		D9 (PB10)
Ground		GND	D8		D8 (PB0)
Ground		GND			
NC		VIN	D7	X8	D7 (PG7)
			D6		D6 (PA1)
A0 (PC2)	X7	A0	D5		D5 (PA9)
A1 (PC13)		A1	D4		D4 (PA7)
A2 (PC4)		A2	D3		D3 (PA0)
A3 (PE6)		A3	D2		D2 (PB15)
A4 (PA6)		A4	D1		D1 (PA2)
A5 (PG8)		A5	D0		D0 (PA3)

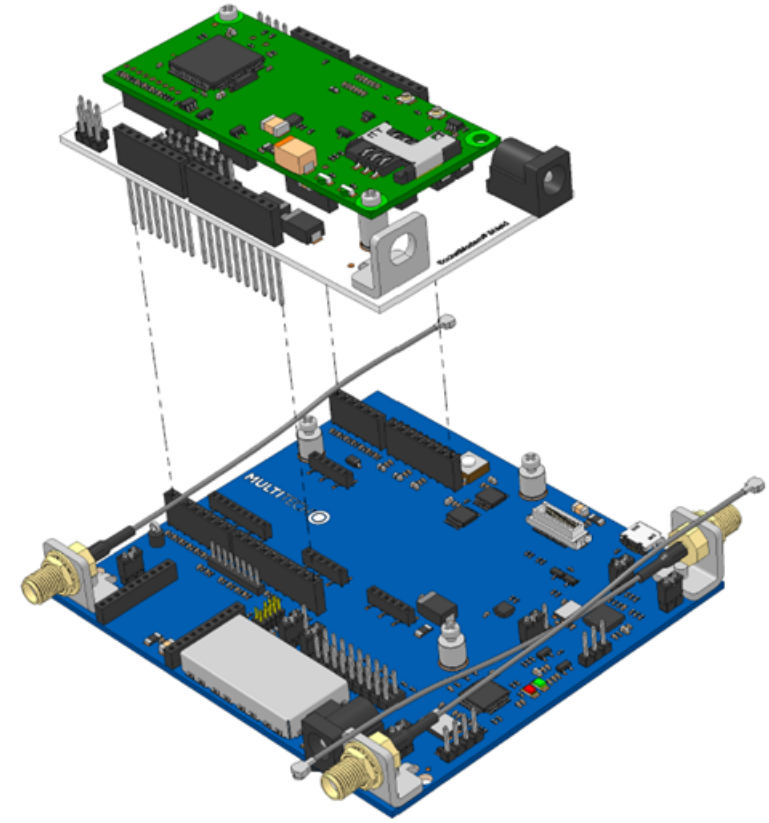
mDot Arduino Pins

Signals (module pin) micro pin		Arduino Shield						Signals (module pin) micro pin
					D15			PWM0/RSSI/I2CSCL (6) PA8
					D14			PWM1/I2CSDA (7) PC9
					AVDD			3.3V
					GND			Ground
			NC		D13		X6	AD2/DIO2/SCK (18) PA5
3.3V			VREF		D12			DO8/MISO (4) PA6
nReset, from pushbutton			nRST		D11			AD4/DIO4/MOSI (11) PA7
3.3V			3.3V		D10			AD3/DIO3/SNSS (17) PA4
5.0V	X9		5.0V		D9			no connect
Ground			GND		D8			no connect
Ground			GND					
5-9V input from J3			VIN		D7			nDTR/SleepRQ/DI8 (9) PA11
					D6			nRTS/AD6/DIO6 (16) PA1
AD0/DIO0 (20) PB1			A0		D5			no connect
AD1/DIO1 (19) PB0			A1		D4		X8	no connect
Associate/AD5/DIO5 (15) PC1	X7		A2		D3			nCTS/DIO7 (12) PA0
no connect			A3		D2			ON/nSleep (13) PC13
no connect			A4		D1			Dout (2) PA2
no connect			A5		D0			Din (3) PA3

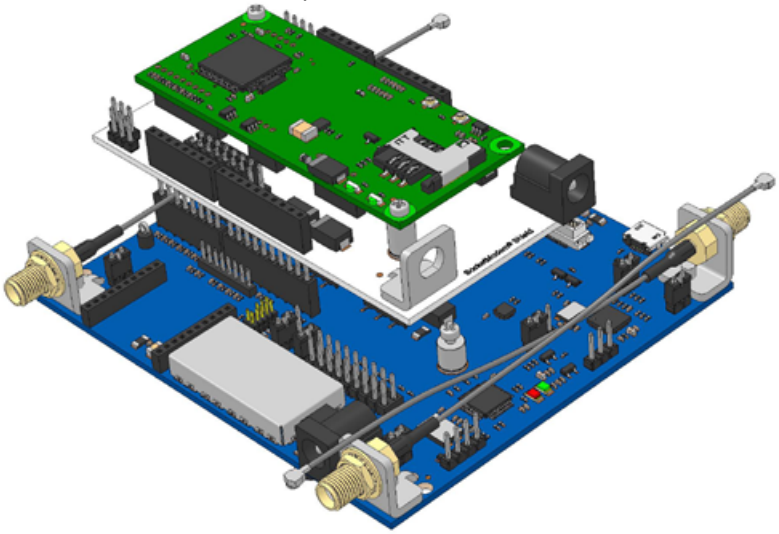
Installing an Arduino Shield with a SocketModem

If using an Arduino Shield with a SocketModem:

1. Move jumpers for JP98 as follows:
   - Move Jumper 3-4 to Jumper 5-6
   - Move Jumper 7-8 to Jumper 9-10
2. Mount the MTSMC device on the Arduino shield as shown in the following image.



3. Connect the Arduino Shield to the developer board.



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 blade

Power Supply with NAM blade

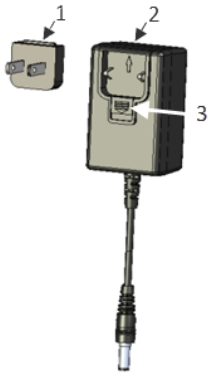
Power Supply with UK blade

Power Supply with AU-NZ 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

SMA to U.FL Cables

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

Connecting an Antenna through the Developer Board Connectors

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

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

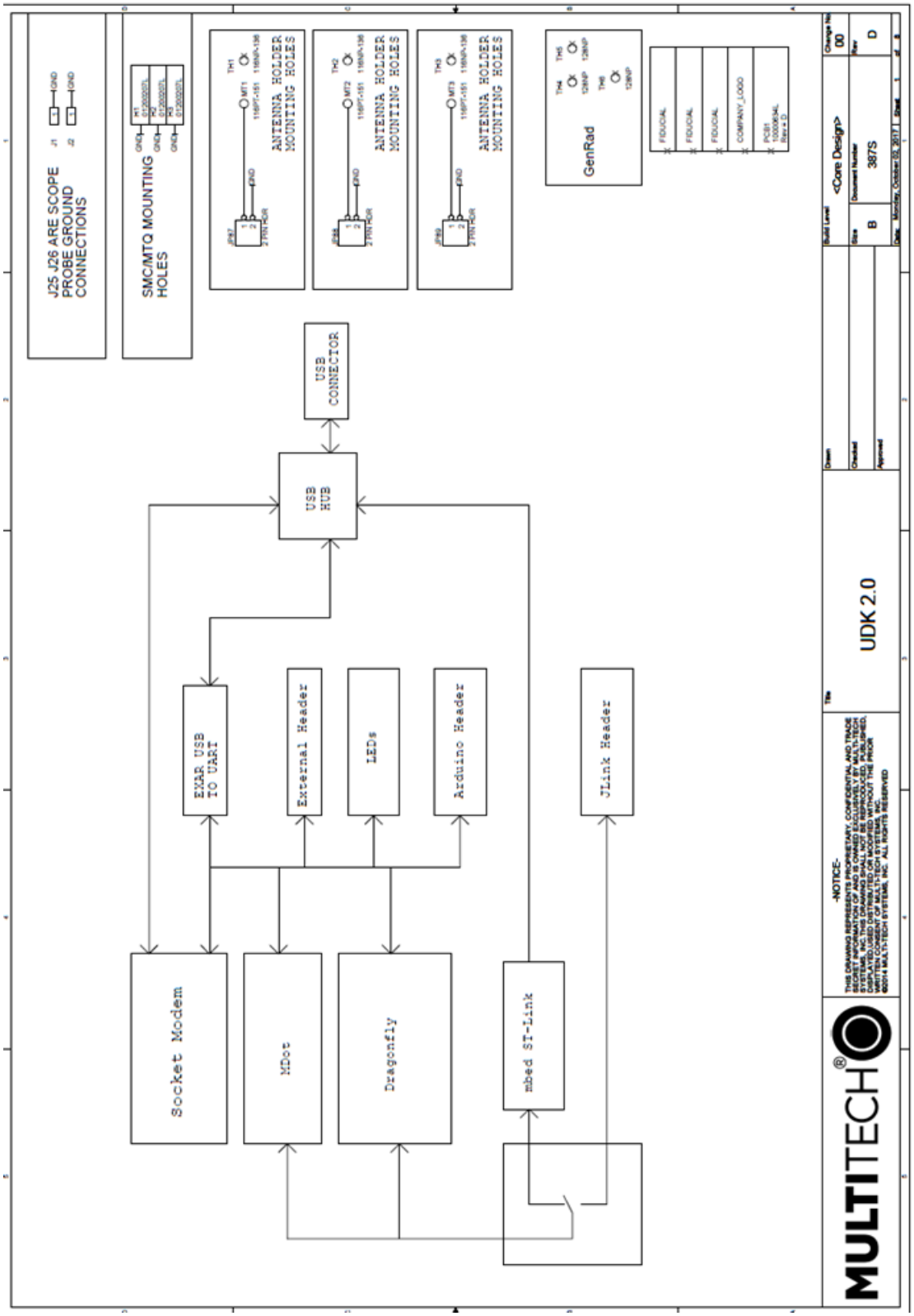
G = GPS (may not apply to your device)

M = Main

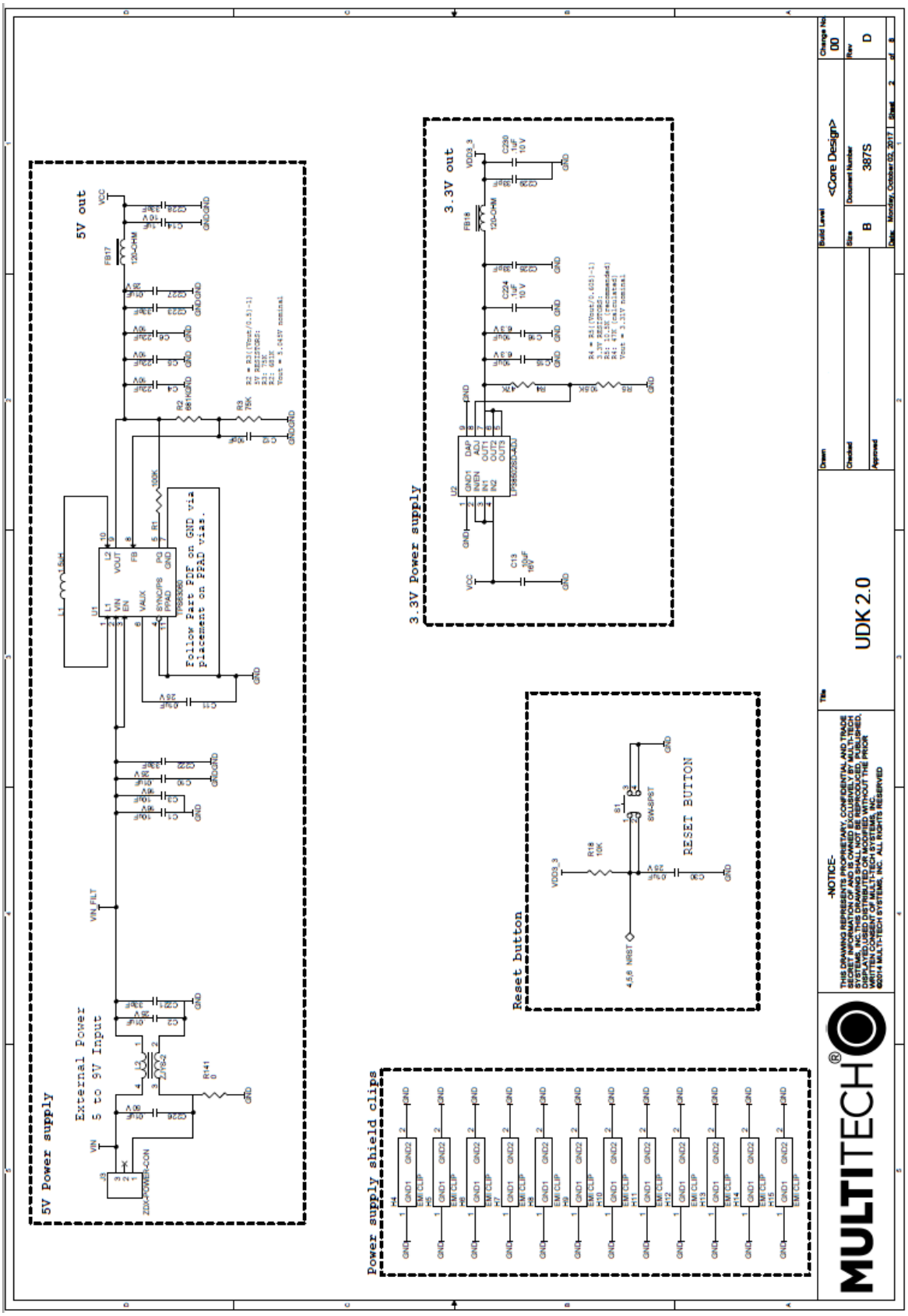
D = Diversity

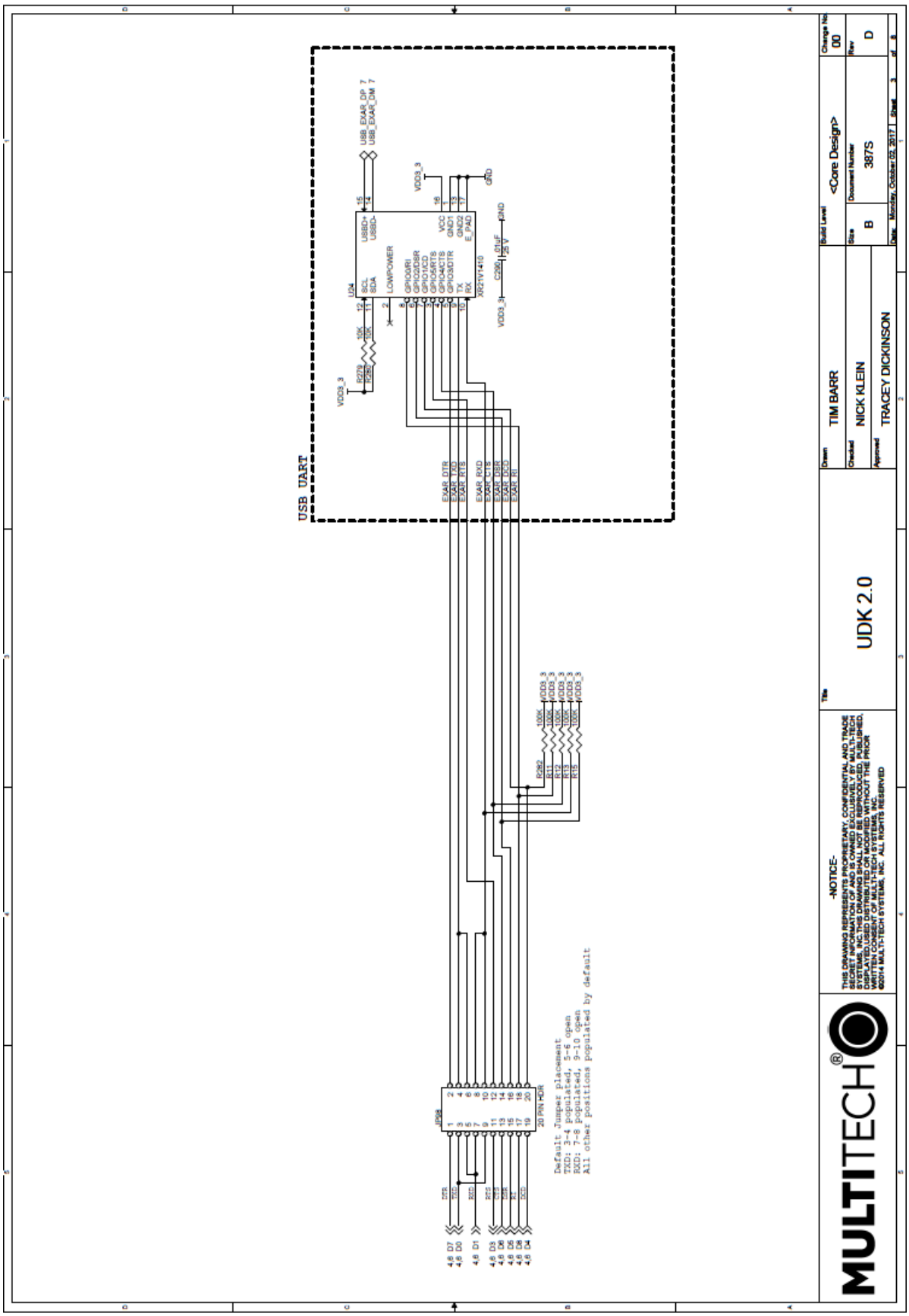
Chapter 4 – Block Diagram and Schematics

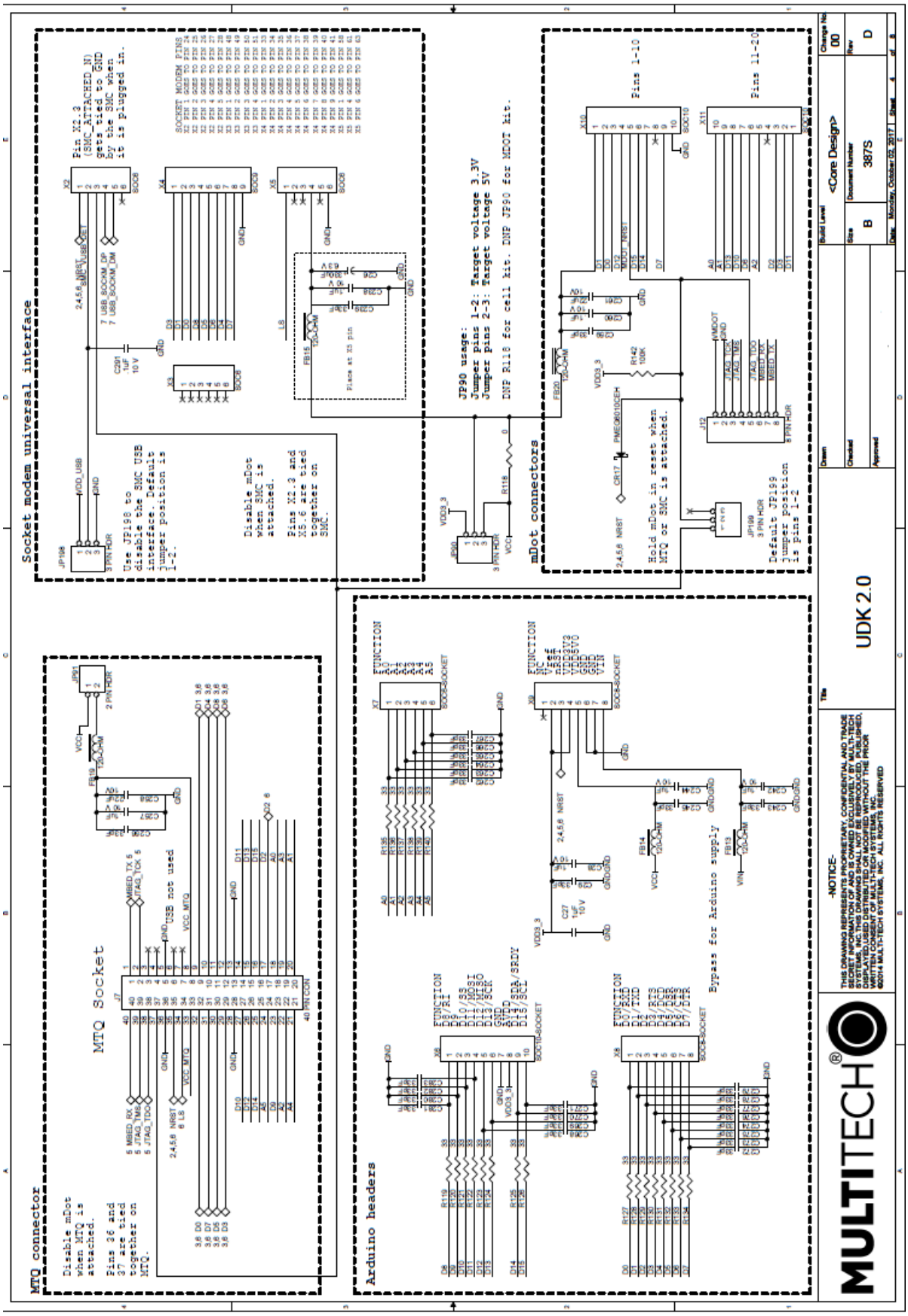
Block Diagram

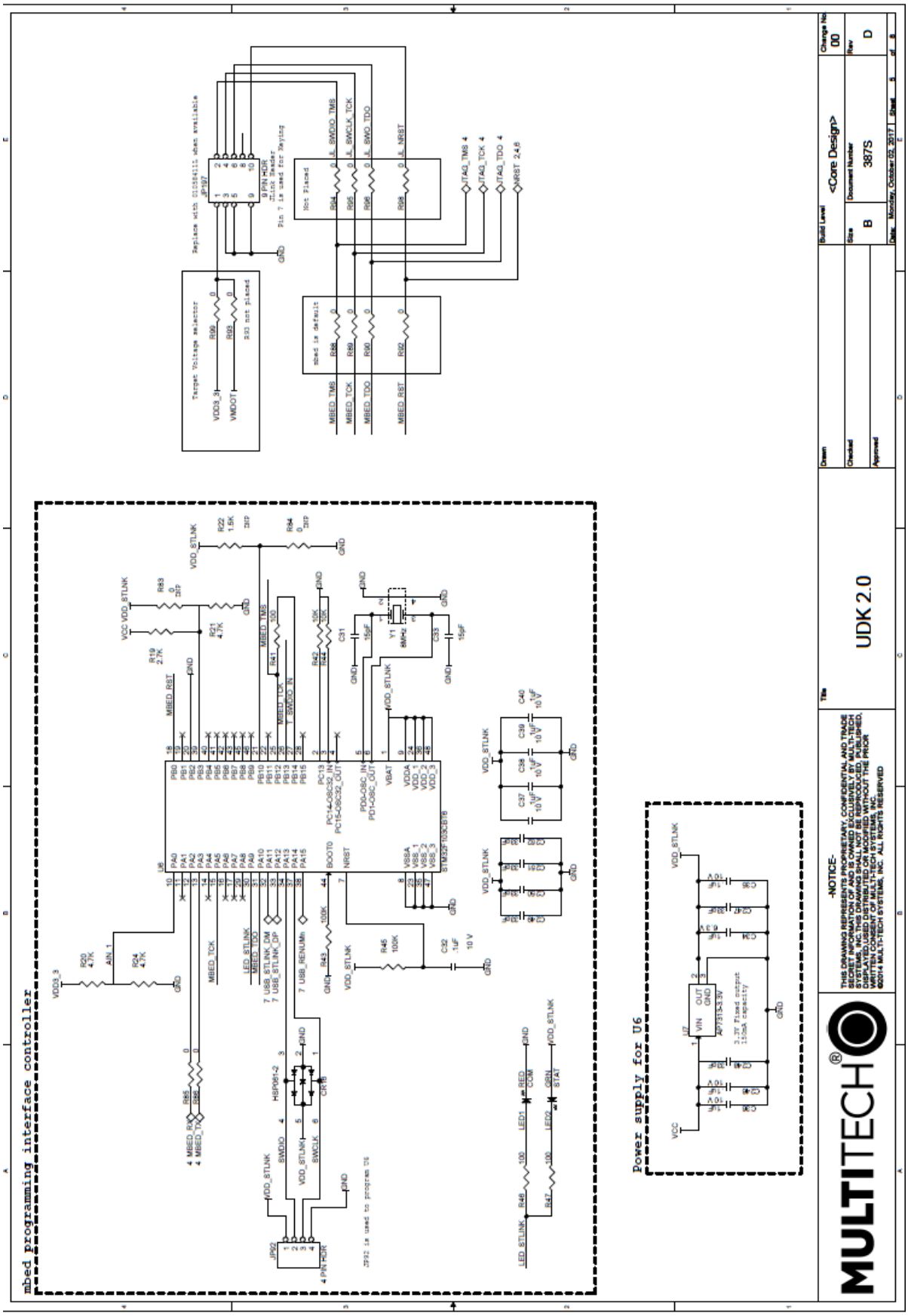


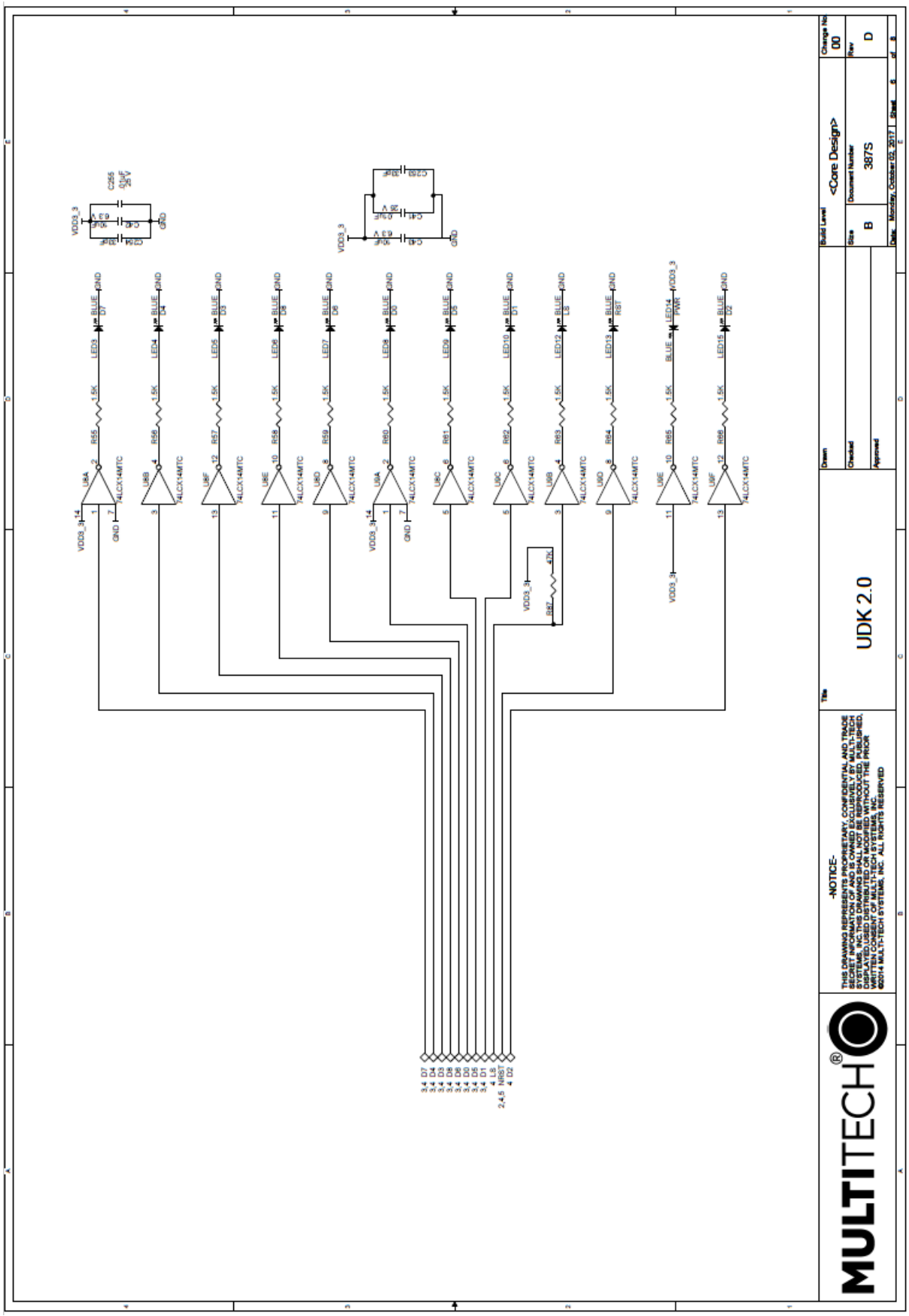
Schematics

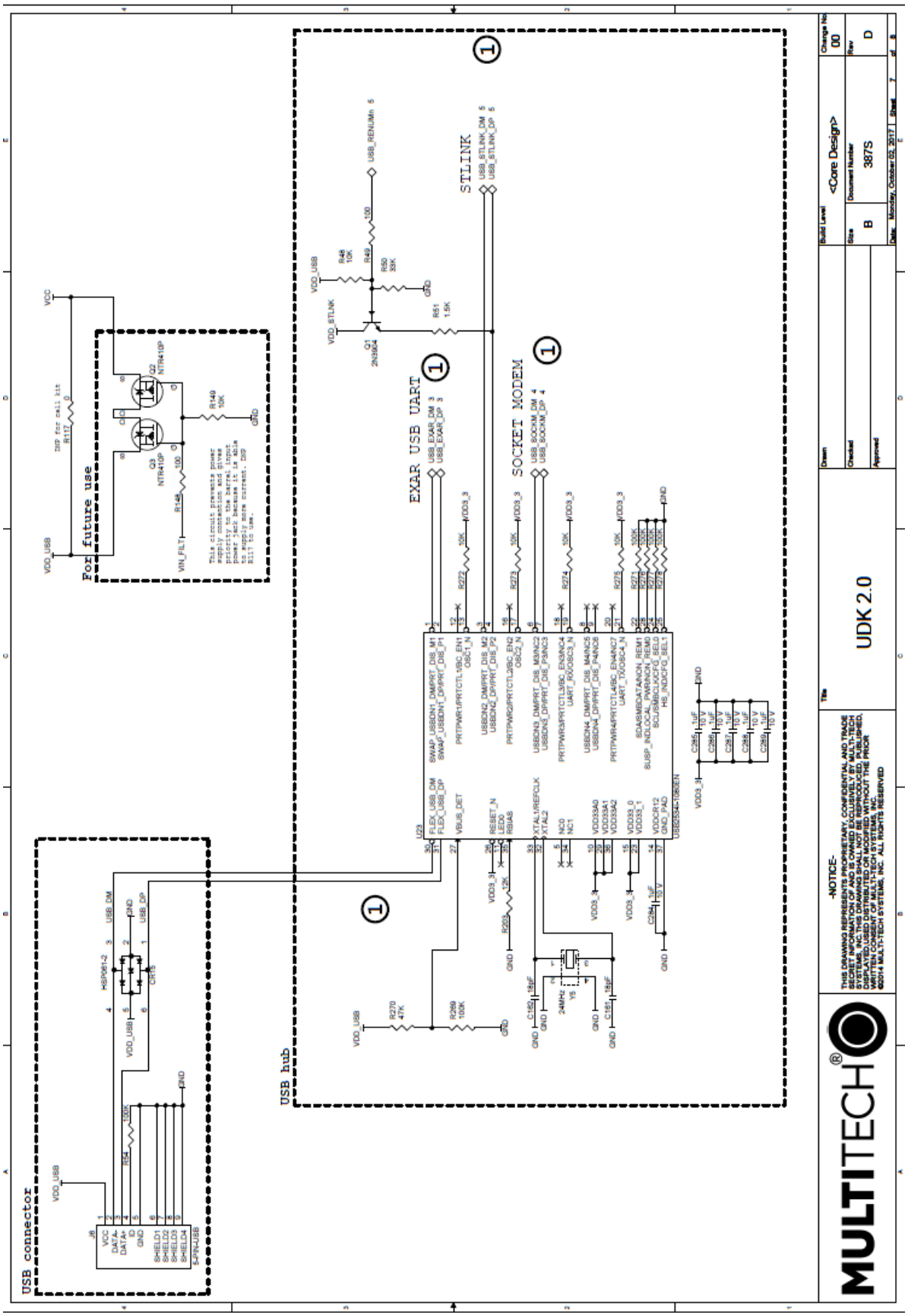

5V Power supply
5V out
External Power
5 to 9V Input
3.3V Power supply
3.3V out
Reset button
RESET BUTTON
Power supply shield clips
Follow Part PDF on GND via placement on PPAD vias.
UDK 2.0
MULTITECH


USB UART
Default Jumper placement
TXD: 3-4 populated, 5-6 open
RXD: 7-8 populated, 9-10 open
All other positions populated by default
20 PIN HDR
UDK 2.0
TIM BARR
NICK KLEIN
TRACEY DICKINSON
<Core Design>
387S
B
D
MULTITECH


Socket modem universal interface
Pin X2.3 (SMC_ATTACHED_N) gets tied to GND by the SMC when it is plugged in.
Use JP198 to disable the SMC USB interface. Default jumper position is 1-2.
Disable mDot when SMC is attached.
Pins X2.3 and X5.6 are tied together on SMC.
JP90 usage:
Jumper pins 1-2: Target voltage 3.3V
Jumper pins 2-3: Target voltage 5V
DNP R118 for cell kit. DNP JP90 for MDOT kit.
mDot connectors
Pins 1-10
Pins 11-20
Hold mDot in reset when MTQ or SMC is attached.
Default JP199 jumper position is pins 1-2
MTQ connector
Disable mDot when MTQ is attached.
Pins 36 and 37 are tied together on MTQ.
MTQ Socket
USB not used
Arduino headers
Bypass for Arduino supply
UDK 2.0
MULTITECH
<Core Design>
387S
B
D
00


mbed programming interface controller
Power supply for U6
UDK 2.0
<Core Design>
387S
MULTITECH


UDK 2.0
MULTITECH
<Core Design>
387S
-NOTICE-
THIS DRAWING REPRESENTS PROPRIETARY, CONFIDENTIAL AND TRADE SECRET INFORMATION OF AND IS OWNED EXCLUSIVELY BY MULTI-TECH SYSTEMS, INC. THIS DRAWING SHALL NOT BE REPRODUCED, PUBLISHED, DISCLOSED OR USED IN WHOLE OR IN PART WITHOUT THE PRIOR WRITTEN CONSENT OF MULTI-TECH SYSTEMS, INC.
©2014 MULTI-TECH SYSTEMS, INC. ALL RIGHTS RESERVED


USB connector
USB hub
For future use
EXAR USB UART
SOCKET MODEM
STLINK
UDK 2.0
MULTITECH

NOTES:

1. Route all USB traces as differential pairs. Use 90 differential impedance traces.

Changelog, RevB to RevC:

Removed micro-USB connector J6 and replaced with more mechanically robust J13

Added circuit to keep mDot in reset whenever an MTQ or SMC are plugged in.

Fixed net names of TXD and RXD on Arduino shield connectors. D0 should be RXD, and D1 should be TXD.

Fixed JTAG_RST and NRST so that the interface controller can reset the targets.

Added a circuit to allow auto-switchover from USB to barrel-jack power.

Removed RS232 transceiver U5 and supporting components. Removed DB9 connector and supporting components.

Fixed the power sequencing issue that caused the "12kB disk error." Power the STM32 (U6) from VCC only; this will prevent it from turning on before the target is powered.

Removed SMC micro-USB connector J5. Connected SMC USB connection to the USB hub instead.

MULTITECH®

-NOTICE-
THIS DRAWING REPRESENTS PROPRIETARY, CONFIDENTIAL AND TRADE SECRET INFORMATION OF AND IS OWNED EXCLUSIVELY BY MULTI-TECH SYSTEMS, INC.THIS DRAWING SHALL NOT BE REPRODUCED, PUBLISHED, DISPLAYED,USED DISTRIBUTED OR MODIFIED WITHOUT THE PRIOR WRITTEN CONSENT OF MULTI-TECH SYSTEMS, INC.
©2014 MULTI-TECH SYSTEMS, INC. ALL RIGHTS RESERVED

Title: UDK 2.0	Drawn	Build Level: <Core Design>		Change No: 00
	Checked	Size: B	Document Number: 387S	Rev: D
	Approved	Date: Monday, October 02, 2017	Sheet 8 of 8	

Chapter 5 – Design Considerations

Noise Suppression Design

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

Any OEM board design 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.

The recommended hole size for the device pins is 0.036 in. +/-0.003 in. in diameter. Use spacers to hold the device vertically in place during the wave solder process.

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 telephone line cables at the telephone line jacks. Typically, use a combination of series inductors, common mode chokes, and shunt capacitors. Methods to decouple telephone lines are similar to decoupling power lines; however, telephone line decoupling may be more difficult and deserves additional attention. A commonly used design aid is to place footprints for these components and populate as necessary during performance/EMI testing and certification.
- Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.