Universal Developer Kit 2.0 Developer Guide
Models: MTUDK-ST-Cell with DB9 RS-232 Connector
Part Number: S000693, Version 1.0

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<table>
<thead>
<tr>
<th>Country</th>
<th>By Email</th>
<th>By Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe, Middle East, Africa:</td>
<td><a href="mailto:support@multitech.co.uk">support@multitech.co.uk</a></td>
<td>+(44) 118 959 7774</td>
</tr>
<tr>
<td>U.S., Canada, all others:</td>
<td><a href="mailto:support@multitech.com">support@multitech.com</a></td>
<td>(800) 972-2439 or (763) 717-5863</td>
</tr>
</tbody>
</table>

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Chapter 1 – Developer Kit Introduction

Overview
The MTUDK2-ST-Cell Universal Developer Kit supports development with cellular SocketModem, Dragonfly, 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 a SocketModem or Dragonfly. 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 so may damage both devices.

Features
- 5V-9V power input
- Selectable 3.3V or 5V on board power supply
- USB and serial interfaces
- USB port for mbed development environment
- RS-232 DB-9 connector for serial interface
- 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:

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer Board</td>
<td>1 - MTUDK 2.0 Cell Developer Board</td>
</tr>
<tr>
<td>Power Supply</td>
<td>1 - 100-240V 9V-1.7A power supply with removable blades</td>
</tr>
<tr>
<td></td>
<td>1 - NAM blade/plug,</td>
</tr>
<tr>
<td></td>
<td>1 - EURO blade/plug</td>
</tr>
<tr>
<td></td>
<td>1 - UK blade/plug</td>
</tr>
<tr>
<td></td>
<td>1 - AU/NZ blade/plug</td>
</tr>
<tr>
<td>Cables</td>
<td>1 - Micro USB Cable</td>
</tr>
<tr>
<td></td>
<td>3 - SMA-U.FL Antenna Cables (attached to developer board)</td>
</tr>
<tr>
<td>Antennas</td>
<td>1 - 3.3V magnetic GPS Antenna</td>
</tr>
<tr>
<td></td>
<td>2 - 700-2600 MHz Antennas</td>
</tr>
<tr>
<td>Customer Notices</td>
<td>Quick Start</td>
</tr>
<tr>
<td>Additional</td>
<td>One promotional screwdriver</td>
</tr>
</tbody>
</table>
Chapter 2 – Board Components

Developer Board
## Developer Board Connectors

![Developer Board Connectors Diagram](image)

### Board Components

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Selector</td>
<td>Selects between the on-board 3.3V or 5V regulator for powering a SocketModem or mDot. Factory default operating voltage is 5V.</td>
</tr>
<tr>
<td>J4</td>
<td>RS-232 DB- Serial Connector.</td>
</tr>
<tr>
<td>J5</td>
<td>SMC-USB Connector.</td>
</tr>
<tr>
<td>J6</td>
<td>USB connection for mbed, serial, and SocketModem. For the MTQ use USB connector on the MTQ. For information on connecting to and using mbed, refer to the device guide for your MTQ model. (Not available for SocketModems.)</td>
</tr>
<tr>
<td>J7</td>
<td>QuickConnect Socket.</td>
</tr>
<tr>
<td>JP98</td>
<td>Serial Disconnect Header.</td>
</tr>
<tr>
<td>JP197</td>
<td>J-Link Header.</td>
</tr>
<tr>
<td>S1</td>
<td>Reset Button. Use to reset the processor of the device attached to the board.</td>
</tr>
<tr>
<td>Label</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>X2</td>
<td>SocketModem, USB Connector.</td>
</tr>
<tr>
<td>X3</td>
<td>SocketModem, GPIO (not connected).</td>
</tr>
<tr>
<td>X4</td>
<td>SocketModem Serial Connector.</td>
</tr>
<tr>
<td>X5</td>
<td>SocketModem Power Connector.</td>
</tr>
<tr>
<td>X6</td>
<td>Arduino Shield Connector.</td>
</tr>
<tr>
<td>X7</td>
<td>Arduino Shield Connector.</td>
</tr>
<tr>
<td>X8</td>
<td>Arduino Shield Connector.</td>
</tr>
<tr>
<td>X9</td>
<td>Arduino Shield Connector.</td>
</tr>
<tr>
<td>X10</td>
<td>MTDOT Connector.</td>
</tr>
<tr>
<td>X11</td>
<td>MTDOT Connector.</td>
</tr>
<tr>
<td>J12</td>
<td>MTDOT Programming Header.</td>
</tr>
</tbody>
</table>

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

### LED Indicators

<table>
<thead>
<tr>
<th>Label</th>
<th>LED</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT</td>
<td>LED1</td>
<td>Same side as RS-232 DB-9 connector</td>
</tr>
<tr>
<td>COM</td>
<td>LED2</td>
<td>Same side as RS-232 DB-9 connector</td>
</tr>
<tr>
<td>D7</td>
<td>LED3</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D4</td>
<td>LED4</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D5</td>
<td>LED5</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D8</td>
<td>LED6</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D6</td>
<td>LED7</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D3</td>
<td>LED8</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D0</td>
<td>LED9</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D1</td>
<td>LED10</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>LS</td>
<td>LED11</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>RST</td>
<td>LED12</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>PWR</td>
<td>LED13</td>
<td>Above the SMC-USB connector</td>
</tr>
<tr>
<td>D2</td>
<td>LED14</td>
<td>Above the SMC-USB connector</td>
</tr>
</tbody>
</table>
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 by removing the jumpers across JP98.
2. Align the Arduino Shield on the developer board as shown. It will overlap the Dragonfly.

### Dragonfly Arduino Pins

<table>
<thead>
<tr>
<th>Signals (MTQ)</th>
<th>Pin (MTQ)</th>
<th>Arduino Shield</th>
<th>Pin (MTQ)</th>
<th>Signals (MTQ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td></td>
<td>NC</td>
<td>35</td>
<td>D15 SCL/SS1 (PB8)</td>
</tr>
<tr>
<td>nReset, from pushbutton</td>
<td>35</td>
<td>VREF</td>
<td>D14</td>
<td>D14 SDA/SRDY (PB9)</td>
</tr>
<tr>
<td>NA</td>
<td>8, 33</td>
<td>nRST</td>
<td>D13</td>
<td>NA</td>
</tr>
<tr>
<td>5.0V</td>
<td></td>
<td>3.3V</td>
<td>D10</td>
<td>Ground</td>
</tr>
<tr>
<td>Ground</td>
<td>*</td>
<td>5.0V</td>
<td>D9</td>
<td>15 D13/SCK (PA5)</td>
</tr>
<tr>
<td>Ground</td>
<td>*</td>
<td>GND</td>
<td>D8</td>
<td>26 D12/MISO (PA6)</td>
</tr>
<tr>
<td>NA</td>
<td></td>
<td>VIN</td>
<td>D7</td>
<td>14 D11/MOSI (PB5)</td>
</tr>
<tr>
<td>A0 (PC2)</td>
<td>18</td>
<td>D6</td>
<td></td>
<td>27 D10/SS2 (PC8)</td>
</tr>
<tr>
<td>A1 (PCD)</td>
<td>20</td>
<td>A0</td>
<td>D5</td>
<td>31 D7/DTR (PA8)</td>
</tr>
<tr>
<td>A2 (PC4)</td>
<td>22</td>
<td>A1</td>
<td>D4</td>
<td>12 D6/CTS (PA1)</td>
</tr>
<tr>
<td>A3 (PB0)</td>
<td>19</td>
<td>A2</td>
<td>D3</td>
<td>30 D5/DSR (PA9)</td>
</tr>
<tr>
<td>A4 (PC1)</td>
<td>21</td>
<td>A3</td>
<td>D2</td>
<td>10 D4/DCD (PA7)</td>
</tr>
<tr>
<td>DIO (PC9)</td>
<td>27</td>
<td>A4</td>
<td>D1</td>
<td>29 D3/RTS (PA0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A5</td>
<td>D0</td>
<td>17 D2 (PB15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9 D1/RXD (PA2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>32 D0/TXD (PA3)</td>
</tr>
</tbody>
</table>

* MTQ pins 5, 13, 28, 36, and 37.
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
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.
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.

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

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

USB Design

MultiTech 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 Power Draw 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.