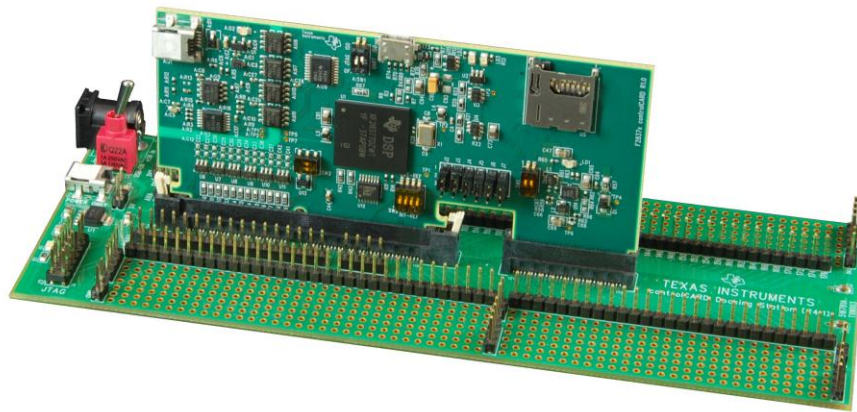


# Delfino TMS320F28377D controlCARD R1.1 Information Guide

Version 1.2 – December 2013

C2000 Systems and Applications Team



*Fig 1: TMSDOCK28377D Experimenter's Kit*

## 1 Introduction

The Delfino F28377D controlCARD (TMDSCNCD28377D) from Texas Instruments (TI) provides a great way to learn and experiment with the F2837x device family within TI's C2000 family of microcontrollers (MCUs). This 180-pin controlCARD is intended to provide a well-filtered robust design capable of working in most environments. This document goes over the hardware details of the F28377D controlCARD and explains the functions, locations of jumpers, and connectors present on the board.

Each controlCARD comes with a "Hardware Developer's Kit", a full set of files necessary to evaluate/develop with a C2000 device. These files include:

- Schematics
- Bill of Materials (BOM)
- Gerber files

NOTE: this kit is designed to explore the functionality of the F2837x microcontroller. Even though the controlCARD can be treated as a good reference design, it is not intended to be a complete customer design. Full compliance to safety, EMI/EMC and other regulations are left to the designer of the final customer's system.

## 2 Errata

### 2.1 Warnings/Notes/Errata –

1. The F28377D controlCARD supports USB host/device connectivity. However, the micro-USB port, J8, is not isolated from the board ground. Care should be taken when this controlCARD is being used in a high power application and this USB port is also being used. Note that external USB isolation buffers may be required for these types of applications.
2. The F28377D Experimenter's Kit ships with a USB cable and is designed to be powered via USB. However, in extreme cases the board/controlCARD may require more power than the 5V @ 500mA a computer's USB port can provide (<0.01% of use cases). This is especially true when additional circuitry has been added to the Docking Station.

In such cases, it is recommended to use an external 5V power supply (2.5mm inner diameter x 5.5mm outer diameter) and plug it into J1. A compatible supply could be the: Phihong *PSAC05R-050(P)-R-C2* + Phihong *RPBAG*

3. Among other changes made, the pinout of the R1.1 F28377D controlCARD is different from the pinout of the prerelease R1.0a controlCARDS. Please refer to the kit documentation and schematics when porting code.

## 3 Getting Familiar with the controlCARD

### 3.1 F28377D controlCARD Features

- **Delfino F28377D Microcontroller** – High performance C2000 microcontroller is located on the controlCARD.
- **180pin HSEC8 Edge Card Interface** – Allows for compatibility with all of C2000's 180pin controlCARD based application kits and controlCARDs. Compatibility with 100pin controlCARDs can be accomplished using the TMD SADAP180TO100 adapter card (sold separately).
- **Built-in Isolated JTAG Emulation** – An xds100v2 emulator provides a convenient interface to Code Composer Studio without additional hardware. Flipping a switch allows an external JTAG emulator to be used.
- **Connectivity** – The controlCARD contains connectors that allow the user to experiment with USB, a microSD card, and isolated UART/SCI with the F2837x MCU.
- **Key Signal Breakout** – Most GPIO, ADC and other key signals routed to hard gold connector fingers.
- **Robust Power Supply Filtering** – Single 5V input supply powers an on-CARD 3.3V LDO. All MCU inputs are then decoupled using LC filters near the device.
- **ADC Clamping** – ADC inputs are clamped by protection diodes.
- **Anti-Aliasing Filters** – Noise filters (small RC filters) can be easily added on several ADC input pins.

### 3.2 Assumed Operating Conditions

This kit is assumed to run at standard room conditions. The EVM should run at approximately Standard Ambient Temperature and Pressure (SATP) with moderate-to-low humidity.

### 3.3 Using the controlCARD

In order for the controlCARD to work, the controlCARD's MCU must be powered. This is most often done by inputting 5V through the HSEC connector via an accompanying baseboard. For example, if using a Docking Station baseboard, 5VDC should be input into the Docking Station's J1 or J17 and then SW1 will need to be toggled to the appropriate position.

Optionally, the MCU could also be powered via the micro-USB connector on the controlCARD.

Based on the way that the controlCARD will be used, additional hardware settings will be necessary. See the table below:

	<b>Debug using CCS and the on-card xds100v2 emulator</b>	<b>Debug using CCS and an external emulator via the baseboard</b>	<b>Standalone (Boot from FLASH or other boot mode)</b>
<b>A:SW1 (controlCARD)</b>	Position 1: ON (up)	Position 1: OFF (down)	Position 1: OFF (down)
<b>A:J1 (controlCARD)</b>	Connect a mini USB cable between A:J1 and your computer.  In CCS, use this target configuration: TMS320F28377D device with an xds100v2 emulator.	---	---
<b>Baseboard's JTAG connector (J2 on the Docking Station baseboard)</b>	---	Connect an external emulator.	---

Code Composer Studio (CCS) is an Integrated Development Environment (IDE) used to debug and develop software for the C2000 series of MCUs. It can be downloaded from the following link: [http://processors.wiki.ti.com/index.php/Download\\_CCS](http://processors.wiki.ti.com/index.php/Download_CCS)

For users new to C2000's F28x7x series of devices and CCS, TI's Technical Training Organization provides several workshops that may be helpful:

[http://processors.wiki.ti.com/index.php/C2000\\_32-bit\\_Real-Time\\_MCU\\_Training](http://processors.wiki.ti.com/index.php/C2000_32-bit_Real-Time_MCU_Training)

[http://processors.wiki.ti.com/index.php/Hands-On\\_Training\\_for\\_TI\\_Embedded\\_Processors](http://processors.wiki.ti.com/index.php/Hands-On_Training_for_TI_Embedded_Processors)

The following PDF documents are provided to describe where each of the F2837x MCU's pins will appear on the controlCARD connector/Docking Station:

**TMDSCNCD28377D\_180cCARD\_pinout\_R1\_1** – tells where each MCU pin will go on the HSEC controlCARD connector or the 120/180-pin controlCARD Docking Station.

**TMDSCNCD28377D\_100DIMmap\_R1\_1** – tells where each MCU pin will go to on the DIM100 controlCARD connector or the DIM100 Docking Station. This assumes that the TMDSADAP180TO100 adapter card is used.

More information on the controlCARD/Docking Station can be found at the following locations:

\controlSUITE\development\_kits\~controlCARDs\TMDSCNCD28377D\_vX.X\  
 \controlSUITE\development\_kits\~ExperimentersKits\

### **3.4 Experimentation Software**

All key examples for the F28377D MCU can be found within controlSUITE at:

`\controlSUITE\device_support\f2837xD\`

This example software package includes many projects which allow the user to experiment with the ADC, PWM, and other C2000 peripherals.

## 4 Special Notes on Connectivity

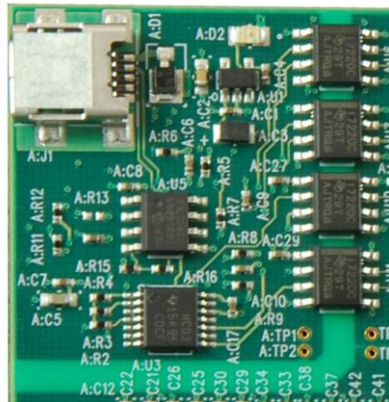
### 4.1 xds100v2 Emulator and SCI/UART Connectivity

The F28377D controlCARD provides emulation and USB-to-UART adapter functionality on the controlCARD. This allows for a convenient method to debug and demo the F2837x MCU.

Note that the FTDI chip, its support circuitry, and associated isolation components are placed in Macro A, the left section of the controlCARD. Each of these components contains an additional A within the component reference designator (ie A:R2 for resistor 2 in Macro A).

Each F28377D controlCARD's xds100v2 is programmed with a fixed serial number. If a debug session needs to involve 2 or more F28377D controlCARD, each controlCARDs will need have a unique serial number and some will need to be reprogrammed. See: <http://processors.wiki.ti.com/index.php/XDS100#Q: Can I change the serial number on my XDS100v2.3F>

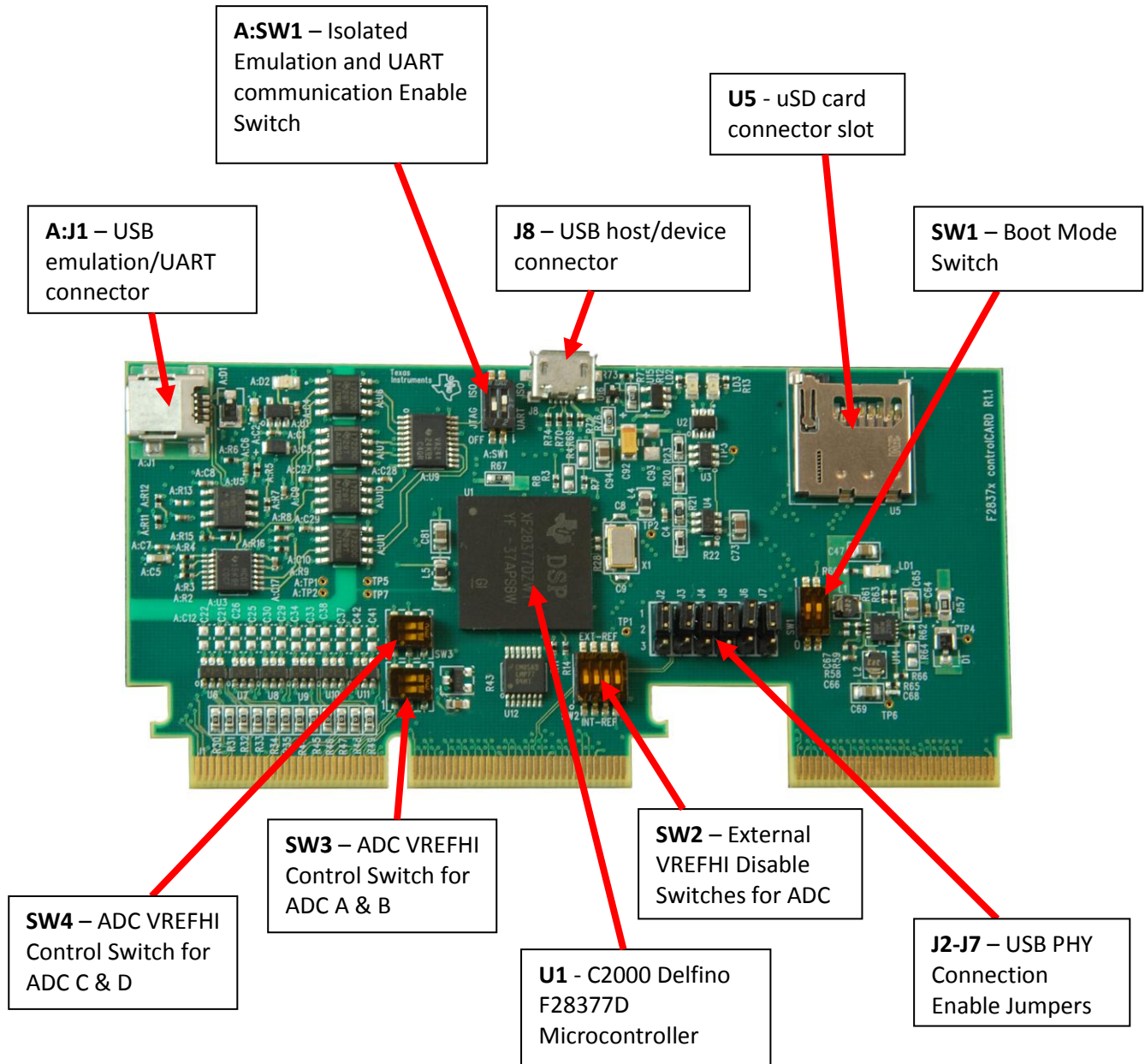
The configuration of the switches on A:SW1 determine whether the on-board emulator is active, whether an external emulator can be used, or whether the device will boot from FLASH/peripherals. See Table 1.



*Fig2: xds100v2 Emulation circuitry and isolation circuitry is denoted by A:*

## 5 Hardware References

On the following pages, Table 1 shows the various connections available on the board. Fig 3, below, illustrates the location of many of these components on the board:



*Fig3: Key components on the controlCARD*

Connectors	
<b>A:J1</b>	Emulation/UART connector - USB mini A connector used to provide xds100v2 emulation and USB-to-UART(SCI) communication through FTDI logic. A:SW1 determines which connections are enabled to the MCU.
<b>U5</b>	SD Micro card slot – connects to MCU via SPI
<b>J8</b>	USB connector – USB micro AB connector supports USB 2.0 host/device
Jumpers	
<b>J2-J7</b>	USB PHY connection enable/disable jumpers – <ul style="list-style-type: none"> <li>• <b>All jumpers up</b> – The MCU will be connected to the USB PHY on the controlCARD via GPIOs 42, 43, 46, 47, 120, and 121.</li> <li>• All jumpers down – The MCU will not connect to the USB PHY and all signals will instead go through the 180pin controlCARD connector.</li> </ul>
LEDs	
<b>LD1</b>	Turns on when the controlCARD is powered ON (green)
<b>LD2</b>	Controlled by GPIO-31 with negative logic (red)
<b>LD3</b>	Controlled by GPIO-34 with negative logic (red)
<b>A:D2</b>	Turns on when ISO JTAG logic is powered on (green)
<b>A:D3</b>	JTAG/UART RX toggle indicator (blue)
<b>A:D4</b>	JTAG/UART TX toggle indicator (blue)
Resistors and Capacitors	
<b>R42, R43</b>	Alternate Reference Configuration Resistors:  These resistors allow the user to choose whether the alternate reference for the ADCs will be given by: <ul style="list-style-type: none"> <li>• If R42 is populated &amp; R43 is unpopulated - A precision 2.5V reference</li> <li>• If R42 is unpopulated &amp; R43 is populated - The reference will be given by pin 45 of the HSEC controlCARD connector. This will presumably allow the baseboard to provide the desired voltage reference.</li> </ul>
<b>R30-R41, R44-R55 and C19-C42</b>	Optional RC input filter for all ADC inputs



## Switches (default position in **BOLD**)

<b>SW1</b>	<p>Boot Mode Switch: Controls the Boot Options of the F2837x device. See the device datasheet for more information. (0 is down, 1 is up)</p> <table><tr><th>Mode #</th><th>Switch Position 1 (GPIO-72)</th><th>Switch Position 2 (GPIO-84)</th><th>Boot from</th></tr><tr><td>00</td><td>0</td><td>0</td><td>Parallel I/O</td></tr><tr><td>01</td><td>0</td><td>0</td><td>Boot from SCI</td></tr><tr><td>02</td><td>0</td><td>1</td><td>Wait Boot Mode</td></tr><tr><td><b>03</b></td><td><b>1</b></td><td><b>1</b></td><td><b>Get Mode (Flash by default)</b></td></tr></table>	Mode #	Switch Position 1 (GPIO-72)	Switch Position 2 (GPIO-84)	Boot from	00	0	0	Parallel I/O	01	0	0	Boot from SCI	02	0	1	Wait Boot Mode	<b>03</b>	<b>1</b>	<b>1</b>	<b>Get Mode (Flash by default)</b>
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<b>03</b>	<b>1</b>	<b>1</b>	<b>Get Mode (Flash by default)</b>																		
<b>SW2</b>	<p>External VREFHI Disable Switches for ADC:</p> <p>This switch determines which ADC voltage reference (VREFHI) inputs will be connected to external references.</p> <p>Each Switch (leftmost switch is for ADC-A, rightmost is for ADC-D, etc):</p> <ul style="list-style-type: none"><li>In the down position, the external reference to the ADC will be disabled. This configuration should not be used.</li><li><b>In the up position</b>, the respective ADC will be configured to use an external voltage reference chosen by SW3 or SW4.</li></ul>																				
<b>SW3</b>	<p>ADC VREFHI Control Switch for ADC modules A &amp; B:</p> <p>Switch 1 (lower switch) – VREFHI Control Switch for ADC module A:</p> <ul style="list-style-type: none"><li>In the left position – If ADC-A is configured to use an external reference via SW2, the ADC will be referenced to the alternate reference chosen by R42/R43 (see above).</li><li><b>In the right position</b> – If ADC-A is configured to use an external reference via SW2, the ADC will be referenced to a precise 3.3V reference located on the controlCARD.</li></ul> <p>Switch 2 (upper switch) – VREFHI Control Switch for ADC module B:</p> <ul style="list-style-type: none"><li>In the left position – If ADC-B is configured to use an external reference via SW2, the ADC will be referenced to the alternate reference chosen by R42/R43 (see above).</li><li><b>In the right position</b> – If ADC-B is configured to use an external reference via SW2, the ADC will be referenced to a precise 3.3V reference located on the controlCARD.</li></ul>																				

<p><b>SW4</b></p>	<p>ADC VREFHI Control Switch for ADC modules C &amp; D:</p> <p>Switch 1 (lower switch) – VREFHI Control Switch for ADC module C:</p> <ul style="list-style-type: none"> <li>• In the left position – If ADC-C is configured to use an external reference via SW2, the ADC will be referenced to the alternate reference chosen by R42/R43 (see above).</li> <li>• <b>In the right position</b> – If ADC-C is configured to use an external reference via SW2, the ADC will be referenced to a precise 3.3V reference located on the controlCARD.</li> </ul> <p>Switch 2 (upper switch) – VREFHI Control Switch for ADC module D:</p> <ul style="list-style-type: none"> <li>• In the left position – If ADC-D is configured to use an external reference via SW2, the ADC will be referenced to the alternate reference chosen by R42/R43 (see above).</li> <li>• <b>In the right position</b> – If ADC-D is configured to use an external reference via SW2, the ADC will be referenced to a precise 3.3V reference located on the controlCARD.</li> </ul>
<p><b>A:SW1</b></p>	<p>Isolated emulation &amp; UART communication enables:</p> <p>Switch Position 1 – JTAG Enable:</p> <ul style="list-style-type: none"> <li>• <b>ON</b> – All signals between the xds100v2 emulation logic and the MCU will be connected. This setting is valid when the MCU is being debugged or programmed via the on-card xds100v2 emulator.</li> <li>• <b>OFF</b> – The xds100v2 emulation logic will <b>NOT</b> be connected to the MCU. This setting is valid when the device will boot from FLASH, boot from a peripheral directly, or when an external JTAG emulator will be used.</li> </ul> <p>Switch Position 2 – ISO UART communication enable:</p> <ul style="list-style-type: none"> <li>• <b>ON</b> – The C2000 MCU's GPIO-28 (and pin76 of the 180pin controlCARD connector) will be coupled to the FTDI's USB-to-Serial adapter. This allows UART communication to a computer via the FTDI chip. However, in this position, GPIO-28 will be forced high by the FTDI chip. Functionality of pin76 of the connector will be limited.</li> <li>• <b>OFF</b> – The C2000 MCU will <b>NOT</b> be connected to the FTDI USB-to-Serial adapter. Pin76 of the 180pin controlCARD connector will be directly connected to GPIO-28.</li> </ul>

*Table 1: Hardware References*

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Such product safety design criteria shall include but not be limited to critical circuit creepages and clearances, component selection, and required protective means (ie output fusing) depending on the specific loads being controlled.

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Post Office Box 655303

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