TI Spins Motors

Piccolo F28054M controlCARD
Hardware Guide

Version 1.0.1 *Motor Solutions*

Fig 1: TMDSCNCD28054MISO controlCARD with default switch settings for InstaSPIN kit use

1 Introduction

The Piccolo F28054M controlCARD (TMDSCNCD28054MISO) from Texas Instruments (TI) provides a great way to learn and experiment with the InstaSPIN enabled TMS320F2805x device family within TI's C2000 family of microcontrollers (MCUs). The 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 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 deploy a C2000 device. These files can be found in controlSUITE (54MISO uses same design as C:\ti\controlSUITE\development_kits\~controlCARDs\TMDSCNCD28055ISO)

and includes:

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

NOTE: this kit is designed to be a kit to explore the functionality of the F28054M 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.

Version: 1.0.1

Revision History:

1.0.1	**May 5, 2014**	**First release**

2 Errata

2.2 Errata – Currently No Errata

3 Getting Familiar with the controlCARD

3.1 F28054M controlCARD Features

- **F28054M Microcontroller** - located on the DIMM100 side of the controlCARD
  - Motor Control Libraries in on-chip ROM allow for InstaSPIN-FOC and InstaSPIN-MOTION solutions using the software provided through MotorWare
- **DIMM100 Edge Card Interface** – Allows for compatibility with all of C2000's DIMM100 controlCARD based application kits and controlCARDs
- **Built-in Isolated JTAG Emulation –** xds100v2 emulator provides a convenient interface to Code Composer Studio without additional hardware. An external JTAG emulator can be used with minor component changes.
- **Key Signal Breakout –** All GPIO, ADC and other key signals routed to 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 clamped with diode protection
- **Anti-Aliasing Filters** – Noise filters (small RC filters) available on several ADC input pins.
- **Separate Power and Ground planes**
- **Small Size –** 90mm x 38mm (3.5" x 1.5")

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 Software

General software

for the TMS320F2805x family of MCUs can be found within controlSUITE . Once installed the key examples can be found at:

\controlSUITE\device_support\f2805x\

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

InstaSPIN-FOC and InstaSPIN-MOTION

solutions are supported through MotorWare.

Run **MotorWare.exe** to browse all available documentation and resources including:

- Kit Readme First
- GUI Quick Start Guides
- Hardware Guides
- InstaSPIN Project & Labs User's Guide
- API Documentation

4 Connectivity

4.1 xds100v2 Emulator and SCI/UART Connectivity

The F28054M controlCARD provides emulation and USB-to-UART adapter functionality on the controlCARD. This allows for a convenient method to debug and demo the F28054M 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 RA2 for resistor 2 in Macro A)

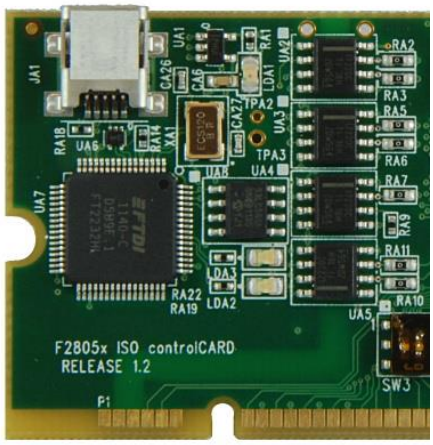

Fig2: xds100v2 Emulation circuitry and isolation circuitry is denoted by an A

5 Hardware References

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

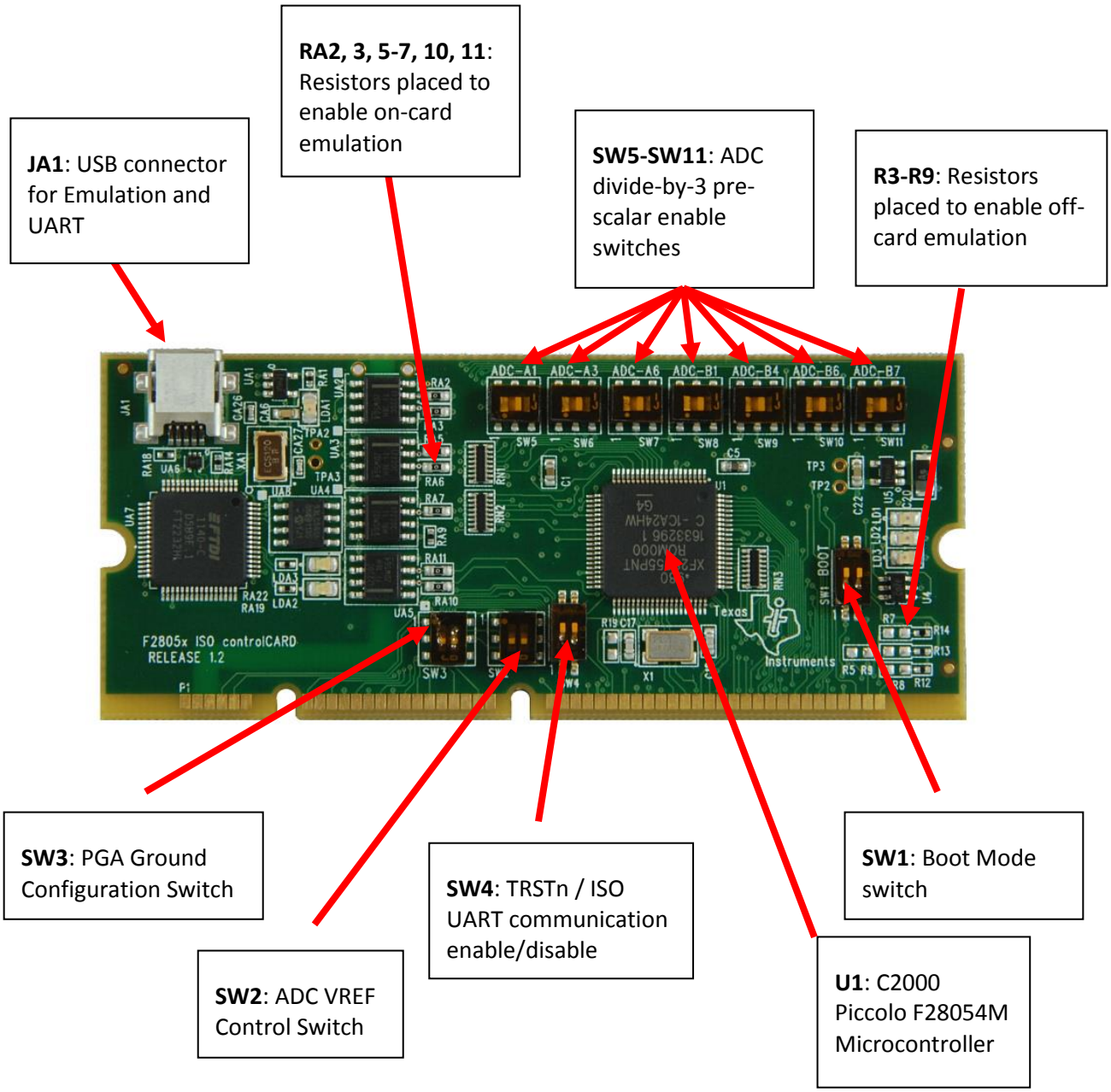

Fig3: Key components on the controlCARD

Isolated JTAG (ISO JTAG)	
JA1	USB mini A connector used to provide xds100v2 emulation and SCI communication through dedicated FTDI logic
LEDs	
LD1	Turns on when the controlCARD is powered ON (green)
LD2	Controlled by GPIO-31 with negative logic (red)
LD3	Controlled by GPIO-34 with negative logic (red)
LDA1	Turns on when ISO JTAG logic is powered on (green)
LDA2	UART/SCI RX toggle indicator (blue)
LDA3	UART/SCI TX toggle indicator (blue)
External JTAG Access Resistors	
RA2, RA3, RA5-RA7, RA10, RA11	Resistors should be removed for external JTAG emulators to be able to access the F2805x MCU.
R3-R9	Resistors should be populated for external JTAG emulators to be able to access the F2805x MCU.
Switches (default position in BOLD)	

SW1

Boot Mode Switch:

Controls the Boot Options of the F2805x device. See the device datasheet for more information. (0 is down, 1 is up)

Position 1 (GPIO-34)	Position 2 (TDO)	
0	0	Parallel I/O
0	1	Wait mode
1	0	SCI
1	**1**	**Get mode; the default get mode is boot-from-FLASH**

SW2

ADC VREF Control:

By default, the ADC will convert from 0 to 3.3V via internal references.

However, if the ADC control registers is configured to allow the ADC to use external limits, the ADC will convert its full range of resolution from VREF-LO to VREF-HI. Note that there are some limits on the valid values of VREF-LO and VREF-HI, please see the datasheet for more information.

Position 1 – Controls VREF-HI, the value that the ratio-metric ADC will convert as the maximum 12-bit value, which is 0x0FFF.

- **In the downward position (0),** VREF-HI will be connected to 3.3V.
- In the upward position, VREF-HI will be connected to pin 66 of the DIMM-100 socket. This will allow a connected motherboard to control the ADC VREF-HI value.

Position 2 – Controls VREF-LO, the value that the ratio-metric ADC will convert as the minimum 12-bit value, which is 0x0000.

- **In the downward position (0),** VREF-LO will be connected to 0V.
- In the upward position, VREF-LO will be connected to pin 16 of the DIMM-100 socket. This will allow a connected motherboard to control the ADC VREF-LO value.

SW3	F2805x PGA Ground Configuration: Position 1 – Motor PGA Ground: • In the upward position, the Motor PGA GND will be connected to pin 5 of the DIMM-100 connector. This will allow a connected motherboard to control drive the PGA GND (potentially for Kelvin sensing). • **In the downward position (0),** the Motor PGA GND will be grounded locally on the controlCARD. Position 2 – PFC PGA Ground: • In the upward position, the PFC PGA GND will be connected to pin 4 of the DIMM-100 connector. This will allow a connected motherboard to control drive the PGA GND (potentially for Kelvin sensing). • **In the downward position (0),** the PFC PGA GND will be grounded locally on the controlCARD.
SW4	TRSTn / ISO UART communication signal enables: Position 1 – TRSTn Enable: • **ON (1) –** TRSTn signal from ISO JTAG circuit will be connected to the MCU. This setting is valid when the MCU is being debugged or programmed via JTAG. • OFF – TRSTn signal from ISO JTAG circuit will **NOT** be connected to the MCU. This setting is valid when the device will boot from FLASH or boot from a peripheral directly. Position 2 – ISO UART communication enable: • **ON (1)**– The C2000 MCU's GPIO-28 (and pin 43 of the DIMM-100 connector) will be coupled to the FTDI USB-to-Serial adapter. This allows UART communication via the FTDI chip. However, in this position, GPIO-28 will be forced high by the FTDI chip. Functionality of pin 43 of the DIMM-100 connector will be limited. • OFF – The C2000 MCU will **NOT** be connected to the FTDI USB-to-Serial adapter. Pin 43 of the DIMM-100 connector will be directly connected to GPIO-28.
	ADC divide-by-3 prescaler enable:

SW5-SW11	Each switch enables or disables a divide-by-3 hardware pre-scalar. This functionality is always necessary in order to allow the F28054M MCU to control existing motor kits: DRV8312 EVM Rev D, DRV8301 EVM Rev D, TMDSHVMTRINSPIN R1p1. Do NOT use TMDSHVMTRKIT5X with 54M and MotorWare projects. SW5-11 allows the user to selectively pre-scale the Gain Amplifiers on ADC-A1, ADC-A3, ADC-A6, ADC-B1, ADC-B4, ADC-B6 or ADC-B7 respectively. • **In the upward position (1, LEFT)**, the specified ADC channel is divided-by-three. This effectively allows the associated ADC and fixed gain amplifier to have a total gain of 1. (if the amplifier's gain is programmable then the default gain of the amplifier is 3). (signal * 1/3 * 3 = signal) • In the downward position, the specified ADC channel is directly passed to the ADC pin of the MCU.

Table 1: Hardware References

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harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If
this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and
on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Compliance (English)

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This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this
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Concerning EVMs Including Detachable Antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain
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This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum
permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain
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l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente
(p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.
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