

CPT-DA28377
Texas Instruments TMS320F28377D controlCARD compatible
DA Series Interface Card
Technical Brief

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Card Version 1.0

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CPT-DA28377 Manual Revision History

CARD VERSION 1.0: Initial Board for prototype purposes.

Release 1.0 – Initial Release

Table of Contents

1.0	CPT-DA28377 Overview	1
1.1	Digital I/O	3
1.2	Analog Inputs	3
1.3	Gate Drive Interface	3
1.4	Communications	3
1.5	On-card memory	3
1.6	Power Supply	4
1.7	JTAG/programming	4
2.0	Specifications	5
2.1	Plug-in controlCARD	5
2.2	Analog Inputs	5
2.2.1	AC General Inputs	5
2.3	Digital I/O	6
2.3.1	All Available Digital I/O	6
2.4	Digital Outputs	6
2.5	PWM Gate Drive Interface	7
2.6	Communications Interface	7
2.6.1	Serial Communication Interface – SCI-A	7
2.6.2	Serial Communication Interface – SCI-B	7
2.6.3	Serial Communication Interface – SCI-C	7
2.6.4	Serial Communication Interface – SCI-D	8
2.6.5	Serial Peripheral Interface – SPI-B	8
2.6.6	Serial Peripheral Interface – SPI-C	8
2.6.7	Enhanced Controller Area Network Module – eCAN - CAN-A	8
2.6.8	Enhanced Controller Area Network Module – eCAN - CAN-B	8
2.7	JTAG	9
2.8	Software	9
2.9	General	9
2.10	Power Supply	9
	Appendices	10
	Appendix A Component Layout	11
	Appendix B Texas Instruments Technical Manuals for Control Card MCU	13

CPT-DA28377 Interface Card

1.0 CPT-DA28377 Overview

The CPT-DA28377 is a controller interface card designed to provide a fully flexible interface between the TMS320F28377DZWT MCU processor on Texas Instruments F28377x controlCARD and a user customised motherboard, such as the CPT-E13. The board has been designed with compatibility for the DA Series motherboards and to provide a processor upgrade option from the previous generation of MCU controller.

The card supports a Texas Instruments F28377x controlCARD, which has been specifically developed for use in digital motor/motion control applications.

The CPT-DA28377 card measures 110mm x 55mm and is consistent with the DA Series Interface structure. The F28377x controlCARD mounts vertically to the CPT-DA28377 and the combination of these cards produces an overall height of 55mm.

On-card facilities (F28377x controlCARD + CPT-DA28377) include:

- TMS320F28377ZWT MCU processor
- 2 CPUs + 2 CLA Modules
- 512k x 16 Flash (256k x 16 Flash per CPU)
- 2k x 16 OTP ROM
- Boot ROM
 - Software Boot Tables
- 102K x 16 Single Access RAM (SARAM) made up of:
 - 64K x 16 Global Shared RAM
 - 18K x 16 Dedicated RAM per CPU
 - 2 K x 16 Message RAM
- Serial Flash Memory with 1Mbit of non-volatile storage (SPI-A)
- 1 off Power LED on CPT-DA28377, 1 off Power LED on F28377x controlCARD
- 4 off indication LEDs on CPT-DA28377, 2 off indication LEDs on F28377x controlCARD
- Digital I/O Expansion Port.
- Reset/Power-On Circuitry
- Operation from single +5VDC
- Power supply to generate all on-card supplies
- DA Series Interface compatible

The card also supports the following peripheral interfaces (some of which cannot operate simultaneously):

- JTAG (IEEE1149.1) interface – USB (F2837x controlCARD)
- 1 off USB Serial Port Interface (F2837x controlCARD)
- 1 off clocked Serial Peripheral Interface micro SD Card – (SPI-C)
- 1 off clocked Serial Peripheral Interface – (SPI-C)
- 2 off 3.3V-TTL serial interface (SCI-B, SCI-C)
- Isolated CAN bus (eCAN 2.0) (CAN-A)
- 1 off 80-way Connector (DA Series Interface) with:
 - 12 off 12-bit 0 - 3(3.3)V ADC inputs
 - 2 off Serial Communications Interfaces (SCI-A, SCI-D)
 - 1 off Enhanced Controller Area Network (eCAN 2.0) (CAN-B)
 - 1 off clocked Serial Peripheral Interface (SPI-B)
 - ePWM interface (ePWM1x – ePWM8x)
 - Quadrature Position Encoder input with Index
 - General Purpose Digital I/O
 - Interrupt inputs

Figure 1-1 is a functional block diagram of the CPT-DA28377 card, illustrating all major sections.

CPT-DA28377 INTERFACE CONTROLLER BOARD TECHNICAL BRIEF

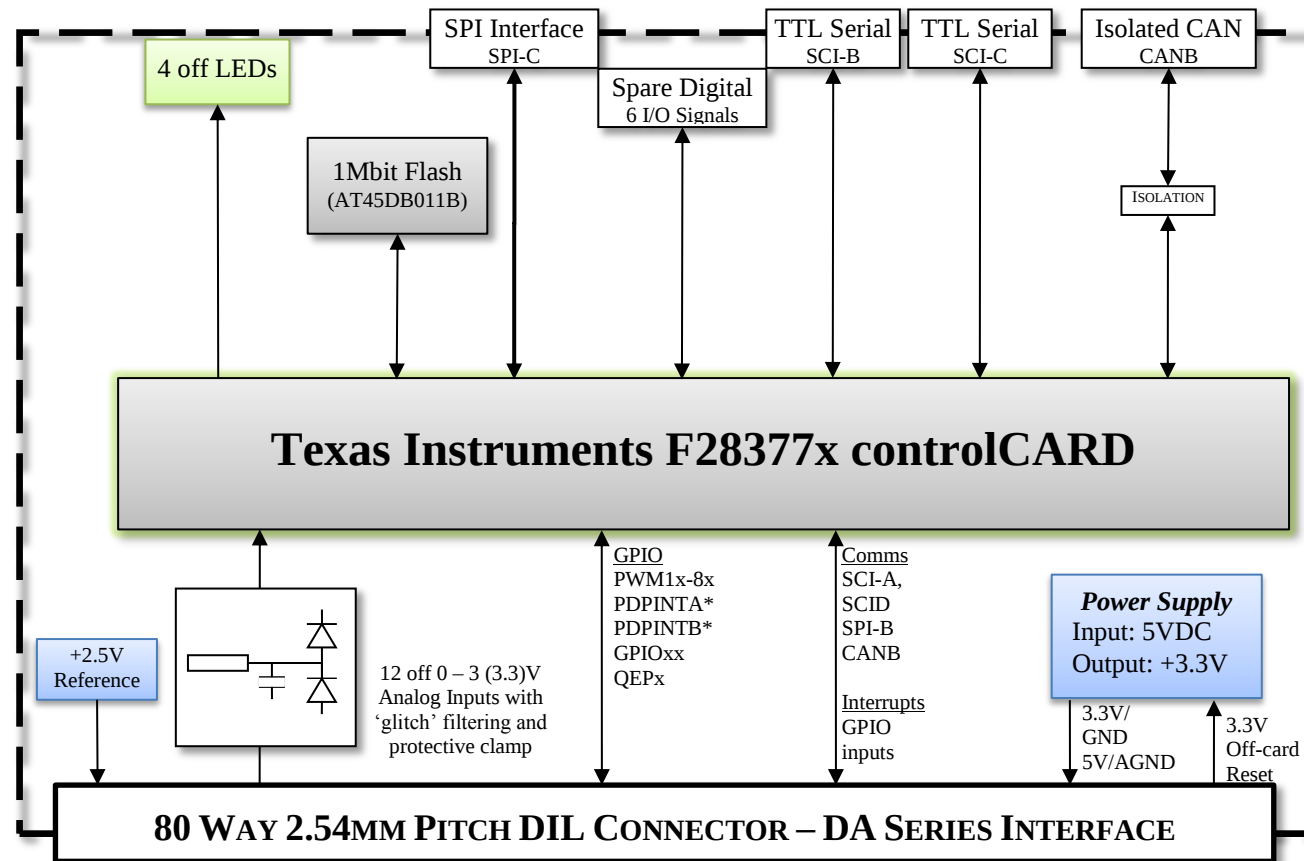


Figure 1-1: Functional Diagram of CPT-DA28377 Interface Controller Board

1.1 Digital I/O

The CPT-DA28377 card supports a maximum of 62 bits of 3.3V-TTL digital I/O, depending on the user-defined configuration of specific MCU pins. Of these pins, 45 are supplied non-buffered to the main external connector, 2 each are on the SCI connectors, 4 on the SPI-C connector, 4 are connected to the on-card LEDs and 6 are available on the Spare Digital I/O connector.

All digital I/O pins on the TMS320F28377DZWT MCU have the capability to operate in either “Digital I/O or “Peripheral I/O” mode. The user must select the correct mode of operation for each pin within their software.

1.2 Analog Inputs

The TMS320F28377DZWT MCU on the F2837x controlCARD has 24 off ADC inputs that accept voltages in the range of 0 – 3 (3.3) Volts. The analog inputs are divided into four Modules (ADCA, ADCB, ADCC and ADCD). Each Module has an 8 to 1 analog multiplexer with a sample and hold circuit. The outputs from the sample and hold circuits are fed into a 12-bit ADC. The maximum total conversion time for each ADC input is 290ns.

The CPT-DA28377 analog inputs are configured to provide 12 off filtered external inputs to the F2837x controlCARD.

The 12 off filtered analog inputs are available on the 80-way DA Series header. They each have a low pass or “glitch” filter and a diode clamp circuit before they are fed into the F2837x controlCARD.

Note that the default configuration of the F2837x controlCARD also contains RC “glitch” filters, but they are shorted out. The board accepts 0 – 3 (3.3)V inputs for these circuits.

A +2.5V reference is available on the 80-way header for use off-card. It is recommended that this reference be fed into an off-card op-amp circuit for external buffering rather than being used directly.

1.3 Gate Drive Interface

The TMS320F28377DZWT MCU supports 12 ePWM Module outputs. The CPT-DA28377 makes available 8 ePWM Modules to the DA Series header.

Gate fault signals are fed back to the F28377 via two PDPINT* interrupt pins. This enables an MCU interrupt trip to be triggered upon detection of a fault, thus disabling the PWM signals.

1.4 Communications

The CPT-DA28377 controller board supports two non-isolated 3.3V-TTL serial communications interfaces (SCI), a 3.3V-TTL synchronous serial peripheral interface (SPI) and an isolated 3.3V-TTL enhanced Controller Area Network (CAN) bus interface. In addition a JTAG/SCI to USB interface is available directly from the F2837x controlCARD.

The high-speed synchronous serial peripheral interface can support either master or slave operation, selected by software.

The 3.3V-TTL serial ports are available for communication to a terminal emulation program, via an interface board, such as the CPT-COM-U, to aid in program development.

1.5 On-card memory

The CPT-DA28377 controller boards, plug-in F2837x controlCARD supports 512k x 16bit of on-card Flash (256k x 16bit per MCU), 102k x 16bit of RAM, a Boot ROM and a 2k x 16bit OTP. Programs can be directly executed from RAM, via the JTAG interface or from Flash. By default, the card executes programs from internal RAM, although the F2837x controlCARD has on-card DIP switches that enable selection of the active boot mode from the other available sources.

In addition to the F2837x controlCARD on-chip memory, the CPT-DA28377 has a 1Mbit SPI interfaced Flash Memory chip for external data storage.

1.6 Power Supply

The standard CPT-DA28377 controller board has an on-card voltage regulator chip that produces a regulated 3.3V from the +5V input on the DA Series connector. The F2837x controlCARD accepts +5VDC and produces its own +3.3V and +1.2V supplies on-card.

Analog supplies are generated via an LC filter from the digital +3.3V supply and a precision reference chip is used to produce a stable +2.5V reference that is available on the DA Series connector.

Off-card analogs requiring a +5VDC supply should use DVCC supplied from pin 58 to minimise analog grounding loops.

1.7 JTAG/programming

The F2837x controlCARD has an isolated JTAG/SCI to USB interface for programming the MCU's Flash ROM or RAM. This port can also be used for emulator/debugging purposes.

2.0 Specifications

2.1 Plug-in controlCARD

Processor	Texas Instruments TMS320F28377D (F2837x controlCARD)
controlCARD On-card Memory	512k x 16 Flash Memory (256k x 16 per CPU) 64k x 16 RAM – Global Shared 36k x 16 RAM – Dedicated (18k x 16 per CPU) 2k x 16 Message RAM Boot ROM 2k x 16 OTP ROM
Reset	Hardware reset generated on-card from power up and supply failure. Can also be triggered via X5.59
Non-Volatile Memory Storage	1Mbit of memory storage using an SPI flash ROM chip Accessed via SPI-A interface on MCU
controlCARD	Micro SD Card supported – SPI-C
DA Interface defined Interrupts	3 off masked external interrupts (XINT1, XINT2, XINT13/NMI) Support for 2 off PDPINT interrupts to MCU pins GPIO61 and GPIO33 Note: All GPIO Inputs on the MCU can be configured as Interrupts

2.2 Analog Inputs

Number of Channels	12 single ended
A/D Resolution	12 bits
A/D Conversion Time	290ns
Number of ADC Modules	4
Number of S/H units	4 (1 per Module)

2.2.1 AC General Inputs

Definition	12 off 0 – 3 (3.3)V analog inputs with low pass filter capacitors capability ADC-A0, ADC-A1, ADC-A2, ADC-A4, ADC-B2, ADC-C2, ADC-C5, ADC-D0, ADC-D2, ADC-D4, ADCIN14, ADCIN15
Input Voltage Range	0 – 3 (3.3)V maximum – range selectable on F2837x controlCARD
Dynamic Response	Cut-off frequency >150kHz Default loaded values on CPT-DA28377 for all inputs are R = 100 Ω and C = 2.2nF Additional Glitch Filters and ESD Clamps supported on the F2837x controlCARD
PCB Connections	80-way IDC header (X5) between pins 60 and 80

2.3 Digital I/O

2.3.1 All Available Digital I/O

Definition	62 bits total GPIO0-15 (shared with ePWM1x to ePWM8x) GPIO33, GPIO61 (shared with TZ interrupt inputs) GPIO24-27, GPIO40-41, GPIO48-49, GPIO51, GPIO56-58 GPIO50, 52-53 (shared with QEP) GPIO30-31, GPIO34, GPIO44, GPIO45, GPIO75 (available on Spare Digital I/O) GPIO35, 59, 62, 67 (shared with interrupts) GPIO63-66 (shared with SPI-B port) GPIO69-72 (shared with SPI-C port) GPIO36-37 (shared with eCAN-A bus) GPIO84-85 (shared with SCI-A port) GPIO54-55 (shared with SCI-B port) GPIO89-90 (shared with SCI-C port) GPIO93-94 (shared with SCI-D port) GPIO73 (shared with XCLKOUT)
Digital high input voltage threshold	2.0V
Digital low input voltage threshold	0.8V
Digital outputs rated at	$\pm 4\text{mA}$ per bit, ABSOLUTE MAXIMUM $\pm 8\text{mA}$ for GPIOD0
PCB Connection	GPIO54-55 – 4-way MOLEX header (X3) GPIO89-90 – 4-way MOLEX header (X4) GPIO30-31, GPIO34, GPIO44, GPIO45, GPIO75 10-way IDC header (X6) GPIO69-72 – 10-way IDC header (X2) All other I/O available on 80-way IDC header (X1)

2.4 Digital Outputs

Definition	GPIO20-23 (on-card LEDs) Note: H1 is accessed through Port GPIO20 H2 is accessed through Port GPIO21 H3 is accessed through Port GPIO22 H4 is accessed through Port GPIO23 H5 is a power LED
Digital outputs rated at	$\pm 4\text{mA}$ per bit, ABSOLUTE MAXIMUM
Colours:	All on-card LEDs are GREEN
PCB Connection	No External Connection

2.5 PWM Gate Drive Interface

Definition	16 PWM Outputs split up across ePWM1-8
Gate Fault Interrupt	GPIO61 (PDPINTA*) and GPIO33 (PDPINTB*), which when software configured as interrupts can immediately disable the ePWM outputs. Response time is ~12nsec after fault detection The PWM signals are placed into a high impedance state by the MCU
Output Voltage	0 – 3 (3.3)V
PCB Connections	80-way IDC header (X1)

2.6 Communications Interface

Definition	The TMS320F28377 has four off serial communications interface ports (SCI-A, SCI-B, SCI-C and SCI-D), three off serial peripheral interfaces (SPI-A, SPI-B and SPI-C), and two enhanced controller area network ports (CAN-A, CAN-B)
Configuration	DEFAULT: All SCI, SPI and CAN ports are Digital I/O
Isolation	None (except CAN-A)

2.6.1 Serial Communication Interface – SCI-A

Definition	Two-wire asynchronous serial port (UART) that supports a 16-level, receive and transmit FIFO for reducing servicing overhead. The receiver and transmitter are double buffered with separate enable and interrupt bits DEFAULT MODE: Configured as GPIO signals
Communications Port	SCI-A (GPIO84, GPIO85)
PCB Connections	80-way IDC header X5 pins 10 (SCITXDA) and 11 (SCIRXDA) Note – GPIO28 and GPIO29 can be configured for SCI-A use on the JTAG/USB interface on the F2837x controlCARD.

2.6.2 Serial Communication Interface – SCI-B

Definition	Two-wire asynchronous serial port (UART) that supports a 16-level, receive and transmit FIFO for reducing servicing overhead. The receiver and transmitter are double buffered with separate enable and interrupt bits 3.3V-TTL level serial connection, providing two pin serial communications for interface to an off-card 3.3V-TTL level to RS232/USB conversion card. This is necessary for interfacing to a standard PC serial port. DEFAULT MODE: Configured as GPIO signals
Communications Port	SCI-B (GPIO54, GPIO55)
PCB Connections	4-way pin strip header with +3.3V and GND connections (X3)

2.6.3 Serial Communication Interface – SCI-C

Definition	Two-wire asynchronous serial port (UART) that supports a 16-level, receive and transmit FIFO for reducing servicing overhead. The receiver and transmitter are double buffered with separate enable and interrupt bits 3.3V-TTL level serial connection, providing two pin serial communications for interface to an off-card 3.3V-TTL level to RS-232 translation card. This is necessary for interfacing to a standard PC serial port DEFAULT MODE: Configured as GPIO signals
Communications Port	SCI-C (GPIO89, GPIO90)
PCB Connections	4-way pin strip header with +3.3V and GND connections (X4)

2.6.4 Serial Communication Interface – SCI-D

Definition	Two-wire asynchronous serial port (UART) that supports a 16-level, receive and transmit FIFO for reducing servicing overhead. The receiver and transmitter are double buffered with separate enable and interrupt bits 3.3V-TTL level serial connection, providing two pin serial communications for interface to an off-card 3.3V-TTL level to RS-232 translation card. This is necessary for interfacing to a standard PC serial port. DEFAULT MODE: Configured as GPIO signals
Communications Port	SCI-D (GPIO93, GPIO94)
PCB Connections	80-way IDC header X7 pins 12 (SCITXD) and 13 (SCIRXD)

2.6.5 Serial Peripheral Interface – SPI-B

Definition	Four-pin serial peripheral interface (SPI) module. It is a high speed, synchronous serial I/O port that allows a serial bit stream of programmed length (one to sixteen bits) to be shifted into and out of the device at a programmable bit-transfer rate DEFAULT MODE: Configured as digital I/O pins
Compatibility	4 wire SPI mode
PCB Connection	Available on 80-way IDC header X5 pins 14 (SPISIMOB), 15 (SPISOMIB), 16 (SPICLKB) and 17 (SPISTEB*)

2.6.6 Serial Peripheral Interface – SPI-C

Definition	Four-pin serial peripheral interface (SPI) module. It is a high speed, synchronous serial I/O port that allows a serial bit stream of programmed length (one to sixteen bits) to be shifted into and out of the device at a programmable bit-transfer rate DEFAULT MODE: Configured as digital I/O pins
Compatibility	4 wire SPI mode (GPIO69 – GPIO72)
PCB Connection	10-way IDC connector (X2)

2.6.7 Enhanced Controller Area Network Module – eCAN - CAN-A

Definition	eCAN bus module which supports up to 1Mbps transfer DEFAULT MODE: Configured as digital I/O pins
Compatibility	Fully compatible with CAN protocol version 2.0B (GPIO36, GPIO37)
Isolation	Nominal 1kV Note: MCU and isolated side should be treated as SELV if T1 power supply is used.
Terminating Options <i>Not Loaded by Default</i>	2 off 60.4Ω resistors (R16, R17) – 120.8Ω effective terminating resistor 1 off 4700pF capacitor (C19) from terminating resistor midpoint to CAN_GND
PCB Connections	Available on mini USB header X5 pins 2 (CANL) and 3 (CANH)

2.6.8 Enhanced Controller Area Network Module – eCAN - CAN-B

Definition	eCAN bus module which supports up to 1Mbps transfer DEFAULT MODE: Configured as digital I/O pins
Compatibility	Fully compatible with CAN protocol version 2.0B (GPIO38, GPIO39)
PCB Connections	Available on 80-way IDC header X1 pins 8 (CANTXB) and 9 (CANRXB)

2.7 JTAG

Definition	MCU programming interface, which enables the F2837x controlCARD to interface to the real-time debugging environment
Compatibility	Compatible with IEEE 1149.1 standard for scan-based emulation Isolated USB – TI XDS100 Emulator
PCB Connection	Mini USB header (A:J1) located on the F2837x controlCARD

2.8 Software

Support Software (Available Separately)	Standard library source code, sample programs Texas Instruments: Code Composer Studio V5.5 and above compatible
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2.9 General

Physical Dimensions	L: 110mm
	W: 55mm
	H: 11mm approx. (55mm with F2837x controlCARD attached).
Layers	4 – The internal planes consist of split power and ground.
Mounting Arrangement	2 off 3.5 mm holes spaced 102mm apart at the top corners of the board 80-way IDC header can also be soldered into the motherboard to provide additional support
Environmental	-40 – 85°C ambient operating temperature 5% - 95% non-condensing humidity

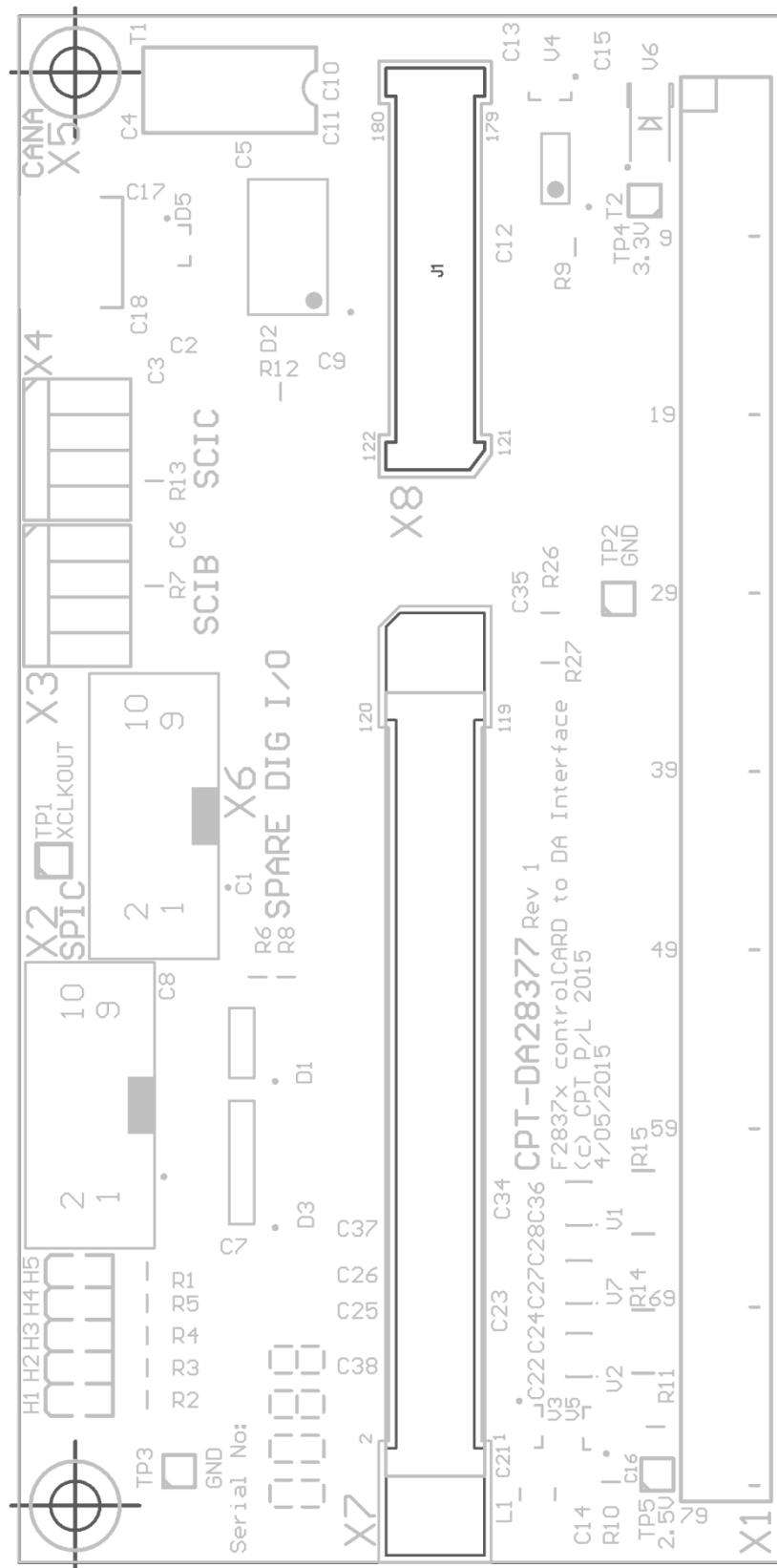
2.10 Power Supply

Input Voltage Range	5VDC (4.5V – 6V)
Standalone Input Current	100-250mA (depending on the active sections within the MCU)
Max Input Power	Approx. TBD ~500mW
Supplies Generated on-card	+3.3V Digital
	+2.5V Analog Reference
Input Power Connector	80-way IDC Connector (X1) +5V on pins 1-3, GND on pins 4-6
Output Power Connections	80-way IDC Connector (X1) +3.3V on pin 7, +2.5V on pin 79 10-way IDC Connector (X2) +5V/GND 10-way IDC Connector (X6) +5V/GND 4-way MOLEX Header (X3) +3.3V/GND 4-way MOLEX Header (X4) +3.3V/GND Mini-USB (X5) CAN_5V/CAN_GND

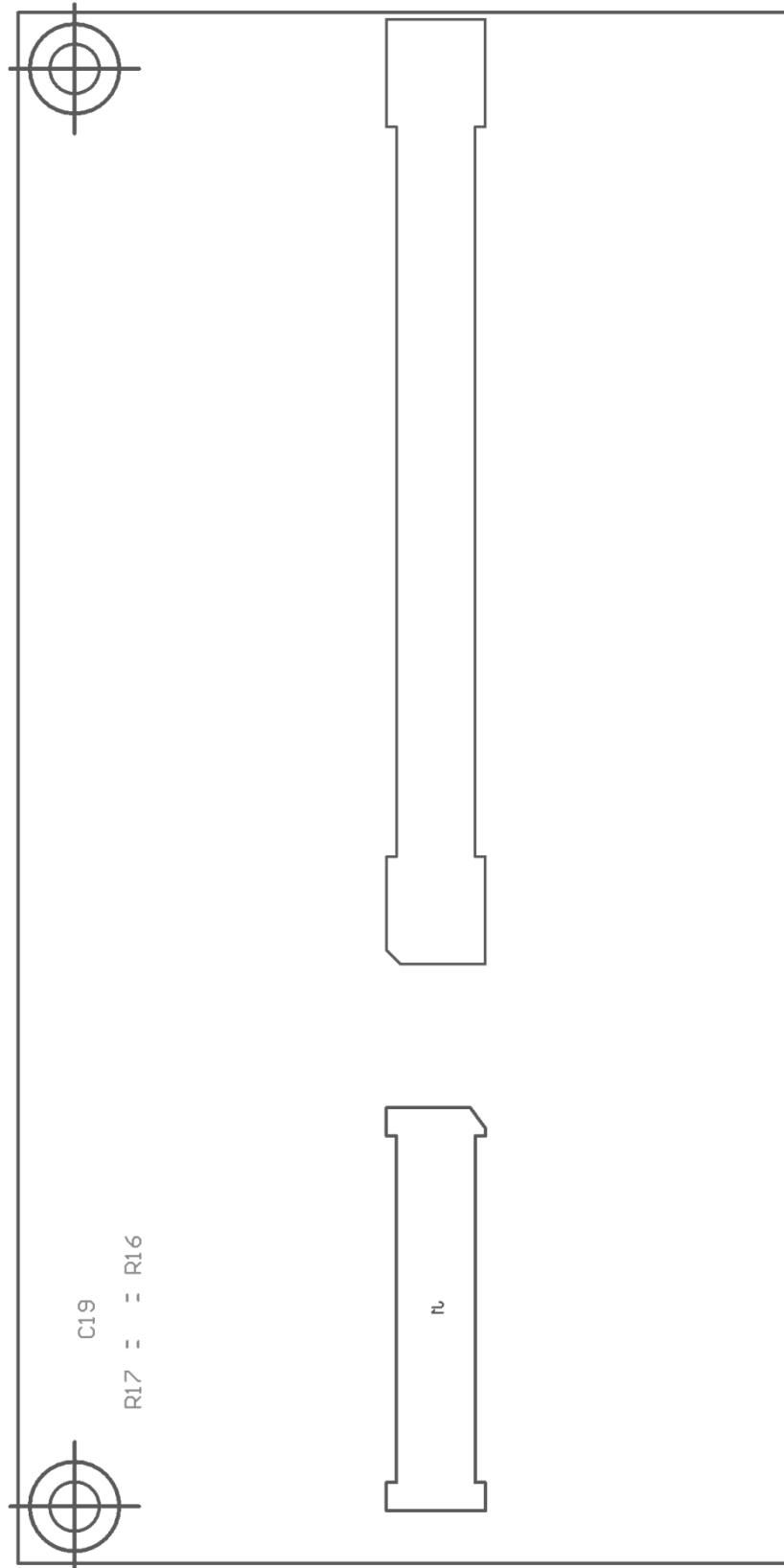
Appendices

Appendix A Component Layout

Top Overlay



CPT-DA28377 INTERFACE CONTROLLER BOARD TECHNICAL BRIEF
Bottom Overlay - Mirrored



Appendix B Texas Instruments Technical Manuals for Control Card MCU

TMS320F2837xD Delfino Microcontroller

Texas Instruments Website: <http://www.ti.com/product/TMS320F28377D/technicaldocuments>

Datasheet Document Number: SPRS880C

Technical Manual Document Number: SPRUHM8C

TMS320F28377D controlCARD R.1 (TMDSCNCD28377D)

Texas Instruments Website: <http://www.ti.com/tool/tmdxcncd28377d>

Datasheet Document Number: TMDSCNCD28377D-Inforsheet_v1_5.pdf