

CPT-DFTS
CPT-DFCC Development and Test Card
Technical Brief

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Card Version 1

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CPT-DFTS Manual Revision History

CARD VERSION 1: Initial Board generated

Release 1 – Initial Release

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DF Series Concept

1.0 DF Series Overview

The DF Series provides a modular, flexible integrated inverter controller platform through a range of interconnected cards. This structure provides an overall reduction in the footprint of the inverter, as well as providing a level of flexibility to support inverters rated from 1kW to 100kW+.

The DF Series Control Card supports Texas Instruments PTP footprint based Piccolo and Delfino Microcontrollers (MCU). Creative Power is actively supporting a subset of these MCU variations as their feature sets are closely aligned. The latest range of MCUs support TI's new integrated analog and control peripherals that are designed to consolidate additional functionality within the MCU.

The modular nature of the DF Series system is seen through the flexible DF Series Interface which connects the DF Series Control Card to a wide range of peripheral cards. These cards include an Inverter Controller and various Communications Peripheral cards. Figure 1-1 shows the general structure of the DF Series stack, with the Control Card mounted to the Inverter Motherboard and any number of Communications Peripheral Cards mounted above.

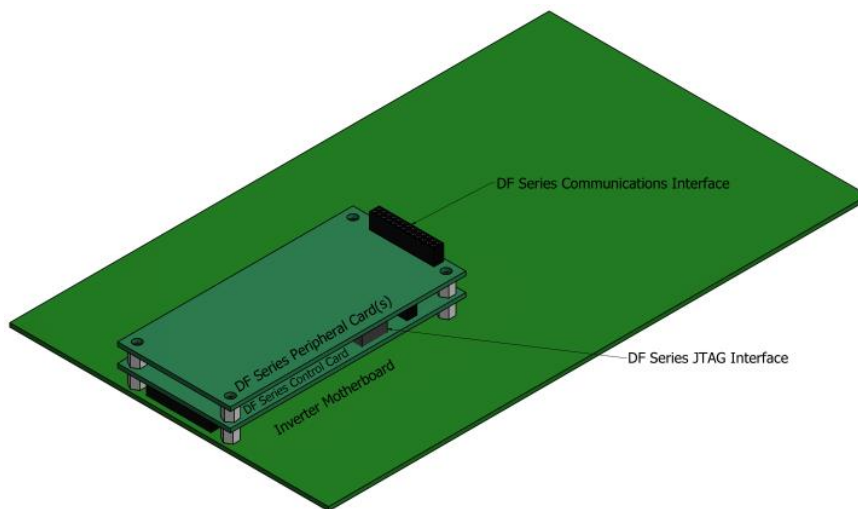


Figure 1-1: DF Series Card Stack Conceptual Overview

1.1 DF Series Card Range

The following is a list of the available cards within the DF Series. Additional cards will be added to the range as they become available.

1.1.1 DF Series Control Card:

The DF Series Control Card is available with the following part numbers:

- **CPT-DF28075 (TMS320F28075PTP MCU Processor)**
- CPT-DF28374S (TMS320F28374SPTP MCU Processor)
- CPT-DF28375S (TMS320F28375SPTP MCU Processor)
- CPT-DF28376S (TMS320F28376SPTP MCU Processor)
- **CPT-DF28377S (TMS320F28377SPTP MCU Processor)**
- CPT-DF28374D (TMS320F28374DPTP MCU Processor)
- CPT-DF28375D (TMS320F28375DPTP MCU Processor)
- CPT-DF28376D (TMS320F28376DPTP MCU Processor)
- **CPT-DF28377D (TMS320F28377DPTP MCU Processor)**

The part number corresponding to the DF Series Control Card must be specified as part of the order. The parts in bold are CPT standard load options.

The Control Card has a footprint of 96mm x 46mm (standard DF Series Footprint size).

1.1.2 DF Series Peripheral Cards

The Peripheral Cards can be mounted within the DF Stack above the Control Card, with interconnection through either the DF Communications Interface or, for the CPT-DFJ, the DF JTAG interface.

All Peripheral Cards are the standard DF Series Footprint size of 96mm x 46mm.

1.1.2.1 CPT-DFC1

CPT-DFC1 Peripheral Card provides external communications interfaces for the Control Card. It interfaces to the Control Card via the 26 way DF Communications Interface.

The CPT-DFC1 Peripheral Card supports the following functionality:

- Dual SCI to Isolated single USB Interface (two serial ports within the one USB connection)
 - USB-A: On-Card DIP Switch Selectable between SCI-A and SCI-C
 - USB-B: On-Card DIP Switch Selectable between SCI-B and SCI-D
- Isolated CAN Interface
 - On-Card DIP Switch Selectable between CAN-A and CAN-B
- Isolated SPI Interface (isoSPI configuration)
 - Direction Selection: On-Card DIP Switch Selectable between Master/Slave
 - Mode Selection: On-Card DIP Switch Selectable Phase and OffsetSupporting SPI Modes 0-3
- Real-Time Clock (I²C) with Supercapacitor backup

1.1.2.2 CPT-DFC4

CPT-DFC4 Peripheral Card provides external communications interfaces for the Control Card. It interfaces to the Control Card via the 26 way DF Communications Interface.

The CPT-DFC4 Peripheral Card supports the following functionality:

- Isolated RS422/RS485 Interface
 - On-Card DIP Switch Selectable between SCI-B and SCI-D
 - On-Card DIP Switch Selectable between RS422 and RS485 Mode
- Isolated CAN Interface
 - On-Card DIP Switch Selectable between CAN-A and CAN-B
- Isolated SPI Interface (isoSPI configuration)
 - Direction Selection: On-Card DIP Switch Selectable between Master/Slave
 - Mode Selection: On-Card DIP Switch Selectable Phase and Offset – supporting SPI Modes 0-3

1.1.2.3 CPT-DFJ

- JTAG + SCI to Isolated single USB Interface
 - USB based UART Serial Port through MCU Port SCI-A
 - USB JTAG Emulation interface for programming and debugging of the Control Card

1.1.3 DF Series Inverter Motherboard

The CPT-DFM1 is Creative Power's next generation high performance MCU based inverter controller motherboard. The CPT-DFM1 has been designed to provide flexibility of connection, combined with a minimum footprint for applications requiring an integrated solution to control up to a four-phase leg VSI stack.

The Inverter Motherboard is compatible with the DF Series Control Cards, and the CPT-DFM1/ Control Card Platform combination contains on-card all necessary functions for a complete standalone inverter control system.

The Inverter Motherboard supports up to 8 plug/solder-in gate driver modules, enabling the system to be scaled to an applications specific topology and power rating. The card has the following features:

- DF Series Main Interface Connectors
- 11 off Conditioned Analog Inputs (Low voltage inputs):
 - 3 off differential AC voltage inputs, (Three-phase 4 wire input compatible)

- 3 off differential AC/DC voltage inputs
- 5 off current inputs (AC and DC compatible)
- Isolated Digital I/O
 - 2 off isolated digital inputs (Field supply)
 - 3 off MOSFET switch isolated outputs
 - 2 off relay output, c/o contact
- On-Card Status Indication
 - 1 off Power LED
 - 4 off indication LEDs
 - Each isolated Digital I/O has an on-card status LED
- 4 off DIP switches
- 8 off CPT-Gxx compatible gate driver interface.
 - 3.3V TTL ePWM compatible outputs
 - Driven by ePWM1x to ePWM4x via the DF Series Main Interface
 - 2 sets of 4 fault feedback interrupt
 - Supports CPT's range of CPT-Gxx gate driver boards
 - Switched Gate Driver Supplies to drive isolating transformers on CPT-Gxx gate driver boards
 - Gate Driver Reset signal
- Quadrature Position Encoder input with Index and Strobe
- Push button reset
- On-card logic level supply generation
- Power supply operation from input 24VDC

The CPT-DFM1 card measures 220mm x 130mm.

1.2 DF Series Interfaces

The DF Series is modular in construction, which implies that signals require connection between the various cards. This is achieved using 2mm Dual-inline connectors between the cards within the DF Series Stack.

The Control Card consists of three Interface types:

- DF Series Main Interface (2 x 26-way + 3 x 20-way 2mm Dual-inline connectors)
- DF Series Communications Interface (26-way 2mm Dual-inline connector)
- DF Series JTAG Interface (10-way 2mm Dual-inline connector)

1.2.1 Main Interface

The DF Series Main Interface provides signal connection between the Control Card and Inverter Motherboard (CPT-DFM1). It is located on the underside of the Control Card.

The DF Series Main Interface has been broken up into 5 separate connectors. The Analog connector is located along the left hand edge of the Control Card and Motherboard. The remaining 4 connectors contain digital signals between the Control Card to the Motherboard. Their precise functionality must be specified within the user software to suit the Motherboard.

The Inverter Motherboard is configured as the base of the Main Interface Stack. The Control Card is mounted above the Inverter Motherboard.

1.2.2 Communications Interface

The DF Series Communications Interface provides signal connection between the Control Card and DFC Series Peripheral Cards. The Communications Interface is located along the right hand edge of the DF Series Footprint cards.

The Control Card is configured as the base of the Communications Interface stack. All Peripherals cards are mounted above the Control Card.

1.2.3 JTAG Interface

The DF Series Control Card has a 10 way connector that interfaces to the isolated CPT-DFJ JTAG and SCI USB card.

The isolated JTAG and SCI board is compatible with TI's default JTAG software EEPROM specification and provides a fully isolated USB JTAG Interface with a Serial Communications Interface to SCI-A on the MCU.

2.0 Overview of the CPT-DFTS Interface Board

The CPT-DFTS is an interface board designed to provide an easy and flexible development environment for the CPT-DFCC range of controller cards. The CPT-DFTS board has a DF Series compatible Controller Interface and provides an on-card regulated power supply, non-isolated RS232 serial communications and JTAG interface, as well as break out interfaces for the GPIO pins on the CPT-DFCC card to IDC headers.

The board is intended to simplify program development for the CPT-DFCC platform.

In addition, the CPT-DFTS board can be configured to provide a fully automatic test environment for the CPT-DFCC range.

The CPT-DFTS measures 180 x 140mm.

Please consult the CPT-DFCC Technical Manual for a detailed description of the functionality of the CPT-DFCC processor card.

The CPT-DFTS board provides conversion of GPIO interfaces from the 2mm sockets used on the CPT-DFCC to standard 0.1" IDC headers. The headers maintain the same pin outs for simplicity. All analog signals are passed directly through to the DF Series Interface.

The CPT-DFTS board requires a CPT-DFCC, or equivalent, MCU processor card to operate.

The basic functionality of the CPT-DFTS is:

- DF Series Main Interface break out headers (IDC compatible)
- DF Series Communications Interface break out header (IDC compatible – requires 2mm ribbon)
- DF Series JTAG Interface break out header (compatible with CPT-DFJ-DA card)
- 7 off power supply status LEDs
- 1 off non-isolated LVTTTL level serial communications port (compatible with CPT-DFJ-DA card)
- 12V Power Supply Input
- On-card voltage regulation
- Manual Reset push button

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

CPT- DFTS INTERFACE BOARD TECHNICAL BRIEF

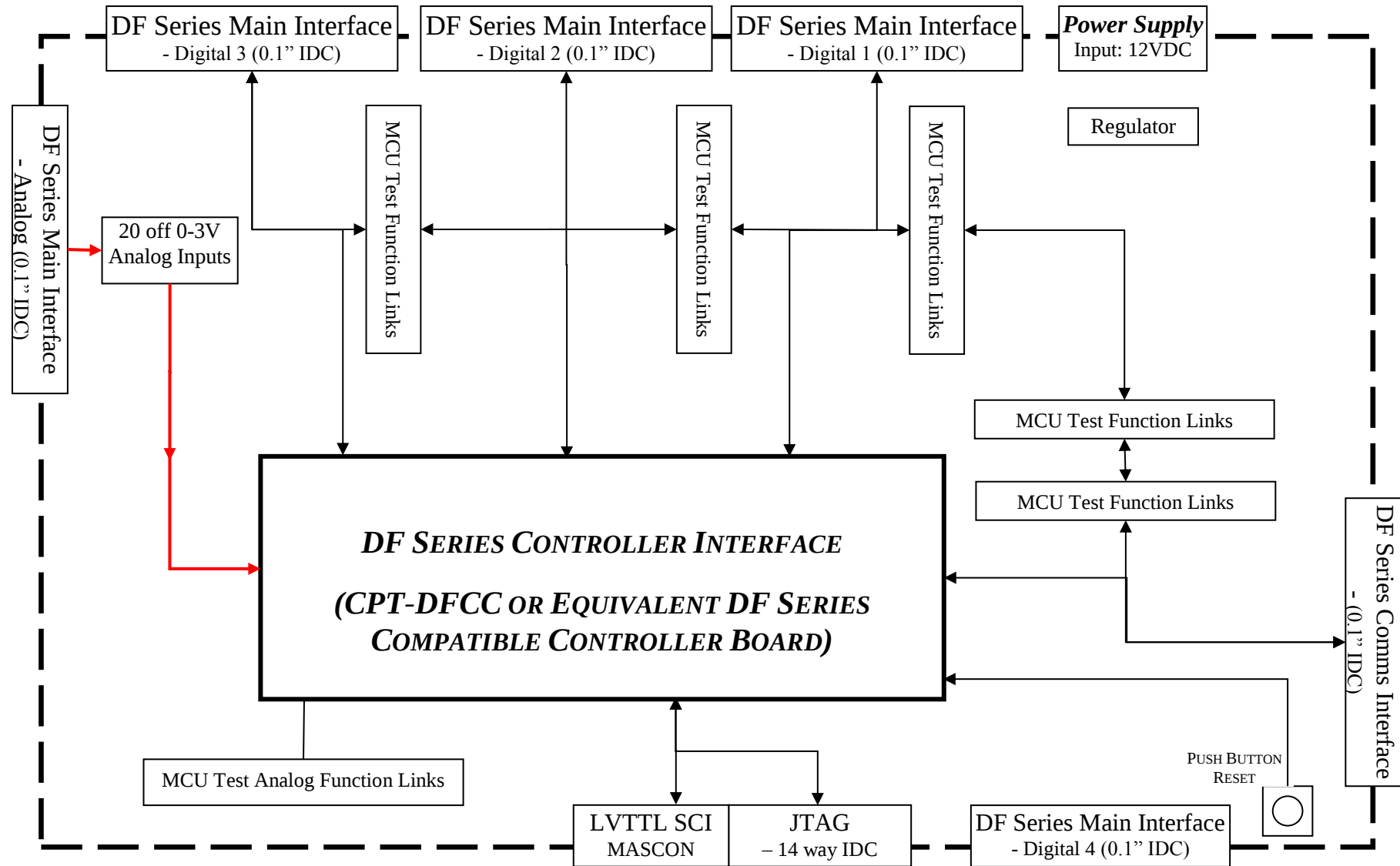


Figure 1-1: Functional Diagram of CPT-DFTS Interface Board

2.1 Digital I/O

The CPT-DFCS interface board supports all of the GPIO pins from the CPT-DFCC's Main and Communications Interface through standard 0.1" IDC connectors. There is no on-card filtering, buffering or level-translation of the signals before they are fed to the CPT-DFCC.

Direct connection of the signals from the CPT-DFCC card ensures that full configuration flexibility is maintained for the GPIO pins.

The *lib_dfcc.h* and *lib_dfcc.c* software configuration files can be used directly.

2.2 Analog Inputs

The CPT-DFCS interface board has 20 off analog inputs configured as 0-3.3V ADC signals. The IDC header, **X8**, passes these directly to the DF Series interface with no on-card buffering, filtering, or protection. Note that the CPT-DFCC MCU Controller board has on-card glitch filters and over-voltage protection diodes.

Please consult either the *CPT-DFCC Technical Manual* or the Texas Instruments documentation on the ADC converter for further information.

The CPT-DFCS contains precision reference inputs that are fed through on-card opamps to enable self-testing and calibration of the CPT-DFCC analog inputs. This requires insertion of the on-card Analog Input Links.

2.3 Communications

The CPT-DFCS interface board supports a non-isolated LVTTTL serial communications port through the DF Series JTAG interface connector. A 2mm 10-way ribbon cable connection is required between the DFCC card's JTAG Interface, **X7**, and **X93**. The SCIA: JTAG header can be connected to a CPT-COM-U, CPT-DAJ or a CPT-DFJ-DA which enables interfacing with a PC terminal emulation program via USB to aid in program development.

2.4 Power Supply

The standard CPT-DFCS interface card operates from a nominal +12VDC. The board has an on-card regulator that generates a regulated +5V supply.

The board should not be powered without an appropriate plug-in MCU Controller connected to the DF Series interface.

3.0 Specifications

3.1 DF Series Plug-In Interface

Configuration	26-way 2mm Analog Header, 26 way IDC Digital Header and 3 x 20-way 2mm Digital Headers - compatible with the CPT-DFCC, or equivalent processor Please consult the <i>CPT-DFCC Technical Manual</i> for the Technical Specifications of this board.
Power Supply	Digital Supply: +5V (DF Series DIG 1 interface Pins 1, 3, 5) GND (DF Series DIG 1 interface Pins 2, 4, 6)
PCB Connection	DF Series Interface (A1A , A1B , A1C , A1D , A1E)

3.2 Analog Inputs

Definition	20 off 0 – 3.3V analog inputs with no on-card filtering Note: The CPT-DFCC contains low pass “glitch” filters and a diode clamp circuit
Input Voltage Range	0 – 3.3V maximum
Dynamic Response	Cut-off frequency >150kHz
PCB Connections	ADCA0-5, ADCB0-3, ADCC2-4, ADCD0-4, ADC14, ADC15 on 26-way IDC header (X8)
DF Series Interface	26-way 2mm DF Series Analog header (A1E)

3.3 Digital I/O – Digital Headers

Definition	85 bits of individually configurable Digital I/O (GPIO), pass through from the DF Series Digital Headers 1 - 4
Digital I/O rated at	Please refer to the datasheet for the relevant Control Card that is attached to the DF Series Interface for specific pin limitations. Typical Limits as a guideline are: Source 4mA per bit, ABSOLUTE MAXIMUM. Sink 4mA per bit, ABSOLUTE MAXIMUM.
PCB Connection	DF Series Digital Header 1 (A1A) → 26-way IDC header (X3) DF Series Digital Header 2 (A1B) → 20-way IDC header (X2) DF Series Digital Header 3 (A1C) → 20-way IDC header (X1) DF Series Digital Header 4 (A1D) → 20-way IDC header (X95) DF Series Comms. Header (X91) → 26-way IDC header (X92)

3.4 Digital I/O – Communications Header

Definition	19 bits of individually configurable Digital I/O (GPIO), pass through from the DF Series Communications Header
Configuration	Requires 2mm Ribbon cable to be inserted into the DF Series Control Card and fed to the X91 header
Digital I/O rated at	Please refer to the datasheet for the relevant Control Card that is attached to the DF Series Interface for specific pin limitations. Source 4mA per bit, ABSOLUTE MAXIMUM. Sink 4mA per bit, ABSOLUTE MAXIMUM.
PCB Connection	DF Series Comms. Header (X91) → 26-way IDC header (X92)

3.5 Communications Interface

3.5.1 LVTTTL Interface –SCI

Definition	LVTTTL connection, providing two pin serial communications for interface to a PC serial port from SCIA on the DF Series JTAG Interface
Compatibility	CPT-COM, CPT-COM-U, CPT-DAJ, CPT-DFJ-DA
PCB Connections	4-way pin strip header with +3.3V_DFJ and GND connections (X96)
DF Series JTAG Interface	Pins 1, 2 (SCIA)

3.5.2 JTAG – Communications Header

Definition	MCU programming interface, which enables the MCU to interface the real-time debugging environment
Compatibility	Compatible with IEEE 1149.1 standard for scan-based emulation Requires a 10-way 2mm ribbon cable to be connected between X93 and the DF Series Control Card's JTAG Interface header.
Configuration	3.3V-TTL Level signals Connector compatible with the standard 14 way JTAG/SCI card For isolated JTAG operation - connect to a CPT-DAJ, CPT-DFJ-DA For non-isolated JTAG operation – connect to an XDS510LC or equivalent
PCB Connection	14-way JTAG Interface Header (X94)

3.6 Digital Loopback Links

Definition	Self-testing of the loaded DF Series control card is supported by connection of loopback links for the GPIO Signals. The links connect the signals to a common TEST_BUS.
Compatibility	Supports 4k7 series resistance between the bus and the GPIO signals
PCB Connections	Two-way jumpers, X5 – X50, X52 – X90

3.7 Analog Self-Test Links

Definition	Self-testing of the loaded DF Series control card analogs is supported through on-card opamps that connect reference voltages to the analog inputs.
Compatibility	Offset Voltages
PCB Connections	Two-way jumpers, X92 – X116
DF Series Analog Interface	26-way 2mm Header (A1E)

3.8 General

Physical Dimensions	L: 140mm
	W: 180mm
	H: $\cong$ 27mm
Mounting Arrangement	11 off 3.5 mm holes
Environmental	-40 – 85°C ambient operating temperature 5% - 95% non-condensing humidity

3.9 Power Supply

Input Voltage Range	9 - 24VDC Absolute Maximum 12VDC nominal
Standalone Input Current	100-250mA (depending on the active sections within the MCU)
Max Input Power	Approx. TBC ~500mW
Supplies Generated on-card	+5V Digital
	CPT-DFCC generates its voltages internally
Input Power Connector	2-way MCV1,5/2-G-3,81 Connector (X4)

Appendix

