TEXAS INSTRUMENTS

TMS320F28388D, TMS320F28386D, TMS320F28384D
TMS320F28388S, TMS320F28386S, TMS320F28384S

SPRSP14 – MAY 2019

TMS320F2838x Microcontrollers With Connectivity Manager

1 Device Overview

1.1 Features

- Dual-core C28x architecture
  - Two TMS320C28x 32-bit CPUs
    - 200 MHz
    - IEEE 754 double-precision (64-bit) Floating-Point Unit (FPU)
    - Trigonometric Math Unit (TMU)
    - CRC engine and instructions (VCRC)
    - Fast Integer Division (FINTDIV)
  - 512KB (256KW) of flash on each CPU (ECC-protected)
  - 44KB (22KW) of local RAM on each CPU
  - 128KB (64KW) of global RAM shared between the two CPUs (parity-protected)
- Two Control Law Accelerators (CLAs)
  - 200 MHz
  - IEEE 754 single-precision floating-point
  - Executes code independently of C28x CPU
- System peripherals
  - Two External Memory Interfaces (EMIFs) with ASRAM and SDRAM support
  - Two 6-channel Direct Memory Access (DMA) controllers
  - Up to 169 General-Purpose Input/Output (GPIO) pins with input filtering
  - Expanded Peripheral Interrupt controller (ePIE)
  - Low-power mode (LPM) support
  - Dual-zone security for third-party development
  - Unique Identification (UID) number
  - Embedded Real-time Analysis and Diagnostic (ERAD)
  - Background CRC (BGCRC)
- Connectivity Manager (CM)
  - Arm® Cortex®-M4 processor
  - 125 MHz
  - 512KB of flash (ECC-protected)
  - 96KB of RAM (ECC-protected or parity-protected)
  - Advanced Encryption Standard (AES) accelerator
  - Generic CRC (GCRC)
  - 32-channel Micro Direct Memory Access (µDMA) controller
  - Universal Asynchronous Receiver/Transmitter (CM-UART)
  - Inter-integrated Circuit (CM-I2C)
  - Synchronous Serial Interface (SSI)
  - 10/100 Ethernet 1588 MII/RMII
  - MCAN (CAN-FD)
- C28x communications peripherals
  - Fast Serial Interface (FSI) with two transmitters and eight receivers
  - Four high-speed (up to 50-MHz) SPI ports (pin-bootable)
  - Four Serial Communications Interfaces (SCI/UART) (pin-bootable)
  - Two I2C interfaces (pin-bootable)
  - Power-Management Bus (PMBus) interface
  - Two Multichannel Buffered Serial Ports (McBSPs)
- CM-C28x shared communications peripherals
  - EtherCAT® Slave Controller (ESC)
  - USB 2.0 (MAC + PHY)
  - Two Controller Area Network (CAN) modules (pin-bootable)
- Analog subsystem
  - Four Analog-to-Digital Converters (ADCs)
    - 16-bit mode
      - 1.1 MSPS each
      - 12 differential or 24 single-ended inputs
    - 12-bit mode
      - 3.5 MSPS each
      - 24 single-ended inputs
    - Single sample-and-hold (S/H) on each ADC
    - Hardware post-processing of conversions
  - Eight windowed comparators with 12-bit Digital-to-Analog Converter (DAC) references
  - Three 12-bit buffered DAC outputs
- Control peripherals
  - 32 Pulse Width Modulator (PWM) channels
    - High resolution on both A and B channels of 8 PWM modules (16 channels)
    - Dead-band support (on both standard and high resolution)
  - Seven Enhanced Capture (eCAP) modules
    - High-resolution Capture (HRCAP) available on two of the seven eCAP modules
  - Three Enhanced Quadrature Encoder Pulse (eQEP) modules
  - Eight Sigma-Delta Filter Module (SDFM) input channels, 2 independent filters per channel

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- Configurable Logic Block (CLB)
  - Augments existing peripheral capability
  - Supports position manager solutions
- Clock and system control
  - Two internal zero-pin 10-MHz oscillators
  - On-chip crystal oscillator
  - Windowed watchdog timer module
  - Missing clock detection circuitry
  - Dual-clock Comparator (DCC)
- 1.2-V core, 3.3-V I/O design
- Package options:
  - Lead-free, green packaging
  - 337-ball New Fine Pitch Ball Grid Array (nFBGA) [ZWT suffix]
- Temperature options:
  - S: –40ºC to 125ºC junction
  - Q: –40ºC to 125ºC ambient (AEC Q100 qualification for automotive applications)

1.2 Applications

- Advanced Driver Assistance Systems (ADAS)
- Building automation
- Electric Vehicle/Hybrid Electric Vehicle (EV/HEV) powertrain
- Factory automation
- Grid infrastructure
- Industrial transport
- Medical, healthcare, and fitness
- Motor drives
- Power delivery
- Telecom infrastructure
- Test and measurement

1.3 Description

C2000™ 32-bit microcontrollers are optimized for processing, sensing, and actuation to improve closed-loop performance in real-time control applications such as industrial motor drives; solar inverters and digital power; electrical vehicles and transportation; motor control; and sensing and signal processing.

The TMS320F2838x is a powerful 32-bit floating-point microcontroller unit (MCU) designed for advanced closed-loop control applications. The F2838x supports a dual-core C28x architecture along with a new Connectivity Manager that offloads critical communication tasks, significantly boosting system performance. The integrated analog and control peripherals with advanced connectivity peripherals like EtherCAT and Ethernet also let designers consolidate real-time control and real-time communications architectures, reducing requirements for multicontroller systems.

The dual real-time control subsystems are based on TI's 32-bit C28x floating-point CPUs, which provide 200 MHz of signal processing performance in each core. The C28x CPUs are further boosted by the TMU accelerator, which enables fast execution of algorithms with trigonometric operations common in transforms and torque loop calculations.

The F2838x microcontroller family features two CLA real-time control coprocessors. The CLA is an independent 32-bit floating-point processor that runs at the same speed as the main CPU. The CLA responds to peripheral triggers and executes code concurrently with the main C28x CPU. This parallel processing capability can effectively double the computational performance of a real-time control system. By using the CLA to service time-critical functions, the main C28x CPU is free to perform other tasks, such as communications and diagnostics. The dual C28x+CLA architecture enables intelligent partitioning between various system tasks. For example, one C28x+CLA core can be used to track speed and position, while the other C28x+CLA core can be used to control torque and current loops.

The Connectivity Manager subsystem is based on the Cortex-M4 CPU and has access to advanced communication IPs like EtherCAT, Ethernet, MCAN (CAN-FD), and AES.

The TMS320F2838x supports up to 1.5MB (512KB per CPU) of flash memory with error correction code (ECC) and up to 312KB (216KB total for C28x CPU1 and CPU2, and 96KB on the Cortex-M4) of SRAM. Two 128-bit secure zones are also available on the device for code protection.

ADVANCE INFORMATION