C2000 Real-Time Control Peripherals

Reference Guide

![Texas Instruments]

Contents

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28x DSP Peripherals

This overview guide describes all the peripherals available for TMS320x28xx and TMS320x28xxx devices. Section 2 shows the peripherals used by each device. Section 3 provides descriptions of the peripherals. You can download the peripheral guide by clicking on the literature number, which is linked to the portable document format (pdf) file.

1   Abbreviations

Throughout this document and other peripheral guides, the following abbreviations are used for a series of 28x microcontrollers:

- **TMS320x28xx** refers to TMS320x281x and TMS320x280x devices.
- **TMS320x28xxx** refers to TMS320x2801x, TMS320x2802x, TMS320x2803x, TMS320x2804x, TMS320x2805x, TMS320x2806x, TMS320x2807x, TMS320x2833x, TMS320x2834x, TMS320x2837xD, and TMS320x2837xS devices.
- **TMS320x28M3xx** refers to F28M35x and F28M36x devices.

Specific device abbreviations are listed in Table 1.

Table 1. Abbreviation Matrix

Family	Device[1]	Device Abbreviation Used	Group Abbreviation
TMS320x280x	TMS320F2801, TMS320C2801	2801	280x
	TMS320F2802, TMS320C2802	2802	
	TMS320F2806, TMS320F2806	2806	
	TMS320F2808, SM320F2808-EP[2]	2808	
	TMS320F2809	2809	
TMS320x281x	TMS320F2810, TMS320C2810, SM320F2810-EP[2]	2810	281x
	TMS320F2811, TMS320C2811, TMS320R2811, SM320F2811-EP[2]	2811	
	TMS320F2812, TMS320C2812, TMS320R2812, SM320F2812-EP[2]	2812	
TMS320x2801x	TMS320F28015	28015	2801x
	TMS320F28016	28016	
TMS320F2802x	TMS320F28020	28020	2802x
	TMS320F28021	28021	
	TMS320F28022	28022	
	TMS320F28023	28023	
	TMS320F28026	28026	
	TMS320F28027	28027	
	TMS320F28026F	28026F	
	TMS320F28027F	28027F	
TMS320F2803x	TMS320F28035	28035	2803x
	TMS320F28034	28034	
	TMS320F28033	28033	
	TMS320F28032	28032	
TMS320x2804x	TMS320F28044	28044	2804x
TMS320F2805x	TMS320F28055	28055	2805x
	TMS320F28054	28054	
	TMS320F28053	28053	
	TMS320F28052	28052	
	TMS320F28051	28051	
	TMS320F28050	28050	

[1] Where F precedes the device abbreviation, it stands for Flash memory; C stands for RAM.
[2] Military device that may be abbreviated differently elsewhere; the abbreviations shown are relevant to this document and peripheral selection only. Military devices in this document all begin with a prefix of SM.

Table 1. Abbreviation Matrix (continued)

Family	Device[1]	Device Abbreviation Used	Group Abbreviation
TMS320F2806x	TMS320F28069	28069	2806x
	TMS320F28068	28068	
	TMS320F28067	28067	
	TMS320F28066	28066	
	TMS320F28065	28065	
	TMS320F28064	28064	
	TMS320F28063	28063	
	TMS320F28062	28062	
	TMS32028069U	28069U	
	TMS32028068U	28068U	
	TMS32028067U	28067U	
	TMS32028066U	28066U	
	TMS32028065U	28065U	
	TMS32028064U	28064U	
	TMS32028063U	28063U	
	TMS32028062U	28062U	
	TMS320F28069M	28069M	
	TMS320F28068M	28068M	
	TMS320F28069F	28069F	
	TMS320F28068F	28068F	
	TMS320F28062F	28062F	
TMS320F2807x	TMS320F28075	28075F	2807x
	TMS320F28074	28074F	
TMS320F2823x	TMS320F28235	28235	2823x
	TMS320F28234	28234	
	TMS320F28232	28232	
TMS320F2833x	TMS320F28335	28335	2833x
	TMS320F28334	28334	
	TMS320F28332	28332	
TMS320x2834x	TMS320C28346	28346	2834x
	TMS320C28345	28345	
	TMS320C28344	28344	
	TMS320C28343	28343	
	TMS320C28342	28342	
	TMS320C28341	28341	
TMS320F2837xD	TMS320F28377D	28377D	2837xD
	TMS320F28376D	28376D	
	TMS320F28375D	28375D	
	TMS320F28374D	28374D	
TMS320F2837xS	TMS320F28377S	28377S	2837xS
	TMS320F28376S	28376S	
	TMS320F28375S	28375S	
	TMS320F28374S	28374S	

Table 1. Abbreviation Matrix (continued)

Family	Device[1]	Device Abbreviation Used	Group Abbreviation
TMS320F28M35x	F28M35H52C	35H52C	M35x
	F28M35H22C	35H22C	
	F28M35M52C	35M52C	
	F28M35M22C	35M22C	
	F28M35M20B	35M20B	
	F28M35E20B	35E20B	
TMS320F28M36x	F28M36P63C	M36P63C	M36x
	F28M36P53C	M36P53C	
	F28M36H53C	M36H53C	
	F28M36H53B	M36H53B	
	F28M36H33C	M36H33C	
	F28M36H33B	M36H33B	

2   Peripherals Available Per Device

Table 4 through Table 6 show the peripherals that are available for each of the 28xx, 28xxx devices. The literature number is a link to the document that can be downloaded.

2.1   Fixed Point Family

2.1.1   TMS320x280x, TMS320x2801x Peripherals

The following peripherals are available on the TMS320x280x and TMS320x2801x devices.

Table 2. TMS320x280x, TMS320x2801x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	2801, 2802, 2806, 2808, 2809	28016	28015
System Control and Interrupts	SPRU712	–	X	X	X
Enhanced Controller Area Network (eCAN)	SPRUEU0	0	X	X	–
Analog-to-Digital Converter (ADC)	SPRU716	1	X	X	X
Serial Communications Interface (SCI)	SPRUFK7	0	X	X	X
Serial Peripheral Interface (SPI)	SPRUG72	0	X	X	X
Boot ROM	SPRU722	–	X	X	X
Enhanced Quadrature Encoder Pulse (eQEP)	SPRU790	0	X	–	–
Enhanced Pulse Width Modulator Module (ePWM)	SPRU791	0	X	X	X
Enhanced Capture (eCAP) Module	SPRU807	0	X	X	X
Inter-Integrated Circuit (I2C)	SPRU721	0	X	X	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRU924	0	X	X	X
ADC Wrapper	SPRU716	0	X	X	X

[1]   A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices which do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

2.1.2   TMS320x2804x Peripherals

The following peripherals are available on the TMS320x2804x device.

Table 3. TMS320x2804x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28044
System Control and Interrupts	SPRU712	–	X
Analog-to-Digital Converter (ADC)	SPRU716	1	X
Serial Communications Interface (SCI)	SPRUFK7	0	X
Serial Peripheral Interface (SPI)	SPRUG72	0	X
Boot ROM	SPRU722	–	X
Enhanced Pulse Width Modulator Module (ePWM)	SPRU791	0	X
Inter-Integrated Circuit (I2C)	SPRU721	0	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRU924	0	X
ADC Wrapper	SPRU716	0	X

[1]   A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices which do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

2.1.3 TMS320x281x Peripherals

The following peripherals are available on the TMS320x281x device.

Table 4. TMS320x281x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	2812	2811, 2810
System Control and Interrupts	SPRU078	–	X	X
External Interface (XINTF)	SPRU067	0	X	–
Enhanced Controller Area Network (eCAN)	SPRU074	0	X	X
Event Manager (EV)	SPRU065	0	X	X
Analog-to-Digital Converter (ADC)	SPRU060	0	X	X
Multichannel Buffered Serial Port (McBSP)	SPRU061	0	X	X
Serial Communications Interface (SCI)	SPRU051	0	X	X
Serial Peripheral Interface (SPI)	SPRU059	0	X	X
Boot ROM	SPRU095	–	X	X
ADC Wrapper	SPRU060	0	X	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices which do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

2.1.4 TMS320F2823x Peripherals

The following peripherals are available on the TMS320F2823x device.

Table 5. TMS320F2823x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28235, 28234, 28232
System Control and Interrupts	SPRUFB0	–	X
External Interface (XINTF)	SPRU949	1	X
Enhanced Controller Area Network (eCAN)	SPRUEU1	0	X
Analog-to-Digital Converter (ADC)	SPRU812	2	X
Multichannel Buffered Serial Port (McBSP)	SPRUFB7	1	X
Serial Communications Interface (SCI)	SPRUFZ5	0	X
Serial Peripheral Interface (SPI)	SPRUEU3	0	X
Boot ROM	SPRU963	–	X
Enhanced Quadrature Encoder Pulse (eQEP)	SPRUG05	0	X
Enhanced Pulse Width Modulator Module (ePWM)	SPRUG04	0	X
Enhanced Capture (eCAP) Module	SPRUFG4	0	X
Inter-Integrated Circuit (I2C)	SPRUG03	0	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRUG02	0	X
Direct Memory Access (DMA)	SPRUFB8	0	X
ADC Wrapper	SPRU812	0	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices which do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

2.2 Piccolo Family

2.2.1 TMS320F2802x Peripherals

The following peripherals are available on the TMS320F2802x device.

Table 6. TMS320F2802x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28027, 28026, 28023, 28022	28021, 28020, 280200
System Control and Interrupts	SPRUFN3	–	X	X
Comparator Module (COMP)	SPRUGE5	0	X	X
Analog-to-Digital Converter (ADC)	SPRUGE5	3	X	X
Serial Communications Interface (SCI)	SPRUGH1	0	X	X
Serial Peripheral Interface (SPI)	SPRUG71	1	X	X
Boot ROM	SPRUFN6	–	X	X
Enhanced Pulse Width Modulator Module (ePWM)	SPRUGE9	1	X	X
Enhanced Capture Module (eCAP)	SPRUFZ8	0	X	X
Inter-Integrated Circuit (I2C)	SPRUFZ9	0	X	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRUGE8	1	X	–
InstaSPIN-FOC™	SPRUHI9	–	X[2]	X[2]
ADC Wrapper	SPRUGE5	1	X	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

[2] InstaSPIN-FOC™ is available only on devices with TMS320F2802xF part numbers.

2.2.2 TMS320F2803x Peripherals

The following peripherals are available on the TMS320F2803x device.

Table 7. TMS320F2803x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28035, 28033	28034, 28032
System Control and Interrupts	SPRUGL8	–	X	X
Enhanced Controller Area Network (eCAN)	SPRUGL7	0	X	X
Comparator Module (COMP)	SPRUGE5	0	X	X
Analog-to-Digital Converter (ADC)	SPRUGE5	3	X	X
Serial Communications Interface (SCI)	SPRUGH1	0	X	X
Serial Peripheral Interface (SPI)	SPRUG71	1	X	X
Boot ROM	SPRUGO0	–	X	X
Enhanced Quadrature Encoder Pulse (eQEP)	SPRUFK8	0	X	X
Enhanced Pulse Width Modulator (ePWM)	SPRUGE9	1	X	X
Enhanced Capture Module (eCAP)	SPRUFZ8	0	X	X
Inter-Integrated Circuit (I2C)	SPRUFZ9	0	X	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRUGE8	1	X	X
Control Law Accelerator (CLA)	SPRUGE6	0	X	–
Local Interconnect Network (LIN)	SPRUGE2	0	X	X
High Resolution Capture (HRCAP)	SPRUH56	0	X	X
ADC Wrapper	SPRUGE5	1	X	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in the peripheral reference guides.

2.2.3   TMS320F2805x Peripherals

The following peripherals are available on the TMS320F2805x device.

Table 8. TMS320F2805x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28055, 28054, 28053	28052, 28051, 28050
System Control and Interrupts	Please see [SPRUHE5](#) which includes all F2805x peripherals shown here	–	X	X
Enhanced Controller Area Network (eCAN)		0	X	X
Analog-to-Digital Converter (ADC)		3	X	X
Analog-to-Digital Converter Wrapper		1	X	X
Comparator Module (COMP)		1	X	X
Serial Communications Interface (SCI)		0	X	X
Serial Peripheral Interface (SPI)		1	X	X
Boot ROM		–	X	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X	X
Enhanced Pulse Width Modulator (ePWM)		1	X	X
Enhanced Capture Module (eCAP)		0	X	X
Inter-Integrated Circuit (I2C)		0	X	X
Control Law Accelerator (CLA)		0	X	–
Programmable Gain Amplifiers (PGA)		0	X	X
Buffered Digital-to-Analog Converter (DAC)		0	X	X

[1]   A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in the peripheral reference guides.

2.2.4 TMS320F2806x Peripherals

The following peripherals are available on the TMS320F2806x device.

Table 9. TMS320F2806x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28069, 28065	28068, 28064	28067, 28066, 28063, 28062
System Control and Interrupts	Please see SPRUH18 for all F2806x peripherals shown here	–	X	X	X
Enhanced Controller Area Network (eCAN)		0	X	X	X
Analog-to-Digital Converter (ADC)		3	X	X	X
Analog-to-Digital Converter Wrapper		1	X	X	X
Comparator Module (COMP)		0	X	X	X
Serial Communications Interface (SCI)		0	X	X	X
Serial Peripheral Interface (SPI)		1	X	X	X
Boot ROM		–	X	X	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X	X	X
Enhanced Pulse Width Modulator (ePWM)		1	X	X	X
Enhanced Capture Module (eCAP)		0	X	X	X
Inter-Integrated Circuit (I2C)		0	X	X	X
High Resolution Capture (HRCAP)		0	X	X	X
High-Resolution Pulse-Width Modulator (HRPWM)		1	X	X	X
Control Law Accelerator (CLA)		0	X	–	–
Direct Memory Access (DMA)		0	X	X	X
Multichannel Buffered Serial Port (McBSP)		1	X	X	X
Viterbi, Complex Math and CRC Unit (VCU)		1	X	X	–
Universal Serial Bus (USB)		0	X[2]	X[2]	X[2]
InstaSPIN–FOC™	SPRUHI9	–	X[3]	X[3]	X[3]
InstaSPIN-MOTION™	SPRUHJ0	–	X[4]	X[4]	X[4]
Floating-Point Unit (FPU)	SPRUHS1	–	X	X	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in the peripheral reference guides.
[2] USB is present only in TMS320F2806xU, TMS320F2806xF, and TMS320F2806xM devices.
[3] InstaSPIN-FOC™ is available only on devices with TMS320F2806xF part numbers.
[4] InstaSPIN-MOTION™ is available only on devices with the TMS320F2806xM part number.

2.2.5 TMS320F2807x Peripherals

The following peripherals are available on the TMS320F2807x device.

Table 10. TMS320F2807x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28075, 28074
System Control and Interrupts	Please see SPRUHM9 for all F2807x peripherals shown here	–	X
ROM Code and Peripheral Booting		–	X
Direct Memory Access (DMA)		0	X
Control Law Accelerator (CLA)		1	X
General Purpose Input /Output (GPIO)		–	X
Analog-to-Digital Converter (ADC)		4	X
Analog-to-Digital Converter Wrapper		3	X
Comparator Subsystem (CMPSS)		0	X
Buffered Digital to Analog Converter (DAC)		1	X
Sigma Delta Filter Module (SDFM)		0	X
Enhanced Pulse Width Modulator (ePWM)		4	X
High-Resolution Pulse-Width Modulator (HRPWM)		2	X
Enhanced Capture Module (eCAP)		0	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X
Serial Peripheral Interface (SPI)		2	X
Serial Communications Interface (SCI)		0	X
Inter-Integrated Circuit (I2C)		0	X
Multichannel Buffered Serial Port (McBSP)		1	X
Controller Area Network (CAN)		1	X
Universal Serial Bus (USB)		0	X
External Memory Interface (EMIF)		0	X
Trigonometric Math Unit (TMU)	SPRUHS1	0	X
Floating-Point Unit (FPU)		–	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in the peripheral reference guides.

2.3 Delfino Family

2.3.1 TMS320F2833x Peripherals

The following peripherals are available on the TMS320F2833x device.

Table 11. TMS320F2833x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	28335, 28334, 28332
System Control and Interrupts	SPRUFB0	–	X
External Interface (XINTF)	SPRU949	1	X
Enhanced Controller Area Network (eCAN)	SPRUEU1	0	X
Analog-to-Digital Converter (ADC)	SPRU812	2	X
Analog-to-Digital Converter Wrapper	SPRU812	0	X
Multichannel Buffered Serial Port (McBSP)	SPRUFB7	1	X
Serial Communications Interface (SCI)	SPRUFZ5	0	X
Serial Peripheral Interface (SPI)	SPRUEU3	0	X
Boot ROM	SPRU963	–	X
Enhanced Quadrature Encoder Pulse (eQEP)	SPRUG05	0	X
Enhanced Pulse Width Modulator Module (ePWM)	SPRUG04	0	X
Enhanced Capture Module (eCAP)	SPRUFG4	0	X
Inter-Integrated Circuit (I2C)	SPRUG03	0	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRUG02	0	X
Direct Memory Access (DMA)	SPRUFB8	0	X
Floating-Point Unit (FPU)	SPRUHS1	–	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices which do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

2.3.2 TMS320x2834x Peripherals

The following peripherals are available on the TMS320x2834x device.

Table 12. TMS320x2834x Peripheral Selection Guide

Peripheral	Lit. No.	TYPE[1]	28346, 28345, 28344, 28343, 28342, 28341
System Control and Interrupts	SPRUFN1	–	X
External Interface (XINTF)	SPRUFN4	1	X
Enhanced Controller Area Network (eCAN)	SPRUEU4	0	X
Multichannel Buffered Serial Port (McBSP)	SPRUG80	1	X
Serial Communications Interface (SCI)	SPRUG75	0	X
Serial Peripheral Interface (SPI)	SPRUG73	0	X
Boot ROM	SPRUFN5	–	X
Enhanced Quadrature Encoder Pulse (eQEP)	SPRUG74	0	X
Enhanced Pulse Width Modulator Module (ePWM)	SPRUFZ6	0	X
Enhanced Capture Module (eCAP)	SPRUG79	0	X
Inter-Integrated Circuit (I2C)	SPRUG76	0	X
High-Resolution Pulse-Width Modulator (HRPWM)	SPRUG77	0	X
Direct Memory Access (DMA)	SPRUG78	0	X
Floating-Point Unit (FPU)	SPRUHS1	–	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in Section 3 and in the peripheral reference guides.

2.3.3 TMS320F2837xD Peripherals

The following peripherals are available on theTMS320F2837xD device.

Table 13. TMS320F2837xD Peripheral Selection Guide

Peripheral	Lit. No.	Type	28374D, 28375D, 28376D, 28377D
System Control and Interrupts	Please see SPRUHM8 for all F2837xD peripherals shown here	–	X
ROM Code and Peripheral Booting		–	X
Direct Memory Access (DMA)		0	X
Control Law Accelerator (CLA)		1	X
Inter-processor Communication (IPC)		–	X
General-Purpose Input/Output (GPIO)		–	X
Analog-to-Digital Converter (ADC)		4	X
Analog-to-Digital Converter Wrapper		3	X
Comparator Subsystem (CMPSS)		0	X
Buffered Digital to Analog Converter (DAC)		1	X
Sigma Delta Filter Module (SDFM)		0	X
Enhanced Pulse Width Modulator (ePWM)		4	X
High-Resolution Pulse-Width Modulator (HRPWM)		2	X
Enhanced Capture Module (eCAP)		0	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X
Serial Peripheral Interface (SPI)		2	X
Serial Communications Interface (SCI)		0	X
Inter-Integrated Circuit (I2C)		0	X
Multichannel Buffered Serial Port (McBSP)		1	X
Controller Area Network (CAN)		1	X
Universal Serial Bus (USB)		0	X
Universal Parallel Port (uPP)		0	X
External Memory Interface (EMIF)		0	X
Trigonometric Math Unit (TMU)	SPRUHS1	0	X
Viterbi, complex Math, and CRC Unit (VCU-II)		2	X
Floating-Point Unit (FPU)		–	X

2.3.4   TMS320F2837xS Peripherals

The following peripherals are available on theTMS320F2837xS device.

Table 14. TMS320F2837xS Peripheral Selection Guide

Peripheral	Lit. No.	Type	28374S, 28375S, 28376S, 28377S
System Control and Interrupts	Please see SPRUHX5 for all F2837xS peripherals shown here	–	X
ROM Code and Peripheral Booting		–	X
Direct Memory Access (DMA)		0	X
Control Law Accelerator (CLA)		1	X
General-Purpose Input/Output (GPIO)		–	X
Analog-to-Digital Converter (ADC)		4	X
Analog-to-Digital Converter Wrapper		3	X
Comparator Subsystem (CMPSS)		0	X
Buffered Digital to Analog Converter (DAC)		1	X
Sigma Delta Filter Module (SDFM)		0	X
Enhanced Pulse Width Modulator (ePWM)		4	X
High-Resolution Pulse-Width Modulator (HRPWM)		2	X
Enhanced Capture Module (eCAP)		0	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X
Serial Peripheral Interface (SPI)		2	X
Serial Communications Interface (SCI)		0	X
Inter-Integrated Circuit (I2C)		0	X
Multichannel Buffered Serial Port (McBSP)		1	X
Controller Area Network (CAN)		1	X
Universal Serial Bus (USB)		0	X
Universal Parallel Port (uPP)		0	X
External Memory Interface (EMIF)		0	X
Trigonometric Math Unit (TMU)	SPRUHS1	0	X
Viterbi, complex Math, and CRC Unit (VCU-II)		2	X
Floating-Point Unit (FPU)		–	X

2.4 Concerto Family

2.4.1 F28M35x Peripherals

The following peripherals are available on the F28M35x device.

Table 15. F28M35x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	M35xx2C	M35xx0B
System Control and Interrupts	Please see SPRUH22 for all F28M35x peripherals shown here	–	X	X
Boot ROM		–	X	X
Analog-to-Digital Converter (ADC)		3	X	X
Analog-to-Digital Converter Wrapper		2	X	X
Comparator Module (COMP)		0	X	X
External Peripheral Interface (EPI)		0	X	X
Hardware Logic Self-Test Module (HWBIST)		0	X	X
Master Subsystem - ARM Cortex M3				
Ethernet Media Access Controller (EMAC)		0	X	–
Synchronous Serial Interface (SSI)		0	X	X
Controller Area Network (CAN)		0	X	X
Universal Serial Bus (USB)		0	X	-
Inter-Integrated Circuit (I2C)		1	X	X
Universal Asynchronous Receiver/Transmitter (UART)		0	X	X
Micro Cyclic Redundancy Check Module (µCRC)		0	X	X
Direct Memory Access (µDMA)		0	X	X
Control Subsystem - TI C28x				
Serial Communications Interface (SCI)		0	X	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X	X
Enhanced Pulse-Width Modulator (ePWM)		2	X	X
High Resolution Pulse-Width Modulator (HRPWM)		2	X	X
Enhanced Capture Module (eCAP)		0	X	X
Inter-Integrated Circuit (I2C)		0	X	X
Direct Memory Access Module (DMA)		0	X	X
Multichannel Buffered Serial Port (McBSP)		1	X	X
Serial Peripheral Interface (SPI)		0	X	X
Viterbi, Complex Math and CRC Unit (VCU)	SPRUHS1	0	X	X
Floating-Point Unit (FPU)		–	X	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in the peripheral reference guides.

2.4.2 F28M36x Peripherals

The following peripherals are available on the F28M36x device.

Table 16. F28M36x Peripheral Selection Guide

Peripheral	Lit. No.	Type[1]	M36xxxC	M36xxxB
System Control and Interrupts	Please see SPRUHE8 for all F28M36x peripherals shown here	–	X	X
Boot ROM		–	X	X
Analog-to-Digital Converter (ADC)		3	X	X
Analog-to-Digital Converter Wrapper		2	X	X
Comparator Module (COMP)		0	X	X
External Peripheral Interface (EPI)[2]		0	X	X
Hardware Logic Self-Test Module (HWBIST)		0	X	X
Master Subsystem - ARM Cortex M3			X	X
Ethernet Media Access Controller (EMAC)		0	X	–
Synchronous Serial Interface (SSI)		0	X	X
Controller Area Network (CAN)		0	X	X
Universal Serial Bus (USB)		0	X	–
Inter-Integrated Circuit (I2C)		1	X	X
Universal Asynchronous Receiver/Transmitter (UART)		0	X	X
Micro Cyclic Redundancy Check Module (µCRC)		0	X	X
Direct Memory Access (µDMA)		0	X	X
Control Subsystem - TI C28x		0	X	X
Serial Communications Interface (SCI)		0	X	X
Enhanced Quadrature Encoder Pulse (eQEP)		0	X	X
Enhanced Pulse Width Modulator (ePWM)		2	X	X
High-Resolution Pulse-Width Modulator (HRPWM)		2	X	X
Enhanced Capture Module (eCAP)		0	X	X
Inter-Integrated Circuit (I2C)		0	X	X
Direct Memory Access (DMA)		0	X	X
Multichannel Buffered Serial Port (McBSP)		1	X	X
Serial Peripheral Interface (SPI)		1	X	X
Viterbi, Complex Math and CRC Unit (VCU)	SPRUHS1	0	X	X
Floating-Point Unit (FPU)		–	X	X

[1] A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices that do not affect the basic functionality of the module. These device-specific differences are listed in the peripheral reference guides.

[2] The EPI module can be controlled by either CPU. Refer to the relevant section of the technical reference manual for more information.

3   Peripheral Descriptions

Brief descriptions of the peripherals are included in the following sections.

3.1   *Coprocessor and C28x Extended Instruction Sets*

3.1.1   Control Law Accelerator (CLA)

The C28x Control Law Accelerator (CLA) module is an independent, fully-programmable, 32-bit floating-point math processor that brings concurrent control-loop execution to the C28x family. The low interrupt-latency of the CLA allows it to read ADC samples "just-in-time." This significantly reduces the ADC sample to output delay to enable faster system response and higher MHz control loops. By using the CLA to service time-critical control loops, the main CPU is free to perform other system tasks such as communications and diagnostics.

The CLA guide is:

- *TMS320x2803x Piccolo Control Law Accelerator (CLA) Reference Guide* (SPRUGE6)

For devices not listed above, refer to the device-specific technical reference manual.

Table 17. Control Law Accelerator (CLA) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original CLA Module Type	2803x	Only supports Data RAM0 and 1 and does not allow CPU access when CLA data RAM is enabled.
		2805x, 2806x	Adds supports for Data RAM2 and adds option to enable CPU access to Data RAMs.
1	Increased Program address reachability to 16-bits; added instructions to support the new address reach; added two new offset addressing modes; CLA program memory is now user selectable and can reside anywhere in the lower 64k address space (excluding the M0 and M1 space). The job of giving control to the CLA and assigning triggers to a task is now done at the system level; a task can now fire an interrupt to main CPU mid execution.	2807x, 2837xD, 2837xS	-

3.1.2   Floating-Point Unit (FPU)

The C28x plus floating-point (C28x+FPU) processor extends the capabilities of the C28x fixed-point CPU by adding registers and instructions to support IEEE single-precision floating point operations. Devices with the C28x+FPU include the standard C28x register set plus an additional set of floating-point unit registers. The additional floating-point unit registers are the following:

- Eight floating-point result registers, RnH (where n = 0–7)
- Floating-point Status Register (STF)
- Repeat Block Register (RB)

All of the floating-point registers, except the repeat block register, are shadowed. This shadowing can be used in high-priority interrupts for fast context save and restore of the floating-point registers.

For more information, see the *TMS320C28x Extended Instruction Sets Reference Guide* (literature number SPRUHS1).

Table 18. Floating-Point Unit Type Description

Type	Description	Devices Covered	Device-Specific Options
-	Original FPU Instruction Set	2806x, 2807x, 2833x, 2834x, 2837xD, 2837xS, M35x, M36x	–

3.1.3   Viterbi, Complex Math, and CRC Unit (VCU)

The C28x Viterbi, Complex Math and CRC Unit (VCU) is a fully-programmable block which accelerates the performance of communications-based algorithms by up to a factor of 8x over C8x alone. In addition to eliminating the need for a second processor to manage the communications link, the performance gains of the VCU provides headroom for future system growth and higher bit rates or, conversely, enables devices to operate at a lower MHz to reduce system cost and power consumption.

Refer to the device family technical reference manual for more information.

Table 19. Viterbi, Complex Math, and CRC Unit (VCU) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0/1	Original VCU Module Type (both types are equivalent)	2806x, M35x, M36x	–
2	Added instructions to improve performance in Viterbi decoding, complex arithmetic instructions, complex FFT, AES encryption and decryption. Added instructions for direct register access between VCU and C28x. Added Interrupt to PIE.	2807x, 2837xD, 2837xS	–

3.1.4   Trigonometric Math Unit (TMU)

The Trigonometric Math Unit (TMU) is an accelerator that extends the capabilities of the C28x+FPU specifically designed to speed up the execution of common trigonometric and arithmetic operations.

Refer to the device family technical reference manual for more information.

Table 20 lists the differences between TMU types, including device-specific differences within each type.

Table 20. Trigonometric Math Unit (TMU) Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original TMU Module Type	2807x, 2837xD, 2837xS	–

3.2 System Peripherals

The following sections describe the system peripherals.

3.2.1 Boot ROM

The device-specific Boot ROM guides are:
- *TMS320x281x Boot ROM Reference Guide* (SPRU095)
- *TMS320x280x, 2801x, 2804x DSP Boot ROM Reference Guide* (SPRU722)
- *TMS320x2833x, 2823x Boot ROM Reference Guide* (SPRU963)
- *TMS320x2834x Delfino Boot ROM Reference Guide* (SPRUFN5)
- *TMS320x2802x Piccolo Boot ROM Reference Guide* (SPRUFN6)
- *TMS320x2803x Piccolo Boot ROM Reference Guide*(SPRUGO0)

For devices not listed above, refer to the device-specific technical reference manual.

The boot ROM is factory-programmable with bootloading software. Boot-mode signals (general-purpose I/Os) are used to tell the bootloader software which mode to use. The Boot ROM also contains standard math tables such as SIN/COS for use in IQ math related algorithms.

3.2.2 Direct Memory Access (DMA)

The Direct Memory Access (DMA) module provides a hardware method of transferring data between peripherals and/or memory without intervention from the CPU, thereby freeing up bandwidth for other system functions. Additionally, the DMA has the capability to orthogonally rearrange the data as it is transferred as well as "ping-pong" data between buffers. These features are useful for structuring data into blocks for optimal CPU processing.

The DMA guide is:
- *TMS320x2833x, 2823x Direct Memory Access (DMA) Module Reference Guide* (SPRUFB8)
- *TMS320x2834x Delfino Direct Memory Access (DMA) Module Reference Guide* (SPRUG78)

For devices not listed above, refer to the device-specific technical reference manual.

Table 21 lists the differences between DMA types, including device-specific differences within each type.

Table 21. Direct Memory Access (DMA) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original DMA Module Type	2834x	DMA does not interface to ePWM
		2823x, 2833x, M35x, M36x	Added interface to ADC and ePWM
		2806x	Added interface to USB
		2807x, 2837xS, 2837xD	Added interface to SPI and SDFM. Modified Peripheral Interrupt Event Trigger configuration registers.

3.2.3 External Memory Interface (EMIF)

The External Memory Interface (EMIF) is a data port that provides ease and flexibility when connecting to a variety of external devices including SDR SDRAM and asynchronous devices. EMIF is compliant with JESD21-C memories utilizing 32-bit or 16-bit data buses.

Refer to the device-specific technical reference manual for more information.

Table 22 lists the differences between EMIF types, including device specific differences within each type.

Table 22. External Memory Interface (EMIF) Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original EMIF Module Type	2807x, 2837xD, 2837xS	–

3.2.4 External Peripheral Interface (EPI)

The External Peripheral Interface (EPI) is a high speed parallel interface to external peripherals or memories. The EPI supports µDMA access, clocking control, 8/16/32 bit dedicated parallel bus, blocking and non-blocking reads, and three functional modes: Synchronous Dynamic Random Access Memory (SDRAM), Host-bus, and General Purpose.

Refer to the device-specific technical reference manual for more information.

Table 23 lists the differences between EPI types, including device-specific differences within each type.

Table 23. External Peripheral Interface (EPI) Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original EPI Module Type	M35x, M36x	–

3.2.5 Event Manager (EV) Module

The Event Manager (EV) module includes general-purpose timers, full-compare/pulse-width modulation (PWM) units, capture inputs (CAP) and quadrature-encoder pulse (QEP) circuits. Two such event managers are provided, which enable two three-phase motors to be driven or four two-phase motors. The event managers on the F281x are compatible to the event managers on the 240x devices (with some minor enhancements).

The EV guide is:
- *TMS320x281x Event Manager Reference Guide* (SPRU065)

For devices not listed above, refer to the device-specific technical reference manual.

Table 24 lists the differences between EV types, including device-specific differences within each type.

Table 24. Event Manager (EV) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original EV Module Type	281x	–

3.2.6 External Interface (XINTF) Module

The External Interface (XINTF) guides are:
- *TMS320x281x External Interface (XINTF) Reference Guide* (SPRU067)
- *TMS320F2833x, 2823x External Interface (XINTF) Reference Guide* (SPRU949)
- *TMS320x2834x Delfino External Interface (XINTF) Reference Guide* (SPRUFN4)

For devices not listed above, refer to the device-specific technical reference manual.

The external interface (XINTF) is an asynchronous bus that is used to interface to external devices and memory.

Table 25 lists the differences between XINTF types, including device-specific differences within each type.

Table 25. External Interface (XINTF) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	External Interface with x16 Data Bus	281x	–
1	External Interface with x16 or x32 Data Bus	2823x, 2833x, 2834x	–

3.2.7 Hardware Built-in Self-Test (HWBIST) Module

The Hardware Built-in Self-Test (HWBIST) module is capable of testing the CPU, VCU, FPU, and TMU for defective circuitry. The library routine can be executed whenever convenient in an application to detect if the circuitry is defective or damaged, and allow the system code to manage the fault condition in a controlled manner. This module produces coverage up to 99%. The execution of this routine can be adjusted to meet performance and latency requirements within the system.

Table 26 lists the differences between HWBIST types, including device-specific differences within each type.

Table 26. Hardware Built-in Self-Test Module (HWBIST) Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original HWBIST Module Type	M35x, M36x	–

3.2.8 System Control and Interrupts

The device-specific guides are:
- *TMS320x281x System Control and Interrupts Reference Guide* (SPRU078)
- *TMS320x280x, 2801x, and 2804x System Control and Interrupts Reference Guide* (SPRU712)
- *TMS320x2833x System Control and Interrupts Reference Guide* (SPRUFB0)
- *TMS320x2834x Delfino System Control and Interrupts Reference Guide* (SPRUFN1)
- *TMS320x2802x Piccolo System Control and Interrupts Reference Guide* (SPRUFN3)
- *TMS320x2803x Piccolo System Control and Interrupts Reference Guide* (SPRUGL8)

For devices not listed above, refer to the device-specific technical reference manual.

These guides include information on the following modules:
- Memory, including Flash and OTP configuration
- Code security module (CSM)
- Clocking and low-power modes
- 32-bit CPU-Timers
- Watchdog Timer
- General-purpose inputs/outputs (GPIO)
- Peripheral frames
- Peripheral interrupt expansion (PIE)
- Low-power modes
- External Interrupts

3.2.9 Micro Cyclic Redundancy Check Module (uCRC)

The Micro Cyclic Redundancy Check Module (uCRC) can be used to compute CRC on data and program data in specified memory locations. The uCRC supports the CRC8, CRC16-1, CRC16-2, CRC32 polynomials.

Refer to the device-specific technical reference manual for more information.

Table 27 lists the differences between uCRC types, including device-specific differences within each type.

Table 27. Micro Cyclic Redundancy Check Module (µCRC) Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original µCRC Module Type	M35x, M36x	–

3.3 Control Peripherals

The following sections describe the Control peripherals.

3.3.1 ADC Modules

This section describes the ADC modules.

- *TMS320x281x Analog-to-Digital Converter (ADC) Reference Guide* ([SPRU060](#))
- *TMS320x280x 2801x, 2804x Analog-to-Digital Converter (ADC) Module Reference Guide* ([SPRU716](#))
- *TMS320x2833x, 2823x Analog-to-Digital Controller (ADC) Module Reference Guide* ([SPRU812](#))
- *TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator Reference Guide* ([SPRUGE5](#))

For devices not listed above, refer to the device-specific technical reference manual.

3.3.1.1 Analog-to-digital Converter (ADC) Module

The Analog-to-digital Converter (ADC) module samples an analog signal and converts it to a digital value for use in an application.

Table 28. Analog-to-Digital Converter (ADC) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original ADC Module Type. Fixed reference range of 0V to 3.0V. 12-bit pipelined architecture.	281x	–
1	Added Offset Trim and Reference Select registers	280x, 2801x, 2804x	–
2	Added Internal/External Trim registers(OTP trim)	2823x, 2833x	–
3	Fixed internal reference range from 0V to 3.3V or ratiometric external reference. 12-bit hybrid pipeline/SAR architecture	2802x, 2803x, 2805x, 2806x, M35x, M36x	–
4	12-bit or 16-bit SAR architecture. Ratiometric external reference. Single-ended or differential inputs. Trimmed for gain, offset, and linearity.	2807x, 2837xD, 2837xS	–

3.3.1.2 Analog-to-digital Converter Wrapper

The Analog-to-digital Converter wrapper provides control and sequencing of the ADC.

Table 29. Analog-to-Digital Converter Wrapper Module Type Descriptions

Type	Description	Devices Covered	Device-Specific Options
0	Original ADC wrapper type. Dual 8-channel sequencer architecture.	281x, 280x, 2801x, 2804x, 2823x, 2833x	–
1	Start-of conversion (SOC) x16 architecture.	2802x, 2803x, 2805x, 2806x	–
2	Modified Type 1 accessed through ACIB	M35x, M36x	–
3	Modified Type 1. Added burst mode, integrated post-processing blocks	2807x, 2837xD, 2837xS	–

3.3.2 Comparator (COMP) Module

The Comparator (COMP) module is built around an analog voltage comparator with a digital output that can signal the on-chip ePWM modules when a trip condition is detected. The positive input of the comparator is sourced directly from a device pin. The negative input of the comparator is sourced by a programmable, full-scale internal reference DAC.

The device-specific comparator guides are:

* *TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator Reference Guide* (SPRUGE5)

For devices not listed above, refer to the device-specific technical reference manual.

Table 30 lists the differences between comparator types, including device-specific differences within each type.

Table 30. Comparator (COMP) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original Comparator module. Internal reference DAC has 10-bit resolution. Qualification stage for glitch filtering. Ramp generator logic.	2802x, 2803x, 2806x M35x, M36x	–
1	Internal reference DAC has 6-bit resolution. Digital filter stage for glitch filtering. No ramp generator logic.	2805x	–

3.3.3 Comparator Subsystem (CMPSS)

The Comparator Subsystem (CMPSS) consists of analog comparators and supporting components that are combined into a topology that is useful for power applications such as peak current mode control, switched-mode power, power factor correction and voltage trip monitoring. Each CMPSS module includes two analog comparators, two programmable 12-bit DACs, one ramp generator, and two digital filters. CMPSS has the ability to synchronize with PWMSYNC signals.

Table 31. Comparator Subsystem (CMPSS) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original CMPSS Module Type	F2807x, F2837xD, F2837xS	–

3.3.4 Digital-to-Analog Converter (DAC) Module

The buffered digital-to-analog converter (DAC) is able to output arbitrary DC voltages to the device pins.

Table 32 lists the differences between DAC types, including device-specific differences within each type.

Table 32. Digital-to-Analog Converter (DAC) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original DAC module. 6-bit programmable range	2805x	–
1	12-bit programmable range	2807x, 2837xD, 2837xS	–

3.3.5 Enhanced Capture (eCAP) Module

The eCAP guides are:

- *TMS320x280x, 2801x, 2804x Enhanced Capture (eCAP) Module Reference Guide* (SPRU807)
- *TMS320x2833x, 2823x Enhanced Capture (eCAP) Module Reference Guide* (SPRUFG4)
- *TMS320x2834x Delfino Enhanced Capture (eCAP) Module Reference Guide* (SPRUG79)
- *TMS320x2802x, 2803x Piccolo Enhanced Capture (eCAP) Module Reference Guide* (SPRUFZ8)

For devices not listed above, refer to the device-specific technical reference manual.

The eCAP Module is essential in systems where accurate timing of external events is important.

Uses for eCAP include:

- Speed measurements of rotating machinery (for example, toothed sprockets sensed via Hall sensors)
- Elapsed time measurements between position sensor triggers
- Period and duty cycle measurements of pulse train signals
- Decoding current or voltage amplitude derived from duty cycle encoded current/voltage sensors

Table 33 lists the differences between eCAP types, including device-specific differences within each type.

Table 33. Enhanced Capture (eCAP) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original ECAP Module Type	280x, 2801x, 2804x	eCAP 1 SYNCIN is fed from the ePWM module. Then all other eCAP modules have their SYNCINs fed from the eCAP module numerically preceding them.
		2802x, 2803x, 2805x, 2806x, 2807x, 2823x, 2833x, 2834x, 2837xD, 2837xS, M35x, M36x	eCAP 1 SYNCIN and eCAP4 SYNCIN are fed from the ePWM module. Then eCAP 2,3, 5, and 6 SYNCINs are fed from the eCAP modules numerically preceding them.

3.3.6 Enhanced Pulse Width Modulator (ePWM) Module

The ePWM guides include:

- *TMS320x280x, 2801x, 2804x Enhanced Pulse Width Modulator (ePWM) Module Reference Guide* (SPRU791)
- *TMS320x2833x, 2823x Enhanced Pulse Width Modulator (ePWM) Module Reference Guide* (SPRUG04)
- *TMS320x2834x Delfino Enhanced Pulse Width Modulator (ePWM) Module Reference Guide* (SPRUFZ6)
- *TMS320x2802x, 2803x Piccolo Enhanced Pulse Width Modulator (ePWM) Module Reference Guide* (SPRUGE9)

For devices not listed above, refer to the device-specific technical reference manual.

The enhanced pulse width modulator (ePWM) peripheral controls many of the power-related systems found in both commercial and industrial equipments. The main systems include digital motor control, switch mode power supply control, uninterruptible power supplies (UPS), and other forms of power conversion. The PWM peripheral performs a DAC function, where the duty cycle is equivalent to a DAC analog value; it is sometimes referred to as a Power DAC.

Table 34 lists the differences between ePWM types, including device-specific differences within each type.

Table 34. Enhanced Pulse Width Modulator (ePWM) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original EPWM Module Type	280x[1], 2801x	Time-base synchronization scheme 1: ePWM1 SYNC out is fed to eCAP1 and ePWM2. All other ePWM modules have their SYNCIN signals fed from the ePWM module numerically preceding them.
		2804x, 2809	Time-base synchronization scheme 2: Two ePWM pinouts are possible: A-channel only or 280x compatible. If the ePWM pinout is configured for A-channel only mode, ePWM1 SYNC out is fed to eCAP1, ePWM2, ePWM5, ePWM9, and ePWM13. All other ePWM modules have their SYNCIN signals fed from the ePWM module numerically preceding them. If the ePWM pinout is configured for 280x-compatible mode, synchronization scheme 1 is used.
		2823x, 2833x, 28234x	Time-base synchronization scheme 3: ePWM1 SYNC out is fed to eCAP1, ePWM2, and ePWM4. All other ePWM modules have their SYNCINs fed from the ePWM module numerically preceding them.
1	Doubled deadband resolution, interrupts and ADC SOC can be generated on both CTR = 0 or CTR = PRD, added digital compare submodule, added hooks for high-resolution period	2802x, 2803x, 2805x, 2806x	–
2	Expanded Register set, added High Resolution to Dead-band RED and FED, added Dead-band generator module enhancements, added HRPWM capability to ePWMxB channels, added enhancements to Counter Compare Module, Event Trigger Module, and Digital Compare Module. Supports Simultaneous writes to TBPRD and CMPx Registers, added Shadow to Active Load on SYNC of TBPRD and CMP registers.	M35x, M36x	–
3	This type is not used.	–	–
4	Remapped address space for ease of use, Added Delayed Trip functionality, Dead-band Generator Module enhancements, One shot and Global reload of Registers, Trip Zone Module Enhancements, and PWM SYNC related enhancements.	2807x, 2837xD, 2837xS	–

[1] The time-base synchronization scheme 1 is not available in the TMS320F2809 part.

3.3.7   Enhanced Quadrature Encoder Pulse (eQEP) Module

The eQEP module guides include:

- *TMS320x280x, 2801x, 2804x Enhanced Quadrature Encoder Pule (eQEP) Module Reference Guide* (SPRU790)
- *TMS320F2833x, 2823x Enhanced Quadrature Encoder Pulse (eQEP) Module Reference Guide* (SPRUG05)
- *TMS320x2834x Delfino Enhanced Quadrature Encoder Pulse (eQEP) Module Reference Guide* (SPRUG74)
- *TMS320x2803x Piccolo Enhanced Quadrature Encoder Pulse (eQEP) Module Reference Guide* SPRUFK8)

For devices not listed above, refer to the device-specific technical reference manual.

The enhanced quadrature encoder pulse (eQEP) module is used for direct interface with a linear or rotary incremental encoder to get position, direction, and speed information from a rotating machine for use in a high-performance motion and position-control system.

Table 35 lists the differences between eQEP types, including device-specific differences within each type.

Table 35. Enhanced Quadrature Encoder Pulse (eQEP) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original eQEP Module Type	280x, 2803x, 2804x, 2805x, 2806x, 2807x, 2823x, 2833x, 2834x, 2837xS, 2837xD, M35x, M36x	–

3.3.8   High-Resolution Capture (HRCAP) Module

The high-resolution capture (HRCAP) module captures the width of pulses with a typical resolution of hundreds of picoseconds and performs both conventional and high-resolution delta time measurements.

Uses for the HRCAP include:

- Capacitive touch applications
- High-resolution period and duty cycle measurements of pulse train cycles
- Instantaneous speed measurements
- Instantaneous frequency measurements
- Voltage measurements across an isolation boundary
- Distance/sonar measurement and scanning

Refer to the device-specific technical reference manual for more information.

Table 36. High-Resolution Capture (HRCAP) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original HRCAP Module Type	2803x, 2806x	–

3.3.9 High-Resolution Pulse Width Modulator (HRPWM) Module

The HRPWM guides are:

- *TMS320x280x, 2801x, 2804x High-Resolution Pulse Width Modulator (HRPWM) Module Reference Guide* (SPRU924)
- *TMS320x2833x, 2823x High Resolution Pulse Width Modulator (HRPWM) Reference Guide* (SPRUG02)
- *TMS320x2834x Delfino High Resolution Pulse Width Modulator (HRPWM) Reference Guide* (SPRUG77)
- *TMS320x2802x, 2803x Piccolo High Resolution Pulse Width Modulator (HRPWM) Reference Guide* (SPRUGE8)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

This document is used in conjunction with the device-specific *Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*.

The HRPWM module extends the time resolution capabilities of the conventionally derived digital pulse width modulator (PWM). HRPWM is typically used when PWM resolution falls below ~ 9-10 bits.

Table 37 lists the differences between HRPWM types, including device-specific differences within each type.

Table 37. High-Resolution Pulse Width Modulator (HRPWM) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original HRPWM Module Type	280x, 2801x, 2804x, 2823x, 2833x, 2834x	–
1	Added high-resolution period support, added option to select high-resolution B output, added automatic micro-step conversion	2802x, 2803x, 2806x	–
2	Added independent high-resolution control on B-channel output, added dead band control for falling and rising edge delay, added additional delay lines per ePWM module, added SYNC pulse timings.	M35x, M36x	–
3	This type is not used.	–	–
4	Remapped address space. Added global shadow-to-active reload. Added one-shot shadow-to-active reload.	2807x, 2837xD, 2837xS	–

3.3.10 InstaSPIN™ Solutions

InstaSPIN^{TM} three-phase motor solutions make designing motor control applications easier whether you have a simple application or a complex design.

3.3.10.1 InstaSPIN-FOC ™

The device-specific InstaSPIN-FOC™ technical reference manuals are

- *TMS320F2802xF InstaSPIN-FOC™ Technical Reference Manual* (SPRUHP4)
- *TMS320F2806xF InstaSPIN-FOC™ Technical Reference Manual* (SPRUHI9A)

InstaSPIN-FOC is a three-phase motor field-oriented torque control solution which can identify, tune the torque controller, and efficiently control your motor in minutes, without the use of any mechanical rotor sensors. It includes the Flux Angle Speed Torque (FAST™) estimator and additional motor control functions needed for cascaded speed and torque loops for efficient three-phase field-oriented motor control. InstaSPIN-FOC is made available in ROM with user callable APIs. The user also has the option of executing all FOC functions in user memory (FLASH or RAM), which then makes calls to the proprietary FAST estimator firmware in ROM.

3.3.10.2 InstaSPIN-MOTION™

The device-specific InstaSPIN-MOTION™ TRMs are:

F2806xM InstaSPIN-MOTION™ Technical Reference Manual (SPRUHJ0)

InstaSPIN-MOTION is the first offering from Texas Instruments to combine TI 32-bit C2000™ Piccolo™ microcontrollers with comprehensive motor-, motion-, speed-, and position-control software. InstaSPIN-MOTION delivers robust velocity and position control at the highest efficiency for motor applications that operate in various motion state transitions. InstaSPIN-MOTION is a sensorless or sensored field-oriented motor control (FOC) solution that can identify, tune, and control your motor in minutes. InstaSPIN-MOTION features the FAST™ premium software sensor and the SpinTAC™ Motion controller.

Table 38. InstaSPIN-MOTION Module Type Description

Module Type	Description	Devices	Device-Specific Options
InstaSPIN-FOC	Original InstaSPIN-FOC ROM	28062F, 28068F, 28069F	1 or 2 motors
		28026F, 28027F	1 motor
InstaSPIN-MOTION	Original InstaSPIN-MOTION ROM	28068M, 28069M	–

3.3.11 Programmable Gain Amplifier (PGA) Module

The programmable gain amplifier (PGA) is designed to buffer and amplify small input signals into an output range that is better suited for the on-chip ADC and Comparator modules.

Table 39. Programmable Gain Amplifier (PGA) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original PGA module	2805x	–

3.3.12 Sigma Delta Filter Module (SDFM)

The Sigma Delta Filter Module (SDFM) is a four-channel digital filter designed for current measurement and resolver position decoding. The SDFM supports 16-bit or 32-bit filter data, four configurable modulator modes, four independent configurable comparator units, and four independent configurable sinc filter units.

Refer to the device-specific technical reference manual for more information.

Table 40 lists the differences between SDFM types, including device-specific differences within each type.

Table 40. Sigma Delta Filter (SDFM) Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original SDFM Module Type	2807x, 2837xD, 2837xS	–

3.4 Communication Peripherals

The communications peripherals are described in the following sections.

3.4.1 Controller Area Network Module (DCAN)

The Controller Area Network (DCAN) module is a serial communications protocol that supports real-time control with a high level of security. This module conforms to the DCAN 2.0A/B specification. DCAN supports bit rates up to 1 Mbits/s, programmable FIFO, parity checking, individual identifier masks, and interrupts. This module is similar to the Cortex M3 DCAN module.

Note: This DCAN is not software compatible with the C28x eCAN module.

Refer to the device-specific technical reference manual for more information.

Table 41 lists the differences between DCAN types, including device-specific differences within each type.

Table 41. DCAN Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original DCAN Design. Not Software compatible with eCAN	2807x, 2837xD, 2837xS, M35x, M36x	–

3.4.2 Enhanced Controller Area Network (eCAN) Module

This is the enhanced version of the CAN peripheral. It supports 32 mailboxes, time stamping of messages, and is DCAN 2.0B-compliant.

The eCAN guides are:

- *TMS320x281x DSP Enhanced Controller Area Network (eCAN) Reference Guide* (SPRU074)
- *TMS320x280x, 2801x DSP Enhanced Controller Area Network (eCAN) Reference Guide* (SPRUEU0)
- *TMS320x2833x/2823x DSP Enhanced Controller Area Network (eCAN) Reference Guide* (SPRUEU1)
- *TMS320x2834x Delfino Enhanced Controller Area Network (eCAN) Reference Guide* (SPRUEU4)
- *TMS320x2803x Piccolo Enhanced Controller Area Network (eCAN) Reference Guide* (SPRUGL7)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

Table 42 lists the differences between eCAN types, including device-specific differences within each type.

Note: The eCAN module is not software-compatible with the CAN module.

Table 42. Enhanced Controller Area Network (eCAN) Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original eCAN Module Type	280x, 281x, 28016	CAN module clock = SYSCLK
		2803x, 2805x, 2806x, 2823x, 2833x	CAN module clock = SYSCLK/2
		2834x	CAN module clock = SYSCLK/4

3.4.3   Ethernet Media Access Controller (EMAC) Module

The Ethernet Media Access Controller (EMAC) conforms to the IEEE 802.3- 2002 specifications and fully supports 10BASE-T and 100BASE-TX standards. It is supports data rates of 10/100Mbps, CRC error-rejection control, user-configurable interrupts, and efficient transfers using the Micro Direct Memory Access Controller.

Refer to the device-specific technical reference manual for more information.

Table 43 lists the differences between EMAC types, including device-specific differences within each type.

Table 43. EMAC Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original EMAC Module Type	M35x, M36x	–

3.4.4   C28x Inter-Integrated Circuit (I2C) Module

The C28x I2C guides include:
- *TMS320x280x, 2801x, 2804x Inter-Integrated Circuit (I2C) Module Reference Guide* (SPRU721)
- *TMS320x2833x, x2823x Inter-Integrated Circuit (I2C) Module Reference Guide* (SPRUG03)
- *TMS320x2834x Delfino Inter-Integrated Circuit (I2C) Module Reference Guide* (SPRUG76)
- *TMS320x2802x, 2803x Piccolo Inter-Integrated Circuit (I2C) Module Reference Guide* (SPRUFZ9)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

This guide describes the features and operation of the C28x Inter-Integrated circuit (I2C) module. The C28x I2C module provides an interface between one of these DSPs and devices compliant with Philips Semiconductors Inter-IC bus (I2C-bus) specification version 2.1 and connected by way of an I2C-bus. External components attached to this 2-wire serial bus can transmit/receive 1- to 8-bit data to/from the DSP through the I2C module. This guide assumes the reader is familiar with the I2C-bus specification.

Table 44 lists the differences between C28x I2C types, including device-specific differences within each type.

Table 44. C28x Inter-Integrated Circuit (I2C) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original C28x I2C Module Type. Not software compatible with M3 I2C.	280x, 2801x, 2804x, 2807x, 2823x, 2833x, 2834x, 2837xD, 2837xS, M35x, M36x	16-level FIFO
		2802x, 2803x, 2806x	4-level FIFO

3.4.5   M3 Inter-Intergrated Circuit (I2C) Module Type Description

This guide describes the features and operation of the M3 Inter-Integrated circuit (I2C) module. The M3 I2C module provides an interface between one of these DSPs and devices compliant with Philips Semiconductors Inter-IC bus (I2C-bus) specification version 2.1 and connected by way of an I2C-bus. External components attached to this 2-wire serial bus can transmit/receive 1- to 8-bit data to/from the DSP through the I2C module. This guide assumes the reader is familiar with the I2C-bus specification.

Refer to the device-specific technical reference manual for more information.

Table 45 lists the differences between M3 I2C types, including device specific differences within each type.

Table 45. M3 Inter-Integrated Circuit (I2C) Type Differences

Module Type	Description	Devices Covered	Device-Specific Options
0	Original M3 I2C Module Type. Not software compatible with C28x I2C.	M35x, M36x	–

3.4.6 Local Interconnect Network (LIN) Module

The LIN module provides a serial communications structure at a hardware and software level. It provides a low-cost solution where the bandwidth and fault tolerance of a communications area network (CAN) are not required. The C28x LIN module is compatible to the LIN1.3 and 2.0 protocols. It is based on a C28x Type 0 SCI module with the addition of an error detector, a mask filter, a synchronizer, and a multi-buffered receiver and transmitter.

The LIN guide is:

- *TMS320x2803x Piccolo Local Interconnect Network (LIN) Module Reference Guide* (SPRUGE2)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

Table 46. Local Interconnect Network (LIN) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original LIN Module Type	2803x	–

3.4.7 Multichannel Buffered Serial Port (McBSP) Module

The device-specific McBSP guides are:
- *TMS320x281x Multichannel Buffered Serial Port (McBSP) Reference Guide* (SPRU061)
- *TMS320x2833x Multichannel Buffered Serial Port (McBSP) Reference Guide* (SPRUFB7)
- *TMS320x2834x Delfino Multichannel Buffered Serial Port (McBSP) Reference Guide* (SPRUG80)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

The McBSP is used to connect to E1/T1 lines, phone-quality codecs for modem applications or high-quality stereo-quality Audio DAC devices. The McBSP receive and transmit registers are supported by a 16-level FIFO. This significantly reduces the overhead for servicing this peripheral.

Table 47 lists the differences between McBSP types, including device-specific differences within each type.

Table 47. Multichannel Buffered Serial Port (McBSP) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original McBSP Module Type	281x	–
1	Removed FIFO to allow interconnect with DMA module. Removed FIFO-related registers (MFFTX, MFFRX, MFFCT, MFFST)	2806x, 2807x, 2823x, 2833x, 2834x, 2837xD, 2837xS, M35x, M36x	–

3.4.8 Serial Communications Interface (SCI) Module

The SCI is a two-wire asynchronous serial port, commonly known as UART. The SCI supports a receive and transmit FIFO for reducing servicing overhead.

The SCI guides are:
- *TMS320x281x Serial Communications Interface (SCI) Reference Guide* (SPRU051)
- *TMS320x280x, 2801x, 28044 Serial Communications Interface (SCI) Reference Guide* (SPRUFK7)
- *TMS320x2833x, 2823x Serial Communications Interface (SCI) Reference Guide* (SPRUFZ5)
- *TMS320x2834x Delfino Serial Communications Interface (SCI) Reference Guide* (SPRUG75)
- *TMS320x2802x, 2803x Piccolo Serial Communications Interface (SCI) Reference Guide* (SPRUGH1)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

Table 48 lists the differences between SCI types, including device-specific differences within each type.

Table 48. Serial Communications Interface (SCI) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original SCI Module Type	280x, 281x, 2801x, 2804x, 2807x, 2823x, 2833x, 2834x, 2837xD, 2837xS, M35x, M36x	16-level FIFO
		2802x, 2803x, 2805x, 2806x	4-level FIFO

3.4.9 Serial Peripheral Interface (SPI) Module

The SPI 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. Normally, the SPI is used for communications between the DSP controller and external peripherals or another processor. Typical applications include external I/O or peripheral expansion through devices such as shift registers, display drivers, and ADCs. Multi-device communications are supported by the master/slave operation of the SPI. The port supports a receive and transmit FIFO for reducing servicing overhead.

The SPI guide is:

- *TMS320x281x Serial Peripheral Interface (SPI) Reference Guide* (SPRU059)
- *TMS320x280, 2801x, 2804x Serial Peripheral Interface (SPI) Reference Guide* (SPRUG72)
- *TMS320x2833x, 2823x Serial Peripheral Interface (SPI) Reference Guide* (SPRUEU3)
- *TMS320x2834x Delfino Serial Peripheral Interface (SPI) Reference Guide* (SPRUG73)
- *TMS320x2802x, 2803x Piccolo Serial Peripheral Interface (SPI) Reference Guide* (SPRUG71)

For devices not listed above, refer to the device-specific technical reference manual (TRM).

Table 49 lists the differences between SPI types, including device-specific differences within each type.

Table 49. Serial Peripheral Interface (SPI) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original SPI Module Type	280x, 281x, 2801x, 2804x, 2823x, 2833x, 2834x	–
1	Added support for 3-wire bidirectional mode and reduced to 4-level FIFO	2802x	No STEINV bit
		2803x, 2805x, 2806x, M35x, M36x	Added STEINV bit (inverts SPISTE signal to support digital audio receive mode with 2 SPIs)
2	Type 1 with STEINV. Added high-speed mode. Added DMA support; increased to 16-bit FIFO.	2807x, 2837xD, 2837xS	–

3.4.10 Synchronous Serial Interface (SSI) Module

The Synchronous Serial Interface (SSI) is a synchronous serial I/O port that supports communication with peripheral devices that have Texas Instruments Synchronous Serial Interfaces, SPI, or Freescale serial formats. This module supports master or slave operation, programmable clock bit rates, 16-bit and 8-deep transmit and receive FIFOs, interrupts, and µDMA access.

Refer to the device-specific technical reference manual for more information.

Table 50 lists the differences between SSI types, including device-specific differences within each type.

Table 50. Synchronous Serial Interface (SSI) Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original SSI Module Type	M35x, M36x	–

3.4.11 Universal Asynchronous Receiver/Transmitter (UART) Module

The Universal Asynchronous Receiver/Transmitter (UART) is a serial communication port that supports programmable baud-rate generation, 16/8 TX and RX FIFOS, serial-to-parallel and parallel-to-serial conversions, µDMA access, and interrupts.

Refer to the device-specific technical reference manual for more information.

Table 51 lists the differences between UART types, including device-specific differences within each type.

Table 51. Universal Asynchronous Receiver/Transmitter (UART) Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original UART Module Type	M35x, M36x	–

3.4.12 Universal Parallel Port (uPP) Module

The Universal Parallel Port (uPP) is a high-speed parallel interface with dedicated data lines and minimal control signals. The uPP is designed to interface with high-speed ADCs, DACs, FPGAs, or other uPP devices. The supports single channel 8-bit input or output as well as 50MHz SDR and 25MHZ DDR interface clock frequencies.

Refer to the device-specific technical reference manual for more information.

Table 52 lists the differences between uPP types, including device specific differences within each type.

Table 52. Universal Parallel Port (uPP) Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original uPP Module Type	2807x, 2837xD, 2837xS	–

3.4.13 Universal Serial Bus (USB) Module

The Universal Serial Port (USB) is a USB 2.0 compliant USB Controller and PHY. The USB supports full speed operation as a device and both low- and full-speed in host operating modes. TI provides drivers for the USB controller as well as a protocol stack free of charge in our controlSUITE™ software package. Both the USB controller and its corresponding software package are very similar to that of the Stellaris® family of microcontrollers, so migration of USB applications between the two platforms requires minimal effort.

Refer to the device-specific technical reference manual for more information.

Table 53 lists the differences between USB types, including device specific differences within each type.

Table 53. Universal Serial Bus (USB) Module Type Description

Module Type	Description	Devices Covered	Device-Specific Options
0	Original USB Module Type	2806x[1], 2837xD, 2837xS	No USB-OTG support
		M35x, M36x	USB-OTG supported

[1]   Original USB module type is only available on devices with TMS320F2806xU, TMS320F2806xF, and TMS320F2806xM part numbers.

Revision History

Changes from May 18, 2015 to June 30, 2015 (from K Revision (May 2014) to L Revision)   **Page**

- This reference guide has implemented extensive changes. It is recommended to review the entire guide for your specific needs or inquiries……………………………………………………………………………………………… 5

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