

TMS320x28xx, 28xxx DSP Peripheral

Reference Guide



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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, TMS320x2804x, TMS320x2833x, TMS320x2834x, TMS320x2802x, and TMS320x2803x devices.

Specific device abbreviations are listed in [Table 1](#).

Table 1. Abbreviation Matrix

Family	Device ⁽¹⁾	Device Abbreviation Used	Group Abbreviation
TMS320x281x	TMS320F2810, TMS320C2810, SM320F2810-EP ⁽²⁾	2810	281x
	TMS320F2811, TMS320C2811, TMS320R2811, SM320F2811-EP ⁽²⁾	2811	
	TMS320F2812, TMS320C2812, TMS320R2812, SM320F2812-EP ⁽²⁾	2812	
TMS320x280x	TMS320F2801, TMS320C2801	2801	280x
	TMS320F2802, TMS320C2802	2802	
	TMS320F2806	2806	
	TMS320F2808, SM320F2808-EP ⁽²⁾	2808	
	TMS320F2809	2809	
TMS320x2801x	TMS320F28015	28015	2801x
	TMS320F28016	28016	
TMS320x2804x	TMS320F28044	28044	2804x
TMS320F2833x	TMS320F28335	28335	2833x
	TMS320F28334	28334	
	TMS320F28332	28332	
TMS320F2823x	TMS320F28235	28235	2823x
	TMS320F28234	28234	
	TMS320F28232	28232	

⁽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
TMS320x2834x	TMS320C28346	28346	2834x
	TMS320C28345	28345	
	TMS320C28344	28344	
	TMS320C28343	28343	
	TMS320C28342	28342	
	TMS320C28341	28342	
TMS320x2802x	TMS320F28020	28020	2802x
	TMS320F28021	28021	
	TMS320F28022	28022	
	TMS320F28023	28023	
	TMS320F28026	28026	
	TMS320F28027	28027	
TMS320x2803x	TMS320F28035	28035	2803x
	TMS320F28034	28034	
	TMS320F28033	28033	
	TMS320F28032	28032	

2 Peripherals Available Per Device

Table 2 through Table 7 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.

Table 2. TMS320x281x Peripheral Selection Guide

Peripheral	Lit. No.	Type ⁽¹⁾	2812	2811, 2810
TMS320x281x System Control and Interrupts	SPRU078	-	X	X
TMS320x281x External Interface (XINTF)	SPRU067	0	X	
TMS320x281x Enhanced Controller Area Network (eCAN)	SPRU074	0	X	X
TMS320x281x Event Manager (EV)	SPRU065	0	X	X
TMS320x281x Analog-to-Digital Converter (ADC)	SPRU060	0	X	X
TMS320x281x Multichannel Buffered Serial Port (McBSP)	SPRU061	0	X	X
TMS320x281x Serial Communications Interface (SCI)	SPRU051	0	X	X
TMS320x281x Serial Peripheral Interface (SPI)	SPRU059	0	X	X
TMS320x281x Boot ROM	SPRU095	-	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.

Table 3. TMS320x280x, TMS320x2801x Peripheral Selection Guide

Peripheral	Lit. No.	Type ⁽¹⁾	2801 2802, 2806, 2808, 2809	28016	28015
TMS320x280x, 2801x, 2804x System Control and Interrupts	SPRU712	-	X	X	X
TMS320x280x, 2801x DSP Enhanced Controller Area Network (eCAN) User's Guide	SPRU710	0	X	X	
TMS320x280x, 2801x, 2804x Analog-to-Digital Converter (ADC)	SPRU716	1	X	X	X
TMS320x280x, 2801x, 2804x Serial Communications Interface (SCI)	SPRU717	0	X	X	X
TMS320x280x, 2801x, 2804x Serial Peripheral Interface (SPI)	SPRU722	0	X	X	X
TMS320x280x, 2801x, 2804x Boot ROM	SPRU722	-	X	X	X
TMS320x280x, 2801x, 2804x Enhanced Quadrature Encoder Pulse (eQEP)	SPRU790	0	X		
TMS320x280x, 2801x, 2804x Enhanced Pulse Width Modulator Module (ePWM)	SPRU791	0	X	X	X
TMS320x280x, 2801x, 2804x Enhanced Capture (eCAP) Module	SPRU807	0	X	X	X
TMS320x280x, 2801x, 2804x Inter-Integrated Circuit (I2C)	SPRU721	0	X	X	X
TMS320x280x, 2801x, 2804x High-Resolution Pulse-Width Modulator (HRPWM)	SPRU924	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.

Table 4. TMS320x2804x Peripheral Selection Guide

Peripheral	Lit. No.	Type ⁽¹⁾	28044
TMS320x280x, 2801x, 2804x System Control and Interrupts	SPRU712	-	X
TMS320x280x, 2801x, 2804x Analog-to-Digital Converter (ADC)	SPRU716	1	X
TMS320x280x, 2801x, 2804x Serial Communications Interface (SCI)	SPRU7K7	0	X
TMS320x280x, 2801x, 2804x Serial Peripheral Interface (SPI)	SPRU7G2	0	X
TMS320x280x, 2801x, 2804x Boot ROM	SPRU722	-	X
TMS320x280x, 2801x, 2804x Enhanced Pulse Width Modulator Module (ePWM)	SPRU791	0	X
TMS320x280x, 2801x, 2804x Inter-Integrated Circuit (I2C)	SPRU721	0	X
TMS320x280x, 2801x, 2804x High-Resolution Pulse-Width Modulator (HRPWM)	SPRU924	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.

Table 5. TMS320F2833x, TMS320F2823x Peripheral Selection Guide

Peripheral	Lit. No.	Type ⁽¹⁾	28335, 28334, 28332, 28235, 28234, 28232
TMS320F2833x, 2823x System Control and Interrupts	SPRUFB0	-	X
TMS320F2833x, 2823x External Interface (XINTF)	SPRU949	1	X
TMS320F2833x, 2823x Enhanced Controller Area Network (eCAN)	SPRU7U1	0	X
TMS320F2833x, 2823x Analog-to-Digital Converter (ADC)	SPRU812	2	X
TMS320F2833x, 2823x Multichannel Buffered Serial Port (McBSP)	SPRUFB7	1	X
TMS320F2833x, 2823x Serial Communications Interface (SCI)	SPRU7Z5	0	X
TMS320F2833x, 2823x Serial Peripheral Interface (SPI)	SPRU7U3	0	X
TMS320F2833x, 2823x Boot ROM	SPRU963	-	X
TMS320F2833x, 2823x Enhanced Quadrature Encoder Pulse (eQEP)	SPRU7G5	0	X
TMS320F2833x, 2823x Enhanced Pulse Width Modulator Module (ePWM)	SPRU7G4	0	X
TMS320F2833x, 2823x Enhanced Capture (eCAP) Module	SPRU7G4	0	X
TMS320F2833x, 2823x Inter-Integrated Circuit (I2C)	SPRU7G3	0	X
TMS320F2833x, 2823x High-Resolution Pulse-Width Modulator (HRPWM)	SPRU7G2	0	X
TMS320F2833x, 2823x Direct Memory Access (DMA)	SPRUFB8	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.

Table 6. TMS320x2834x Peripheral Selection Guide

PERIPHERAL GUIDE	Lit. No.	TYPE ⁽¹⁾	28346, 28345, 28344, 28343, 28342, 28341
TMS320x2834x Delfino System Control and Interrupts	SPRUEN1	-	X
TMS320x2834x Delfino External Interface (XINTF)	SPRUEN4	1	X
TMS320x2834x Delfino Enhanced Controller Area Network (eCAN)	SPRUEN4	0	X
TMS320x2834x Delfino Multichannel Buffered Serial Port (McBSP)	SPRUG80	1	X
TMS320x2834x Delfino Serial Communications Interface (SCI)	SPRUG75	0	X
TMS320x2834x Delfino Serial Peripheral Interface (SPI)	SPRUG73	0	X
TMS320x2834x Delfino Boot ROM	SPRUEN5	-	X
TMS320x2834x Delfino Enhanced Quadrature Encoder Pulse (eQEP)	SPRUG74	0	X
TMS320x2834x Delfino Enhanced Pulse Width Modulator Module (ePWM)	SPRUENZ6	0	X
TMS320x2834x Delfino Enhanced Capture (eCAP) Module	SPRUG79	0	X
TMS320x2834x Delfino Inter-Integrated Circuit (I2C)	SPRUG76	0	X
TMS320x2834x Delfino High-Resolution Pulse-Width Modulator (HRPWM)	SPRUG77	0	X
TMS320x2834x Delfino Direct Memory Access (DMA)	SPRUG78	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 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.

Table 7. TMS320F2802x Peripheral Selection Guide

Peripheral	Lit. No.	Type ⁽¹⁾	28027, 28026, 28023, 28022	28021, 28020
TMS320x2802x Piccolo System Control and Interrupts	SPRUEN3	-	X	X
TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator	SPRUGE5	3/0 ⁽²⁾	X	X
TMS320x2802x, 2803x Piccolo Serial Communications Interface (SCI)	SPRUGH1	0	X	X
TMS320x2802x, 2803x Piccolo Serial Peripheral Interface (SPI)	SPRUG71	1	X	X
TMS320x2802x Piccolo Boot ROM	SPRUEN6	-	X	X
TMS320x2802x, 2803x Piccolo Enhanced Pulse Width Modulator Module (ePWM)	SPRUGE9	1	X	X
TMS320x2802x, 2803x Piccolo Enhanced Capture Module (eCAP)	SPRUENZ8	0	X	X
TMS320x2802x, 2803x Piccolo Inter-Integrated Circuit (I2C)	SPRUENZ9	0	X	X
TMS320x2802x, 2803x Piccolo High-Resolution Pulse-Width Modulator (HRPWM)	SPRUGE8	1	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⁾ The ADC module is Type 3 and the comparator module is Type 0. See [Section 3.5](#) for more details.

Table 8. TMS320F2803x Peripheral Selection Guide

Peripheral	Lit. No.	Type ⁽¹⁾	28035, 28033	28034, 28032
TMS320x2803x Piccolo System Control and Interrupts	SPRUGL8	-	x	x
TMS320x2803x Piccolo Enhanced Controller Area Network (eCAN)	SPRUGL7	0	x	x
TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator	SPRUGE5	3/0 ⁽²⁾	x	x
TMS320x2802x, 2803x Piccolo Serial Communications Interface (SCI)	SPRUGH1	0	x	x
TMS320x2802x, 2803x Serial Peripheral Interface (SPI)	SPRUG71	1	x	x
TMS320x2803x Piccolo Boot ROM	SPRUGQ0	-	x	x
TMS320x2803x Piccolo Enhanced Quadrature Encoder Pulse (eQEP)	SPRUJF8	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⁾ The ADC module is Type 3 and the comparator module is Type 0.

Table 8. TMS320F2803x Peripheral Selection Guide (continued)

Peripheral	Lit. No.	Type ⁽¹⁾	28035, 28033	28034, 28032
TMS320x2802x, 2803x Piccolo Enhanced Pulse Width Modulator (ePWM)	SPRUGE9	1	x	x
TMS320x2802x, 2803x Piccolo Enhanced Capture Module (eCAP)	SPRUZF8	0	x	x
TMS320x2802x, 2803x Piccolo Inter-Integrated Circuit (I2C)	SPRUZF9	0	x	x
TMS320x2802x, 2803x High-Resolution Pulse-Width Modulator (HRPWM)	SPRUGE8	1	x	x
TMS320x2803x Piccolo Control Law Accelerator (CLA)	SPRUGE6	0	x	
TMS320x2803x Piccolo Local Interconnect Network (LIN)	SPRUGE2	0	x	x

3 Peripheral Descriptions

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

3.1 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](#))

These guides include information on the following modules:

- **Memory, including Flash and OTP configuration**
- **Code security module (CSM)**
Security is defined with respect to the access of the on-chip program memory and prevents unauthorized copying of proprietary code. The code security module (CSM) blocks access to several on-chip program memory blocks.
- **Clocking and Low-Power Modes**
The clocks to each individual peripheral can be enabled/disabled so as to reduce power consumption when a peripheral is not in use. Additionally, the system clock to the serial ports and the event managers, CAP and QEP blocks can be scaled relative to the CPU clock. This enables the timing of peripherals to be decoupled from increasing CPU clock speeds.
- **32-bit CPU-Timers**
CPU-Timers 0, 1, and 2 are identical 32-bit timers with presetable periods and with 16-bit clock prescaling. The timers have a 32-bit count down register, which generates an interrupt when the counter reaches zero. The counter is decremented at the CPU clock speed divided by the prescale value setting. When the counter reaches zero, it is automatically reloaded with a 32-bit period value. CPU-Timers 1 and 2 are reserved for Real-Time OS (RTOS) applications. CPU-Timer 2 is connected to INT14 of the CPU. CPU-Timer 1 can be connected to INT13 of the CPU. CPU-Timer 0 is for general use and is connected to the PIE block.
- **Watchdog Timer**
The 28x devices support a watchdog timer. The user software must regularly reset the watchdog counter within a certain time frame; otherwise, the watchdog generates a reset to the processor. The watchdog can be disabled if necessary.
- **General-purpose inputs/outputs (GPIO)**
Most of the peripheral signals are multiplexed with general-purpose I/O (GPIO) signals. This enables you to use a pin as GPIO if the peripheral signal or function is not used. On reset, all GPIO pins are configured as inputs. You can then individually program each pin for GPIO mode or peripheral signal mode. For specific inputs, you can also select the number of input qualification cycles to filter unwanted noise glitches.

- **Peripheral frames**

The 28x devices contain three peripheral register spaces. Some registers within these frames can be protected from CPU writes by the EALLOW protection mechanism.

- **Peripheral interrupt expansion (PIE)**

The PIE block multiplexes numerous interrupt sources into a smaller set of interrupt inputs. The interrupts are grouped into blocks of eight and each group is fed into one of 12 CPU interrupt lines (INT1 to INT12). Each of the 96 interrupts is supported by its own vector stored in a dedicated RAM block that can be overwritten by the user. The vector is automatically fetched by the CPU on servicing the interrupt. It takes nine CPU clock cycles to fetch the vector and save critical CPU registers. Therefore, the CPU can respond quickly to interrupt events. Prioritization of interrupts is controlled in hardware and software. Each individual interrupt can be enabled/disabled within the PIE block.

- **External Interrupts**

3.2 External Interface (XINTF)

The 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](#))

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

[Table 9](#) lists the differences between XINTF types, including device-specific differences within each type.

Table 9. External Interface (XINTF) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	External Interface with x16 Data Bus	2810, 2811, 2812	-
1	External Interface with x16 or x32 Data Bus	28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	-

3.3 Enhanced Controller Area Network (eCAN)

This is the enhanced version of the CAN peripheral. It supports 32 mailboxes, time stamping of messages, and is CAN 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](#))

[Table 10](#) lists the differences between eCAN types, including device-specific differences within each type.

Table 10. Enhanced Controller Area Network (eCAN) Module Types

Module Type	Description	Devices Covered	Device-Specific Options
0	Original eCAN Module Type	2810, 2811, 2812, 2801, 2802, 2806, 2808, 2809, 28016	CAN module clock = SYSCLK
		28335, 28334, 28332, 28235, 28234, 28232, 28035, 28034, 28033, 28032	CAN module clock = SYSCLK/2
		28346, 28345, 28344, 28343, 28342, 28341	CAN module clock = SYSCLK/4

3.4 Event Manager (EV)

The event manager 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](#))

[Table 11](#) lists the differences between EV types, including device-specific differences within each type.

Table 11. Event Manager (EV) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original EV Module Type	2810, 2811, 2812	-

3.5 Analog Modules

The analog-to-digital converter (ADC) module and comparator module descriptions are in this section.

3.5.1 Analog-to-Digital Converter (ADC)

The device-specific ADC guides are:

- *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](#))

The ADC block is a 12-bit converter, single ended, 16-channels. It contains two sample-and-hold units for simultaneous sampling.

[Table 12](#) lists the differences between ADC types, including device-specific differences within each type.

Table 12. Analog Digital Controller (ADC) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original ADC Module Type	2810, 2811, 2812	—
1	Added Offset Trim and Reference Select registers	2801, 2802, 2806, 2808, 2809, 28015, 28016, 28044	—
2	Added Internal/External Trim registers(OTP trim)	28335, 28334, 28332, 28235, 28234, 28232	—
3	Different control register interface, converts from 0 to 3.3 V fixed scale range, supports ratiometric VREFHI/VREFLO references	28027, 28026, 28023, 28022, 28021, 28020, 28035, 28034, 28033, 28032	—

3.5.2 Comparator Module (COMP)

The device-specific comparator guides are:

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

The comparator module includes a 10-bit reference and can be routed to directly control ePWM outputs.

[Table 13](#) lists the differences between comparator types, including device-specific differences within each type.

Table 13. Comparator Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original Comparator Module Type	28027, 28026, 28023, 28022, 28021, 28020, 28035, 28034, 28033, 28032	—

3.6 Multichannel Buffered Serial Port (McBSP)

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](#))

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 14](#) lists the differences between ADC types, including device-specific differences within each type.

Table 14. Multichannel Buffered Serial Port (McBSP) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original McBSP Module Type	2810, 2811, 2812	-
1	Removed FIFO to allow interconnect with DMA module. Removed FIFO-related registers (MFFTX, MFFRX, MFFCT, MFFST)	28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	-

3.7 Serial Communications Interface (SCI)

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* ([SPRUZF5](#))
- *TMS320x2834x Delfino Serial Communications Interface (SCI) Reference Guide* ([SPRUG75](#))
- *TMS320x2802x, 2803x Piccolo Serial Communications Interface (SCI) Reference Guide* ([SPRUGH1](#))

[Table 15](#) lists the differences between SCI types, including device-specific differences within each type.

Table 15. Serial Communications Interface (SCI) Module Type

Type	Description	Devices Covered	Device-Specific Options
0	Original SCI Module Type	2810, 2811, 2812, 2801, 2802, 2806, 2808, 2809, 28015, 28016, 28044, 28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	16-level FIFO
1		28027, 28026, 28023, 28022, 28021, 28020, 28035, 28034, 28033, 28032	4-level FIFO

3.8 Serial Peripheral Interface (SPI)

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](#))

Table 16 lists the differences between SPI types, including device-specific differences within each type.

Table 16. Serial Peripheral Interface (SPI) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original SPI Module Type	2810, 2811, 2812, 2801, 2802, 2806, 2808, 2809, 28015, 28016, 28044, 28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	–
1	Added support for 3-wire bidirectional mode and reduced to 4-level FIFO	28027, 28026, 28025, 28024, 28023, 28022 28035, 28034, 28033, 28032	No STEINV bit Added STEINV bit (inverts SPISTE signal to support digital audio receive mode with 2 SPIs)

3.9 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](#))

The boot ROM is factory-programmable with boot-loading 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.

3.10 Inter-Integrated Circuit (I2C) Module

The 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* ([SPRUZF9](#))

This guide describes the features and operation of the inter-integrated circuit (I2C) module. The 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 17 lists the differences between I2C types, including device-specific differences within each type.

Table 17. Inter-Integrated Circuit (I2C) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original I2C Module Type	2801, 2802, 2806, 2808, 2809, 28015, 28016, 28044, 28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	16-level FIFO
		28027, 28026, 28023, 28022, 28021, 28020, 28035, 28034, 28033, 28032	4-level FIFO

3.11 Enhanced Quadrature Encoder Pulse (eQEP) Module

The eQEP module guides include:

- *TMS320x280x, 2801x, 2804x Enhanced Quadrature Encoder Pulse (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](#))

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

Table 18. Enhanced Quadrature Encoder Pulse (eQEP) Module Type Description

Type	Description	Devices Covered	Device-Specific Options
0	Original eQEP Module Type	2801, 2802, 2806, 2808, 2809, 28044, 28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341, 28035, 28034, 28033, 28032	-

3.12 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* ([SPRUGF4](#))
- *TMS320x2834x Delfino Enhanced Capture (eCAP) Module Reference Guide* ([SPRUG79](#))
- *TMS320x2802x, 2803x Piccolo Enhanced Capture (eCAP) Module Reference Guide* ([SPRUFZ8](#))

The enhanced Capture (eCAP) Module is essential in systems where accurate timing of external events is important.

Uses for eCAP include:

- Speed measurements of rotating machinery (e.g., 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 19 lists the differences between eCAP types, including device-specific differences within each type.

Table 19. Enhanced Capture (eCAP) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original ECAP Module Type	2801, 2802, 2806, 2808, 2809, 28015, 28016, 28044 28346, 28345, 28344, 28343, 28342, 28341, 28335, 28334, 28332, 28235, 28234, 28232, 28027, 28026, 28023, 28022, 28021, 28020, 28035, 28034, 28033, 28032	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. 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.

3.13 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](#))

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 20](#) lists the differences between ePWM types, including device-specific differences within each type.

Table 20. Enhanced Pulse Width Modulator (ePWM) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original EPWM Module Type	2801, 2802, 2806, 2808, 2809, 28015, 28016 28044 28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	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. 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. 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	28027, 28026, 28023, 28022, 28021, 28020, 28035, 28034, 28033, 28032	—

3.14 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)*

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

Table 21. High-Resolution Pulse Width Modulator (HRPWM) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original HRPWM Module Type	2801, 2802, 2806, 2808, 2809, 28015, 28016, 28044, 28335, 28334, 28332, 28235, 28234, 28232, 28346, 28345, 28344, 28343, 28342, 28341	—
1	Added high-resolution period support, added option to select high-resolution B output, added automatic micro-step conversion	28027, 28026, 28023, 28022, 28035, 28034, 28033, 28032	—

3.15 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](#))

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

Table 22. Direct Memory Access (DMA) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original DMA Module Type	28346, 28345, 28344, 28343, 28342, 28341 Revision 0 Silicon: 28335, 28334, 28332, 28235, 28234, 28232 Revision A Silicon: 28335, 28334, 28332, 28235, 28234, 28232	DMA does not interface to ePWM. DMA interfaces with ePWM.

3.16 Local Interconnect Network (LIN)

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](#))

Table 23. Local Interconnect Network (LIN) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original LIN Module Type	28035, 28034, 28033, 28032	-

3.17 Control Law Accelerator (CLA)

The C28x Control Law Accelerator (CLA) 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](#))

Table 24. Control Law Accelerator (CLA) Module Types

Type	Description	Devices Covered	Device-Specific Options
0	Original CLA Module Type	28035, 28033	-

Appendix A Revision History

This document was revised to SPRU566I from SPRU566H. The scope of the revisions was limited to technical changes as described in [Section A.1](#). This appendix lists only revisions made in the most recent version.

A.1 *Changes Made in This Revision*

The following changes were made in this revision:

Global	Added more information on module types
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