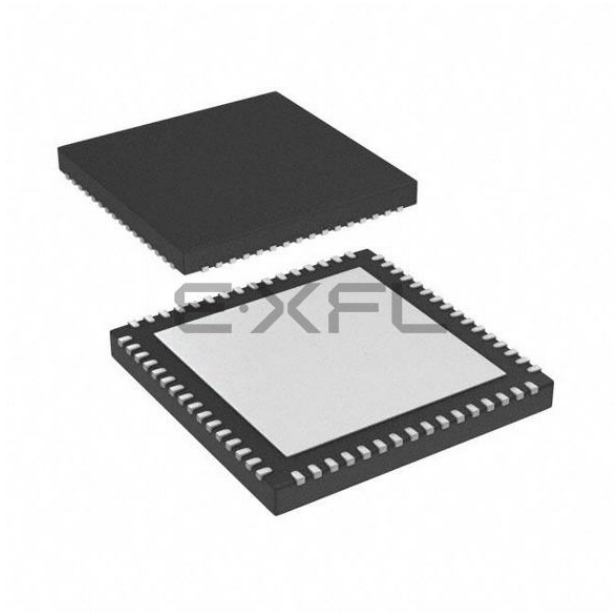
Microchip Technology - DSPIC33CK256MP506-E/MR Datasheet



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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit
Speed	100MHz
Connectivity	CANbus, I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, QEI, WDT
Number of I/O	53
Program Memory Size	256KB (256K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	24K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 20x12b; D/A 3x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ck256mp506-e-mr

5.5 Dual Partition Flash Configuration

For dsPIC33CK256MP508 devices operating in Dual Partition Flash Program Memory modes, the Inactive Partition can be erased and programmed without stalling the processor. The same programming algorithms are used for programming and erasing the Flash in the Inactive Partition, as described in **Section 5.2 "RTSP Operation"**. On top of the page erase option, the entire Flash memory of the Inactive Partition can be erased by configuring the NVMOP<3:0> bits in the NVMCON register.

Note 1:	The application software to be loaded into the Inactive Partition will have the address of the Active Partition. The bootloader firmware will need to offset the address by 0x400000 in order to write to the Inactive Partition.

5.5.1 FLASH PARTITION SWAPPING

The Boot Sequence Number is used for determining the Active Partition at start-up and is encoded within the FBTSEQ Configuration register bits. Unlike most Configuration registers, which only utilize the lower 16 bits of the program memory, FBTSEQ is a 24-bit Configuration Word. The Boot Sequence Number (BSEQ) is a 12-bit value and is stored in FBTSEQ twice. The true value is stored in bits, FBTSEQ<11:0>, and its complement is stored in bits, FBTSEQ<23:12>. At device Reset, the sequence numbers are read and the partition with the lowest sequence number becomes the Active Partition. If one of the Boot Sequence Numbers is invalid, the device will select the partition with the valid Boot Sequence Number, or default to Partition 1 if both sequence numbers are invalid. See **Section 30.0 "Special Features"** for more information.

The `BOOTSWP` instruction provides an alternative means of swapping the Active and Inactive Partitions (soft swap) without the need for a device Reset. The `BOOTSWP` must always be followed by a `GOTO` instruction. The `BOOTSWP` instruction swaps the Active and Inactive Partitions, and the PC vectors to the location specified by the `GOTO` instruction in the newly Active Partition.

It is important to note that interrupts should temporarily be disabled while performing the soft swap sequence and that after the partition swap, all peripherals and interrupts which were enabled remain enabled. Additionally, the RAM and stack will maintain state after the switch. As a result, it is recommended that applications using soft swaps jump to a routine that will reinitialize the device in order to ensure the firmware runs as expected. The Configuration registers will have no effect during a soft swap.

For robustness of operation, in order to execute the `BOOTSWP` instruction, it is necessary to execute the NVM unlocking sequence as follows:

1. Write 0x55 to NVMKEY.
2. Write 0xAA to NVMKEY.
3. Execute the `BOOTSWP` instruction.

If the unlocking sequence is not performed, the `BOOTSWP` instruction will be executed as a forced `NOP` and a `GOTO` instruction, following the `BOOTSWP` instruction, will be executed, causing the PC to jump to that location in the current operating partition.

The SFTSWP and P2ACTIV bits in the NVMCON register are used to determine a successful swap of the Active and Inactive Partitions, as well as which partition is active. After the `BOOTSWP` and `GOTO` instructions, the SFTSWP bit should be polled to verify the partition swap has occurred and then cleared for the next panel swap event.

5.5.2 DUAL PARTITION MODES

While operating in Dual Partition mode, the dsPIC33CK256MP508 family devices have the option for both partitions to have their own defined security segments, as shown in Figure 27-4. Alternatively, the device can operate in Protected Dual Partition mode, where Partition 1 becomes permanently erase/write-protected. Protected Dual Partition mode allows for a "Factory Default" mode, which provides a fail-safe backup image to be stored in Partition 1.

dsPIC33CK256MP508 family devices can also operate in Privileged Dual Partition mode, where additional security protections are implemented to allow for protection of intellectual property when multiple parties have software within the device. In Privileged Dual Partition mode, both partitions place additional restrictions on the FBSLIM register. These prevent changes to the size of the Boot Segment and General Segment, ensuring that neither segment will be altered.

REGISTER 7-3: INTCON1: INTERRUPT CONTROL REGISTER 1 (CONTINUED)

bit 3 **ADDRERR:** Address Error Trap Status bit
1 = Address error trap has occurred
0 = Address error trap has not occurred

bit 2 **STKERR:** Stack Error Trap Status bit
1 = Stack error trap has occurred
0 = Stack error trap has not occurred

bit 1 **OSCFAIL:** Oscillator Failure Trap Status bit
1 = Oscillator failure trap has occurred
0 = Oscillator failure trap has not occurred

bit 0 **Unimplemented:** Read as '0'

TABLE 8-6: REMAPPABLE OUTPUT PIN REGISTERS

Register	RP Pin	I/O Port
RPOR0<5:0>	RP32	Port Pin RB0
RPOR0<13:8>	RP33	Port Pin RB1
RPOR1<5:0>	RP34	Port Pin RB2
RPOR1<13:8>	RP35	Port Pin RB3
RPOR2<5:0>	RP36	Port Pin RB4
RPOR2<13:8>	RP37	Port Pin RB5
RPOR3<5:0>	RP38	Port Pin RB6
RPOR3<13:8>	RP39	Port Pin RB7
RPOR4<5:0>	RP40	Port Pin RB8
RPOR4<13:8>	RP41	Port Pin RB9
RPOR5<5:0>	RP42	Port Pin RB10
RPOR5<13:8>	RP43	Port Pin RB11
RPOR6<5:0>	RP44	Port Pin RB12
RPOR6<13:8>	RP45	Port Pin RB13
RPOR7<5:0>	RP46	Port Pin RB14
RPOR7<13:8>	RP47	Port Pin RB15
RPOR8<5:0>	RP48	Port Pin RC0
RPOR8<13:8>	RP49	Port Pin RC1
RPOR9<5:0>	RP50	Port Pin RC2
RPOR9<13:8>	RP51	Port Pin RC3
RPOR10<5:0>	RP52	Port Pin RC4
RPOR10<13:8>	RP53	Port Pin RC5
RPOR11<5:0>	RP54	Port Pin RC6
RPOR11<13:8>	RP55	Port Pin RC7
RPOR12<5:0>	RP56	Port Pin RC8
RPOR12<13:8>	RP57	Port Pin RC9
RPOR13<5:0>	RP58	Port Pin RC10
RPOR13<13:8>	RP59	Port Pin RC11
RPOR14<5:0>	RP60	Port Pin RC12
RPOR14<13:8>	RP61	Port Pin RC13
RPOR15<5:0>	RP62	Port Pin RC14
RPOR15<13:8>	RP63	Port Pin RC15
RPOR16<5:0>	RP64	Port Pin RD0
RPOR16<13:8>	RP65	Port Pin RD1
RPOR17<5:0>	RP66	Port Pin RD2
RPOR17<13:8>	RP67	Port Pin RD3
RPOR18<5:0>	RP68	Port Pin RD4
RPOR18<13:8>	RP69	Port Pin RD5
RPOR19<5:0>	RP70	Port Pin RD6
RPOR19<13:8>	RP71	Port Pin RD7
RPOR20<5:0>	RP72	Port Pin RD8
RPOR20<13:8>	RP73	Port Pin RD9
RPOR21<5:0>	RP74	Port Pin D10
RPOR21<13:8>	RP75	Port Pin RD11
RPOR22<5:0>	RP76	Port Pin RD12
RPOR22<13:8>	RP77	Port Pin RD13

REGISTER 8-41: RPINR30: PERIPHERAL PIN SELECT INPUT REGISTER 30

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
—	—	—	—	—	—	—	—
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
SS3R7	SS3R6	SS3R5	SS3R4	SS3R3	SS3R2	SS3R1	SS3R0
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-8 **Unimplemented:** Read as '0'

bit 7-0 **SS3R<7:0>:** Assign SPI3 Slave Select ($\overline{SS2}$) to the Corresponding RPn Pin bits
See Table 8-4.

REGISTER 8-42: RPINR32: PERIPHERAL PIN SELECT INPUT REGISTER 32

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
TCKI9R7	TCKI9R6	TCKI9R5	TCKI9R4	TCKI9R3	TCKI9R2	TCKI9R1	TCKI9R0
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
—	—	—	—	—	—	—	—
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-8 **TCKI9R<7:0>:** Assign MCCP Timer9 Input (TCKI9) to the Corresponding RPn Pin bits
See Table 8-4.

bit 7-0 **Unimplemented:** Read as '0'

9.6 Oscillator Control Registers

REGISTER 9-1: OSCCON: OSCILLATOR CONTROL REGISTER(1)

U-0	R-0	R-0	R-0	U-0	R/W-y	R/W-y	R/W-y
—	COSC2	COSC1	COSC0	—	NOSC2(2)	NOSC1(2)	NOSC0(2)
bit 15							bit 8

R/W-0	U-0	R-0	U-0	R/W-0	U-0	U-0	R/W-0
CLKLOCK	—	LOCK	—	CF(3)	—	—	OSWEN
bit 7							bit 0

Legend:	y = Value set from Configuration bits on POR		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15 **Unimplemented:** Read as '0'

bit 14-12 **COSC<2:0>:** Current Oscillator Selection bits (read-only)
111 = Fast RC Oscillator (FRC) with Divide-by-n (FRCDIVN)
110 = Backup FRC (BFRC)
101 = Low-Power RC Oscillator (LPRC)
100 = Reserved – default to FRC
011 = Primary Oscillator (XT, HS, EC) with PLL (XTPLL, HSPLL, ECPLL)
010 = Primary Oscillator (XT, HS, EC)
001 = Fast RC Oscillator (FRC) with PLL (FRCPLL)
000 = Fast RC Oscillator (FRC)

bit 11 **Unimplemented:** Read as '0'

bit 10-8 **NOSC<2:0>:** New Oscillator Selection bits(2)
111 = Fast RC Oscillator (FRC) with Divide-by-n (FRCDIVN)
110 = Backup FRC (BFRC)
101 = Low-Power RC Oscillator (LPRC)
100 = Reserved – default to FRC
011 = Primary Oscillator (XT, HS, EC) with PLL (XTPLL, HSPLL, ECPLL)
010 = Primary Oscillator (XT, HS, EC)
001 = Fast RC Oscillator (FRC) with PLL (FRCPLL)
000 = Fast RC Oscillator (FRC)

bit 7 **CLKLOCK:** Clock Lock Enable bit
1 = If (FCKSM0 = 1), then clock and PLL configurations are locked; if (FCKSM0 = 0), then clock and PLL configurations may be modified
0 = Clock and PLL selections are not locked, configurations may be modified

bit 6 **Unimplemented:** Read as '0'

bit 5 **LOCK:** PLL Lock Status bit (read-only)
1 = Indicates that PLL is in lock or PLL start-up timer is satisfied
0 = Indicates that PLL is out of lock, start-up timer is in progress or PLL is disabled

bit 4 **Unimplemented:** Read as '0'

Note 1: Writes to this register require an unlock sequence.

2: Direct clock switches between any Primary Oscillator mode with PLL and FRCPLL mode are not permitted. This applies to clock switches in either direction. In these instances, the application must switch to FRC mode as a transitional clock source between the two PLL modes.

3: This bit should only be cleared in software. Setting the bit in software (= 1) will have the same effect as an actual oscillator failure and will trigger an oscillator failure trap.

12.0 HIGH-RESOLUTION PWM WITH FINE EDGE PLACEMENT

Note 1: This data sheet summarizes the features of the dsPIC33CK256MP508 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"High-Resolution PWM with Fine Edge Placement"** (DS70005320) in the *"dsPIC33/PIC24 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

The High-Speed PWM (HSPWM) module is a Pulse-Width Modulated (PWM) module to support both motor control and power supply applications. This flexible module provides features to support many types of Motor Control (MC) and Power Control (PC) applications, including:

- AC-to-DC Converters
- DC-to-DC Converters
- AC and DC Motors: BLDC, PMSM, ACIM, SRM, etc.
- Inverters
- Battery Chargers
- Digital Lighting
- Power Factor Correction (PFC)

12.1 Features

- 8 Independent PWM Generators, each with Dual Outputs
- Operating modes:
  - Independent Edge mode
  - Variable Phase PWM mode
  - Center-Aligned mode
  - Double Update Center-Aligned mode
  - Dual Edge Center-Aligned mode
  - Dual PWM mode
- Output modes:
  - Complementary
  - Independent
  - Push-Pull
- Dead-Time Generator
- Leading-Edge Blanking (LEB)
- Output Override for Fault Handling
- Flexible Period/Duty Cycle Updating Options
- Programmable Control Inputs (PCI)
- Advanced Triggering Options
- 6 Combinatorial Logic Outputs
- 6 PWM Event Outputs

REGISTER 12-18: PGxEVTH: PWM GENERATOR x EVENT REGISTER HIGH

R/W-0	R/W-0	R/W-0	R/W-0	U-0	U-0	R/W-0	R/W-0
FLTIEN(1)	CLIEN(2)	FFIEN(3)	SIEN(4)	—	—	IEVTSEL1	IEVTSEL0
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
ADTR2EN3	ADTR2EN2	ADTR2EN1	ADTR1OFS4	ADTR1OFS3	ADTR1OFS2	ADTR1OFS1	ADTR1OFS0
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15 **FLTIEN:** PCI Fault Interrupt Enable bit(1)
- 1 = Fault interrupt is enabled
- 0 = Fault interrupt is disabled

bit 14 **CLIEN:** PCI Current-Limit Interrupt Enable bit(2)
- 1 = Current-limit interrupt is enabled
- 0 = Current-limit interrupt is disabled

bit 13 **FFIEN:** PCI Feed-Forward Interrupt Enable bit(3)
- 1 = Feed-forward interrupt is enabled
- 0 = Feed-forward interrupt is disabled

bit 12 **SIEN:** PCI Sync Interrupt Enable bit(4)
- 1 = Sync interrupt is enabled
- 0 = Sync interrupt is disabled

bit 11-10 **Unimplemented:** Read as '0'

bit 9-8 **IEVTSEL<1:0>:** Interrupt Event Selection bits
- 11 = Time base interrupts are disabled (Sync, Fault, current-limit and feed-forward events can be independently enabled)
- 10 = Interrupts CPU at ADC Trigger 1 event
- 01 = Interrupts CPU at TRIGA compare event
- 00 = Interrupts CPU at EOC

bit 7 **ADTR2EN3:** ADC Trigger 2 Source is PGxTRIGC Compare Event Enable bit
- 1 = PGxTRIGC register compare event is enabled as trigger source for ADC Trigger 2
- 0 = PGxTRIGC register compare event is disabled as trigger source for ADC Trigger 2

bit 6 **ADTR2EN2:** ADC Trigger 2 Source is PGxTRIGB Compare Event Enable bit
- 1 = PGxTRIGB register compare event is enabled as trigger source for ADC Trigger 2
- 0 = PGxTRIGB register compare event is disabled as trigger source for ADC Trigger 2

bit 5 **ADTR2EN1:** ADC Trigger 2 Source is PGxTRIGA Compare Event Enable bit
- 1 = PGxTRIGA register compare event is enabled as trigger source for ADC Trigger 2
- 0 = PGxTRIGA register compare event is disabled as trigger source for ADC Trigger 2

bit 4-0 **ADTR1OFS<4:0>:** ADC Trigger 1 Offset Selection bits
- 11111 = Offset by 31 trigger events
- . . .
- 00010 = Offset by 2 trigger events
- 00001 = Offset by 1 trigger event
- 00000 = No offset

Note 1: An interrupt is only generated on the rising edge of the PCI Fault active signal.
2: An interrupt is only generated on the rising edge of the PCI current-limit active signal.
3: An interrupt is only generated on the rising edge of the PCI feed-forward active signal.
4: An interrupt is only generated on the rising edge of the PCI Sync active signal.

Table 15-1 shows the truth table that describes how the Quadrature signals are decoded.

TABLE 15-1: TRUTH TABLE FOR QUADRATURE ENCODER

Current Quadrature State		Previous Quadrature State		Action
QEA	QEB	QEA	QEB	
1	1	1	1	No count or direction change
1	1	1	0	Count up
1	1	0	1	Count down
1	1	0	0	Invalid state change; ignore
1	0	1	1	Count down
1	0	1	0	No count or direction change
1	0	0	1	Invalid state change; ignore
1	0	0	0	Count up
0	1	1	1	Count up
0	1	1	0	Invalid state change; ignore
0	1	0	1	No count or direction change
0	1	0	0	Count down
0	0	1	1	Invalid state change; ignore
0	0	1	0	Count down
0	0	0	1	Count up
0	0	0	0	No count or direction change

Figure 15-2 illustrates the simplified block diagram of the QEI module. The QEI module consists of decoder logic to interpret the Phase A (QEAx) and Phase B (QEBx) signals, and an up/down counter to accumulate the count. The counter pulses are generated when the Quadrature state changes. The count direction information must be maintained in a register until a direction change is detected. The module also includes digital noise filters, which condition the input signal.

The QEI module consists of the following major features:

- Four Input Pins: Two Phase Signals, an Index Pulse and a Home Pulse
- Programmable Digital Noise Filters on Inputs
- Quadrature Decoder providing Counter Pulses and Count Direction
- Count Direction Status
- 4x Count Resolution
- Index (INDXx) Pulse to Reset the Position Counter
- General Purpose 32-Bit Timer/Counter mode
- Interrupts generated by QEI or Counter Events
- 32-Bit Velocity Counter
- 32-Bit Position Counter
- 32-Bit Index Pulse Counter
- 32-Bit Interval Timer
- 32-Bit Position Initialization/Capture Register
- 32-Bit Compare Less Than and Greater Than Registers
- External Up/Down Count mode
- External Gated Count mode
- External Gated Timer mode
- Interval Timer mode

REGISTER 18-3: I2CxSTAT: I2Cx STATUS REGISTER

R-0, HSC	R-0, HSC	R-0, HSC	U-0	U-0	R/C-0, HSC	R-0, HSC	R-0, HSC
ACKSTAT	TRSTAT	ACKTIM	—	—	BCL	GCSTAT	ADD10
bit 15							bit 8

R/C-0, HS	R/C-0, HS	R-0, HSC	R-0, HSC	R-0, HSC	R-0, HSC	R-0, HSC	R-0, HSC
IWCOL	I2COV	D/$\overline{A}$	P	S	R/$\overline{W}$	RBF	TBF
bit 7							bit 0

Legend:	C = Clearable bit	HSC = Hardware Settable/Clearable bit	
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	HS = Hardware Settable bit

bit 15 **ACKSTAT:** Acknowledge Status bit (updated in all Master and Slave modes)
1 = Acknowledge was not received from Slave
0 = Acknowledge was received from Slave

bit 14 **TRSTAT:** Transmit Status bit (when operating as I^2C Master; applicable to Master transmit operation)
1 = Master transmit is in progress (8 bits + ACK)
0 = Master transmit is not in progress

bit 13 **ACKTIM:** Acknowledge Time Status bit (valid in I^2C Slave mode only)
1 = Indicates I^2C bus is in an Acknowledge sequence, set on 8th falling edge of SCLx clock
0 = Not an Acknowledge sequence, cleared on 9th rising edge of SCLx clock

bit 12-11 **Unimplemented:** Read as '0'

bit 10 **BCL:** Bus Collision Detect bit (Master/Slave mode; cleared when I^2C module is disabled, I2CEN = 0)
1 = A bus collision has been detected during a Master or Slave transmit operation
0 = No bus collision has been detected

bit 9 **GCSTAT:** General Call Status bit (cleared after Stop detection)
1 = General call address was received
0 = General call address was not received

bit 8 **ADD10:** 10-Bit Address Status bit (cleared after Stop detection)
1 = 10-bit address was matched
0 = 10-bit address was not matched

bit 7 **IWCOL:** I2Cx Write Collision Detect bit
1 = An attempt to write to the I2CxTRN register failed because the I^2C module is busy; must be cleared in software
0 = No collision

bit 6 **I2COV:** I2Cx Receive Overflow Flag bit
1 = A byte was received while the I2CxRCV register is still holding the previous byte; I2COV is a "don't care" in Transmit mode, must be cleared in software
0 = No overflow

bit 5 **D/$\overline{A}$:** Data/$\overline{\text{Address}}$ bit (when operating as I^2C Slave)
1 = Indicates that the last byte received was data
0 = Indicates that the last byte received or transmitted was an address

bit 4 **P:** I2Cx Stop bit
Updated when Start, Reset or Stop is detected; cleared when the I^2C module is disabled, I2CEN = 0.
1 = Indicates that a Stop bit has been detected last
0 = Stop bit was not detected last

REGISTER 18-3: I2CxSTAT: I2Cx STATUS REGISTER (CONTINUED)

bit 3 **S:** I2Cx Start bit
Updated when Start, Reset or Stop is detected; cleared when the I^2C module is disabled, I2CEN = 0.
1 = Indicates that a Start (or Repeated Start) bit has been detected last
0 = Start bit was not detected last

bit 2 **R/$\overline{W}$:** Read/$\overline{Write}$ Information bit (when operating as I^2C Slave)
1 = Read: Indicates the data transfer is output from the Slave
0 = Write: Indicates the data transfer is input to the Slave

bit 1 **RBF:** Receive Buffer Full Status bit
1 = Receive is complete, I2CxRCV is full
0 = Receive is not complete, I2CxRCV is empty

bit 0 **TBF:** Transmit Buffer Full Status bit
1 = Transmit is in progress, I2CxTRN is full (8-bits of data)
0 = Transmit is complete, I2CxTRN is empty

REGISTER 18-4: I2CxMSK: I2Cx SLAVE MODE ADDRESS MASK REGISTER

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0
—	—	—	—	—	—	MSK<9:8>	
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
MSK<7:0>							
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-10 **Unimplemented:** Read as '0'

bit 9-0 **MSK<9:0>:** I2Cx Mask for Address Bit x Select bits
1 = Enables masking for bit x of the incoming message address; bit match is not required in this position
0 = Disables masking for bit x; bit match is required in this position

19.0 PARALLEL MASTER PORT (PMP)

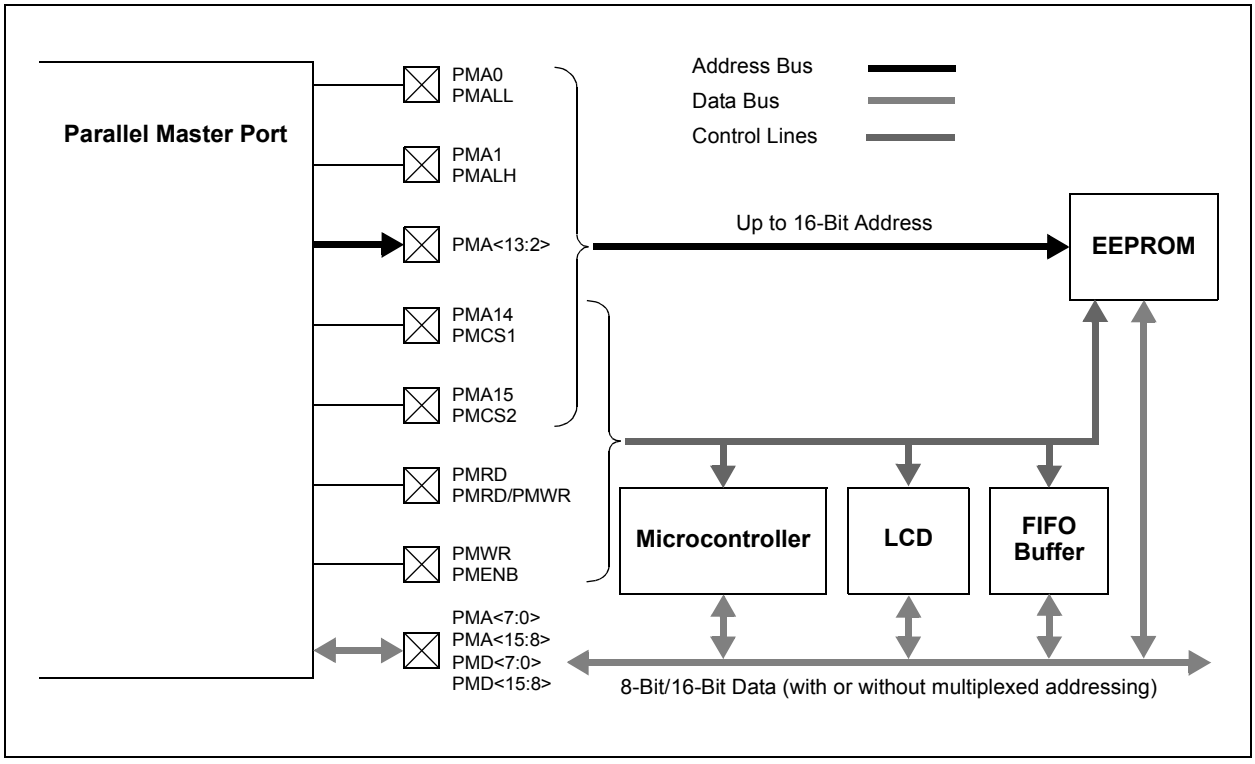
Note 1: This data sheet summarizes the features of the dsPIC33CK256MP508 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"Parallel Master Port (PMP)"** (DS70005344) in the *"dsPIC33/PIC24 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

2: Not all device variants include the PMP. Refer to Table 1 and Table 2 for availability.

The Parallel Master Port (PMP) is a parallel 8-bit/16-bit I/O module specifically designed to communicate with a wide variety of parallel devices, such as communication peripherals, LCDs, external memory devices and microcontrollers. Because the interfaces to parallel peripherals vary significantly, the PMP module is highly configurable. The key features of the PMP module include:

- Master and Slave Operating modes
- Up to 16 Programmable Address Lines
- Up to Two Chip Select Lines
- Programmable Strobe Options:
  - Individual read and write strobes or read/write strobe with enable strobe
- Address Auto-Increment/Auto-Decrement
- Programmable Address/Data Multiplexing
- Programmable Polarity on Control Signals
- Legacy Parallel Slave Port Support
- Enhanced Parallel Slave Support:
  - Address support
  - 4 bytes deep, auto-incrementing buffer
- Schmitt Trigger or TTL Input Buffers
- Programmable Wait States
- Dual Buffer Mode with Separate Read and Write Registers
- Read Initiate Control

FIGURE 19-1: PMP MODULE PINOUT AND CONNECTIONS TO EXTERNAL DEVICES



REGISTER 19-10: PMSTAT: PARALLEL MASTER PORT STATUS REGISTER (SLAVE MODES ONLY)

R-0	R/W-0	U-0	U-0	R-0	R-0	R-0	R-0
IBF	IBOV	—	—	IB3F	IB2F	IB1F	IB0F
bit 15							bit 8

R-1	R/W-0	U-0	U-0	R-1	R-1	R-1	R-1
OBE	OBUF	—	—	OB3E	OB2E	OB1E	OB0E
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15 **IBF:** Input Buffer Full Status bit
1 = All writable Input Buffer registers are full
0 = Some or all of the writable Input Buffer registers are empty

bit 14 **IBOV:** Input Buffer Overflow Status bit
1 = A write attempt to a full input byte buffer occurred (must be cleared in software)
0 = No overflow occurred
This bit is set (= 1) in hardware; it can only be cleared (= 0) in software.

bit 13-12 **Unimplemented:** Read as '0'

bit 11-8 **IB<3:0>F:** Input Buffer x Status Full bits
1 = Input buffer contains data that has not been read (reading buffer will clear this bit)
0 = Input buffer does not contain any unread data

bit 7 **OBE:** Output Buffer Empty Status bit
1 = All readable Output Buffer registers are empty
0 = Some or all of the readable Output Buffer registers are full

bit 6 **OBUF:** Output Buffer Underflow Status bit
1 = A read occurred from an empty output byte buffer (must be cleared in software)
0 = No underflow occurred
This bit is set (= 1) in hardware; it can only be cleared (= 0) in software.

bit 5-4 **Unimplemented:** Read as '0'

bit 3-0 **OB<3:0>E:** Output Buffer x Status Empty bits
1 = Output buffer is empty (writing data to the buffer will clear this bit)
0 = Output buffer contains data that has not been transmitted

REGISTER 19-13: PMRDIN: PARALLEL MASTER PORT READ INPUT DATA REGISTER(1)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
RDATAIN<15:8>(2)							
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
RDATAIN<7:0>(2)							
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-0 **RDATAIN<15:0>:** Port Read Input Data bits(2)

Note 1: This register is only used when the DUALBUF bit (PMCONH<1>) is set to '1' and exclusively for reads. If the DUALBUF bit is '0', the PMDIN1 register (Register 19-7) is used for reads instead of PMRDIN.

2: Only used when MODE16 = 1.

REGISTER 22-1: CCPxCON1L: CCPx CONTROL 1 LOW REGISTERS (CONTINUED)

bit 3-0 **MOD<3:0>:** CCPx Mode Select bits

For CCSEL = 1 (Input Capture modes):

1xxx = Reserved
011x = Reserved
0101 = Capture every 16th rising edge
0100 = Capture every 4th rising edge
0011 = Capture every rising and falling edge
0010 = Capture every falling edge
0001 = Capture every rising edge
0000 = Capture every rising and falling edge (Edge Detect mode)

For CCSEL = 0 (Output Compare/Timer modes):

1111 = External Input mode: Pulse generator is disabled, source is selected by ICS<2:0>
1110 = Reserved
110x = Reserved
10xx = Reserved
0111 = Reserved
0110 = Reserved
0101 = Dual Edge Compare mode, buffered
0100 = Dual Edge Compare mode
0011 = 16-Bit/32-Bit Single Edge mode, toggles output on compare match
0010 = 16-Bit/32-Bit Single Edge mode, drives output low on compare match
0001 = 16-Bit/32-Bit Single Edge mode, drives output high on compare match
0000 = 16-Bit/32-Bit Timer mode, output functions are disabled

REGISTER 24-9: PTGC0LIM: PTG COUNTER 0 LIMIT REGISTER(1)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGC0LIM<15:8>							
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGC0LIM<7:0>							
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-0 **PTGC0LIM<15:0>:** PTG Counter 0 Limit Register bits

This register is used to specify the loop count for the PTGJMPC0 Step command or as a Limit register for the General Purpose Counter 0.

Note 1: These bits are read-only when the module is executing Step commands.

REGISTER 24-10: PTGC1LIM: PTG COUNTER 1 LIMIT REGISTER(1)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGC1LIM<15:8>							
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGC1LIM<7:0>							
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-0 **PTGC1LIM<15:0>:** PTG Counter 1 Limit Register bits

This register is used to specify the loop count for the PTGJMPC1 Step command or as a Limit register for the General Purpose Counter 1.

Note 1: These bits are read-only when the module is executing step commands.

TABLE 24-2: PTG COMMAND OPTIONS (CONTINUED)

bit 3-0	Step Command	OPTION<3:0>	Option Description
	PTGWHI(1) or PTGWLO(1)	0000	PTGI0 (see Table 24-3 for input assignments).
		• • •	• • •
		1111	PTGI15 (see Table 24-3 for input assignments).
	PTGIRQ(1)	0000	Generate PTG Interrupt 0.
		• • •	• • •
		0111	Generate PTG Interrupt 7.
		1000	Reserved; do not use.
		• • •	• • •
		1111	Reserved; do not use.
	PTGTRIG	00000	PTGO0 (see Table 24-4 for output assignments).
		00001	PTGO1 (see Table 24-4 for output assignments).
		• • •	• • •
		11110	PTGO30 (see Table 24-4 for output assignments).
		11111	PTGO31 (see Table 24-4 for output assignments).
	PTGWHI(1) or PTGWLO(1)	0000	PTGI0 (see specific device data sheet for input assignments).
		• • •	• • •
		1111	PTGI15 (see specific device data sheet for input assignments).
	PTGIRQ(1)	0000	Generate PTG Interrupt 0 (see specific device data sheet for interrupt assignments).
		• • •	• • •
		0111	Generate PTG Interrupt 7 (see specific device data sheet for interrupt assignments).
		1000	Reserved; do not use.
		• • •	• • •
		1111	Reserved; do not use.
	PTGTRIG	00000	PTGO0 (see specific device data sheet for assignments).
		00001	PTGO1 (see specific device data sheet for assignments).

Note 1: All reserved commands or options will execute, but they do not have any affect (i.e., execute as a NOP instruction).

REGISTER 30-15: FALTREG CONFIGURATION REGISTER

U-1	U-1	U-1	U-1	U-1	U-1	U-1	U-1
—	—	—	—	—	—	—	—
bit 23							bit 16

U-1	R/PO-1	R/PO-1	R/PO-1	U-1	R/PO-1	R/PO-1	R/PO-1
—	CTXT4<2:0>			—	CTXT3<2:0>		
bit 15							bit 8

U-1	R/PO-1	R/PO-1	R/PO-1	U-1	R/PO-1	R/PO-1	R/PO-1
—	CTXT2<2:0>			—	CTXT1<2:0>		
bit 7							bit 0

Legend:	PO = Program Once bit		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 23-15 **Unimplemented:** Read as '1'

bit 14-12 **CTXT4<2:0>:** Specifies the Alternate Working Register Set #4 with Interrupt Priority Levels (IPL) bits
111 = Not assigned
110 = Alternate Register Set #4 is assigned to IPL Level 7
101 = Alternate Register Set #4 is assigned to IPL Level 6
100 = Alternate Register Set #4 is assigned to IPL Level 5
011 = Alternate Register Set #4 is assigned to IPL Level 4
010 = Alternate Register Set #4 is assigned to IPL Level 3
001 = Alternate Register Set #4 is assigned to IPL Level 2
000 = Alternate Register Set #4 is assigned to IPL Level 1

bit 11 **Unimplemented:** Read as '1'

bit 10-8 **CTXT3<2:0>:** Specifies the Alternate Working Register Set #3 with Interrupt Priority Levels (IPL) bits
111 = Not assigned
110 = Alternate Register Set #3 is assigned to IPL Level 7
101 = Alternate Register Set #3 is assigned to IPL Level 6
100 = Alternate Register Set #3 is assigned to IPL Level 5
011 = Alternate Register Set #3 is assigned to IPL Level 4
010 = Alternate Register Set #3 is assigned to IPL Level 3
001 = Alternate Register Set #3 is assigned to IPL Level 2
000 = Alternate Register Set #3 is assigned to IPL Level 1

bit 7 **Unimplemented:** Read as '1'

bit 6-4 **CTXT2<2:0>:** Specifies the Alternate Working Register Set #2 with Interrupt Priority Levels (IPL) bits
111 = Not assigned
110 = Alternate Register Set #2 is assigned to IPL Level 7
101 = Alternate Register Set #2 is assigned to IPL Level 6
100 = Alternate Register Set #2 is assigned to IPL Level 5
011 = Alternate Register Set #2 is assigned to IPL Level 4
010 = Alternate Register Set #2 is assigned to IPL Level 3
001 = Alternate Register Set #2 is assigned to IPL Level 2
000 = Alternate Register Set #2 is assigned to IPL Level 1

bit 3 **Unimplemented:** Read as '1'

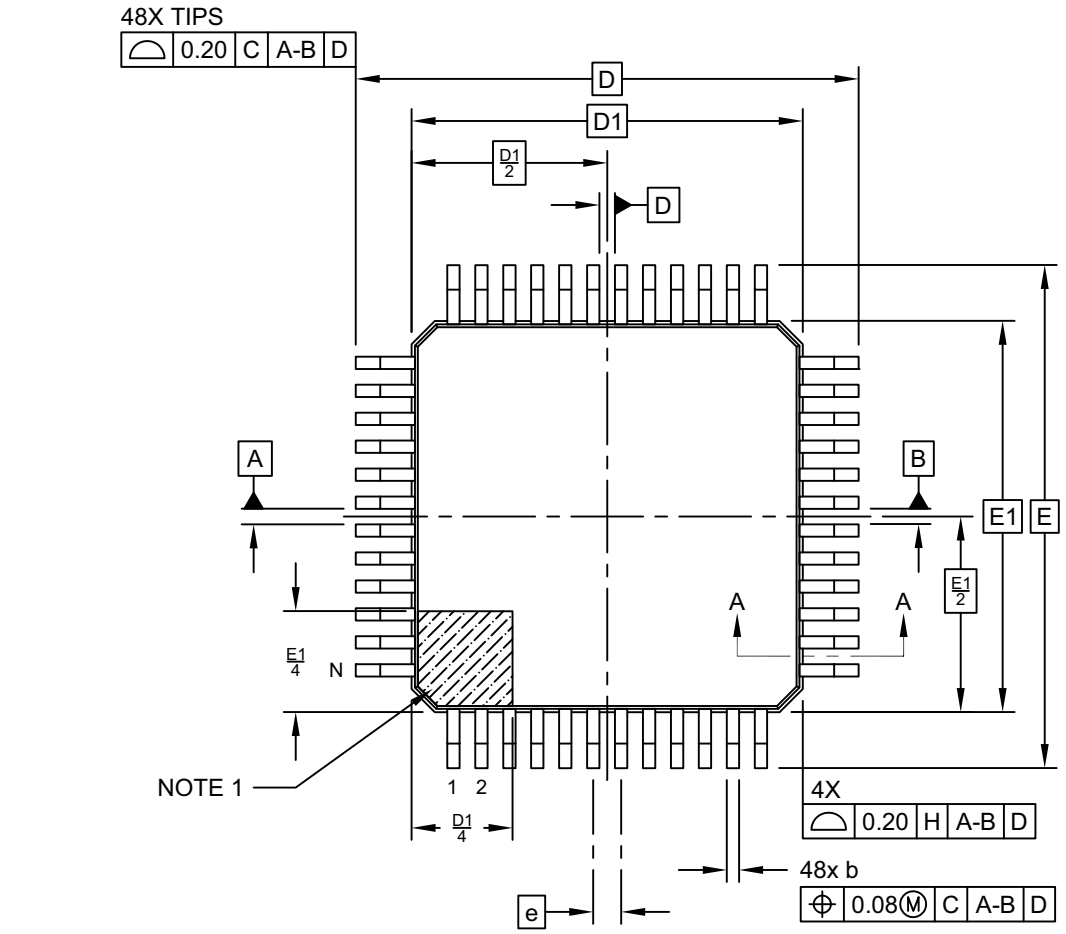
TABLE 33-18: PROGRAM MEMORY

Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended						
Param No.	**Symbol**	**Characteristic**	**Min.**	**Max.**	**Units**	**Conditions**
		Program Flash Memory				
D130	EP	Cell Endurance	10,000	—	E/W	-40°C to +125°C
D131	VPR	VDD for Read	3.0	3.6	V	
D132b	VPEW	VDD for Self-Timed Write	3.0	3.6	V	
D134	TRETD	Characteristic Retention	20	—	Year	Provided no other specifications are violated, -40°C to +125°C
D137a	TPE	Page Erase Time	15.3	16.82	ms	TPE = 128,454 FRC cycles **(Note 1)**
D138a	TWW	Word Write Time	47.7	52.3	µs	TWW = 400 FRC cycles **(Note 1)**
D139a	TRW	Row Write Time	2.0	2.2	ms	TRW = 16,782 FRC cycles **(Note 1)**

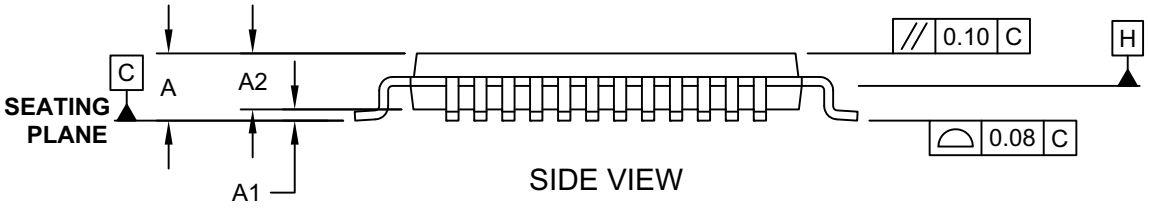
Note 1: Other conditions: FRC = 8 MHz, TUN<5:0> = `011111` (for Minimum), TUN<5:0> = `100000` (for Maximum). This parameter depends on the FRC accuracy (see Table 33-22) and the value of the FRC Oscillator Tuning register (see Register 9-4). For complete details on calculating the Minimum and Maximum time, see **Section 5.3 "Programming Operations"**.

48-Lead Thin Quad Flatpack (PT) - 7x7x1.0 mm Body [TQFP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW

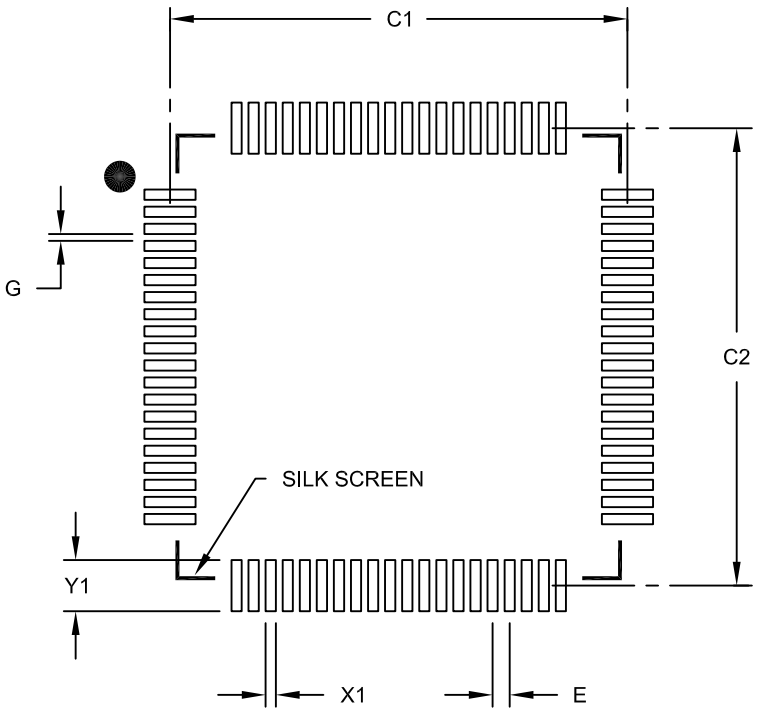


SIDE VIEW

Microchip Technology Drawing C04-300-PT Rev A Sheet 1 of 2

80-Lead Plastic Thin Quad Flatpack (PT) - 12x12x1mm Body, 2.00 mm Footprint [TQFP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.50 BSC	
Contact Pad Spacing	C1		13.40	
Contact Pad Spacing	C2		13.40	
Contact Pad Width (X80)	X1			0.30
Contact Pad Length (X80)	Y1			1.50
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2092B

