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#### Details

E·XFI

Product Status	Active
Core Processor	PIC
Core Size	16-Bit
Speed	40 MIPs
Connectivity	I <sup>2</sup> C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	85
Program Memory Size	64KB (22K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 32x10b/12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	100-TQFP
Supplier Device Package	100-TQFP (12x12)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic24hj64gp210a-e-pt

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IABLE	4-6:	IIIVIE	R REG	ISTER N	IAP													
SFR Name	SFR Addr	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
TMR1	0100								Timer1	Register								0000
PR1	0102								Period F	Register 1								FFFF
T1CON	0104	TON		TSIDL		_	—	_	_	—	TGATE	TCKP	S<1:0>	_	TSYNC	TCS	_	0000
TMR2	0106								Timer2	Register								0000
TMR3HLD	0108						Tin	ner3 Holding	Register (fo	r 32-bit time	r operations of	only)						xxxx
TMR3	010A		Timer3 Register 0000									0000						
PR2	010C								Period F	Register 2								FFFF
PR3	010E								Period F	Register 3								FFFF
T2CON	0110	TON	_	TSIDL		_	—	_	_	—	TGATE	TCKP	S<1:0>	T32	—	TCS	_	0000
T3CON	0112	TON	—	TSIDL		—	—	_	—	—	TGATE	TCKP	S<1:0>	—	—	TCS	_	0000
TMR4	0114								Timer4	Register								0000
TMR5HLD	0116		Timer5 Holding Register (for 32-bit operations only) xxxx															
TMR5	0118		Timer5 Register 0000									0000						
PR4	011A								Period F	Register 4								FFFF
PR5	011C								Period F	Register 5								FFFF
T4CON	011E	TON	—	TSIDL	_	_	—	—	—	—	TGATE	TCKP	S<1:0>	T32	—	TCS	—	0000
T5CON	0120	TON	_	TSIDL		_	—	—	—	—	TGATE	TCKP	S<1:0>	_	—	TCS	—	0000
TMR6	0122								Timer6	Register								0000
TMR7HLD	0124							Timer7 Hold	ing Register	(for 32-bit o	perations only	y)						xxxx
TMR7	0126								Timer7	Register								0000
PR6	0128								Period F	Register 6								FFFF
PR7	012A								Period F	Register 7								FFFF
T6CON	012C	TON	—	TSIDL		_	—	—	—	—	TGATE	TCKP	S<1:0>	T32	_	TCS	—	0000
T7CON	012E	TON	—	TSIDL		—	—	—	—	—	TGATE	TCKP	S<1:0>	—	—	TCS	—	0000
TMR8	0130								Timer8	Register								0000
TMR9HLD	0132							Timer9 Hold	ing Register	(for 32-bit o	perations only	y)						xxxx
TMR9	0134								Timer9	Register								0000
PR8	0136								Period F	Register 8								FFFF
PR9	0138	Period Register 9 FFFF																
T8CON	013A	TON	—	TSIDL	_	—	—	—	—	—	TGATE	TCKP	S<1:0>	T32	—	TCS	_	0000
T9CON	013C	TON	—	TSIDL	—	—	—	—	_	—	TGATE	TCKP	S<1:0>	—	—	TCS	—	0000

#### . . TIMED DEGIGTED MAD

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.

#### 4.4.2 DATA ACCESS FROM PROGRAM MEMORY USING TABLE INSTRUCTIONS

The TBLRDL and TBLWTL instructions offer a direct method of reading or writing the lower word of any address within the program space without going through data space. The TBLRDH and TBLWTH instructions are the only method to read or write the upper 8 bits of a program space word as data.

The PC is incremented by two for each successive 24-bit program word. This allows program memory addresses to directly map to data space addresses. Program memory can thus be regarded as two 16-bit, word wide address spaces, residing side by side, each with the same address range. TBLRDL and TBLWTL access the space which contains the least significant data word and TBLRDH and TBLWTH access the space which contains the upper data byte.

Two table instructions are provided to move byte or word sized (16-bit) data to and from program space. Both function as either byte or word operations.

 TBLRDL (Table Read Low): In Word mode, it maps the lower word of the program space location (P<15:0>) to a data address (D<15:0>).

In Byte mode, either the upper or lower byte of the lower program word is mapped to the lower byte of a data address. The upper byte is selected when Byte Select is '1'; the lower byte is selected when it is '0'.  TBLRDH (Table Read High): In Word mode, it maps the entire upper word of a program address (P<23:16>) to a data address. Note that D<15:8>, the 'phantom byte', will always be '0'.

In Byte mode, it maps the upper or lower byte of the program word to D<7:0> of the data address, as above. Note that the data will always be '0' when the upper 'phantom' byte is selected (Byte Select = 1).

In a similar fashion, two table instructions, TBLWTH and TBLWTL, are used to write individual bytes or words to a program space address. The details of their operation are explained in **Section 5.0 "Flash Program Memory"**.

For all table operations, the area of program memory space to be accessed is determined by the Table Page register (TBLPAG). TBLPAG covers the entire program memory space of the device, including user and configuration spaces. When TBLPAG<7> = 0, the table page is located in the user memory space. When TBLPAG<7> = 1, the page is located in configuration space.



# 5.0 FLASH PROGRAM MEMORY

- Note 1: This data sheet summarizes the features of the PIC24HJXXXGPX06A/X08A/X10A family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to Section 5. "Flash Programming" (DS70191) of the "dsPIC33F/PIC24H Family Reference Manual", which is available from the Microchip web site (www.microchip.com).
  - 2: Some registers and associated bits described in this section may not be available on all devices. Refer to Section 4.0 "Memory Organization" in this data sheet for device-specific register and bit information.

The PIC24HJXXXGPX06A/X08A/X10A devices contain internal Flash program memory for storing and executing application code. The memory is readable, writable and erasable during normal operation over the entire VDD range.

Flash memory can be programmed in two ways:

- In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) programming capability
- 2. Run-Time Self-Programming (RTSP)

ICSP programming capability allows a PIC24HJXXXGPX06A/X08A/X10A device to be serially programmed while in the end application circuit. This is simply done with two lines for programming clock and programming data (one of the alternate programming pin pairs: PGECx/PGEDx, and three other lines for power (VDD), ground (VSS) and Master Clear (MCLR). This allows customers to manufacture boards with unprogrammed devices and then program the digital signal controller just before shipping the product. This also allows the most recent firmware or a custom firmware to be programmed.

RTSP is accomplished using TBLRD (table read) and TBLWT (table write) instructions. With RTSP, the user can write program memory data either in blocks or 'rows' of 64 instructions (192 bytes) at a time, or single instructions and erase program memory in blocks or 'pages' of 512 instructions (1536 bytes) at a time.

### 5.1 Table Instructions and Flash Programming

Regardless of the method used, all programming of Flash memory is done with the table read and table write instructions. These allow direct read and write access to the program memory space from the data memory while the device is in normal operating mode. The 24-bit target address in the program memory is formed using bits<7:0> of the TBLPAG register and the Effective Address (EA) from a W register specified in the table instruction, as shown in Figure 5-1.

The TBLRDL and the TBLWTL instructions are used to read or write to bits<15:0> of program memory. TBLRDL and TBLWTL can access program memory in both Word and Byte modes.

The TBLRDH and TBLWTH instructions are used to read or write to bits<23:16> of program memory. TBLRDH and TBLWTH can also access program memory in Word or Byte mode.

#### FIGURE 5-1: ADDRESSING FOR TABLE REGISTERS



# 5.2 RTSP Operation

The PIC24HJXXXGPX06A/X08A/X10A Flash program memory array is organized into rows of 64 instructions or 192 bytes. RTSP allows the user to erase a page of memory, which consists of eight rows (512 instructions) at a time, and to program one row or one word at a time. Table 24-12 displays typical erase and programming times. The 8-row erase pages and single row write rows are edge-aligned, from the beginning of program memory, on boundaries of 1536 bytes and 192 bytes, respectively.

The program memory implements holding buffers that can contain 64 instructions of programming data. Prior to the actual programming operation, the write data must be loaded into the buffers in sequential order. The instruction words loaded must always be from a group of 64 boundary.

The basic sequence for RTSP programming is to set up a Table Pointer, then do a series of TBLWT instructions to load the buffers. Programming is performed by setting the control bits in the NVMCON register. A total of 64 TBLWTL and TBLWTH instructions are required to load the instructions.

All of the table write operations are single-word writes (two instruction cycles) because only the buffers are written. A programming cycle is required for programming each row.

#### 5.3 Programming Operations

A complete programming sequence is necessary for programming or erasing the internal Flash in RTSP mode. The processor stalls (waits) until the programming operation is finished.

The programming time depends on the FRC accuracy (see Table 24-19) and the value of the FRC Oscillator Tuning register (see Register 9-4). Use the following formula to calculate the minimum and maximum values for the Row Write Time, Page Erase Time and Word Write Cycle Time parameters (see Table 24-12).

#### EQUATION 5-1: PROGRAMMING TIME



For example, if the device is operating at +125°C, the FRC accuracy will be  $\pm 5\%$ . If the TUN<5:0> bits (see Register 9-4) are set to `bl11111, the minimum row write time is equal to Equation 5-2.

#### EQUATION 5-2: MINIMUM ROW WRITE TIME

$$T_{RW} = \frac{11064 \ Cycles}{7.37 \ MHz \times (1 + 0.05) \times (1 - 0.00375)} = 1.435 ms$$

The maximum row write time is equal to Equation 5-3.

#### EQUATION 5-3: MAXIMUM ROW WRITE TIME

$$T_{RW} = \frac{11064 \ Cycles}{7.37 \ MHz \times (1 - 0.05) \times (1 - 0.00375)} = 1.586 ms$$

Setting the WR bit (NVMCON<15>) starts the operation, and the WR bit is automatically cleared when the operation is finished.

# 5.4 Control Registers

The two SFRs that are used to read and write the program Flash memory are:

- NVMCON
- NVMKEY

The NVMCON register (Register 5-1) controls which blocks are to be erased, which memory type is to be programmed and the start of the programming cycle.

NVMKEY is a write-only register that is used for write protection. To start a programming or erase sequence, the user must consecutively write 0x55 and 0xAA to the NVMKEY register. Refer to **Section 5.3 "Programming Operations"** for further details.

#### REGISTER 8-5: DMAxPAD: DMA CHANNEL x PERIPHERAL ADDRESS REGISTER<sup>(1)</sup>

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
			PAD	<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
			PAE	)<7:0>			
bit 7							bit 0
Legend:							
R = Readable	bit	W = Writable	bit	U = Unimpler	nented bit, rea	d as '0'	
-n = Value at POR '1' = Bit is set '0' = Bit is cleared x = Bit is unknown							nown

bit 15-0 PAD<15:0>: Peripheral Address Register bits

**Note 1:** If the channel is enabled (i.e., active), writes to this register may result in unpredictable behavior of the DMA channel and should be avoided.

### REGISTER 8-6: DMAxCNT: DMA CHANNEL x TRANSFER COUNT REGISTER<sup>(1)</sup>

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0		
—	—	—		—	—	CNT<	9:8> <b>(2)</b>		
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		
CNT<7:0> <sup>(2)</sup>									

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 CNT<9:0>: DMA Transfer Count Register bits<sup>(2)</sup>

- **Note 1:** If the channel is enabled (i.e., active), writes to this register may result in unpredictable behavior of the DMA channel and should be avoided.
  - 2: Number of DMA transfers = CNT<9:0> + 1.

bit 7

bit 0

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
			_				_
bit 15							bit 8
U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	_			TUN	<5:0>(1)		
bit 7	·						bit 0
Legend:							
R = Readable	bit	W = Writable I	oit	U = Unimpler	mented bit, read	1 as '0'	
-n = Value at F	POR	'1' = Bit is set		'0' = Bit is cle	x = Bit is unkr	Iown	
bit 15-6	Unimplemen	ted: Read as 'o	)'				
bit 5-0	TUN<5:0>: FI	RC Oscillator T	uning bits <sup>(1)</sup>				
	111111 <b>= Ce</b>	nter frequency	– 0.375% (7.3	345 MHz)			
	•						
	•						
	100001 <b>= Ce</b>	nter frequency	– 11.625% (6	6.52 MHz)			
	100000 <b>= Ce</b>	nter frequency	– 12% (6.49	MHz)			
	011111 = Ce	nter frequency	+ 11.625% (8	8.23 MHz)			
	•	nter frequency	+ 11.25% (8.4	20 MHZ)			
	•						
	•						
	000001 = Ce	nter frequency	+ 0.375% (7.4	40 MHz)			
	000000 = Ce	nter frequency	(1.31 WHZ NC	ominal)			

### REGISTER 9-4: OSCTUN: FRC OSCILLATOR TUNING REGISTER<sup>(2)</sup>

- **Note 1:** OSCTUN functionality has been provided to help customers compensate for temperature effects on the FRC frequency over a wide range of temperatures. The tuning step size is an approximation and is neither characterized nor tested.
  - 2: This register is reset only on a Power-on Reset (POR).

# 17.0 INTER-INTEGRATED CIRCUIT™ (I<sup>2</sup>C™)

- Note 1: This data sheet summarizes the features of the PIC24HJXXXGPX06A/X08A/X10A family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to Section 19. "Inter-Integrated Circuit™ (I<sup>2</sup>C™)" (DS70195) of the "dsPIC33F/ PIC24H Family Reference Manual", which is available from the Microchip web site (www.microchip.com).
  - Some registers and associated bits described in this section may not be available on all devices. Refer to Section 4.0 "Memory Organization" in this data sheet for device-specific register and bit information.

The Inter-Integrated Circuit ( $I^2C$ ) module provides complete hardware support for both Slave and Multi-Master modes of the  $I^2C$  serial communication standard, with a 16-bit interface.

The PIC24HJXXXGPX06A/X08A/X10A devices have up to two I<sup>2</sup>C interface modules, denoted as I2C1 and I2C2. Each I<sup>2</sup>C module has a 2-pin interface: the SCLx pin is clock and the SDAx pin is data.

Each  $I^2C$  module 'x' (x = 1 or 2) offers the following key features:

- I<sup>2</sup>C interface supporting both master and slave operation
- I<sup>2</sup>C Slave mode supports 7-bit and 10-bit addressing
- I<sup>2</sup>C Master mode supports 7-bit and 10-bit addressing
- I<sup>2</sup>C Port allows bidirectional transfers between master and slaves
- Serial clock synchronization for I<sup>2</sup>C port can be used as a handshake mechanism to suspend and resume serial transfer (SCLREL control)
- I<sup>2</sup>C supports multi-master operation; detects bus collision and will arbitrate accordingly

# 17.1 Operating Modes

The hardware fully implements all the master and slave functions of the  $l^2C$  Standard and Fast mode specifications, as well as 7 and 10-bit addressing.

The  $I^2C$  module can operate either as a slave or a master on an  $I^2C$  bus.

The following types of I<sup>2</sup>C operation are supported:

- I<sup>2</sup>C slave operation with 7-bit addressing
- I<sup>2</sup>C slave operation with 10-bit addressing
- I<sup>2</sup>C master operation with 7-bit or 10-bit addressing

For details about the communication sequence in each of these modes, please refer to the *"dsPIC33F/PIC24H Family Reference Manual"*.

# REGISTER 17-2: I2CxSTAT: I2Cx STATUS REGISTER (CONTINUED)

bit 3	<ul> <li>Start bit</li> <li>1 = Indicates that a Start (or Repeated Start) bit has been detected last</li> <li>0 = Start bit was not detected last</li> </ul>
bit 2	Hardware set or clear when Start, Repeated Start or Stop detected. <b>R_W:</b> Read/Write Information bit (when operating as $I^2C$ slave) 1 = Read – indicates data transfer is output from slave
	0 = Write - indicates data transfer is input to slaveHardware set or clear after reception of I2C device address byte.
bit 1	RBF: Receive Buffer Full Status bit
	<ul> <li>1 = Receive complete, I2CxRCV is full</li> <li>0 = Receive not complete, I2CxRCV is empty</li> <li>Hardware set when I2CxRCV is written with received byte. Hardware clear when software reads I2CxRCV.</li> </ul>
bit 0	TBF: Transmit Buffer Full Status bit
	<ul> <li>1 = Transmit in progress, I2CxTRN is full</li> <li>0 = Transmit complete, I2CxTRN is empty</li> <li>Hardware set when software writes I2CxTRN. Hardware clear at completion of data transmission.</li> </ul>

#### REGISTER 19-20: CIRXMnSID: ECAN™ MODULE ACCEPTANCE FILTER MASK n STANDARD **IDENTIFIER**

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x		
			SID	<10:3>					
bit 15							bit 8		
R/W-x	R/W-x	R/W-x	U-0	R/W-x	U-0	R/W-x	R/W-x		
	SID<2:0>		—	MIDE	—	EID<1	17:16>		
bit 7							bit 0		
l egend:							]		
R = Readable bit W = Writable bit U = Unimplemented bit, read as '0'									
-n = Value at	POR	'1' = Bit is set		'0' = Bit is cle	ared	x = Bit is unkr	nown		
bit 15-5	SID<10:0>: \$	Standard Identi	fier bits						
	1 = Include bi	it SIDx in filter	comparison						
	0 = Bit SIDx i	s don't care in	filter compari	son					
bit 4	Unimplemen	ted: Read as '	0'						
bit 3	MIDE: Identi	fier Receive Mo	ode bit						
	1 = Match or	nly message typ	oes (standard	l or extended a	ddress) that cor	respond to EXI	DE bit in filter		
	0 = Match ei	ther standard o	or extended a	ddress messag	e if filters match				
	(I.e., If (F	(Me)	essage SID) (	or if (Filter SID/I	=ID) = (Messag	e SID/EID))			
bit 2	Unimplemen	ted: Read as '	0'						
bit 1-0	EID<17:16>:	Extended Ider	ntifier bits						
	1 = Include b	it EIDx in filter	comparison						
	0 = Bit EIDx	is don't care in	filter compar	ison					

#### REGISTER 19-21: CIRXMnEID: ECAN™ TECHNOLOGY ACCEPTANCE FILTER MASK n EXTENDED **IDENTIFIER**

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x					
	EID<15:8>											
bit 15							bit 8					
R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x					
			EID	<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 EID<15:0>: Extended Identifier bits

1 = Include bit EIDx in filter comparison

0 = Bit EIDx is don't care in filter comparison

### 21.4 Watchdog Timer (WDT)

For PIC24HJXXXGPX06A/X08A/X10A devices, the WDT is driven by the LPRC oscillator. When the WDT is enabled, the clock source is also enabled.

The nominal WDT clock source from LPRC is 32 kHz. This feeds a prescaler than can be configured for either 5-bit (divide-by-32) or 7-bit (divide-by-128) operation. The prescaler is set by the WDTPRE Configuration bit. With a 32 kHz input, the prescaler yields a nominal WDT time-out period (TwDT) of 1 ms in 5-bit mode, or 4 ms in 7-bit mode.

A variable postscaler divides down the WDT prescaler output and allows for a wide range of time-out periods. The postscaler is controlled by the WDTPOST<3:0> Configuration bits (FWDT<3:0>) which allow the selection of a total of 16 settings, from 1:1 to 1:32,768. Using the prescaler and postscaler, time-out periods ranging from 1 ms to 131 seconds can be achieved.

The WDT, prescaler and postscaler are reset:

- On any device Reset
- On the completion of a clock switch, whether invoked by software (i.e., setting the OSWEN bit after changing the NOSC bits) or by hardware (i.e., Fail-Safe Clock Monitor)
- When a PWRSAV instruction is executed (i.e., Sleep or Idle mode is entered)
- When the device exits Sleep or Idle mode to resume normal operation
- By a CLRWDT instruction during normal execution

If the WDT is enabled, it will continue to run during Sleep or Idle modes. When the WDT time-out occurs, the device will wake the device and code execution will continue from where the PWRSAV instruction was executed. The corresponding SLEEP or IDLE bits (RCON<3,2>) will need to be cleared in software after the device wakes up.

The WDT flag bit, WDTO (RCON<4>), is not automatically cleared following a WDT time-out. To detect subsequent WDT events, the flag must be cleared in software.

Note: The CLRWDT and PWRSAV instructions clear the prescaler and postscaler counts when executed.

The WDT is enabled or disabled by the FWDTEN Configuration bit in the FWDT Configuration register. When the FWDTEN Configuration bit is set, the WDT is always enabled.

The WDT can be optionally controlled in software when the FWDTEN Configuration bit has been programmed to '0'. The WDT is enabled in software by setting the SWDTEN control bit (RCON<5>). The SWDTEN control bit is cleared on any device Reset. The software WDT option allows the user to enable the WDT for critical code segments and disable the WDT during non-critical segments for maximum power savings.

Note: If the WINDIS bit (FWDT<6>) is cleared, the CLRWDT instruction should be executed by the application software only during the last 1/4 of the WDT period. This CLRWDT window can be determined by using a timer. If a CLRWDT instruction is executed before this window, a WDT Reset occurs.



#### FIGURE 21-2: WDT BLOCK DIAGRAM

NOTES:



АС СН/	ARACTER	RISTICS	$\begin{array}{l} \mbox{Standard Operating Conditions: 3.0V to 3.6V} \\ \mbox{(unless otherwise stated)} \\ \mbox{Operating temperature} & -40^\circ C \leq TA \leq +85^\circ C \mbox{ for Industrial} \\ & -40^\circ C \leq TA \leq +125^\circ C \mbox{ for Extended} \end{array}$						
Param No.	Symbol	Characteristic	Min	Typ <sup>(1)</sup>	Мах	Units	Conditions		
OS10	FIN	External CLKI Frequency (External clocks allowed only in EC and ECPLL modes)	DC	_	40	MHz	EC		
		Oscillator Crystal Frequency	3.5 10		10 40 33	MHz MHz kHz	XT HS SOSC		
OS20	Tosc	Tosc = 1/Fosc	12.5	_	DC	ns	_		
OS25	Тсү	Instruction Cycle Time <sup>(2)</sup>	25		DC	ns	—		
OS30	TosL, TosH	External Clock in (OSC1) High or Low Time	0.375 x Tosc	_	0.625 x Tosc	ns	EC		
OS31	TosR, TosF	External Clock in (OSC1) Rise or Fall Time	—	_	20	ns	EC		
OS40	TckR	CLKO Rise Time <sup>(3)</sup>	—	5.2	—	ns	—		
OS41	TckF	CLKO Fall Time <sup>(3)</sup>	—	5.2	—	ns	—		
OS42	Gм	External Oscillator Transconductance <sup>(4)</sup>	14	16	18	mA/V	VDD = 3.3V TA = +25°C		

#### TABLE 24-16: EXTERNAL CLOCK TIMING REQUIREMENTS

Note 1: Data in "Typ" column is at 3.3V, 25°C unless otherwise stated.

2: Instruction cycle period (TCY) equals two times the input oscillator time-base period. All specified values are based on characterization data for that particular oscillator type under standard operating conditions with the device executing code. Exceeding these specified limits may result in an unstable oscillator operation and/or higher than expected current consumption. All devices are tested to operate at "min." values with an external clock applied to the OSC1/CLKI pin. When an external clock input is used, the "max." cycle time limit is "DC" (no clock) for all devices.

- 3: Measurements are taken in EC mode. The CLKO signal is measured on the OSC2 pin.
- 4: Data for this parameter is Preliminary. This parameter is characterized, but not tested in manufacturing.

# TABLE 24-34:SPIX SLAVE MODE (FULL-DUPLEX, CKE = 0, CKP = 1, SMP = 0) TIMING<br/>REQUIREMENTS

АС СНА	ARACTERIS	TICS	$\begin{array}{l} \mbox{Standard Operating Conditions: 2.4V to 3.6V} \\ \mbox{(unless otherwise stated)} \\ \mbox{Operating temperature} & -40^{\circ}C \leq TA \leq +85^{\circ}C \mbox{ for Industrial} \\ & -40^{\circ}C \leq TA \leq +125^{\circ}C \mbox{ for Extended} \end{array}$						
Param No.	Symbol	Characteristic <sup>(1)</sup>	Min	Тур <sup>(2)</sup>	Max	Units	Conditions		
SP70	TscP	Maximum SCK Input Frequency	—	_	15	MHz	See Note 3		
SP72	TscF	SCKx Input Fall Time	—			ns	See parameter DO32 and <b>Note 4</b>		
SP73	TscR	SCKx Input Rise Time	—			ns	See parameter DO31 and <b>Note 4</b>		
SP30	TdoF	SDOx Data Output Fall Time	—			ns	See parameter DO32 and <b>Note 4</b>		
SP31	TdoR	SDOx Data Output Rise Time	—		_	ns	See parameter DO31 and <b>Note 4</b>		
SP35	TscH2doV, TscL2doV	SDOx Data Output Valid after SCKx Edge	—	6	20	ns	—		
SP36	TdoV2scH, TdoV2scL	SDOx Data Output Setup to First SCKx Edge	30	_	_	ns	—		
SP40	TdiV2scH, TdiV2scL	Setup Time of SDIx Data Input to SCKx Edge	30	_	_	ns	—		
SP41	TscH2diL, TscL2diL	Hold Time of SDIx Data Input to SCKx Edge	30	_	_	ns	—		
SP50	TssL2scH, TssL2scL	$\overline{SSx} \downarrow$ to SCKx $\uparrow$ or SCKx Input	120			ns	_		
SP51	TssH2doZ	SSx ↑ to SDOx Output High-Impedance <sup>(4)</sup>	10	—	50	ns	_		
SP52	TscH2ssH TscL2ssH	SSx after SCKx Edge	1.5 TCY + 40	_	_	ns	See Note 4		

Note 1: These parameters are characterized, but are not tested in manufacturing.

2: Data in "Typ" column is at 3.3V, 25°C unless otherwise stated.

**3:** The minimum clock period for SCKx is 66.7 ns. Therefore, the SCK clock generated by the Master must not violate this specificiation.

**4:** Assumes 50 pF load on all SPIx pins.







AC CHARACTERISTICS         (unless otherwise stated) Operating temperature $40^{\circ}C \le Ta \le +125^{\circ}C$ for Extended           Param No.         Symbol         Characteristic         Min <sup>(1)</sup> Max         Units         Conditions           IM10         TL0:SCL         Clock Low Time 400 kHz mode         100 kHz mode TCV/2 (BRG + 1)         — $\mu$ s         —           IM11         TH:SCL         Clock High Time 400 kHz mode         100 kHz mode TCV/2 (BRG + 1)         — $\mu$ s         —           IM20         TF:SCL         SDA and SCLx         100 kHz mode 400 kHz mode         —         300         ns         Clois specified to be from 10 to 400 pF           IM21         TF:SCL         SDA and SCLx         100 kHz mode         —         300         ns         Clois specified to be from 10 to 400 pF           IM21         TR:SCL         SDA and SCLx         100 kHz mode         —         300         ns         Form 10 to 400 pF           IM24         TR:SCL         SDA and SCLx         100 kHz mode         —         300         ns         Form 10 to 400 pF           IM26         TSU:DAT         Data Input Hold KHz mode         100 kHz mode         —         ns         Clois specified to be from 10 to 400 pF           IM27         Data Input					Standard Operating Conditions: 3.0V to 3.6V						
Operating temperature	AC CHA	ARACTER	ISTICS		(unless otherwise	stated)					
Param No.         Symbol         Characteristic         Min <sup>(1)</sup> Max         Units         Conditions           IM10         TL0:SCL         Clock Low Time         100 kHz mode         TCv/2 (BRG + 1)         — $\mu$ s         —           101         TL0:SCL         Clock High Time         100 kHz mode         TCv/2 (BRG + 1)         — $\mu$ s         —           1111         TH:SCL         Clock High Time         100 kHz mode         TCv/2 (BRG + 1)         — $\mu$ s         —           1111         TH:SCL         Clock High Time         100 kHz mode         TCv/2 (BRG + 1)         — $\mu$ s         —           1111         TH:SCL         SDAx and SCLx         100 kHz mode         TCv/2 (BRG + 1)         — $\mu$ s         —           1111         TR:SCL         SDAx and SCLx         100 kHz mode         20 + 0.1 CB         300         ns         form 10 to 400 pF           1111         TR:SCL         SDAx and SCLx         100 kHz mode         20 + 0.1 CB         300         ns         form 10 to 400 pF           1111         TR:SCL         SDAx and SCLx         100 kHz mode         20 + 0.1 CB         300         ns         form 10 to 400 pF           11111         TR:					Operating tempera	iture -40	)°C ≤ IA <u>≤</u> )°C < T∧ <	$\leq$ +85°C for Industrial			
Param No.         Symbol         Characteristic         Min <sup>(1)</sup> Max         Units         Conditions           IM10         TLO:SCL         Clock Low Time 400 kHz mode         100 kHz mode         TC:V/2 (BRG + 1)          µs            IM11         TH:SCL         Clock High Time -         10 kHz mode         TC:V/2 (BRG + 1)          µs            IM11         TH:SCL         Clock High Time -         10 kHz mode         TC:V/2 (BRG + 1)          µs            IM12         TS:SCL         SDAx and SCLx         TC:V/2 (BRG + 1)          µs           100 kHz          100         ns         Cs is specified to be from 10 to 400 pF           IM20         TF:SCL         SDAx and SCLx         100 kHz mode          1000         ns         from 10 to 400 pF         101 kHz mode <sup>12</sup> 1000         ns         from 10 to 400 pF         104 kHz mode         104 kHz mode         100 kHz mode         100         ns         from 10 to 400 pF         104 kHz mode         100 kHz mode         100 kHz mode         100         ns         from 10 to 400 pF         104 kHz mode         104 kHz mode         104 kHz mode         104 kHz mode         1			1			-4(					
IM10         TLO:SCL         Clock Low Time         100 kHz mode         Tcv/2 (BRG + 1)          μs            1 MHz mode         Tcv/2 (BRG + 1)          μs	Param No.	Symbol	Charac	teristic	Min <sup>(1)</sup>	Max	Units	Conditions			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	IM10	TLO:SCL	Clock Low Time	100 kHz mode	Tcy/2 (BRG + 1)		μs	_			
IM11         TH:SCL         Clock High Time         100 KHz mode         Tc:Y2 (BRG + 1)          μs            IM11         TH:SCL         Clock High Time         100 KHz mode         Tc:Y2 (BRG + 1)          μs            IM20         TF:SCL         SDAx and SCLx         100 kHz mode          300         ns         Fisse Time          400 kHz mode          1000         ns         Fisse Time          400 kHz mode          1000         ns         Fisse Time          400 kHz mode          300         ns         Fisse Time          400 kHz mode          300         ns         Fisse Time          400 kHz mode           100 kHz           400 kHz          400 kHz </td <td></td> <td></td> <td></td> <td>400 kHz mode</td> <td>Tcy/2 (BRG + 1)</td> <td>_</td> <td>μS</td> <td>_</td>				400 kHz mode	Tcy/2 (BRG + 1)	_	μS	_			
IM11         TH:SCL         Clock High Time (400 kHz mode 1 MHz mode <sup>42)</sup> TC:V/2 (BRG + 1) TC:V/2 (BRG + 1)				1 MHz mode <sup>(2)</sup>	Tcy/2 (BRG + 1)	_	μS	_			
IM20         Field Time         400 kHz mode 1 MHz mode 20 + 0.1 CB	IM11	THI:SCL	Clock High Time	100 kHz mode	Tcy/2 (BRG + 1)	_	μS	_			
IM20         Tr:ScL Fall Time         SDAx and SCLx Fall Time         100 kHz mode 400 kHz mode 1 MHz mode <sup>42</sup> 300         ns mon 10 to 400 pF           IM21         Tr:ScL Resc         SDAx and SCLx Rise Time Network         100 kHz mode 400 kHz mode 1 MHz mode <sup>42</sup> 1000         ns mon 10 to 400 pF           IM21         Tr:ScL Rise Time Network         SDAx and SCLx 400 kHz mode 1 MHz mode <sup>42</sup> 100 kHz mode 20 + 0.1 CB         300         ns mon 10 to 400 pF           IM25         Tsu:Dat Setup Time         Data Input Setup Time         100 kHz mode 400 kHz mode 1 MHz mode <sup>42</sup> ns mon 10 to 400 pF           IM26         ThD:Dat Pata Input Hold Time         100 kHz mode 400 kHz mode 1 MHz mode <sup>42</sup> 0.0          µs mon 10 to 400 pF           IM30         Tsu:STA Start Condition Hold Time         100 kHz mode 400 kHz mode 100 kHz m				400 kHz mode	Tcy/2 (BRG + 1)	_	μS	_			
IM20         TF:SCL         SDAx and SCLx Fail Time         100 kHz mode         —         300         ns.         Ca is specified to be from 10 to 400 pF           IM21         TR:SCL         SDAx and SCLx Rise Time         100 kHz mode         —         1000         ns         Ca is specified to be from 10 to 400 pF           IM21         TR:SCL         SDAx and SCLx Rise Time         100 kHz mode         20 + 0.1 CB         300         ns         Ca is specified to be from 10 to 400 pF           IM25         TSU:DAT         Data Input Setup Time         100 kHz mode         20 + 0.1 CB         300         ns         from 10 to 400 pF           IM26         THD:DAT         Data Input Hold Time         100 kHz mode         20 -         ns         -         -           IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0         -         µs         -           IM30         TSU:STA         Start Condition         100 kHz mode         0.2         -         µs         Repeated Start condition           IM31         THD:STA         Start Condition         100 kHz mode         Tc://2 (BRG + 1)         -         µs         After this period the frist clock pulse is generated           IM33         TSU:STO         Stop Condition         100				1 MHz mode <sup>(2)</sup>	Tcy/2 (BRG + 1)	_	μS	_			
Fall Time         400 kHz mode         20 + 0.1 CB         300         ns         from 10 to 400 pF           IM21         TR:SCL         SDAx and SCLx         100 kHz mode         —         1000         ns         from 10 to 400 pF           IM21         TR:SCL         SDAx and SCLx         100 kHz mode         —         1000         ns         from 10 to 400 pF           IM25         Tsu:DAT         Data Input         100 kHz mode         20 + 0.1 CB         300         ns         from 10 to 400 pF           IM25         Tsu:DAT         Data Input         100 kHz mode         250         —         ns         —           IM25         Tsu:DAT         Data Input         100 kHz mode         0         —         ns         —           IM30         Tsu:STA         Start Condition         100 kHz mode         0          µs         Repeated Start           IM31         THD:STA         Start Condition         100 kHz mode         Tcv/2 (BRG + 1)         —         µs         After this period the           IM31         THD:STA         Start Condition         100 kHz mode         Tcv/2 (BRG + 1)         —         µs         from 10 to 400 pF           IM33         Tsu:STO         Stop Condition	IM20	TF:SCL	SDAx and SCLx	100 kHz mode	—	300	ns	CB is specified to be			
IM21         TR:SCL         SDAx and SCLx Rise Time         100 kHz mode 400 kHz mode 1 MHz mode <sup>(2)</sup> 1000 300         ns mode         Case specified to be from 10 to 400 pF           IM25         Tsu:DaT         Data Input Setup Time         100 kHz mode 400 kHz mode         20 + 0.1 CB         300         ns         from 10 to 400 pF           IM25         Tsu:DaT         Data Input Setup Time         100 kHz mode         250          ns            IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          µs            IM30         Tsu:STA         Start Condition Setup Time         100 kHz mode         0          µs         0nly relevant for           IM30         Tsu:STA         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          µs         Only relevant for           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM33         Tsu:Start         Stop Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          µs            IM34         THD:STO         Stop			Fall Time	400 kHz mode	20 + 0.1 Св	300	ns	from 10 to 400 pF			
IM21         TR:SCL Rise Time         SDAx and SCLx Rise Time         100 kHz mode 400 kHz mode 1 MHz mode <sup>(2)</sup> 1000 300         ns from 10 to 400 pF           IM25         Tsu:DAT Setup Time         Data Input Setup Time         100 kHz mode 400 kHz mode <sup>(2)</sup> ns ns            IM26         THD:DAT Hold Time         Data Input Hold Time         100 kHz mode 400 kHz mode         0          ns            IM26         THD:DAT TSU:STA         Data Input Hold Time         100 kHz mode 400 kHz mode         0          µs            IM30         TSU:STA         Start Condition Setup Time         100 kHz mode         TCY/2 (BRG + 1)          µs         Conly relevant for condition           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         TCY/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         TCY/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM33         TSU:STO         Stop Condition Hold Time         100 kHz mode         TCY/2 (BRG + 1)          µs            IM40				1 MHz mode <sup>(2)</sup>	—	100	ns	-			
Rise Time         400 kHz mode         20 + 0.1 CB         300         ns         from 10 to 400 pF           IM25         Tsu:DAT         Data Input Setup Time         100 kHz mode         250          ns            IM26         THD:DAT         Data Input Setup Time         100 kHz mode         000          ns            IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          ms            IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          ms            IM30         Tsu:STA         Start Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          ms         After this period the first clock pulse is generated           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          ms         After this period the first clock pulse is generated           IM33         Tsu:STO         Stop Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          ms            IM34         THD:STO         Stop Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          ms	IM21	TR:SCL	SDAx and SCLx	100 kHz mode	—	1000	ns	CB is specified to be			
IM25         Tsu:Dat Setup Time         Data Input Setup Time         100 kHz mode         250          ns           IM25         Tsu:Dat Setup Time         Data Input Setup Time         100 kHz mode         100          ns           IM26         THD:DAT H0:DAT         Data Input Hold Time         100 kHz mode         0          ns           IM30         Tsu:STA M30         Start Condition Setup Time         100 kHz mode         0          µs           IM30         Tsu:STA M30         Start Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          µs           IM31         THD:STA H0! Time         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          µs           IM33         Tsu:STO H0! Time         Start Condition Hold Rize mode         Tcv/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM33         Tsu:STO H0! Time         Stop Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          µs           IM34         THD:STO H0! KHz mode <sup>(2)</sup> Tcv/2 (BRG + 1)          µs            IM40         Tak:sccL H0! KHz mode <sup>(2)</sup> Cov/2 (BRG + 1) </td <td></td> <td></td> <td>Rise Time</td> <td>400 kHz mode</td> <td>20 + 0.1 Св</td> <td>300</td> <td>ns</td> <td>from 10 to 400 pF</td>			Rise Time	400 kHz mode	20 + 0.1 Св	300	ns	from 10 to 400 pF			
IM25         Tsu:DAT         Data Input Setup Time         100 kHz mode         250          ns            IM26         THD:DAT         Data Input Hold Time         100 kHz mode         100          ns          ns           IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          ms            IM30         TSU:STA         Start Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          ms         Only relevant for Repeated Start condition           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          ms         After this period the first clock pulse is generated           IM33         TSU:STA         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          ms            IM33         TSU:STO         Stop Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          ms            IM34         THD:STO         Stop Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          ms            IM34         THD:STO         Stop Condition Hold Time         100 kHz mode				1 MHz mode <sup>(2)</sup>	_	300	ns	-			
Setup Time         400 kHz mode         100          ns           IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          µs           IM30         Tsu:STA         Start Condition Setup Time         100 kHz mode         0.2          µs           IM30         Tsu:STA         Start Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          µs         Only relevant for Repeated Start condition           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         Tcv/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM33         TSU:STO         Stop Condition Setup Time         100 kHz mode         Tcv/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM33         TSU:STO         Stop Condition Not prime         100 kHz mode         Tcv/2 (BRG + 1)          µs            IM34         THD:STO         Stop Condition Netup Time         100 kHz mode         Tcv/2 (BRG + 1)          µs            IM34         THD:STO         Stop Condition Netup Time         100 kHz mode         Tcv/2 (BRG + 1)          ns         <	IM25	TSU:DAT	Data Input	100 kHz mode	250		ns	—			
IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          ns           IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          µs            IM30         TSU:STA         Start Condition Setup Time         100 kHz mode         TcY/2 (BRG + 1)          µs         Only relevant for Repeated Start condition           IM30         THD:STA         Start Condition Setup Time         100 kHz mode         TcY/2 (BRG + 1)          µs         Only relevant for Repeated Start condition           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         TcY/2 (BRG + 1)          µs         After this period the first clock pulse is generated           IM33         TSU:STO         Stop Condition Setup Time         100 kHz mode         TcY/2 (BRG + 1)          µs            IM34         THD:STO         Stop Condition Hold Time         100 kHz mode         TcY/2 (BRG + 1)          µs            IM34         THD:STO         Stop Condition Hold Time         100 kHz mode         TcY/2 (BRG + 1)          ns            IM40         TAA:SCL         Output Valid From Clock         100 kH			Setup Time	400 kHz mode	100	_	ns	-			
IM26         THD:DAT         Data Input Hold Time         100 kHz mode         0          μs            IM30         TsU:STA         Start Condition Setup Time         100 kHz mode         TcY/2 (BRG + 1)          μs         Only relevant for Repeated Start condition           IM31         THD:STA         Start Condition Setup Time         100 kHz mode         TcY/2 (BRG + 1)          μs         Repeated Start condition           IM31         THD:STA         Start Condition Hold Time         100 kHz mode         TcY/2 (BRG + 1)          μs         After this period the first clock pulse is generated           IM33         TSU:STO         Stop Condition Netup Time         100 kHz mode         TcY/2 (BRG + 1)          μs         first clock pulse is generated           IM33         TSU:STO         Stop Condition Netup Time         100 kHz mode         TcY/2 (BRG + 1)          μs         first clock pulse is generated           IM34         THD:STO         Stop Condition Hold Time         100 kHz mode         TcY/2 (BRG + 1)          μs            IM40         TAR:SCL         Output Valid From Clock         100 kHz mode         TcY/2 (BRG + 1)          ns            IM40				1 MHz mode <sup>(2)</sup>	40		ns	-			
$ \begin{array}{ c c c c c c } \hline Hold Time & \hline Hold Tim$	IM26	THD:DAT	Data Input	100 kHz mode	0		μs	—			
IM30         TSU:STA Setup Time         Start Condition Setup Time         100 kHz mode         TCY/2 (BRG + 1)         —         μs         Only relevant for Repeated Start condition           IM30         TSU:STA Main         Start Condition Setup Time         100 kHz mode         TCY/2 (BRG + 1)         —         μs         Only relevant for Repeated Start condition           IM31         THD:STA Mole Time         Start Condition Hold Time         100 kHz mode         TCY/2 (BRG + 1)         —         μs         After this period the first clock pulse is generated           IM33         TSU:STO Main         Stop Condition Setup Time         100 kHz mode         TCY/2 (BRG + 1)         —         μs         After this period the first clock pulse is generated           IM33         TSU:STO Main         Stop Condition Setup Time         100 kHz mode         TCY/2 (BRG + 1)         —         μs         —           IM34         THD:STO Main         Stop Condition Hold Time         100 kHz mode         Tcy/2 (BRG + 1)         —         μs         —         —           IM34         THD:STO Main         Stop Condition Hold Time         100 kHz mode         Tcy/2 (BRG + 1)         —         ns         —           IM40         TAA:SCL Prom Clock         Output Valid From Clock         100 kHz mode         —         100 kHz			Hold Time	400 kHz mode	0	0.9	μS				
IM30Tsu:STAStart Condition Setup Time100 kHz modeTcy/2 (BRG + 1)-μsOnly relevant for Repeated Start conditionIM31THD:STAStart Condition Hold Time100 kHz modeTcy/2 (BRG + 1)-μsAfter this period the first clock pulse is generatedIM33Tsu:STOStart Condition Hold Time100 kHz modeTcy/2 (BRG + 1)-μsAfter this period the first clock pulse is generatedIM33Tsu:STOStop Condition Setup Time100 kHz modeTcy/2 (BRG + 1)-μs-IM33Tsu:STOStop Condition Setup Time100 kHz modeTcy/2 (BRG + 1)-μs-IM34THD:STOStop Condition Hold Time100 kHz modeTcy/2 (BRG + 1)-μs-IM34THD:STOStop Condition Hold Time100 kHz modeTcy/2 (BRG + 1)-μs-IM34THD:STOStop Condition Hold Time100 kHz modeTcy/2 (BRG + 1)-ns-IM40TaA:SCLOutput Valid From Clock100 kHz modeTcy/2 (BRG + 1)-ns-IM45TBF:SDABus Free Time How Hz mode100 kHz mode-1000ns-IM45TBF:SDABus Capacitive Loading-400-μsfree before a new transmission can startIM50CBBus Capacitive Loading-400pFIM51TPGDPulse Gobbler Delay65390 <t< td=""><td></td><td></td><td></td><td>1 MHz mode<sup>(2)</sup></td><td>0.2</td><td></td><td>μS</td><td>-</td></t<>				1 MHz mode <sup>(2)</sup>	0.2		μS	-			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	IM30	TSU:STA	Start Condition	100 kHz mode	Tcy/2 (BRG + 1)		μS	Only relevant for			
$ \begin{array}{ c c c c c c } \hline \mbox{IM31} \\ \mbox{IM31} \\ \mbox{IM31} \\ \mbox{IM31} \\ \mbox{IM2} \\ \mbox{IM32} \\ \mbox{IM33} \\ \mbox{IM33} \\ \mbox{IM33} \\ \mbox{ISU:STO} \\ \mbox{ISU:STO} \\ \mbox{ISO} \\ \mbox{Condition} \\ \mbox{Image 1} \\ \mbox{Image 1}$			Setup Time	400 kHz mode	Tcy/2 (BRG + 1)		μS	Repeated Start			
IM31THD:STAStart Condition Hold Time100 kHz modeTCY/2 (BRG + 1)μsAfter this period the first clock pulse is generatedIM33TSU:STOStop Condition Setup Time100 kHz modeTCY/2 (BRG + 1)μsfirst clock pulse is generatedIM33TSU:STOStop Condition Setup Time100 kHz modeTCY/2 (BRG + 1)μsIM34THD:STOStop Condition Hold Time100 kHz modeTCY/2 (BRG + 1)μsIM34THD:STOStop Condition Hold Time100 kHz modeTCY/2 (BRG + 1)μsIM40TAA:SCLOutput Valid From Clock100 kHz modeTCY/2 (BRG + 1)nsIM45TBF:SDABus Free Time 400 kHz mode100 kHz mode1000nsIM50CBBus Capacitive Loading400pFμsIM50CBBus Capacitive Loading400pFIM51TPGDPulse Gobbler Delay65390nsSee Note 3				1 MHz mode <sup>(2)</sup>	Tcy/2 (BRG + 1)	—	μS	condition			
Hold Time400 kHz mode 1 MHz modeTCY/2 (BRG + 1) $\mu$ sfirst clock pulse is generatedIM33TSU:STOStop Condition Setup Time100 kHz modeTCY/2 (BRG + 1) $\mu$ s $\mu$ s $\mu$ sIM34THD:STOStop Condition Net Prime100 kHz modeTCY/2 (BRG + 1) $\mu$ s $$ IM34THD:STOStop Condition Hold Time100 kHz modeTCY/2 (BRG + 1) $\mu$ s $$ IM34THD:STOStop Condition Hold Time100 kHz modeTCY/2 (BRG + 1) $\mu$ s $$ IM40TAA:SCLOutput Valid From Clock100 kHz modeTCY/2 (BRG + 1) $n$ s $$ IM45TBF:SDABus Free Time Hus100 kHz mode1000 $n$ s $$ IM50CBBus Capacitive Loading400 $$ $\mu$ sTime the bus must be free before a new transmission can startIM50CBBus Capacitive Loading400 $p$ FIM51TPGDPulse Gobbler Delay65390nsSee Note 3	IM31	THD:STA	Start Condition	100 kHz mode	Tcy/2 (BRG + 1)	—	μS	After this period the			
$ \begin{array}{ c c c c c } \hline \mbox{IM1} & \mbox{IM2} & \mbox{IM3} & \mbox{ISU:STO} & \mbox{Stop Condition} & \mbox{Setup Time} & \mbox{IO0 kHz mode} & \mbox{TCY/2 (BRG + 1)} & & \mbox{\mus} & \mbox{\mus} & \\ \hline \mbox{A00 kHz mode} & \mbox{TCY/2 (BRG + 1)} & & \mbox{\mus} & \\ \hline \mbox{A00 kHz mode} & \mbox{TCY/2 (BRG + 1)} & & \mbox{\mus} & \\ \hline \mbox{IM34} & \mbox{IHD:STO} & \mbox{Stop Condition} & \mbox{IO0 kHz mode} & \mbox{TCY/2 (BRG + 1)} & & \mbox{\mus} & \\ \hline \mbox{IM40} & \mbox{IHD:STO} & \mbox{Stop Condition} & \mbox{IO0 kHz mode} & \mbox{TCY/2 (BRG + 1)} & & \mbox{ns} & \\ \hline \mbox{IM40} & \mbox{IHD:STO} & \mbox{Stop Condition} & \mbox{IO0 kHz mode} & \mbox{TCY/2 (BRG + 1)} & & \mbox{ns} & \\ \hline \mbox{IM40} & \mbox{ILD:A1} & \mbox{IIM40} & \mbox{IIM42} & \mbox{IIM43} & \mbox{IIM45} & \mbox{IIM45} & \mbox{IIM45} & \mbox{IIM45} & \mbox{IIB5:SDA} & \mbox{IIB Since Time} & \mbox{III00 kHz mode} & \mbox{III00} & \mbox{III00} & \mbox{IIII0} & \mbox{III00} & \mbox{IIII00} & \mbox{IIIII0} & \mbox{IIIII00} & \mbox{IIIIII0} & \mbox{IIIIIII0} & IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII$			Hold Time	400 kHz mode	Tcy/2 (BRG + 1)	—	μS	first clock pulse is			
$ \begin{array}{ c c c c c c } \hline \text{IM33} & \end{Tsu:sto} & \end{Stop} \ \mbox{Stop} \ \mbox{Condition} \\ & \end{Stup} \ \mbox{Time} & \end{Inverse} & \end{Tcy/2} \ (BRG + 1) & & \end{\mus} \\ \hline \end{Tcy/2} \ (BRG + 1) & & \end{\mus} \\ \hline \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{\mus} \\ \hline \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{\mus} \\ \hline \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{Tcy/2} \\ \hline \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{Tcy/2} \\ \hline \end{Tcy/2} \ \mbox{(BRG + 1)} & & \end{Tcy/2} \ \mbox{(BRG + 1)} \ \mbox{(Dvice)} \ \ \ \mbox{(Dvice)} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$				1 MHz mode <sup>(2)</sup>	Tcy/2 (BRG + 1)	—	μS	generated			
$ \begin{array}{ c c c c c } \hline \mbox{Setup Time} & \mbox{400 kHz mode} & \mbox{Tcy/2 (BRG + 1)} & - & \mbox{$\mu$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$\mu$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$400 kHz mode} & \mbox{$Tcy/2 (BRG + 1)$ $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - $ & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - $ & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - $ & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ Tcy/2 (BRG + 1) $ - $ & \mbox{$n$s$} \\ \hline \mbox{$1$ MHz mode($$^{$2$}$) $ - $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $$	IM33	TSU:STO	Stop Condition	100 kHz mode	Tcy/2 (BRG + 1)	—	μS	_			
$ \begin{array}{ c c c c c c } \hline \mbox{IMHz mode}^{(2)} & \mbox{Tcy/2 (BRG + 1)} & & \mbox{$\mu$s$} \\ \hline \mbox{IM34} & \mbox{THD:STO} & \mbox{Stop Condition} & \mbox{$100 kHz mode} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$400 kHz mode} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$Tcy/2 (BRG + 1)$} & & \mbox{$n$s$} & \mbox{$-$n$s$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$100 kHz mode$} & & \mbox{$1000 ns$} & \mbox{$-$-$} \\ \hline \mbox{$100 kHz mode}^{(2)} & \mbox{$-$-$} & \mbox{$400 ns$} & \mbox{$-$-$} \\ \hline \mbox{$100 kHz mode$} & \mbox{$1.3$} & \mbox{$-$-$} & \mbox{$\mu$s$} \\ \hline \mbox{$100 kHz mode$} & \mbox{$1.3$} & \mbox{$-$\mu$s$} \\ \hline \mbox{$100 kHz mode$} & \mbox{$1.3$} & \ \mbox{$-$\mu$s$} \\ \hline \mbox{$100 kHz mode$} & \mbox{$1.3$} & \ \mbox{$-$\mu$s$} \\ \hline \mbox{$100 kHz mode$} & \mbox{$1.3$} & \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $			Setup Time	400 kHz mode	Tcy/2 (BRG + 1)	_	μS				
$ \begin{array}{ c c c c c c } \hline IM34 & THD:STO \\ \hline IM34 & THD:STO \\ \hline M0d Time \\ \hline Hold Time \\ \hline \hline \hline HOld Hz mode \\ \hline \hline I MHz mode \\ \hline \hline I MHz mode \\ \hline \hline I MHz mode \\ \hline \hline I CY/2 (BRG + 1) \\ \hline \hline I CY/2 (BRG + 1) \\ \hline \hline I MHz mode \\ \hline \hline I MHz mode \\ \hline \hline I MHz mode \\ \hline \hline I CY/2 (BRG + 1) \\ \hline I MHz mode \\ \hline \hline I CY/2 (BRG + 1) \\ \hline I MHz mode \\ \hline \hline I O KHz mode \\ \hline I O KHz mode \\ \hline I 0 KHz mode \\ \hline I MHz mode \\ \hline \hline I MHz mode \\ \hline I MHz mode \\ \hline \hline I MHz mode \\ \hline I MZ mode \\ \hline I MZ m mz mode \\ \hline I MZ mode \\ \hline I MZ m mz mode \\ \hline I MZ m mz mode \\ \hline I MZ mz mode \\ \hline I MZ mz $				1 MHz mode <sup>(2)</sup>	Tcy/2 (BRG + 1)	_	μS				
$ \begin{array}{ c c c c c c } \hline Hold Time & \hline 400 \ \text{kHz mode} & \hline \text{Tcy/2 (BRG + 1)} & - & \text{ns} \\ \hline 1 \ \text{MHz mode}^{(2)} & \hline \text{Tcy/2 (BRG + 1)} & - & \text{ns} \\ \hline 1 \ \text{MHz mode}^{(2)} & \hline \text{Tcy/2 (BRG + 1)} & - & \text{ns} \\ \hline 1 \ \text{MHz mode}^{(2)} & \hline 100 \ \text{kHz mode} & - & 3500 \ \text{ns} & - & \\ \hline 400 \ \text{kHz mode} & - & 1000 \ \text{ns} & - & \\ \hline 400 \ \text{kHz mode}^{(2)} & - & 400 \ \text{ns} & - & \\ \hline 1 \ \text{MHz mode}^{(2)} & - & 400 \ \text{ns} & - & \\ \hline 1 \ \text{MHz mode}^{(2)} & - & 400 \ \text{ns} & - & \\ \hline 1 \ \text{MHz mode}^{(2)} & - & & \\ \hline 1 \ \text{MHz mode}^{(2)} & - & & \\ \hline 100 \ \text{kHz mode} & 1.3 & - & & \\ \hline 100 \ \text{kHz mode}^{(2)} & 0.5 & - & & \\ \hline 1 \ \text{MHz mode}^{(2)} & 0.5 & - & \\ \hline 1 \ \text{MS1} & 1 \ \ $	IM34	THD:STO	Stop Condition	100 kHz mode	Tcy/2 (BRG + 1)	_	ns	_			
$ \begin{array}{ c c c c c c } \hline \mbox{IMHz mode}^{(2)} & \mbox{Tcy/2 (BRG + 1)} & & \mbox{ns} \\ \hline \mbox{IM40} & \mbox{TAA:SCL} & \mbox{Output Valid} & \mbox{I00 kHz mode} & & \mbox{3500} & \mbox{ns} & \\ \hline \mbox{400 kHz mode} & & \mbox{1000} & \mbox{ns} & \\ \hline \mbox{400 kHz mode}^{(2)} & & \mbox{400} & \mbox{ns} & \\ \hline \mbox{IM45} & \mbox{TBF:SDA} & \mbox{Bus Free Time} & \mbox{I00 kHz mode}^{(2)} &  & \mbox{400} & \mbox{ns} & \\ \hline \mbox{400 kHz mode}^{(2)} & & \mbox{400} & \mbox{ns} & \\ \hline \mbox{400 kHz mode}^{(2)} &  & \mbox{\mus} & \mbox{Time the bus must be} \\ \hline \mbox{free before a new} & \mbox{transmission can start} \\ \hline \mbox{IM50} & \mbox{CB} & \mbox{Bus Capacitive Loading} & & \mbox{400} & \mbox{pF} & \\ \hline \mbox{IM51} & \mbox{TPGD} & \mbox{Pulse Gobbler Delay} & \mbox{65} & \mbox{390} & \mbox{ns} & \mbox{See Note 3} \\ \hline \end{tabular}$			Hold Time	400 kHz mode	Tcy/2 (BRG + 1)	_	ns				
$ \begin{array}{ c c c c c c } \hline \mbox{IM40} \\ \hline \mbox{IM40} \\ \hline \mbox{IM40} \\ \hline \mbox{IM40} \\ \hline \mbox{IM45} \\ \hline \mbox{IBF:SDA} \\ \hline \mbox{IM45} \\ \hline \mbox{IBF:SDA} \\ \hline \mbox{IBF:SDA} \\ \hline \mbox{IBF:SDA} \\ \hline \mbox{IM45} \\ \hline \mbox{IBF:SDA} \\ \hline IBF:SD$				1 MHz mode <sup>(2)</sup>	Tcy/2 (BRG + 1)	_	ns				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	IM40	TAA:SCL	Output Valid	100 kHz mode	—	3500	ns	_			
$ \begin{array}{ c c c c c c c } \hline \mbox{IMHz mode}^{(2)} & & 400 & \mbox{ns} & \\ \hline \mbox{IM45} & \mbox{TBF:SDA} & \mbox{Bus Free Time} & \begin{tabular}{c c c c c c c c } \hline 100 \ \mbox{Hz mode} & \begin{tabular}{c c c c c c c } \hline 100 \ \mbox{Hz mode} & \begin{tabular}{c c c c c c c c } \hline 100 \ \mbox{Hz mode} & \begin{tabular}{c c c c c c c c } \hline 100 \ \mbox{Hz mode} & \begin{tabular}{c c c c c c c c } \hline 100 \ \mbox{Hz mode} & \begin{tabular}{c c c c c c c c c c c c c c c c c c c $			From Clock	400 kHz mode	_	1000	ns	_			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $				1 MHz mode <sup>(2)</sup>	—	400	ns	_			
400 kHz mode     1.3     —     μs     free before a new transmission can start       1 MHz mode <sup>(2)</sup> 0.5     —     μs     transmission can start       IM50     CB     Bus Capacitive Loading     —     400     pF     —       IM51     TPGD     Pulse Gobbler Delay     65     390     ns     See Note 3	IM45	TBF:SDA	Bus Free Time	100 kHz mode	4.7	_	μS	Time the bus must be			
IM50     CB     Bus Capacitive Loading     0.5      μs     transmission can start       IM51     TPGD     Pulse Gobbler Delay     65     390     ns     See Note 3				400 kHz mode	1.3	—	μs	free before a new			
IM50CBBus Capacitive Loading—400pF—IM51TPGDPulse Gobbler Delay65390nsSee Note 3				1 MHz mode <sup>(2)</sup>	0.5	—	μs	transmission can start			
IM51   TPGD   Pulse Gobbler Delay   65   390   ns   See Note 3	IM50	Св	Bus Capacitive L	oading	_	400	pF	—			
	IM51	TPGD	Pulse Gobbler De	elay	65	390	ns	See Note 3			

#### TABLE 24-36: I2Cx BUS DATA TIMING REQUIREMENTS (MASTER MODE)

Note 1: BRG is the value of the I<sup>2</sup>C Baud Rate Generator. Refer to Section 19. "Inter-Integrated Circuit™ (I<sup>2</sup>C™)" (DS70195) in the "*PIC24H Family Reference Manual*". Please see the Microchip web site (www.microchip.com) for the latest PIC24H Family Reference Manual chapters.

2: Maximum pin capacitance = 10 pF for all I2Cx pins (for 1 MHz mode only).

**3:** Typical value for this parameter is 130 ns.

AC CHARACTERISTICS		Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated)Operating temperature $-40^{\circ}C \le TA \le +150^{\circ}C$ for High Temperature					
Param No.	Symbol	Characteristic	Min	Тур	Max	Units	Conditions
Clock Parameters							
HAD50	Tad	ADC Clock Period <sup>(1)</sup>	147	—	—	ns	—
Conversion Rate							
HAD56	FCNV	Throughput Rate <sup>(1)</sup>	_	—	400	Ksps	_

#### TABLE 25-17: ADC CONVERSION (12-BIT MODE) TIMING REQUIREMENTS

Note 1: These parameters are characterized but not tested in manufacturing.

#### TABLE 25-18: ADC CONVERSION (10-BIT MODE) TIMING REQUIREMENTS

AC TERISTICS	Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated)Operating temperature $-40^{\circ}C \le TA \le +150^{\circ}C$ for High Temperature					
Symbol	Characteristic	Min	Тур	Max	Units	Conditions
Clock Parameters						
Tad	ADC Clock Period <sup>(1)</sup>	104	_		ns	—
Conversion Rate						
FCNV	Throughput Rate <sup>(1)</sup>	_	_	800	Ksps	—
	AC TERISTICS Symbol TAD	Standard Operating Condition Operating temperature     -40°C       Symbol     Characteristic       Symbol     Characteristic       TAD     ADC Clock Period <sup>(1)</sup> FCNV     Throughput Rate <sup>(1)</sup>	AC TERISTICS       Standard Operating Conditions: $3.0V$ to Operating temperature $-40^{\circ}C \le TA \le +1$ Symbol       Characteristic       Min         Symbol       Characteristic       Min         TAD       ADC Clock Period <sup>(1)</sup> 104         FCNV       Throughput Rate <sup>(1)</sup> —	AC TERISTICSStandard Operating Conditions: $3.0V$ to $3.6V$ (un Operating temperature $-40^{\circ}C \le TA \le +150^{\circ}C$ forSymbolCharacteristicMinTypClock ParametersTADADC Clock Period <sup>(1)</sup> $104$ —Conversion RateFCNVThroughput Rate <sup>(1)</sup> ——	AC TERISTICSStandard Operating Conditions: 3.0V to 3.6V (unless oth Operating temperature $-40^{\circ}C \le TA \le +150^{\circ}C$ for High TemSymbolCharacteristicMinTypMaxClock ParametersClock ParametersTADADC Clock Period <sup>(1)</sup> 104——Conversion RateFCNVThroughput Rate <sup>(1)</sup> ——800	AC TERISTICSStandard Operating Conditions: 3.0V to 3.6V (unless otherwise state Operating temperature $-40^{\circ}C \le TA \le +150^{\circ}C$ for High TemperatureSymbolCharacteristicMinTypMaxUnitsClock ParametersTADADC Clock Period <sup>(1)</sup> 104——nsConversion RateFCNVThroughput Rate <sup>(1)</sup> ——800Ksps

**Note 1:** These parameters are characterized but not tested in manufacturing.

# 64-Lead Plastic Quad Flat, No Lead Package (MR) – 9x9x0.9 mm Body with 5.40 x 5.40 Exposed Pad [QFN]

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



	MILLIMETERS				
Dimension Limits		MIN	NOM	MAX	
Number of Pins		64			
Pitch		0.50 BSC			
Overall Height		0.80	0.90	1.00	
Standoff	A1	0.00	0.02	0.05	
Contact Thickness	A3	0.20 REF			
Overall Width	E	9.00 BSC			
Exposed Pad Width	E2	5.30	5.40	5.50	
Overall Length	D	9.00 BSC			
Exposed Pad Length	D2	5.30	5.40	5.50	
Contact Width	b	0.20	0.25	0.30	
Contact Length	L	0.30	0.40	0.50	
Contact-to-Exposed Pad	K	0.20	-	-	

#### Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.

2. Package is saw singulated.

3. Dimensioning and tolerancing per ASME Y14.5M.

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

REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-154A Sheet 2 of 2

# APPENDIX A: MIGRATING FROM PIC24HJXXXGPX06/ X08/X10 DEVICES TO PIC24HJXXXGPX06A/ X08A/X10A DEVICES

The PIC24HJXXXGPX06A/X08A/X10A devices were designed to enhance the PIC24HJXXXGPX06/X08/ X10 families of devices.

In general, the PIC24HJXXXGPX06A/X08A/X10A devices are backward-compatible with PIC24HJXXXGPX06/X08/X10 devices; however, manufacturing differences may cause PIC24HJXXXGPX06A/X08A/X10A devices to behave differently from PIC24HJXXXGPX06/X08/X10 devices. Therefore, complete system test and characterization is recommended if PIC24HJXXXGPX06A/X08A/X10A devices are used to replace PIC24HJXXXGPX06/X08/ X10 devices.

The following enhancements were introduced:

- Extended temperature support of up to +125°C
- Enhanced Flash module with higher endurance and retention
- New PLL Lock Enable configuration bit
- Added Timer5 trigger for ADC1 and Timer3 trigger for ADC2

# INDEX

Α	
AC Characteristics	252, 291
ADC Module	
ADC Module (10-bit Mode)	
ADC Module (12-bit Mode)	
Internal RC Accuracy	
Load Conditions	252, 291
ADC Module	
ADC1 Register Map	42
ADC2 Register Map	42
Alternate Interrupt Vector Table (AIVT)	69
Analog-to-Digital Converter	
DMA	
Initialization	
Key Features	
Arithmetic Logic Unit (ALU)	28
Assembler	
MPASM Assembler	
Automatic Clock Stretch	

### В

Block Diagrams	
16-bit Timer1 Module	145
ADC1 Module	208
Connections for On-Chip Voltage Regulator	226
ECAN Module	180
Input Capture	153
Output Compare	155
PIC24H	16
PIC24H CPU Core	24
PIC24H Oscillator System Diagram	123
PIC24H PLL	125
Reset System	65
Shared Port Structure	141
SPI	159
Timer2 (16-bit)	149
Timer2/3 (32-bit)	148
UART	173
Watchdog Timer (WDT)	227

# С

C Compilers	
MPLAB C18	
Clock Switching	131
Enabling	131
Sequence	131
Code Examples	
Erasing a Program Memory Page	62
Initiating a Programming Sequence	63
Loading Write Buffers	63
Port Write/Read	142
PWRSAV Instruction Syntax	133
Code Protection	221, 228
Configuration Bits	221
Description (Table)	222
Configuration Register Map	221
Configuring Analog Port Pins	142
CPU	
Control Register	
CPU Clocking System	124
PLL Configuration	124
Selection	124
Sources	124
Customer Change Notification Service	321

Customer Notification Service Customer Support	321 321
D	
Data Address Space	31
Alignment	31
Memory Map for PIC24HJXXXGPX06A/X08A/X1	0A
Devices with 16 KB RAM	33
Memory Map for PIC24HJXXXGPX06A/X08A/X1	0A
Devices with 8 KB RAM	32
Near Data Space	31
Software Stack	53
Width	31
DC and AC Characteristics	
Graphs and Tables	297
DC Characteristics	242
Doze Current (IDOZE)	289
High Temperature	288
I/O Pin Input Specifications	248
I/O Pin Output Specifications 25	50, 290
Idle Current (IDOZE)	247
Idle Current (IIDLE)	245
Operating Current (IDD)	244
Operating MIPS vs. Voltage	288
Power-Down Current (IPD)	246
Power-down Current (IPD)	288
Program Memory	251
Temperature and Voltage	288
Temperature and Voltage Specifications	243
Thermal Operating Conditions	288
Development Support	237
DMA Module	
DMA Register Map	43
DMAC Registers	114
DMAxCNT	114
DMAxCON	114
DMAxPAD	114
DMAxREQ	114
DMAxSTA	114
DMAxSTB	114

# Е

ECAN Module
CiFMSKSEL2 register 199
ECAN1 Register Map (C1CTRL1.WIN = 0 or 1) 44
ECAN1 Register Map (C1CTRL1.WIN = 0) 45
ECAN1 Register Map (C1CTRL1.WIN = 1) 45
ECAN2 Register Map (C2CTRL1.WIN = 0 or 1) 47
ECAN2 Register Map (C2CTRL1.WIN = 0) 47
ECAN2 Register Map (C2CTRL1.WIN = 1) 48
Frame Types 179
Modes of Operation 181
Overview 179
ECAN Registers
Filter 15-8 Mask Selection Register
(CiFMSKSEL2) 199
Electrical Characteristics 241
AC 252, 291
Enhanced CAN Module 179
Equations
Device Operating Frequency 124
FOSC Calculation 124
XT with PLL Mode Example 125
Errata

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