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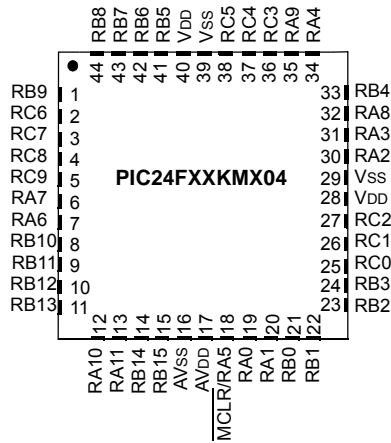
Details

Product Status	Obsolete
Core Processor	PIC
Core Size	16-Bit
Speed	32MHz
Connectivity	I ² C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, LVD, POR, PWM, WDT
Number of I/O	17
Program Memory Size	8KB (2.75K x 24)
Program Memory Type	FLASH
EEPROM Size	512 x 8
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5V
Data Converters	A/D 16x10b/12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Through Hole
Package / Case	20-DIP (0.300", 7.62mm)
Supplier Device Package	20-PDIP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic24fv08km101-e-p

PIC24FV16KM204 FAMILY

Pin Diagrams (Continued)

44-Pin TQFP/QFN⁽¹⁾



Pin	Pin Features	
	PIC24FXXKM04	PIC24FVXXKM04
1	AN21/SDA1/T1CK/U1RTS/U1BCLK/IC2/	/CLC10/CTED4/CN21/RB9
2	U1RX/	/CN18/RC6
3	U1TX/	/CN17/RC7
4		/CN20/RC8
5	IC4/OC2F/CTED7/CN19/RC9	
6	IC1/	/CTED3/CN9/RA7
7	/OC1A/CTED1/INT2/CN8/RA6	VCAP or VDDCORE
8	PGED2/SDI1/OC1C/CTED11/CN16/RB10	
9	PGEC2/SCK1/OC2A/CTED9/CN15/RB11	
10	/AN12/HLVDIN/	/CTED2/
	CN14/RB12	/AN12/HLVDIN/ /CTED2/INT2/ CN14/RB12
11	/	/AN11/SDO1/OC1D/CTPLS/CN13/RB13
12	/	/CN35/RA10
13	/	/CTED8/CN36/RA11
14	/CVREF/	/AN10/ /C1OUT/OCFA/CTED5/INT1/CN12/ RB14
15	/	/AN9/ /REFO/SS1/TCKIA/CTED6/CN11/RB15
16	AVSS	
17	AVDD	
18	MCLR/VPP/RA5	
19	CVREF+/VREF+/	/AN0/ /CN2/ CVREF+/VREF+/ /AN0/ /
	RA0	CTED1/CN2/RA0
20	CVREF-/VREF-/AN1/CN3/RA1	
21	PGED1/AN2/CTCMP/ULPWU/C1IND/	/ / /CN4/RB0
22	PGEC1/	/AN3/C1INC/ /CTED12/CN5//RB1
23	/	/AN4/C1INB/ /TCKIB/CTED13/CN6/RB2
24	/AN5/C1INA/	/CN7/RB3
25	AN6/CN32/RC0	
26	AN7/CN31/RC1	
27	AN8/CN10/RC2	
28	VDD	
29	VSS	
30	OSCI/CLKI/AN13/CN30/RA2	
31	OSCO/CLKO/AN14/CN29/RA3	
32	OCFB/CN33/RA8	
33	SOSCI/AN15/	/CN1/RB4
34	SOSCO/SCLKI/AN16/PWRLCLK/	/CN0/RA4
35	/CN34/RA9	
36	/CN28/RC3	
37	/CN25/RC4	
38	/CN26/RC5	
39	VSS	
40	VDD	
41	PGED3/AN17/ASDA1/OC1E/CLCINA/CN27/RB5	
42	PGEC3/AN18/ASCL1/OC1F/CLCINB/CN24/RB6	
43	AN19/INT0/CN23/RB7	AN19/ /OC1A/INT0/CN23/RB7
44	AN20/SCL1/U1CTS/C3OUT/OC1B/CTED10/CN22/RB8	

Legend: Values in indicate pin function differences between PIC24F(V)XXKM202 and PIC24F(V)XXKM102 devices.

Note 1: Exposed pad on underside of device is connected to Vss.

PIC24FV16KM204 FAMILY

TABLE 1-1: DEVICE FEATURES FOR THE PIC24F16KM204 FAMILY

Features	PIC24F16KM204	PIC24F08KM204	PIC24F16KM202	PIC24F08KM202
Operating Frequency	DC-32 MHz			
Program Memory (bytes)	16K	8K	16K	8K
Program Memory (instructions)	5632	2816	5632	2816
Data Memory (bytes)	2048			
Data EEPROM Memory (bytes)	512			
Interrupt Sources (soft vectors/NMI traps)	40 (36/4)			
Voltage Range	1.8-3.6V			
I/O Ports	PORTA<11:0> PORTB<15:0> PORTC<9:0>		PORTA<7:0> PORTB<15:0>	
Total I/O Pins	38		24	
Timers	11 (One 16-bit timer, five MCCPs/SCCPs with up to two 16/32 timers each)			
Capture/Compare/PWM modules	3 2			
MCCP				
SCCP				
Serial Communications	2 2			
MSSP				
UART				
Input Change Notification Interrupt	37		23	
12-Bit Analog-to-Digital Module (input channels)	22	22	19	19
Analog Comparators	3			
8-Bit Digital-to-Analog Converters	2			
Operational Amplifiers	2			
Charge Time Measurement Unit (CTMU)	Yes			
Real-Time Clock and Calendar (RTCC)	Yes			
Configurable Logic Cell (CLC)	2			
Resets (and delays)	POR, BOR, RESET Instruction, MCLR, WDT, Illegal Opcode, REPEAT Instruction, Hardware Traps, Configuration Word Mismatch (PWRT, OST, PLL Lock)			
Instruction Set	76 Base Instructions, Multiple Addressing Mode Variations			
Packages	44-Pin QFN/TQFP, 48-Pin UQFN		28-Pin SPDIP/SSOP/SOIC/QFN	

TABLE 1-5: PIC24FV16KM204 FAMILY PINOUT DESCRIPTION (CONTINUED)

Function	F					FV					I/O	Buffer	Description
	Pin Number					Pin Number							
	20-Pin PDIP/ SSOP/ SOIC	28-Pin PDIP/ SSOP/ SOIC	28-Pin QFN	44-Pin QFN/ TQFP	48-Pin UQFN	20-Pin PDIP/ SSOP/ SOIC	28-Pin PDIP/ SSOP/ SOIC	28-Pin QFN	44-Pin QFN/ TQFP	48-Pin UQFN			
CTED1	11	20	17	7	7	11	2	27	19	21	I	ST	CTMU Trigger Edge Inputs
CTED2	15	23	20	10	11	15	23	20	10	11	I	ST	CTMU Trigger Edge Inputs
CTED3	—	19	16	6	6	—	19	16	6	6	I	ST	CTMU Trigger Edge Inputs
CTED4	13	18	15	1	1	13	18	15	1	1	I	ST	CTMU Trigger Edge Inputs
CTED5	17	25	22	14	15	17	25	22	14	15	I	ST	CTMU Trigger Edge Inputs
CTED6	18	26	23	15	16	18	26	23	15	16	I	ST	CTMU Trigger Edge Inputs
CTED7	—	—	—	5	5	—	—	—	5	5	I	ST	CTMU Trigger Edge Inputs
CTED8	—	—	—	13	14	—	—	—	13	14	I	ST	CTMU Trigger Edge Inputs
CTED9	—	22	19	9	10	—	22	19	9	10	I	ST	CTMU Trigger Edge Inputs
CTED10	12	17	14	44	48	12	17	14	44	48	I	ST	CTMU Trigger Edge Inputs
CTED11	—	21	18	8	9	—	21	18	8	9	I	ST	CTMU Trigger Edge Inputs
CTED12	5	5	2	22	24	5	5	2	22	24	I	ST	CTMU Trigger Edge Inputs
CTED13	6	6	3	23	25	6	6	3	23	25	I	ST	CTMU Trigger Edge Inputs
CTPLS	16	24	21	11	12	16	24	21	11	12	O	—	CTMU Pulse Output
CVREF	17	25	22	14	15	17	25	22	14	15	O	ANA	Comparator Voltage Reference Output
CVREF+	2	2	27	19	21	2	2	27	19	21	I	ANA	Comparator Voltage Reference Positive Input
CVREF-	3	3	28	20	22	3	3	28	20	22	I	ANA	Comparator Voltage Reference Negative Input
DAC1OUT	—	23	20	10	11	—	23	20	10	11	O	ANA	DAC1 Output
DAC1REF+	—	2	27	19	21	—	2	27	19	21	I	ANA	DAC1 Positive Voltage Reference Input
DAC2OUT	—	25	22	14	15	—	25	22	14	15	O	ANA	DAC2 Output
DAC2REF+	—	26	23	15	16	—	26	23	15	16	I	ANA	DAC2 Positive Voltage Reference Input
HLVDIN	15	23	20	10	11	15	23	20	10	11	I	ANA	External High/Low-Voltage Detect Input
IC1	14	19	16	6	6	11	19	16	6	6	I	ST	MCCP1 Input Capture Input
IC2	13	18	15	1	1	13	18	15	1	1	I	ST	MCCP2 Input Capture Input
IC3	—	23	20	13	14	—	23	20	13	14	I	ST	MCCP3 Input Capture Input
IC4	—	14	11	5	5	—	14	11	5	5	I	ST	SCCP4 Input Capture Input
IC5	—	15	12	12	13	—	15	12	12	13	I	ST	SCCP5 Input Capture Input
INT0	11	16	13	43	47	11	16	13	43	47	I	ST	External Interrupt 0 Input
INT1	17	25	22	14	15	17	25	22	14	15	I	ST	External Interrupt 1 Input
INT2	14	20	17	7	7	15	23	20	10	11	I	ST	External Interrupt 2 Input

Legend: ANA = Analog level input/output, ST = Schmitt Trigger input buffer, $I^2C^TM = I^2C/SMBus$ input buffer

TABLE 1-5: PIC24FV16KM204 FAMILY PINOUT DESCRIPTION (CONTINUED)

Function	F					FV					I/O	Buffer	Description
	Pin Number					Pin Number							
	20-Pin PDIP/ SSOP/ SOIC	28-Pin PDIP/ SSOP/ SOIC	28-Pin QFN	44-Pin QFN/ TQFP	48-Pin UQFN	20-Pin PDIP/ SSOP/ SOIC	28-Pin PDIP/ SSOP/ SOIC	28-Pin QFN	44-Pin QFN/ TQFP	48-Pin UQFN			
OSCI	7	9	6	30	33	7	9	6	30	33	I	ANA	Primary Oscillator Input
OSCO	8	10	7	31	34	8	10	7	31	34	O	ANA	Primary Oscillator Output
PGEC1	5	5	2	22	24	5	5	2	22	24	I/O	ST	ICSP Clock 1
PGED1	4	4	1	21	23	4	4	1	21	23	I/O	ST	ICSP Data 1
PGEC2	2	22	19	9	10	2	22	19	9	10	I/O	ST	ICSP Clock 2
PGED2	3	21	18	8	9	3	21	18	8	9	I/O	ST	ICSP Data 2
PGEC3	10	15	12	42	46	10	15	12	42	46	I/O	ST	ICSP Clock 3
PGED3	9	14	11	41	45	9	14	11	41	45	I/O	ST	ICSP Data 3
PWRLCLK	10	12	9	34	37	10	12	9	34	37	I	ST	RTCC Power Line Clock Input
RA0	2	2	27	19	21	2	2	27	19	21	I/O	ST	PORTA Pins
RA1	3	3	28	20	22	3	3	28	20	22	I/O	ST	PORTA Pins
RA2	7	9	6	30	33	7	9	6	30	33	I/O	ST	PORTA Pins
RA3	8	10	7	31	34	8	10	7	31	34	I/O	ST	PORTA Pins
RA4	10	12	9	34	37	10	12	9	34	37	I/O	ST	PORTA Pins
RA5	1	1	26	18	19	1	1	26	18	19	I/O	ST	PORTA Pins
RA6	14	20	17	7	7	—	—	—	—	—	I/O	ST	PORTA Pins
RA7	—	19	16	6	6	—	19	16	6	6	I/O	ST	PORTA Pins
RA8	—	—	—	32	35	—	—	—	32	35	I/O	ST	PORTA Pins
RA9	—	—	—	35	38	—	—	—	35	38	I/O	ST	PORTA Pins
RA10	—	—	—	12	13	—	—	—	12	13	I/O	ST	PORTA Pins
RA11	—	—	—	13	14	—	—	—	13	14	I/O	ST	PORTA Pins
RB0	4	4	1	21	23	4	4	1	21	23	I/O	ST	PORTB Pins
RB1	5	5	2	22	24	5	5	2	22	24	I/O	ST	PORTB Pins
RB2	6	6	3	23	25	6	6	3	23	25	I/O	ST	PORTB Pins
RB3	—	7	4	24	26	—	7	4	24	26	I/O	ST	PORTB Pins
RB4	9	11	8	33	36	9	11	8	33	36	I/O	ST	PORTB Pins
RB5	—	14	11	41	45	—	14	11	41	45	I/O	ST	PORTB Pins
RB6	—	15	12	42	46	—	15	12	42	46	I/O	ST	PORTB Pins
RB7	11	16	13	43	47	11	16	13	43	47	I/O	ST	PORTB Pins
RB8	12	17	14	44	48	12	17	14	44	48	I/O	ST	PORTB Pins

Legend: ANA = Analog level input/output, ST = Schmitt Trigger input buffer, $I^2C^{TM} = I^2C/SMBus$ input buffer

PIC24FV16KM204 FAMILY

4.2.2 DATA MEMORY ORGANIZATION AND ALIGNMENT

To maintain backward compatibility with PIC® devices and improve Data Space memory usage efficiency, the PIC24F instruction set supports both word and byte operations. As a consequence of byte accessibility, all EA calculations are internally scaled to step through word-aligned memory. For example, the core recognizes that Post-Modified Register Indirect Addressing mode [Ws++] will result in a value of Ws + 1 for byte operations and Ws + 2 for word operations.

Data byte reads will read the complete word, which contains the byte, using the LSB of any EA to determine which byte to select. The selected byte is placed onto the LSB of the data path. That is, the data memory and the registers are organized as two parallel, byte-wide entities with shared (word) address decode, but separate write lines. Data byte writes only write to the corresponding side of the array or register, which matches the byte address.

All word accesses must be aligned to an even address. Misaligned word data fetches are not supported, so care must be taken when mixing byte and word operations, or translating from 8-bit MCU code. If a misaligned read or write is attempted, an address error trap will be generated. If the error occurred on a read, the instruction underway is completed; if it occurred on a write, the instruction will be executed, but the write will not occur. In either case, a trap is then executed, allowing the system and/or user to examine the machine state prior to execution of the address Fault.

All byte loads into any W register are loaded into the LSB; the MSB is not modified.

A Sign-Extend (SE) instruction is provided to allow the users to translate 8-bit signed data to 16-bit signed values. Alternatively, for 16-bit unsigned data, users can clear the MSB of any W register by executing a Zero-Extend (ZE) instruction on the appropriate address.

Although most instructions are capable of operating on word or byte data sizes, it should be noted that some instructions operate only on words.

4.2.3 NEAR DATA SPACE

The 8-Kbyte area between 0000h and 1FFFh is referred to as the Near Data Space. Locations in this space are directly addressable via a 13-bit absolute address field within all memory direct instructions. The remainder of the Data Space is addressable indirectly. Additionally, the whole Data Space is addressable using MOV instructions, which support Memory Direct Addressing (MDA) with a 16-bit address field. For PIC24FV16KM204 family devices, the entire implemented data memory lies in Near Data Space (NDS).

4.2.4 SFR SPACE

The first 2 Kbytes of the Near Data Space, from 0000h to 07FFh, are primarily occupied with Special Function Registers (SFRs). These are used by the PIC24F core and peripheral modules for controlling the operation of the device.

SFRs are distributed among the modules that they control and are generally grouped together by that module. Much of the SFR space contains unused addresses; these are read as '0'. The SFR space, where the SFRs are actually implemented, is provided in Table 4-2. Each implemented area indicates a 32-byte region where at least one address is implemented as an SFR. A complete listing of implemented SFRs, including their addresses, is provided in Table 4-3 through Table 4-26.

TABLE 4-2: IMPLEMENTED REGIONS OF SFR DATA SPACE

	SFR Space Address							
	xx00	xx20	xx40	xx60	xx80	xxA0	xxC0	xxE0
000h	Core			ICN	Interrupts			—
100h	Timers	CLC	MCCP/SCCP					
200h	MSSP	UART	Op Amp	DAC	—	—	I/O	
300h	A/D/CMTU				—	—	—	—
400h	—	—	—	—	—	—	—	ANSEL
500h	—	—	—	—	—	—	—	—
600h	—	RTCC/Comp	—	Band Gap	—			
700h	—	—	System/ HLVD	NVM/PMD	—	—	—	—

Legend: — = No implemented SFRs in this block.

TABLE 4-17: OP AMP 1 REGISTER MAP

File Name	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
AMP1CON ⁽¹⁾	24Ah	AMPEN	—	AMPSIDL	AMPSLP	—	—	—	—	SPDSEL	—	NINSEL2	NINSEL1	NINSEL0	PINSEL2	PINSEL1	PINSEL0	0000

Legend: x = unknown, u = unchanged, — = unimplemented, q = value depends on condition, r = reserved.

Note 1: This registers are available only on PIC24F(V)16KM2XX devices.

TABLE 4-18: OP AMP 2 REGISTER MAP

File Name	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
AMP2CON ⁽¹⁾	24Ch	AMPEN	—	AMPSIDL	AMPSLP	—	—	—	—	SPDSEL	—	NINSEL2	NINSEL1	NINSEL0	PINSEL2	PINSEL1	PINSEL0	0000

Legend: x = unknown, u = unchanged, — = unimplemented, q = value depends on condition, r = reserved.

Note 1: This registers are available only on PIC24F(V)16KM2XX devices.

TABLE 4-19: DAC1 REGISTER MAP

File Name	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
DAC1CON ⁽¹⁾	274h	DACEN	—	DACSIDL	DACSLP	DACFM	—	SRDIS	DACTRIG	DACOE	DACTSEL4	DACTSEL3	DACTSEL2	DACTSEL1	DACTSEL0	DACREF1	DACREF0	0000
DAC1DAT ⁽¹⁾	276h	DACDAT15 ⁽²⁾	DACDAT14 ⁽²⁾	DACDAT13 ⁽²⁾	DACDAT12 ⁽²⁾	DACDAT11 ⁽²⁾	DACDAT10 ⁽²⁾	DACDAT9 ⁽²⁾	DACDAT8 ⁽²⁾	DACDAT7 ⁽²⁾	DACDAT6 ⁽²⁾	DACDAT5 ⁽²⁾	DACDAT4 ⁽²⁾	DACDAT3 ⁽²⁾	DACDAT2 ⁽²⁾	DACDAT1 ⁽²⁾	DACDAT0 ⁽²⁾	0000

Legend: x = unknown, u = unchanged, — = unimplemented, q = value depends on condition, r = reserved.

Note 1: These registers are available only on PIC24F(V)16KM1XX devices.

2: The 8-bit result format depends on the value of the DACFM control bit.

TABLE 4-20: DAC2 REGISTER MAP

File Name	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
DAC2CON ⁽¹⁾	278h	DACEN	—	DACSIDL	DACSLP	DACFM	—	SRDIS	DACTRIG	DACOE	DACTSEL4	DACTSEL3	DACTSEL2	DACTSEL1	DACTSEL0	DACREF1	DACREF0	0000
DAC2DAT ⁽¹⁾	27Ah	DACDAT15 ⁽²⁾	DACDAT14 ⁽²⁾	DACDAT13 ⁽²⁾	DACDAT12 ⁽²⁾	DACDAT11 ⁽²⁾	DACDAT10 ⁽²⁾	DACDAT9 ⁽²⁾	DACDAT8 ⁽²⁾	DACDAT7 ⁽²⁾	DACDAT6 ⁽²⁾	DACDAT5 ⁽²⁾	DACDAT4 ⁽²⁾	DACDAT3 ⁽²⁾	DACDAT2 ⁽²⁾	DACDAT1 ⁽²⁾	DACDAT0 ⁽²⁾	0000

Legend: x = unknown, u = unchanged, — = unimplemented, q = value depends on condition, r = reserved.

Note 1: These registers are available only on PIC24F(V)16KM2XX devices.

2: The 8-bit result format depends on the value of the DACFM control bit.

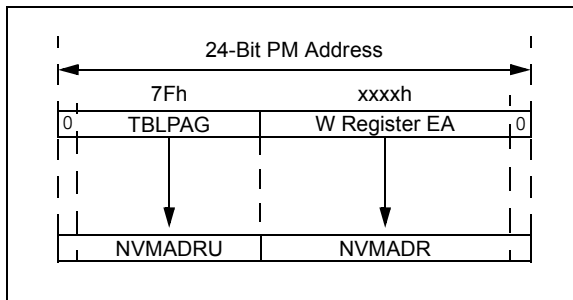
6.3 NVM Address Register

As with Flash program memory, the NVM Address registers, NVMADRU and NVMADR, form the 24-bit Effective Address (EA) of the selected row or word for data EEPROM operations. The NVMADRU register is used to hold the upper 8 bits of the EA, while the NVMADR register is used to hold the lower 16 bits of the EA. These registers are not mapped into the Special Function Register (SFR) space; instead, they directly capture the EA<23:0> of the last Table Write instruction that has been executed and select the data EEPROM row to erase. Figure 6-1 depicts the program memory EA that is formed for programming and erase operations.

Like program memory operations, the Least Significant bit (LSb) of NVMADR is restricted to even addresses. This is because any given address in the data EEPROM space consists of only the lower word of the program memory width; the upper word, including the uppermost “phantom byte”, are unavailable. This means that the LSb of a data EEPROM address will always be ‘0’.

Similarly, the Most Significant bit (MSb) of NVMADRU is always ‘0’, since all addresses lie in the user program space.

FIGURE 6-1: DATA EEPROM ADDRESSING WITH TBLPAG AND NVM ADDRESS REGISTERS



6.4 Data EEPROM Operations

The EEPROM block is accessed using Table Read and Write operations, similar to those used for program memory. The TBLWTH and TBLRDH instructions are not required for data EEPROM operations since the memory is only 16 bits wide (data on the lower address is valid only). The following programming operations can be performed on the data EEPROM:

- Erase one, four or eight words
- Bulk erase the entire data EEPROM
- Write one word
- Read one word

Note 1: Unexpected results will be obtained if the user attempts to read the EEPROM while a programming or erase operation is underway.

- 2:** The XC16 C compiler includes library procedures to automatically perform the Table Read and Table Write operations, manage the Table Pointer and write buffers, and unlock and initiate memory write sequences. This eliminates the need to create assembler macros or time critical routines in C for each application.

The library procedures are used in the code examples detailed in the following sections. General descriptions of each process are provided for users who are not using the XC16 compiler libraries.

PIC24FV16KM204 FAMILY

6.4.1.1 Data EEPROM Bulk Erase

To erase the entire data EEPROM (bulk erase), the address registers do not need to be configured because this operation affects the entire data EEPROM. The following sequence helps in performing a bulk erase:

1. Configure NVMCON to Bulk Erase mode.
2. Clear the NVMIF status bit and enable the NVM interrupt (optional).
3. Write the key sequence to NVMKEY.
4. Set the WR bit to begin the erase cycle.
5. Either poll the WR bit or wait for the NVM interrupt (NVMIF is set).

A typical bulk erase sequence is provided in Example 6-3.

6.4.2 SINGLE-WORD WRITE

To write a single word in the data EEPROM, the following sequence must be followed:

1. Erase one data EEPROM word (as mentioned in the previous section) if the PGONLY bit (NVMCON<12>) is set to '1'.
2. Write the data word into the data EEPROM latch.
3. Program the data word into the EEPROM:
 - Configure the NVMCON register to program one EEPROM word (NVMCON<5:0> = 0001xx).
 - Clear the NVMIF status bit and enable the NVM interrupt (optional).
 - Write the key sequence to NVMKEY.
 - Set the WR bit to begin the erase cycle.
 - Either poll the WR bit or wait for the NVM interrupt (NVMIF is set).
 - To get cleared, wait until NVMIF is set.

A typical single-word write sequence is provided in Example 6-4.

EXAMPLE 6-3: DATA EEPROM BULK ERASE

```
// Set up NVMCON to bulk erase the data EEPROM
NVMCON = 0x4050;

// Disable Interrupts For 5 Instructions
asm volatile ("disi #5");

// Issue Unlock Sequence and Start Erase Cycle
__builtin_write_NVM();
```

EXAMPLE 6-4: SINGLE-WORD WRITE TO DATA EEPROM

```
int __attribute__((space(eedata))) eeData = 0x1234;
int newData; // New data to write to EEPROM
/*-----
The variable eeData must be a Global variable declared outside of any method
the code following this comment can be written inside the method that will execute the write
-----*/
unsigned int offset;

// Set up NVMCON to erase one word of data EEPROM
NVMCON = 0x4004;

// Set up a pointer to the EEPROM location to be erased
TBLPAG = __builtin_tblpage(&eeData); // Initialize EE Data page pointer
offset = __builtin_tbloffset(&eeData); // Initizlize lower word of address
__builtin_tblwtl(offset, newData); // Write EEPROM data to write latch

asm volatile ("disi #5"); // Disable Interrupts For 5 Instructions
__builtin_write_NVM(); // Issue Unlock Sequence & Start Write Cycle
while(NVMCONbits.WR=1); // Optional: Poll WR bit to wait for
// write sequence to complete
```

PIC24FV16KM204 FAMILY

7.0 RESETS

Note: This data sheet summarizes the features of this group of PIC24F devices. It is not intended to be a comprehensive reference source. For more information on Resets, refer to the “PIC24F Family Reference Manual”, “Reset with Programmable Brown-out Reset” (DS39728).

The Reset module combines all Reset sources and controls the device Master Reset Signal, $\overline{\text{SYSRST}}$. The following is a list of device Reset sources:

- POR: Power-on Reset
- MCLR: Pin Reset
- SWR: RESET Instruction
- WDTR: Watchdog Timer Reset
- BOR: Brown-out Reset
- LPBOR: Low-Power BOR
- TRAPR: Trap Conflict Reset
- IOPUWR: Illegal Opcode Reset
- UWR: Uninitialized W Register Reset

A simplified block diagram of the Reset module is shown in Figure 7-1.

Any active source of Reset will make the $\overline{\text{SYSRST}}$ signal active. Many registers associated with the CPU and peripherals are forced to a known Reset state. Most registers are unaffected by a Reset; their status is unknown on Power-on Reset (POR) and unchanged by all other Resets.

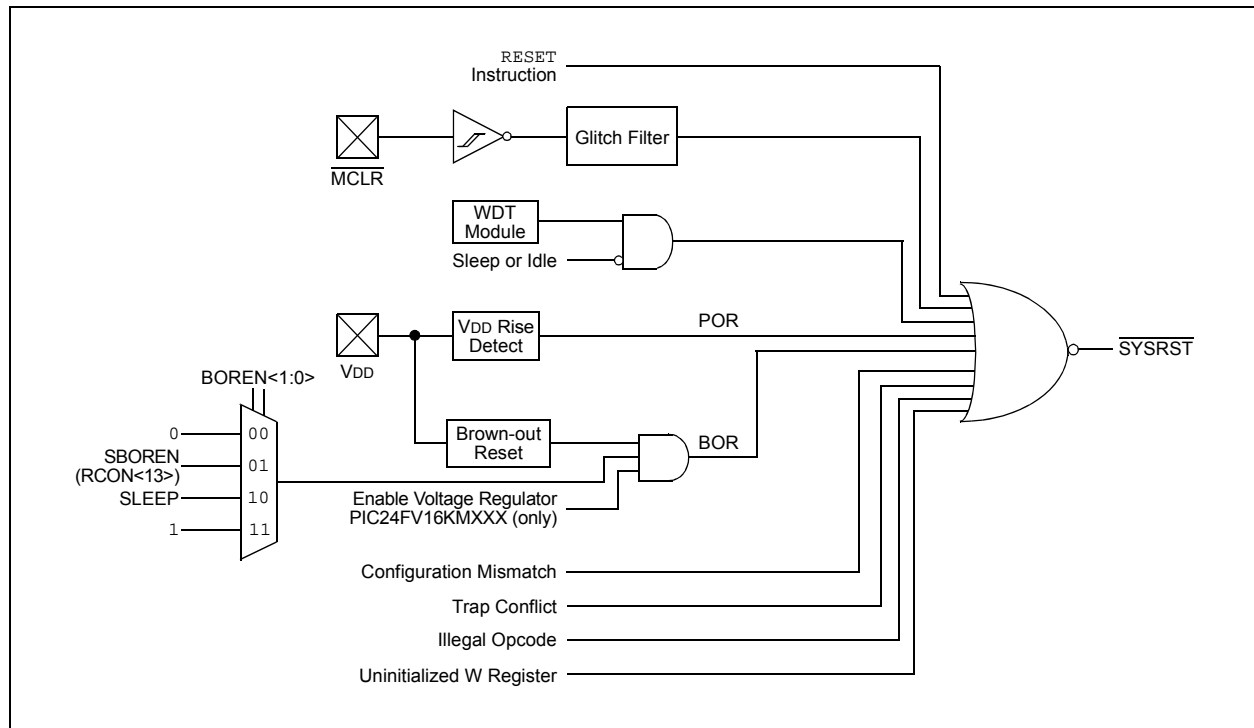
Note: Refer to the specific peripheral or Section 3.0 “CPU” of this data sheet for register Reset states.

All types of device Reset will set a corresponding status bit in the RCON register to indicate the type of Reset (see Register 7-1). A Power-on Reset will clear all bits except for the BOR and POR bits ($\text{RCON}<1:0>$) which are set. The user may set or clear any bit at any time during code execution. The RCON bits only serve as status bits. Setting a particular Reset status bit in software will not cause a device Reset to occur.

The RCON register also has other bits associated with the Watchdog Timer (WDT) and device power-saving states. The function of these bits is discussed in other sections of this manual.

Note: The status bits in the RCON register should be cleared after they are read so that the next RCON register value after a device Reset will be meaningful.

FIGURE 7-1: RESET SYSTEM BLOCK DIAGRAM



PIC24FV16KM204 FAMILY

REGISTER 8-29: IPC15: INTERRUPT PRIORITY CONTROL REGISTER 15

U-0	U-0	U-0	U-0	U-0	R/W-1	R/W-0	R/W-0
—	—	—	—	—	RTCIP2	RTCIP1	RTCIP0
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 15-11 **Unimplemented:** Read as '0'

bit 10-8 **RTCIP<2:0>:** Real-Time Clock and Calendar Interrupt Priority bits

111 = Interrupt is Priority 7 (highest priority interrupt)

•
•
•

001 = Interrupt is Priority 1

000 = Interrupt source is disabled

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

PIC24FV16KM204 FAMILY

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

bit 7	CLKLOCK: Clock Selection Lock Enable bit <u>If FSCM is Enabled (FCKSM1 = 1):</u> 1 = Clock and PLL selections are locked 0 = Clock and PLL selections are not locked and may be modified by setting the OSWEN bit <u>If FSCM is Disabled (FCKSM1 = 0):</u> Clock and PLL selections are never locked and may be modified by setting the OSWEN bit.
bit 6	Unimplemented: Read as '0'
bit 5	LOCK: PLL Lock Status bit ⁽²⁾ 1 = PLL module is in lock or PLL module start-up timer is satisfied 0 = PLL module is out of lock, PLL start-up timer is running or PLL is disabled
bit 4	Unimplemented: Read as '0'
bit 3	CF: Clock Fail Detect bit 1 = FSCM has detected a clock failure 0 = No clock failure has been detected
bit 2	SOSCDRV: Secondary Oscillator Drive Strength bit ⁽³⁾ 1 = High-power SOSC circuit is selected 0 = Low/high-power select is done via the SOSCSRC Configuration bit
bit 1	SOSCEN: 32 kHz Secondary Oscillator (SOSC) Enable bit 1 = Enables the Secondary Oscillator 0 = Disables the Secondary Oscillator
bit 0	OSWEN: Oscillator Switch Enable bit 1 = Initiates an oscillator switch to the clock source specified by the NOSC<2:0> bits 0 = Oscillator switch is complete

- Note 1:** Reset values for these bits are determined by the FNOSCx Configuration bits.
- 2:** This bit also resets to '0' during any valid clock switch or whenever a non-PLL Clock mode is selected.
- 3:** When SOSC is selected to run from a digital clock input, rather than an external crystal (SOSCSRC = 0), this bit has no effect.

9.4 Clock Switching Operation

With few limitations, applications are free to switch between any of the four clock sources (POSC, SOSC, FRC and LPRC) under software control and at any time. To limit the possible side effects that could result from this flexibility, PIC24F devices have a safeguard lock built into the switching process.

Note: The Primary Oscillator mode has three different submodes (XT, HS and EC), which are determined by the POSCMDx Configuration bits. While an application can switch to and from Primary Oscillator mode in software, it cannot switch between the different primary submodes without reprogramming the device.

9.4.1 ENABLING CLOCK SWITCHING

To enable clock switching, the FCKSM1 Configuration bit in the FOSC Configuration register must be programmed to '0'. (Refer to **Section 25.0 "Special Features"** for further details.) If the FCKSM1 Configuration bit is unprogrammed ('1'), the clock switching function and FSCM function are disabled; this is the default setting.

The NOSCx control bits (OSCCON<10:8>) do not control the clock selection when clock switching is disabled. However, the COSCx bits (OSCCON<14:12>) will reflect the clock source selected by the FNOSCx Configuration bits.

The OSWEN control bit (OSCCON<0>) has no effect when clock switching is disabled; it is held at '0' at all times.

9.4.2 OSCILLATOR SWITCHING SEQUENCE

At a minimum, performing a clock switch requires this basic sequence:

1. If desired, read the COSCx bits (OSCCON<14:12>) to determine the current oscillator source.
2. Perform the unlock sequence to allow a write to the OSCCON register high byte.
3. Write the appropriate value to the NOSCx bits (OSCCON<10:8>) for the new oscillator source.
4. Perform the unlock sequence to allow a write to the OSCCON register low byte.
5. Set the OSWEN bit to initiate the oscillator switch.

Once the basic sequence is completed, the system clock hardware responds automatically, as follows:

1. The clock switching hardware compares the COSCx bits with the new value of the NOSCx bits. If they are the same, then the clock switch is a redundant operation. In this case, the OSWEN bit is cleared automatically and the clock switch is aborted.
2. If a valid clock switch has been initiated, the LOCK (OSCCON<5>) and CF (OSCCON<3>) bits are cleared.
3. The new oscillator is turned on by the hardware if it is not currently running. If a crystal oscillator must be turned on, the hardware will wait until the OST expires. If the new source is using the PLL, then the hardware waits until a PLL lock is detected (LOCK = 1).
4. The hardware waits for 10 clock cycles from the new clock source and then performs the clock switch.
5. The hardware clears the OSWEN bit to indicate a successful clock transition. In addition, the NOSCx bits value is transferred to the COSCx bits.
6. The old clock source is turned off at this time, with the exception of LPRC (if WDT, FSCM or RTCC with LPRC as a clock source is enabled) or SOSC (if SOSSEN remains enabled).

Note 1: The processor will continue to execute code throughout the clock switching sequence. Timing-sensitive code should not be executed during this time.

- 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.

PIC24FV16KM204 FAMILY

REGISTER 14-1: SSPxSTAT: MSSPx STATUS REGISTER (SPI MODE)

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-0	R-0	R-0	R-0	R-0	R-0
SMP	CKE ⁽¹⁾	D/ \overline{A}	P	S	R/ \overline{W}	UA	BF
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 **SMP:** Sample bit

SPI Master mode:

1 = Input data is sampled at the end of data output time

0 = Input data is sampled at the middle of data output time

SPI Slave mode:

SMP must be cleared when SPI is used in Slave mode.

bit 6 **CKE:** SPI Clock Select bit⁽¹⁾

1 = Transmit occurs on transition from active to Idle clock state

0 = Transmit occurs on transition from Idle to active clock state

bit 5 **D/ \overline{A} :** Data/Address bit

Used in I²C™ mode only.

bit 4 **P:** Stop bit

Used in I²C mode only. This bit is cleared when the MSSPx module is disabled; SSPEN bit is cleared.

bit 3 **S:** Start bit

Used in I²C mode only.

bit 2 **R/ \overline{W} :** Read/Write Information bit

Used in I²C mode only.

bit 1 **UA:** Update Address bit

Used in I²C mode only.

bit 0 **BF:** Buffer Full Status bit

1 = Receive is complete, SSPxBUF is full

0 = Receive is not complete, SSPxBUF is empty

Note 1: Polarity of clock state is set by the CKP bit (SSPxCON1<4>).

PIC24FV16KM204 FAMILY

REGISTER 14-8: SSPxADD: MSSPx SLAVE ADDRESS/BAUD RATE GENERATOR REGISTER

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
ADD7	ADD6	ADD5	ADD4	ADD3	ADD2	ADD1	ADD0
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 **ADD<7:0>:** Slave Address/Baud Rate Generator Value bits

SPI Master and I²C™ Master modes:

Reload value for the Baud Rate Generator. Clock period is $(([SPxADD] + 1) * 2) / F_{osc}$.

I²C Slave modes:

Represents 7 or 8 bits of the slave address, depending on the addressing mode used:

7-Bit mode: Address is ADD<7:1>; ADD<0> is ignored.

10-Bit LSb mode: ADD<7:0> are the Least Significant bits of the address.

10-Bit MSb mode: ADD<2:1> are the two Most Significant bits of the address; ADD<7:3> are always '11110' as a specification requirement; ADD<0> is ignored.

REGISTER 14-9: SSPxMSK: I²C™ SLAVE ADDRESS MASK REGISTER

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

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
MSK7	MSK6	MSK5	MSK4	MSK3	MSK2	MSK1	MSK0 ⁽¹⁾
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 **MSK<7:0>:** Slave Address Mask Select bits⁽¹⁾

1 = Masking of corresponding bit of SSPxADD is enabled

0 = Masking of corresponding bit of SSPxADD is disabled

Note 1: MSK0 is not used as a mask bit in 7-bit addressing.

PIC24FV16KM204 FAMILY

REGISTER 19-2: AD1CON2: A/D CONTROL REGISTER 2

R/W-0	R/W-0	R/W-0	U-0	R/W-0	R/W-0	U-0	U-0
PVCFG1	PVCFG0	NVCFG0	—	BUFREGEN	CSCNA	—	—
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
BUFS ⁽¹⁾	SMPI4	SMPI3	SMPI2	SMPI1	SMPI0	BUFM ⁽¹⁾	ALTS
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 15-14 **PVCFG<1:0>**: A/D Converter Positive Voltage Reference Configuration bits

11 = 4 * Internal V_{BG}⁽²⁾

10 = 2 * Internal V_{BG}⁽³⁾

01 = External V_{REF+}

00 = AV_{DD}

bit 13 **NVCFG0**: A/D Converter Negative Voltage Reference Configuration bits

1 = External V_{REF-}

0 = AV_{SS}

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

bit 11 **BUFREGEN**: A/D Buffer Register Enable bit

1 = Conversion result is loaded into a buffer location determined by the converted channel

0 = A/D result buffer is treated as a FIFO

bit 10 **CSCNA**: Scan Input Selections for CH0+ S/H Input for MUX A Setting bit

1 = Scans inputs

0 = Does not scan inputs

bit 9-8 **Unimplemented**: Read as '0'

bit 7 **BUFS**: A/D Buffer Fill Status bit⁽¹⁾

1 = A/D is filling the upper half of the buffer; user should access data in the lower half

0 = A/D is filling the lower half of the buffer; user should access data in the upper half

bit 6-2 **SMPI<4:0>**: Interrupt Sample Rate Select bits

11111 = Interrupts at the completion of the conversion for each 32nd sample

11110 = Interrupts at the completion of the conversion for each 31st sample

•

•

•

00001 = Interrupts at the completion of the conversion for every other sample

00000 = Interrupts at the completion of the conversion for each sample

bit 1 **BUFM**: A/D Buffer Fill Mode Select bit⁽¹⁾

1 = Starts filling the buffer at address, ADC1BUF0, on the first interrupt and ADC1BUF(x/2) on the next interrupt (Split Buffer mode)

0 = Starts filling the buffer at address, ADC1BUF0, and each sequential address on successive interrupts (FIFO mode)

bit 0 **ALTS**: Alternate Input Sample Mode Select bit

1 = Uses channel input selects for Sample A on the first sample and Sample B on the next sample

0 = Always uses channel input selects for Sample A

Note 1: This is only applicable when the buffer is used in FIFO mode (BUFREGEN = 0). In addition, BUFS is only used when BUFM = 1.

2: PIC24FV16KMXXX devices only. Reference setting will not be within specification for V_{DD} below 4.5V.

3: Reference setting will not be within specification for V_{DD} below 2.3V.

PIC24FV16KM204 FAMILY

REGISTER 19-8: AD1CSSH: A/D INPUT SCAN SELECT REGISTER (HIGH WORD)⁽¹⁾

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	U-0
—	CSS30	CSS29	CSS28	CSS27	CSS26	—	—
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
CSS23	CSS22	CSS21	CSS20 ⁽²⁾	CSS19 ⁽²⁾	CSS18	CSS17	CSS16
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 **Unimplemented:** Read as '0'

bit 14-10 **CSS<30:26>:** A/D Input Scan Selection bits

1 = Includes the corresponding channel for input scan

0 = Skips the channel for input scan

bit 9-8 **Unimplemented:** Read as '0'

bit 7-0 **CSS<23:16>:** A/D Input Scan Selection bits⁽²⁾

1 = Includes the corresponding channel for input scan

0 = Skips the channel for input scan

Note 1: Unimplemented channels are read as '0'. Do not select unimplemented channels for sampling as indeterminate results may be produced.

2: The CSS<20:19> bits are not implemented in 20-pin devices.

REGISTER 19-9: AD1CSSL: A/D INPUT SCAN SELECT REGISTER (LOW WORD)⁽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
CSS15	CSS14	CSS13	CSS12	CSS11	CSS10	CSS9	CSS8 ^(2,3)
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
CSS7 ^(2,3)	CSS6 ^(2,3)	CSS5 ⁽²⁾	CSS4	CSS3	CSS2	CSS1	CSS0
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 **CSS<15:0>:** A/D Input Scan Selection bits^(2,3)

1 = Includes the corresponding ANx input for scan

0 = Skips the channel for input scan

Note 1: Unimplemented channels are read as '0'. Do not select unimplemented channels for sampling as indeterminate results may be produced.

2: The CSS<8:5> bits are not implemented in 20-pin devices.

3: The CSS<8:6> bits are not implemented in 28-pin devices.

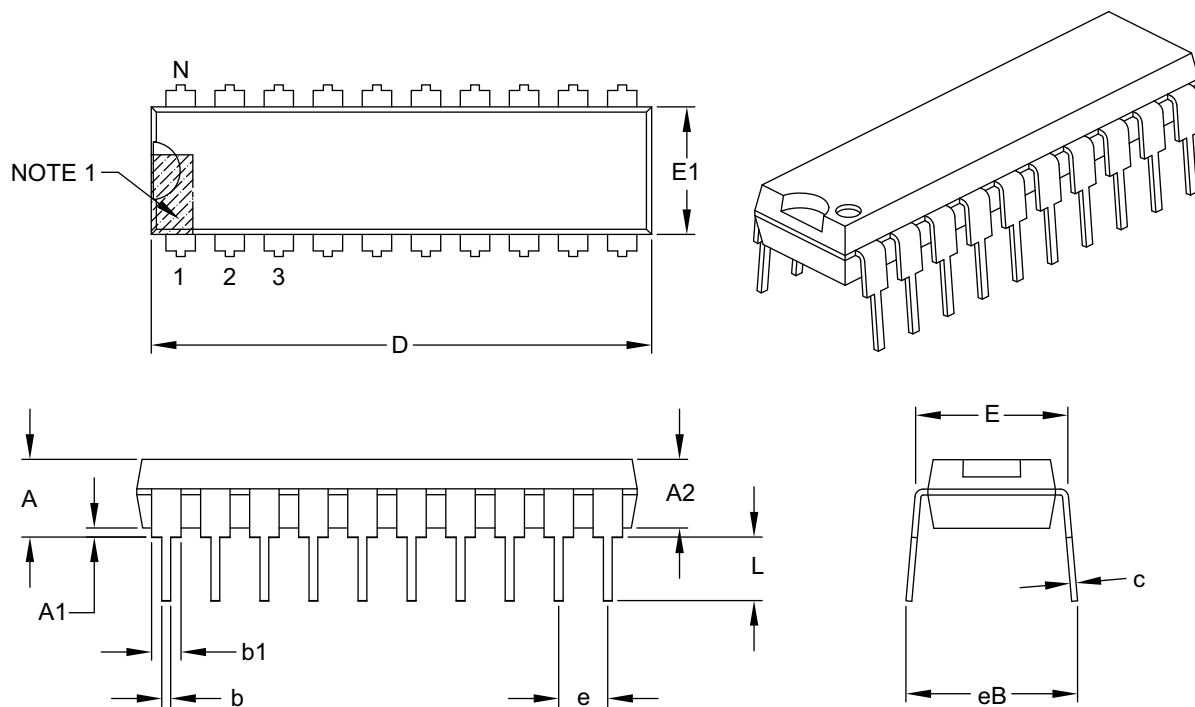
PIC24FV16KM204 FAMILY

28.2 Package Details

The following sections give the technical details of the packages.

20-Lead Plastic Dual In-Line (P) – 300 mil Body [PDIP]

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



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N	20		
Pitch	e	.100 BSC		
Top to Seating Plane	A	–	–	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	–	–
Shoulder to Shoulder Width	E	.300	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.980	1.030	1.060
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.045	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	–	–	.430

Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M.

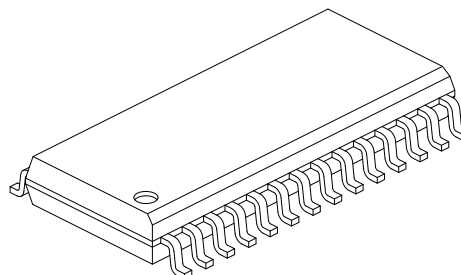
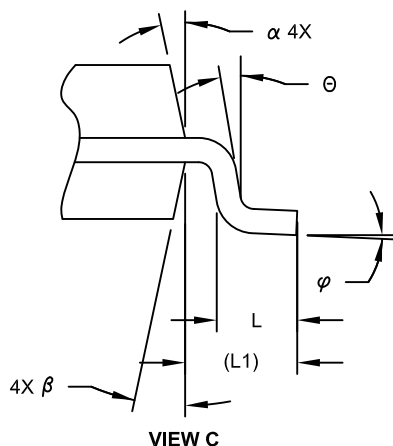
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-019B

PIC24FV16KM204 FAMILY

28-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

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



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	28		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	2.65
Molded Package Thickness	A2	2.05	-	-
Standoff §	A1	0.10	-	0.30
Overall Width	E	10.30 BSC		
Molded Package Width	E1	7.50 BSC		
Overall Length	D	17.90 BSC		
Chamfer (Optional)	h	0.25	-	0.75
Foot Length	L	0.40	-	1.27
Footprint	L1	1.40 REF		
Lead Angle	θ	0°	-	-
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.18	-	0.33
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
- 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.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing C04-052C Sheet 2 of 2

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