dsPIC30F to PIC24H Conversion Guidelines

Author: *Richard L. Fischer*
Microchip Technology Inc.

GENERAL INFORMATION

This document provides an overview of considerations for converting from dsPIC30F to PIC24H devices. If you are undertaking this conversion, it is recommended that you download data sheets and errata documents on these devices from our web site, *www.microchip.com*.

The PIC24H devices are 3.3 VDC operational devices. If the dsPIC30F design was originally implanted at 3.3 VDC, this will greatly simplify the conversion to the PIC24H family.

PIC24H and dsPIC30F 64-pin TQFP devices are pin-compatible with the exception of one pin. The PIC24H VDDCORE pin (pin 56) must be connected to circuit ground via a 1µF capacitor. On dsPIC30F devices, this same pin is a VSS pin and must be tied to ground.

The PIC24H devices do not feature the Low-Voltage-Detect (LVD) as on the dsPIC30F devices. Conversion can be simplified if the dsPIC30F LVD feature is not implemented.

The PIC24H devices support a Brown-out Reset (BOR) feature, but not an equivalent dsPIC30F BOR with adjustable trip points.

Both families support the Programmable Power-up Timer (POR). The port I/O sink/source current is 4mA for the PIC24H devices versus 25mA for the dsPIC30F devices.

Run, Sleep and Idle currents are not yet characterized. Run and Idle currents will be reduced on the PIC24H devices versus the dsPIC30F devices.

The PIC24H devices have a programmable PLL, whereas the dsPIC30F PLL features x4, x8 or x16 modes.

PIC24H does not support DSP instructions or associated operations and conditional instructions which depend on accumulator status bits. The remaining instruction set is 100% identical to the dsPIC30F product family.

In general, Assembly and C language code developed for the dsPIC30F devices are directly portable to PIC24H devices using the associated device header (.h), include (.inc) and linker (.gld) support files. PIC24H devices support more interrupt sources, therefore the interrupt vector table length has increased. User code starts at 0x200 versus 0x100 on the dsPIC30F devices. Using the associated device linker (.gld) support file makes this change transparent.

Some peripherals have new features therefore, additional bits have been added in respective SFRs. Some SFR bits have moved or been renamed between the dsPIC30F and PIC24H devices. If existing Assembly and C language code utilizes the provided device support files, code conversion is straight forward.

Table 1 presents a summary of the key differences between the dsPIC30F to PIC24H devices. Please refer to the specific device data sheets for further information.

TABLE 1: KEY DIFFERENCES BETWEEN dsPIC30F AND PIC24H DEVICES

Peripheral Module	Channels		Comments
	dsPIC30F	PIC24H	
Interrupt Controller	45	61	SFR bits are located in different SFRs. There are more interrupts and associated SFRs on the PIC24H devices. Old SFR bit names are retained for compatibility.
Timers 16-bit	5	9	No SFR bit name changes. Four new timers on the PIC24H devices.
Input Capture	5	8	No SFR bit name changes. Three new channels on the PIC24H devices.
Output Compare	5	8	No SFR bit name changes. Three new channels on the PIC24H devices.
10-bit 1 Msps ADC	16	0	New module on the PIC24H devices.
12-bit 200 Ksps ADC	16	0	New module on the PIC24H devices.

TABLE 1: KEY DIFFERENCES BETWEEN dsPIC30F AND PIC24H DEVICES (CONTINUED)

Peripheral Module	Channels		Comments
	dsPIC30F	PIC24H	
10- to 12-bit ADC 10-bit 1.1 Msps 12-bit 500 Ksps	0	32	ADxCON1 SFR: No bit name changes. New modes/SFR bits added: 10/12 ADC mode bit. Added SFR bits to support 32 ADC channels.
UART	2	2	UxMODE SFR: No bit name changes. New modes/SFR bits added. UxSTA SFR: No bit name changes. New mode/SFR bit added. Features added on PIC24H devices: IrDA®, LIN support and Interrupt-on-TSR empty.
I^2C™	1	2	No SFR bit name changes. New SFR (I2CxMSK) and address masking feature added.
SPI	2	2	SPIxSTAT SFR: No bit name changes. SPIxCON1 SFR: No bit name changes. New bits added and some relocated to new SFR SPIxCON2. FIFO and Frame modes added.
DCI (CODEC)	1	0	N/A
CAN	2	0	N/A
ECAN™ Technology	0	2	New module on PIC24H devices.
Motor Control PWM	8	0	N/A
QEI	1	0	N/A
I/O Ports	Ports A-G	Ports A-G	New feature added: Open Drain output on some ports.
DMA	0	8	8 channels assignable to several peripherals.
Clock Switching	Yes	Yes	Additional clock modes/features on PIC24H devices. Oscillator control SFRs are different.
Power Saving Mode	2	3	New Doze mode added to existing Sleep and Idle modes.
Device Configuration	—	—	Use new device support files (.h, .inc and .gld) for support.
PLL modes	x4, x8 and x16 PLL	Programmable PLL	See Section 8.1 of the PIC24H data sheet (DS7xxxx) for system clock selection information.
Programming Pins	1 pair	3 pairs	There are now 3 PGC/EMUC and PGD/EMUD pairs of pins, which can be used for both programming and debugging.
Debugging Pins	4 pairs	3 pairs	

PERIPHERALS

The PIC24H peripheral set is enhanced versus the first generation dsPIC30F product family. Several peripherals have identical features with some peripherals supporting additional features.

The ADC module on the PIC24H devices are slightly different from the dsPIC30F ADC module. The basic functionality is the same, however the PIC24H ADC module is selectable between 10- and 12-bit operation, supports higher conversion rates and features more external ADC pins.

The PIC24H supports 8 channels of DMA, which are assignable to the following peripherals: UART, SPI, ADC, Input Capture, Output Compare/Standard PWM and ECAN™ technology.

Additional status bits for determination of specific Math Exception Traps are available on the PIC24H devices. These bits are located in the INTCON1 SFR.

PIC24H digital I/O ports are 5V tolerant. New open drain features are provided on some ports. Configured as digital I/O pins, the PIC24H analog pins are 3.6V tolerant. See the PIC24H data sheet (DS70175) for further information.

FLASH PROGRAM MEMORY

Like the dsPIC30F devices, the PIC24H devices support Run-Time-Self-Programming (RTSP) . Table 2 lists some small RTSP differences between the two families

SFR registers, NVMADR and NVMADRU, are not available or utilized for programming/erasing operations on PIC24H Flash program memory.

The PIC24H devices do not support data EEPROM. Likewise, there is no vector location for the NVM interrupt as there is on the dsPIC30F devices. The interrupt vector location is reserved.

The PIC24H Program Flash Erase/Write endurance specifications differ from dsPIC30F devices. Please refer to the PIC24H data sheet (DS70175) for further information.

All program/erase operations of the PIC24H devices are self-timed like the dsPIC30F devices, therefore no additional timer is required to terminate a program/erase operation.

.

TABLE 2: RTSP DIFFERENCES BETWEEN PIC24H AND dsPIC30F FAMILIES

Parameter	PIC24H	dsPIC30F
Smallest PM Erase Size	1 Page - 512 instructions/1536 bytes	1 Row - 32 instructions/96 bytes
Smallest PM Program Size	1 Row - 64 instructions/192 bytes	1 Row - 32 instructions/96 bytes

Basic PM Erase Code Sequence	`; Setup NVMCON for page erase operation`
	`MOV #0x4042, w0`
	`MOV w0, NVMCON`
	
	`; Init pointer for Erase Op.`
	`MOV #tblpage(PROG_ADDR), w0`
	`MOV w0, TBLPAG`
	`MOV #tbloffset(PROG_ADDR), w0`
	`TBLWTL w0, [w0]  ; Set base address of erase block`
	`; Disable interrupts, if enabled`
	
	`; Write the KEY sequence`
	`MOV #0x55, w0`
	`MOV w0, NVMKEY`
	`MOV #0xAA, w0`
	`MOV w0, NVMKEY`
	
	`; Start the erase operation`
	`BSET NVMCON, #WR`
	
	`; Insert two NOPs (required)`
	`NOP`
	`NOP`
	`Re-enable interrupts, if needed`
		`; Setup NVMCON for row erase operation`
		`MOV #0x4041, w0`
		`MOV w0, NVMCON`
		
		`; Init pointer for Erase Op.`
		`MOV #tblpage(PROG_ADDR), w0`
		`MOV w0, NVMADRU`
		`MOV #tbloffset(PROG_ADDR), w0`
		`MOV w0, NVMADR`
		
		`; Disable interrupts, if enabled;`
		
		`Write the KEY sequence`
		`MOV #0x55, w0`
		`MOV w0, NVMKEY`
		`MOV #0xAA, w0`
		`MOV w0, NVMKEY`
		
		`; Start the erase operation`
		`BSET NVMCON, #WR`
		
		`; Insert two NOPs (required)`
		`NOP`
		`NOP`
		`Re-enable interrupts, if needed`

Basic PM Program Code Sequence (Example loading 1 write latch only)	`; Setup the address pointer to program space`
	`MOV #tblpage(PROG_ADDR), w0`
	`; get table page value`
	`MOV w0, TBLPAG  ; load TBLPAG register`
	`MOV #tbloffset(PROG_ADDR), w0`
	`; load address LS word`
	
	`; Load write data into W registers`
	`MOV #PROG_LOW_WORD, w2`
	`MOV #PROG_HI_BYTE, w3`
	
	`; Perform the table writes to load the latch`
	`TBLWTL w2, [w0]`
	`TBLWTH w3, [w0++]`
		`; Setup the address pointer to program space`
		`MOV #tblpage(PROG_ADDR), w0`
		`; get table page value`
		`MOV w0, TBLPAG  ; load TBLPAG register`
		`MOV #tbloffset(PROG_ADDR), w0`
		`; load address LS word`
		
		`; Load write data into W registers`
		`MOV #PROG_LOW_WORD, w2`
		`MOV #PROG_HI_BYTE, w3`
		
		`; Perform the table writes to load the latch`
		`TBLWTL w2, [w0]`
		`TBLWTH w3, [w0++]`

ELECTRICAL CHARACTERISTICS

Operating from 3.0 to 3.6 VDC and rated at 40 MIPS @ 85ºC, the PIC24H product family is designed using 0.25 µm process technology. Therefore, the DC and AC Electrical Specifications are different from the dsPIC30F product family. Please refer to the PIC24H data sheet (DS70175) for further information.

PACKAGE CONVERSION CONSIDERATIONS

Table 3 presents a summary of the programming/debugging pin differences between the dsPIC30F "A" devices and the PIC24H devices.

Check the mechanical/package footprint of a 64-pin TQFP dsPIC30F and PIC24H device. Layout PCB to accommodate a common 10x10x1 mm package.

PIC24H is not currently offered in the 80-pin TQFP package.

TABLE 3: PROGRAMMING/DEBUGGING PIN DIFFERENCES

Programming/Debugging Pins	dsPIC30F	PIC24H	dsPIC30F	PIC24H
	64-pin	64-pin	80-pin	80-pin
PGC/EMUC + PGD/EMUD	RB6 + RB7	—	RB1 + RB0	—
EMUC1/EMUD1	RC14 + RC13	—	RC14 + RC13	—
EMUC2/EMUD2	RD0 + RD1	—	RD0 + RD1	—
EMUC3/EMUD3	RF6 + RF3	—	RF6 + RF8	—
PGC1/EMUC1 + PGD1/EMUD1	—	RB6 + RB7	—	RB6 + RB7
PGC2/EMUC2 + PGD2/EMUD2	—	RC14 + RC13	—	RC14 + RC13
PGC3/EMUC3 + PGD3/EMUD3	—	RB1 + RB0	—	RB1 + RB0

Legend: PGC - Primary Programming Clock Pin;
PGD - Primary Programming Data Pin
EMUCx - Debugging Clock Pin (where x = 1, 2 or 3)
EMUDx - Debugging Data Pin (where x = 1, 2 or 3)

PROGRAMMING SUPPORT

No high voltage is required or provided by the MPLAB® ICD 2 or MPLAB PM 3 tools when programming the PIC24H devices. The ~12.5 VDC currently supplied by MPLAB ICD 2 or MPLAB PM 3, when programming the dsPIC30F devices, is not required for the PIC24H devices.

Note: Possible damage to the $\overline{\text{MCLR}}$ pin will be sustained if more than 5.5 VDC is applied.

DEVELOPMENT TOOLS AND BOARDS

MPLAB IDE, MPLAB C30, MPLAB ICD 2, MPLAB PM3 and Real ICE™ In-Circuit Emulator tools support the PIC24H product family of devices. See Table 4 below for information on tool version support.

TABLE 4: DEVELOPMENT TOOL SUPPORT FOR THE PIC24H FAMILY

Development Tools	PIC24H
MPLAB® IDE	MPLAB IDE 7.40 or later
MPLAB C30	MPLAB C30 2.00
MPLAB ICD 2 Programmer/Debugger	MPLAB ICD2 1.40
MPLAB PM3 Device Programmer	MPLAB PM3 7.40
MPLAB ICE 4000	No
Real ICE™ In-Circuit Emulator	Yes

The dsPICDEM™ 80-pin Starter Development Board (DM300019) and the Explorer 16 Development Board (DM240001) support the PIC24H silicon.

Plug-in modules (PIMs) are not currently available for the PIC24H product family.

APPLICATION LIBRARIES

Several advanced application libraries developed for the dsPIC30F product family support the PIC24H product family. These libraries are scheduled for testing and release after the PIC24H devices are released to production.

APPENDIX A: REVISION HISTORY

Revision A (01/2006)

Original version of the document.

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Trademarks

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

Microchip received ISO/TS-16949:2002 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona and Mountain View, California in October 2003. The Company's quality system processes and procedures are for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Alpharetta, GA
Tel: 770-640-0034
Fax: 770-640-0307

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

San Jose
Mountain View, CA
Tel: 650-215-1444
Fax: 650-961-0286

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8676-6200
Fax: 86-28-8676-6599

China - Fuzhou
Tel: 86-591-8750-3506
Fax: 86-591-8750-3521

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Shunde
Tel: 86-757-2839-5507
Fax: 86-757-2839-5571

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7250
Fax: 86-29-8833-7256

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-2229-0061
Fax: 91-80-2229-0062

India - New Delhi
Tel: 91-11-5160-8631
Fax: 91-11-5160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Gumi
Tel: 82-54-473-4301
Fax: 82-54-473-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Penang
Tel: 60-4-646-8870
Fax: 60-4-646-5086

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-399
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

10/31/05