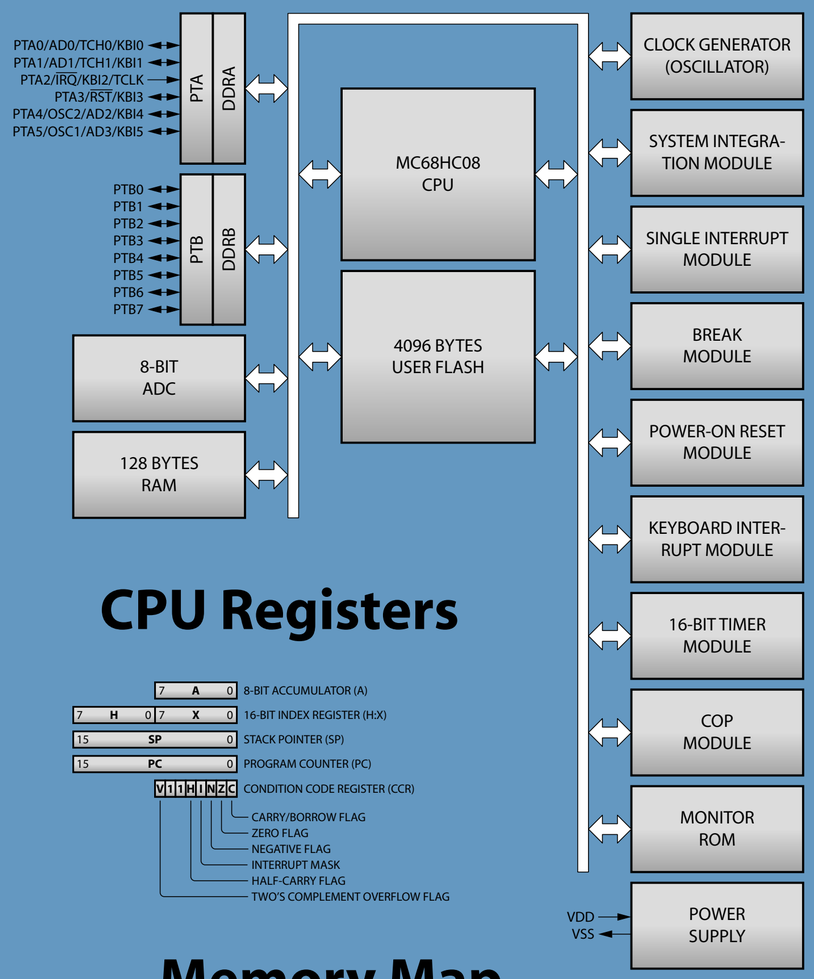
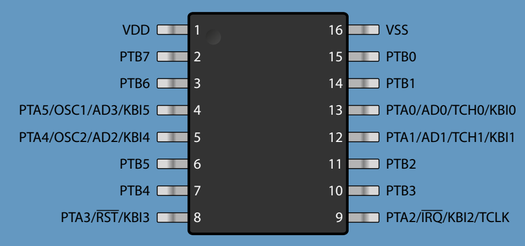
MC68HC908QY4 Easy Reference

freescale™ Enabled

Block Diagram



16-Pin SOIC Package



Device Summary

Device	FLASH Memory Size	A/D Converter	Pin Count
MC68H(L)C908QT1	1536 bytes	-	8 pins
MC68H(L)C908QT2	1536 bytes	4 ch, 8 bit	8 pins
MC68H(L)C908QT4	4096 bytes	4 ch, 8 bit	8 pins
MC68H(L)C908QY1	1536 bytes	-	16 pins
MC68H(L)C908QY2	1536 bytes	4 ch, 8 bit	16 pins
MC68H(L)C908QY4	4096 bytes	4 ch, 8 bit	16 pins

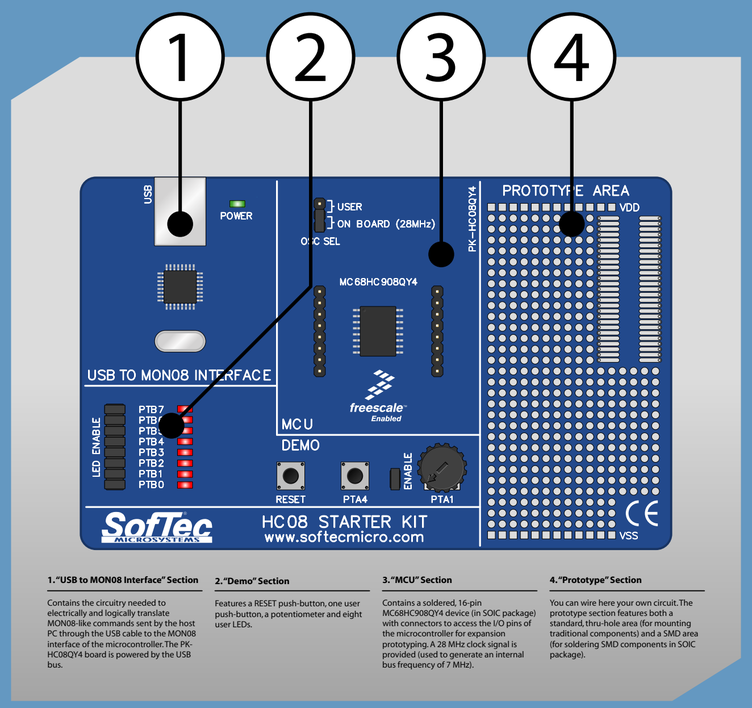
Instruction Set

Mnemonic	Description	Operation	Flags
ADC	Add with Carry	A ← (A) + (M) + (C)	V, H, N, Z, C
ADD	Add without Carry	A ← (A) + (M)	V, H, N, Z, C
AIS	Add Immediate Value to Stack Pointer	SP ← (SP) + (16<<M)	-
AIX	Add Immediate Value to Index Register	H:X ← (H:X) + (16<<M)	-
AND	Logical AND	A ← (A) & (M)	V, N, Z
ASL	Arithmetic Shift Left (Same as LSL)		V, N, Z, C
ASR	Arithmetic Shift Right		V, N, Z, C
BCC	Branch if Carry Bit Clear (Same as BHS)	If (C) = 0, PC ← (PC) + $0002 + *rel*	-
BCLR *n*	Clear Bit *n* in Memory	*Mn* ← 0	-
BCS	Branch if Carry Bit Set (Same as BLO)	If (C) = 1, PC ← (PC) + $0002 + *rel*	-
BEQ	Branch if Equal	If (Z) = 1, PC ← (PC) + $0002 + *rel*	-
BGE	Branch if Greater Than or Equal To	If (N ⊕ V) = 0, PC ← (PC) + $0002 + *rel*	-
BGT	Branch if Greater Than	If (Z) | (N ⊕ V) = 0, PC ← (PC) + $0002 + *rel*	-
BHCC	Branch if Half Carry Bit Clear	If (H) = 0, PC ← (PC) + $0002 + *rel*	-
BHCS	Branch if Half Carry Bit Set	If (H) = 1, PC ← (PC) + $0002 + *rel*	-
BHI	Branch if Higher	If (C) | (Z) = 0, PC ← (PC) + $0002 + *rel*	-
BHS	Branch if Higher or Same (Same as BCC)	If (C) = 0, PC ← (PC) + $0002 + *rel*	-
BIH	Branch if IRQ Pin High	If $\overline{IRQ1}$ = 1, PC ← (PC) + $0002 + *rel*	-
BIL	Branch if IRQ Pin Low	If $\overline{IRQ}$ = 0, PC ← (PC) + $0002 + *rel*	-
BIT	Bit Test	(A) & (M)	V, N, Z
BLE	Branch if Less Than or Equal To	If (Z) | (N ⊕ V) = 1, PC ← (PC) + $0002 + *rel*	-
BLO	Branch if Lower (Same as BCS)	If (C) = 1, PC ← (PC) + $0002 + *rel*	-
BLS	Branch if Lower or Same	If (C) | (Z) = 1, PC ← (PC) + $0002 + *rel*	-
BLT	Branch if Less Than	If (N ⊕ V) = 1, PC ← (PC) + $0002 + *rel*	-
BMC	Branch if Interrupt Mask Clear	If (I) = 0, PC ← (PC) + $0002 + *rel*	-
BMI	Branch if Minus	If (N) = 1, PC ← (PC) + $0002 + *rel*	-
BMS	Branch if Interrupt Mask Set	If (I) = 1, PC ← (PC) + $0002 + *rel*	-
BNE	Branch if Not Equal	If (Z) = 0, PC ← (PC) + $0002 + *rel*	-
BPL	Branch if Plus	If (N) = 0, PC ← (PC) + $0002 + *rel*	-
BRA	Branch Always	PC ← (PC) + $0002 + *rel*	-
BRCLR *n*	Branch if Bit *n* in Memory Clear	If bit *n* of M = 0, PC ← (PC) + $0003 + *rel*	C
BRN	Branch Never	PC ← (PC) + $0002	-
BRSET *n*	Branch if Bit *n* in Memory Set	If bit *n* of M = 1, PC ← (PC) + $0003 + *rel*	C
BSET *n*	Set Bit *n* in Memory	*Mn* ← 1	-
BSR	Branch to Subroutine	PC ← (PC) + $0002, Push (PCL), SP ← (SP) – $0001, Push (PCH), SP ← (SP) - $0001, PC ← (PC) + *rel*	-
CBEQ	Compare and Branch if Equal	For DIR or IMM modes: if (A) = (M), PC ← (PC) + $0003 + *rel*; or for IX+ mode: if (A) = (M), PC ← (PC) + $0002 + *rel*; or for SP1 mode: if (A) = (M), PC ← (PC) + $0004 + *rel*; or for CBEQX mode: if (X) = (M), PC ← (PC) + $0003 + *rel*	-
CLC	Clear Carry Bit	C bit ← 0	C
CLI	Clear Interrupt Mask Bit	I bit ← 0	I
CLR	Clear	A ← $00; or M ← $00; or X ← $00; or H ← $00	V, N, Z
CMP	Compare Accumulator with Memory	(A) – (M)	V, N, Z, C
COM	Complement (One's Complement)	A ← $FF – (A); or X ← $FF – (X); or M ← $FF – (M)	V, N, Z, C
CPHX	Compare Index Register with Memory	(H:X) – (M:M + $0001)	V, N, Z, C
CPX	Compare X (Index Register Low) with Mem.	(X) – (M)	V, N, Z, C
DAA	Decimal Adjust Accumulator	$(A)_{10}$	V, N, Z, C
DBNZ	Decrement and Branch if Not Zero	A ← (A) - $01; or M ← (M) – $01; or X ← (X) - $01 For DIR or IX1 modes: PC ← (PC) + $0003 + *rel* if (result) ≠ 0; or for INH or IX modes: PC ← (PC) + $0002 + *rel* if (result) ≠ 0; or for SP1 mode: PC ← (PC) + $0004 + *rel* if (result) ≠ 0	-
DEC	Decrement	A ← (A) – $01; or X ← (X) – $01; or M ← (M) – $01	V, N, Z
DIV	Divide	A ← (H:A) ÷ (X), H ← Remainder	Z, C
EOR	Exclusive-OR Memory with Accumulator	A ← (A ⊕ M)	V, N, Z
INC	Increment	A ← (A) + $01; or X ← (X) + $01; or M ← (M) + $01	V, N, Z
JMP	Jump	PC ← effective address	-
JSR	Jump to Subroutine	PC ← (PC) + *n* (*n* = 1, 2, or 3), Push (PCL), SP ← (SP) – $0001, Push (PCH), SP ← (SP) – $0001, PC ← effective address	-
LDA	Load Accumulator from Memory	A ← (M)	V, N, Z
LDHX	Load Index Register from Memory	H:X ← (M:M + $0001)	V, N, Z
LDX	Load X (Index Register Low) from Memory	X ← (M)	V, N, Z
LSL	Logical Shift Left (Same as ASL)		V, N, Z, C
LSR	Logical Shift Right		V, N, Z, C
MOV	Move	$(M)_{destination}$ ← $(M)_{source}$	V, N, Z
MUL	Unsigned Multiply	X:A ← (X) x (A)	H, C
NEG	Negate (Two's Complement)	A ← – (A); or X ← – (X); or M ← – (M)	V, N, Z, C
NOP	No Operation	-	-
NSA	Nibble Swap Accumulator	A ← (A[3:0]:A[7:4])	-
ORA	Inclusive-OR Accumulator and Memory	A ← (A) | (M)	V, N, Z
PSHA	Push Accumulator onto Stack	Push (A), SP ← (SP) – $0001	-
PSHH	Push H (Index Register High) onto Stack	Push (H), SP ← (SP) – $0001	-
PSHX	Push X (Index Register Low) onto Stack	Push (X), SP ← (SP) – $0001	-
PULA	Pull Accumulator from Stack	SP ← (SP + $0001), Pull (A)	-
PULH	Pull H (Index Register High) from Stack	SP ← (SP + $0001), Pull (H)	-
PULX	Pull X (Index Register Low) from Stack	SP ← (SP + $0001), Pull (X)	-
ROL	Rotate Left through Carry		V, N, Z, C
ROR	Rotate Right through Carry		V, N, Z, C
RSP	Reset Stack Pointer	SP ← $FF	-
RTI	Return from Interrupt	SP ← SP + $0001, Pull (CCR), SP ← SP + $0001, Pull (A), SP ← SP + $0001, Pull (X), SP ← SP + $0001, Pull (PCH), SP ← SP + $0001, Pull (PCL)	V, H, I, N, Z, C
RTS	Return from Subroutine	SP ← SP + $0001, Pull (PCH), SP ← SP + $0001, Pull (PCL)	-
SBC	Subtract with Carry	A ← (A) – (M) – (C)	V, N, Z, C
SEC	Set Carry Bit	C bit ← 1	C
SEI	Set Interrupt Mask Bit	I bit ← 1	I
STA	Store Accumulator in Memory	M ← (A)	V, N, Z
STHX	Store Index Register	(M:M + $0001) ← (H:X)	V, N, Z
STOP	Enable IRQ Pin, Stop Oscillator	I bit ← 0, stop oscillator	I
STX	Store X (Index Register Low) in Memory	M ← (X)	V, N, Z
SUB	Subtract	A ← (A) – (M)	V, N, Z, C
SWI	Software Interrupt	PC ← (PC) + $0001, Push (PCL), SP ← (SP) – $0001, Push (PCH), SP ← (SP) – $0001, Push (X), SP ← (SP) – $0001, Push (A), SP ← (SP) - $0001, Push (CCR), SP ← (SP) – $0001, I bit ← 1, PCH ← ($FFFC), PCL ← ($FFFD)	I
TAP	Transfer Accumulator to CCR	CCR ← (A)	V, H, I, N, Z, C
TAX	Transfer Accumulator to X (Index Reg. Low)	X ← (A)	-
TPA	Transfer CCR to Accumulator	A ← (CCR)	-
TST	Test for Negative or Zero	(A) – $00; or (X) – $00; or (M) – $00	V, N, Z
TSX	Transfer Stack Pointer to Index Register	H:X ← (SP) + $0001	-
TXA	Transfer X (Index Reg. Low) to Accumulator	A ← (X)	-
TXS	Transfer Index Register to Stack Pointer	(SP) ← (H:X) - $0001	-
WAIT	Enable Interrupts, Stop Processor	I bit ← 0, inhibit CPU clocking until interrupted	I

CPU Registers

Memory Map

$0000 ↓ $003F	I/O REGISTERS 64 BYTES
$0040 ↓ $007F	RESERVED 64 BYTES
$0080 ↓ $00FF	RAM 128 BYTES
$0100 ↓ $27FF	UNIMPLEMENTED 9984 BYTES
$2800 ↓ $2DFF	AUXILIARY ROM 1536 BYTES
$2E00 ↓ $EDFF	UNIMPLEMENTED 49152 BYTES
$EE00 ↓ $FDFF	FLASH MEMORY 4096 BYTES
$FE00	BREAK STATUS REGISTER (BSR)
$FE01	RESET STATUS REGISTER (SRSR)
$FE02	BREAK AUXILIARY REGISTER (BRKAR)
$FE03	BREAK FLAG CONTROL REGISTER (BFCR)
$FE04	INTERRUPT STATUS REGISTER 1 (INT1)
$FE05	INTERRUPT STATUS REGISTER 2 (INT2)
$FE06	INTERRUPT STATUS REGISTER 3 (INT3)
$FE07	RESERVED FOR FLASH TEST CONTROL REGISTER (FLTCR)
$FE08	FLASH CONTROL REGISTER (FLCR)
$FE09	BREAK ADDRESS HIGH REGISTER (BRKH)
$FE0A	BREAK ADDRESS LOW REGISTER (BRKL)
$FE0B	BREAK STATUS AND CONTROL REGISTER (BRKSCR)
$FE0C	LVISR
$FE0D ↓ $FE0F	RESERVED FOR FLASH TEST 3 BYTES
$FE10 ↓ $FFAF	MONITOR ROM 416 BYTES
$FFB0 ↓ $FFBD	FLASH 14 BYTES
$FFBE	FLASH BLOCK PROTECT REGISTER (FLBPR)
$FFBF	RESERVED FLASH
$FFC0	INTERNAL OSCILLATOR TRIM VALUE
$FFC1	RESERVED FLASH
$FFC2 ↓ $FFCF	FLASH 14 BYTES
$FFD0 ↓ $FFFF	USER VECTORS 48 BYTES



1. "USB to MON08 Interface" Section

Contains the circuitry needed to electrically and logically translate MON08-like commands sent by the host PC through the USB cable to the MON08 interface of the microcontroller. The PK-HC08QY4 board is powered by the USB bus.

2. "Demo" Section

Features a RESET push-button, one user push-button, a potentiometer and eight user LEDs.

3. "MCU" Section

Contains a soldered, 16-pin MC68HC908QY4 device (in SOIC package) with connectors to access the I/O pins of the microcontroller for expansion prototyping. A 28 MHz clock signal is provided (used to generate an internal bus frequency of 7 MHz).

4. "Prototype" Section

You can wire here your own circuit. The prototype section features both a standard, thru-hole area (for mounting traditional components) and a SMD area (for soldering SMD components in SOIC package).

Vector Addresses

Priority	Vector	Address	Description
Lowest	IF15	$FFDE	ADC conversion complete vector (high)
		$FFDF	ADC conversion complete vector (low)
	IF14	$FFE0	Keyboard vector (high)
		$FFE1	Keyboard vector (low)
	IF13 ↓ IF6	-	Not used
	IF5	$FFF2	TIM overflow vector (high)
		$FFF3	TIM overflow vector (low)
	IF4	$FFF4	TIM channel 1 vector (high)
		$FFF5	TIM channel 1 vector (low)
	IF3	$FFF6	TIM channel 0 vector (high)
		$FFF7	TIM channel 0 vector (low)
	IF2	-	Not used
	IF1	$FFFA	IRQ vector (high)
		$FFFB	IRQ vector (low)
	-	$FFFC	SWI vector (high)
		$FFFD	SWI vector (low)
Highest	-	$FFFE	Reset vector (high)
		$FFFF	Reset vector (low)

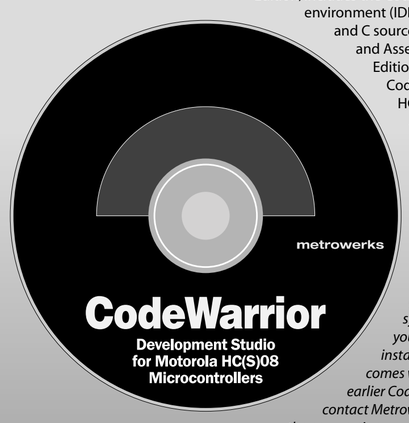
PK-HC08QY4 Quickstart Tutorial

freescale™ Enabled

1 Install CodeWarrior for HC(S)08

PK-HC08QY4 comes with a free version of CodeWarrior Development Studio for HC(S)08 Microcontrollers, Special Edition.

CodeWarrior Development Studio for HC(S)08 Microcontrollers, Special Edition, includes the CodeWarrior integrated development environment (IDE); 4 KB code-size limited C compiler and C source-level debugger; macro assembler and Assembly-level debugger. The Special Edition allows you to evaluate CodeWarrior Development Studio for HC(S)08 Microcontrollers at no cost.



To install the CodeWarrior IDE, insert the CodeWarrior CD-ROM into your computer's CD-ROM drive. A startup window will automatically appear. Follow the on-screen instructions.

Note: PK-HC08QY4 requires that a CodeWarrior version equal to or greater than 3.0 is present on your system. If you have an earlier version on your system, you must uninstall it and install the new CodeWarrior version which comes with PK-HC08QY4. If you purchased an earlier CodeWarrior version, we advise you to contact Metrowerks to have your license extended to the new version.

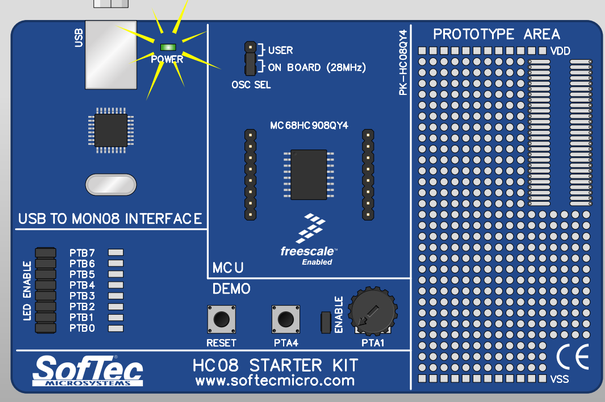
2 Install the Instrument Software

SofTec Microsystems Additional Components include the PK-HC08QY4 USB driver, the PK-HC08QY4 software plug-in for CodeWarrior HC(S)08, SofTec Microsystems DataBlaze programming utility, examples and documentation in PDF format.

To install the SofTec Microsystems Additional Components, insert the SofTec Microsystems **"System Software"** CD-ROM into your computer's CD-ROM drive. A startup window will automatically appear. Choose **"Install Instrument Software"** from the main menu. Click on the **"PK-HC08 Series Additional Components"** option. Follow the on-screen instructions.

3 Connect the Board to the PC

Connect PK-HC08QY4 to a free USB port on your PC. The green "POWER" LED on the instrument will turn on.

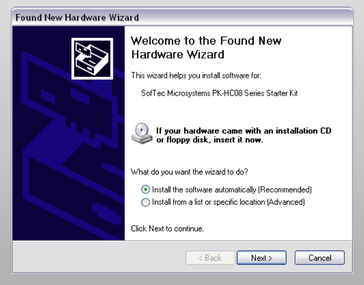


4 Found New Hardware Wizard

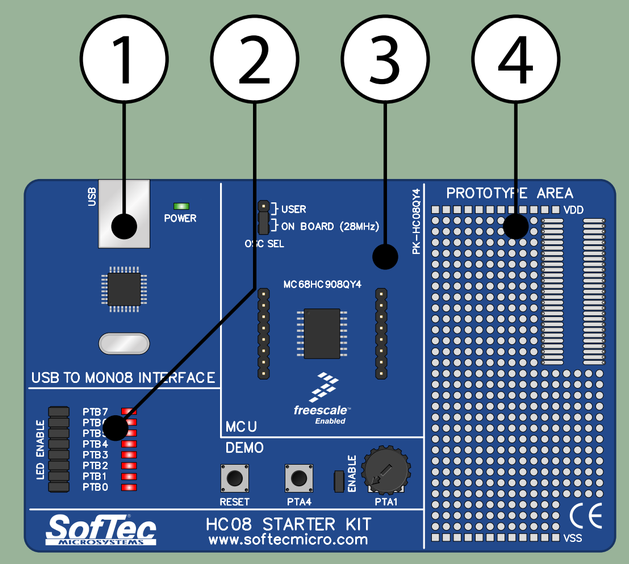
The first time PK-HC08QY4 is connected to the PC, Windows recognizes the instrument and starts the **"Found New Hardware Wizard"** procedure, asking you to specify the drivers to use for the instrument.

The procedure is slightly different on each version of Windows. On Windows XP, select the **"Install the software automatically"** option and click on the **"Next"** button.

Be sure not to specify any drive or optional location where to look for the driver, since it has already been installed on your hard disk by the PK-HC08 Series Additional Components setup.



Note: both Windows 2000 and Windows XP may issue a warning during the "Found New Hardware Wizard" procedure. This warning is related to the fact that the USB driver used by PK-HC08QY4 is not digitally signed by Microsoft, and Windows considers it to be potentially malfunctioning or dangerous for the system. However, you can safely ignore the warning, since every kind of compatibility/security test has been carried out by SofTec Microsystems.



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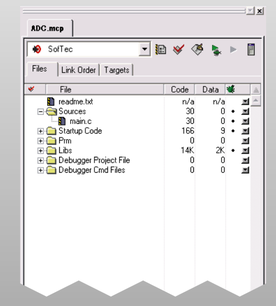
5 Run CodeWarrior and Open the Example

Start the CodeWarrior IDE by selecting **Start > Programs > Metrowerks CodeWarrior > CW08 > CodeWarrior IDE**. The CodeWarrior IDE will open.

Choose **File > Open** from the main menu.

Select the **"ADC.mcp"** workspace file that is located in the **"[Programs Folder]\Metrowerks\CodeWarrior CW08\(CodeWarrior_Examples)\HC08\SofTec Microsystems\PK-HC08QY4\C\ADC"** folder.

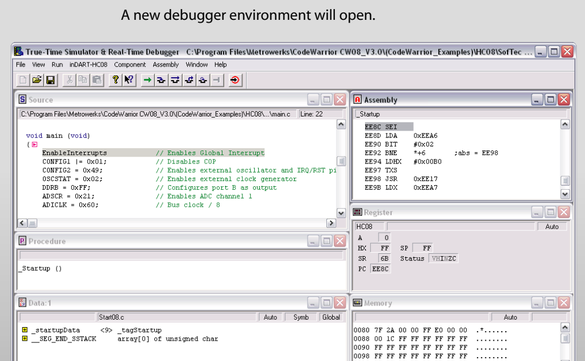
Click **"Open"**.



6 Start a Debugging Session

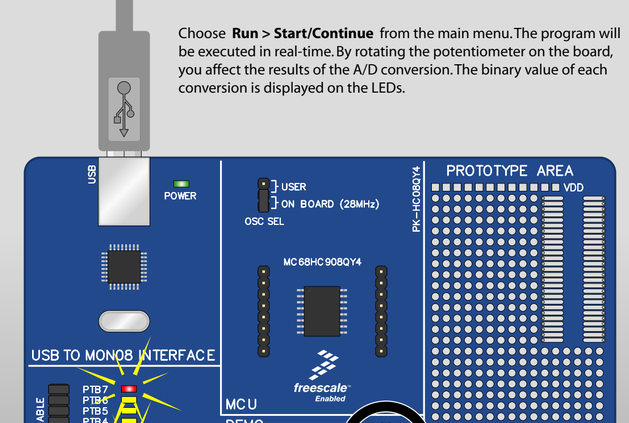
Choose **Project > Debug** from the main menu. This will generate an executable file and will download it to the board.

A new debugger environment will open.



7 Run the Example

Choose **Run > Start/Continue** from the main menu. The program will be executed in real-time. By rotating the potentiometer on the board, you affect the results of the A/D conversion. The binary value of each conversion is displayed on the LEDs.



8 Congratulations!

You have successfully completed this tutorial! You can now continue to experiment with the CodeWarrior user interface and discover its potentialities (step commands, breakpoints, watch windows, etc.) on your own.

Please also read carefully all of the PK-HC08QY4 documentation.

For the latest software releases, new products, new supported devices, discussion forums and FAQs, log on to

http://www.softecmicro.com/

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