KTUSBSPIEVBSIUG
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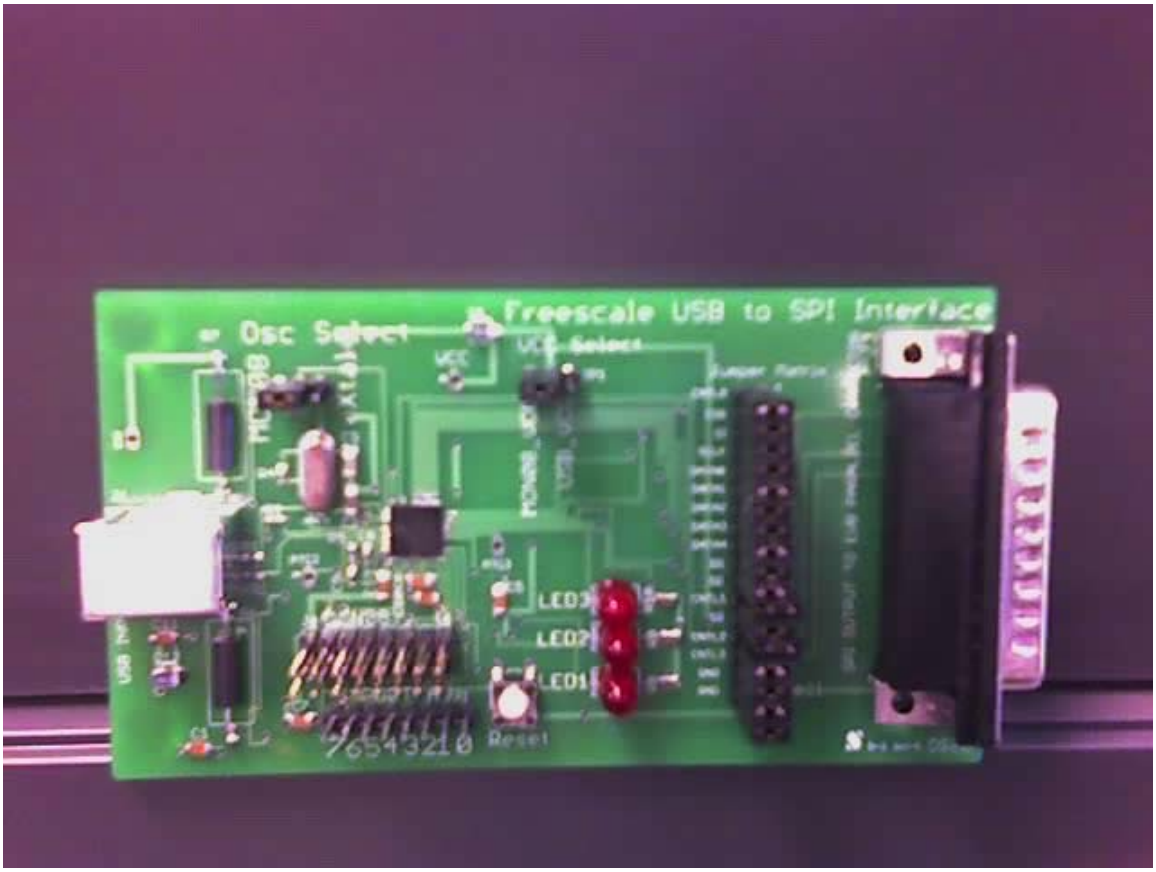
USB to SPI Interface Evaluation Board
(Featuring MCHC908JW32FC)

The **KITUSBSPIEVME** Evaluation Board is a working hardware/software example that allows a user to become familiar with the MCHC908JW32FC by means of an actual useful application, a USB to SPI and USB to parallel converter. The main function provided by this Evaluation Board is to allow a PC, that may not have a parallel port, to communicate with other Freescale Evaluation Boards, via a USB port.

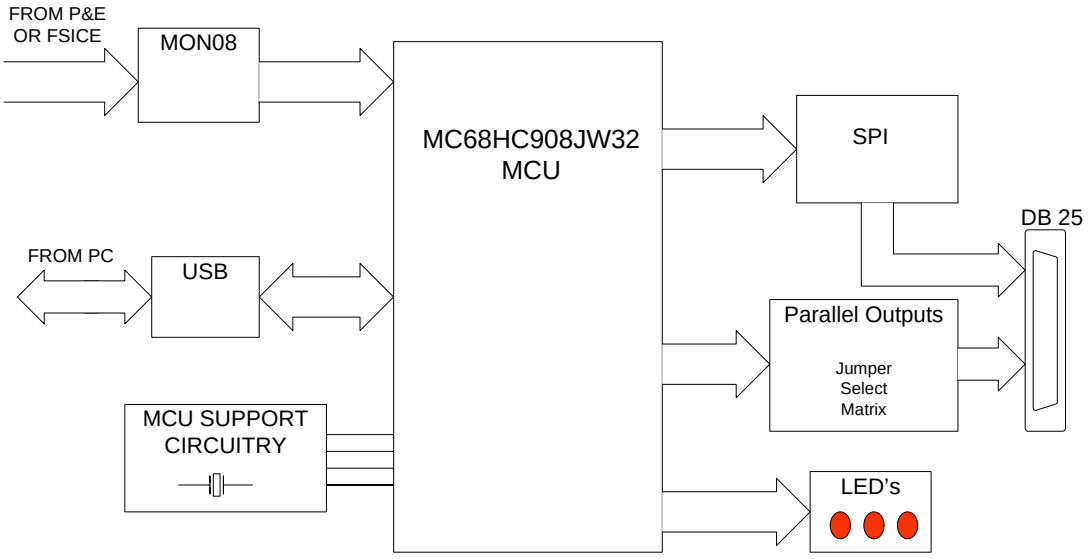
The USB port is a standard feature on almost every new PC. This kit makes use of the MCHC908JW32FC's built-in USB, SPI and parallel ports.



Hardware Description

The hardware Block Diagram is shown below:

MC68HC908JW32 Demo Board Block Diagram



The Evaluation Board consists of a MCHC908JW32FC MCU (hereafter called the “JW32”), various MCU support components (crystal, capacitors, resistors, etc.), three LEDs, a programmable jumper matrix with a DB25 connector, a USB interface connector (B-type), a 16 pin MON08 interface connector (to allow programming the MCU’s flash RAM), and a 4 wire SPI interface (SI, SO, SCLK and CSB). All 5 volt power required by the Evaluation Board is obtained from either the USB or MON08 connectors. A set of two jumper select blocks configure the Evaluation Board to select which connector provides the 5 volt power(MON08 or USB) and whether the internal 4.00 MHz crystal or external 4.9152 MHz oscillator from the P&E or FSICEBASE unit is used. A detailed schematic is included on the accompanying CD.

LED Display

The LED’s are provided as a visual output device for debugging and test purposes. As configured from the factory, LED 2 indicates when power is applied and a USB connection is established, and LED 1 and 3 are tied to the DATA0 and CNTL0 lines, which will be explained in detail in the Software section of this document.

Jumper Matrix

The Evaluation Board will convert USB serial data to both parallel and SPI (serial) data, which can be assigned via jumper shorting plugs or wire jumpers to various pins on the DB25 connector. The reason for this jumper matrix feature is to accommodate the various other Freescale Evaluation Boards that use a non-standard parallel port pinout.

Jumper Definitions

As shipped from the factory the jumper matrix programming is as follows:

DB25 Pin Number	Name	JW32 Pin Number	JW32 Name
1	CNTL0	18	PTD5
2	CSB	8	SSB
3	SI	10	MOSI

DB25 Pin Number	Name	JW32 Pin Number	JW32 Name
4	SCLK	11	SPCLK
5	DATA0	13	PTD0
6	DATA1	14	PTD1
7	DATA2	15	PTD2
8	DATA3	16	PTD3
9	DATA4	17	PTD4
10	NC	---	-------
11	NC	---	-------
12	SO	9	MISO
13	NC (alt SO)	(9)	(MISO)
14	CNTL1	19	PTD6
15	NC (alt SO)	(9)	(MISO)
16	CNTL2	22	PTD7
17	CNTL3	7	PTC0
18	NC	---	-------
19	NC	---	-------
20	GND	44	VSS
21	NC	---	-------
22	NC	---	-------
23	NC	---	-------
24	NC	---	-------
25	NC	---	-------

* NC = No Connection

The SO signal can be connected to pin 12 (normal), pin 13 (alternate), or pin 15 (alternate) of the DB25 connector via shorting plugs. This again is to accommodate different Freescale Evaluation Boards that at different times have used each of these pins for the SO SPI signal.

If the Evaluation Board is to be used as an interface to a Freescale Evaluation Board, the user can select the correct pin outs for the SPI signals and Control and Data signals by using shorting jumper plugs or wire jumpers. Consult the specific Freescale Evaluation Board documentation for the correct signal/pin definitions for the SPI and parallel control and data signals.

MON08 Connector

The MON08 connector consists of the following 16 pins:

Pin Number	Name	Description
1	NC	Unused
2	GND	VSS (System Gnd)
3	NC	Unused
4	RST	Reset
5	NC	Unused
6	IRQB	Interrupt Request (Low active)
7	NC	Unused
8	NC	Unused
9	NC	Unused
10	PTA0	Port A Bit 0
11	NC	Unused
12	PTA1	Port A Bit 1
13	OSC	4.9152 MHz Oscillator
14	PTA2	Port A Bit 2
15	MON08_VCC	+5 Volts from P & E or FSICE
16	PTC1	Port C Bit 1

This connector mates with the MON08 cable provided with the P & E Cyclone Pro or Freescale FSICEBASE programmer.

USB Connector

A “B” type USB connector is provided to allow a standard “A to B” USB cable to interconnect the PC to the Evaluation Board. The pinout of this connector is as follows:

Pin Number	Name	Description
1	+5	+5 Volts from the PC
2	D-	Signal - line
3	D+	Signal + line
4	GND	System ground (VSS)

VCC and Oscillator Jumper Selects

Two separate three pin jumpers, labeled JP1 and JP2 are provided to allow the selection of power and clock source for the Evaluation Board.

JP1 selects the source of the VCC power (+5 volts) in accordance with the following table:

JP1	
Position of Shorting Jumper	Selection Description
Pins 1 & 2 (Pin 3 open)	Normal operating position +5 supplied from USB Connector
Pins 2 & 3 (Pin 1 open)	Programming position +5 supplied from MON08 Connector
JP2	
Position of Shorting Jumper	Selection Description
Pins 1 & 2 (Pin 3 open)	Normal operating position Clock = 4.000 MHz crystal
Pins 2 & 3 (Pin 1 open)	Programming position Clock = 4.9152 from MON08

The factory default setting for both JP1 and JP2 is the Normal operating position. To change the programming of the JW32's flash RAM, both jumpers must be moved to the Programming position, and the MON08 connector should be attached to the cable from the P & E Cyclone Pro or the Freescale FSICEBASE unit.

Other Available Port/Pin Connections

The JW32 provides several I/O ports which have been brought out to additional access pins on the Evaluation Board. Below is a list of the available ports and bits within the ports for the JW32:

Port Name	Bits Available	Connector
Port A	0 – 7	J2 pins 1 – 8, MON08 port
Port B	0, 1, 5	LED2, LED1, LED3
Port C	1, 2, 3	MON08 pin 16, J9, J10
Port D	0 – 7	Data 0 – 4, Cntl 0 – 2
Port E	2, 3, 4 – 7	USB D+, D-, SPI port

Port A is not used in the Evaluation Board design, so it is available for use as an input or output port by the user. It is used, however, for the MON08 port, as is Port C bit 1. All of the Port E bits are reserved for the SPI and USB signal lines. All of Port D is reserved for the Data and Control (Cntl) signals.

MCU Support Circuitry

The JW32 requires a clock source. The clock source can either be an external 5 volt square wave or an internal crystal oscillator. The 4.000 MHz. crystal, along with capacitors C2 and C3 (27 pf) and resistor R4 (10M) provide the operating clock source for the JW32. The 4.000 MHz. clock is used as a reference for the PLL in the JW32. The internal bus frequency is 8 MHz. and the CGMCLK clock supplied to the USB and SPI blocks is 48 MHz. The PLL is filtered by components C8 (100 pF), R5 (2.2K), C13 (.1 μF) and C9 (2.2 nF).

Bypass capacitors are provided for all three power supply lines used by the JW32, +5 volts, +3.3 volts, and +2.5 volts. The +5 and +3.3 volt supplies are bypassed with 10 uf and .1 uf capacitors (C1, C4, C5, C6, C11 and C12) and the +2.5 volt supply is bypassed with C10, a .1 uF capacitor. The +3.3 volt and +2.5 volt supplies are derived from the +5 volt source (VCC) by internal voltage regulators.

The USB signal lines are buffered by 27 ohm resistors (R1 and R2) and the D+ line is pulled up to +3.3 volts via a 1.5K resistor (R3) as per the USB specification. Ferrite inductor filters are provided on the +5 volt and Ground lines of the USB connector to prevent EM radiation.

A Reset button and bypass capacitor is provided on board to manually reset the JW32, if necessary.

Software Description

There are three main components that comprise the Evaluation Board software system.

1) The firmware that runs on the JW32 is a compiled C and assembly language program, that is programmed into flash RAM.

2) The user interface software (GUI) that sends USB messages to the Evaluation Board, and runs under Windows 2000 or Windows XP, is called the “SPIGen” program, which is written in Visual Basic.

3) The third piece of software is a “device driver” called **spi_usbio.sys** and it interfaces the SPIGen program I/O through the Windows operating system to the USB port on the user’s PC. The device driver interfaces to the Visual Basic program, through a special “wrapper” library called **usbiocom.dll** that translates the Visual Basic COM interface, into the lower level calls in the device driver. These two pieces of software were licensed from Thesycon, a software development company in Germany.

All of the source code that is available is provided on the Installation CD in a directory called “source”.

For an explanation of the SPIGen program, the user is referred to the documentation that comes with the disk for that program.

JW32 Software Code

The software for the JW32 was written in C and HC08 assembly language using the CodeWarrior version 5.0 software development environment.

Below is a listing of the source code modules and their descriptions:

main.c	Beginning module, contains service loop.
main.asm	Generated by CodeWarrior, used for additions to main.c written in assembly language.
MCHC908JW32FC.C	Defines the 16 and 8 Bit Registers
constant.c	Random data to fill unused flash RAM
isr.c	Interrupt service routine for the timer
pll.asm	Sets up the PLL using 4.00 MHz reference frequency
spi.c	SPI read and write handlers and initialization routine
tb.c	Initializes the time base for the JW32
timer.c	Initializes the timer and PWM output (not used)
USB_descriptor.asm	Defines the USB information such as VID, PID, etc.
USB_driver.c	Handles USB setup, decode and interrupt service
utilities.c	Misc. routines for delay and debug

The following files are include (header) files to support the above:

application.h	Defines some outputs and some useful macros
derivative.h	Generated by CodeWarrior to define the MCU used
derivative.inc	Generated by CodeWarrior for COP

global.h	Some useful defines for debug
jw32_registers.h	More register definitions
main_asm.h	Header file for main_asm.c
MCHC908JW32FC.H	Header file for MCHC908JW32FC.C
motdef.h	General purpose definitions from the old days
pll.h	Header file for pll.c
spi.h	Header file for spi.c
tb.h	Header file for tb.c Timebase
timer.h	Header file for timer.c timer initialization
usb.h	Header file for USB_driver.
usb_vars.h	Header for variables used in USB_Driver.c
utilities.h	Header for utilities.
ansii.lib	c library for ansii c functions
Start08.c	Generated by CodeWarrior to define initialization code
Project.prm	Defines interrupt and memory map
Project.map	Map file generated by compile process
Burner.bbl	Some defines used in the programming of the JW32

Modifying and Adding to the Software

To modify and recompile this software, one must download a copy of the CodeWarrior software development suite (IDE) from Freescale. The link to this software is:

http://www.freescale.com/CodeWarrior

The USB to SPI software transfers 8 bytes of data from the SPIGen.exe program, via USB, to the JW32 MCU. The definitions of the 8 bytes can be found in the main.c program, and the actual transfer and decoding is done in the USB_driver.c program. Comments are provided throughout the code to explain the operation of the individual routines.

Once the code is compiled (without errors), the CodeWarrior IDE provides a means to download the binaries to the P&E Cyclone Pro programmer, via the MON08 port to re-Flash the JW32. The documentation for this process is contained in the CodeWarrior suite of tools and the P&E documentation.

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