TWR-S08MM128

User Manual

Rev. 1.0

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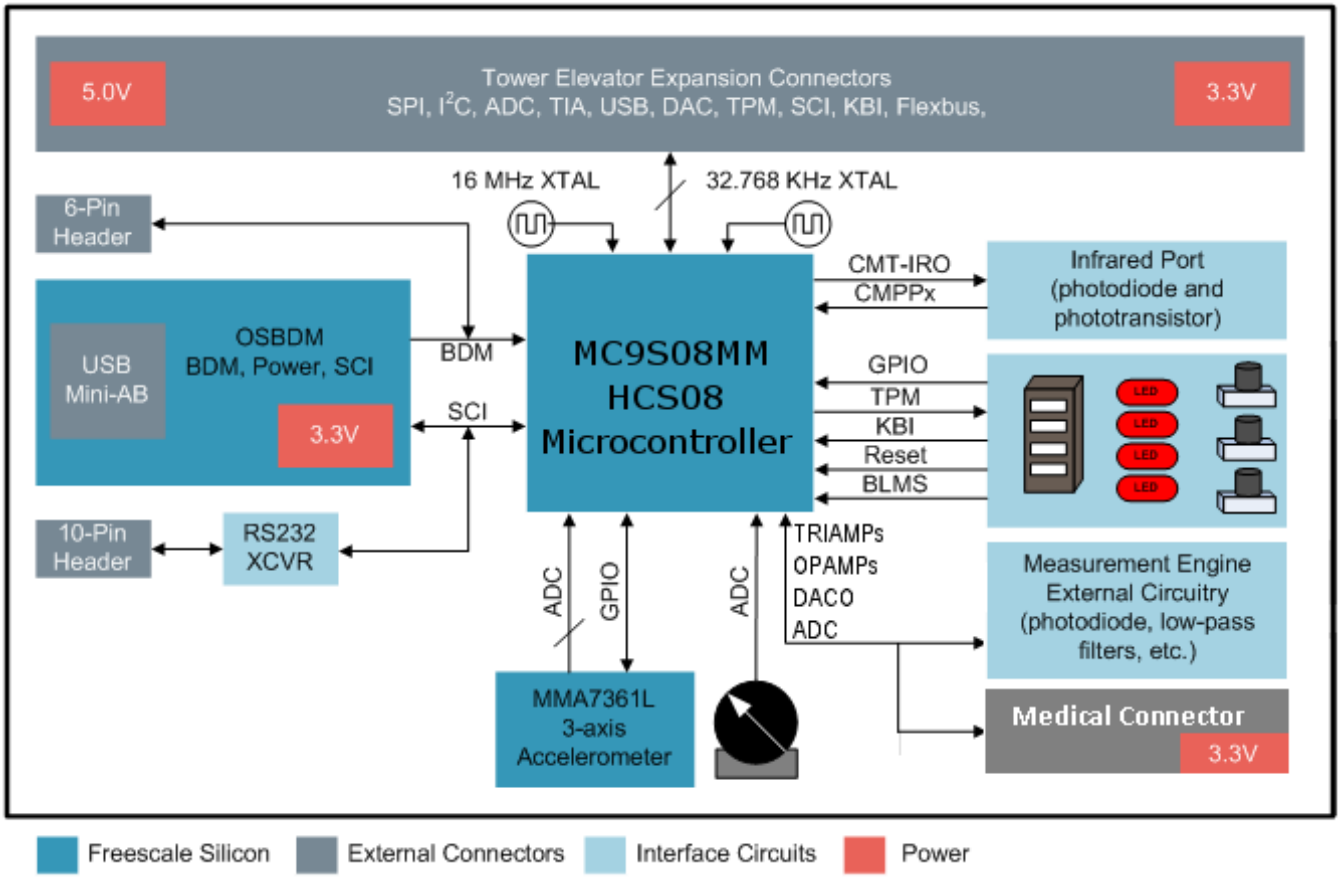
1 Overview

TWR-S08MM128 is a low-cost evaluation, demonstration and development board that features an 8-bit MC9S08MM128 microcontroller. The TWR-S08MM128 can operate stand-alone or as the main control board in a Tower System with peripheral modules.

The following list summarizes the features of the MC9S08MM Tower MCU board:

- Tower compatible processor board
- Open Source BDM (OSBDM) circuit
- Analog measurement circuitry
- 4 LEDs
- DIP Switches and push buttons for user input
- Potentiometer
- MMA7361L three-axis accelerometer
- RS232 transceiver and 2x5 pin header

Figure 1. TWR-S08MM128 Block Diagram



2 Reference Documents

The documents listed below are available online. Refer to http://www.freescale.com/tower for the latest revision of all Tower System documentation.

- *TWR-S08MM128 Schematics*
- *TWR-S08MM128 Quick Start Guide*
- *TWR-S08MM128-KIT Lab Tutorial*
- *MC9S08MM128 Reference Manual*
- *MC9S08MM128 Data Sheet*
- *AN3561, USB Bootloader for the MC9S08JM60*

3 Hardware Features

This section provides more details about the features and functionality of the TWR-S08MM128.

3.1 Clocking

Two crystals are provided on the board for clocking the MC9S08MM128 device:

1. A 16 MHz crystal connected to XTAL2 and EXTAL2 for system clocking
2. A 32.768kHz crystal connected to XTAL1 and EXTAL1 for TOD usage

3.2 System Power

The TWR-S08MM128 can be powered by the Open Source BDM (OSBDM) circuit via the Mini-B USB connector when stand-alone. When assembled with the Tower System and the TWR-SER is configured to run USB device mode (J16 pin 3 and 4 connected), the Mini-B USB connector is no longer used as a power source and only used for OSBDM debugging purposes. In this case, the power will be supplied from the Mini-B USB from the TWR-SER. Please plug in the Mini-B USB connector from TWE-SER before plugging in the Mini-B USB connector from TWR-S08MM128.

A standard USB A male to Mini-B male cable (provided) can be used to supply power from a USB host or powered USB hub. Optionally, an AC to DC adapter with a USB A female receptacle (not provided) can be used as the power source.

A jumper, J11, can be used to isolate the 3.3V supply from the microcontroller. This connection can be used to measure the power usage of the MC9S08MM128 microcontroller.

3.3 Debug Interface

An on-board, MC9S08JM60 based OSBDM circuit provides a debug interface to the MC9S08MM128. A standard USB A male to Mini-B male cable (provided) can be used for debugging via the USB connector, J17. Refer to Section 6 for information on other modes of operation of the OSBDM.

3.4 RS232 Interface

An RS232 transceiver on the TWR-S08MM128 connects to a standard 2x5 pin header (refer to Figure 2). Selection jumpers J15 and J16 allow MC9S08MM128 SCI2 signals to be routed to either the RS232 transceiver or the OSBDM circuit. Refer to Figure 5 for more details.

Alternatively, when assembled as a Tower System, the MC9S08MM128 SCI1 TX and RX are routed to the SER-TWR. If the SER-TWR jumpers are configured to run in RS-232 mode, the SCI1 TX and the RX signal can be communicated via the RS232 connector from the TWR-SER. Please refer to the TWR-SER user manual (TWRSERUM) from www.freescale.com/tower for more detail.

MC9S08MM128 Signal	Pin		MC9S08MM128 Signal
Not Connected	1	2	Not Connected
TX2	3	4	Not Connected
RX2	5	6	Not Connected
Not Connected	7	8	Not Connected
GND	9	10	3.3V

Figure 2. RS232 2x5 Pin Header Connections

3.5 Infrared Port

The TWR-S08MM128 implements an infrared transmit and receive port. The transmit circuit is implemented with an infrared diode and the user can choose to drive the diode either with IRO or SCI TX. The receiver is implemented by an infrared transistor and the user can choose to input this signal to the SCI RX or the ACMP input. Jumpers J9, J25 and J26 are used for routing the connections, refer to Section 4 to set the jumpers. Please refer to application note AN4116, searchable from www.freescale.com

3.6 Medical Connector

The TWR-S08MM128 features a 2x10 expansion connector J27 (refer to Figure 3) to MED-EKG for routing the medical engine signals to external medical board so it can use the OPAMP, TRIAMP, ADC and DAC on MC9S08MM128 to implement the requirement signal conditioning for medical applications.

When the DSC MC56F8006 from the MED-EKG is enabled, MC9S08MM128 can choose to read the conditioned EKG results output from the DSC via I2C transmission (pin 3 and pin 4). To enable I2C communication, you must assemble the MEG-EKG with the Tower System because the TWR-SER has the pulled up resistors circuit required for I2C transmission.

In Figure 3, the **bold** text highlights the functions that are used to implement the MED-EKG demonstration. For detail about the MED-EKG, please refer to the MED-EKG user manual, MED-EKG lab

and schematic included in the TWR-S08MM128-KIT or TWR-MCF51MM-KIT. All of these are also available on Freescale.com/tower

TWR-S08MM128 Signal	Pin		TWR-S08MM128 Signal
MOSFET Q6 (pin 3)-Power (3.3V)	1	2	**Ground(GND)**
PTD4/**SDA**/TPM1CH2	3	4	PTD5/**SCL**/ TPM1CH3
DADP0	5	6	**DADM0**
PTC4/KBI1P7/CMPP0/**ADP8**	7	8	**DACO_E**
OUT1	9	10	**OUT2**
INP1-	11	12	**INP2-**
PTA4/**INP1+**	13	14	PTA7/**INP2+**
VINP1	15	16	**VINP2**
VINN1/DADM2	17	18	**VINN2**/DADM3
TRIOUT1/DADP2	19	20	**TRIOUT2**/DADP3

Figure 3. Medical Connector 2x10 Pin Header Connections

3.7 Elevator Connections

The TWR-S08MM128 features two expansion card-edge connectors that interface to elevator boards in a Tower System: the Primary and Secondary Elevator connectors. The Primary Elevator connector, comprised of sides A and B, is utilized by the TWR-S08MM128, while the Secondary Elevator connector only makes connections to ground (GND). Figure 4 provides the pinout for the Primary Elevator connector. An “X” in the “Used” column indicates that there is a connection from the TWR-S08MM128 to that pin on the elevator connector. An “X” in the “Jmp” column indicates that a jumper is available that can configure or isolate the connection from the elevator connector.

Figure 4. TWR-S08MM128 Primary Elevator Connector Pinout

TWR-S08MM128 Primary Connector									
Pin	Name	Usage	Used	Jmp	Pin	Name	Usage	Used	Jmp
B1	**5V**	**5.0V Power**	**X**		A1	**5V**	**5.0V Power**	**X**	
B2	**GND**	**Ground**	**X**		A2	**GND**	**Ground**	**X**	
B3	**3.3V**	**3.3V Power**	**X**		A3	**3.3V**	**3.3V Power**	**X**	
B4	ELE_PS_SENSE	Elevator Power Sense	**X**		A4	**3.3V**	**3.3V Power**	**X**	
B5	**GND**	**Ground**	**X**		A5	**GND**	**Ground**	**X**	
B6	**GND**	**Ground**	**X**		A6	**GND**	**Ground**	**X**	
B7	SPI1_CLK	PTG0/SPSCK1	**X**		A7	SCL0	PTD5/SCL/TPM1CH3	**X**	
B8	SPI1_CS1				A8	SDA0	PTD4/SDA/TPM1CH2	**X**	
B9	SPI1_CS0	PTA0/SS1_b	**X**		A9	GPIO9 / OPEN	PTE4/CMPP3/TPMCLK/IRQ	**X**	
B10	SPI1_MOSI	PTF6/MOSI1	**X**		A10	GPIO8 / OPEN	PTC7/KBI2P2/CLKOUT/ADP11	**X**	
B11	SPI1_MISO	PTF7/MISO1	**X**		A11	GPIO7 / OPEN	PTC6/KBI2P1/PRACMPO/ADP10	**X**	

TWR-S08MM128 Primary Connector									
Pin	Name	Usage	Used	Jmp	Pin	Name	Usage	Used	Jmp
B12	ETH_COL				A12	ETH_CRS			
B13	ETH_RXER				A13	ETH_MDC			
B14	ETH_TXCLK				A14	ETH_MDIO			
B15	ETH_TXEN				A15	ETH_RXCLK			
B16	ETH_TXER				A16	ETH_RXDV			
B17	ETH_TXD3				A17	ETH_RXD3			
B18	ETH_TXD2				A18	ETH_RXD2			
B19	ETH_TXD1				A19	ETH_RXD1			
B20	ETH_TXD0				A20	ETH_RXD0			
B21	GPIO1 / OPEN	PTA2/KBI1P1/RX1/ADP4	X		A21	SSI_MCLK			
B22	GPIO2 / OPEN	PTA6	X		A22	SSI_BCLK	VINN1/DADM2	X	
B23	GPIO3 / OPEN	PTB1/BLMS_b	X		A23	SSI_FS	TRIOUT2/DADP3	X	
B24	CLKIN0				A24	SSI_RXD	TRIOUT1/DADP2	X	
B25	CLKOUT1				A25	SSI_TXD	OUT1	X	
B26	**GND**	**Ground**	X		A26	**GND**	**Ground**	X	
B27	AN7	PTC5/KBI2P0/CMPP1/ADP9	X		A27	AN3	DADM0	X	
B28	AN6	PTC4/KBI1P7/CMPP0/ADP8	X		A28	AN2	DADP0	X	
B29	AN5	PTC3/KBI1P6/SS2/ADP7	X		A29	AN1	VINP2	X	
B30	AN4	PTC2/KBI1P5/SPSCK2/ADP6	X		A30	AN0	VINN2/DADM3	X	
B31	**GND**	**Ground**	X		A31	**GND**	**Ground**	X	
B32	DAC1	VREFO	X		A32	DAC0	DACO_E	X	X
B33	TMR3	PTD5/SCL/TPM1CH3	X		A33	TMR1	PTD3/TPM1CH1	X	
B34	TMR2	PTD4/SDA/TPM1CH2	X		A34	TMR0	PTD2/TPM1CH0	X	
B35	GPIO4				A35	GPIO6			
B36	**3.3V**	**3.3V Power**	X		A36	**3.3V**	**3.3V Power**	X	
B37	PWM7	PTD5/SCL/TPM1CH3	X		A37	PWM3	PTE7/TPM2CH3	X	
B38	PWM6	PTD4/SDA/TPM1CH2	X		A38	PWM2	PTF0/TPM2CH2	X	
B39	PWM5	PTD3/TPM1CH1	X		A39	PWM1	PTF1/RX2/TPM2CH1	X	
B40	PWM4	PTD2/TPM1CH0	X		A40	PWM0	PTF2/TX2/TPM2CH0	X	
B41	CANRX0				A41	RXD0			
B42	CANTX0				A42	TXD0			
B43	CAN				A43	RXD1	PTD7/RX1	X	
B44	SPI0_MISO	PTF7/MISO1	X		A44	TXD1	PTD6/TX1	X	
B45	SPI0_MOSI	PTF6/MOSI1	X		A45	BKGD			
B46	SPI0_CS0	PTA0/SS1_b	X		A46	ALLPST			
B47	SPI0_CS1				A47	JTAG_EN			
B48	SPI0_CLK	PTG0/SPSCK1	X		A48	TRST_b / DSCLK			
B49	**GND**	**Ground**	X		A49	**GND**	**Ground**	X	
B50	SCL1				A50	TCLK / DSCLK			
B51	SDA1				A51	TDI / DSI			
B52	GPIO5 / OPEN	PTA3/KBI1P2/ADP5	X		A52	TDO / DSO			
B53	USB0_DP_PDOWN				A53	TMS / BKPT_b			

TWR-S08MM128 Primary Connector									
Pin	Name	Usage	Used	Jmp	Pin	Name	Usage	Used	Jmp
B54	USB0_DM_PDOWN				A54	USB_DM	USB_DM	X	
B55	IRQ_H	PTC6/KBI2P1/PRACMPO/ADP10	X		A55	USB_DP	USB_DP	X	
B56	IRQ_G	PTC7/KBI2P2/CLKOUT/ADP11	X		A56	USB_ID			
B57	IRQ_F	PTC7/KBI2P2/CLKOUT/ADP11	X		A57	USB_VBUS	VBUS	X	
B58	IRQ_E	PTC6/KBI2P1/PRACMPO/ADP10	X		A58	TMR7	OUT2	X	
B59	IRQ_D	PTE4/CMPP3/TPMCLK/IRQ	X		A59	TMR6	INP1-	X	
B60	IRQ_C	PTE4/CMPP3/TPMCLK/IRQ	X		A60	TMR5	INP2-	X	
B61	IRQ_B	PTA3/KBI1P2/ADP5	X		A61	TMR4	PTA4/INP1+	X	
B62	IRQ_A	PTA2/KBI1P1/RX1/ADP4	X		A62	RSTIN_b			
B63	EBI_ALE / EBI_CS1_b	PTE0/KBI2P3	X		A63	RSTOUT_b			
B64	EBI_CS0_b	PTC0/MOSI2	X		A64	CLKOUT0	PTC7/KBI2P2/CLKOUT/ADP11	X	
B65	**GND**	**Ground**	X		A65	**GND**	**Ground**	X	
B66	EBI_AD15		X		A66	EBI_AD14		X	
B67	EBI_AD16	PTB6/KBI1P3	X		A67	EBI_AD13		X	
B68	EBI_AD17		X		A68	EBI_AD12		X	
B69	EBI_AD18		X		A69	EBI_AD11		X	
B70	EBI_AD19		X		A70	EBI_AD10		X	
B71	EBI_R/W_b	MCU_RXD1	X	X	A71	EBI_AD9		X	
B72	EBI_OE_b		X		A72	EBI_AD8		X	
B73	EBI_D7		X		A73	EBI_AD7	MCU_TXD1	X	
B74	EBI_D6		X		A74	EBI_AD6	PTA3/KBI1P2/ADP5	X	
B75	EBI_D5		X		A75	EBI_AD5	PTF3/SCL	X	
B76	EBI_D4		X		A76	EBI_AD4	PTF4/SDA	X	
B77	EBI_D3		X		A77	EBI_AD3	PTF5/KBI2P7	X	
B78	EBI_D2		X		A78	EBI_AD2	PTA0/SS1_b	X	
B79	EBI_D1		X		A79	EBI_AD1	PTA1/KBI1P0/TX1	X	
B80	EBI_D0		X		A80	EBI_AD0	PTC1/MISO2	X	
B81	**GND**	**Ground**	X		A81	**GND**	**Ground**	X	
B82	**3.3V**	**3.3V Power**	X		A82	**3.3V**	**3.3V Power**	X	

3.8 Mechanical Form Factor

The TWR-S08MM128 is designed for the Freescale Tower System and complies with the electrical and mechanical specification as described in *Freescale Tower Electromechanical Specification*.

4 Jumper Table

There are several jumpers provided for isolation, configuration, and feature selection. Refer to the following table for details. The default installed jumper settings are shown in **bold**.

Figure 5. TWR-S08MM128 Jumper Table

Jumper	Option	Setting	Description of MC9S08MM128 signal routing
J1	DADP0 routing selection	**1-2**	Connect DADP0 to medical connector J27 pin 5
J2	DADM0 routing selection	**1-2**	Connect DADM0 to medical connector J27 pin 6
J3	VINP1 routing selection	1-2	VINP1 connect to GND
		2-3	VINP1 optionally connected to DACO
J4	Potentiometer connection	**1-2**	Connection of ADP4 to potentiometer
J5	DACO routing selection	1-2	Connect DACO to VINP1 if pin 2-3 of J3 is connected
		2-3	Connect DACO to a RC low pass filter
J6	DACO routing selection	**1-2**	Connect DACO to medical connector J27 pin 8
J7	TRIAMP routing selection	1-2	Connect TRIOUT1 to TRIOUT_SEL2
		2-3	Connect TRIOUT2 to TRIOUT_SEL2
J8	TRIAMP routing selection	1-2	Connect TRIOUT1 to TRIOUT_SEL1
		2-3	Connect TRIOUT2 to TRIOUT_SEL1
J9	Infrared receive routing	**1-2**	Connect Infrared transistor output to CMPP1
J10	USB3.3V connection	1-2	USB3.3V connects to external 3.3V power supply
		2-3	USB3.3V connects to on-chip USB 3.3V regulator output
J11	MCU IDD measure	**1-2**	For measuring MC9S08MM128 current
J12	OSBDM Bootloader mode or debugger mode selection	1-2	OSBDM IC in bootloader mode(For OSBDM firmware reprogramming)
		Open	OSBDM IC in debugger mode .
J13	BDM connector for MC9S08MM128	**Open**	BDM connector for MC9S08MM128
J14	BDM connector for JM60	**Open**	BDM connector for MC9S08JM60
J15	SCI2 TXD Routing Selection	**1-2**	Connect TX2 to the RS232 transceiver
		2-3	Connect TX2 to the OSBDM debugger interface circuit
J16	SCI2 RXD Routing Selection	**1-2**	Connect RX2 to the RS232 transceiver
		2-3	Connect RX2 to the OSBDM debugger interface circuit
J18	LED & Accelerometer connections	**1-2**	Connects LED4 to pin PTE7/TPM2CH3
		3-4	Connects LED3 to pin PTF0/TPM2CH2
		5-6	Connects LED2 to pin PTF1/RX2/TPM2CH1
		7-8	Connects LED1 to pin PTF2/TX2/TPM2CH0
		9-10	Connects ADP8 to ACCZ
		11-12	Connects ADP7 to ACCY
		13-14	Connects ADP6 to ACCX
J19	Accelerometer mode control	**1-2**	Connects PTA3 to SELF TEST pin of accelerometer
		3-4	Connects PTA6 to $\overline{\text{SLEEP}}$ pin of accelerometer
		5-6	Connects PTA5 to G-SELECT pin of accelerometer

J20	Accelerometer control	1-2	Connects PTB0 to 0G-DETECT pin of accelerometer
J21	RS232 connector	**Open**	2x5 RS232 connector
J24	Infrared filter connection	1-2	Choose whether to filter Infrared output
J25	Infrared transmit routing	1-2	Connects Infrared transistor output to ADP10
		3-4	Connects Infrared transistor output to RX1
		5-6	Connects either IRO or TX1 to Infrared diode base on J26
J26	Infrared transmit routing	1-2	TX1 pin drives Infrared transmit
		2-3	IRO pin drives Infrared transmit
J27	Medical board connector	**Open**	Connects to MED-EKG board

NOTE: For more detail, please refer to TWR-S08MM128 schematics available in the TWR-S08MM128-KIT or on Freescale.com/tower.

5 Input/Output Connectors and Pin Usage Table

The following tables provide details on which MC9S08MM128 pins are communicating with the TWR-MC9S08MM sensors, LEDs, switches and other I/O interfaces.

Figure 6. I/O Connectors and Pin Usage Table

TWR-S08MM128		MC9S08MM128			
I/O Component	I/O Label	Default	Alt 1	Alt 2	Alt 3
Dip Switch	SW3-1&4	PTA5	-	-	-
	SW3-2&3	PTB1	/BLMS	-	-
Push Button	SW1	PTD1	CMPP2	/RESET	-
	SW2	PTC6	KBI2P1	PRACMPO	ADP10
	SW4	PTE4	CMPP3	TPMCLK	IRQ
LED	LED1 (D9)	PTF2	TX2	TPM2CH0	-
	LED2(D10)	PTF1	RX2	TPM2CH1	-
	LED3(D11)	PTF0	TPM2CH2	-	-
	LED4(D12)	PTE7	TPM2CH3	-	-
Accelerometer MMA7361L	X_OUT	PTC2	KBI1P5	SPSCK2	ADP6
	Y_OUT	PTC3	KBI1P6	/SS2	ADP7
	Z_OUT	PTC4	KBI1P7	CMPP0	ADP8
Potentiometer	POT	PTA2	KBI1P1	RX1	ADP4
RS232 ICL3232	232_RXD	PTE6	RX2	-	-
	232_TXD	PTE5	TX2	-	-

NOTE: LED1 to LED4 are labelled as D9 to D12 on the TWR-S08MM128 silkscreen.

6 OSBDM

An on-board, MC9S08JM60 based OSBDM circuit provides a debug interface to the MC9S08MM128. The MC9S08JM60 is a USB-enabled microcontroller with an 8-bit HC9S08 core. The OSBDM circuit provides a USB-to-debug interface that allows run-control and debugging of the MC9S08MM128 target device. The USB drivers required to communicate with the OSBDM are provided in development tools such as Freescale CodeWarrior. When TWR-S08MM128 is used stand-alone, this single USB connection can also be used for power.

6.1 Bootloader Mode For MC9S08JM60

The MC9S08JM60 device used in the OSBDM circuit is preprogrammed with OSBDM debugger firmware and a USB Bootloader. The bootloader mode can be used to update the OSBDM debugger firmware if an update becomes available. Jumper J12 determines which application will run following a power-on reset. If the Bootloader Mode is chosen (jumper shunt on J12), the bootloader will be executed, allowing in-circuit reprogramming of the JM60 flash memory via USB. Refer to Application Note AN3561 on the Freescale website (http://www.freescale.com) for details on the USB Bootloader.

The USB Bootloader communicates with a GUI application running on a host PC. The GUI application can be found on the Freescale website; search keyword "JM60 GUI." Refer to section 2.5 and 3.3 of AN3561 for details on installing and running the application.

Note:
The JM60 GUI Installer should be run before connecting the OSBDM in Bootloader Mode to a host USB port. Otherwise, the JM60 USB device will not be recognized and the proper drivers will not be loaded.

7 Bootloader Mode For MC9S08MM128

Unlike MC9S08JM60, MC9S08MM128 has an on-chip ROM based USB bootloader that allows the MC9S08MM128 for mass erase and programming via its USB interface. This on-chip bootloader does not consume user flash space. To enable USB bootloader mode for MC9S08MM128, on the TWR-S08MM128 module, set SW3 DIP switch 2 and 3 to position 3, as indicated in Figure 7. NOTE: Under normal development you will need to set SW3 DIP switch 2 and 3 to position 2.

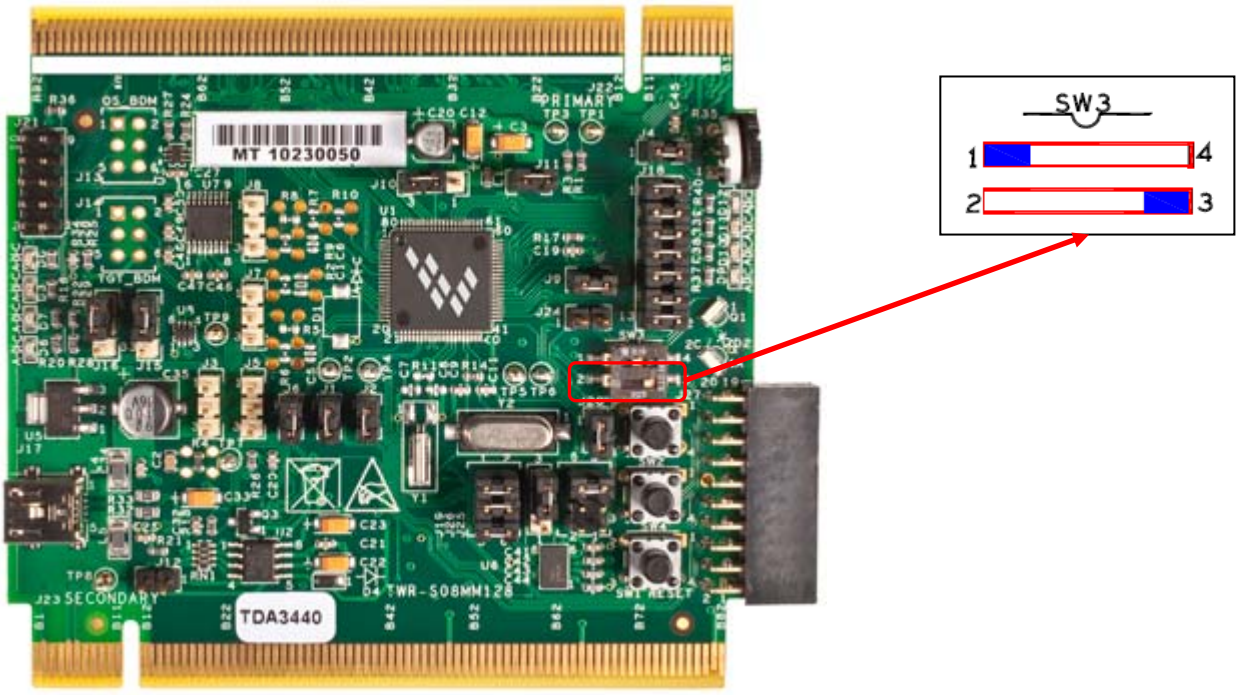


Figure 7. Setting SW3 for MC9S08MM128 USB bootloader mode

8 BDM inteface (Optional)

Both MC9S08MM128 and MC9S08JM60 have an on-chip background debug module. The user can choose to bypass the USB OSBDM interface and use the BDM interface for debugging and programming the corresponding chip instead. The BDM interface for MC9S08MM128 is at J13 header and MC9S08JM60 is at J14 from the TWR-S08MM128 module. The user needs a P&E USB BDM MULTILINK in order to use this interface. This is a repeat function of the OSBDM and is not required.

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