Freescale Semiconductor
User Guide

Document Number: TWR56F8200UG
Rev 1, 10/2013

TWR-56F8200 Tower Board

1 Overview

The MC56F8200 Tower System 32-bit MCU module (TWR-56F8200) is an evaluation, demonstration and development board. The TWR-56F8200 can operate standalone or as the main control board in a Tower system with peripheral modules. It can also be used as the main control board with an APMOTOR56F8000E motor control board.

The following list summarizes the features of the TWR-56F8200:

- 32-bit Digital Signal Controller module featuring MC56F82748 in a 64-LQFP package
- Tower system compatible
- Selectable power sources:
    - USB on 56F8200 card
    - Barrel connector on 56F8200 card
    - Motor control board plug direct to 56F8200 card, no Tower System connection, plug motor control to 9 V.
    - Tower System elevator board (USB or Barrel on Primary side)

Contents

1 Overview 1
2 Hardware features 3
3 Jumper table 15
4 Getting started 18
5 Revision history 35
6 Appendix A – Tower system elevator connector pin functions 35
7 Appendix B—TWR-56F8200 board schematic 38
8 Appendix C—TWR-56F8200 board BOM 38
9 Appendix D—TWR-56F8200 board jack layout (top view) 43
10 Appendix E—TWR-56F8200 board jack layout (bottom view) 44

© 2013 Freescale Semiconductor, Inc.

- Filtered power for VDDA and VSSA on the 32-bit MC56F82748DSC
- Optional 8 MHz crystal circuit for the MC56F82748 DSC
- Nine LEDs controlled by the MC56F82748 DSC
- Two trimmer potentiometers for user to change analog input voltage
- Motor Control Board connector for the APMOTOR56F8000E motor control board
- Auxiliary Signal connector
- Four thermistors for single-ended or differential analog inputs to the MC56F82748 DSC
- CAN transceiver, header, and termination
- Two push-buttons for user input or interrupts to the MC56F82748 DSC
- Reset push-button for the MC56F82748 DSC
- JTAG header for the MC56F82748 DSC with header to disconnect from OSBDM/OSJTAG
- Headers to connect SCI signals to either USB bridge with CDC(one channel) or elevator board (two channels) or connect one to each
- Expansion via Primary Elevator connector
- MC9S08JM60 MCU with a 4 MHz crystal provides:
    - Open Source Debug (OSBDM/OSJTAG) circuit
    - USB- to-SCI bridge with CDC and other techniques supported by third parties
    - Simultaneous OSBDM/OSJTAG and USB -to-SCI bridge functions with no header required to select
    - Header with enabled boot loader allows easy upgrade to latest S08 firmware pushed down by CodeWarrior
    - BDM header for the MC9S08JM60 MCU
    - Status and Target Power indicator LEDs
    - Control of semiconductor switch to supply power to board from USB
    - Voltage translators between 5 V MC9S08JM60 MCU chip and 3.3 V MC56F82748 DSC chip

1.1 Block diagram

The block diagram for the TWR-56F8200 board is shown in this figure.

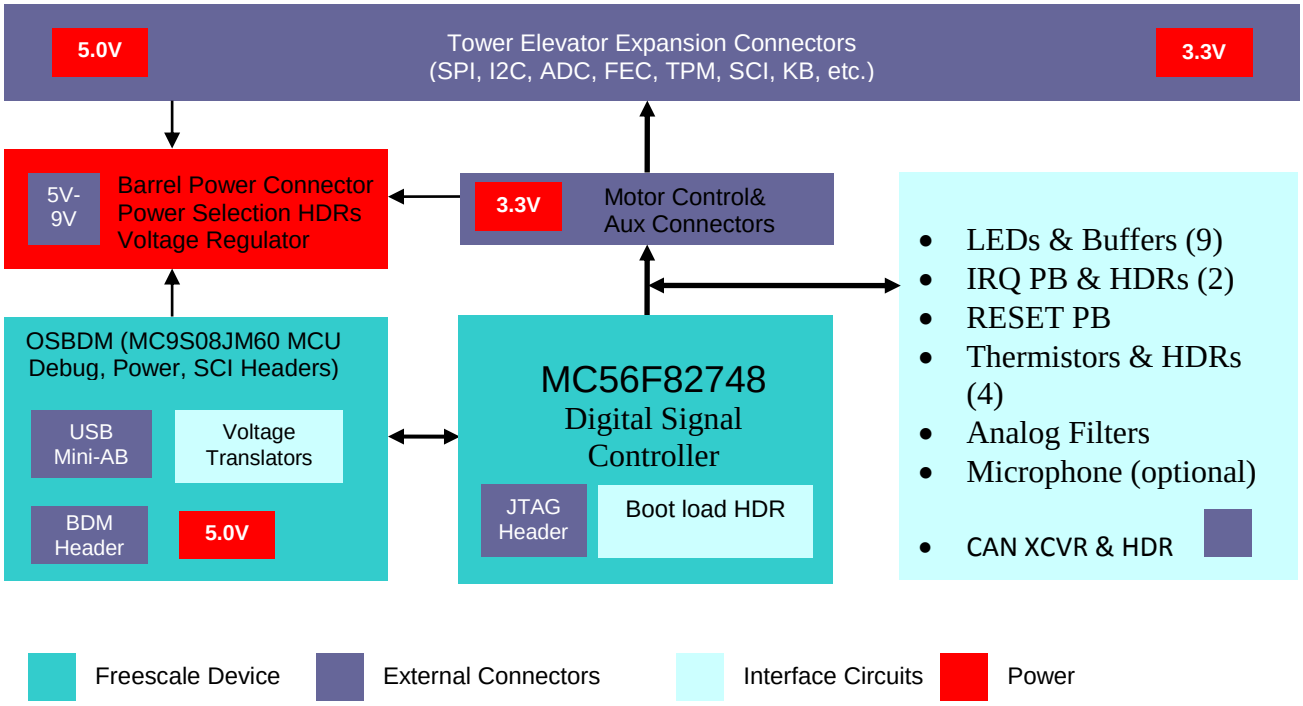


Figure 1. TWR-56F8200 block diagram

1.2 Reference documents

The documents listed below should be referenced for more information on the Freescale Tower system and the TWR-56F8200. See www.freescale.com/MC56F827xx, www.freescale.com/TWR-56F8200, and www.freesale.com/Tower for the latest revision of all applicable documentation (if and when available).

1. *Freescale Tower Electromechanical Specification*
2. *TWR-56F8200 Quick Start Guide*
3. *TWR-56F8200 Sample code*
4. *MC56F82XXX Reference Manual*
5. *MC56F82XXX Data Sheet*
6. *MC56F82XXX Chip Errata [if exists]*
7. *USB Bootloader for the MC9S08JM60* (document number AN3561)
8. *APMOTOR56F8000e Motor Control Demonstration System User Guide*
9. *BLDC Motor Control with Hall Sensors Driven by DSC using TWR-56F8257 and TWR-MC-LV3PH* (document number AN4413)

2 Hardware features

This section provides more details about the features and functionality of the TWR-56F8200.
A schematic drawing of the TWR-56F8200 showing the jack locations is given in Appendix D—TWR-56F8200 board jack layout (top view). Features are discussed in the following sections.

2.1 Tower system MCU module

The TWR-56F8200 board is an MCU module designed for standalone use (or with a Freescale Tower system) and complies with the electrical and mechanical specification as described in *Freescale Tower Electromechanical Specification* [1]. Connection to the Tower system is through two expansion card-edge connectors that interface to the 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-56F8200, while the Secondary Elevator connector only makes connections to ground (GND). On sheet 8 of the TWR-56F8200-SCH (See Appendix B—TWR-56F8200 board schematic), the J500A and J500B symbols have names assigned to the card edge fingers that correspond with the normal Tower system pin assignments.

Note: On the top and bottom of one edge of the TWR-56F8200 board, there is a WHITE BELT; the card-edge connectors next to the WHITE BELT on the TWR-56F8200 board should be connected to the Primary Elevator board which uses the WHITE PCI connector. The card-edge connectors without the WHITE BELT on the TWR-56F8200 board should be connected to the secondary Elevator board (or left unconnected) using the Black PCI connector. This instruction overrides any silkscreen information that may be present, such as the words “Primary” or “Secondary” on the TWR-56F8200, since early revisions had this reversed.

2.2 System power

The TWR-56F8200 board has three power rails: P5V_USB, P3_3V, and P3_3V/5V. The sources and usage of these power rails is described as follows.

2.2.1 P5V_USB

The P5V_USB power rail is derived from the mini-B USB connector at J18 and the inductor at L2. It is used to power the on board OSBDM/OSJTAG/Serial Bridge circuit. This consists of the OSBDM/OSJTAG MCU at U6, several pullup resistors at R13, R14, R15, R527, and R528, the USB power switch at U501, and the STATUS and TPWR LEDs at D12 and D13. If there is no USB cable connected to J18, there is no power on this rail and all these circuits are powered down.

2.2.2 P3_3V

The P3_3V power rail is derived from either of the following sources.

- the P3_3V_MOTOR power net from the motor control board connector at J501,
- the P3_3V_ELEV power net from the Tower connector at J500, or
- the onboard 3.3 V regulator at U1

The selection of any of these power sources is made with a shunt from J7-2 (jumper J7 pin 2) to another pin of J7 or to J6. A shunt from J11-2 (Jumper J11-pin2) to another pin of J11 or to J10, is used to select power to the regulator from the following sources:

- the P5V_TRG_USB power net out of the USB switch at U501,
- the P5V_ELEV power net from the elevator connection at J500 pins A1 and B1, or
- the PWR_IN power net from the 2mm barrel jack at J3 through resettable fuse F1.

Table 6 shows the operation of the different shunt positions. The barrel jack input is protected from reverse voltage inputs by diode D11. The input to the barrel jack may be from a 5-9 V source and needs to be center-positive.

The P3_3V power rail provides power to the majority of the circuits on the board including the MC56F82748 (including the analog power pins through L500 and L501), inverters at U500 and U502, a buffer at U505, the onboard LEDs at D1-D9, the thermistor divider circuits at RT1-RT4, and the pullup resistors at R2, R3, R11, R565, R570, and R562.

2.2.3 P3_3V/5V

The P3_3V/5V power rail is derived from the diode OR (using D500 and D501) of:

- the P5V_ELEV power net from the elevator connection (J500 pins A1 and B1),
- the P5V output of the USB power switch at U501, or c) the P3_3V power rail from J7.

When there is a USB cable connected or when the Tower elevator boards are connected, this power rail will be a Schottky diode drop (about 0.3V) below the 5 V power nets. When there is no 5 V source, this power rail will be a Schottky diode drop below the P3.3V power rail. This allows the inputs of the ICs powered by this rail to stay in a high-impedance state instead of loading down the inputs through the input protection diodes as would happen if there were no power supplied to the buffers.

2.2.4 Default power configuration

The TWR-56F8200 board default power configuration uses the OSBDM/OSJTAG USB port for all power. As soon as the OSBDM/OSJTAG firmware has started, it negotiates with the host PC USB port for full USB power. Once approved, it enables the 5V USB power switch (U501) which provides 5 V to the P3_3V/5 V power rail and to the 3.3 V regulator (U1) through headers J10 and J11. Likewise, the onboard voltage regulator provides 3.3 V to the P3_3V power rail through headers J6 and J7. The 3.3 V regulator is able to provide up to 700 mA current, subject to the power dissipation and temperature limits of the device.

2.3 MC56F82748 DSC

The primary circuits on the board are related to the MC56F82748 DSC. This part is supplied in a surface-mounted 64-pin LQFP package at U2. Although the board was laid out to allow a ZIF socket at U3 in parallel to the chip at U2, the TWR-56F8200 is only available for purchase with the surface-mounted chip.

2.3.1 Clock sources for the MC56F82748 DSC

Three options are available for clocking the MC56F82748 device:

- Oscillator internal to the MC56F82748 chip —approximately 8 MHz.
- 8 MHz crystal
- External clock input from Primary Tower Connector or the AUX Connector.

The internal oscillator is used to clock the MC56F82748 MCU immediately following reset. This is the default operation. In this mode, the 0-ohm resistors at R4 and R10 allow the GPIOC0 and GPIOC1 pins of the MC56F82748 MCU to be used as inputs or outputs.

To use an external crystal with the MC56F82748, 0-ohm resistors R4 and R10 must be removed and placed in the R5 and R7 positions. The desired crystal, load capacitors, and parallel resistor (if needed) must be soldered to the board at Y1, C5, C6, and R6. (These components are not provided with the TWR-56F8200 kit.) Following reset, reconfigure the GPIOC0 and GPIOC1 pins to the XTAL and EXTAL functions to allow the use of an external crystal.

To use an external clock for the MC56F82748, make sure the 0-ohm resistors are installed at R4 and R10 and removed from R5 and R7. Provide a clock signal on either the Primary Tower Connector J500A - pin B24 (the pin designated as CLOCKIN0), or on the AUX connector J502 - pin 8. Following reset, configure the GPIOC0 pin to the CLKIN input function. In this mode, the 0-ohm resistors at R10 allows the GPIOC1 pin of the MC56F82748 (pin 10) to be used as an input or output.

2.3.2 Serial I/O source select headers

The TWR-56F8200 board allows the UART functions of the MC56F82748 DSC to be connected to the serial interface of the Primary Tower Connector J500A or through a USB bridge to the host PC using the OSBDM/OSJTAG MCU (U6). The selection of the RXD connections is done as shown in Table 1**.** The selection of the TXD connections is done as shown in Table 2**.**

Table 1. J8-RXD source select header

Pin#	Connected signal	Description
1	ELEV_RXD0 at J500A pin A41	Shunt pins 1 and 2 together to connect the DSC RXD0 pin to the primary Tower Connector RXD0 pin. (This is a default position.)
2	GPIOF8/RXD0/TB1 from the 56F82748 DSC – pin 6 (RXD0 function)	—

Pin#	Connected signal	Description
3	RXD_SEL from the USB bridge function on the OSBDM/OSJTAG MCU.	• Shunt pins 2 and 3 together to connect the DSC RXD0 pin to the USB serial bridge function. • Shunt pins 3 and 4 together to connect the DSC RXD1 pin to the USB serial bridge function.
4	GPIOF5/RXD1/XB_OUT5 from the 56F82748 DSC – pin 42 (RXD1 function)	—
5	ELEV_RXD1 at J500 pin A43	Shunt pins 4 and 5 together to connect the DSC RXD1 pin to the primary Tower Connector RXD1 pin. (This is a default position.)

Table 2. J9–TXD source select header

Pin #	Connected Signal	Description
1	ELEV_TXD0 at J500A pin A42	Shunt pins 1 and 2 together to connect the DSC TXDO pin to the primary Tower Connector TXD0 pin. (This is a default position.)
2	GPIOC2/TXD0/TB0/XB_IN2/CLKO from the 56F82748 DSC – pin 5 (TXD0 function)	—
3	TXD_SEL to the USB bridge function on the OSBDM/OSJTAG MCU.	• Shunt pins 2 and 3 together to connect the DSC TXD0 pin to the USB serial bridge function. • Shunt pin 3 and 4 together to connect the DSC TXD1 pin to the USB serial bridge function.
4	GPIOF4/TXD1/XB_OUT4 from the 56F82748 DSC – pin 41 (TXD1 function)	—
5	ELEV_TXD1 at J500 pin A44	Shunt pins 4 and 5 together to connect the DSC TXD1 pin to the primary Tower Connector TXD1 pin. (This is a default position.)

As can be seen in the tables, the 56F82748 DSC serial signals may be connected to either the Tower serial signals or to the USB bridge chip; however, only one channel may be connected to the USB bridge chip. If the associated 56F82748 DSC serial pins are not being used for the serial functions, the shunts should be removed from those pins. For more information on the USB Serial Bridge function, see USB serial bridge interface.

There are some tower boards available, such as TWR-SER that provide serial ports based on these elevator connections. These boards can work with the TWR-56F8200, if configured and installed in the same Tower system.

2.3.3 LEDs controlled by the MC56F82748 DSC

There are nine LEDs with buffers connected to the MC56F82748 DSC. Inverting buffers (U500A-F and U502D-F) isolate the LEDs from the DSC pins by providing high-impedance inputs. The LEDs are powered by the P3_3V rail and each LED draws about 5 mA current. This table shows the DSC pin names associated with each LED.

Table 3. LEDs controlled by the MC56F82748 DSC

MC56F82748 DSC Pin name	MC56F82748 Pin number	LED Reference	LED Label	LED Color
GPIOE0/PWM0B	45	D1	E0	Green
GPIOE1/PWM0A	46	D2	E1	Yellow
GPIOE2/PWM1B	47	D3	E2	Green
GPIOE3/PWM1A	48	D4	E3	Yellow
GPIOE4/PWM2B/XB_IN2	51	D5	E4	Green
GPIOE5/PWM2A/XB_IN3	52	D6	E5	Yellow
GPIOE6/PWM3B/XB_IN4	53	D7	E6	Green
GPIOE7/PWM3A/XB_IN5	54	D8	E7	Yellow
GPIOF6/TB2/PWM3X	94	D9	F6	Amber

2.3.4 Motor control connector

The TWR-56F8200 board may be connected to a motor control board APMOTOR56F8000E. The motor control connector (J501) is at the bottom of the board to provide a convenient connection to the motor control board.

Some of the MC56F82748 DSC pins are connected to the motor control connector. The pins associated with analog inputs have 100 Ω resistors in series to provide some ESD protection for the analog inputs of the DSC. The pins providing analog signals from the motor control board have 2200 pF capacitors with the 100 Ω resistors to provide a low-pass filter. The connector pinout is shown in Table 4.

Table 4. Motor control connector pinout

Pin #	MC56F82748 DSC signal	Pin #	MC56F82748 DSC signal
1	P3_3V_MOTOR	2	GPIOB7/ANB7&ANC15&CMPB_IN2 (With 100 Ω in series)
3	GND	4	RESETB/ GPIOD4 (With 0 Ω in series – remove to isolate)
5	GPIOF4/TXD1/XB_OUT8	6	GPIOA3/ANA3&VREFLA&CMPA_IN2 (With 100 Ω in series)
7	GPIOF3/SDA1/XB_OUT7	8	GND
9	GPIOE1/PWMA_0A	10	GPIOA0/ANA0&CMPA_IN3/CMPC_O (With 100 Ω, 2200 pF low-pass filter)
11	GPIOE0/PWMA_0B	12	GPIOA1/ANA1&CMPA_IN0 (With 100 Ω, 2200 pF low-pass filter)
13	GPIOC3/TA0/CMPA_O/RXD0/CLKIN1	14	GPIOA2/ANA2&VREFHA&CMPA_IN1 (With 100 Ω, 2200 pF low-pass filter)
15	GPIOC13/TA3/XB_IN6/EWM_OUT_B	16	GND
17	GPIOC4/TA1/CMPB_O/XB_IN8/EWM_OUT_B	18	GPIOB0/ANB0&CMPB_IN3 (With 100 Ω, 2200 pF low-pass filter)
19	GPIOC6/TA2/XB_IN3/CMP_REF	20	GPIOB1/ANB1&CMPB_IN0 (With 100 Ω, 2200 pF low-pass filter)
21	GPIOC15/SCL0/XB_OUT5	22	GPIOB2/ANB2&VREFHB&CMPC_IN3 (With 100 Ω, 2200 pF low-pass filter)
23	GPIOC14/SDA0/XB_OUT4	24	GND
25	TDI /GPIOD0	26	GPIOE7/PWMA_3A/XB_IN5/PWMB_2A
27	TDO/ GPIOD1	28	GPIOE6/PWMA_3B/XB_IN4/PWMB_2B

Pin #	MC56F82748 DSC signal	Pin #	MC56F82748 DSC signal
29	TCK/GPIOD2	30	GPIOE3/PWMA_1A
31	TMS /GPIOD3	32	GPIOE2/PWMA_1B
33	GPIOB3/ANB3&VREFLB&CMPC_IN0 (With 100 Ω in series)	34	GPIOE5/PWMA_2A/XB_IN3
35	GPIOB4/ANB4&ANC12&CMPC_IN1 (With 100 Ω in series)	36	GPIOE4/PWMA_2B/XB_IN2
37	GPIOB5/ANB5&ANC13&CMPC_IN2 (With 100 Ω in series)	38	GPIOA4/ANA4&ANC8&CMPD_IN0 (With 100 Ω in series)
39	GPIOB6/ANB6&ANC14&CMPB_IN1 (With 100 Ω in series)(100K Trimpot in parallel)	40	GPIOA5/ANA5&ANC9 (With 100 Ω in series)(100K Trimpot in parallel)

2.3.5 Auxiliary connectors

In addition to the motor control connector, the TWR-56F8200 board also provides two auxiliary connectors J502 at the bottom of the board. These connectors provide access to the MC56F82748 DSC signals that are not covered by the motor control connector. The pins associated with analog inputs have 100 Ω resistors in series to provide some ESD protection for the analog inputs of the DSC. The connector pinout is shown in this table.

Table 5. Auxiliary connector J502 pinout

Pin #	MC56F82748 DSC signal	Pin #	MC56F82748 DSC signal
J502-1	GPIOF0/XB_IN6/TB2/SCK1	J502-2	GPIOA6/ANA6&ANC10 (With 100 Ω in series)
J502-3	GPIOF1/CLKO1/XB_IN7/CMPD_O	J502-4	GPIOA7/ANA7&ANC11 (With 100 Ω in series)
J502-5	GPIOF2/SCL1/XB_OUT6	J502-6	GND
J502-7	GPIOF5/RXD1/XB_OUT9	J502-8	GPIOC0/EXTAL/CLKIN0
J502-9	GPIOF6/TB2/PWMA_3X/PWMB_3X/XB_IN2	J502-10	GPIOC1/XTAL

Pin #	MC56F82748 DSC signal	Pin #	MC56F82748 DSC signal
J502-11	GPIOF7/TB3/CMPC_O/SS1_B/XB_IN3	J502-12	GPIOC2/TXD0/TB0/XB_IN2/CLKO 0
J502-13	GPIOF8/RXD0/TB1/CMPD_O	J502-14	GPIOC5/DACO/XB_IN7
J502-15	GPIOC11/CANTX/SCL1/TXD1	J502-16	GPIOC7/SS0_B/TXD0
J502-17	GPIOC12/CANRX/SDA1/RXD1	J502-18	GPIOC8/MISO0/RXD0/XB_IN9
J502-19	GND	J502-20	GPIOC9/SCK0/XB_IN4
J502-21	No Connection	J502-22	GPIOC10/MOSI0/XB_IN5/MISO0
J502-23	No Connection	J502-24	No Connection
J502-25	No Connection	J502-26	No Connection

2.3.6 Tower system elevator connectors

The TWR-56F8200 board 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-56F8200 board, while the Secondary Elevator connector only makes connections to ground (GND). Table 7 lists the pin functions for the Primary Elevator Connector.

2.3.7 Thermistors as analog inputs

The TWR-56F8200 board provides four thermistors (RT1–RT4) near the corners of the board that can be used as single-ended or differential analog inputs to the MC56F82748 DSC as can be seen on sheet 6 of the schematic (See Appendix B—TWR-56F8200 board schematic). In addition to each thermistor, there is a resistor between the thermistor and P3_3V and another resistor between the thermistor and ground. All the thermistors are 10 kΩ parts but the associated divider chain uses different resistors. This makes the voltage across the thermistor larger or smaller and provides the ability to try the different gain settings on the analog channels. All the four thermistor circuits are designed to provide useable differential inputs over the temperature range of 90 °C to –20 °C. RT2 and RT4 both give a differential voltage of ~1.65 V at 25 °C. RT1 gives a differential voltage of 0.10 V and RT3 gives a differential voltage of 0.28 V at 25 °C.

In addition to the thermistor voltage divider chain, each thermistor has a 0.1 µF capacitor in parallel. Each thermistor circuit also has a header that allows the thermistor to be disconnected from the analog inputs to the DSC. If a user wishes to apply an external analog value, these headers may be removed and the external analog signal attached to the DSC side of the headers. Finally, each analog input to the DSC has a 100 Ω series resistor and a 2200 pF capacitor as a low pass filter. This helps protect the DSC from

electrostatic discharges and lowers the impedance of the analog signal so that it can be sampled with less noise.

2.3.8 CAN transceiver

The TWR-56F8200 board has a CAN transceiver circuit that may be connected to the CAN pins of the DSC. The CAN transceiver (U503) can be connected to the GPIOC11/CANTX/SCL1/TXD1 and GPIOC12/CANRX/SDA1/RXD1 pins of the DSC through the header at J16. Installing a shunt from pin 1 to pin 2 connects the TXD nets and installing a shunt from pin 3 to pin 4 connects the RXD nets.

Note: The GPIOC11/CANTX/SCL1/TXD1 and GPIOC12/CANRX/SDA1/RXD1 nets also go to the primary elevator edge connector (J500A) pins B41 and B42 and to the auxiliary connector (J502) pins 15 and 17. When using these nets for CAN communications, care must be taken that these nets are not driven from these other connectors.

The transceiver is capable of running from 3.3 V and is powered by the P3_3V/5V power rail. The transceiver output is connected to header J13 with CANH connected to pin 4 and CANL connected to pin 3. A 120 Ω parallel termination resistor, R560, may be connected between these nets by installing a shunt on header J15.

2.3.9 IRQ or input push-buttons

The TWR-56F8200 board has two push-buttons (SW1 and SW2) that can be used to provide inputs or interrupts to the DSC. Each has a 10 kΩ pullup resistor to P3_3V and a 0.1 µF capacitor to ground to minimize bounce on the output.

The push-button SW1 is connected to header J4 where the switch output can be connected to either DSC pin GPIOC2/TXD0/TB0/XB_IN2/CLKO (default) or GPIOF6/TB2/PWM3X depending on the position of the shunt on the header (pin 1 to pin 2 is the default). Similarly, push-button SW2 is connected to header J5 where the switch output can be connected to either DSC pin GPIOF8/RXD0/TB1 (default) or GPIOF7/TB3 depending on the position of the shunt on the header (pin 1 to pin 2 is the default).

If the push-button switches are not being used as an interrupt, or other purpose, it is best to remove the shunt to the DSC so that the 0.1 µF capacitor is not loading down the DSC pins.

2.3.10 RESET

The GPIOD4/RESET_B pin of the DSC is connected to the motor control connector and the Tower connector but also to a push-button (SW3) and through buffers to the OSBDM/OSJTAG chip. It is pulled to P3_3V by a 10 kΩ resistor. It may be pulled low by the push-button or by Q1 in response to a high output from the OSBDM/OSJTAG chip (pin 1) on the TRESET_OUT net. The state of the GPIOD4/RESET_B signal is provided to the OSBDM/OSJTAG chip through a voltage translator (U504B). This buffer is powered by the P3_3V/5V power rail so that its input will remain high-impedance when there is no USB cable connected. The buffered RESET signal is provided to pin 33 of the OSBDM/OSJTAG chip and is used by the OSBDM/OSJTAG program in that chip.

2.3.11 JTAG header and OSBDM/OSJTAG disconnect header

The TWR-56F8200 board includes an OSBDM/OSJTAG circuit as a debug interface to the C56F82748 DSC for normal purposes. If the user desires to use a different debugger connection, header J14 provides a connection point for an external JTAG hardware debugger. If an external debugger is connected to the JTAG header, the shunts at J21 (pins 1 to 2, 3 to 4, 5 to 6, and 7 to 8) which connect the SBDM/OSJTAG circuit to the JTAG signals should be removed, allowing the external debugger to control the JTAG port, rather than the JM60.

The TWR-56F8200 board provides a 2.2 kΩ pullup resistor to 3.3 V on the TMS line. If an external JTAG hardware debugger also has a pullup on this line, the external debugger may not be able to pull the TMS line low. If this happens, remove one of the pull up resistors on the TMS line.

2.4 OSBDM/OSJTAG

2.4.1 Debug interface

An onboard MC9S08JM60 based Open Source BDM (OSBDM/OSJTAG) circuit provides a debug interface to the MC56F82748. A standard USB A male to mini-B male cable (supplied with the tower card) can be used for debugging via the USB connector, J18.

2.4.2 USB serial bridge interface

The onboard MC9S08JM60 can also be used as a USB-to-serial bridge interface for the UART signals from the MC56F82748 DSC. This bridge circuit is described in detail in Serial I/O source select headers**.**

The RXD_SEL signal goes to the MC56F82748 DSC. The USB bridge chip is powered by 5 V; so it has a 5 V output. The buffer (U505) is able to accept the 5 V signal from the USB bridge chip (T_TXD1) and converts it to the 3.3 V signal (RXD_SEL) for the DSC. The buffer output is enabled by an inverted RTS signal (TXD_RXD_EN_B) from the USB bridge chip. If there is no USB connection to the TWR board, the RTS signal is not driven and the 3.3 V powered inverter (U502C) input is biased low disabling the output of the buffer.

In a similar way, TXD_SEL is a 3.3 V signal from the MC56F82748 DSC. The USB bridge chip is expecting a 5 V input on T_RXD1. The buffer between these two signals (U504C) is powered by P3_3V/5V. It will accept the 3.3 V input from the DSC and convert it to the 5 V signal needed by the USB bridge chip. The buffer output is enabled by the same inverted RTS signal (TXD_RXD_EN_B) discussed above. If there is no USB connection to the TWR board, the RTS signal is not driven and the 5 V powered buffer is disabled; so nothing is driving the powered down USB bridge chip.

The serial interface signals from the MC56F82748 DSC may be routed to the MC9S08JM60 serial interface via header and Berg straps. Using the USB serial bridge, the MC9S08JM60 will convert the serial interface data into USB packets and send them to the host PC where they may be handled by a PC application normally conversant with a serial port.

2.4.3 Clocking the OSBDM/OSJTAG MCU (MC9S08JM60)

The MC9S08JM60 MCU uses an onboard 4 MHz external crystal circuit (Y2, R16, C7, and C9) for its clock. There are no user options for clocking the MC9S08JM60 MCU.

2.4.4 Reserved function select header

Header J20 selects whether the onboard MC9S08JM60 MCU operates as an OSBDM/OSJTAG debug interface or as a USB Serial Bridge interface on *older* versions of S08 firmware such as may have existed on prototypes of the TWR56F8200. Leaving the shunt on the header enables the OSBDM/OSJTAG debug interface. Removing the shunt on header J20 enables the USB Serial Bridge interface. The header J20 is subsequently reserved for future use.

2.4.5 Bootloader enable

In addition to the OSBDM/OSJTAG Debug interface and the USB Serial Bridge interface, the MC9S08JM60 device used in the OSBDM/OSJTAG circuit is preprogrammed with a USB boot loader. The USB boot loader will run following a power-on reset if a shunt is installed on header J17. This allows in-circuit reprogramming of the JM60 flash memory via USB. This enables the OSBDM/OSJTAG firmware to be upgraded by the user when upgrades become available. In normal OSBDM/OSJTAG or USB Serial Bridge operation, this shunt must be left open. For details on the USB boot loader, see *USB Bootloader for the MC9S08JM60* (document number AN3561), available on freescale.com.

The USB boot loader communicates with a GUI application running on a host PC. The GUI application can be found on freescale.com using the search keyword "JM60 GUI". See Section 2.5 "PC Driver and PC GUI Tool," and Section 3.3 "Running PC GUI Tool," of *USB Bootloader for the MC9S08JM60* (document number AN3561) for details on installing and running the application.

2.4.6 BDM header

The BDM header at J22 is used for initial programming of the MC9S08JM60 MCU or if reprogramming when the boot loader fails. An external S08 BDM debugger would be connected to J22 and used to program the MCU. This is not expected to be a normal user interface; however it is useful if the JM60 device is inadvertently reprogrammed with firmware that is not functional.

2.4.7 OSBDM/OSJTAG status LEDs

The MC9S08JM60 OSBDM/OSJTAG MCU controls two status LEDs at D12 and D13. See the OSBDM/OSJTAG instructions for the meaning of the LEDs.

2.4.8 OSBDM/OSJTAG voltage translation

Since the OSBDM/OSJTAG MCU runs from 5 V and the 56F82748 DSC runs from 3.3 V, there needs to be voltage translation between the two circuits. This is done through U505, U504A, and U502B. U505 has 5 V tolerant inputs and provides 3.3 V signals (TCK, TDI, and TMS) to the DSC's JTAG pins through the shunts on header J21. U504A is powered by the P3_3V/5V rail and translates the 3.3 V TDO signal from the DSC to a 5 V signal for the OSBDM/OSJTAG MCU. The outputs of both these

translators are high-impedance if the signal OUT_EN_B goes high. This happens if the OSBDM/OSJTAG circuit looses power (no power to the USB connector). In that case, the OUT_EN signal from the OSBDM/OSJTAG MCU (pin 15) is biased low by R12. The inverter at U502B then drives OUT_EN_B high in response. For additional information, see USB serial bridge interface.

3 Jumper table

There are several headers provided for isolation, configuration, and feature selection. See Table 6 for details. The default shunt positions are shown in **bold**.

Table 6. TWR-56F8200 jumper table

Jumper	Function	Shunts	Description	Power use case
J1	Thermistor RT1 Connect	**1-2, 3-4**	**Connect RT1 circuit to the MC56F82748 DSC**	
		none	Disconnect RT1 circuit from the MC56F82748 DSC	
J2	Thermistor RT2 Connect	**1-2, 3-4**	**Connect RT2 circuit to the MC56F82748 DSC**	
		none	Disconnect RT2 circuit from the MC56F82748 DSC	
J4	IRQ1 Select	**1-2**	**Connect SW1 to MC56F82748 DSC pin GPIOC2/TXD0/TB0/XB_IN2/CLKO**	
		2-3	Connect SW1 to MC56F82748 DSC pin GPIOF6/TB2/PWM3X	
		none	Disconnect SW1 from the MC56F82748 DSC	
J5	IRQ0 Select	**1-2**	**Connect SW2 to MC56F82748 DSC pin GPIOF8/RXD0/TB1**	
		2-3	Connect SW2 to MC56F82748 DSC pin GPIOF7/TB3	
		none	Disconnect SW2 from the MC56F82748 DSC	
J6 and J7	3.3 V Source Select	**J6-1 to J7-2**	**Connect the on-board voltage regulator to the P3_3V power rail**	**1, 2, 3a**
		J7-1 to J7-2	Connect P3_3V_MOTOR to the P3_3V power rail (power the 3.3V rail from the motor control connector)	4
		J7-2 to J7-3	Connect P3_3V_ELEV to the P3_3V power rail (power the 3.3V rail from the Tower connector)	3
		J7-2 open	Disconnect the P3_3V power rail – no power	

Jumper	Function	Shunts	Description	Power use case
J8	RXD Source Select (note that only one connection can be made to pin 3 at a time)	**1-2**	**Connect ELEV_RXD0 from the Tower connector to MC56F82748 DSC pin GPIOF8/RXD0/TB1**	
		2-3	Connect RXD_SEL from the USB Serial Bridge to MC56F82748 DSC pin **GPIOF8/RXD0/TB1**	
		Pin 2 open	Disconnect MC56F82748 DSC pin **GPIOF8/RXD0/TB1**	
		3-4	Connect RXD_SEL from the USB Serial Bridge to MC56F82748 DSC pin GPIOF5/RXD1/XB_OUT5	
		4-5	**Connect ELEV_RXD1 from the Tower connector to MC56F82748 DSC pin GPIOF5/RXD1/XB_OUT5**	
		Pin 4 open	Disconnect MC56F82748 DSC pin GPIOF5/RXD1/XB_OUT5	
J9	TXD Source Select (note that only one connection can be made to pin 3 at a time)	**1-2**	**Connect ELEV_TXD0 from the Tower connector to MC56F82748 DSC pin GPIOC2/TXD0/TB0/XB_IN2/CLKO**	
		2-3	Connect TXD_SEL from the USB Serial Bridge to MC56F82748 DSC pin GPIOC2/TXD0/TB0/XB_IN2/CLKO	
		Pin 2 open	Disconnect MC56F82748 DSC pin GPIOC2/TXD0/TB0/XB_IN2/CLKO	
		3-4	Connect TXD_SEL from the USB Serial Bridge to MC56F82748 DSC pin GPIOF4/TXD1/XB_OUT4	
		4-5	**Connect ELEV_TXD1 from the Tower connector to MC56F82748 DSC pin GPIOF4/TXD1/XB_OUT4**	
		Pin 4 open	Disconnect MC56F82748 DSC pin GPIOF4/TXD1/XB_OUT4	
J10 and J11	5 V Source Select	J10-1 to J11-2	Connect the power in barrel connector (through fuse F1) to the input of the 3.3V voltage regulator	1
		J11-1 to J11-2	**Connect P5V_TRG_USB (the switched USB 5V) to the input of the 3.3V voltage regulator**	**2**
		J11-2 to J11-3	Connect P5V_ELEV to the input of the 3.3V voltage regulator	3a
		J11-2 open	Disconnect the input of the 3.3V voltage regulator	3, 4
J12	Unused	**open**	**Unused**	
J15	CAN Termination Enable	**1-2**	**Connect the 120 ohm CAN termination resistor**	

Jumper	Function	Shunts	Description	Power use case
		open	No CAN termination	
J16	CAN Enable	**1-2, 3-4**	**Connect the CAN transceiver TXD and RXD to MC56F82748 DSC pins GPIOC11/CANTX/SCL1/TXD1 GPIOC12/CANRX/SDA1/RXD1**	
		open	Disconnect the CAN transceiver	
J17	MC9S08JM60 Bootload Enable	1-2	Enable USB bootloading of the MCU Flash memory	
		open	**Disable bootloading**	
J19	Thermistor RT3 Connect	**1-2, 3-4**	**Connect RT3 circuit to the MC56F827 DSC**	
		none	Disconnect RT3 circuit from the MC56F82748 DSC	
J20	RESERVED / OSBDM/OSJTAG Enable	**1-2**	**Reserved-deprecated**	
		none	Reserved-deprecated	
J21	OSBDM/OSJTAG Connect to JTAG	**1-2, 3-4, 5-6, 7-8**	**Connect the OSBDM/OSJTAG debug signals (JTAG) to the MC56F82748 DSC JTAG pins**	
		none	Disconnect OSBDM/OSJTAG from the MC56F82748 DSC	
J23	Thermistor RT4 Connect	**1-2, 3-4**	**Connect RT4 circuit to the MC56F827 DSC**	
		none	Disconnect RT4 circuit from the MC56F82748 DSC	

Due to the large number of use cases for the TWR-56F8200 board, the following power use cases are referred in the table above to ease the configuration of the board with Berg Straps and/or wires for power configurations.

The use cases enumerated are:

1. TWR-56F8200 standalone with the barrel power connector and the U-MULTILINK or USB-TAP. Use this mode for initial programming of the board, especially prior to using it to control high voltages.
2. TWR-56F8200 standalone with the USB connector. Use this for OSJTAG programming of the board. No other hardware is required than the board and cable supplied for connection to USB of computer.
3. TWR-56F8200 in Tower system driving TWR-MC-LV3PH board, also in Tower system, or for any other Tower application other than APMOTOR56800E motor driving in Tower. (3a is alternative connection.)
4. TWR-56F8200 in Tower system driving APMOTOR56800E (equipped with three 1 inch #4 hardware plastic standoffs (female both ends) with six #4 screws).
5. TWR-56F8200 driving APMOTOR56800E outside the Tower system. (Same power configuration as 4).

4 Getting started

4.1 Introduction

In this section, you will find details that give step by step instructions on how to set up your Tower system for several different scenarios:

- **Debugging new application on TWR-56F8200 using MultiLink**
  - Set up a new project application interfacing with the Universal Multilink interface
- **Debugging new application on TWR-56F8200 using OSJTAG**
  - Set up a new project application interfacing with the standard TWR interface, OSJTAG
- **Programming TWR board with the Thermistor demo using Universal Multilink**
  - Set up the standard out of box demo using the Universal Multilink interface
- **Programming TWR board with thermistor demo using OSBDM/OSJTAG**
  - Set up the standard out of box demo with the standard TWR interface, OSJTAG
- **Programming TWR board with a three-phase motor demo using Universal Multilink**
  - Set up the TWR-MC-LV3PH BLDC motor kit to spin the motor, controlled via the hardware buttons, interfacing with the Universal Multilink.
- **Programming TWR board with a three-phase motor control demo using OSBDM/OSJTAG**
  - Set up the TWR-MC-LV3PH BLDC motor kit to spin the motor, controlled via the hardware buttons, interfacing with OSJTAG.
- **Three-phase motor control demo controlled via FreeMASTER using P&E Universal Multilink**
  - Spin the TWR-MC-LV3PH BLDC motor controlling it from your PC via FreeMASTER, interfacing with Universal Multilink.
- **Three-phase motor control demo controlled via FreeMASTER using OSBDM/ OSJTAG**
  - Spin the TWR-MC-LV3PH BLDC motor, controlled from your PC via FreeMASTER, interfacing with OSJTAG.

You can also view a video of how to set up the scenarios at freescale.com/TWR-56F8200.

4.2 Hardware installation

The first step to any of the scenarios is to configure the hardware. Set up the hardware as mentioned in Table 6 or, the TWR-56F8200 Jumper Table in the Quick Start Guide [2] and your board should look like the one shown in this figure.

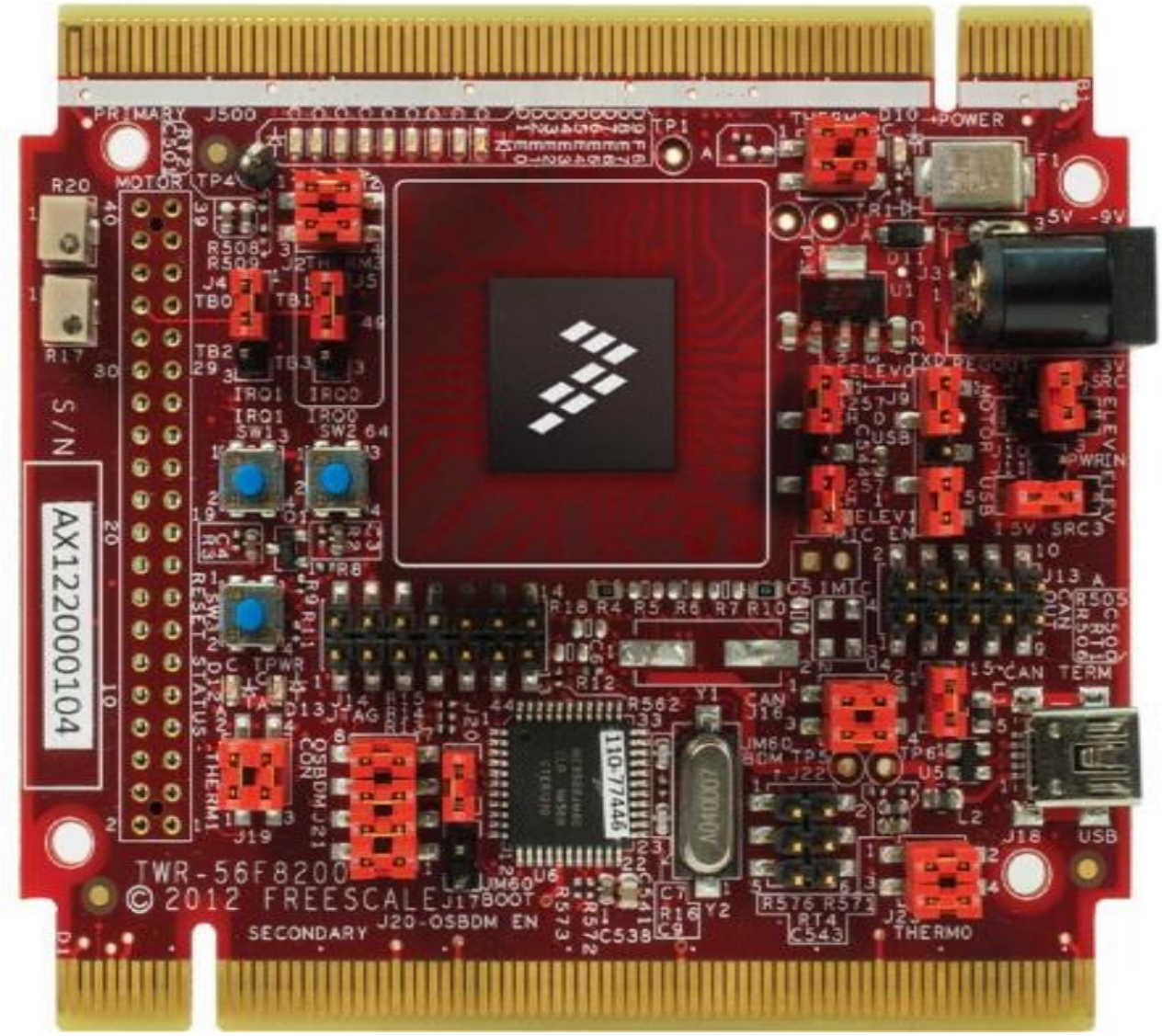


Figure 3. TWR-56F8200 tower board

4.3 Software installation

After the hardware is configured, the software needs to be set up. The first step is for the user to set up CodeWarrior. You need to install CodeWarrior to program and debug the TWR-56F8200, and FreeMASTER for debugging via GUI.

The installation software can be found in the following locations, or by following the “Jump Start Your Design“ section in the Quick Start Guide available in Tower System box.

- CodeWarrior Development Tools: www.freescale.com/CodeWarrior
- FreeMASTER Application and Communication Driver: www.freescale.com/FREEMASTER

4.4 Procedure for debugging new applications on TWR-56F8200 Using MultiLink

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Connect all the jumpers on 56F8200 board as mentioned in Table 6.

2. Make the connection using U-Multilink and USB cable: Connect one end of the USB cable to TWR-56F8200 board and other to the computer for supplying the power to board. Connect the P&E U-Multilink to the JTAG Connector J14. Make sure the red wire of P&E Multilink ribbon connector connects to pin1 of J14. Connect the other end of the multilink to the computer USB port.

3. Create an application for MC56F82748: Launch CodeWarrior and run the program.

a) From the menu, choose File > New > Bareboard Project.
b) Assign a project name, such as "ProjDSC" and click Next.
c) Expand the 56800/E (DSC) drop box, expand 56F827xx, select MC56F82748, and then click Next.
d) Select all the checkboxes on "Connection to be used," and click Next twice.
e) Select Processor Expert, and click Finish.

4. Build your application: Wait for Processor Expert to finish loading. Observe the activity in the lower right of the IDE screen, such as progress indications. Once idle, click the project name "ProjDSC" and then click the hammer icon to build the project.

5. Load your application using U-MultiLink:

a) When finished building, right-click the project name.
b) Choose Debug As > Debug configurations and then select CodeWarrior Download.
c) Select U-MultiLink and click OK.
d) Observe the activity in the lower portion of the IDE screen, such as progress indications. Once the debugger runs, it will stop in the Main program for you to take control.

6. Debug your application: Set a breakpoint at the "for" instruction from within the C language program by right-clicking in the margin to the left of the "for" statement and selecting "toggle breakpoint." Look for a red square at the top of the screen, among the debug controls. Mouse over them to the left and find and click Resume to continue.

4.5 Procedure for debugging new applications on TWR-56F8200 Using OSJTAG

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Connect all the jumpers on 56F8200 board as mentioned in Table 6.

2. Connect USB cable: Connect one end of the USB cable to the TWR-56F8200 board and other to the computer.

3. Create an application for MC56F82748: Launch CodeWarrior and run the program.

a) From the menu, choose File > New > Bareboard Project.
b) Assign a project name, such as "ProjDSC" and click Next.
c) Expand the 56800/E (DSC) drop box, expand 56F827xx, select MC56F82748, and then click Next.
d) Select all the checkboxes on "Connection to be used," and click Next twice.
e) Select Processor Expert, and click Finish.

4. Build your application: Wait for Processor Expert to finish loading. Observe the activity in the lower right of the IDE screen. Once idle, click the project name "ProjDSC" and click the hammer icon to build the project.

5. Load your application using OSJTAG:

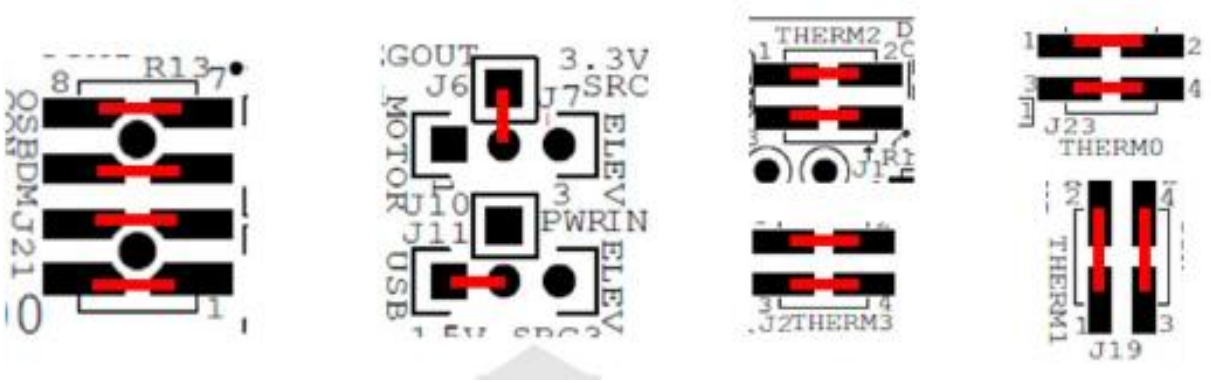
a) When finished building, right-click the project name.
b) Choose Debug As > Debug configurations and then select CodeWarrior Download.
c) Select OSJTAG and click OK.
d) Observe the activity in the lower portion of the IDE screen. Once the debugger runs, it will stop in the Main program for you to take control.

6. Debug your application: Set a breakpoint at the "for" instruction from within the C language program by right-clicking in the margin to the left of the "for" statement and selecting "toggle breakpoint."Look for a red square at the top of the screen, among the debug controls. Mouse over them to the left and find and click Resume to continue.

4.6 Programming the Tower system with thermistor demo using Universal Multilink

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Make sure the following pins shown in red are connected as shown in the following figure.



2. Power to TWR-56F8200 TWR card: Power up the TWR-56F8200 board using the USB cable from the computer's USB port.

3. Connect programming /debugging tool: Connect P&E Universal multilink to TWR-56F8200 at JTAG connector J14, and make sure the red wire of ribbon connector connects to Pin1 on J14. Connect the other end of the P&E Universal Multilink to computer USB port

4. Launch CodeWarrior: Import and run the TWR56F8200_Thermistor_lab_JTAG project from the "MC56F827xxCodeExample" directory:

a) Create a new work area called "ThermistorDemoMultilink" for example.
b) Choose File > Import, expand "General", select "Existing Projects into Workspace" and then click Next.
c) On the "Select Root directory" radio button, click Browse and browse to the "MC56F827xxCodeExample".
d) A list of projects appears. Select MC56F827xxCode Example and click OK.
e) A list of all the selected projects will appear. Select TWR56F8200_Thermistor_lab_JTAG and click "Copy projects into workspace" button and then click Finish.
f) Clean and build TWR56F8200_Thermistor_lab_JTAG project by using Project > Clean. Click the "Clean projects selected below" button and select TWR56F8200_Thermistor_lab_JTAG. Select "Start a build immediately" and "Build only selected projects" checkboxes.
g) After the build completes, right-click the project and choose Debug As > Debug Configurations, and then select CodeWarrior Download.
h) Select "SDM_PnE U-Multilink" as the choice of hardware for debugging.
i) In the Debug Configuration window, under the 'main' tab in the application, click "search project" and select TWR56F8200_Thermistor_lab_JTAG.elf and click OK.
j) Click 'Debug' on the right bottom of the window to load the program.
k) After the program loads, it will stop in the main program.
l) Click the resume icon to resume execution.

5. Run the thermistor demo: Now you should see LEDs E0-E7 flashing in pairs, with a period of 400 ms. With a finger, touch one of the onboard thermistors (RT1, RT2, RT3, RT4) placed on each corner of the board. By touching the thermistor, you will increase its temperature. The change in temperature is detected by the DSC and it will update the LED flashing pattern. If you touch RT1, LEDs

E0 and E1 will flash in intervals of 200 ms. All other LEDs will be turned off. The thermistors and the LEDs are related as shown in this table.

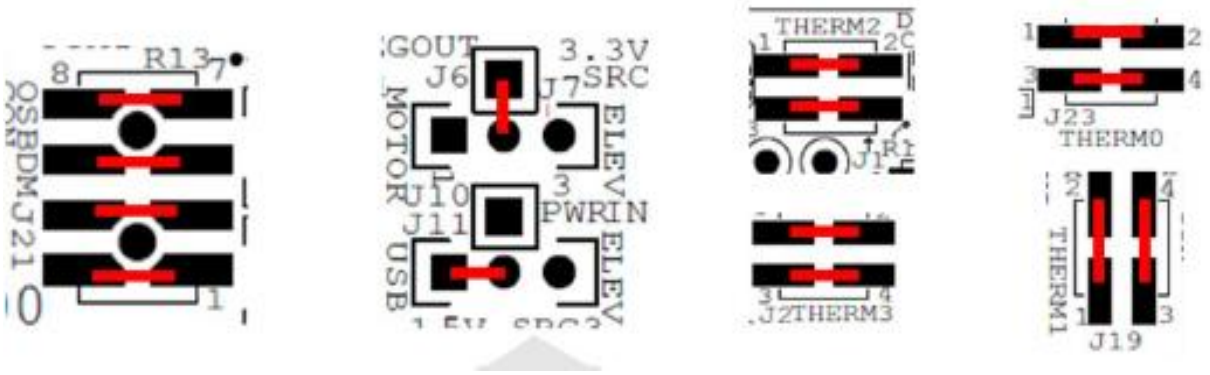
Thermistor	LEDs
RT1	E0, E1
RT2	E2, E3
RT3	E4, E5
RT4	E6, E7

If you remove the finger from the thermistor, the LED will return to the default flash pattern.

4.7 Programming the Tower system with thermistor demo using OSBDM/OSJTAG

Prerequisite: Download and Install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Make sure following pins shown in red are connected as shown in this figure.



2. Power to TWR-56F8200 TWR card: Power up the TWR-56F8200 board using the USB cable from the computer's USB port.

3. Launch CodeWarrior: Import and run the TWR56F8200_Thermistor_lab_JTAG project from the "MC56F827xxCodeExample" directory:

a) Create a new work area called "ThermistorDemoMultilink" for example.
b) Choose File > Import, expand "General", select "Existing Projects into Workspace" and then click Next.
c) On the "Select Root directory" radio button, click Browse and browse to the MC56F827xxCodeExample.
d) A list of projects appears. Select MC56F827xxCode Example and click OK.

e) A list of all the selected projects will appear. Select TWR56F8200_Thermistor_lab_JTAG and click “Copy projects into workspace” button and then click Finish.
f) Choose Project > Clean to clean and build TWR56F8200_Thermistor_lab_JTAG project. Click the “Clean projects selected below” button and select TWR56F8200_Thermistor_lab_JTAG. Select “Start a build immediately” and “Build only selected projects” checkboxes.
g) After the build completes, right-click the project and choose Debug As > Debug Configurations, and then select CodeWarrior Download.
h) Select SDM_OSJTAG as the choice of hardware for debugging.
i) In the Debug Configuration window, under the ‘main’ tab in the application, click “search project” and select TWR56F8200_Thermistor_lab_JTAG.elf and click OK.
j) Click ‘Debug’ on the right bottom of the window to load the program.
k) After the program loads, it will stop in the main program.
l) Click the resume icon to resume execution.

4. Run the thermistor demo: Now you should see LEDs E0-E7 flashing in pairs, with a period of 400 ms. With a finger, touch one of the onboard thermistors (RT1, RT2, RT3, RT4) placed on each corner of the board. By touching the thermistor, you will increase its temperature. The change in temperature is detected by the DSC and it will update the LED flashing pattern. If you touch RT1, LEDs E0 and E1 will flash in intervals of 200 ms. All other LEDs will be turned off. The thermistors and the LEDs are related as shown in this table.

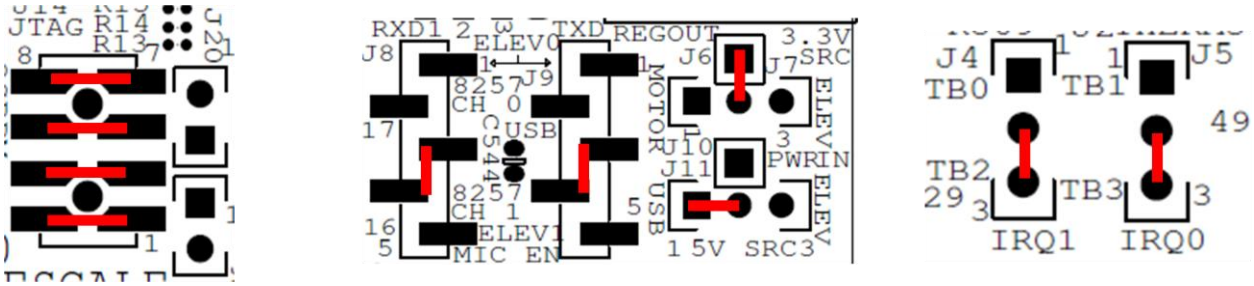
Thermistor	LEDs
RT1	E0, E1
RT2	E2, E3
RT3	E4, E5
RT4	E6, E7

If you remove the finger from the thermistor, the LED will return to the default flash pattern.

4.8 Programming TWR board with LV_Motor demo using Universal Multilink

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Reconfigure the TWR-56F8200 module by removing all the jumpers. Reconnect the 10 pins shown in red in the following figure to first program the TWR-56F8200 standalone with “MC56F82748_TWR_LV_BLDC” source code.



2. Power to TWR-56F8200 TWR card: Connect one end of the USB cable to the TWR-56F8200 board and the other to the computer for supplying power to the board.

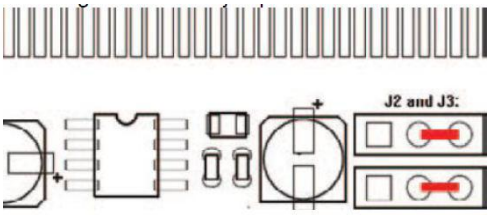
3. Connect programming /debugging tool: Connect P&E Universal multilink to TWR-56F8200 at JTAG connector J14, and make sure red wire of ribbon connector connects to Pin1 on J14. Connect other end of P&E Universal Multilink to computer USB port.

4. Launch CodeWarrior: Import and run the MC56F82748_TWR_LV_BLDC project from the "MC56F827xxCodeExample" directory:

a) Create a new work area called "WS_8200" for example.
b) Choose File > Import. Expand "General", select "Existing Projects into Workspace" and then click Next.
c) On the "Select Root directory" radio button, click Browse and browse to the MC56F827xxCodeExample.
d) A list of projects appears. Select MC56F827xxCode Example and click OK.
e) A list of all the selected projects will appear. Select MC56F82748_TWR_LV_BLDC and click the "Copy projects into workspace" button. Then, click Finish.
f) Clean and build "MC56F82748_TWR_LV_BLDC" project by choosing Project > Clean. Click the "Clean projects selected below" button and select MC56F82748_TWR_LV_BLDC. Select "Start a build immediately" and "Build only selected projects" checkboxes.
g) After the build completes, right-click the project and choose Debug As > Debug Configurations, and then select CodeWarrior Download.
h) Select SDM_PnE U-Multilink as the choice of hardware for debugging.
i) In the Debug Configuration window, under the 'main' tab in the application, click "search project" and select MC56F82748_TWR_LV_BLDC.elf and click OK.
j) Click Debug on the right bottom of the window to load the program.
k) After the program loads, it will stop in the main program.
l) Click the resume icon to resume execution.

5. Disconnect the computer and power: Remove the USB cable from the TWR-56F8200.
Remove the P&E U-Multilink from TWR-56F8200. Click OK on the pop-up window which appears while disconnecting USB cable.

6. Connect jumpers on TWR-MC-LV3PH module: Reconfigure the TWR-MC-LV3PH module by removing all the wires and jumpers. Reconnect the two pins shown in red, as shown in the following figure.

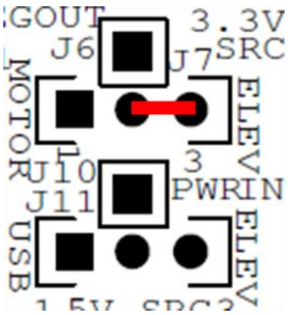


7. Assemble TWR-MC-LV3PH module: Connect the white edge of the TWR-MC-LV3PH module with the white edge of the primary Tower elevator.

8. Assemble TWR-56F8200 module: Connect the white edge of the TWR-56F8200 module with the white edge of the primary Tower elevator.

9. Put the modules together: Connect the black edge of the TWR-MC-LV3PH and TWR-56F8200 modules into the black edge of the secondary Tower elevator using the corresponding connectors.

10. Power to TWR-56F8200 TWR card from TWR-MC-LV3PH: Reconfigure the TWR-56F8200 power selection module to power from "TWR-MC-LV3PH" by removing jumper from J11 and short pins 2 and 3 of connector J7 as shown in this figure.



11. Connect the motor and the power: Connect the motor three-prong cable to the three-prong connection on the TWR-MC-LV3PH. Connect the motor five-prong cable to the five-prong connection on the TWR-MC-LV3PH. The green wires of both the cables will be on the inside, facing each other.

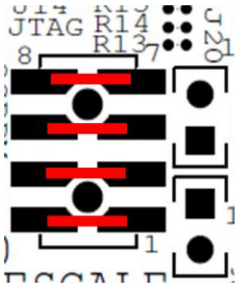
12. Power the motor: Plug in the included 24-volt power supply. Apply the resulting 24 volts to the barrel connector of the TWR-MC-LV3PH module only.

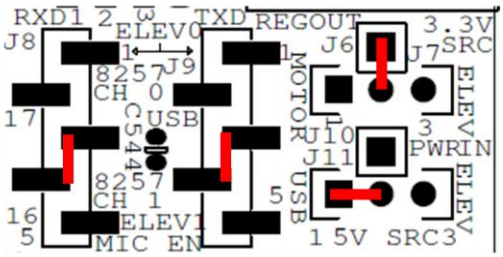
13. Adjust the motor speed: Use the motor speed buttons S1 and S2 on the TWR-56F8200 to change the speed of the motor in either a clockwise or counterclockwise direction. The S3 button resets MC56F82748 and will stop the motor. Pressing the two motor speed buttons at the same time will also safely stop the motor.

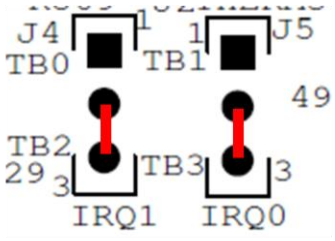
4.9 Programming the Tower System with LV_Motor Demo using OSBDM/OSJTAG

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Reconfigure the TWR-56F8200 module by removing all jumpers. Reconnect the ten pins shown in diagrams below in red to first program the TWR-56F8200 stand alone with "MC56F82748_TWR_LV_BLDC" source code.







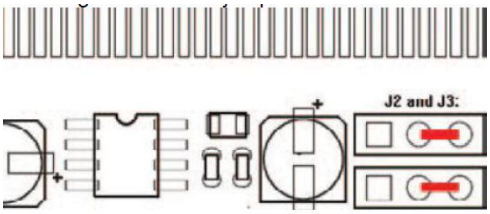
2. Power to TWR-56F8200 TWR card: Connect one end of the USB cable to TWR-56F8200 board and the other to computer for supplying power to the board.

3. Launch CodeWarrior: Import and run the MC56F82748_TWR_LV_BLDC project from the "MC56F827xxCodeExample" directory:

a) Create a new work area called "WS_8200" for example.
b) Choose File > Import. Expand "General", select "Existing Projects into Workspace" and then click Next.
c) On the "Select Root directory" radio button, click Browse and browse to the "MC56F827xxCodeExample".
d) A list of projects appears. Select MC56F827xxCode Example and click OK.
e) A list of all the selected projects will appear. Select MC56F82748_TWR_LV_BLDC and click the "Copy projects into workspace" button. Then, click Finish.
f) Clean and build MC56F82748_TWR_LV_BLDC project by choosing Project > Clean. Click the "Clean projects selected below" button and select MC56F82748_TWR_LV_BLDC. Select "Start a build immediately" and "Build only selected projects" checkboxes.
g) After the build completes, right-click the project and choose Debug As > Debug Configurations, and then select CodeWarrior Download.
h) Select SDM_OSJTAG as the choice of hardware for debugging.
i) In the Debug Configuration window, under the 'main' tab in the application, click "search project" and select MC56F82748_TWR_LV_BLDC.elf and click OK.
j) Click Debug on the right bottom of the window to load the program.
k) After the program loads, it will stop in the main program.
l) Click the resume icon to resume execution.

4. Disconnect the computer and power: Remove the USB cable from the TWR-56F8200.
Click OK on the pop-up window which appears while disconnecting USB cable.

5. Connect jumpers on TWR-MC-LV3PH module: Reconfigure the TWR-MC-LV3PH module by removing all wires and jumpers. Reconnect the two pins shown in red in this figure.

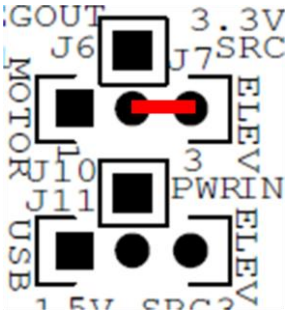


6. Assemble TWR-MC-LV3PH module: Connect the white edge of the TWR-MC-LV3PH module with the white edge of the primary Tower elevator.

7. Assemble TWR-56F8200 module: Connect the white edge of the TWR-56F8200 module with the white edge of the primary Tower elevator.

8. Put the modules together: Connect the black edge of the TWR-MC-LV3PH and TWR-56F8200 modules into the black edge of the secondary Tower elevator using the corresponding connectors.

9. Power to TWR-56F8200 TWR card from TWR-MC-LV3PH: Reconfigure the TWR-56F8200 power selection module to power from "TWR-MC-LV3PH" by removing jumper from J11 and short pins 2 and 3 of connector J7 as shown in this figure.



10. Connect the motor and the power: Connect the motor three-prong cable to the three-prong connection on the TWR-MC-LV3PH. Connect the motor five-prong cable to the five-prong connection on the TWR-MC-LV3PH. The green wires of both cables will be on the inside, facing each other.

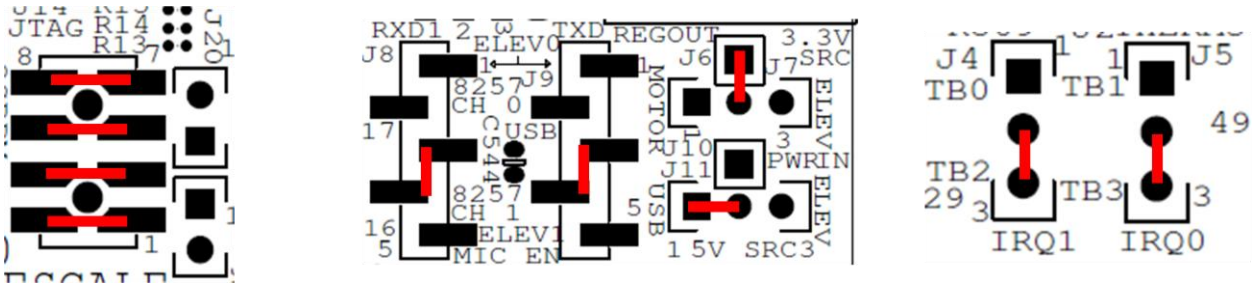
11. Power the motor: Plug in the included 24-volt power supply. Apply the resulting 24 volts to the barrel connector of the TWR-MC-LV3PH module only.

12. Adjust the motor speed: Use the motor speed buttons S1 and S2 on the TWR-56F8200 to change the speed of the motor in either a clockwise or counterclockwise direction. The S3 button resets MC56F82748 and will stop the motor. Pressing the two motor speed buttons at the same time will also safely stop the motor.

4.10 LV_Motor Spin demo controlled via FreeMASTER using Universal Multilink

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Reconfigure the TWR-56F8200 module by removing all jumpers. Reconnect the 10 pins shown in red in the following figure to first program the TWR-56F8200 standalone with "MC56F82748_TWR_LV_BLDC" source code.



2. Power to TWR-56F8200 TWR card: Connect one end of the USB cable to TWR-56F8200 board and other with computer for supplying the power to board.

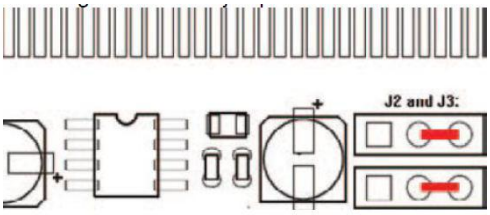
3. Connect programming /debugging tool: Connect P&E Universal multilink to TWR-56F8200 at JTAG connector J14, and make sure red wire of ribbon connector connects to Pin1 on J14. Connect other end of P&E Universal Multilink to computer USB port.

4. Launch CodeWarrior: Import and run the MC56F82748_TWR_LV_BLDC project from the "MC56F827xxCodeExample" directory:

a) Create a new work area called "WS_8200" for example.
b) Choose File > Import. Expand "General", select "Existing Projects into Workspace" and then click Next.
c) On the "Select Root directory" radio button, click Browse and browse to the "MC56F827xxCodeExample".
d) A list of project appears. Select MC56F827xxCode Example and click OK.
e) A list of all the selected projects will appear. Select MC56F82748_TWR_LV_BLDC and click the "Copy projects into workspace" button. Then, click Finish.
f) Clean and build "MC56F82748_TWR_LV_BLDC" project by choosing Project > Clean. Click the "Clean projects selected below" button and select MC56F82748_TWR_LV_BLDC. Select "Start a build immediately" and "Build only selected projects" checkboxes.
g) After the build completes, right-click the project and choose Debug As > Debug Configurations, and then select CodeWarrior Download.
h) Select SDM_PnE U-Multilink as the choice of hardware for debugging.
i) In the Debug Configuration window, under the 'main' tab in the application, click "search project" and select MC56F82748_TWR_LV_BLDC.elf and click OK.
j) Click Debug on the right bottom of the window to load the program.
k) After the program loads, it will stop in the main program.
l) Click the resume icon to resume execution.

5. Disconnect the computer and power: Remove the USB cable from the TWR-56F8200.
Remove the P&E U-Multilink from TWR-56F8200. Click OK on the pop-up window which appears while disconnecting USB cable.

6. Connect jumpers on TWR-MC-LV3PH module: Reconfigure the TWR-MC-LV3PH module by removing all wires and jumpers. Reconnect the two pins shown in red in the following figure.

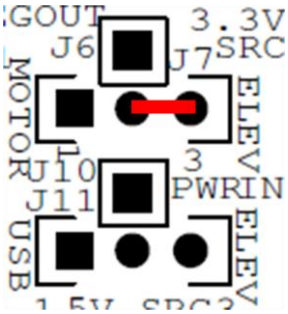


7. Assemble TWR-MC-LV3PH module: Connect the white edge of the TWR-MC-LV3PH module with the white edge of the primary Tower elevator.

8. Assemble TWR-56F8200 module: Connect the white edge of the TWR-56F8200 module with the white edge of the primary Tower elevator.

9. Put the modules together: Connect the black edge of the TWR-MC-LV3PH and TWR-56F8200 modules into the black edge of the secondary Tower elevator using the corresponding connectors.

10. Power to TWR-56F8200 TWR card from TWR-MC-LV3PH: Reconfigure the TWR-56F8200 power selection module to power from "TWR-MC-LV3PH" by removing jumper from J11 and short pins 2 and 3 of connector J7 as shown in this figure.



11. Connect the motor: Connect the motor three-prong cable to the three-prong connection on the TWR-MC-LV3PH. Connect the motor five-prong cable to the five-prong connection on the TWR-MC-LV3PH. The green wires of both cables will be on the inside, facing each other.

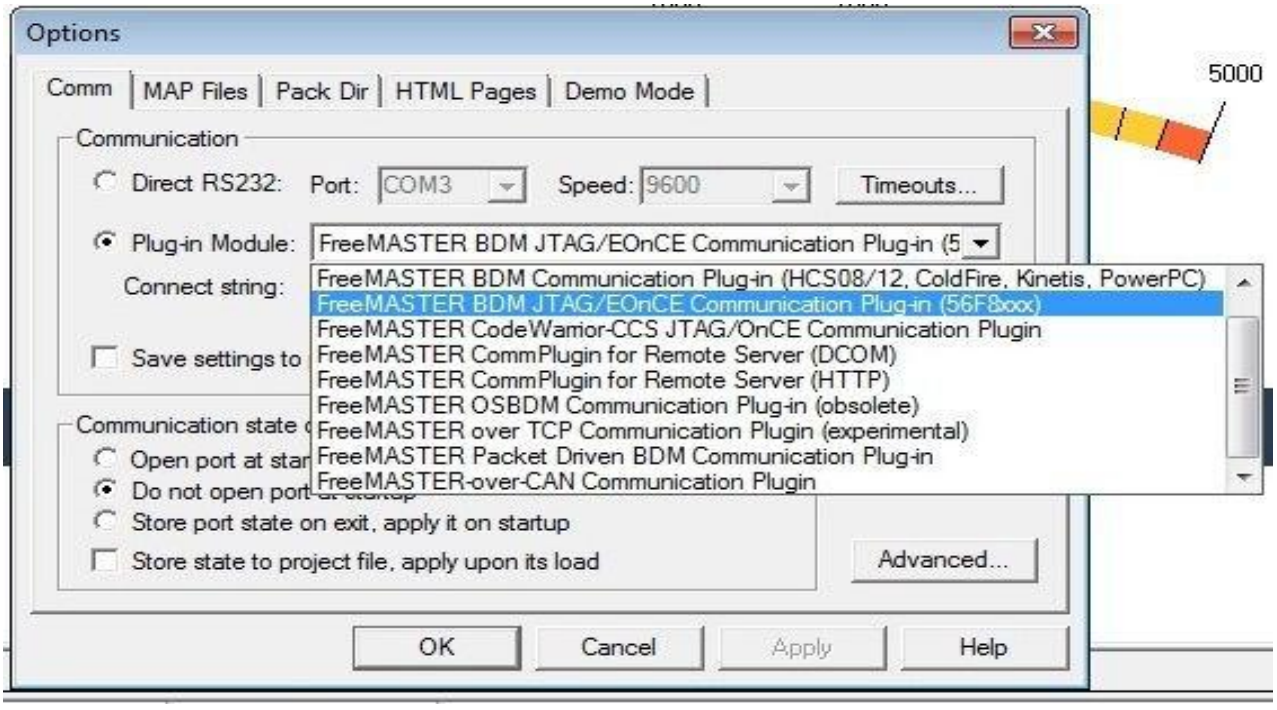
12. Connect programming /debugging tool: Connect P&E Universal multilink to TWR-56F8200 at JTAG connector J14, and make sure red wire of ribbon connector connects to Pin1 on J14. Connect other end of P&E Universal Multilink to computer USB port.

13. Power the motor: Plug in the included 24-volt power supply. Apply the resulting 24 volts to the barrel connector of the TWR-MC-LV3PH module only.

14. Open FreeMASTER: In CodeWarrior, under MC56F82748_TWR_LV_BLDC, click the FreeMASTER folder. Double click the BLDC_HS_demo_TWR56F8400.pmp file. It will open the FreeMASTER application.

15. FreeMASTER settings:

1. In the FreeMASTER application, click "Project select options"; this opens the Options window.
2. In the Communications (Comm) tab, select Plug-in Module and from the dropdown list, select “FreeMASTER BDM JTAG/EOnCE Communication Plug-in (56F8xxx)”. See the following figure.
3. Now, in the MAP Files tab, click the dotted button to locate the MC56F82748_TWR_LV_BLDC.elf file. This is located inside the MC56F82748_TWR_LV_BLDC project folder.
4. Click OK.



16. Make the connection: On the Menu bar of FreeMASTER, click the STOP button. The status of FreeMASTER at the rightmost corner changes from NOT CONNECTED to a display showing the connection details.

17. Adjust the motor speed

The motor can now be controlled from the graphical user interface shown on screen.

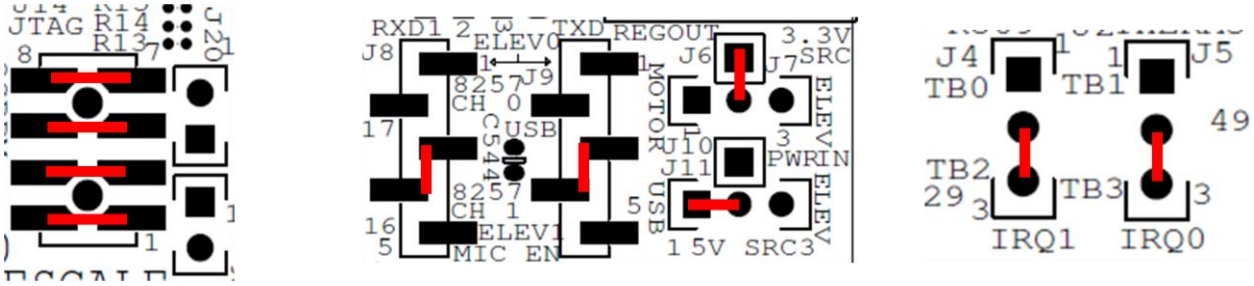
1. Change the position of needle to change the speed of the motor in either a clockwise or counter clockwise direction, or

2. Click the RUN/STOP button to Run position and provide desired speed in “Required Speed” column
3. Click the Demo switch to “on” position. This will run the demo code and the motor will run by speed and direction that are predefined in the source code.

4.11 LV_Motor Spin demo controller via FreeMASTER using OSBDM/ OSJTAG

Prerequisite: Download and install CodeWarrior Development Tools as mentioned in Software installation.

1. Connect jumpers on TWR-56F8200 module: Reconfigure the TWR-56F8200 module by removing all the jumpers. Reconnect the ten pins shown in red (in the following figure) to first program the TWR-56F8200 standalone with “MC56F82748_TWR_LV_BLDC” source code.



2. Power to TWR-56F8200 TWR card: Connect one end of the USB cable to TWR-56F8200 board and other with computer for supplying power to the board.

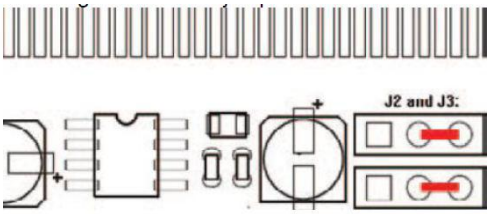
3. Launch CodeWarrior: Import and run the MC56F82748_TWR_LV_BLDC project from the “MC56F827xxCodeExample” directory:

a) Create a new work area called “WS_8200” for example.
b) Choose File > Import. Expand “General”, select “Existing Projects into Workspace” and then click Next.
c) On the “Select Root directory” radio button, click Browse and browse to the “MC56F827xxCodeExample”.
d) A list of projects will appear. Select MC56F827xxCode Example and click OK.
e) A list of all the selected projects will appear. Select MC56F82748_TWR_LV_BLDC and click the “Copy projects into workspace” button. Then, click Finish.
f) In the CW window, browse to the Project headers folder of the “MC56F82748_TWR_LV_BLDC” project directory. Open the *freemaster_cfg.h* file. In the file, modify “`#define FMSTR_USE_SCI 0`” to “`#define FMSTR_USE_SCI 1`” (line 23) and “`#define FMSTR_USE_JTAG 1`” to “`#define FMSTR_USE_JTAG 0`” (line 27). Save and close the file.
g) Clean and build “MC56F82748_TWR_LV_BLDC” project by choosing Project > Clean. Click the “Clean projects selected below" button and select MC56F82748_TWR_LV_BLDC. Select “Start a build immediately” and “Build only selected projects” checkboxes.
h) After the build completes, right-click the project and choose Debug As > Debug Configurations, and then select CodeWarrior Download.

i) Select SDM_OSJTAG as the choice of hardware for debugging.
j) In the Debug Configuration window, under the 'main' tab in the application, click "search project", select MC56F82748_TWR_LV_BLDC.elf and click OK.
k) Click Debug on the right bottom of the window to load the program.
l) After the program loads, it will stop in the main program.
m) Click the resume icon to resume execution.

4. Disconnect the computer and power: Remove the USB cable from the TWR-56F8200. Click "Ok" on the pop-up window which appears while disconnecting USB cable.

5. Connect jumpers on TWR-MC-LV3PH module: Reconfigure the TWR-MC-LV3PH module by removing all wires and jumpers. Reconnect the two pins shown in red in this figure.

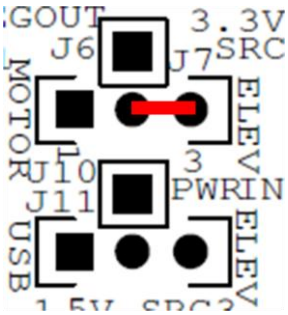


6. Assemble TWR-MC-LV3PH module: Connect the white edge of the TWR-MC-LV3PH module with the white edge of the primary Tower elevator.

7. Assemble TWR-56F8200 module: Connect the white edge of the TWR-56F8200 module with the white edge of the primary Tower elevator.

8. Put the modules together: Connect the black edge of the TWR-MC-LV3PH and TWR-56F8200 modules into the black edge of the secondary Tower elevator using the corresponding connectors.

9. Power to TWR-56F8200 TWR card from TWR-MC-LV3PH: Reconfigure the TWR-56F8200 power selection module to power from "TWR-MC-LV3PH" by removing jumper from J11 and short pins 2 and 3 of connector J7 as shown in this figure.



10. Connect the motor and the power: Connect the motor three-prong cable to the three-prong connection on the TWR-MC-LV3PH. Connect the motor five-prong cable to the five-prong connection on the TWR-MC-LV3PH. The green wires of both cables will be on the inside, facing each other.

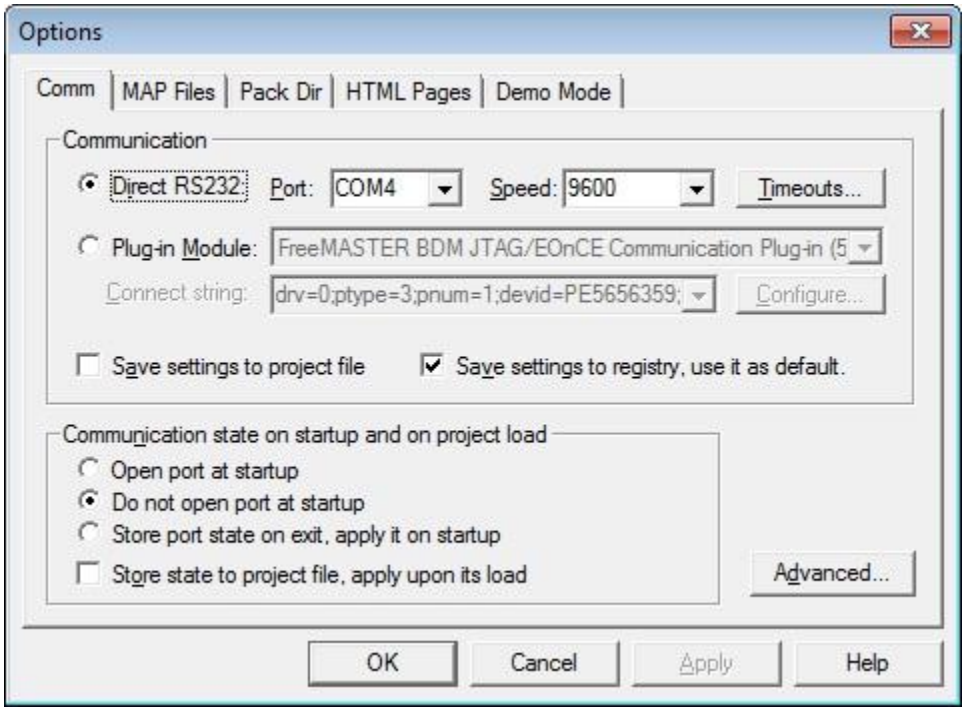
11. Connect programming /debugging tool: Connect the USB cable to the TWR-56F8200 and computer.

12. Power the motor: Plug in the included 24-volt power supply. Apply the resulting 24 volts to the barrel connector of the TWR-MC-LV3PH module only.

13. Open FreeMASTER: In CodeWarrior under MC56F82748_TWR_LV_BLDC, click the FreeMASTER folder. In this folder, double click the BLDC_HS_demo_TWR56F8200.pmp file. This will open FreeMASTER tool.

14. FreeMASTER settings:

1. In FreeMaster application, choose Project > Options. It will open the Options window.
2. Click the Communications (Comm) tab, and select Direct RS232.
3. In the Port section, select the correct COM port (for example, COM2). The appropriate COM port can be found as OSBDM/OSJTAG—CDC serial port in the Ports section of Device manager (MS Windows utility) of your system.
4. In the Speed section, select 9600.
5. In the MAP Files tab, click the dotted button to locate the MC56F82748_TWR_LV_BLDC.elf file which is located inside MC56F82748_TWR_LV_BLDC project folder. See the following figure.
6. Press OK.



15. Make the connection: On the Menu bar of FreeMASTER, click the STOP button. The status of FreeMASTER at rightmost corner must change from NOT CONNECTED to a display showing the connection details.

16. Adjust the motor speed: The motor can now be controlled via the graphical user interface shown on screen.

a) Change the position of needle to change the speed of the motor in either a clockwise or counter clockwise direction, or
b) Click the RUN/STOP button to Run position and provide desired speed in "Required Speed" column
c) Click the Demo switch to "on" position. This will run the demo code and the motor will run by speed and direction that are pre-defined in the source code.

5 Revision history

Revision number	Date	Changes
1	10/2013	Initial public release

6 Appendix A – Tower system elevator connector pin functions

Table 7 provides the pin out for the Primary Elevator Connector. An "**X**" in the "Used" column indicates that there is a connection from the TWR-56F8200 board to that pin on the Elevator connector. An "**X**" in the "Jmp" column indicates that a jumper is available that can isolate the onboard circuitry from the Elevator connector.

The function listed in the "Usage" column is the function(s) that the pin is expected to provide when used with the Tower system. All of the MC56F82748 pins (except power) have multiple functions. Not all of the possible functions are shown.

Note that all analog pins (ANAn or ANBn) have a low-pass filter to ground consisting of a 100 ohm resistor and a 2200 pF capacitor. This is to protect the analog inputs of the DSC from a static discharge at one of the connectors. See schematic sheets 6 and 7 in Appendix B—TWR-56F8200 board schematic.

Table 7. TWR-56F8200 Primary Elevator connector pinout

Primary Elevator Connector									
Pin	Name	Usage	Used	Jmp	Pin	Name	Usage	Used	Jmp
B1	5V_1	5V Power	X	X	A1	5V_2	5V Power	X	X
B2	GND	Ground	X		A2	GND_9	Ground	X	

B3	**3.3V_1**	**3.3V Power**	**X**	**X**	A3	**3.3V_4**	**3.3V Power**	**X**	**X**
B4	ELE_PS_SENSE_1	**(must not be connected)**	**X**	**X**	A4	**3.3V_5**	**3.3V Power**	**X**	**X**
B5	**GND_2**	**Ground**	**X**		A5	**GND_10**	**Ground**	**X**	
B6	**GND_3**	**Ground**	**X**		A6	**GND_11**	**Ground**	**X**	
B7	SDHC_CLK / SPI1_CLK	SCK (see also pin B48)	**X**		A7	I2C0_SCL	SCL0	**X**	
B8	SDHC_D3 / SPI1_CS1_b				A8	I2C0_SDA	SDA0	**X**	
B9	SDHC_D3 / SPI1_CS0_b	SS_B (see also pin B46)	**X**		A9	GPIO9/UART1_CTS1	GPIOA4/ANA4	**X**	X
B10	SDHC_CMD / SPI1_MOSI	MOSI (see also pin B45)	**X**		A10	GPIO8/SDHC_D2	GPIOA5/ANA5	**X**	X
B11	SDHC_D0 / SPI1_MISO	MISO (see also pin B44)	**X**		A11	GPIO7 / SD_WP_DET	GPIOA6/ANA6	**X**	X
B12	ETH_COL_1				A12	ETH_CRS			
B13	ETH_RXER_1				A13	ETH_MDC_1			
B14	ETH_TXCLK_1				A14	ETH_MDIO_1			
B15	ETH_TXEN_1				A15	ETH_RXCLK_1			
B16	ETH_TXER				A16	ETH_RXDV_1			
B17	ETH_TXD3				A17	ETH_RXD3			
B18	ETH_TXD2				A18	ETH_RXD2			
B19	ETH_TXD1_1				A19	ETH_RXD1_1			
B20	ETH_TXD0_1				A20	ETH_RXD0_1			
B21	GPIO1 / UART1_RTS1	GPIOB4/ANB4&CMPC_M1	**X**	X	A21	I2S0_MCLK			
B22	GPIO2 / SDHC_D1	GPIOB5/ANB5&CMPC_M2	**X**	X	A22	I2S0_DOUT_SCLK			
B23	GPIO3	GPIOB6/ANB6&CMPB_M1	**X**	X	A23	I2S0_DOUT_WS			
B24	CLKIN0	XTAL&CLKIN	**X**	X	A24	I2S0_DOUT_DIN0			
B25	CLKOUT1				A25	I2S0_DOUT_DOUT0			
B26	**GND_4**	**Ground**	**X**		A26	**GND_12**	**Ground**	**X**	
B27	AN7	ANB3&CMPC_M0	**X**		A27	AN3	ANA3&CMPA_M2	**X**	X
B28	AN6	ANB2&CMPC_P2	**X**		A28	AN2	ANA2&CMPA_M1	**X**	
B29	AN5	ANB1&VERFLB&CMPB_M0	**X**		A29	AN1	ANA1&VREFLA&CMPA_M0	**X**	
B30	AN4	ANB0&VERFHB&CMPB_P2	**X**		A30	AN0	ANA0&VREFHA&CMPA_P2/CMPC_O	**X**	
B31	**GND_5**	**Ground**	**X**		A31	**GND_13**	**Ground**	**X**	
B32	DAC1				A32	DAC0	DAC0	**X**	
B33	TMR3	TA3	**X**		A33	TMR1	TA1	**X**	
B34	TMR2	TA2	**X**		A34	TMR0	TA0	**X**	
B35	GPIO4	GPIOB7/ANB7&CMPB_M2	**X**	X	A35	GPIO6	GPIOA7/ANA7	**X**	X
B36	**3.3V_2**	**3.3V Power**	**X**	**X**	A36	**3.3V_6**	**3.3V Power**	**X**	**X**
B37	PWM7	PWM3B	**X**		A37	PWM3	PWM1B	**X**	
B38	PWM6	PWM3A	**X**		A38	PWM2	PWM1A	**X**	
B39	PWM5	PWM2B	**X**		A39	PWM1	PWM0B	**X**	
B40	PWM4	PWM2A	**X**		A40	PWM0	PWM0A	**X**	

B41	CAN0_RX0	CANRX	X	X	A41	UART0_RX	ELEV_RXD0 (see also pin B61)	X	X
B42	CAN0_TX0	CANTX	X	X	A42	UART0_TX	ELEV_TXD0 (see also pin B62)	X	X
B43	1WIRE				A43	UART1_RX	ELEV_RXD1	X	X
B44	SPI0_MISO/IO1	MISO (see also pin B11)	X		A44	UART1_TX	ELEV_TXD1	X	X
B45	SPI0_MOSI/IO0	MOSI (see also pin B10)	X		A45	VSSA			
B46	SPI0_CS0_b	SS_B (see also pin B9)	X		A46	VDDA			
B47	SPI0_CS1_b				A47	CAN1_RX			
B48	SPI0_CLK	SCK (see also pin B7)	X		A48	CAN1_TX			
B49	**GND_6**	**Ground**	X		A49	**GND_14**	**Ground**	X	
B50	I1C1_SCL1	SCL1	X		A50	GPIO14			
B51	I2C1_SDA1	SDA1	X		A51	GPIO15			
B52	GPIO5/SPI0_HOLD/IO3	GPIOF0	X		A52	GPIO16/SPI0_WP/IO2			
B53	RSRV_B53				A53	GPIO17			
B54	RSRV_B54				A54	USB0_DM			
B55	IRQ_H				A55	USB0_DP			
B56	IRQ_G				A56	USB0_ID			
B57	IRQ_F				A57	USB0_VBUS			
B58	IRQ_E				A58	I2S0_DIN_SCK	TB3	X	X
B59	IRQ_D				A59	I2S0_DIN_WS	TB2	X	X
B60	IRQ_C				A60	I2S0_DIN1			
B61	IRQ_B	TB1 (see also pin A41)	X	X	A61	I2S0_DOUT1			
B62	IRQ_A	TB0 (see also pin A42)	X	X	A62	RSTIN_b	RESET_B		
B63	EBI_ALE / EBI_CS1_b				A63	RSTOUT_b	RESET_B		
B64	EBI_CS0_b				A64	CLKOUT0	CLKO		
B65	**GND_7**	**Ground**	X		A65	**GND_15**	**Ground**		
B66	EBI_AD15				A66	EBI_AD14			
B67	EBI_AD16				A67	EBI_AD13			
B68	EBI_AD17				A68	EBI_AD12			
B69	EBI_AD18				A69	EBI_AD11			
B70	EBI_AD19				A70	EBI_AD10			
B71	EBI_R/ W_b				A71	EBI_AD9			
B72	EBI_OE_b				A72	EBI_AD8			
B73	EBI_D7				A73	EBI_AD7			
B74	EBI_D6				A74	EBI_AD6			
B75	EBI_D5				A75	EBI_AD5			
B76	EBI_D4				A76	EBI_AD4			
B77	EBI_D3				A77	EBI_AD3			
B78	EBI_D2				A78	EBI_AD2			
B79	EBI_D1				A79	EBI_AD1			
B80	EBI_D0				A80	EBI_AD0			
B81	**GND_8**	**Ground**	X		A81	**GND_16**	**Ground**		
B82	**3.3V_3**	**3.3V Power**	X	X	A82	**3.3V_7**	**3.3V Power**		

7 Appendix B—TWR-56F8200 board schematic

The schematic is available as a standalone pdf at: freescale.com/TWR-56F8200 under the “Downloads” tab then within the “Hardware Development Tools” section.

8 Appendix C—TWR-56F8200 board BOM

Qty	Reference	Description	Mfg. name	Mfg. part number
7	C1,C2,C506,C516,C520,C540,C541	CAP CER 10UF 16V 10% X5R 0805	AVX	0805YD106KAT2A
23	C3,C4,C8,C500,C501,C503,C505,C509,C510,C513,C514,C515,C530,C532,C533,C535,C536,C537,C538,C539,C542,C543,C544	CAP CER 0.10UF 25V 10% X7R 0603	KEMET	C0603C104K3RAC
2	C5,C6	CAP CER 22PF 50V 5% C0G 0805	KEMET	C0805C220J5GAC
2	C7,C9	CAP CER 18PF 50V 5% C0G 0603	YAGEO AMERICA	CC0603JRNPO9BN180
15	C502,C504,C507,C512,C517,C518,C519,C521,C522,C523,C524,C525,C526,C527,C528	CAP CER 2200PF 50V 10% X7R 0402	MURATA	GRM155R71H222KA01D
2	C508,C511	CAP CER 2.2UF 10V 10% X5R 0603	TDK	C1608X5R1A225K
2	C529,C531	CAP CER 0.47UF 25V 10% X7R 0805	VENKEL COMPANY	C0805X7R250-474KNE
1	C534	CAP CER 1000PF 50V 5% C0G 0603	MURATA	GRM1885C1H102JA01D
6	D1,D3,D5,D7,D10,D12	LED YEL/GRN SGL 25MA SMD 0603	DIALIGHT	598-8060-107F
5	D2,D4,D6,D8,D13	LED YEL SGL 30MA SMT 0603	KINGBRIGHT	AP1608SYCK

1	D9	LED AMBER SGL 25MA 0603	AVAGO TECHNOLOGIES	HSMA-C190
1	D11	DIODE ZNR 200W 12V SOD-123	ON Semiconductor	SMF12AT1G
1	D500	DIODE SCH PWR RECT 1A 30V SOD-123	ON Semiconductor	MBR130LSFT1G
1	D501	DIODE SCH DUAL CC 200MA 30V SOT23	Fairchild	BAT54C
1	F1	FUSE PLYSW 1.1A 0.48 OHM SMT	TYCO ELECTRONICS	SMD100F-2
5	J1,J2,J16,J19,J23	HDR 2X2 SMT 100MIL CTR 400H AU	Samtec	TSM-102-01-L-DV-P-TR
1	J3	CON 1 PWR PLUG RA TH 1A -- 430H NI	SWITCHCRAFT	RAPC722X
4	J4,J5,J7,J11	HDR 1X3 TH 100MIL SP 339H AU 100L	SAMTEC	TSW-103-07-G-S
2	J6,J10	HDR 1X1 TH -- 350H AU 100L	Samtec	TSW-101-07-L-S
2	J8,J9	HDR 1X5 SMT 100MIL SP 380H AU	Samtec	TSM-105-01-L-SV-P-TR
1	J12	HDR 1X2 TH 100MIL SP 339H AU 98L	SAMTEC	TSW-102-07-G-S
1	J13	HDR 2X5 SMT 100MIL CTR 400H AU	Samtec	TSM-105-01-L-DV-A-P-TR
1	J14	HDR 2X7 SMT 2.54MM SP 397H AU	Samtec	TSM-107-01-L-DV-P-TR
3	J15,J17,J20	HDR 1X2 TH 100MIL SP 339H AU 98L	SAMTEC	TSW-102-07-G-S
1	J18	CON 1X5 USB_MINI_B 32MILS AU SMT	SAMTEC	MUSB-05-F-B-SM-A
1	J21	HDR 2X4 SMT 100MIL CTR 400H AU	Samtec	TSM-104-01-L-DV-A-P-TR
1	J22	HDR 2X3 SMT 100MIL CTR 414H AU	SAMTEC	TSM-103-01-L-DV-P-TR

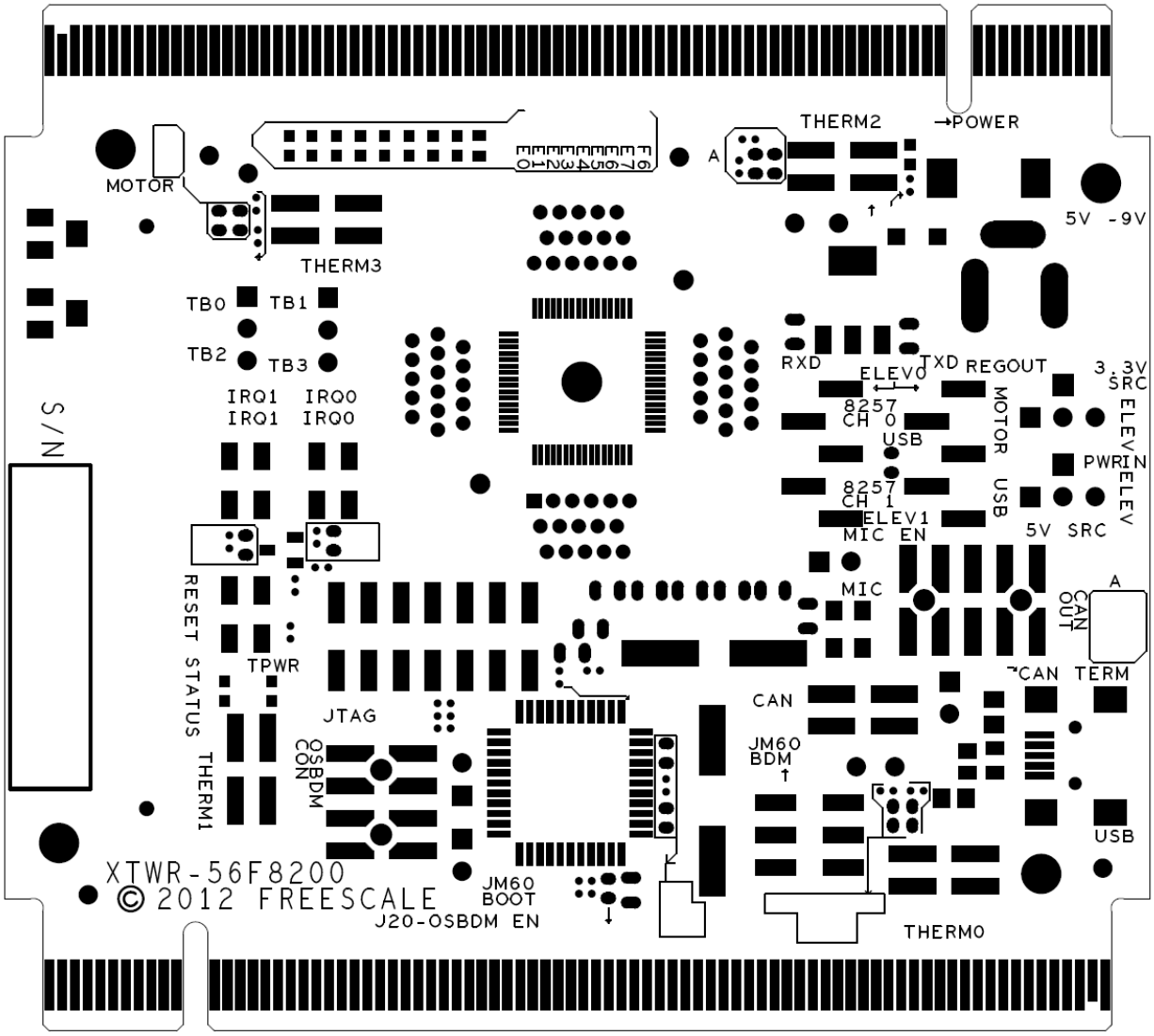
1	J500	CON DUAL 2X82 Edge PCI Express SMT 1MM SP 591H FOR TOWER SYSTEM NOT A PART TO ORDER	NA	EDGE PCI EXPRESS 164
1	J501	CON 2X20 SMT SKT 100MIL CTR 307H AU	SAMTEC	SSM-120-L-DV-BE
1	J502	CON 2X13 SKT SMT 100MIL CTR 300H AU	SAMTEC	SSM-113-L-DV-TR
2	L1,L2	IND FER BEAD 330OHM@100MHZ 2.5A -- SMT	TDK	MPZ2012S331A
2	L500,L501	IND 600 OHM@100MHZ 0.2A 25% 0603 SMT	MURATA	BLM18BD601SN1D
1	Q1	TRAN NPN GEN 200MA 40V SOT-23	ON SEMICONDUCTOR	MMBT3904LT1G
1	Q3	TRAN NPN W/RES 100MA 50V SOT346	PHILIPS SEMICONDUCTOR	PDTC115TK
4	RT1,RT2,RT3,RT4	THERMISTOR 10K 1/10W 1% 0603	MuRata	NCP18XH103F03RB
1	R1	RES MF 270 OHM 1/16W 5% 0402	VISHAY INTERTECHNOLOGY	CRCW0402270RJNED
15	R2,R3,R8,R9,R11,R12,R13,R14,R15,R554,R555,R561,R570,R574,R575	RES MF 10.0K 1/16W 1% 0402	VISHAY INTERTECHNOLOGY	CRCW040210K0FKED
3	R4,R10,R568	RES MF ZERO OHM 1/8W -- 0805	YAGEO AMERICA	RC0805JR-070RL
4	R5,R7,R18,R19	RES MF ZERO OHM 1/8W -- 0805	YAGEO AMERICA	RC0805JR-070RL
1	R6	RES MF 1.0M 1/8W 1% 0805	VENKEL COMPANY	CR0805-8W-1004FSNT
1	R16	RES MF 10M 1/16W 1% 0402	KOA SPEER	RK73H1ETTP1005F
2	R17,R20	RES POT 100K 1/4W 10% 5 TURNS WSH SMT	BOURNS	3214W-1-104E

9	R500,R501,R502,R503,R504,R507,R556,R558,R559	RES MF 330 OHM 1/16W 1% 0402	VISHAY INTERTECHNOLOGY	CRCW0402330RFK
2	R505,R506	RES MF 158K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP1583F
6	R508,R509,R562,R569,R571,R576	RES MF 4.99K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP4991F
40	R510,R511,R512,R513,R514,R515,R516,R517,R518,R519,R520,R521,R522,R523,R524,R525,R526,R529,R530,R531,R532,R533,R534,R535,R537,R538,R540,R541,R542,R543,R544,R545,R546,R547,R548,R549,R550,R551,R552,R553	RES MF 100 OHM 1/16W 1% 0402	THYE MING TECH CO LTD	CR-02FL6--100R
2	R527,R528	RES MF 1.0K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP1001F
1	R536	RES MF 100 OHM 1/16W 1% 0402	THYE MING TECH CO LTD	CR-02FL6--100R
1	R539	RES MF 100OHM 1/8W 1% 0805	VENKEL COMPANY	CR0805-8W-1000FT
3	R557,R563,R564	RES MF 1.0K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP1001F
1	R560	RES MF 120 OHM 1/16W 1% 0402	VISHAY INTERTECHNOLOGY	CRCW0402120RFKED
1	R565	RES MF 2.2K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP2201F
2	R566,R567	RES MF 53.6K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP5362F
2	R572,R573	RES MF 33.0 OHM 1/16W 1% 0402	THYE MING TECH CO LTD	CR-02FL6---33R
3	SW1,SW2,SW3	SW SMT 4.0MM FMS 0.1A MAX 16V MAX ROHS COMPLIANT	BOURNS	7914J-1-000E

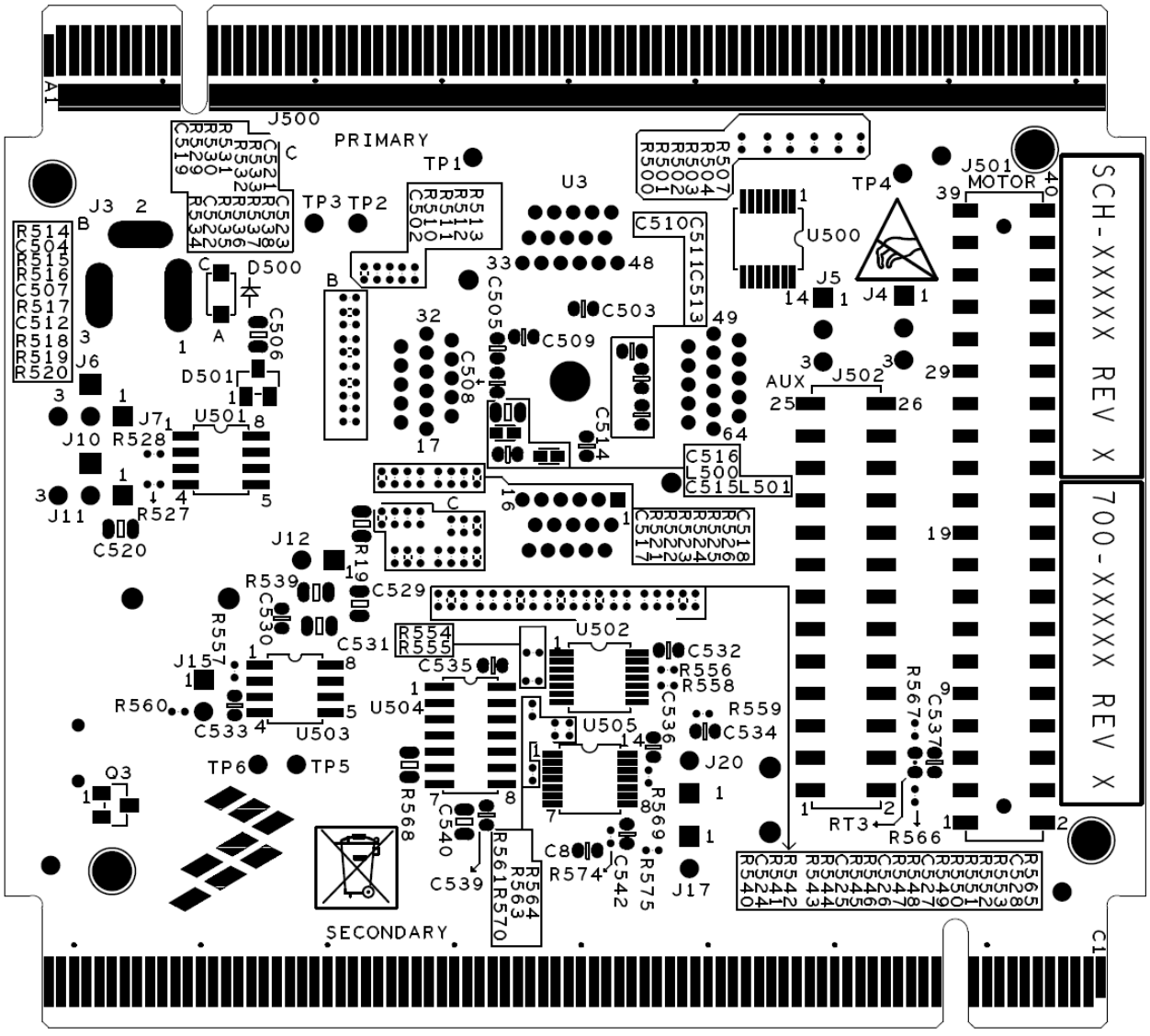
5	TP1,TP2,TP3,TP5,TP6	TEST POINT BLACK 40 MIL DRILL 180 MIL TH 109L	COMPONENTS CORPORATION	TP-105-01-00
1	TP4	TEST POINT BLACK 40 MIL DRILL 180 MIL TH 109L	COMPONENTS CORPORATION	TP-105-01-00
1	U1	IC VREG LDO 3.3V 0.7A 4.3-20V SOT-223	LINEAR TECHNOLOGY	LT1129CST-3.3#PBF
1	U2	IC CTLER DSP 32BIT 2.7-3.3V LQFP64	FREESCALE SEMICONDUCTOR	PC56F82748MLH
1	U3	SUBASSEMBLY, IC CTLER DSP 32BIT 2.7-3.3V LQFP64 + SKT 64 QFP TH 0.5MM 847H AU 87L	SUBASSEMBLY	312-80379,210-79953
1	U4	MICROPHONE MINI SISONIC 300 OHM 59DB 1.5-3.6V SMT	Knowles Acoustics	SPM0408HE5H-SB
1	U5	DIODE TVS ARRAY 3CH --5V 0.225W SOT143	LITTELFUSE	SP0503BAHTG
1	U6	IC MCU 8BIT 60K FLASH 48MHZ 2.7-5.5V LQFP44	FREESCALE SEMICONDUCTOR	MC9S08JM60CLD
2	U500,U502	IC GATE HEX INV --TSSOP14	TEXAS INSTRUMENTS	SN74LVC04APWE4_
1	U501	IC LIN SW PWR ACTIVE HIGH DUAL 2.7V-5.5V 0.5A SOIC8	MICREL	MIC2026-1YM
1	U503	IC XCVR CAN 1MBAUD 5V S08	PHILIPS SEMICONDUCTOR	PCA82C250TD
1	U504	IC BUF QUAD TS 4.5-5.5V SOIC14	Texas Instruments	SN74HCT125D

1	U505	IC BUF QUAD TS 1.65-3.6V TSSOP14	TEXAS INSTRUMENTS	SN74LVC125APWG4
1	Y1	XTAL 8.000MHZ SER SMT	Citizen	HCM49-8.000MABJ-UT
1	Y2	XTAL 4MHZ -- 18PF 20PPM SMT	ABRACON CORP	ABLS-4.000MHZ-B2-T

9 Appendix D—TWR-56F8200 board jack layout (top view)



10 Appendix E—TWR-56F8200 board jack layout (bottom view)



with

How to Reach Us:

Home Page:
freescale.com

Web Support:
freescale.com/support

Information in this document is provided solely to enable system and software implementers to use Freescale products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits based on the information in this document. Freescale reserves the right to make changes without further notice to any products herein.

Freescale makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. “Typical” parameters that may be provided in Freescale data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including “typicals,” must be validated for each customer application by customer’s technical experts. Freescale does not convey any license under its patent rights nor the rights of others. Freescale sells products pursuant to standard terms and conditions of sale, which can be found at the following address: freescale.com/SalesTermsandConditions.

Freescale, the Freescale logo, and CodeWarrior are trademarks of Freescale Semiconductor, Inc., Reg. U.S. Pat. & Tm. Off. Tower is a registered trademark of Freescale Semiconductor Inc. All other product or service names are the property of their respective owners.

© 2013 Freescale Semiconductor, Inc.

Document Number TWR56F8200UG

Revision Number 1, October 2013