Freescale Semiconductor
User's Guide

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TWR-MC36XSDEVB Tower System Platform

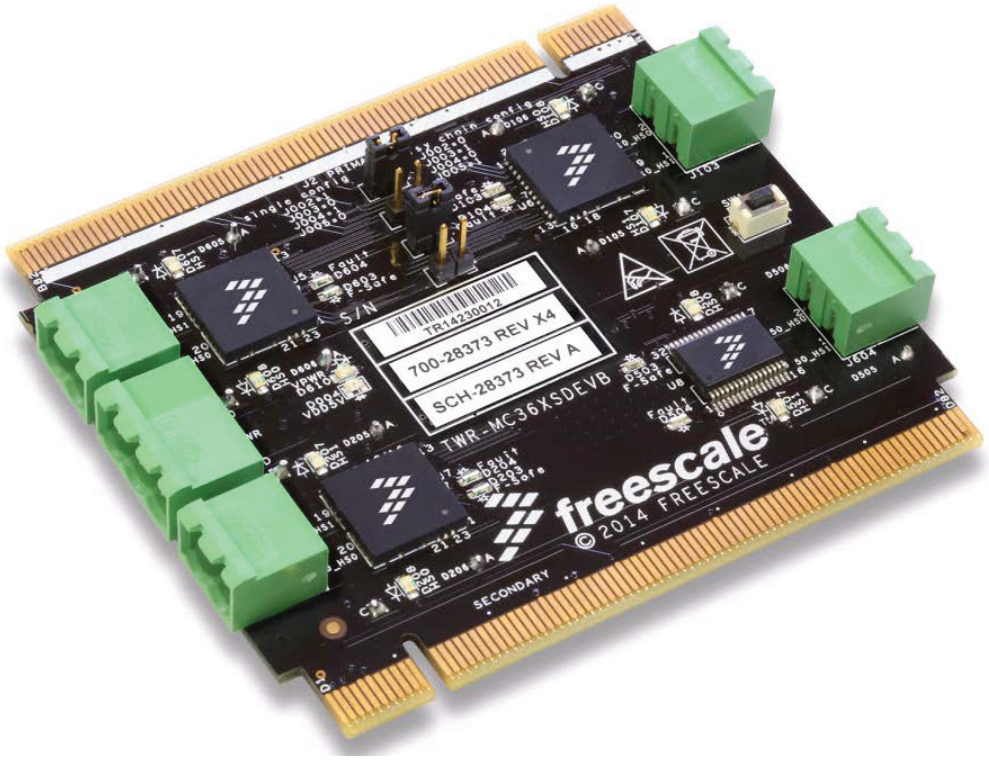

Figure 1. TWR-MC36XSDEVB

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1 Important Notice

Freescale provides the enclosed product(s) under the following conditions:

This evaluation kit is intended for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY. It is provided as a sample IC pre-soldered to a printed circuit board to make it easier to access inputs, outputs, and supply terminals. This EVB may be used with any development system or other source of I/O signals by simply connecting it to the host MCU or computer board via off-the-shelf cables. This EVB is not a Reference Design and is not intended to represent a final design recommendation for any particular application. Final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

The goods provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end product incorporating the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. In order to minimize risks associated with the customers applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact Freescale sales and technical support services.

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2 Getting Started

2.1 Kit Contents/Packing List

The TWR-MC36XSDEVB contents include:

- Plug-in connectors

2.2 Jump Start

Freescale's analog product development boards help to easily evaluate Freescale products. These tools support analog mixed signal and power solutions including monolithic ICs using proven high-volume SMARTMOS mixed signal technology, and system-in-package devices utilizing power, SMARTMOS and MCU dies. Freescale products enable longer battery life, smaller form factor, component count reduction, ease of design, lower system cost and improved performance in powering state of the art systems.

- Go to www.freescale.com/analogtools
- Locate your kit
- Review your Tool Summary Page
- Look for

- Download documents, software, and other information

Once the files are downloaded, review the user guide in the bundle. The user guide includes setup instructions, BOM and schematics. Jump start bundles are available on each tool summary page with the most relevant and current information. The information includes everything needed for design.

2.3 Required Equipment and Software

To use this kit, you need:

- Power supply 8.0 V - 36 V with current limit set initially to 1.5 A - 9. A
- Oscilloscope (preferably 4-channel) with current probe(s) (optional)
- Digital multimeter
- FRDM-KL25Z Development Platform
- Typical loads (DC motor, bulbs)
- TWR-K70F120M MCU Tower board: http://www.freescale.com/TWR-K70F120M
- CodeWarrior for MCUs (Eclipse IDE) family installed: http://www.freescale.com/CodeWarrior
- PE Micro's OSBDM/OSJTAG Tower Toolkit (REV 0): http://cache.freescale.com/files/microcontrollers/hardware_tools/PE_OSBDM_OSJTAG_TOWER_TOOLKIT.exe

2.4 System Requirements

The kit requires the following to function properly with the software:

- USB-enabled PC with Windows® XP or higher

3 Understanding the Platform

Freescale's Tower System peripheral module is designed to be combined and used with other Tower System modules.

The Freescale Tower System is a modular development platform for 8-, 16-, and 32-bit MCUs and MPUs enabling advanced development through rapid prototyping. Featuring more than fifty development boards or modules, the Tower System provides designers with building blocks for entry-level to advanced MCU development.
TWR-MC36XSDEVB works depend Tower System and need a MCU board to drive it via Elevator Board.

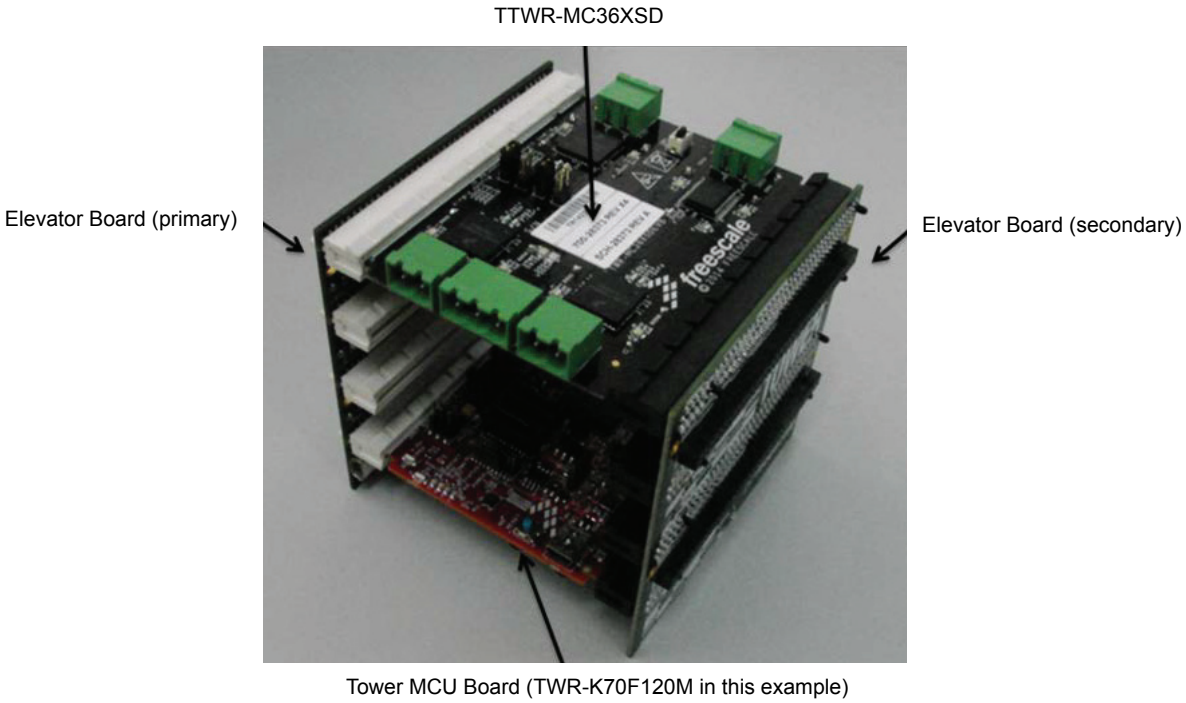

Figure 2. TWR-MC36XSDEVB on Tower System Overview (without load)

3.1 Block Diagram

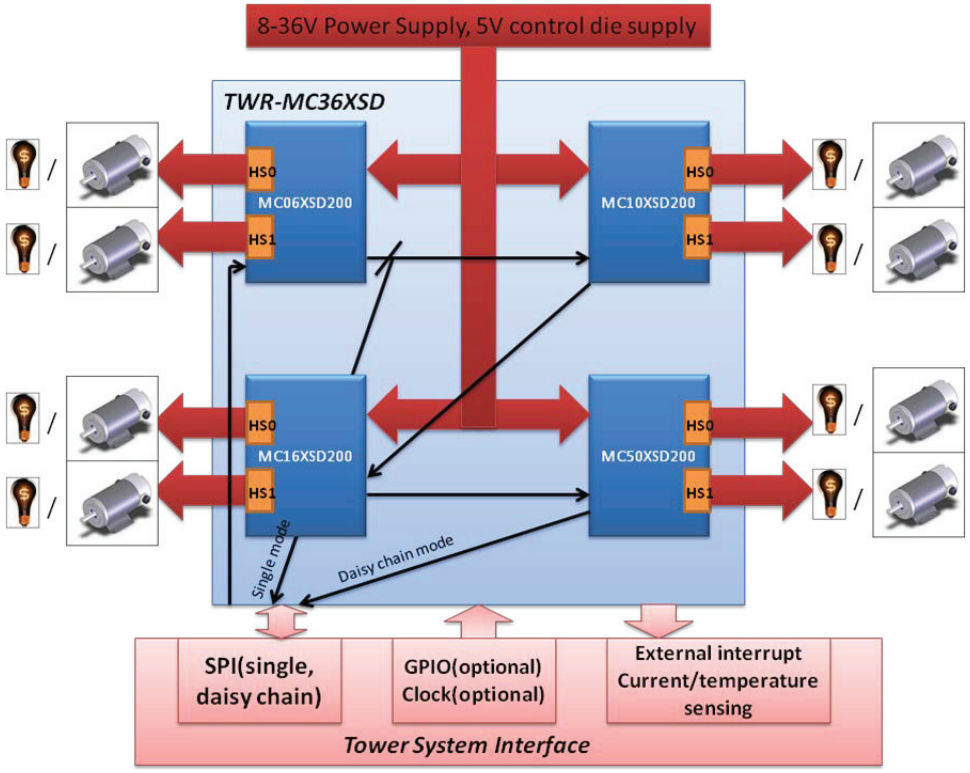

Figure 3. Block Diagram

3.1.1 Device Features

This reference design/evaluation board features the following Freescale products:

Table 1. Device Features

Device	Description	Features
MC06XSD200	Extreme Switch	• Normal operating range: 8.0 V - 36 V, extended range: 6.0 V - 58 V, 3.3 V and 5.0 V compatible 16-bit SPI port for device control, configuration, and diagnostics at rates up to 8.0 MHz • Two fully-protected 6.0 mOhm (at 25 °C) high side switches • Up to 9.0 A steady-state current per channel • Separate bulb and DC motor latched overcurrent handling • Parallel output operating mode with improved switching synchronization • Individually programmable internal/external PWM clock signals (switching frequency, duty cycle, slew rate, switch-on time-shift) • Overcurrent, short-circuit, and overtemperature protection with programmable auto-retry functions • Accurate temperature and current sensing (high/low sensing ratios/offset compensation) • OpenLoad detection (channel in OFF and ON state), also for LED applications (7.0 mA typ.)
MC10XSD200	Extreme Switch	• Normal operating range: 8.0 V - 36 V, extended range: 6.0 V - 58 V • Two fully protected 10 mOhm at 25 °C) high-side switches • Up to 6.0 A steady state current per channel • Separate bulb and DC motor latched overcurrent handling • Individually programmable internal/external PWM clock signals • Overcurrent, short-circuit, and overtemperature protection with programmable autoretry functions • Accurate temperature and current sensing • OpenLoad detection (channel in OFF and ON state), also for LED applications (7.0 mA typ.) • 3.3 V and 5.0 V compatible 16-bit SPI port for device control, configuration and diagnostics at rates up to 8.0 MHz

Table 1. Device Features (continued)

Device	Description	Features
MC16XSD200	Extreme Switch	• Normal operating range: 8.0 V - 36 V, extended range: 6.0 - 58 V • Two fully-protected 16 mOhm (at 25 °C) high side switches • Up to 3.0 A steady-state current per channel • Separate bulb and DC motor latched overcurrent handling • Individually programmable internal/external PWM clock signals • Overcurrent, short-circuit, and overtemperature protection with programmable autoretry functions • Accurate temperature and current sensing • OpenLoad detection (channel in OFF and ON state), also for LED applications (7.0 mA typ.) • 3.3 V and 5.0 V compatible 16-bit SPI port for device control, configuration and diagnostics at rates up to 8.0 MHz
MC50XSD200	Extreme Switch	• Normal operating range: 8.0 V - 36 V, extended range: 6.0 V - 58 V • Up to 1.2 A steady-state current per channel • Separate bulb and DC motor latched overcurrent handling • Individually programmable internal/external PWM clock signals • Overcurrent, short-circuit, and overtemperature protection with programmable autoretry functions • Accurate temperature and current sensing • OpenLoad detection (channel in OFF and ON state), also for LED applications (7.0 mA typ.) • 3.3 V and 5.0 V compatible 16-bit SPI port for device control, configuration and diagnostics at rates up to 8.0 MHz

4 Getting to Know the Hardware

4.1 Board Overview

The TWR-MC36XSDEVB is an easy-to-use circuit board allowing the user to exercise functions of the for ESwitch product base on Tower System. Tower System will mirror a debug port and communication port to PC that can be used to debug/download program from CodeWarrior system.

4.2 Board Features

- Four Extreme Switch devices on the module for the Tower System: MC06XSD200, MC10XSD200, MC16XSD200, MC50XSD200
- Normal operating range: 8.0 V - 36 V, extended range: 6.0 V - 58 V, 3.3 V and 5.0 V compatible 16-bit SPI port for device control, configuration, and diagnostics at rates up to 8.0 MHz
- Up to 1.5 A - 9.0 A steady-state current per channel
- Each ESwitch device has Two fully protected high side switches
- Controllable by any processor module with an single SPI interface or jumper selected daisy chain
- Individually programmable internal/external PWM clock signals for each channel
- Overcurrent, short-circuit, and overtemperature protection with programmable auto-retry functions
- Accurate temperature and current sensing
- OpenLoad detection (channel in OFF and ON state), also for LED applications (7.0 mA typ.)

4.3 Board Description

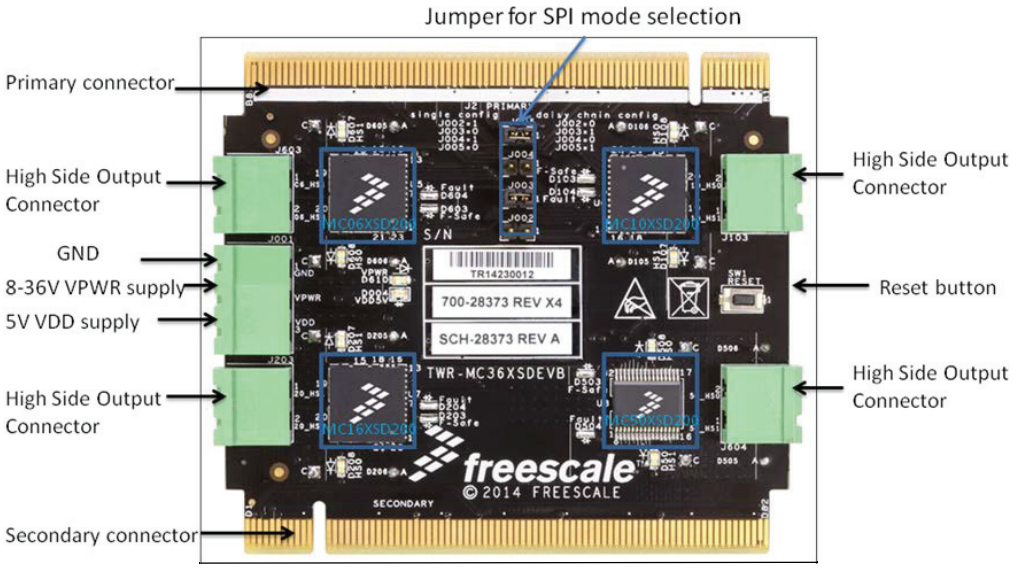

Figure 4. TTWR-MC36XSDEVB on Tower System Overview (without load)

Table 2. Board Description

Name	Description
Jumper for SPI Mode Selection	
Primary Connector	
High-side Output Connector	
GND	
8 V - 36 V VPWR Supply	

Table 2. Board Description (continued)

Name	Description
5 V VDD Supply	
High-side Output Connector	
Secondary Connector	
High-side Output Connector	
Reset Button	
High-side Output Connector	

4.4 LED Display

The following LEDs are provided as visual output devices for the TWR-MC36XSDEVB:

1. D607 Indicates when HS1 of MC06XSD200 is ON
2. D608 Indicates when HS0 of MC06XSD200 is ON
3. D604 Indicates when MC06XSD200 enter Fault Mode
4. D603 Indicates when MC06XSD200 enter Fail-safe Mode
5. D107 Indicates when HS1 of MC10XSD200 is ON
6. D108 Indicates when HS0 of MC10XSD200 is ON
7. D104 Indicates when MC10XSD200 enter Fault Mode
8. D103 Indicates when MC10XSD200 enter Fail-safe Mode
9. D207 Indicates when HS1 of MC16XSD200 is ON
10. D208 Indicates when HS0 of MC16XSD200 is ON
11. D204 Indicates when MC16XSD200 enter Fault Mode
12. D203 Indicates when MC16XSD200 enter Fail-safe Mode
13. D507 Indicates when HS1 of MC50XSD200 is ON
14. D508 Indicates when HS0 of MC50XSD200 is ON
15. D504 Indicates when MC50XSD200 enter Fault Mode
16. D503 Indicates when MC50XSD200 enter Fail-safe Mode
17. D610 Indicates when VPWR is supplied
18. D004 Indicates when VDD is supplied

4.5 Connectors

There are input/output connectors, which provide the following signals:

1. 06_HS0 - high-side output channel 0 of MC06XSD200
2. 06_HS1 - high-side output channel 1 of MC06XSD200
3. 10_HS0 - high-side output channel 0 of MC10XSD200
4. 10_HS1 - high-side output channel 1 of MC10XSD200
5. 16_HS0 - high-side output channel 0 of MC16XSD200
6. 16_HS1 - high-side output channel 1 of MC16XSD200
7. 50_HS0 - high-side output channel 0 of MC50XSD200
8. 50_HS1 - high-side output channel 1 of MC50XSD200
9. VPWR - power supply of 8.0 V-36 V
10. VDD - power supply of 5.0 V

4.6 Jumper Definitions

The following table defines the evaluation board jumper positions and explains their functions. (The default settings are shown in bold.)

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Jumper	Description	Setting	Connection
J006	ADC input pin selection	**1-2**	Monitor to AN1 pin on Elevator board
		2-3	Monitor to AN5 pin on Elevator board

SPI Work Mode	Description	Connection			
		J002	J003	J004	J005
J006	ADC input pin selection	X	O	X	O
		O	X	O	X

4.7 Elevator Connections

The TWR-MC36XSDEVB 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 only makes connections to ground (GND). **Table 3** provides the pinouts for the primary Elevator Connector.

Table 3. Primary Elevator Connector Pinouts

Side B				Side A			
Pin #	**Name**	**Group**	**Usage**	**Pin #**	**Name**	**Group**	**Usage**
B1	5V	Power	5.0V Power	A1	5V	Power	5.0V Power
B2	GND	Power	Ground	A2	GND	Power	Ground
B3	3.3V	Power	3.3V Power	A3	3.3V	Power	3.3V Power
B4	ELE_PS_SENSE	Power	Elevator Power Sense	A4	3.3V	Power	3.3V Power
B5	GND	Power	Ground	A5	GND	Power	Ground
B6	GND	Power	Ground	A6	GND	Power	Ground
B7	SDHC_CLK / SPI1_CLK	SDHC / SPI 1		A7	SCL0	I2C 0	
B8	SDHC_D3 / SPI1_CS1_b	SDHC / SPI 1		A8	SDA0	I2C 0	
B9	SDHC_D3 / SPI1_CS0_b	SDHC / SPI 1		A9	GPIO9 / CTS1	GPIO / UART	20_IN1
B10	SDHC_CMD / SPI1_MOSI	SDHC / SPI 1		A10	GPIO8 / SDHC_D2	GPIO / SDHC	10_IN1
B11	SDHC_D0 / SPI1_MISO	SDHC / SPI 1		A11	GPIO7 / SD_WP_DET	GPIO / SDHC	10_IN0
Mechanical Key							
B12	ETH_COL	Ethernet		A12	ETH_CRS	Ethernet	
B13	ETH_RXER	Ethernet		A13	ETH_MDC	Ethernet	
B14	ETH_TXCLK	Ethernet		A14	ETH_MDIO	Ethernet	
B15	ETH_TXEN	Ethernet		A15	ETH_RXCLK	Ethernet	
B16	ETH_TXER	Ethernet		A16	ETH_RXDV	Ethernet	
B17	ETH_TXD3	Ethernet		A17	ETH_RXD3	Ethernet	
B18	ETH_TXD2	Ethernet		A18	ETH_RXD2	Ethernet	
B19	ETH_TXD1	Ethernet		A19	ETH_RXD1	Ethernet	
B20	ETH_TXD0	Ethernet		A20	ETH_RXD0	Ethernet	

Table 3. Primary Elevator Connector Pinouts (continued)

B21	GPIO1 / RTS1	GPIO / UART	20_IN0	A21	SSI_MCLK	SSI	
B22	GPIO2 / SDHC_D1	GPIO / SDHC	06_IN1	A22	SSI_BCLK	SSI	
B23	GPIO3	GPIO	CSB	A23	SSI_FS	SSI	
B24	CLKIN0	Clock		A24	SSI_RXD	SSI	
B25	CLKOUT1	Clock		A25	SSI_TXD	SSI	
B26	GND	Power	Ground	A26	GND	Power	Ground
B27	AN7	ADC		A27	AN3	ADC	
B28	AN6	ADC		A28	AN2	ADC	
B29	AN5	ADC	CSNS	A29	AN1	ADC	CSNS
B30	AN4	ADC		A30	AN0	ADC	
B31	GND	Power	Ground	A31	GND	Power	Ground
B32	DAC1	DAC		A32	DAC0	DAC	
B33	TMR3	Timer		A33	TMR1	Timer	
B34	TMR2	Timer		A34	TMR0	Timer	
B35	GPIO4	GPIO	06_IN0	A35	GPIO6	GPIO	50_IN1
B36	3.3V	Power	3.3V Power	A36	3.3V	Power	3.3V Power
B37	PWM7	PWM		A37	PWM3	PWM	
B38	PWM6	PWM		A38	PWM2	PWM	
B39	PWM5	PWM		A39	PWM1	PWM	
B40	PWM4	PWM		A40	PWM0	PWM	CLOCK
B41	CANRX0	CAN 0		A41	RXD0	UART 0	
B42	CANTX0	CAN 0		A42	TXD0	UART 0	
B43	1WIRE	1-Wire		A43	RXD1	UART 1	
B44	SPI0_MISO (IO1)	SPI 0	MISO	A44	TXD1	UART 1	
B45	SPI0_MOSI (IO0)	SPI 0	MOSI	A45	VSS	Analog Vref	
B46	SPI0_CS0_b	SPI 0		A46	VDDA	Analog Vref	
B47	SPI0_CS1_b	SPI 0		A47	VREFA1	Analog Vref	
B48	SPI0_CLK	SPI 0	CLK	A48	VREFA2	Analog Vref	
B49	GND	Power	Ground	A49	GND	Power	Ground
B50	SCL1	I2C 1		A50	GPIO14	GPIO	
B51	SDA1	I2C 1		A51	GPIO15	GPIO	
B52	GPIO5 / SPI0_HOLD (IO3)	GPIO / SPI 0	50_IN0	A52	GPIO16 / SPI0_WP (IO2)	GPIO / SPI 0	
B53	USB0_DP_PDOW	USB 0		A53	GPIO17	GPIO	
B54	USB0_DM_PDOW	USB 0		A54	USB0_DM	USB 0	
B55	IRQ_H	Interrupt		A55	USB0_DP	USB 0	
B56	IRQ_G	Interrupt		A56	USB0_ID	USB 0	
B57	IRQ_F	Interrupt	06_FSOB	A57	USB0_VBUS	USB 0	
B58	IRQ_E	Interrupt		A58	TMR7	Timer	
B59	IRQ_D	Interrupt	06_FSB	A59	TMR6	Timer	
B60	IRQ_C	Interrupt		A60	TMR5	Timer	
B61	IRQ_B	Interrupt		A61	TMR4	Timer	
B62	IRQ_A	Interrupt	06_SYNC	A62	RSTIN_b	Reset	
B63	EBI_ALE / EBI_CS1_b	EBI		A63	RSTOUT_b	Reset	

Table 3. Primary Elevator Connector Pinouts (continued)

B64	EBI_CS0_b	EBI		A64	CLKOUT0	Clock	
B65	GND	Power	Ground	A65	GND	Power	Ground
B66	EBI_AD15	EBI		A66	EBI_AD14	EBI	
B67	EBI_AD16	EBI		A67	EBI_AD13	EBI	
B68	EBI_AD17	EBI		A68	EBI_AD12	EBI	
B69	EBI_AD18	EBI		A69	EBI_AD11	EBI	
B70	EBI_AD19	EBI		A70	EBI_AD10	EBI	
B71	EBI_R/W_b	EBI		A71	EBI_AD9	EBI	
B72	EBI_OE_b	EBI		A72	EBI_AD8	EBI	
B73	EBI_D7	EBI		A73	EBI_AD7	EBI	
B74	EBI_D6	EBI		A74	EBI_AD6	EBI	
B75	EBI_D5	EBI		A75	EBI_AD5	EBI	
B76	EBI_D4	EBI		A76	EBI_AD4	EBI	
B77	EBI_D3	EBI		A77	EBI_AD3	EBI	
B78	EBI_D2	EBI		A78	EBI_AD2	EBI	
B79	FB_D1	Flexbus		A79	FB_AD1	Flexbus	
B80	FB_D0	Flexbus		A80	FB_AD0	Flexbus	
B81	GND	Power	Ground	A81	GND	Power	Ground
B82	3.3 V	Power	3.3 V Power	A82	3.3 V	Power	3.3 V Power

5 Installing the Software and Setting up the Hardware

5.1 Installing CodeWarrior on your Computer

This procedure explains how to obtain and install the latest version of CodeWarrior 10.x.

Note:

The sample software in this kit requires CodeWarrior 10.x and above. If CodeWarrior 10.x or above is already on your system, the steps in this section can be skipped.

1. Obtain the latest CodeWarrior 10.x installer file from the Freescale CodeWarrior website.
2. Run the executable file and follow the instructions.

During the installation, there is a request to select components to install. You must install at least the Kinetis component. This kit requires the Kinetis component which also must be installed. Select the Kinetis component and click on “Next” to complete the installation.

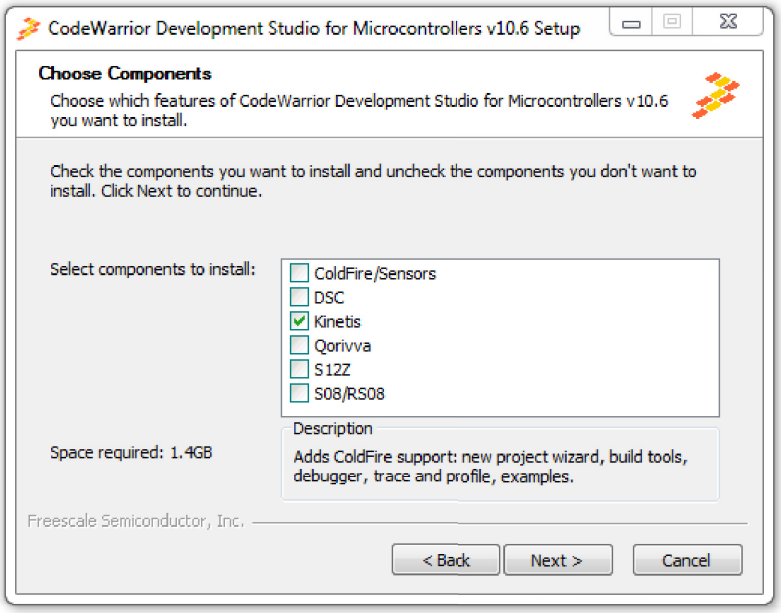


Figure 5. Choose Components GUI

5.1.1 Launch CW10.x and Create a New Project with Process Expert

1. Create an MCU bareboard project and name it.

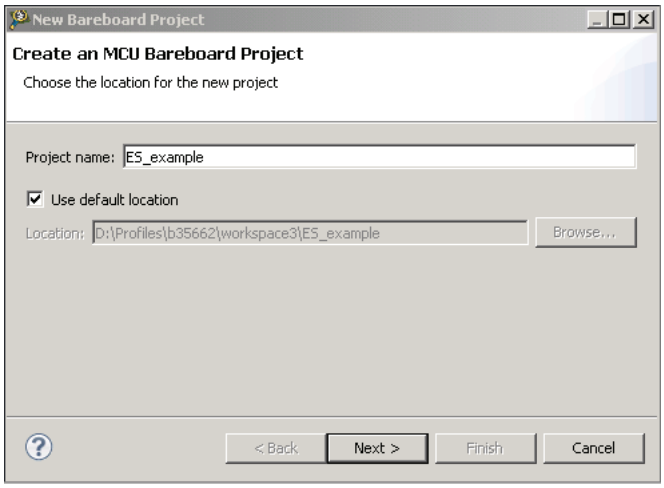


Figure 6. Create an MCU Bareboard Project

2. Choose the MCU class to be used in the tower MCU board (MK70N1M0 in this example):

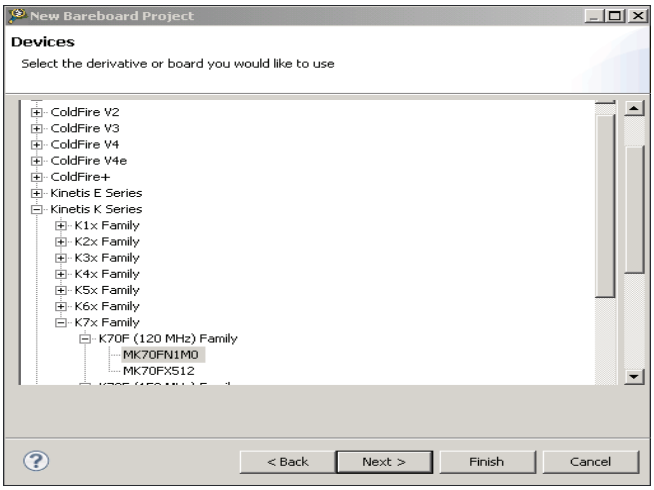


Figure 7. Choose the MCU Class

3. Choose the connections to be used.

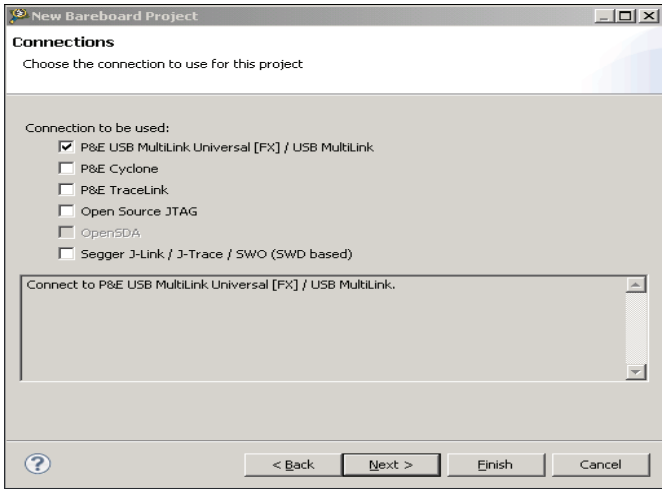


Figure 8. Choose the Connections

4. Select Process Expert then select Finish.

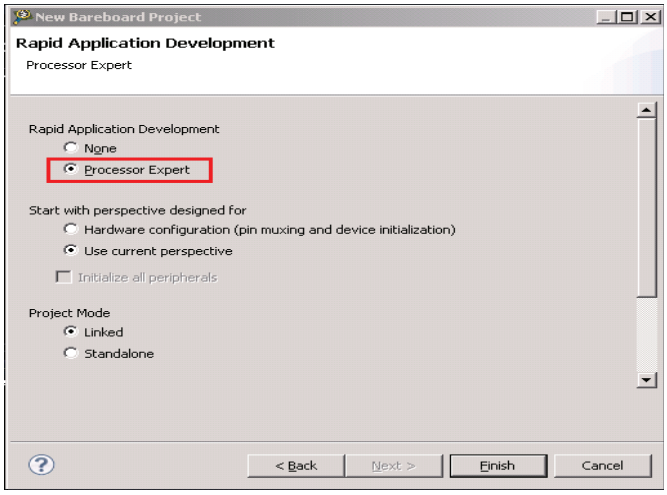


Figure 9. Select Process Expert

5.1.2 Setup Project for the TWR-MC36XSDEVB

1. Find 36VeXtremeSwitch in the Component Library and Import it into this project.

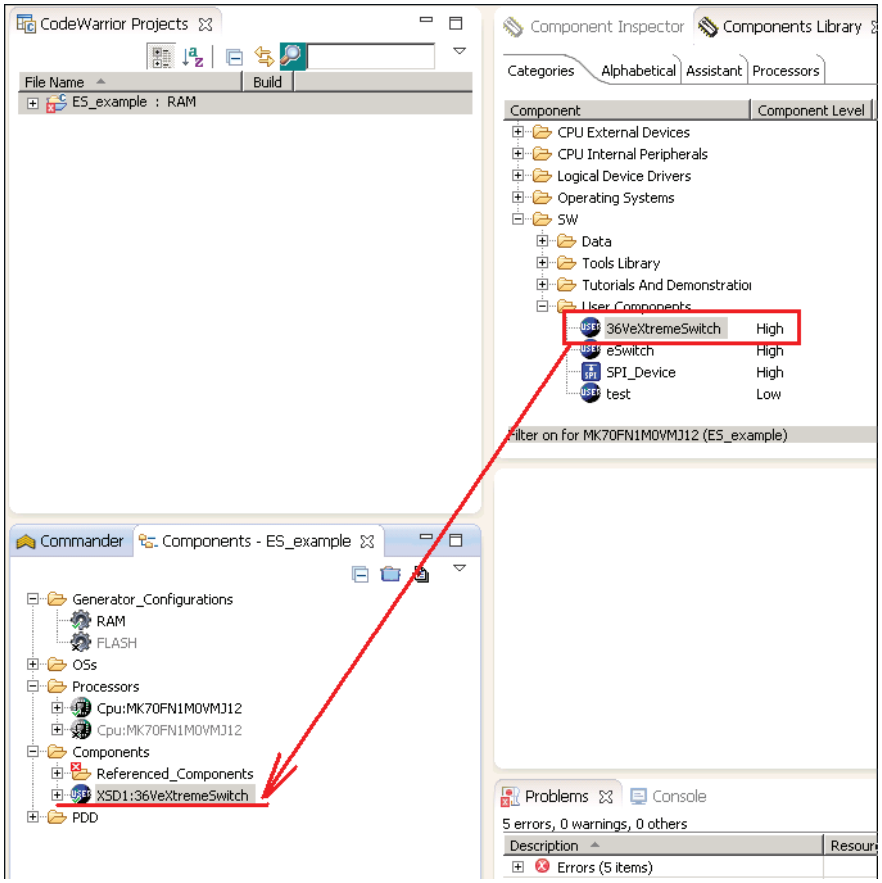


Figure 10. Import 36VeXtremeSwitch

2. Setup the 36VeXtremeSwitch component configuration according to the TWR-MC36XSDEVB connection. Set the SPI master component that is linked to the 36VeXtremeSwitch component and automatically loaded to the project.

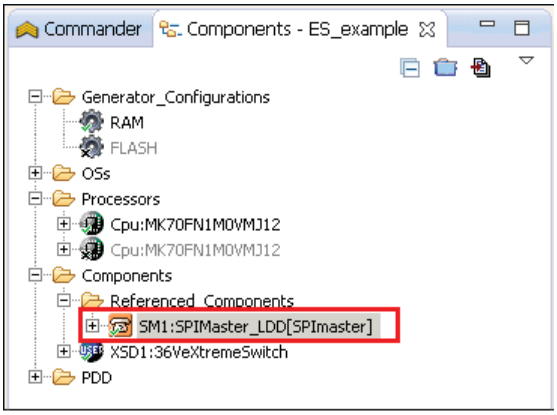


Figure 11. Setup 36VeXtremeSwitch

3. Double click this component to show configurations in the Component Inspector view and to setup SPI port/pin usage on TWR-K70F120M, SPI communication rate, and Auto initialization.

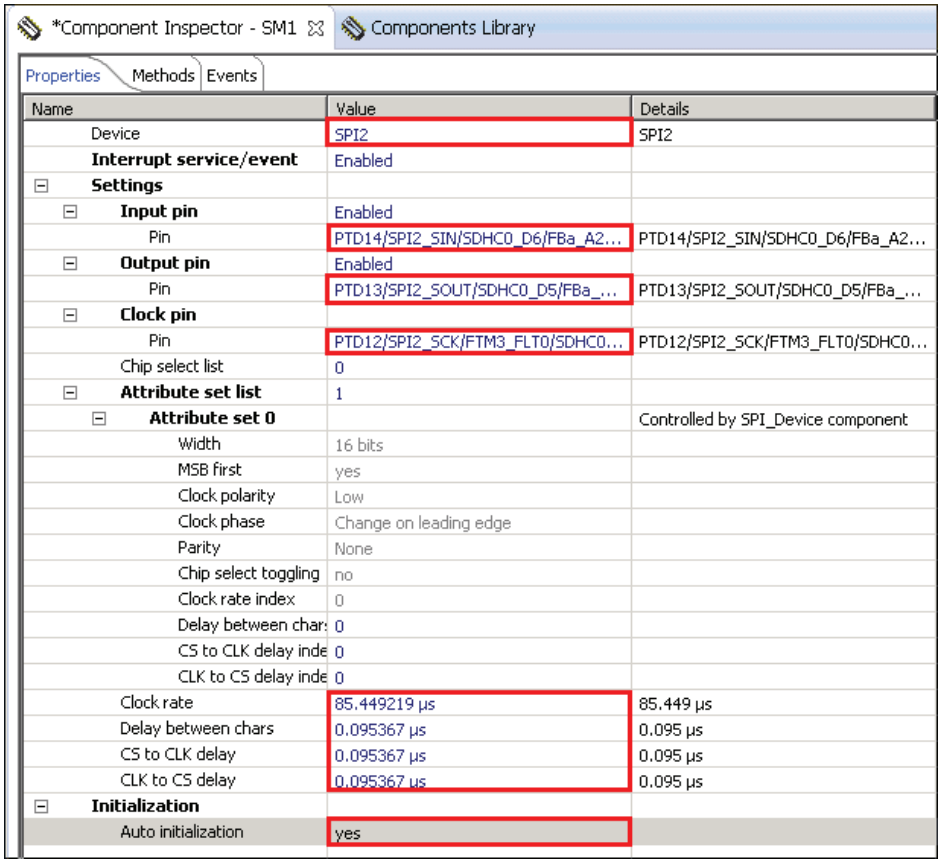


Figure 12. Configurations are Shown in Component Inspector

4. Double click the CSpin component in 36VeXtremeSwitch->SPI_Device->CSpin. Input and select PTE28 for this chip. Select the pin that is used for the TWR-K70F120M SPI chip. Select waveform generate within SPI daisy chain waveform sequence (CSB). Set init.Value to 1 because active voltage of ESwitch is LOW.

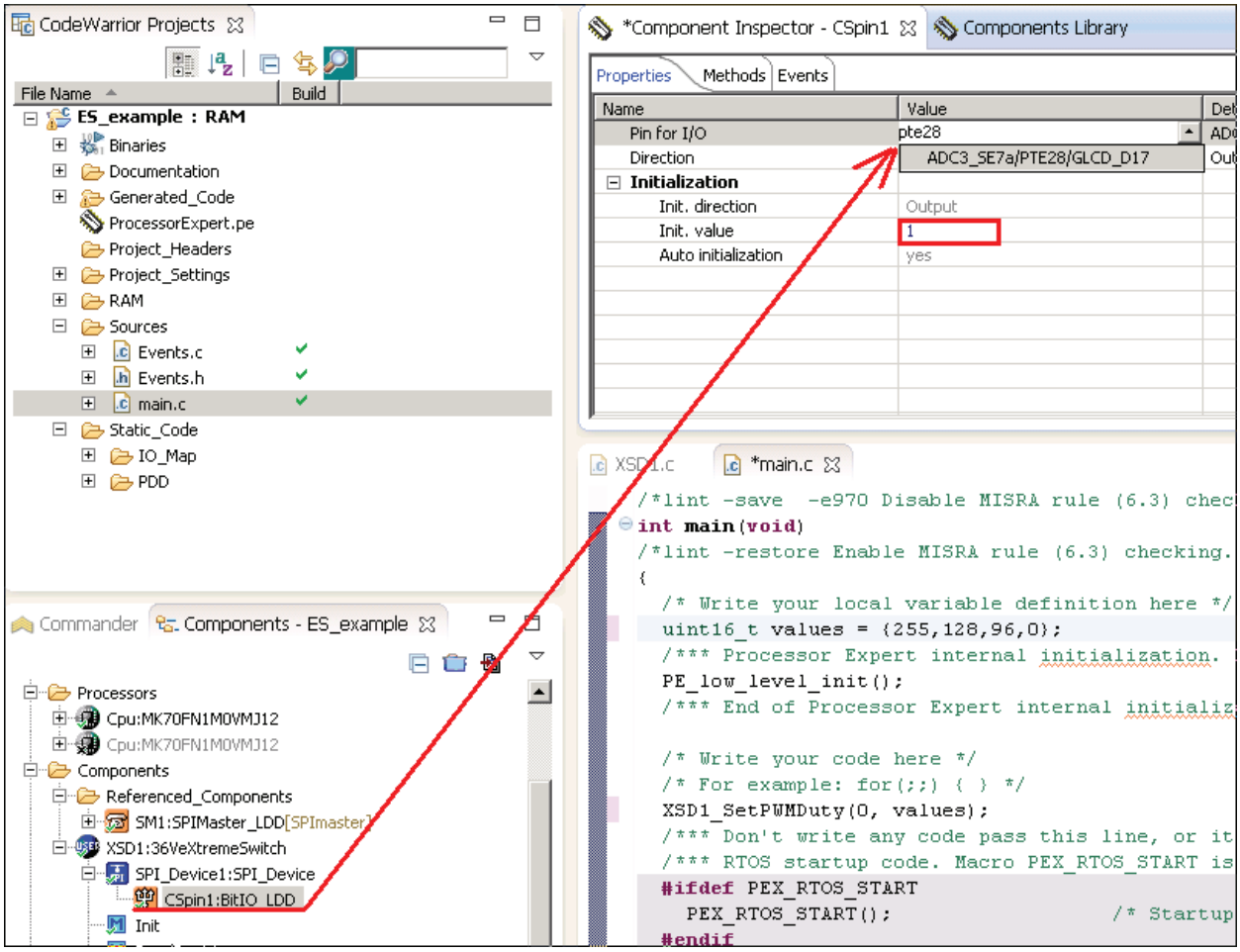


Figure 13. Input and Select PTE28

5. To configure 36VeXtremeSwitch component, double click this component then configurations are shown in the Component Inspector view.

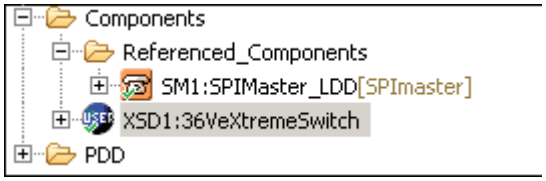


Figure 14. Configure 36VeXtremeSwitch

Device On Daisy Chain: if the jumper on TWR-MC36XSDEVB is set to single SPI mode (J002,J004 short;J003,J005 open) then it should be configured as 1; if jumper is set to daisy chain SPI mode (J002,J004 open,J003,J005 short) then it should be configured as 4 because four devices on board are linked by a daisy chain.

Configurations: the configurations are for ESwitch settings, and can be shared between devices independently in the Devices On Daisy Chain list. Configure the devices as needed by the project.

5.1.3 Generate Code for the Application

After Configuration, generate the related source code for the application. Then the driver code for Extreme Switch devices is generated and placed to Generated_Code folder in project view. The component can only generate driver code used for application program, it cannot generate application code.

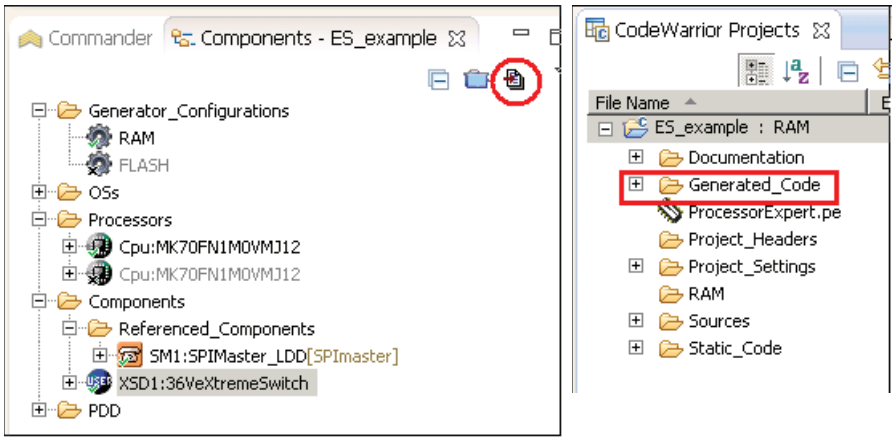


Figure 15. Generate Related Source Code

5.1.4 Using the Interface

Application code can be easily coded in the project and tested. For example, open the 36VeXtremeSwitch component methods list, drag SetPWM duty cycle to main.c, add any necessary parameters, then the program is ready to compile.

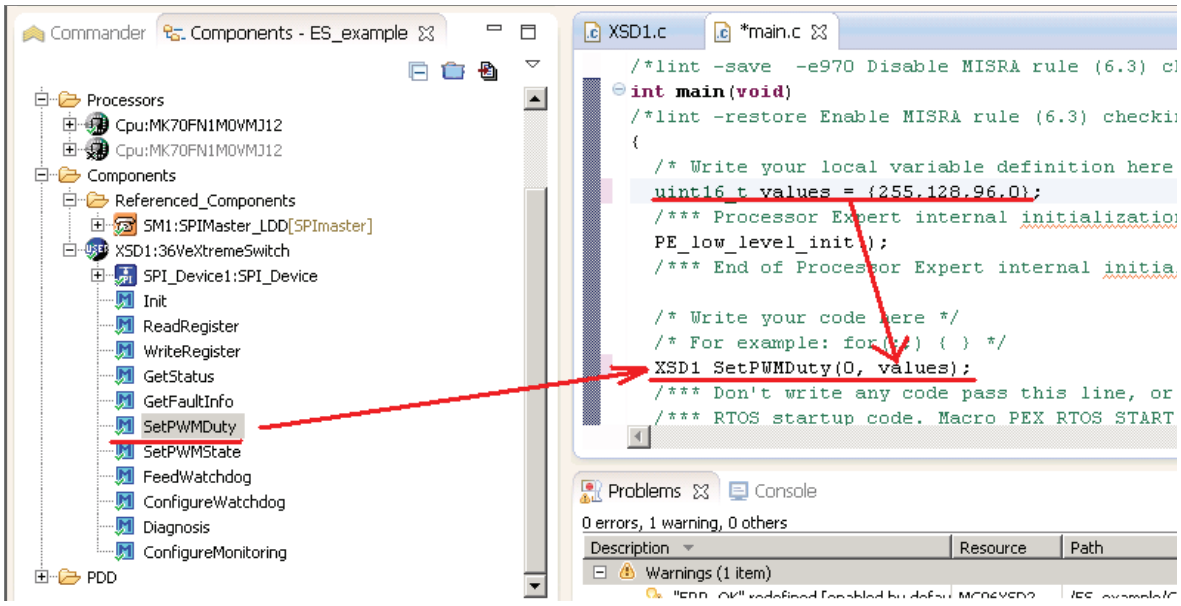
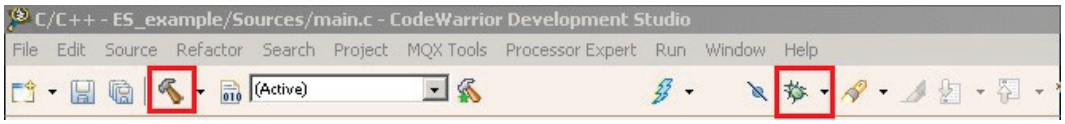


Figure 16. Generate Application Code

Compile/download and debug on board. Click compile, the debug button in the toolbar, then CodeWarrior will download and launch the program on board.



5.2 Configuring the Hardware

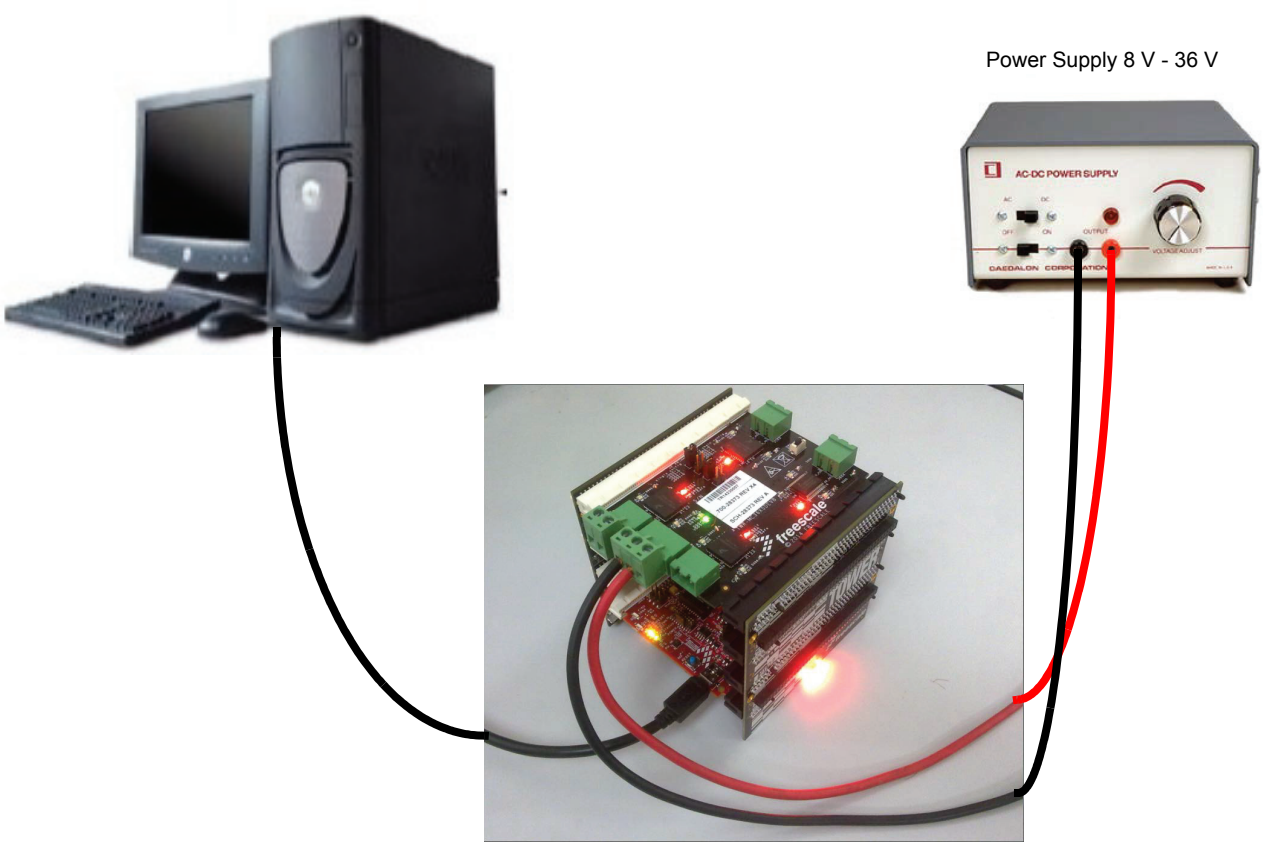


Figure 17. TWR-MC36XSDEVB Setup

6 Schematic

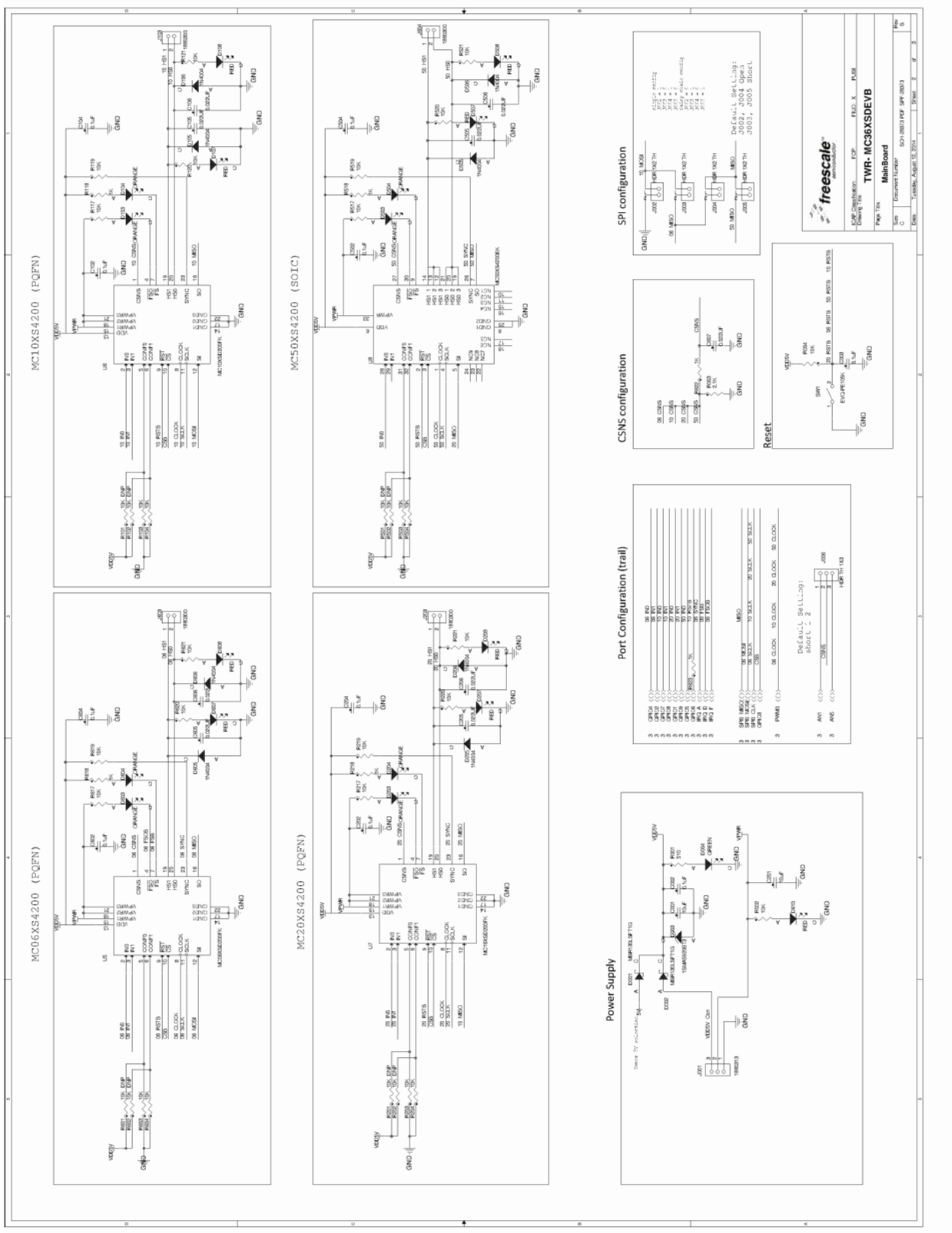


Figure 18. Schematic 1

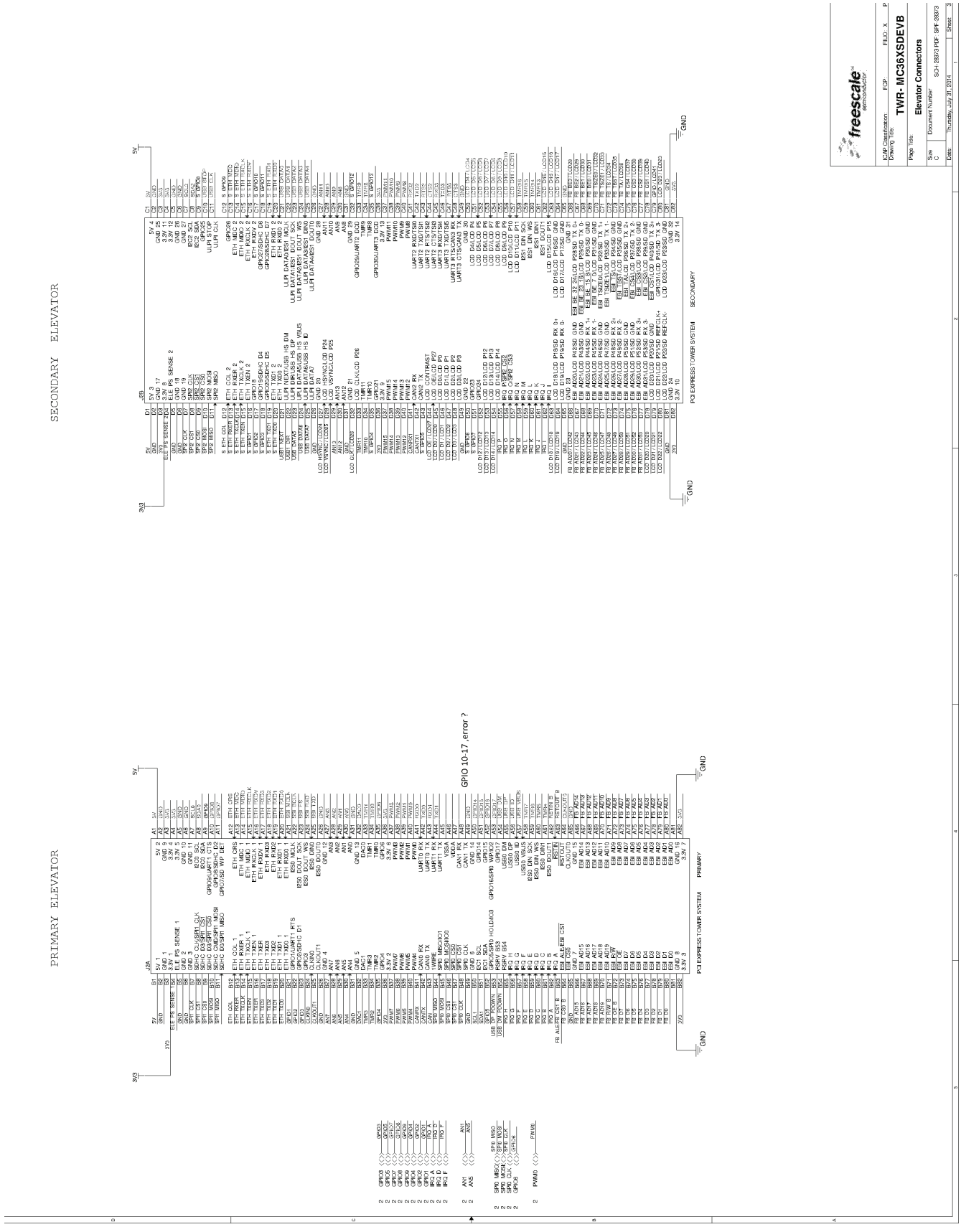
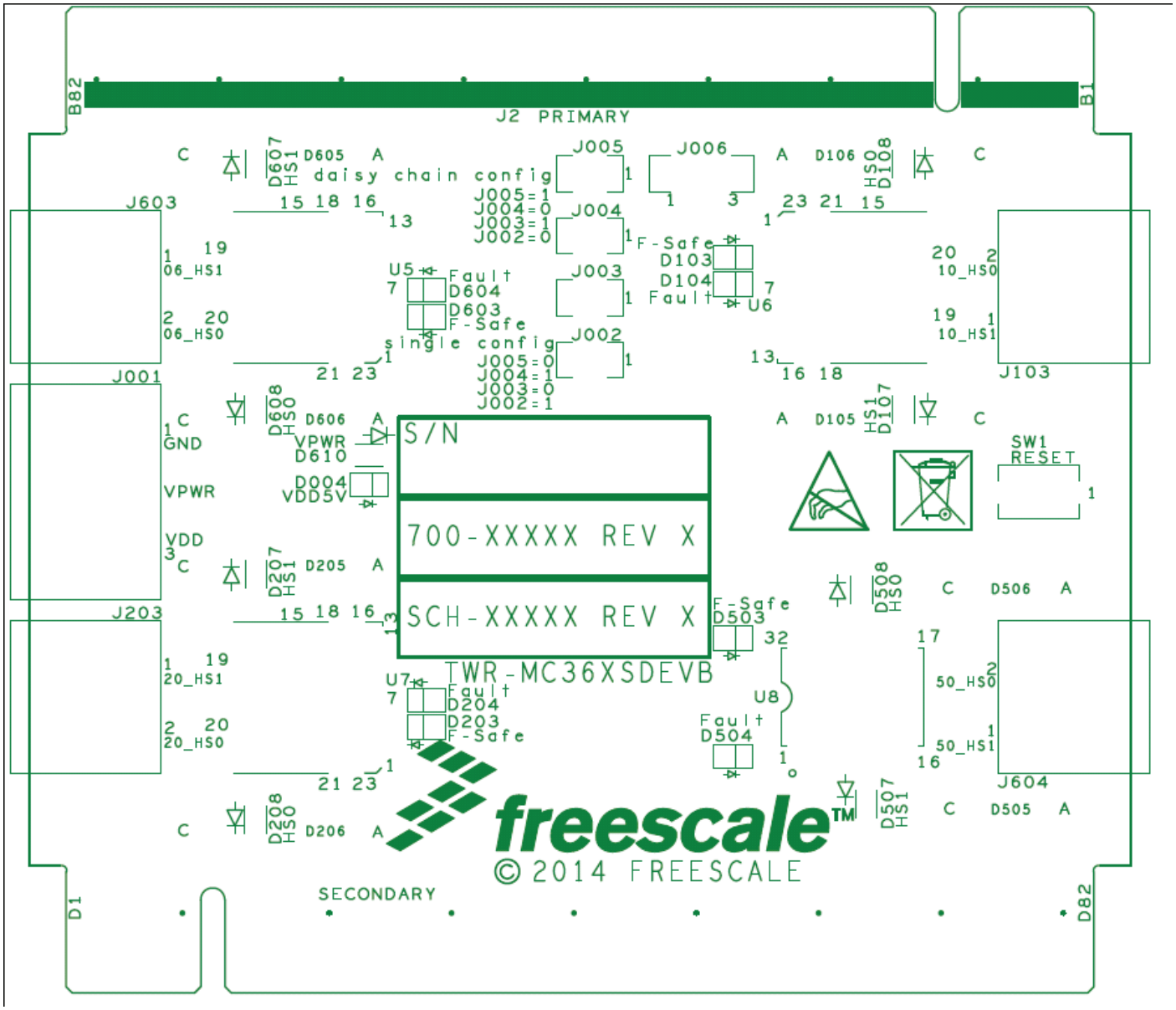


Figure 19. Schematic 2

7 Board Layout

7.1 Silkscreen



8 References

Following are URLs where you can obtain information on related Freescale products and application solutions:

Freescale.com Support Pages	Description	URL
Tower System	Tower System Modular Development Board Platform	http://www.freescale.com/webapp/sps/site/homepage.jsp?code=TOWER_HOME&tid=vantower
Development IDE	Code-Warrior Development Tools	http://www.freescale.com/webapp/sps/site/homepage.jsp?code=CW_HOME&tid=vanCODEWARRIOR
CodeWarrior	Software	http://www.freescale.com/webapp/sps/site/homepage.jsp?code=CW_HOME&tid=vanCODEWARRIOR

8.1 Support

Visit www.freescale.com/support for a list of phone numbers within your region.

8.2 Warranty

Visit www.freescale.com/warranty for a list of phone numbers within your region.

9 Revision History

Revision	Date	Description of Changes
1.0	11/2014	• Initial Release

RoHS

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Document Number: MC36XSD
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11/2014

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