KITVALVECNTLEVM Valve Controller SoC Evaluation Kit
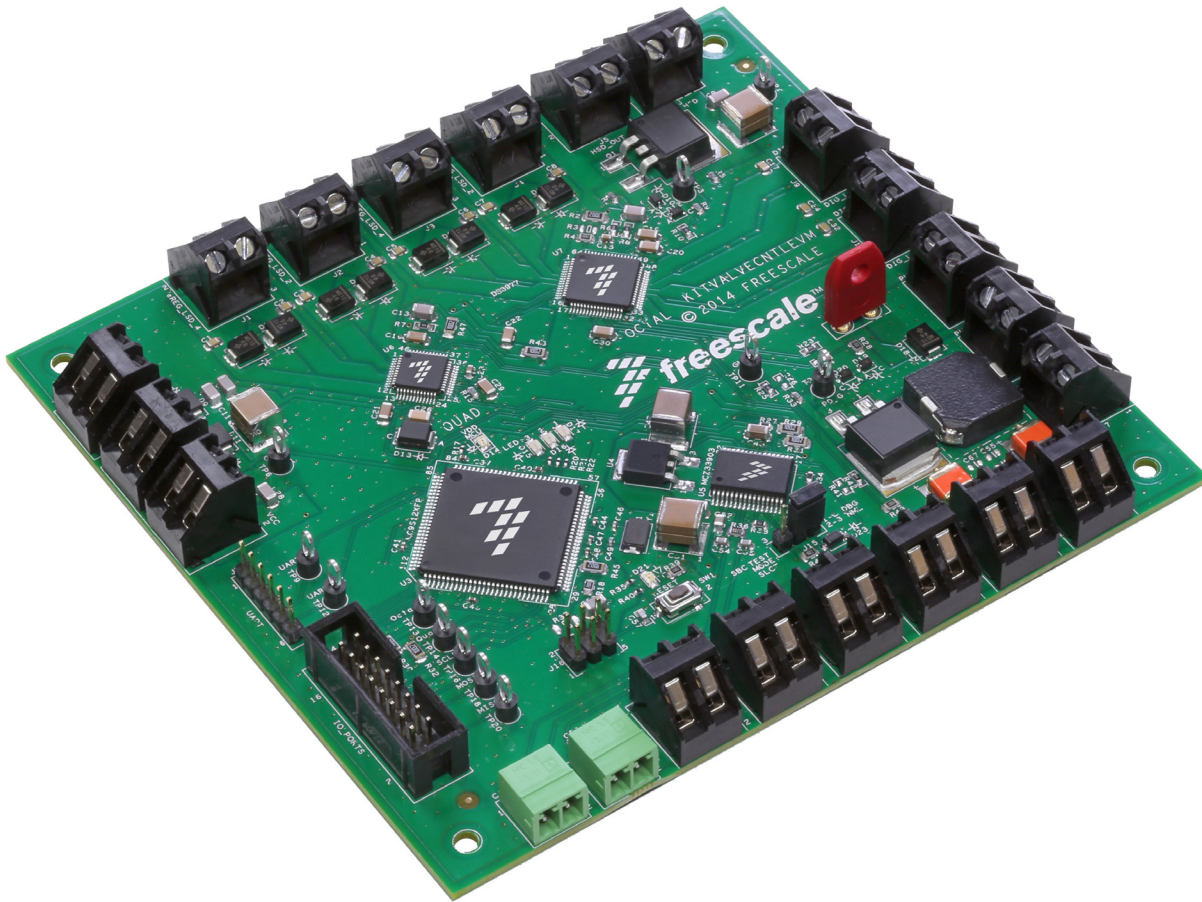
Figure 1. KITVALVECNTLEVM

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Contents

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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 evaluation board 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 evaluation board 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 **KITVALVECNTLEVM** contents include:
- Assembled and tested evaluation module in anti-static bag.
- USB to FTDI cable
- USB Key containing
  - A code example
  - Schematics
  - Gerber files
  - Bill of Materials
  - Graphical User Interface software
  - A training package/user guide
- Warranty card

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/KITVALVECNTLEVM
- Review your Tool Summary Page
- Look for

  ⤴ Jump Start Your Design

- Download documents, software and other information

Once the files are downloaded, review the user guide in the bundle. The user guide includes setup instructions. 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:
- A DC Power Supply with variable voltage (0 to 16 V), 10 A capability
- A 5.0 V DC Power Supply with 200 mA capability

2.4 System Requirements

The kit requires the following to function properly with the software:
- Windows® XP, Windows 7, or Vista in 32- and 64-bit versions

3 Getting to Know the Hardware

3.1 Board Overview

The KITVALVECNTLEVM Evaluation Board facilitates the development of hydraulic and pneumatic systems that use either the SB0800 Octal Valves Controller SoC or the SB0410 Quad Valves Controller SoC. The EVB allows designers to evaluate the MC34SB0800 and the MC34SB0410 separately or in unison. Designers monitor and control, through the MCU, the Valve Controller SoC functions using a downloadable Windows-based Graphical User Interface (GUI.) The KITVALVECNTLEVM communicates with the PC through an on-board FTDI to USB port. The board comes preloaded with firmware, but users can download their own firmware using a program connector provided on the board. (Use the S12 Multilink Programmer/Debugger to perform the programming.) The board also contains an SPI connector that allows direct access to the MC34SB0800 and MC34SB0410 SPI pins.

3.2 Board Features

The board features are as follows:

- Support for both MC34SB0800 and MC34SB0410 (either separately or in unison)
- SPI port providing direct access to MCU SPI pins
- CAN and LIN bus connectors

3.2.1 Device Features

This evaluation board features the following Freescale products:

Table 1. Device Features

| Device	Description	Features
MC34SB0800	Octal Valve and Pump System on Chip	• Operating voltage 6.0 V to 36 V • Eight Valve Controls - Four current regulated, four PWMed • High-side predriver for valve protection • Pump motor predriver up to 500 Hz PWM • 16-bit SPI interface with watchdog • Three 10-bit ADC channels
MC34SB0410	Quad Valve and Pump System on Chip	• Operating voltage 6.0 V to 36 V • Four Current-regulated or PWM Valve Controls • Pump motor predriver up to 16 kHz PWM • 16-bit SPI interface with watchdog • Three 10-bit ADC channels
MC9S12XEP	16-bit MCU for General Purpose Automotive and Industrial Applications	• S12X CPU @ 50Mhz bus speed • ADC 12-bit resolution and 3 µs conversion time • Pulse width modulator (PWM) • Serial peripherial interface (SPI) • Serial communication interface (SCI) • Background debug module (BDM) debugger (xDBG)
MCZ33903	System Basis Chip	• Voltage regulator for MCU, 5.0 V or 3.3 V • ISO11898-5 high-speed CAN interface compatibility for baud rates of 40 kb/s to 1.0 Mb/s • Fully-protected embedded 5.0 V regulator for the CAN driver • Advanced SPI, MCU, ECU power supply and critical pins diagnostics and monitoring • Auxiliary 5.0 V or 3.3 V SPI configurable regulator, for additional ICs

3.2.2   GUI-enabled Features

Table 2. GUI-enabled Features

	High-side Driver (HSD)	LSD (x12) (both Current Regulated and PWM)	DC Motor	High-side Driver (HS)	Low-side Driver (LD)	Supervision	ADC
WRITE	Turn ON/OFF	• Current Value Targeted • Duty-cycle • Change PI Value • Change Frequency	• Turn ON/OFF • PWM • Control by external pin (ADN1)	Turn ON/OFF	• Turn ON/OFF • Control by external pin (ADN2)	Frequency Modulation selection (for the Main clock)	
READ	Overcurrent	• Overcurrent • Open load • Overtemperature • VDS monitoring • Current Targeted • Duty-cycle value for gate driver	Overcurrent	• Overcurrent • Open load • Overtemperature • VDS Monitoring	• Overcurrent • Open load • Overtemperature • VDS Monitoring	• Internal Analog Regulator Voltage • Internal Digital Regulator Voltage • Internal 10 V and 12 V Regulator Voltage • Charge Pump Voltage • Die temperature	Monitoring of ADIN pin (LSB)

3.3   Board Description

Figure 2 and Table 3 below describe the major components of the KITVALVECNTLEVM evaluation board.
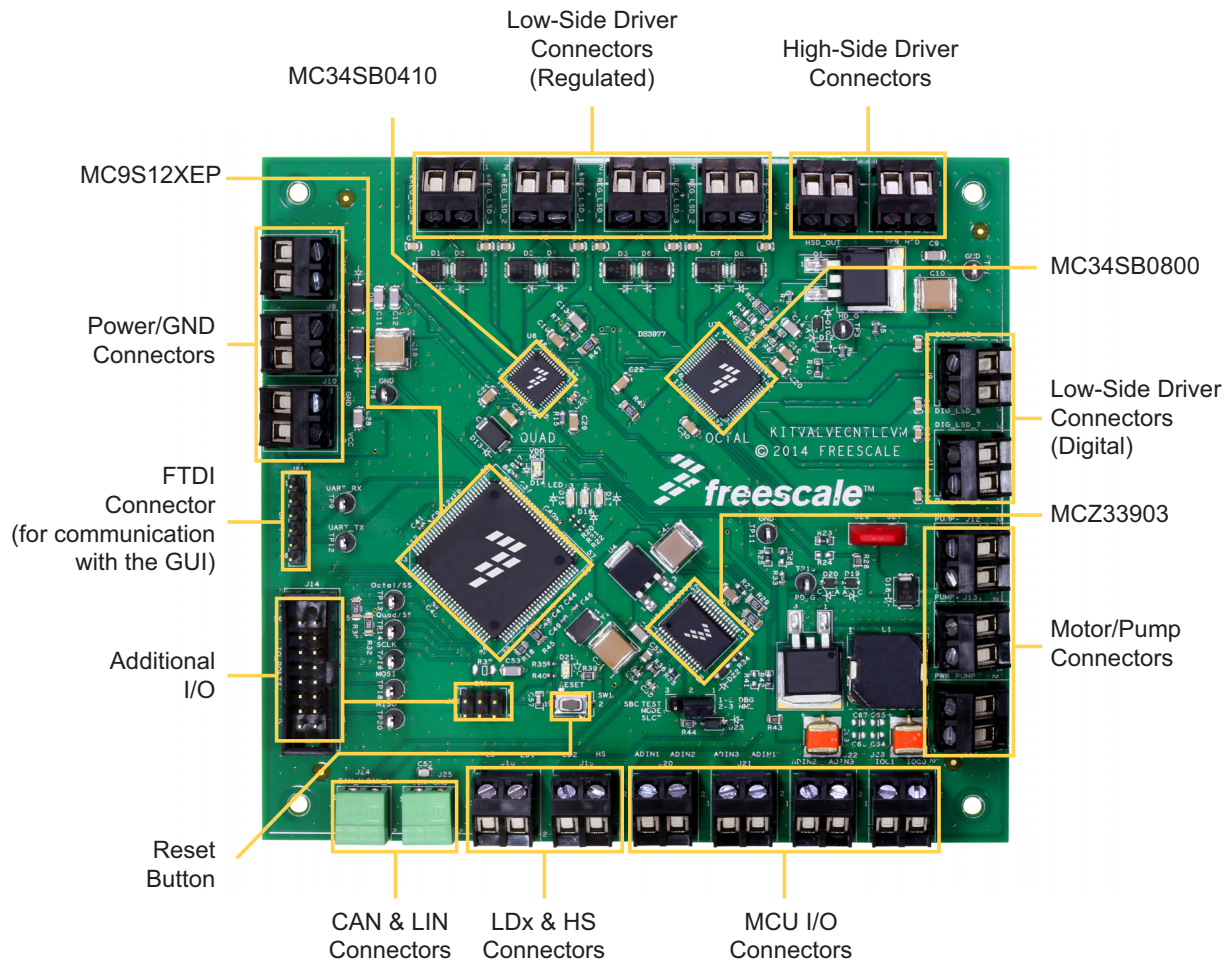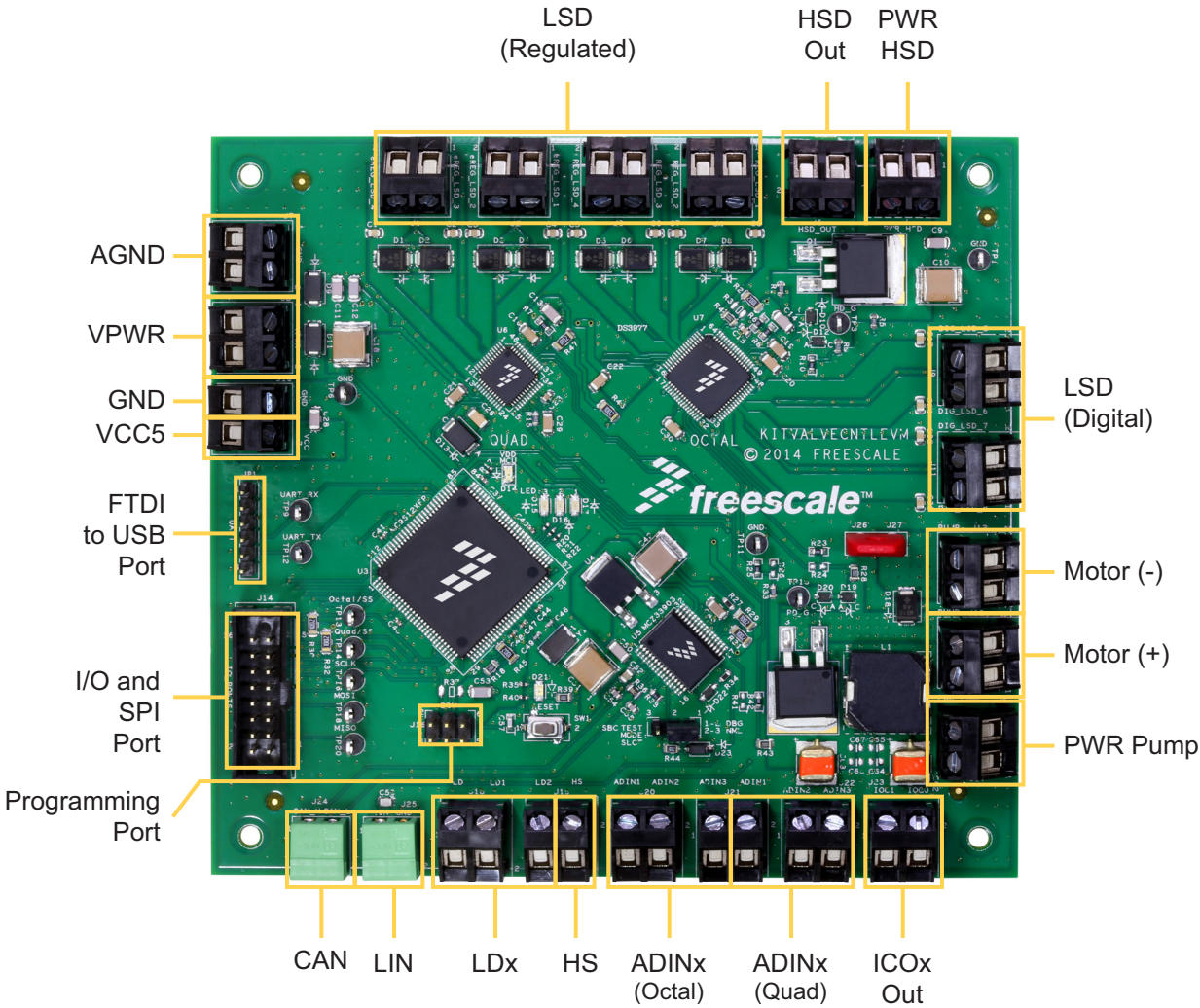

Figure 2. KITVALVECNTLEVM Board Description

Table 3. Board Description

Name	Description
MC34SB0410	Valve and motor control MCU with four valve control capability
MC34SB0800	Valve and motor control MCU with eight valve control capability (four regulated, four PWM)
MC9S12XEP	16-bit MCU for General Purpose Automotive and Industrial Applications
MCZ33903	System Basis Chip
Power/GND Connectors	Provide connections for external power supplies
FTDI Connector	Primary communication link with PC when used with GUI
Additional I/O	Serve as a communication links between the board and a PC
Reset button	Resets the board MCU's
CAN & LIN Connectors	Provide connections to CAN and LIN buses
LDx and HS Connectors	Provide connections for LDx and HS signals
MCU I/O Connectors	Provide connections for ADINx (quad and octal) and ICOx signals
Motor/Pump Connectors	Provide connections for external pumps and motors
Low-side Driver Connectors (Digital)	Provide connections for digital low-side drivers
High-side Driver Connectors	Provide connections for high-side driver
Low-side Driver Connectors (Regulated)	Provide connections for low-side drivers

3.4   Connectors

Figure 3 shows input/output connectors, which provide the signals described in Table 4:

Figure 3. KITVALVECNTLEVM Connectors

Table 4. KITVALVECNTLEVM Connectors

Name	Description
LSD (Regulated)	Connections to MCU pins for regulated Low-side Drivers
HSD Out	Connections for High-side Driver output
LSD (Digital)	Connections for digital Low-side Drivers
Motor (-)	Connections for motor negative lead
Motor (+)	Connections for motor positive lead
PWR Pump	PWR connection for pump
ICOx	Input/Output Capture connection to the MCU
ADINx (Quad)	Connections to MC34SB0410 ADC pins (ADIN1, ADIN2, ADIN3)
ADINx (Octal)	Connections to MC34SB0800 ADC pins (ADIN1, ADIN2, ADIN3)
HS	Connection to MC34SB0800 general purpose high-side driver pin

Table 4. KITVALVECNTLEVM Connectors (continued)

Name	Description
LDx	Connection to Low-side driver general purpose pins (LD1, LD2)
CAN	CAN bus connector
LIN	LIN bus connector
Programming Port	USB BDM Multilink cable connection to PC (for downloading firmware)
I/O and SPI Port	16-bit parallel connector providing SPI bus access to MCU SPI pins (SCLK, CSB, SI, SO)
FTDI to USB Port	Primary communication link with PC when used with GUI
VCC5	Power supply connection for EVB VCC5
GND	Digital ground connection for EVB
VPWR	Power supply connection for EVB VPWR
AGND	Analog ground connection for EVB

3.5   Test Point Definitions

The following test-point jumpers provide access to signals on the MC34SB0410 and the MC34SB0800:

Table 5. Test Point Definitions

Schematic Label	Description
TP1	Ground connection
TP3	High Side Gate Driver signal of the High Side Safe Switch
TP6	Ground Connection
TP9	MCU UART RX Signal
TP11	Ground Connection
TP12	MCU UART TX Signal
TP13	Octal Valves Controller SoC Chip Selection signal
TP14	Quad Valves Controller SoC Chip Selection signal
TP15	High Side Gate Driver signal of the DC Motor Pump
TP16	Serial Peripheral Clock signal
TP18	Serial Peripheral MOSI signal
TP20	Serial Peripheral MISO signal

3.6   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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Table 6. Jumper Definitions

Jumper	Description	Setting	Connection
JP1	Selects debug mode or normal mode for the SBC (MCZ33903)	**1-2**	Debug mode (no watchdog)
		2-3	Normal mode

4   Installing the Software and Setting up the Hardware

4.1   Installing User Firmware on the KITVALVECNTLEVM

The KITVALVECNTLEVM comes with firmware installed. As an option, you can also develop your own firmware and download it to the EVB. To do so, you must:

1. Purchase a USB BDM Multilink programming cable (See the P&E Micro site at the following url: https://www.pemicro.com/products/product_viewDetails.cfm?product_id=33).

2. Locate the programming connector (see Table 4) on the EVB. Attach the 6-pin (Berg) connector to the program connector. Make sure the red wire side of the cable is at the J1 side of the connector.

3. Attach the USB end of the cable to the PC

4. Install Freescale's CodeWarrior V10.x on the PC

5. Use the S12Z Multilink Programmer/Debugger to perform the programming and download the code.

4.2   Installing CodeWarrior

Freescale's CodeWarrior for MCUs integrates the development tools for several architectures, including the S12Z architecture, into a single product based on the Eclipse open development platform. Eclipse offers an excellent framework for building software development environments and is a standard framework used by many embedded software vendors. The latest version of CodeWarrior for MCUs (Eclipse IDE) can be downloaded from freescale.com/CodeWarrior.

During the installation, there is a request to select components to install. You must install at least the ColdFire component. This kit also requires the S12Z component. Select the S12Z component and click on "Next" to complete the installation.
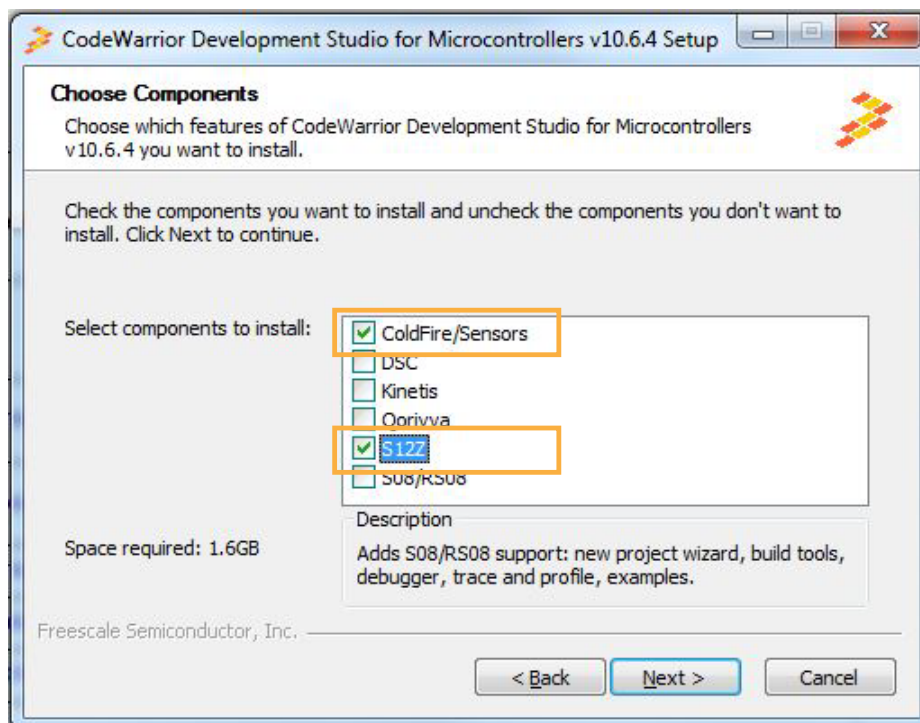
Figure 4. Code Warrior GUI

For additional instructions on installing and using CodeWarrior see the "CodeWarrior Development Studio for Microcontrollers V10.x Quick Start" guide the following URL:
http://cache.freescale.com/files/soft_dev_tools/doc/quick_ref_guide/MCU_QS.pdf?fpsp=1&WT_TYPE=Quick%20Reference%20Guides&WT_VENDOR=FREESCALE&WT_FILE_FORMAT=pdf&WT_ASSET=Documentation&fileExt=.pdf

4.3   Configuring the Hardware

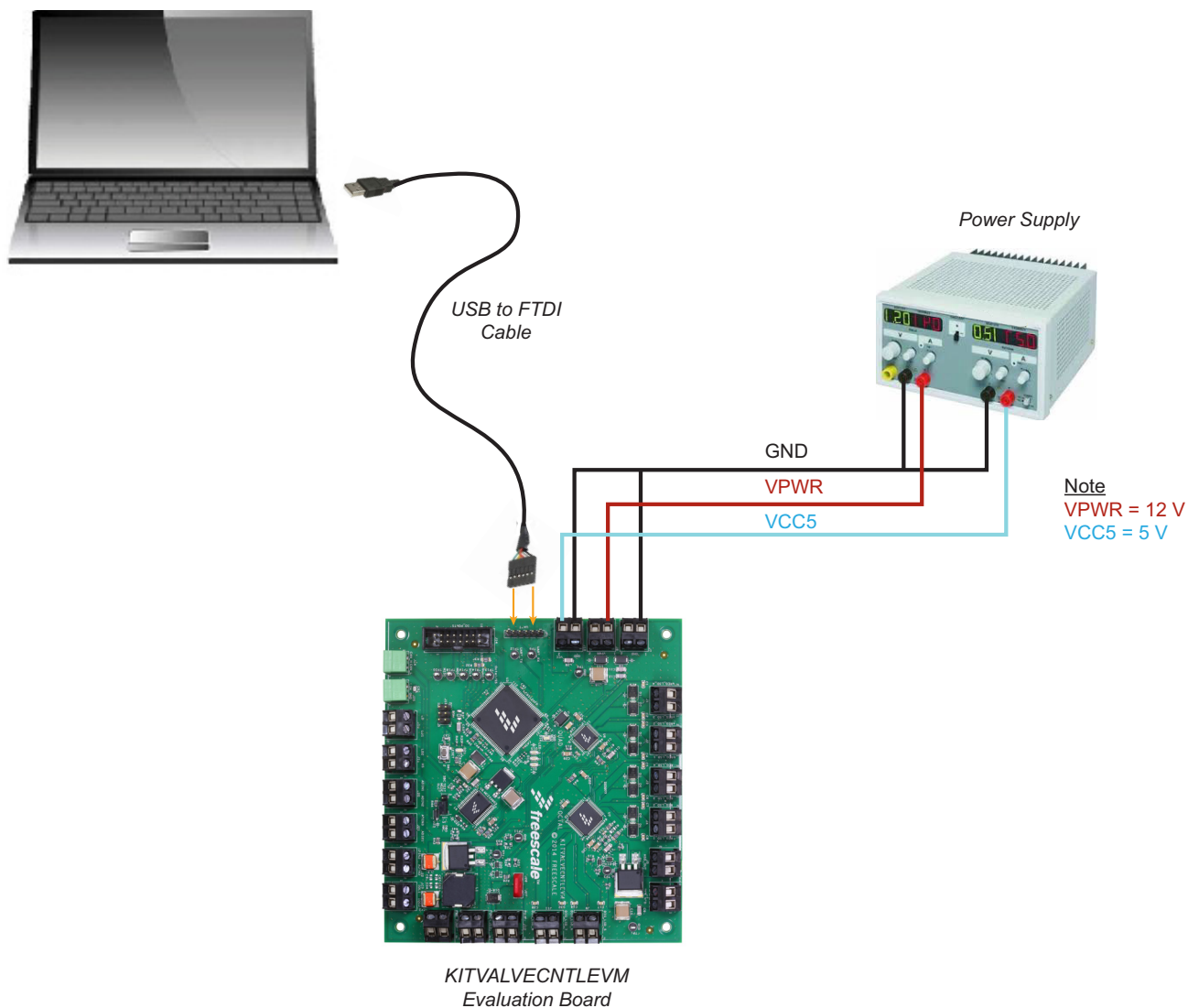Figure 5 shows the configuration diagram for the KITVALVECNTLEVM.

Power Supply

GND

VPWR

VCC5

Note
VPWR = 12 V
VCC5 = 5 V

USB to FTDI
Cable

KITVALVECNTLEVM
Evaluation Board

Figure 5. Board Setup

4.3.1 Step-by-step Instructions for Setting up the Hardware

1. Make sure the "GUI_EVM_VAPS_REV1.0" program is installed on the PC and can communicate with the KITVALVECNTLEVM. If the GUI_EVM_VAPS_REV1.0 software is not installed on the PC, run the Setup.exe program located on the VAPS Training package (included in the USB key provided with the kit). Follow the on-screen instructions to install GUI_EVM_VAPS_REV1.0 on the PC.

2. Attach a +12 VDC power supply (do not turn power on yet) to the VPWR connector on the KITVALVECNTLEVM board. Make sure the negative power supply terminal is connected to the screw terminal labeled "GND" and the positive power supply terminal is connected to the screw terminal labeled "VPWR".

3. Attach a +5 VDC power supply (do not turn power on yet) to the VCC5 connector on the KITVALVECNTLEVM board. Make sure the negative power supply terminal is connected to the screw terminal labeled "GND" and the positive power supply terminal is connected to the screw terminal labeled "VCC5".

4. Turn on the +12 VDC power supply. Then turn on the +5 VDC power supply.

5. Connect the USB to FTDI cable with the USB plug connected to the computer and the FTDI plug to the board as shown in Figure 6:

The USB to FTDI cable must be connected with the FTDI black wire on Pin 1

Note:
You must reset the board (by clicking on the RESET button) in order to activate the EVM software
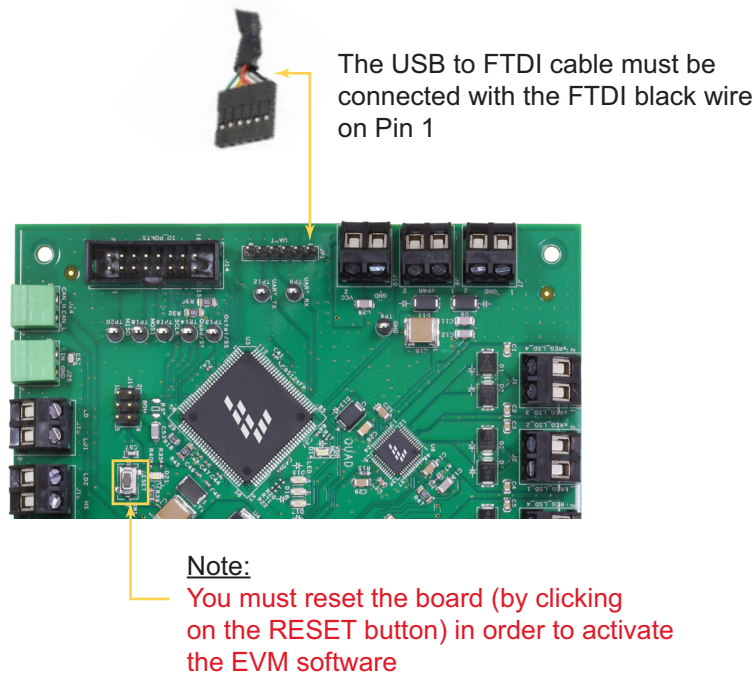
Figure 6. Connection to the PC

6. Launch the GUI "GUI_EVM_VAPS_V1.0.exe"

7. You should see the screen shown in Figure 7:
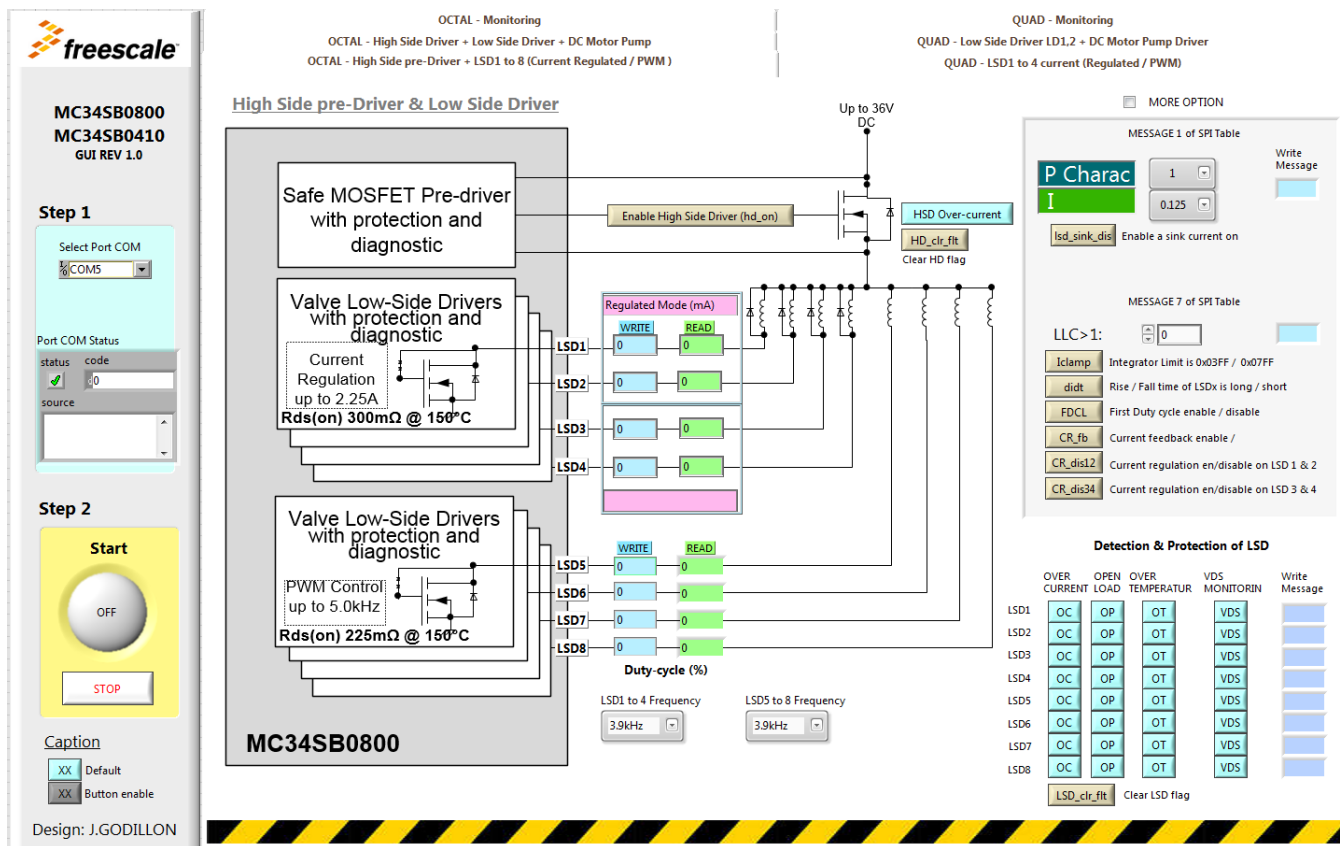
Figure 7. GUI Start-up View

8. Select the port COM used by the USB to FTDI cable.

9. Start the GUI by clicking the arrow, as shown below:
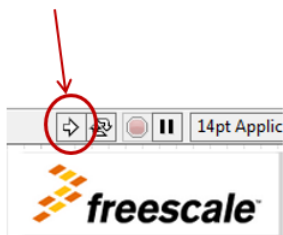
10. Select the tab "OCTAL-Monitoring"

11. You should see the screen shown in Figure 8:
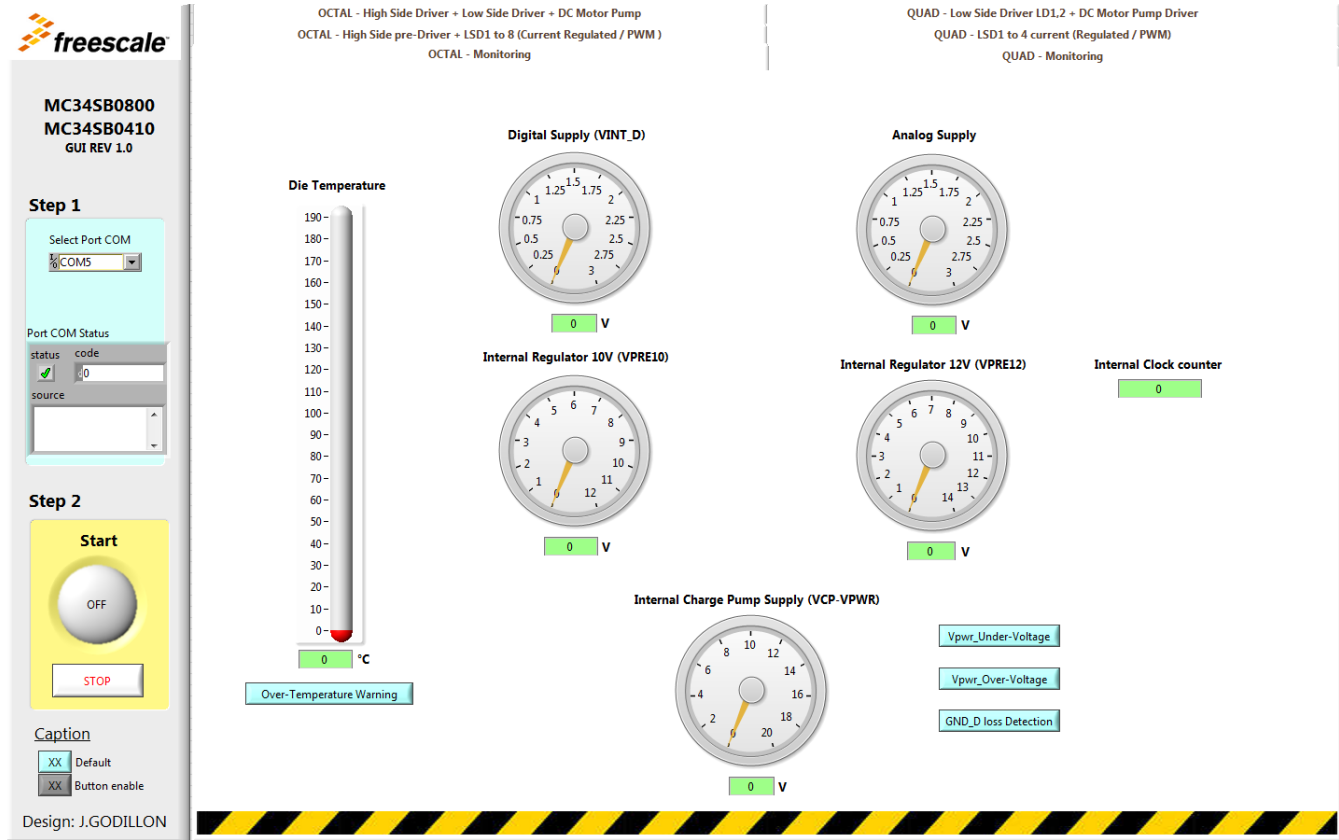
Figure 8. Octal Monitoring Screen

12. Click on the "Start" button. The voltage on each dashboard should arrive at a stabilized value.

13. As a typical example, Digital & Analog Supply will be set around 2.5 V, internal regulator 10 V around 9.5 V to 10 V and the other internal regulator 12V around 11.5 V to 12 V. Finally Internal Charge Pump supply should be set around 13 V.

5   Schematics, Board Layout and Bill of Materials

KITVALVECNTLEVM board schematics, board layout, and bill of materials are available in the Download section of the KITVALVECNTLEVM Tool Summary page: http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITVALVECNTLEVM.

6   References

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

Freescale.com Support Pages	Description	URL
KITVALVECNTLEVM	Tool Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITVALVECNTLEVM
MC34SB0410	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MC34SB0410
MC34SB0800	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MC34SB0800
MC33903	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MC33903
S12XE	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=S12XE
CodeWarrior	CodeWarrior Page	www.freescale.com/CodeWarrior

6.1   Support

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

6.2   Warranty

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

7 Revision History

Revision	Date	Description of Changes
1.0	6/2015	• Initial Release