Using the UCD3138064EVM-166

User's Guide



Literature Number: SLUUAC6
March 2013

Control Card in Digitally Controlled Off-Line Isolated Power Converters

1 Introduction

This UCD3138064EVM-166 evaluation module is to help evaluate the UCD3138064 digital controller device from Texas Instruments and aid in design of digitally controlled isolated power converters. The UCD3138064 device belongs to the UCD31xx family of highly integrated digital controllers devices optimized for isolated power supply applications. Compared to the UCD3138 device, the UCD3138064 device offers the following features:

- 64 kB of on-chip program flash memory (vs 32 kB in UCD3138)
- An additional I^2C port (Master Only) and a SPI port (Master only) for communication with external EEPROM devices (vs UCD3138)

For additional device information, please visit http://www.ti.com/product/ucd3138064.

The UCD3138064EVM-166 can be used either as a stand-alone control card to study the UCD3138064 controller device or as a DPWM controller board working with a power stage board to implement a fully regulated power converter. To help the targeted off-line isolated power applications, this EVM has been designed to work seamlessly with three power converter EVMs offered by TI UCD3138PFCEVM-026, UCD3138PSFBEVM-027, and UCD3138LLCEVM-028. Please contact Texas Instruments for assistance with firmware needed to configure the UCD3138064 device and successfully interface UCD3138064EVM-166 with abovementioned power converter EVMs, that were originally developed to support the UCD3138 device. Alternately the EVM can also be loaded with user's custom developed firmware. In order to communicate with the UCD3138064 digital controller in this EVM, a separate USB Interface Adapter EVM from Texas Instruments known as the "USB-TO-GPIO Adapter" is required. The USB-TO-GPIO adapter is NOT supplied with UCD3138064EVM-166 evaluation module and must be purchased separately. Texas Instruments also offers a Graphical User Interface in order to program the UCD3138064 controller and configure parameters when used with the 3 power converter EVMs mentioned above.

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2 Description

UCD3138064EVM-166 is an EVM board, functioning as a control card for UCD3138064RGC digital power supply applications. This EVM is used to control a power converter topology such as PFC pre-regulator, LLC Resonant Half-Bridge DC converter, and Phase-Shifted Full-Bridge DC converter, etc., by downloading the associated firmware and interfacing with an appropriate power stage board. The EVM works seamlessly with the following EVM boards, together with corresponding firmware, all developed by Texas Instrument:

- UCD3138PSFBEVM-027, A Digital Controlled Phase-Shifted Full-Bridge DC-to-DC Converter Evaluation Board.
- UCD3138PFCEVM-026, A Digital Controlled PFC Pre-Regulator Evaluation Board.
- UCD3138LLCEVM-028, A Digital Controlled LLC Half-Bridge DC-to-DC Converter Evaluation board.

Please contact Texas Instruments for assistance with firmware needed to configure the UCD3138064 device and successfully interface UCD3138064EVM-166 with abovementioned power converter EVMs, that were originally developed to support the UCD3138 device.

2.1 Typical Applications

- Off-line isolated power supply applications such as single-phase, dual-phase or bridgeless PFC, LLC resonant half-bridge dc-to-dc power converter, and phase-shifted full-bridge dc-to-dc power converter.
- Server systems.
- Telecommunication systems.

2.2 Features

- 40-pin digital signal connector to connect digital signals to power converters.
- 40-pin analog signal connector to connect analog signals to power converters.
- Choice of SPI or I^2C accessible EEPROMs for additional, onboard memory storage capacity.
- JTAG connector.
- LED indicator.
- PMBus connector to PC computer connection through USB-to-GPIO adapter.
- Rich test points to facilitate the device evaluation, system design and circuit and firmware debugging.

2.3 Configuring the EVM to access EEPROM SPI or I^2C Communication with UCD3138064

The UCD3138064EVM-166 contains all features of the UCD3138CC64EVM-030. However, the UCD3138064EVM-166 adds two programmable EEPROM devices for use with the UCD3138064 device – one accessed via SPI communication port and the other via the 2nd I^2C port in UCD3138064. Both EEPROMs cannot be accessed by the device simultaneously, since the communication hardware are multiplexed on the same pins of the device. Appropriate firmware is necessary to configure the UCD3138064 device to choose the communication port desired. In conjunction with firmware, the following hardware changes are necessary for accessing the appropriate EEPROM device:

- To choose I^2C EEPROM, connect jumpers J9 and J10, each in position 1 (Pins 1 and 2). Also, make sure J7 and J8 are disconnected.
- To choose SPI EEPROM, connect jumpers J7 and J8 as well as jumpers J9 and J10, each in position 2 (Pins 2 and 3).

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3 Electrical Specifications

Table 1. UCD3138064EVM-166 Specifications

Parameter	Conditions	Min	TYP	Max	Units
Connector J1					
PMBus connector	Port of connection to USB-to-GPIO, pin definition refer to TI standard USB-to-GPIO document SLLU093	Standard			
Connector J2					
3.3V connection to PMBus	Port to use on board 3.3VD to bias PMBus	3.25	3.30	3.35	VDC
Connector J3					
Analog signal connection	Pin definition in compliance with UCD3138	40-pin			
Connector J4					
Digital signal connection	Pin definition in compliance with UCD3138	40-pin			
Pin 39	External voltage source input	11.5	12.0	12.5	VDC
Connector J5					
JTAG	Standard JTAG communication connection	Standard			
Connector J6					
3.3V on board to external use	Port to use 3.3 V on board to bias external circuit	3.27	3.30	3.32	VDC
Connector J7					
Single Position Jumper	Jumper for SPI interface with EEPROM	Standard			
Connector J8					
Single Position Jumper	Jumper for SPI interface with EEPROM	Standard			
Connector J9					
2 Position Jumper	Jumper to choose I^2C or SPI interface with EEPROM	Standard			
Connector J10					
2 Position Jumper	Jumper to choose I^2C or SPI interface with EEPROM	Standard			
Operation Environment					
Operating temperature range	Natural convection		25		°C
Mechanical Characterstics					
Dimensions	Width		2.2		inches
	Length		3.4		
	Component height		0.5		

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4 Schematics

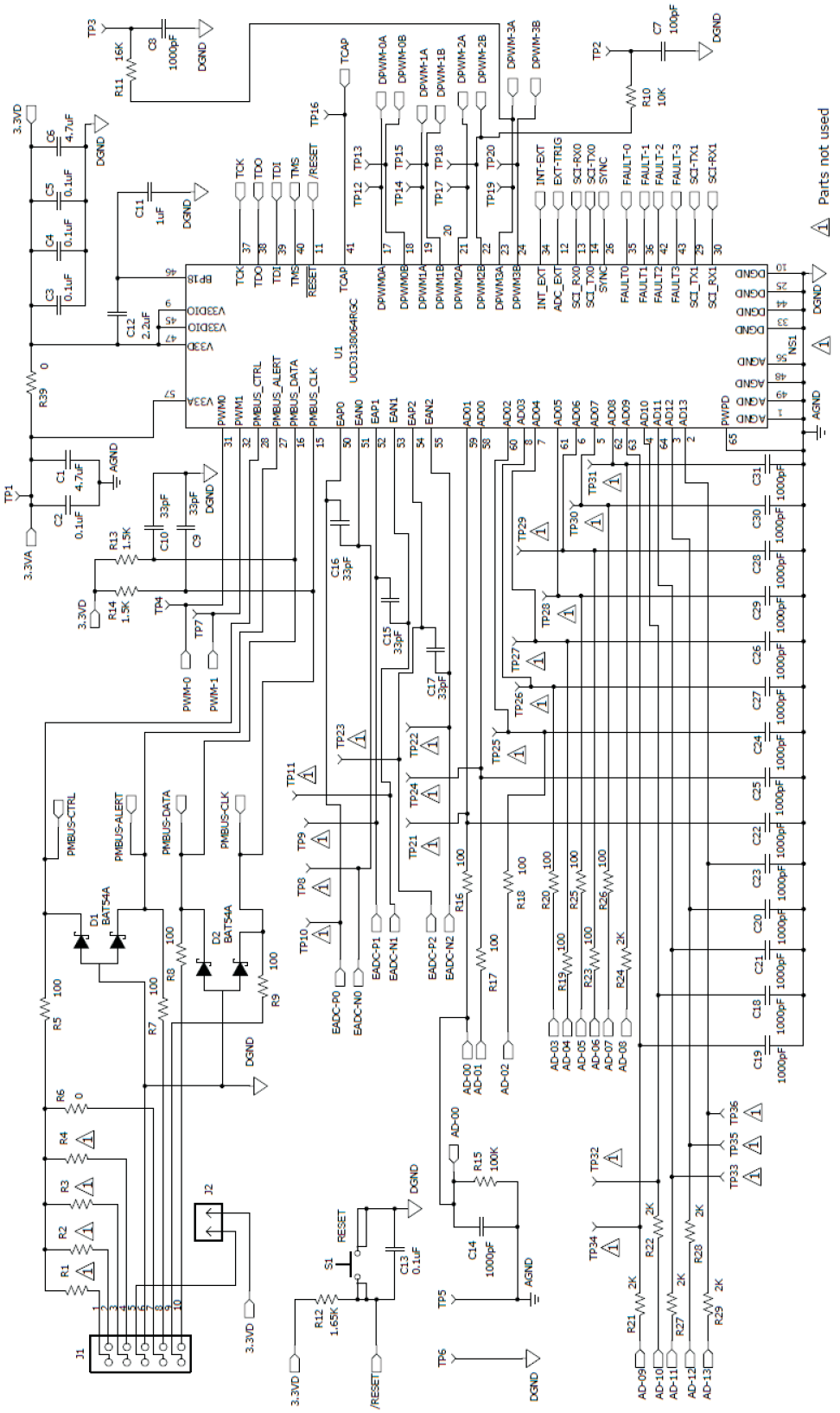


Figure 1. UCD3138064EVM-166 Schematics (1 of 2)

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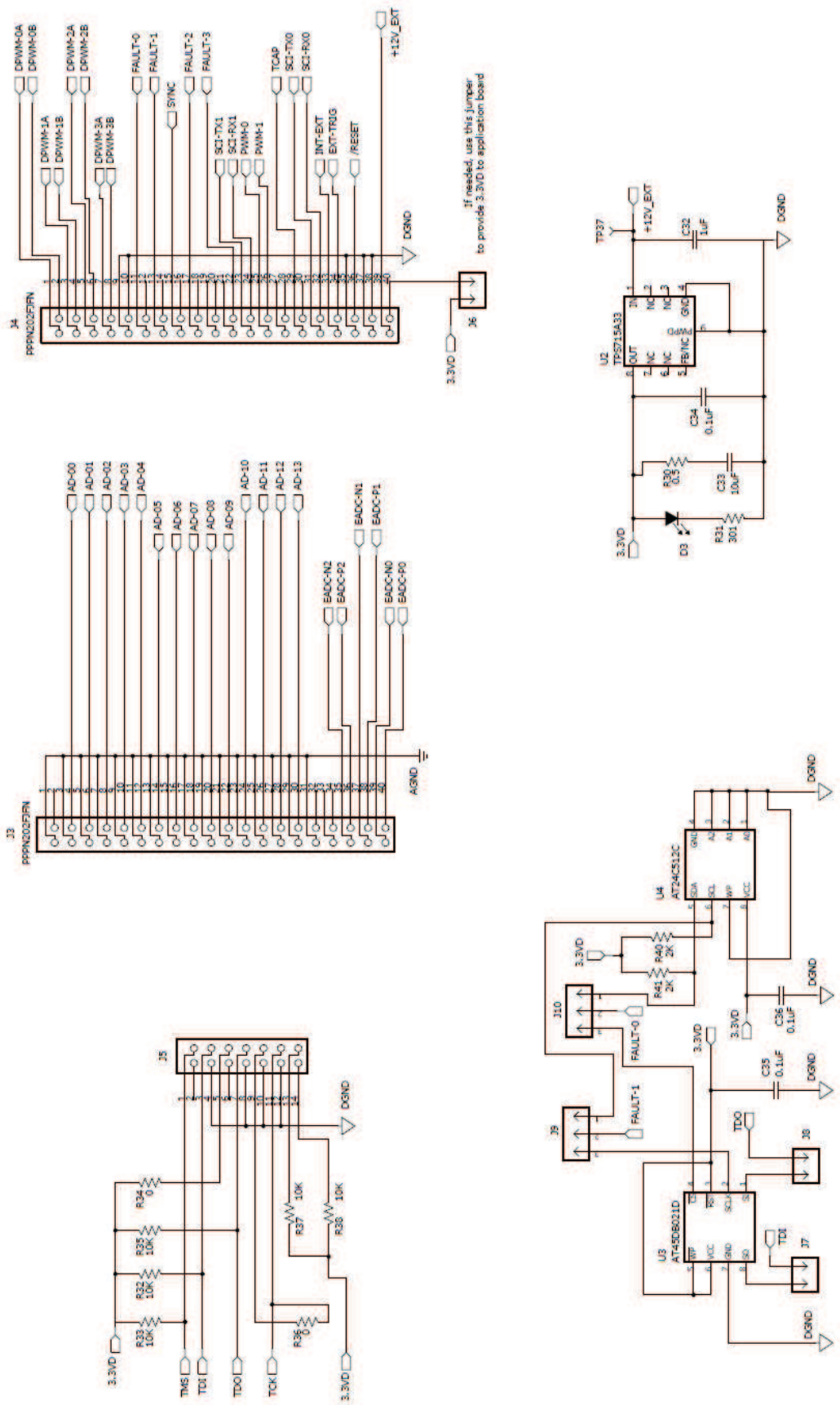


Figure 2. UCD3138064EVM-166 Schematics (2 of 2)

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5 Test Equipment

5.1 Operating System

- Microsoft Windows XP (32 bit), or Vista (32 bit), or Windows 7 (32 bit).

5.2 USB-to-GPIO Interface Adapter

This adapter is to establish the communication between the control card UCC3138064EVM-166 and the PC computer through the PMBus and the GUI, Texas Instruments Fusion Digital Power Designer. To order the USB-to-GPIO adaptor, please visit: http://www.ti.com/tool/usb-to-gpio

5.2.1 USB-to-GPIO Interface Adapter

Accessories including:

- USB interface adapter.
- USB cable, 5 pin B Mini Male to Type A Male.
- Ribbon cable, socket to socket, 10 pin, 2 headers, polarized.

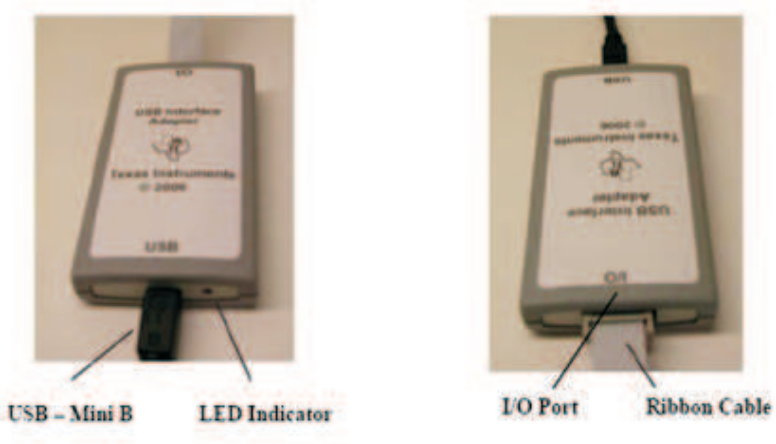


Figure 3. USB-to-GPIO Interface Adapter Outlook

5.3 Oscilloscope

An oscilloscope of analog or digital type is capable of 200-MHz bandwidth with Tektronix P6138 or equivalent oscilloscope probe.

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6 Equipment Setup

6.1 Graphical User Interface (GUI)

6.1.1 File for Installation

The GUI installation file is “TI-Fusion-Digital-Power-Designer-Version-1.8.284.exe” or newer version. To obtain the latest version of GUI, please visit TI-Fusion-Digital-Power-Designer-Version-1.8.284.exe

6.1.2 Installation

Double click and launch the .exe file to start the installation. Click Next all the way through. When present, click I accept the agreement after reading it. Then click Install. After the installation, click Finish to exit setup. Then click Exit Program.

6.1.3 Launch UCD3138064 Device GUI

The GUI for UCD3138064EVM-166 board can be launched through the below steps:

Click the window start → click All Programs → click Texas Instruments Fusion Digital Power Designer → click Device GUIs → click UCD3xxx and UCD9xxx Device GUI.

6.2 Hardware Setup

6.2.1 Setup Overview

Shown below in Figure 4 is the connection between UCD3138064EVM-166 and the PC computer through USB-to-GPIO Interface Adapter.

USB Adapter Connection

- Connect one end of the ribbon cable to the EVM (PWR166), and connect the other end to the USB interface adapter
- Connect the Mini connector of the USB cable to the USB interface adapter, and connect the other end to the USB port of the PC computer.

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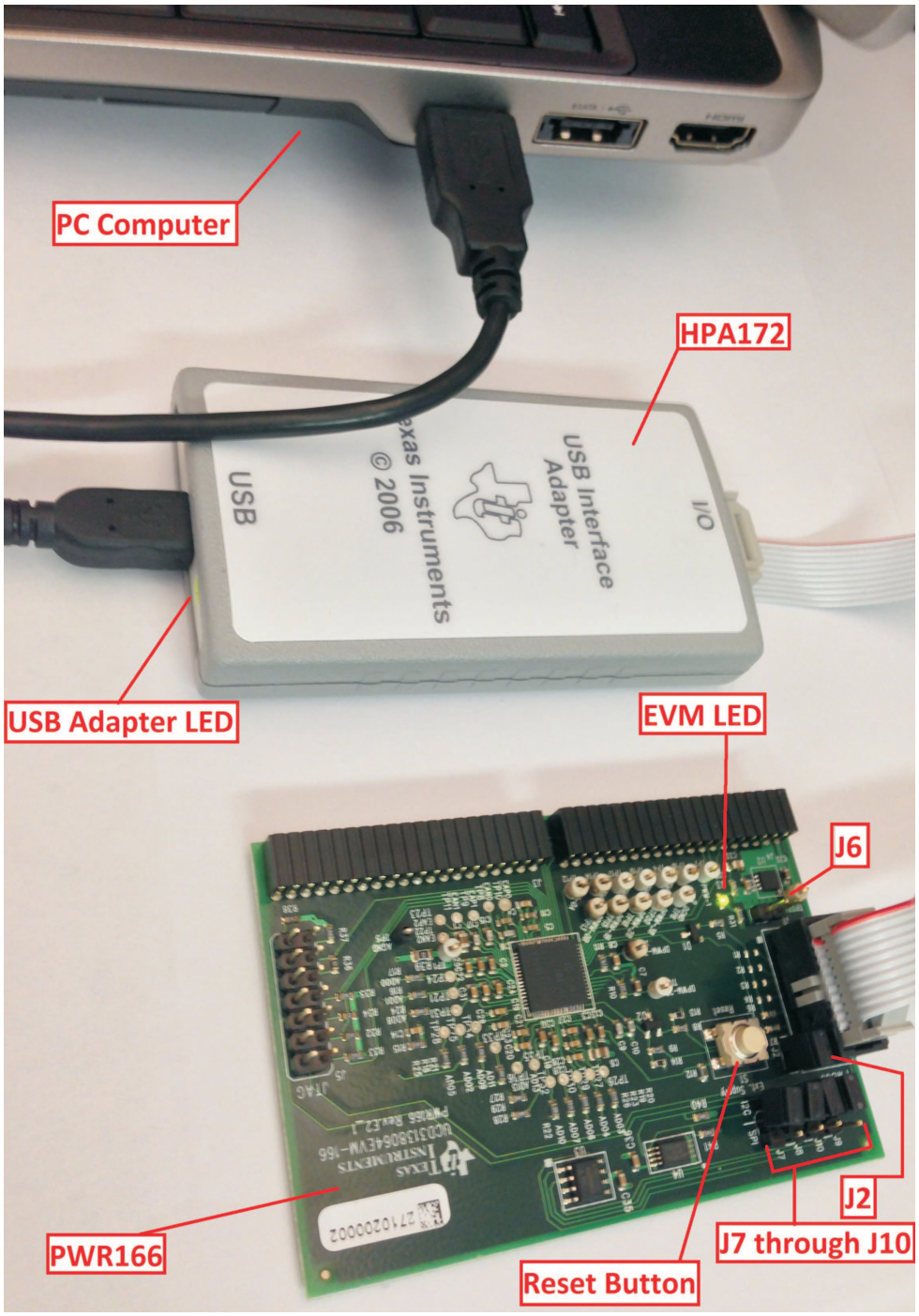


Figure 4. UCD3138064EVM-166 Test Connections

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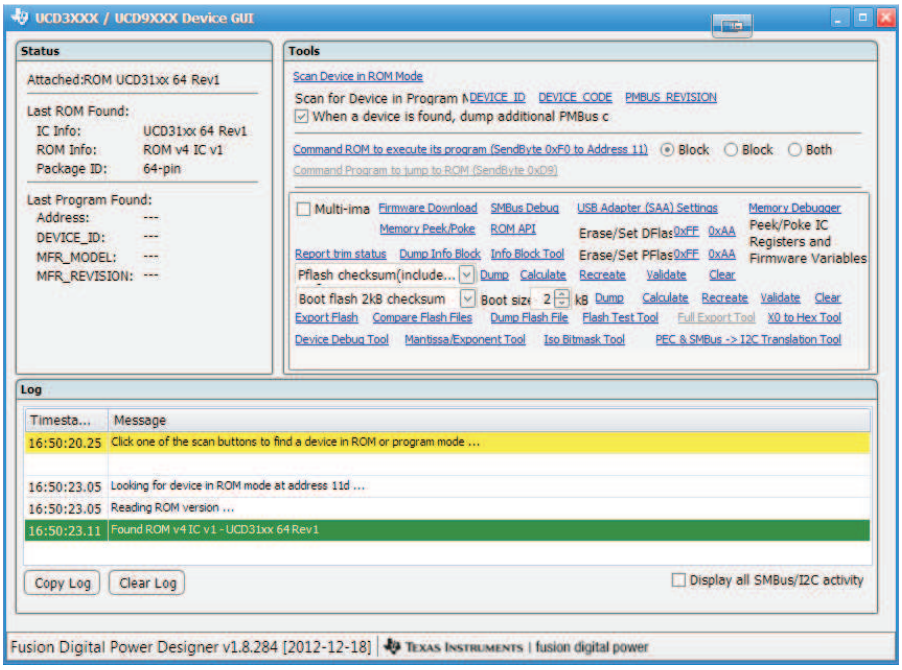


Figure 5. UCD3xxx/UCD9xxx Device GUI

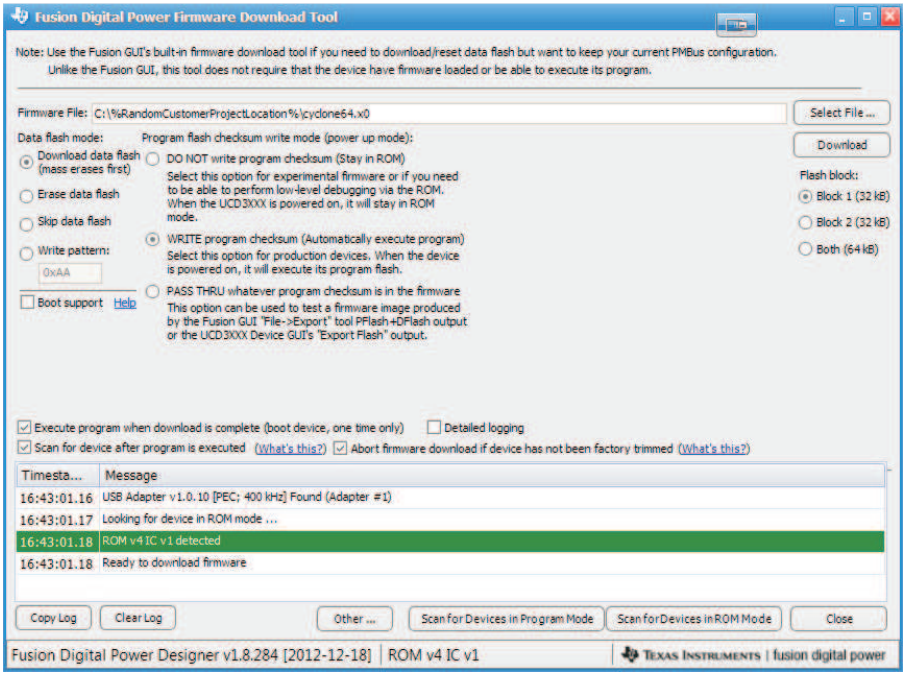


Figure 6. Firmware Code Downloading

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6.3 List of Test Points

Table 2. Test Point Funtions

TEST POINTS	NAME	DESCRIPTION
TP1	3.3VA	3.3V analog on board
TP2	RC filter 2B	DPWM2B RC filter
TP3	RC filter 3A	DPWM3A RC filter
TP4	PWM-0	PWM0
TP5	AGND	Analog GND
TP6	DGND	Digital GND
TP7	PWM-1	PWM1
TP8	EADC-N0	EAN0
TP9	EADC-P1	EAP1
TP10	EADC-P0	EAP0
TP11	EADC-N1	EAN1
TP12	DPWM-0A	DPWM0A
TP13	DPWM-0B	DPWM0B
TP14	DPWM-1A	DPWM1A
TP15	DPWM-1B	DPWM1B
TP16	TCAP	TCAP
TP17	DPWM-2A	DPWM2A
TP18	DPWM-2B	DPWM2B
TP19	DPWM-3A	DPWM3A
TP20	DPWM-3B	DPWM3B
TP21	AD-00	A to D converter channel AD01
TP22	EADC-N2	EAN2
TP23	EADC-P2	EAP2
TP24	AD-01	A to D converter channel AD00
TP25 to 36	AD-02 to -13	A to D converter channels AD02 to AD13
TP37	+12V_EXT	External 12V
J1	PMBus Connection	PMBus connector, 10 pins
J2	+3.3VD	Jumper header, if jump across, 3.3V supplied from USB connection
J3	Analog Connection	40-pin header, analog signals
J4	Digital Connection	40-pin header, digital signals
J5	JTAG Connection	14-pin header, JTAG connector
J6	+3.3VD	Jumper header, if jump across, 3.3V supplied to outside need
J7, J8	SPI Connection	Jumper headers, if jump across, SPI enabled
J9, J10	SPI/I2C Connection	2 position jumper headers, if jump position 1 (pins 1 and 2), I2C communication enabled; if jump position 2 (pins 2 and 3), SPI communication enabled
S1	Reset	UCD3138064 reset, press to reset

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7 Test Procedure

7.1 Download Firmware Codes to UCD3138064EVM-166

Set up the EVM connection based on Figure 4.

1. Set up the EVM connection based on Figure 4. The LED of USB adapter is light on.
2. Use provided jumper and jump across J2. The LED of the EVM is light on.
3. Launch the UCD3xxx/UCD9xxx device GUI following the steps described in Section 6.1.3. A window shown in Figure 5 appears.
4. Click Firmware Download; then a new window appears as shown in Figure 6. Click Select File and browse an intended firmware code file with file extension .x0, for example, cyclone64.x0; then click Download. The firmware of cyclone64.x0 is being downloaded to the device UCD3138064 on the board of UCD3138064EVM-166. When prompted, click yes to complete the download. Click Close to exit the download window.
5. After the firmware codes downloaded to the UCD3138064 device, the intended test can be performed. For example, with the provided firmware cyclone64.x0, one can observe voltage toggled between 0 V and 3.3 V on test point TP7.
6. If the firmware used the additional EEPROM bank, refer to Section 2.3 for setting up the appropriate EVM jumper connections for accessing either the I^2C or SPI EEPROM.

7.2 Erase Firmware Codes from UCD3138064EVM-166

Erase the downloaded firmware codes from UCD3138064 flash memory can be made with the below steps based on Figure 6.

1. Click Device ID
2. Click Command Program to jump to ROM (SendByte.0xD9)
3. Click Erase/Set PFlash: 0xFF

7.3 Equipment Shutdown

1. Exit the GUI.
2. Disconnect the USB cable and the ribbon cable.

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8 EVM Assembly Drawing and PCB layout

The following figures (Figure 7 through Figure 12) show the design of the UCD3138064EVM-166 printed circuit board. PCB dimensions: L x W = 3.4 inch x 2.2 inch, PCB material: FR4 or compatible, four layers and 1-oz copper on each layer.

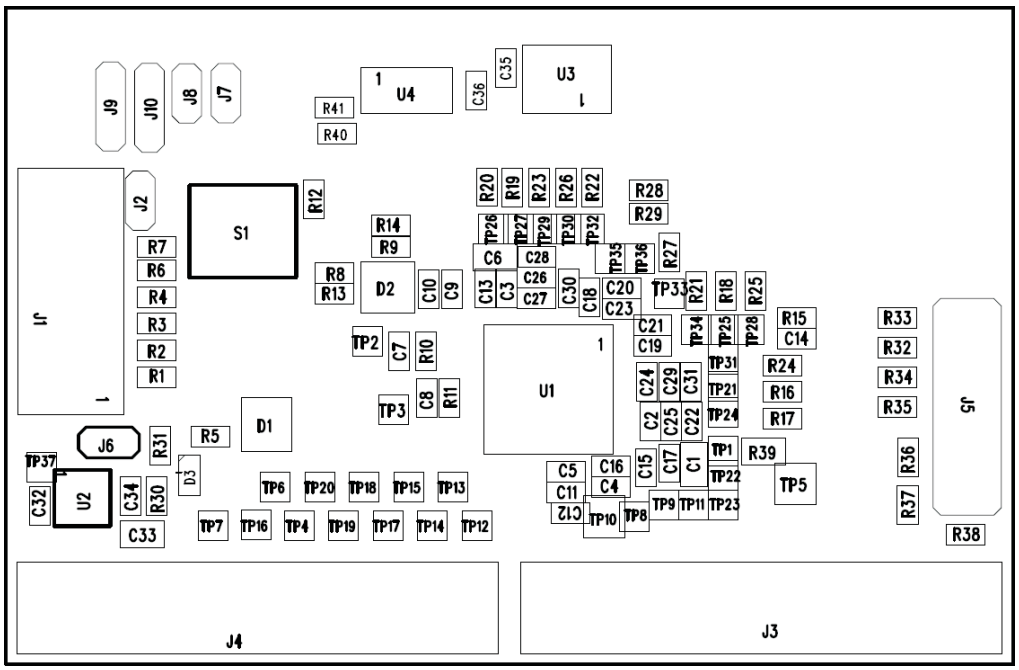


Figure 7. UCD3138064EVM-166 Top Layer Assembly Drawing (top view)

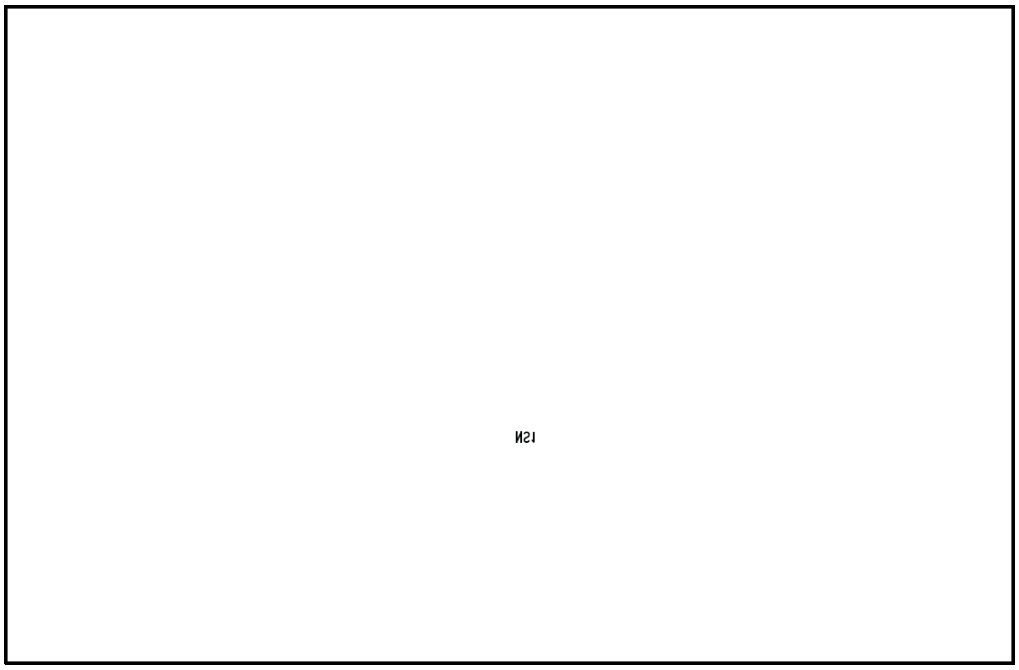


Figure 8. UCD3138064EVM-166 Bottom Assembly Drawing (no components on this side)

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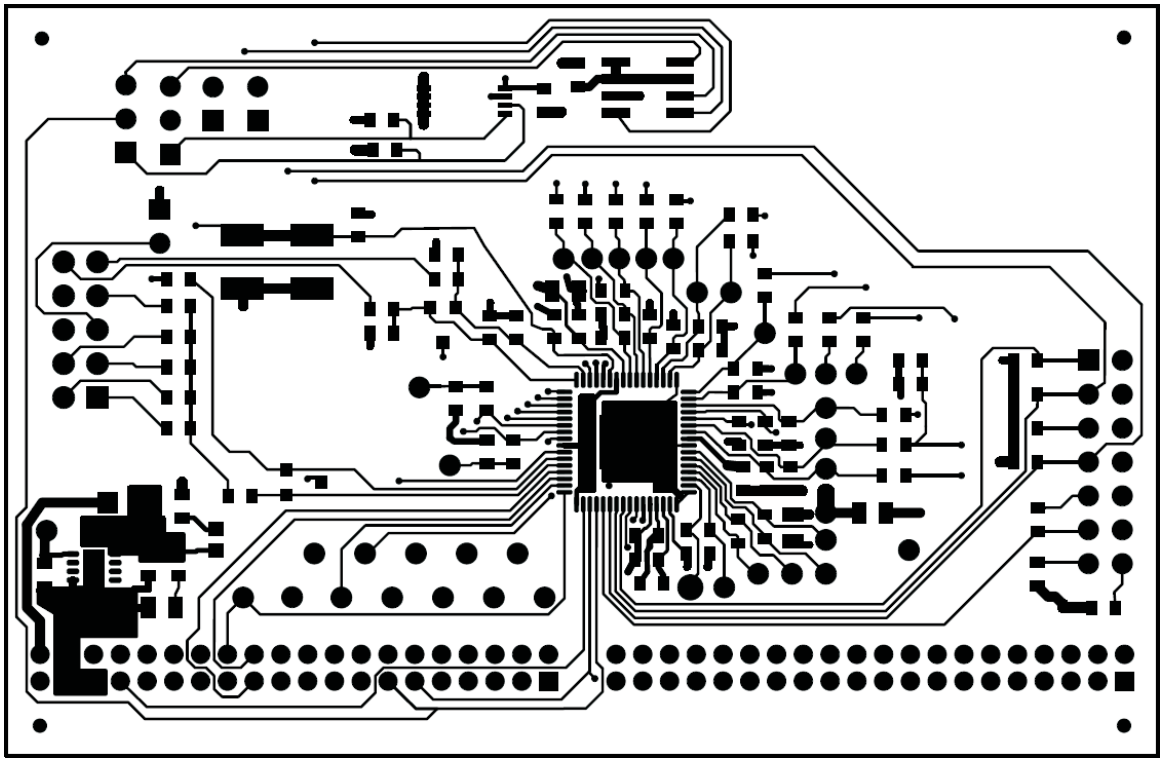


Figure 9. UCD3138064EVM-166 Top Copper (top view)

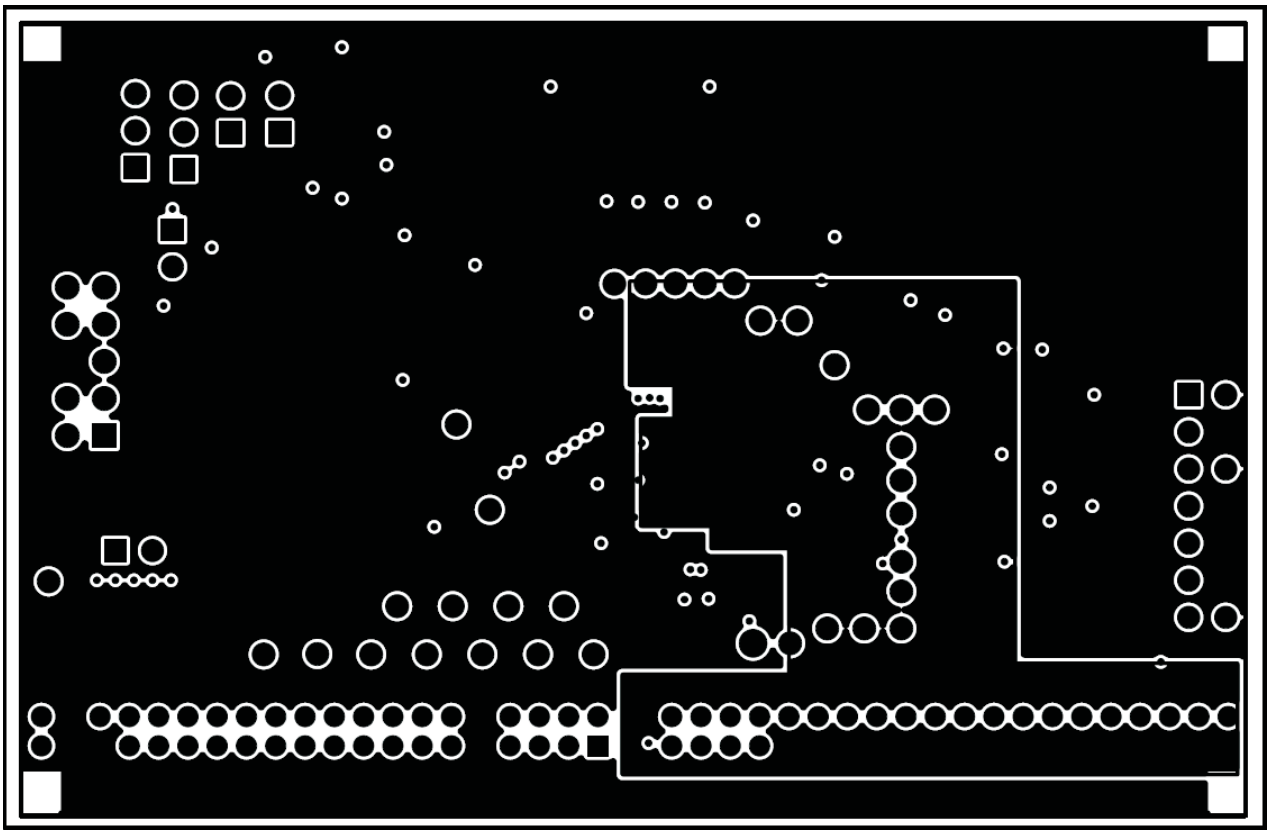


Figure 10. UCD3138064EVM-166 Internal Layer 1 (top view)

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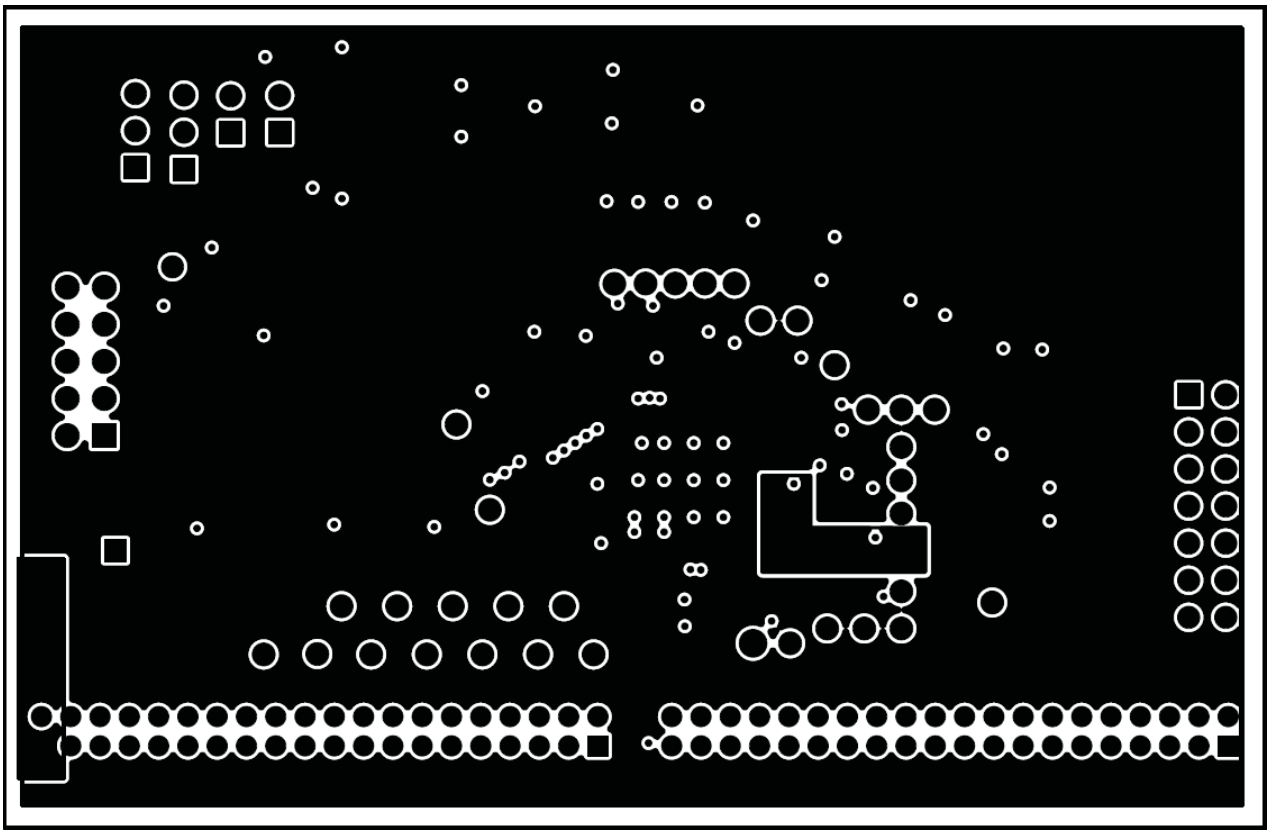


Figure 11. UCD3138064EVM-166 Internal Layer 2 (top view)

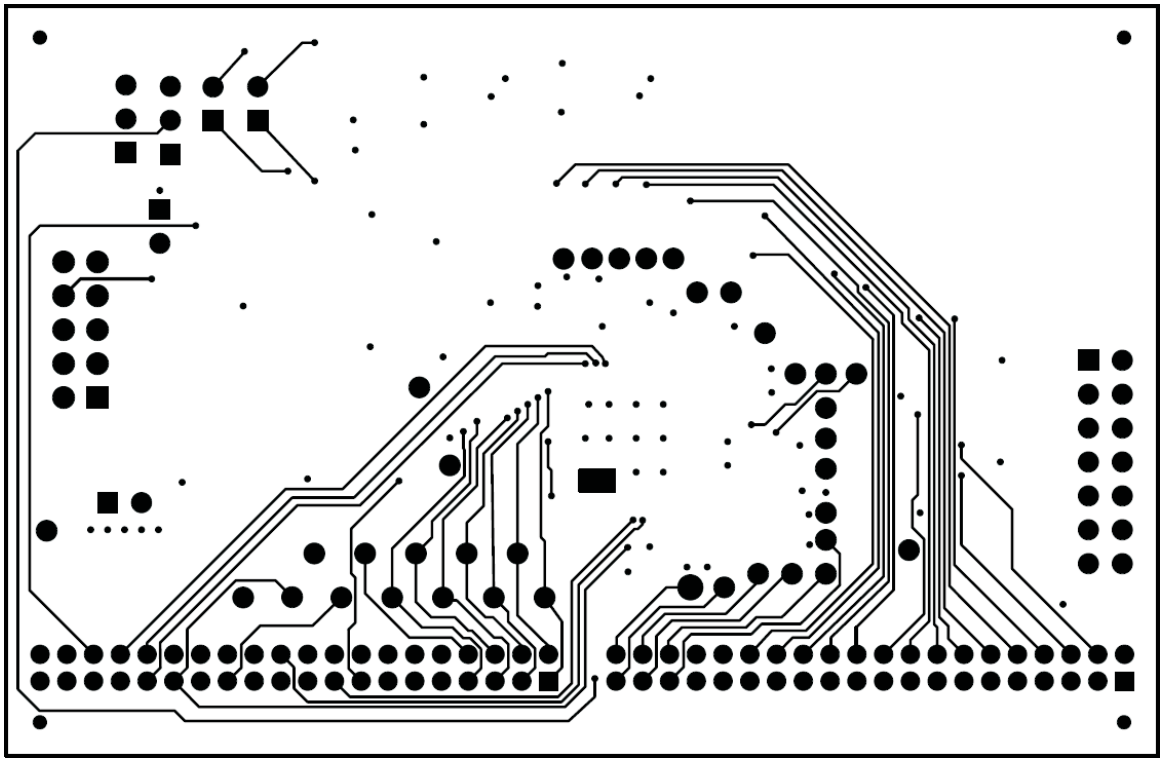


Figure 12. UCD3138064EVM-166 Bottom Copper (top view)

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9 List of Materials

The EVM components list according to the schematic shown in Figure 1 and Figure 2.

Table 3. UCD3138064EVM-166 List of Materials

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
2	C1, C6	Capacitor, ceramic, 16 V, X7R, ±10%, 4.7 µF, 0805	STD	STD
2	C11, C32	Capacitor, ceramic, 16 V, X7R, ±10%, 1 µF, 0603	STD	STD
1	C12	Capacitor, ceramic, 16 V, X5R, ±10%, 2.2 µF, 0603	STD	STD
8	C2, C3, C4, C5, C13, C34, C35, C36	Capacitor, ceramic, 16 V, X7R, ±10%, 0.1 µF, 0603	STD	STD
1	C33	Capacitor, ceramic, 10 V, X5R, ±10%, 10 µF, 0805	STD	STD
1	C7	Capacitor, ceramic, 50 V, X7R, ±10%, 100 pF, 0603	STD	STD
16	C8, C14, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31	Capacitor, ceramic, 50 V, X7R, ±10%, 1000 pF, 0603	STD	STD
5	C9, C10, C15, C16, C17	Capacitor, ceramic, 50 V, NP0, ±10%, 33 pF, 0603	STD	STD
2	D1, D2	Diode, dual Schottky, common anode, 300 mA, 30 V, SOT23	BAT54AFILM	ST
1	D3	Diode, LED, green, 2.1 V, 20 mA, 6 mcd, 0603	LTST-C190GKT	Lite On
1	J1	Header, 2 x 5 pin, 100-mil spacing, 0.330 inch x 0.800 inch	5103308-1	Tyco
4	J2, J6, J7, J8	Header, male 2 pin, 100-mil spacing, 0.100 inch x 2 inch	PEC02SAAN	Sullins
2	J3, J4	Conn header 2mm dual R/A 40 pos, 0.100 inch x 20 inch x 2 inch	PPPN202FJFN-RC	Sullins
1	J5	Header, male 2 x 7 pin, 100-mil spacing, 0.100 inch x 2 inch x 7 inch	PEC07DAAN	Sullins
2	J9, J10	Header, male 3 pin, 100-mil spacing, 0.100 inch x 3 inch	PEC03SAAN	Sullins
0	NS1	Short jumper, open, 0402	STD	STD
0	R1, R2, R3, R4	Resistor, chip, 1/16 W, 1%, open, 0603	STD	STD
6	R10, R32, R33, R35, R37, R38	Resistor, chip, 1/16 W, 1%, 10 kΩ, 0603	STD	STD
1	R11	Resistor, chip, 1/16 W, 1%, 16 kΩ, 0603	STD	STD
1	R12	Resistor, chip, 1/16 W, 1%, 1.65 kΩ, 0603	STD	STD
2	R13, R14	Resistor, chip, 1/16 W, 1%, 1.5 kΩ, 0603	STD	STD
1	R15	Resistor, chip, 1/16 W, 1%, 100 kΩ, 0603	STD	STD
8	R21, R22, R24, R27, R28, R29, R40, R41	Resistor, chip, 1/16 W, 1%, 2 kΩ, 0603	STD	STD
1	R30	Resistor, chip, 1/16 W, 1%, 0.5 Ω, 0603	STD	STD
1	R31	Resistor, chip, 1/16 W, 1%, 301 Ω, 0603	STD	STD
1	R39	Resistor, chip, 1/10 W, 1%, 0 Ω, 0805	Std	Std
12	R5, R7, R8, R9, R16, R17, R18, R19, R20, R23, R25, R26	Resistor, chip, 1/16 W, 1%, 100 Ω, 0603	STD	STD
3	R6, R34, R36	Resistor, chip, 1/16 W, 1%, 0 Ω, 0603	STD	STD
1	S1	Switch, SPST, PB momentary, sealed washable, 0.245 inch x 0.251 inch	KT11P2JM-34LFS	C & K

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Table 3. UCD3138064EVM-166 List of Materials (continued)

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
16	TP1, TP2, TP3, TP4, TP6, TP7, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP37	Test point, white, thru hole color keyed, 0.100 inch x 0.100 inch	5002	Keystone
1	TP5	Test point, black, thru hole color keyed, 0.100 inch x 0.100 inch	5006	Keystone
0	TP8, TP9, TP10, TP11, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36	Test point, O.032 inch hole, open, 0.100 inch x 0.100 inch	STD	STD
1	U1	Digital Power Controller, PFC-64	UCD3138064RGC	TI
1	U2	High Input Voltage, Micropower, 3.2 µA at 80 mA LDO, 3.3 V, QFN-8	TPS715A33DRBR	TI
1	U3	Serial-Interface Flash Memory, SO	AT45DB021D-SSH-B	Atmel
1	U4	512 kΩ, Serial EEPROM, TSSOP	AT24C512C-XHM-T	Atmel
4	See Note 5	Jumper, dual beam contacts, 0.100 inch	SPC02SYAN	Sullins
1	PCB	PCB, FR-4, 0.062 mil, 1 oz Cu all 4 layers, PWR166	ANY	ANY

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Appendix A Summary of Using Code Composer Studio v3.3

In this appendix, we describe basic steps how to use Code Composer Studio v3.3, or CCS, to compile firmware for UCD3138. A design flow is described while detailed steps for firmware code creation, and firmware debugging along with hardware are obviously beyond the scope of this user's guide and this appendix.

A.1 Setup Code Composer Studio v3.3 for UCD3138064

The recommended version of Code Composer Studio is v3.3. After completing the CCS v3.3 installation, and when first time open CCS, a window as shown in Figure A1 will be prompted to allow users to select their required configuration. For UCD3138064 device, please select "ARM7 SIMULATOR BIG ENDIAN". Click "ADD" and then "Save & Quit".

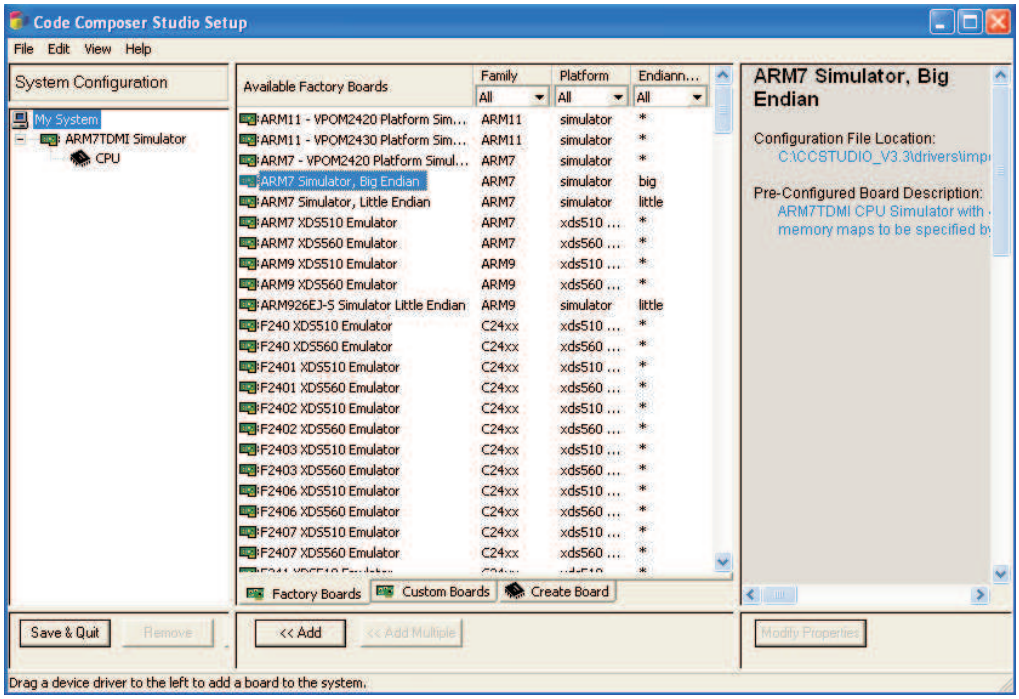


Figure 13. Setup Code Composer Studio v3.3 for UCD3138

If CCS has existing configurations in "My System", click "Launch Setup" under "File" pull-down menu. Select "Remove All" to remove the existing configurations; then select "ARM7 SIMULATOR BIG ENDIAN" as shown in Figure A1, Click "ADD" and then "Save & Quit" for UCD3138064 device.

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A.2 Build/Compile a Project using Code Composer Studio

After a project is created with all source codes developed, one can compile the project using CCS. On the matter how to create a project, please refer to reference 2, Code Composer Studio Development Tools v3.3 – Getting Started Guide. The example below is to describe typical compile process for UCD3138064 firmware. The project file name is “Cyclone64.pjt” in a folder named “Training 02”. The final result is a file with extension “.x0”. As the project name is “Cyclone64.pjt”, the final file name “Cyclone64.x0” is naturally chosen. “Cyclone64.x0” will be the final firmware code to be downloaded to the UCD3138064 device memory for UCD3138064 intended functional operation. Here are the steps for a typical compile process.

1. Copy file folder “Training 02” in any desired directory inside your PC.
2. Launch CCS and open the CCS project file “Cyclone64.pjt” from the directory where “Training 02” was saved. The following window appears shown in Figure A2.
3. Note that as project “Cyclone64.pjt” has been created and orientated for UCD3138064 functions, CCS can be launched without connecting an emulator.
4. From CCS project window, Right click on “Cyclone64.pjt (Debug)” and then select “Build Options…” the window as shown in Figure A3 appears when the “Linker” tab is selected.
5. Figure A3 shows the project “Build Options” have been selected to create the file “Cyclone64.out” from CCS.
6. The next step is to convert file “Cyclone64.out” to “Cyclone64.x0”. “Cyclone64.x0” will be the final firmware code to be downloaded to the UCD3138064 device memories. To convert “Cyclone64.out” to “Cyclone64.x0”, the first step is to click “General” tab under “Build Options for Cyclone64.pjt (Debug)”, as Figure A4 shown, under the “Build Command”, confirm the file to be converted is “Cyclone64.out”, then click ok to close “Build Options”.
7. Note 4, 5, and 6 are only necessary once per project. If using a TI developed firmware as a platform, these steps have been set up and no need to repeat.
8. As shown in Figure A5, select “Project M Rebuild All”. This will generate the file “Cyclone64.x0” based on “Cyclone64.out”, and the file of “Cyclone64.x0” is saved inside the folder where “Cyclone64.pjt” is saved.

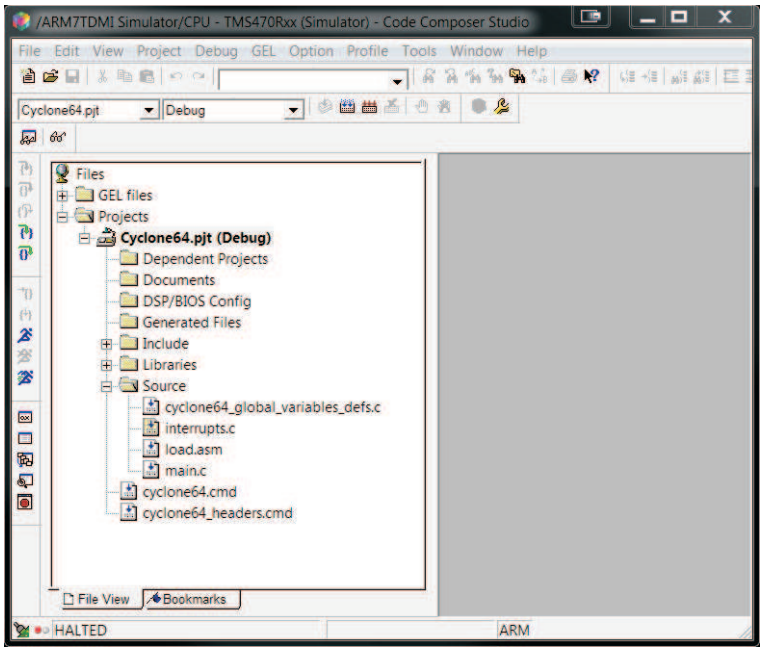


Figure 14. Open Project File With Example of “Cyclone64.pjt” – Initial Open

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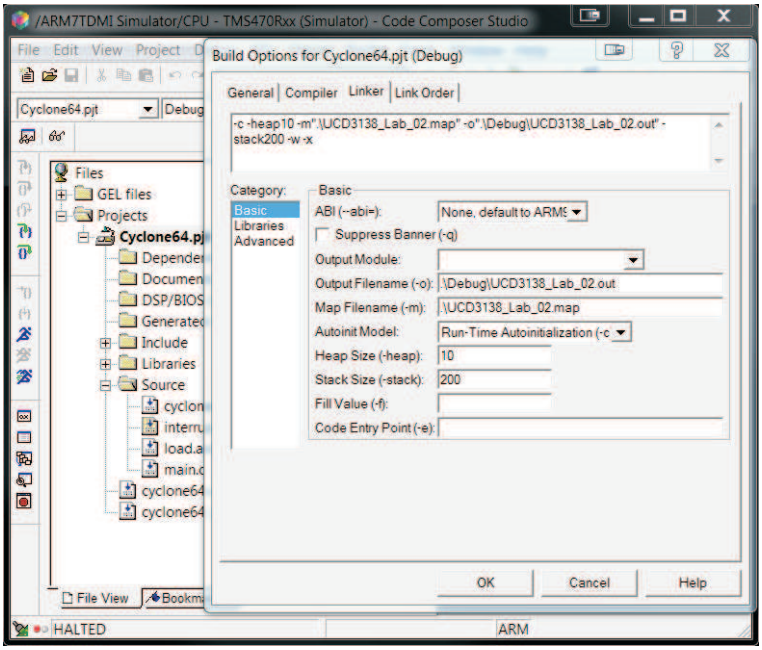


Figure 15. Open Project File With Example of "Cyclone64.pjt" – Build Options and Linker Tab

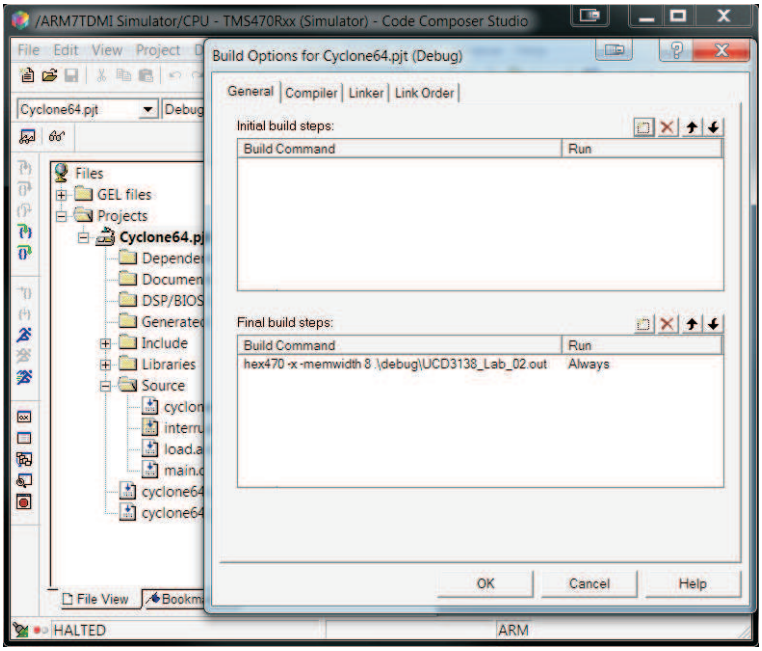


Figure 16. Open Project File With Example of "Cyclone64.pjt"- Build Options and General Tab

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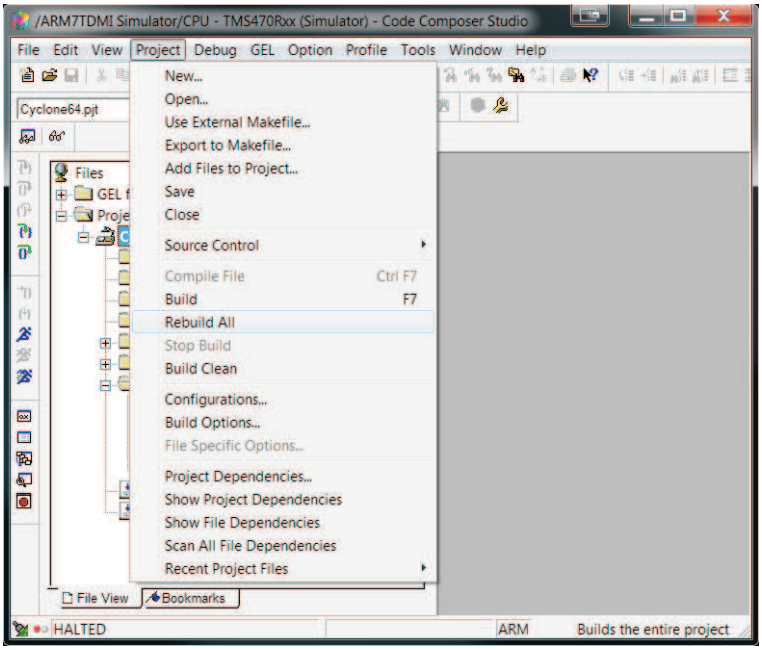


Figure 17. Open Project File With Example of "Cyclone64.pjt"- Rebuild All

A.3 References

1. *UCD3138064 Data Manual* , Texas Instruments Literature Number SLUSB72 – December 2012
2. *UCD3138 Monitoring and Communications Programmer's Manual*, Texas Instruments Literature Number SLUU996 – July 2012
3. *UCD3138 Digital Power Peripherals Programmer's Manual*, Texas Instruments Literature Number SLUU995 – July 2012
4. *UCD3138 ARM and Digital System Programmer's Manual*, Texas Instruments Literature Number SLUU994 – July 2012
5. *Code Composer Studio Development Tools v3.3 – Getting Started Guide*, Texas Instruments Literature Number SPRU509H – October 2006

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EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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西新宿三井ビル

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4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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