Using the UCD3138OL40EVM-032

User's Guide



Literature Number: SLUUA80
January 2013

Using the UCD3138OL40EVM-032

1 Introduction

UCD3138OL40CEVM-032 EVM offers an easy to use test platform for stand-alone evaluation of Texas Instruments' UCD3138 highly integrated digital controller that is optimized for isolated power applications. Featuring a 40-pin socket and comprehensive set of test points, the EVM allows hardware and firmware engineers to manipulate signals on the different pins of the device individually and study open loop operation. The EVM also offers the flexibility to realize simple closed loop control configurations (eg. using RC circuits to filter PWM output signals and regulate a DC voltage in closed loop control). Hardware ports available to communicate with the device include PMBus, UART and JTAG. The EVM accepts up to 5-V DC input and an on-board 3.3-V LDO can be used to bias the device. Alternately, using jumpers, the device can be biased using the PMBus communication pins.

NOTE: In order to download firmware and program the UCD3138 device in UCD3138OL40EVM-032, a separate EVM from Texas Instruments known as the USB-TO-GPIO Adapter is required. The USB-TO-GPIO Adapter is NOT supplied with UCD3138OL40EVM-032 and must be purchased separately. The USB-TO-GPIO Adapter serves as a communication interface adaptor or a bridge between a host PC and the UCD3138 via a standard type-A to mini-B USB cable. The USB-TO-GPIO Adapter is listed below in the related products section.

2 Description

The UCD3138OL40EVM-032 is an EVM board used to facilitate the evaluation on the UCD3138RHA digital power controller. This EVM provides hardware needed to evaluate UCD3138 40-pin device. All pins of UCD3138RHA are accessible through header connections, including all GPIO pins, ADC12 pins, front end pins, DPWM pins, and Fault pins, etc. Particularly, the board has terminal of PMBus, UART DB-9 RS232, and JTAG. All headers can be jumped to configure for a particular interested evaluation need.

2.1 Typical Applications

- UCD3138RHA Function Evaluation
- Firmware Debug
- Hardware Design Assistance

2.2 Features

- Drop-In Socket to Flexible Change the Device
- External 5.0-V Supply or PMBus Bias Supply
- JTAG Connector
- UART Connector, DB-9, RS232
- LED Indicators
- PMBus Connector to PC Computer Connection Through USB-to-GPIO Adapter
- Rich Test Points to Facilitate the Device's Evaluation, System Design and Circuit and Firmware Debugging
- Board with Jumpers (to make flexible configuration to adapt various evaluation target)

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3 Electrical Specifications

Table 1. UCD3138OL40EVM-032 Specifications

PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Connector J1					
JTAG	Standard JTAG communication connection		Standard		
Connector J3					
PMBus connector	Port of connection to USB-to-GPIO, pin definition refer to TI standard USB-to-GPIO document SLLU093		Standard		
Connector J4					
UART	Female DB-9, RS232		Standard		
Connector J5					
JTAG	Standard JTAG communication connection		Standard		
Connector J38					
J38-4	Port to use 3.3 V on board to bias external circuit	3.25	3.30	3.45	VDC
J38-3	External 5.0 V to board	4.90	5.00	5.10	
J38-2	External 3.3 V to board	3.27	3.30	3.33	
J38-1	Digital ground DGND				
Operation Environment					
Operating temperature range	Natural convection		25		°C
Mechanical Characteristics					
Dimensions	Width		4.0		inches
	Length		6.0		
	Component height		0.5		
Firmware for Testing					
Filename	PWR032_UART0.x0				
	PWR032_Test_2.x0				

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4 Schematics

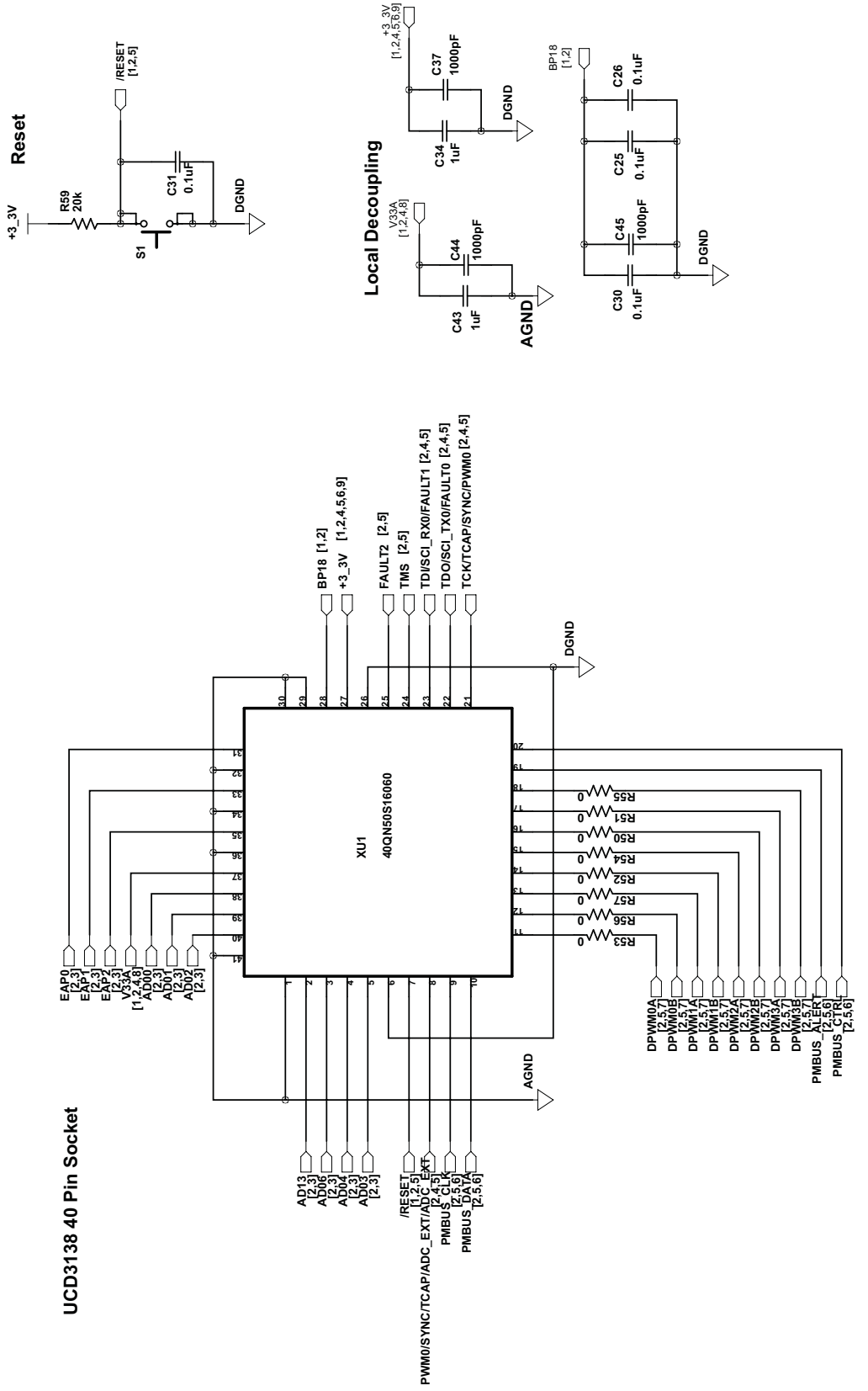


Figure 1. UCD3138OL40EVM-032 Schematics (socket) 1 of 9

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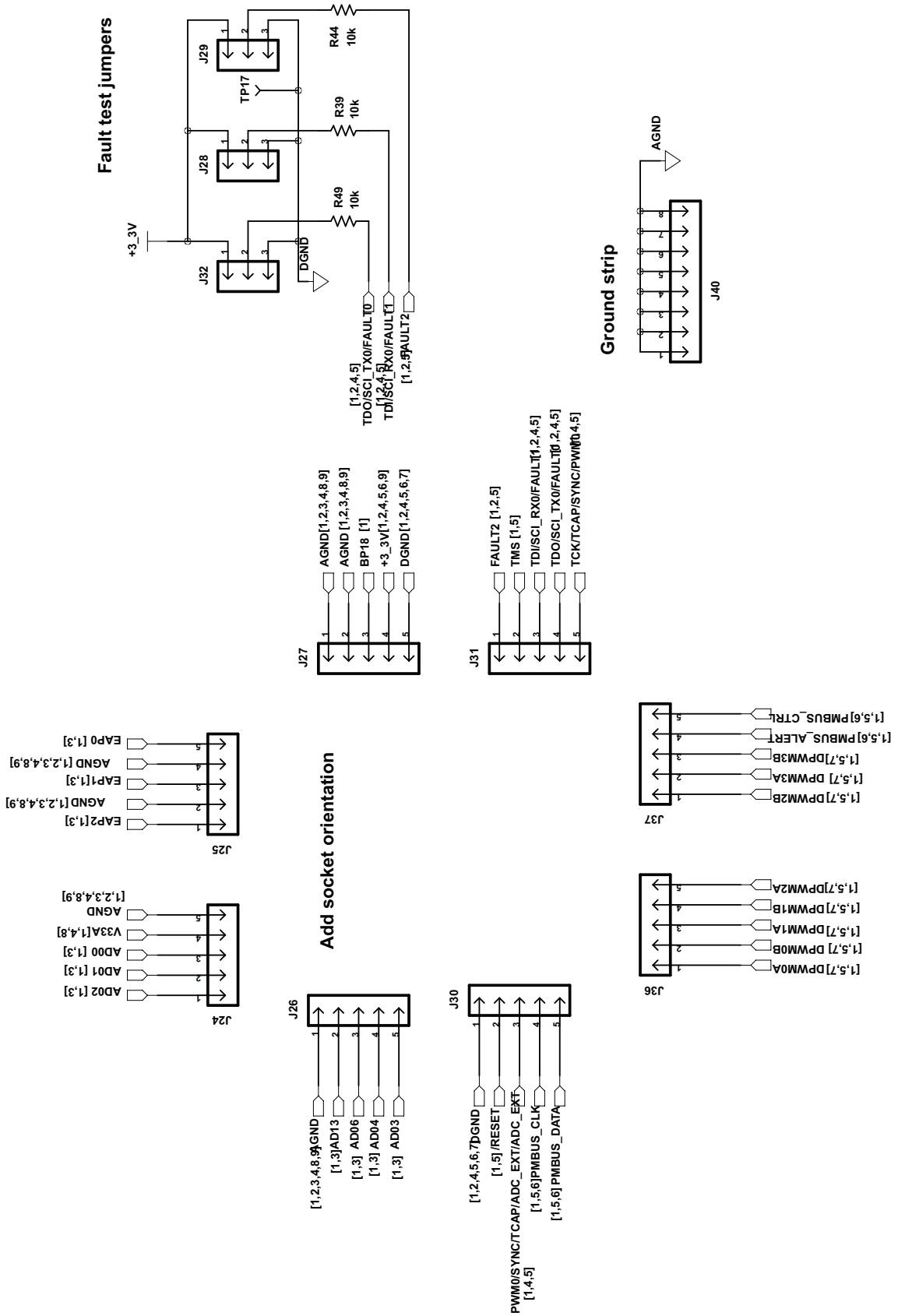


Figure 2. UCD3138OL40EVM-032 Schematics (headers) 2 of 9

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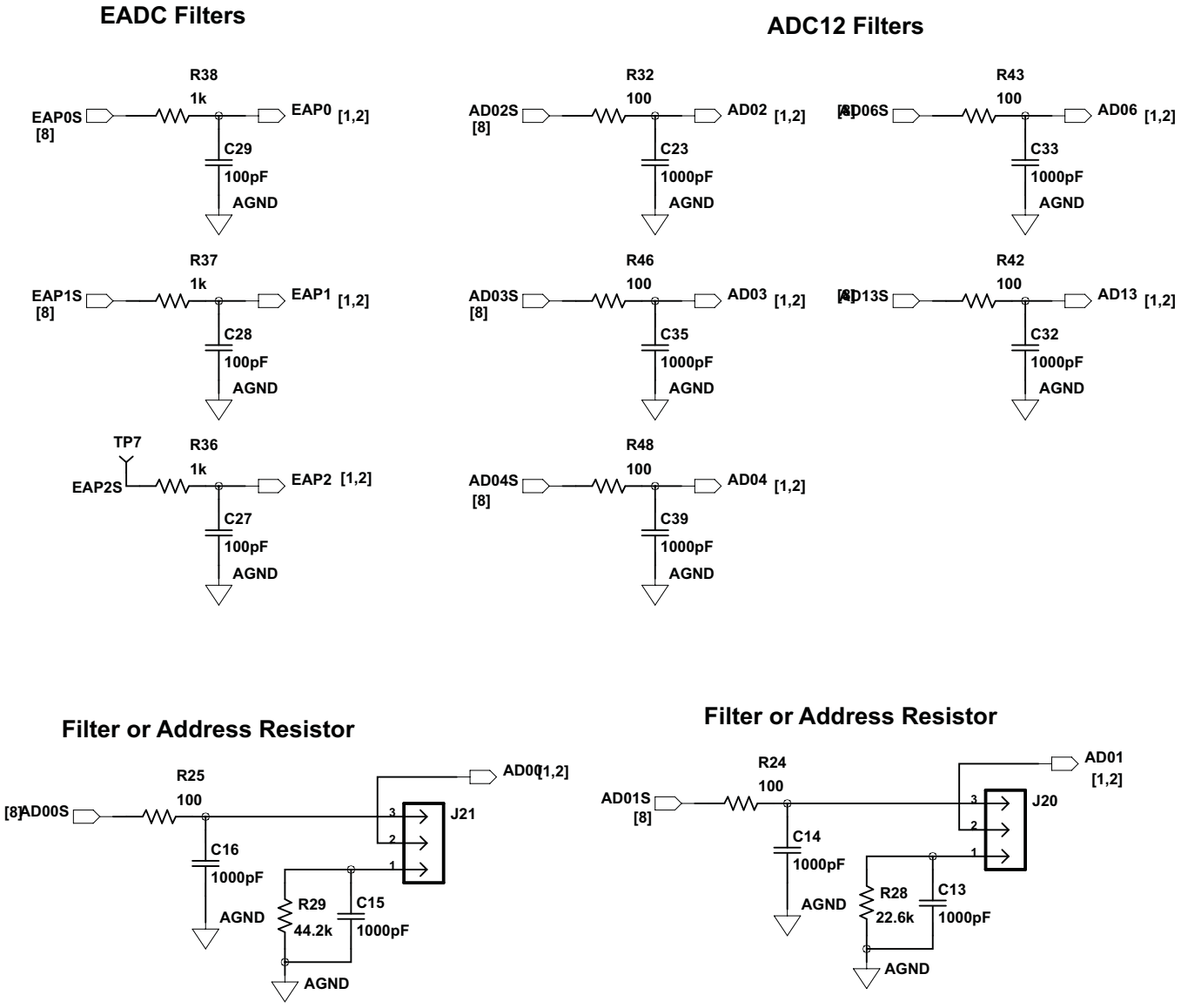


Figure 3. UCD3138OL64EVM-031 Schematics (filters) 3 of 9

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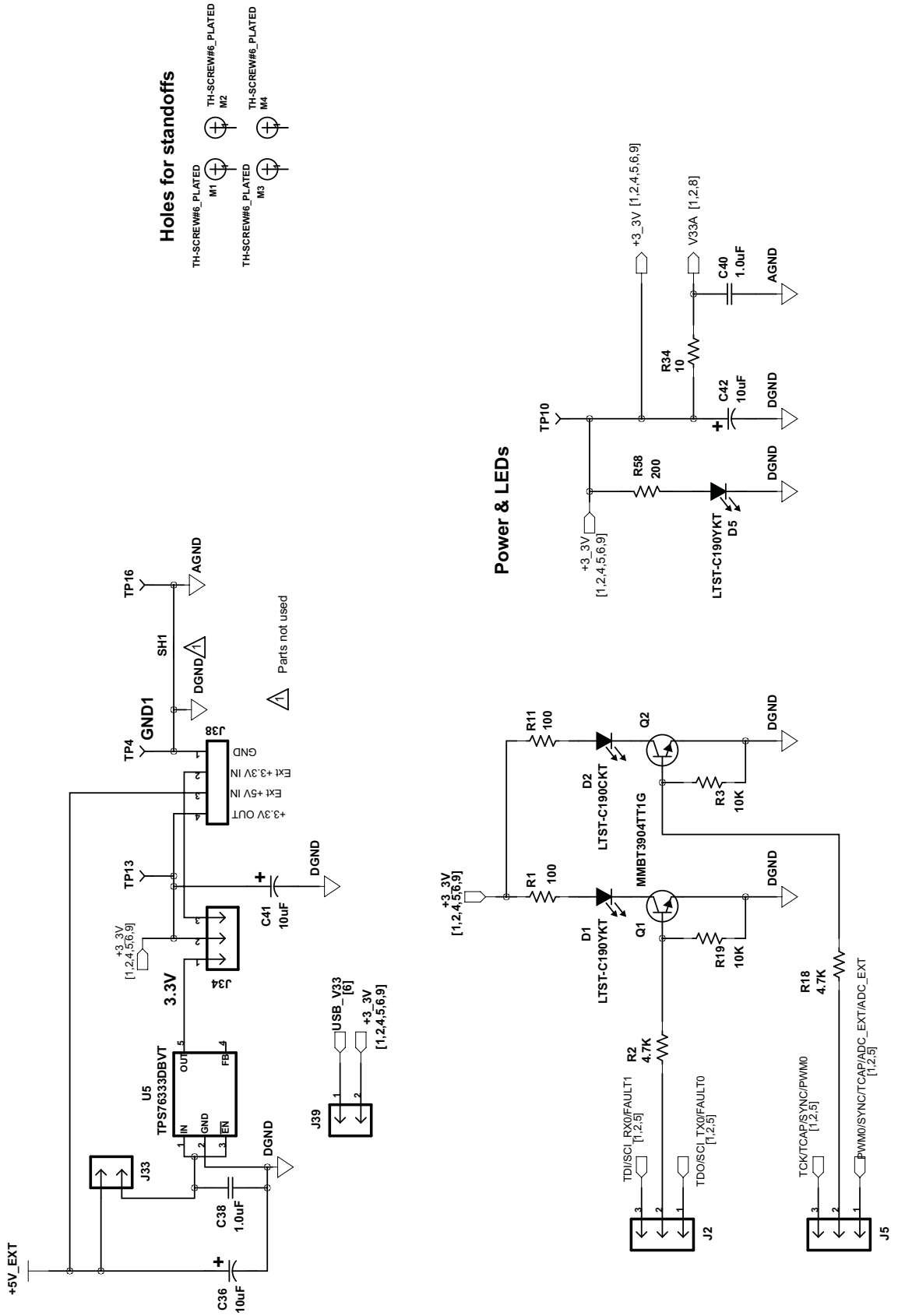


Figure 4. UCD3138OL40EVM-032 Schematics (bias and LEDs) 4 of 9

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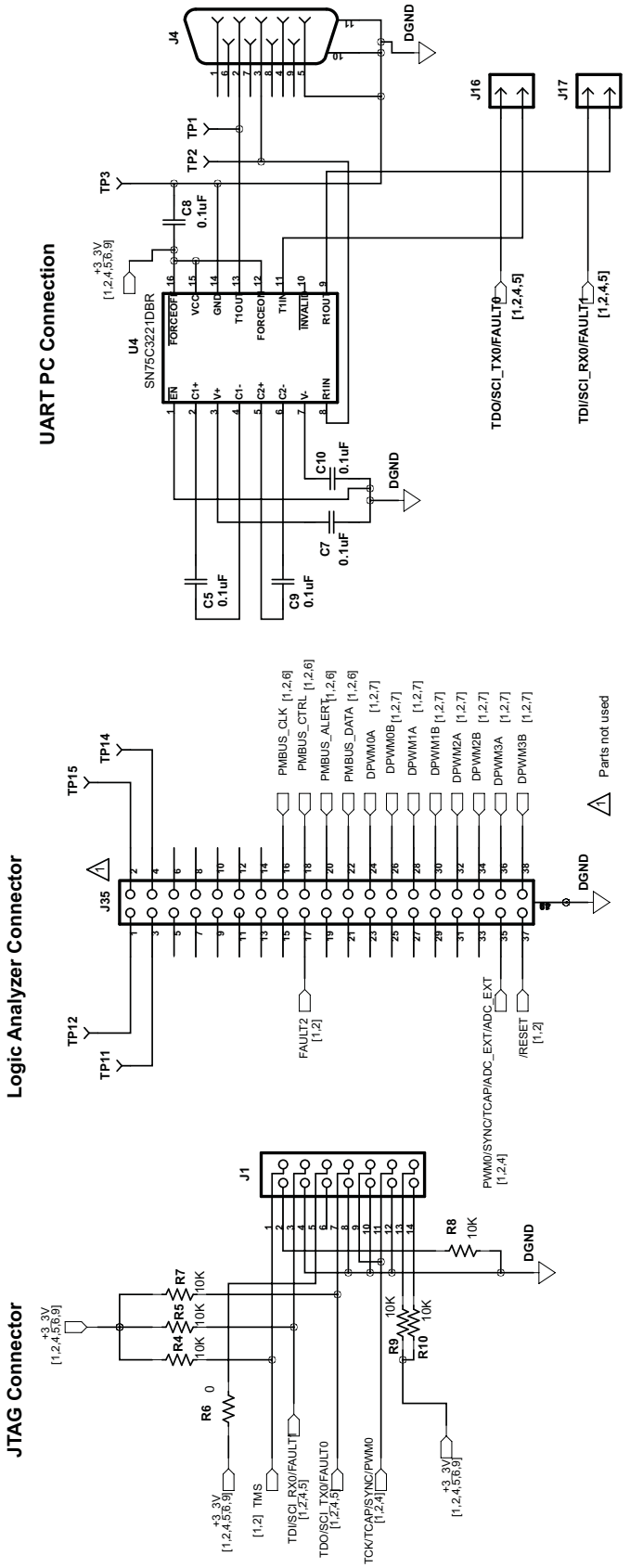


Figure 5. UCD3138OL40EVM-032 Schematics (UART and JTAG) 5 of 9

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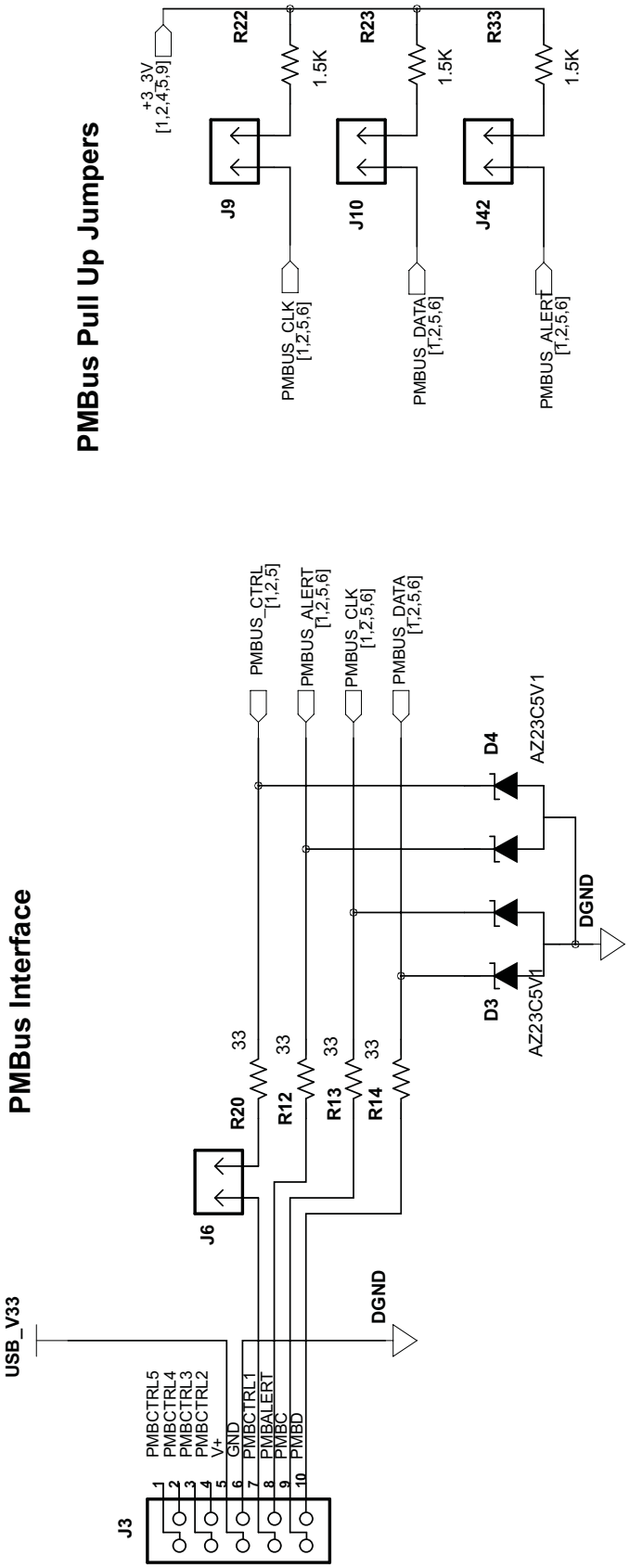


Figure 6. UCD3138OL40EVM-032 Schematics (PMBus) 6 of 9

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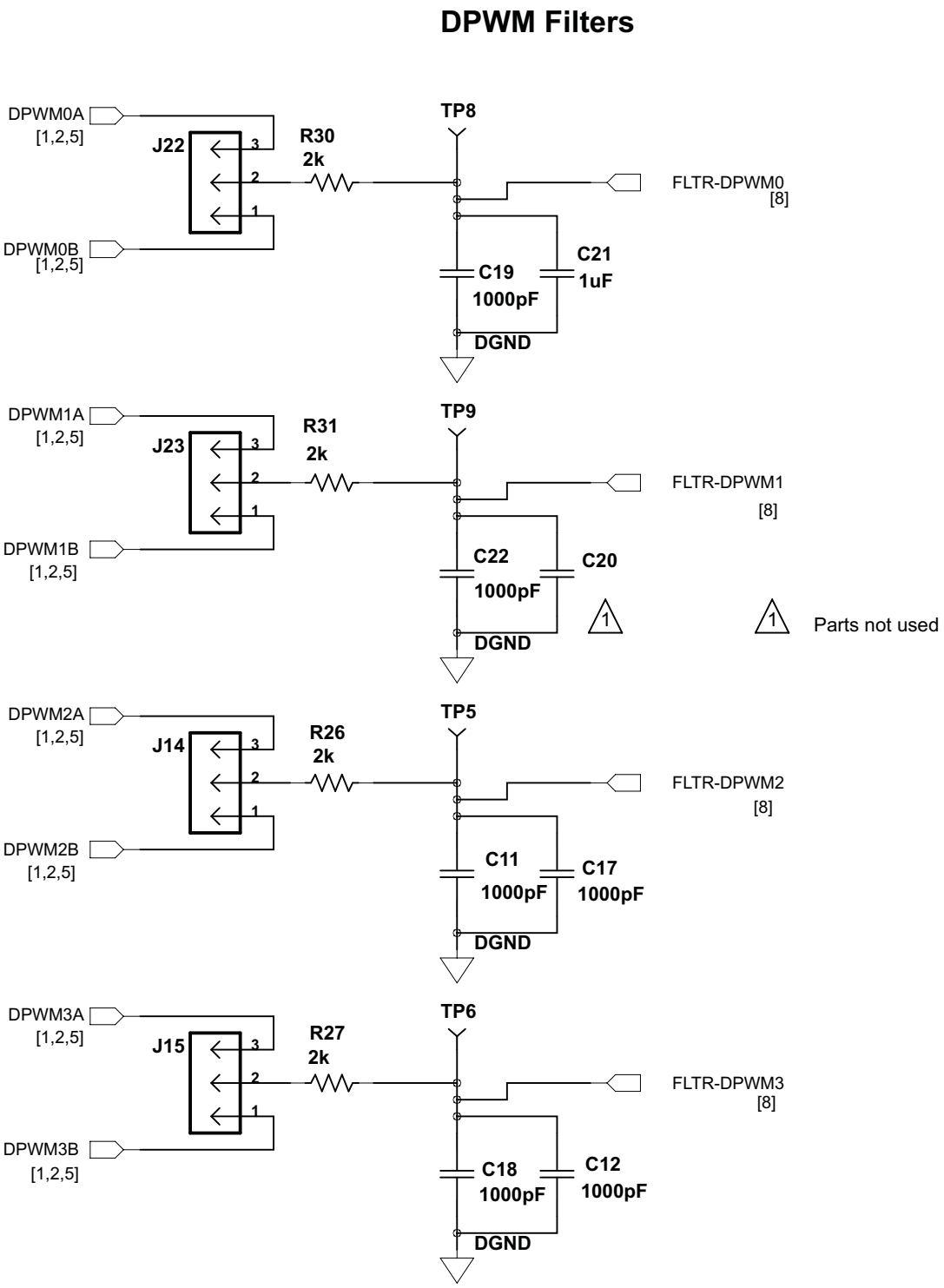


Figure 7. UCD3138OL40EVM-032 Schematics (DPWM) 7 of 9

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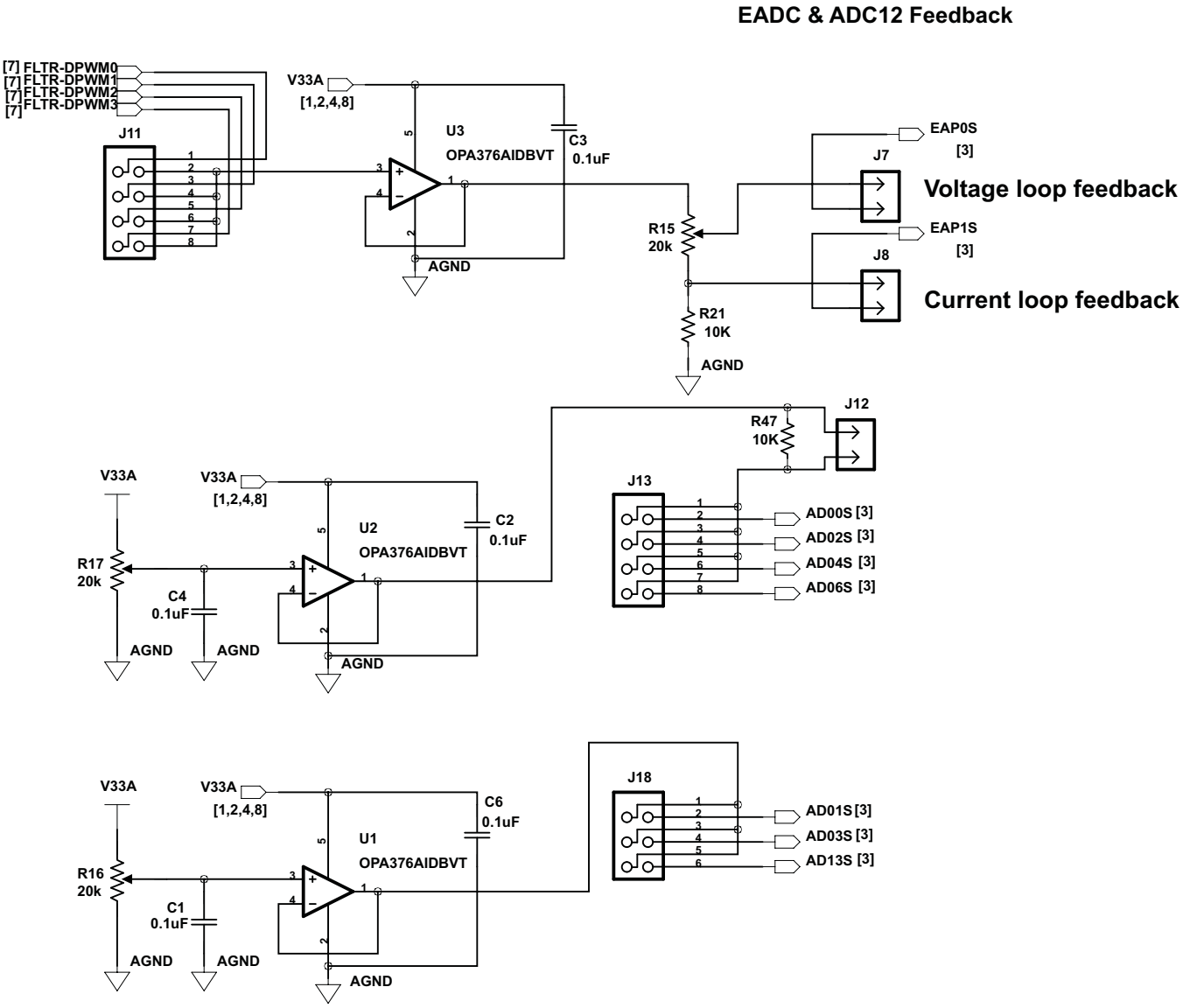
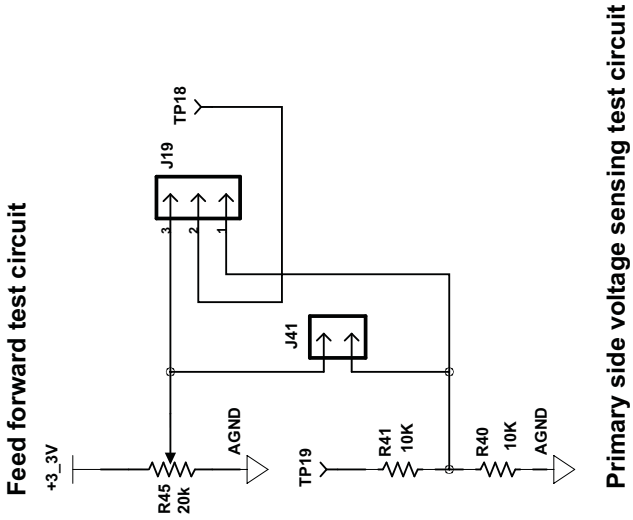


Figure 8. UCD3138OL40EVM-032 Schematics (EADC and ADC12) 8 of 9

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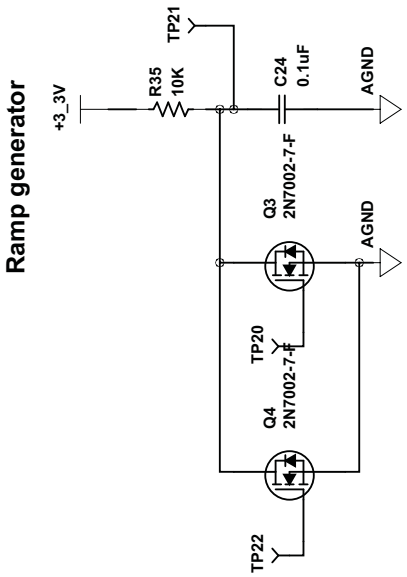


Figure 9. UCD3138OL40EVM-032 Schematics (miscellaneous) 9 of 9

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5 Test Equipment

5.1 PC Computer

5.1.1 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 UCC3138OL40EVM-032 and the PC computer through the PMBus and the GUI, Texas Instruments Fusion Digital Power Designer.

5.2.1 USB-to-GPIO Interface Adapter (HPA172)

Accessories including:

- USB interface adapter (HPA172).
- USB cable, 5-pin B mini male to type A male.
- Ribbon cable, socket-to-socket, 10 pin, 2 headers, polarized.

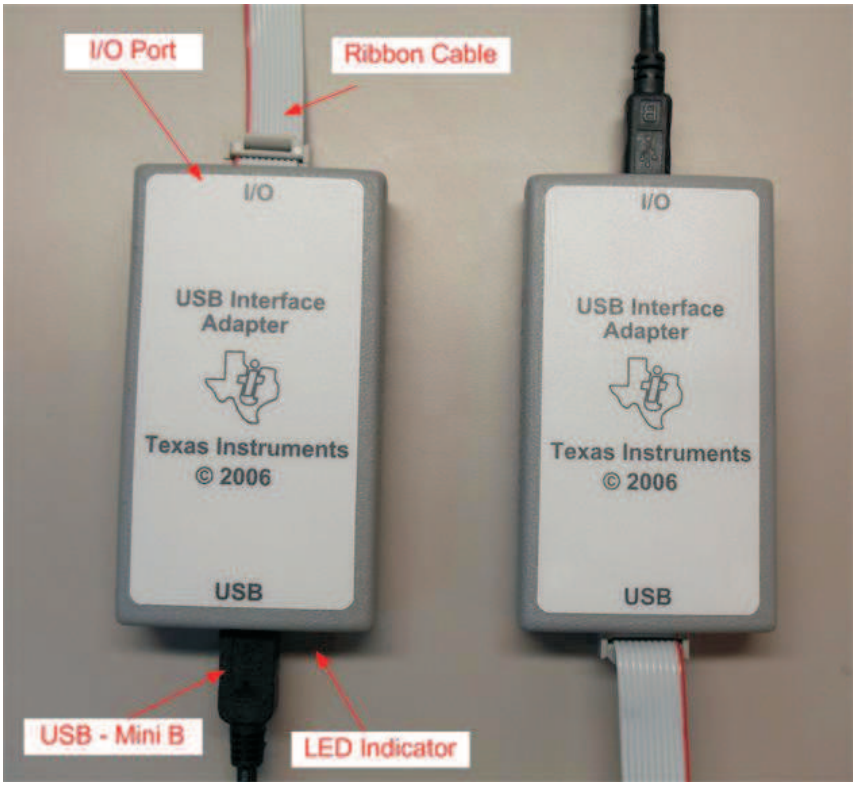


Figure 10. USB-to-GPIO Interface Adapter (HPA172)

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 GUI (Graphical User Interface)

6.1.1 File for Installation

The GUI installation file is “TI-Fusion-Digital-Power-Designer-Version-1.8.92.exe” or newer version. To get a latest version of GUI, go on TI web site, www.ti.com, search “TI Fusion Digital Power Designer” then download and install to one’s computer.

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 read it. Then click “install”. After the installation, click “Finish” to exit setup. Then click “Exit Program”.

6.1.3 Launch UCD3138 Device GUI

The GUI for UCD3138OL40EVM-032 board can be launched through the below steps:

1. Click the window “start”.
2. click “All Programs”.
3. Click “Texas Instruments Fusion Digital Power Designer”.
4. Click “Device GUIs”.
5. Click “UCD3xxx Device GUI”.

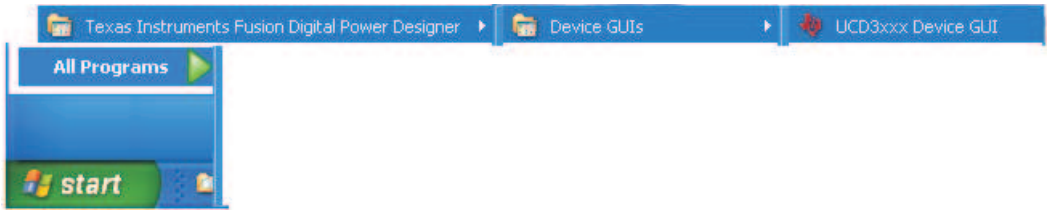


Figure 11. Device GUI Launch Path

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6.2 Hardware Setup

6.2.1 Setup Overview

Shown below in Figure 12 is the connection between UCD3138OL40EVM-032 and the personal computer through USB-to-GPIO interface adapter.

USB Adapter Connection

- Connect one end of the ribbon cable to the EVM, 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 personal computer.

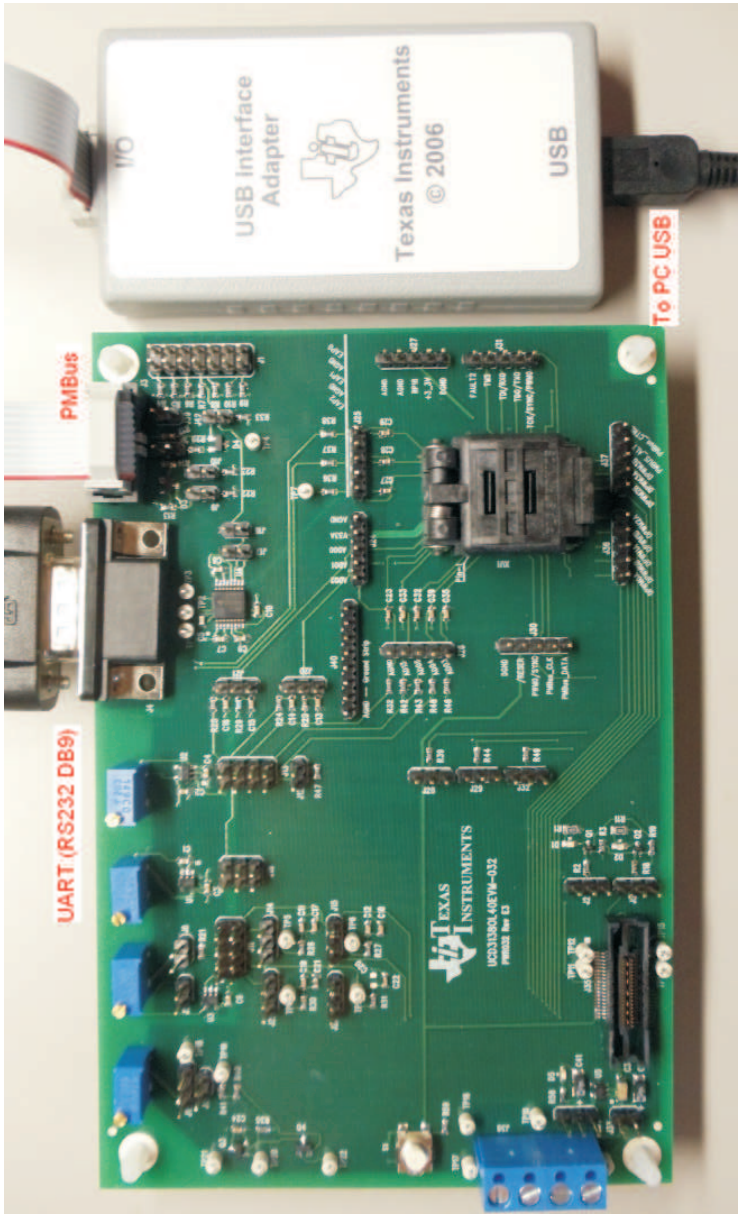


Figure 12. UCD3138OL40EVM-032 Test Connections

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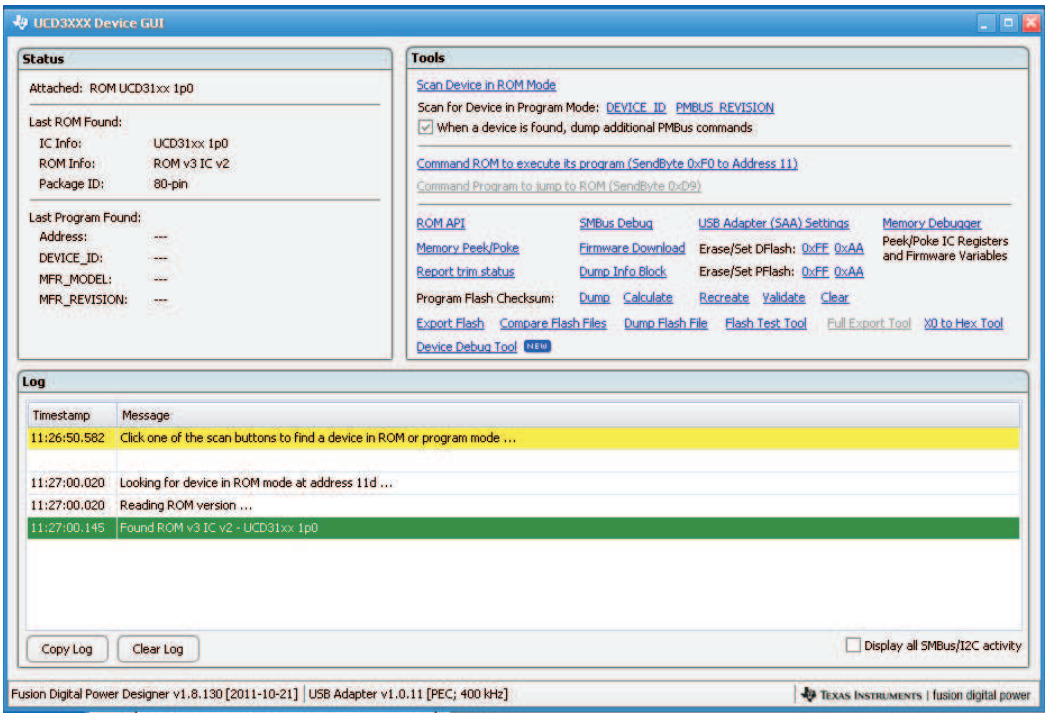


Figure 13. UCD31xx Device GUI

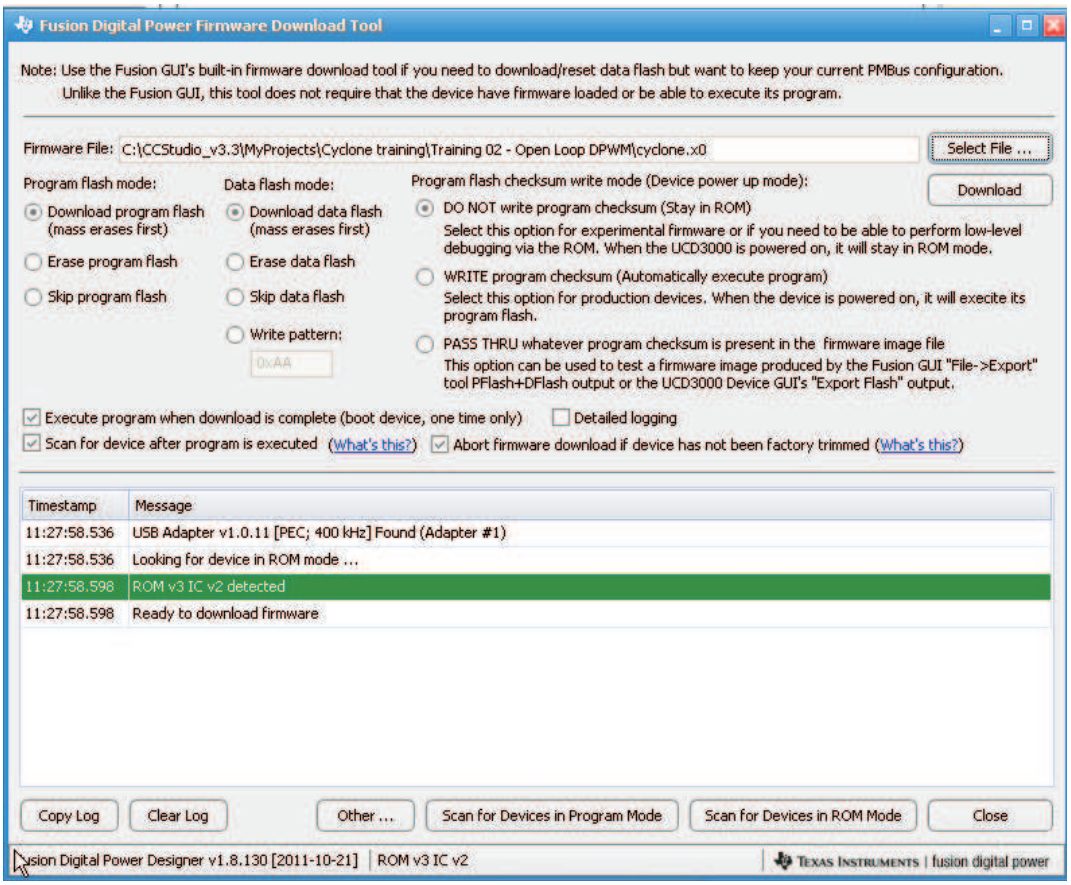


Figure 14. Firmware Code Downloading

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6.3 List of Test Points

Table 2. UCD3138OL40EVM-032 Test Point Functions

TEST POINTS	NAME	DESCRIPTION
TP1	UART J4-2	UART transmitting
TP2	UART J4-3	UART receiving
TP3	UART GND	DGND
TP4	J38-1	DGND
TP5	FLTR-DPWM2	DPWM2 front end connection
TP6	FLTR-DPWM3	DPWM3 front end connection
TP7	EAP2S	EAP2 before filter
TP8	FLTR-DPWM0	DPWM0 front end connection
TP9	FLTR-DPWM1	DPWM1 front end connection
TP10	+3.3V	3.3 V
TP11	J35-3	Logic analyzer pin 3
TP12	J35-1	Logic analyzer pin 1
TP13	J38-4	3.3 V to outside circuit
TP14	J35-4	Logic analyzer pin 4
TP15	J35-2	Logic analyzer pin 2
TP16	AGND	AGND
TP17	DGND	DGND
TP18	FFCS	Feed forward control selection
TP19	FFC_adj	Feed forward control adjustment
TP20	Q3 Gate	Ramp generator
TP21	Q3 and Q4 Drain	Ramp generator
TP22	Q4 gate	Ramp generator
J1		JTAG
J2, 5		LED D1 and D2 control
J3,6,9,10,42		PMBus
J4,16,17		UART, DB-9 female, RS232
J7, 8,11		EADC and DPWM
J12,13,18,20,21		ADC12
J14,15, 22, 23		DPWM
J19,41		Feed forward control
J24,25,26,27,30,31,36,37		UCD3138 pinout headers
J28,29,32		Faults connections
J33,34,38,39		Board bias power management
J35		Logic analyzer connector, not populated
J40		AGND strip
S1		UCD3138 reset, press to reset

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7 Test Procedure

7.1 Download Firmware Codes to UCD3138OL40EVM-032

Set up the EVM connection based on Figure 12.

1. Set up the EVM connection based on Figure 12. The LED of USB adapter is lighted up.
2. Use provided jumper jump across J39. The LED of the EVM is lighted on.
3. Launch the UCD31xx device GUI following the steps described in Section 6.1.3. A window shown in appears.
4. Check “Download program flash”, “Download data flash” and “DO NOT write program checksum” as shown in Figure 14.
5. Click “Firmware Download”; then a new window appears as shown in Figure 14. Click “Select File” and browse an intended firmware code file with file extension “.x0”; then click “Download”. Click “Close” to exit the download window.
6. After the firmware codes downloaded to the UCD3138 device, the intended test can be performed. In this user’s guide, we use “PWR032_UART0.x0” and “PWR032_Test_2.x0” to show how to use the board.

7.2 Example Test and Steps

1. Setup hyper terminal using RS232 serial port with the settings shown. Then launch the hyper terminal.

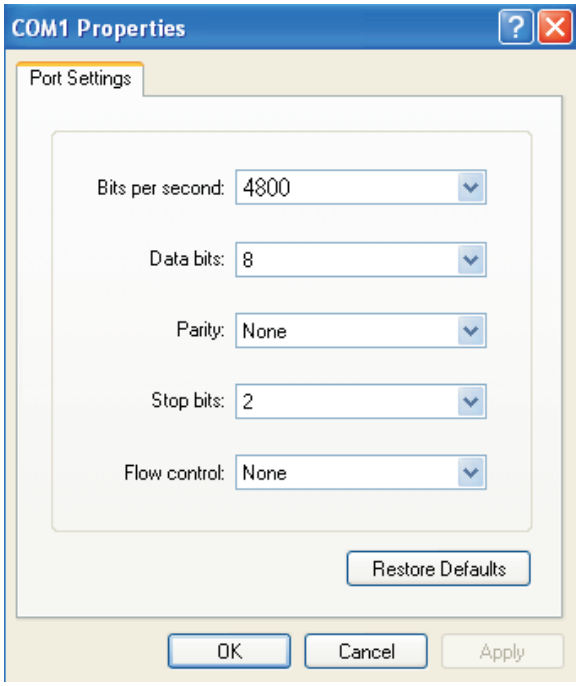


Figure 15. Hyper Terminal Settings

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2. Place jumpers on the following Headers, jump across J J2 pin 1 and pin 2, i.e., J2(1 and 2), J5(1 and 2), J13(1 and 2, 3 and 4, 5 and 6), J18(1 and 2, 3 and 4, 5 and 6).

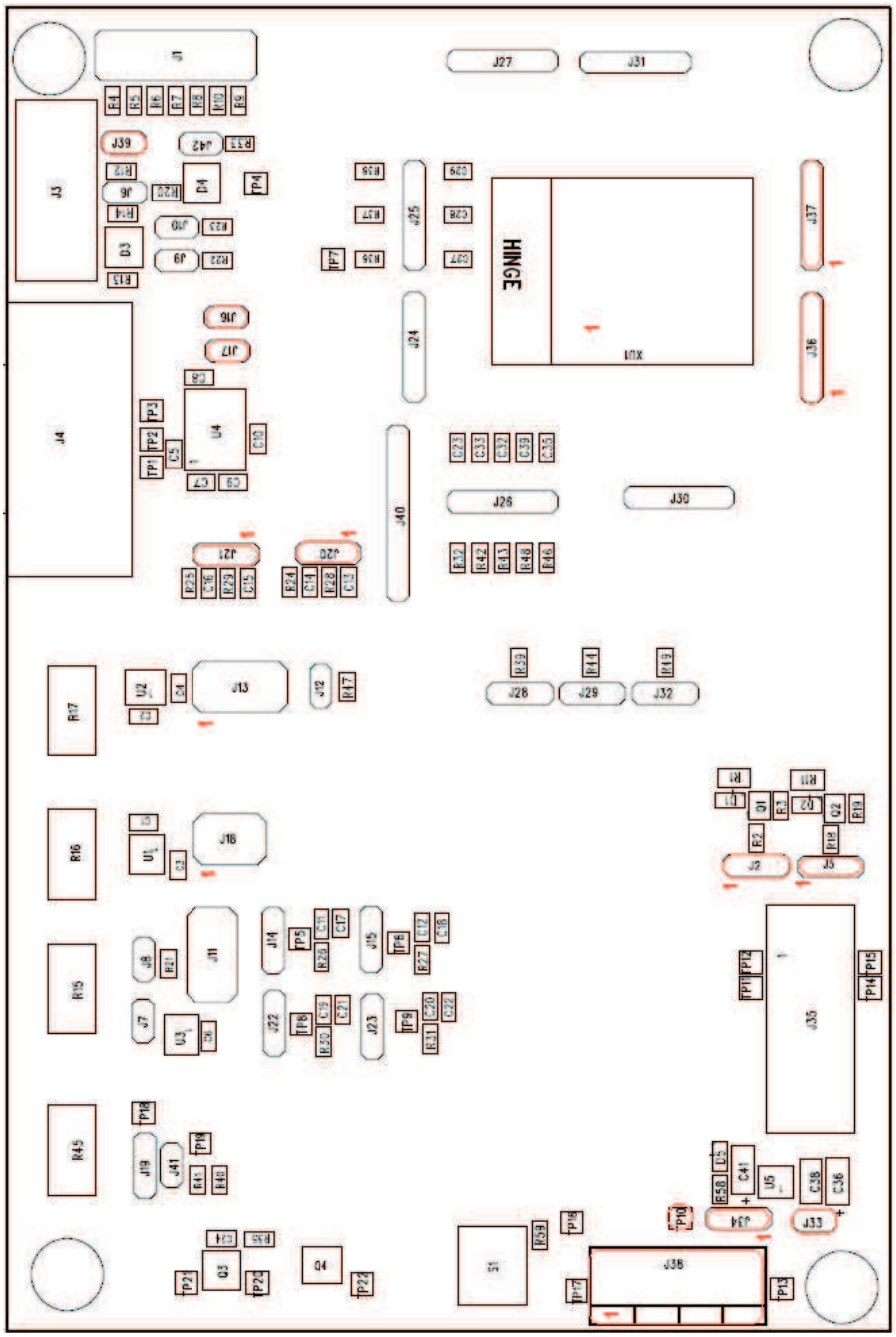


Figure 16. Location of Jumpers in Use

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3. Connect J36 all pins together using single-in-line connector; connect J37 pin 1 to 3 together. Use a click-hook-wire connect J36-1, J37-1 and J5-3.
4. Place jumpers on J12(1 and 2), J16(1 and 2), J17(1 and 2), J20(2 and 3), J21(2 and 3).
5. Adjust R17 to make ADC12 input to 250 mV by a voltmeter to monitor the voltage between terminal J13-1 and J40-1, and between J18-1 and J40-1.
6. Press “Reset” button once on the board. Click “Command ROM to execute its program (sendByte0xF0 to Address 11)”. The firmware downloaded is executed, and the executed result is transmitted to the hyper terminal as shown with the firmware “PWR032_UART0.x0”.

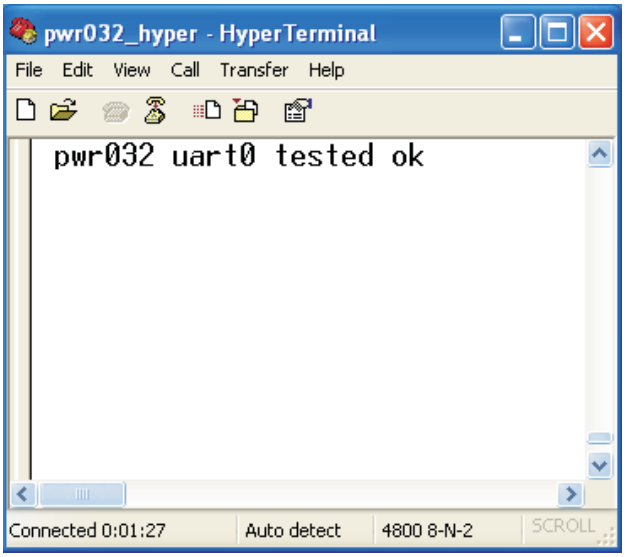


Figure 17. Execution Result of Example Test

7.3 Equipment Shutdown

1. Exit the GUI and UART.
2. Disconnect the cables.

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8 EVM Assembly Drawing and PCB Layout

The following figures (Figure 18 through Figure 23) show the design of the UCD3138OL40EVM-032 printed circuit board. PCB dimensions: L x W = 6.0 inch x 4.0 inch, PCB material: FR4 or compatible, four layers and 1-oz copper on each layer.

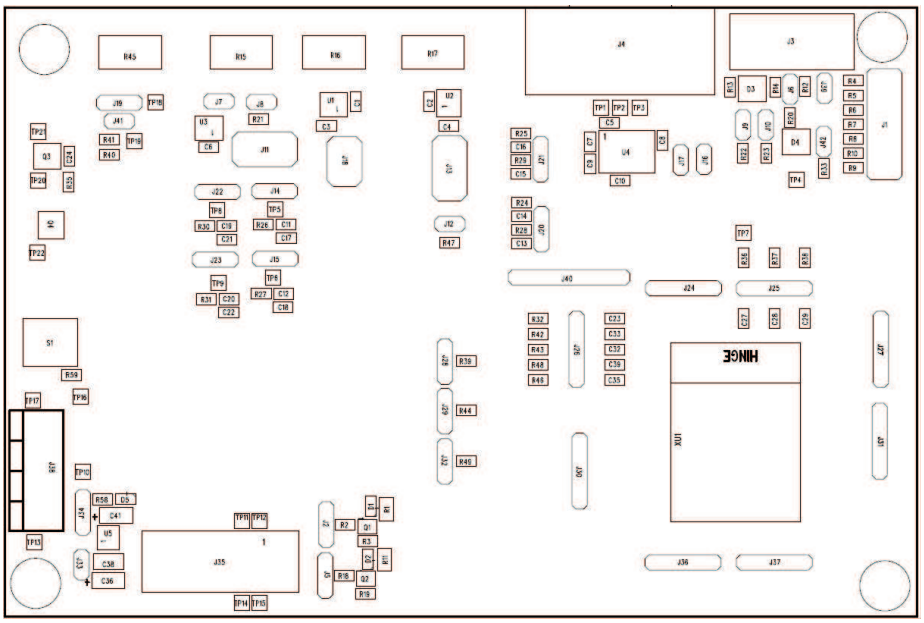


Figure 18. UCD3138OL40EVM-032 Top Layer Assembly Drawing (top view)

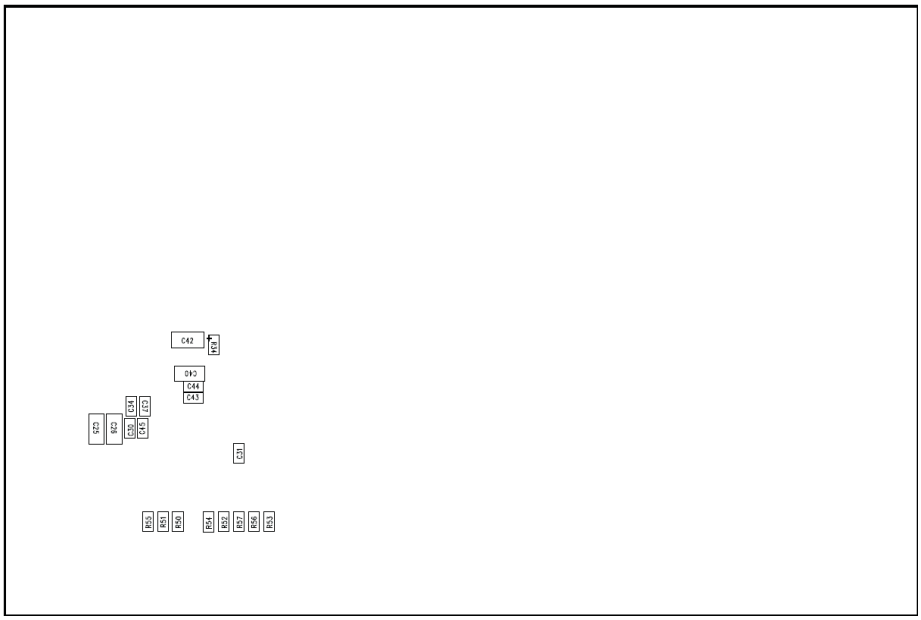


Figure 19. UCD3138OL40EVM-032 Bottom Assembly Drawing (bottom view)

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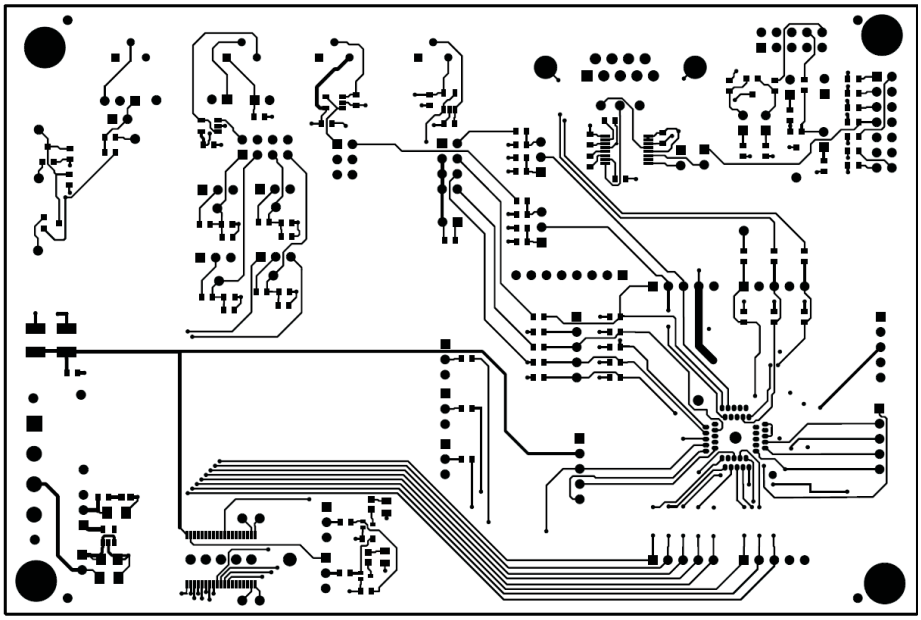


Figure 20. UCD3138OL40EVM-032Top Copper (top view)

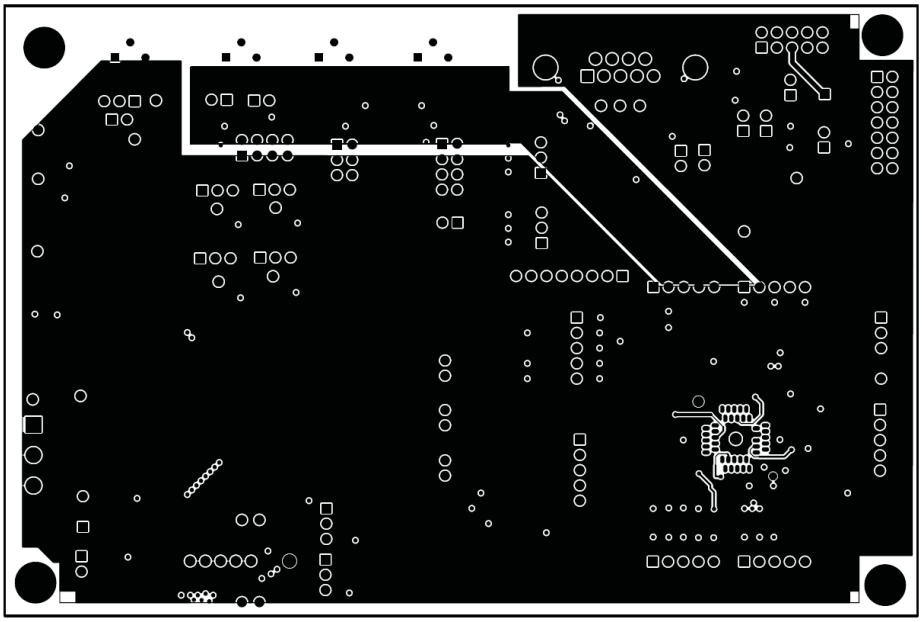


Figure 21. UCD3138OL40EVM-032 Internal Layer 1 (top view)

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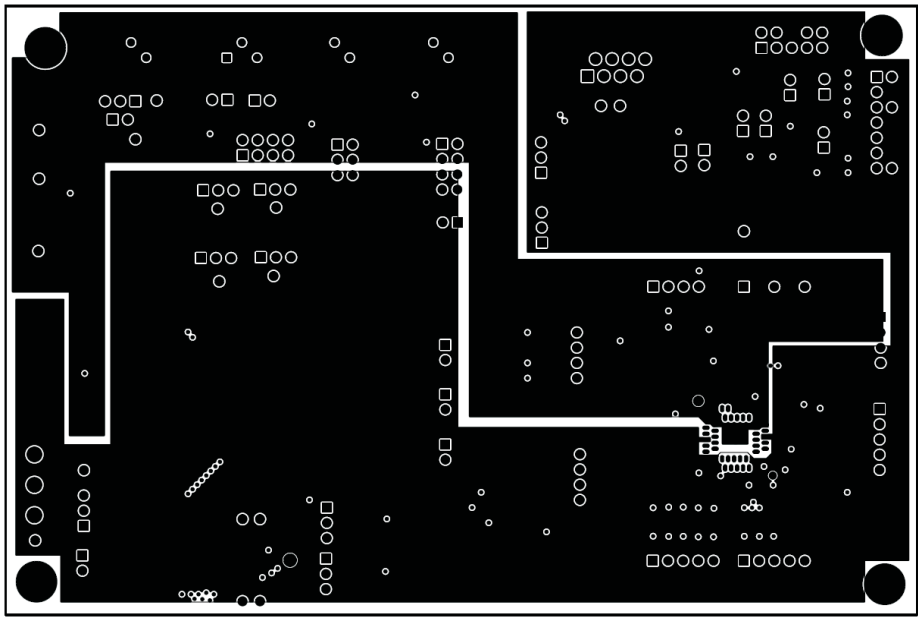


Figure 22. UCD3138OL40EVM-032 Internal Layer 2 (top view)

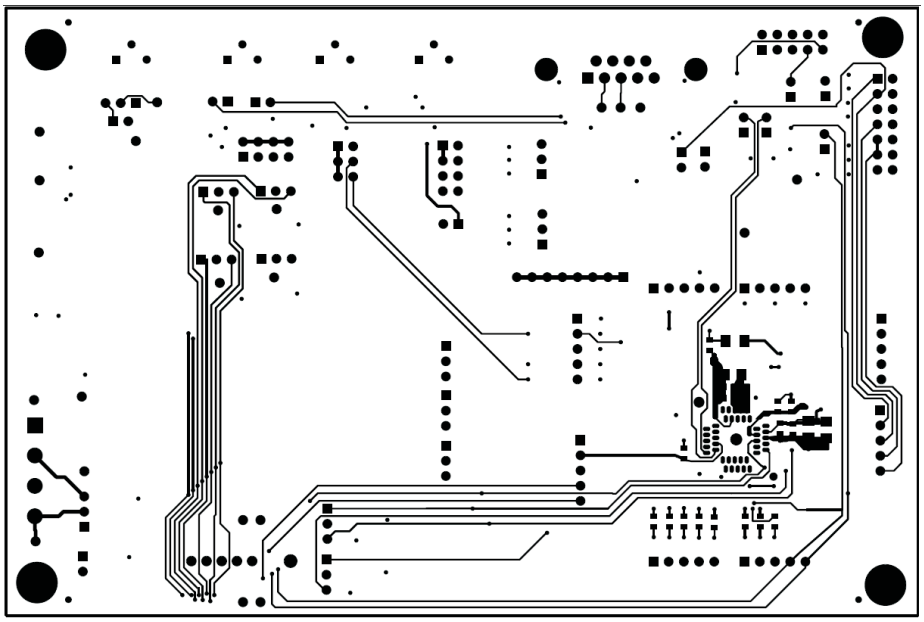


Figure 23. UCD3138OL40EVM-032 Bottom Copper (top view)

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9 List of Materials

The EVM components list according to the schematics shown in Figure 1 to Figure 9.

Table 3. UCD3138OL40EVM-032 List of Materials

QTY	REFDES	DESCRIPTION	PART NUMBER	MFR
13	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C24, C30, C31	Capacitor, ceramic, 50 V, X7R, 10%, 0.1 µF, 0603	STD	STD
18	C11, C12, C13, C14, C15, C16, C17, C18, C19, C22, C23, C32, C33, C35, C37, C39, C44, C45	Capacitor, ceramic, 50 V, X7R, 10%, 1000 pF, 0603	STD	STD
0	C20	Capacitor, ceramic, 50 V, X7R, 10%, not populated, open, 0603	STD	STD
3	C21, C34, C43	Capacitor, ceramic, 16 V, X7R, 10%, 1 µF, 0603	STD	STD
4	C25, C26, C38, C40	Capacitor, ceramic, 25 V, X7R, 10%, 0.1 µF, 1206	STD	STD
3	C27, C28, C29	Capacitor, ceramic, 50 V, C0G, 5%, 100 pF, 0603	STD	STD
3	C36, C41, C42	Capacitor, tantalum, 10 V, 20%, 10 µF, 3216	293D106X0010A2T	Vishay
2	D1, D5	Diode, LED, yellow, 2.1 V, 20 mA, 6 mcd, 0603	LTST-C190YKT	Lite On
1	D2	Diode, LED, red, 2.1 V, 20 mA, 6 mcd, 0603	LTST-C190CKT	Lite On
2	D3, D4	Diode, dual, Zener, 5.1 V, 300 mW, SOT23	AZ23C5V1-7-F	Diodes
1	J1	Header, 2 x 7 pin, 100-mil spacing, 0.100 inch x 2 inch x 7 inch	PEC07DAAN	Sullins
2	J11, J13	Header, male 2 x 4 pin, 100-mil spacing, 0.20 inch x 0.40 inch	PEC04DAAN	Sullins
1	J18	Header, male 2 x 3 pin, 100-mil spacing, 0.20 inch x 0.30 inch	PEC03DAAN	Sullins
13	J2, J5, J14, J15, J19, J20, J21, J22, J23, J28, J29, J32, J34	Header, male 3 pin, 100-mil spacing, 0.100 inch x 3 inch	PEC03SAAN	Sullins
8	J24, J25, J26, J27, J30, J31, J36, J37	Header, male 5 pin, 100-mil spacing, 0.100 inch x 5 inch	PEC05SAAN	Sullins
1	J3	Connector, male straight 2 x 10 pin, 100-mil spacing, 4 wall, 0.338 inch x 0.788 inch	N2510-6002-RB	3M
1	J35	Plug, 38 pin with holddown, 0.272 inch x 1.000 inch	2-5767004-2	Tyco
1	J38	Terminal block, 4 pin, 15 A, 5.1 mm, 0.80 inch x 0.35 inch	ED120/4DS	OST
1	J4	Connector, 9 pin, right angle, female, 1.213 inch x 0.510 inch	182-009-213R171	Norcomp
1	J40	Header, male 8 pin, 100-mil spacing, 0.100 inch x 8 inch	PEC08SAAN	Sullins
12	J6, J7, J8, J9, J10, J12, J16, J17, J33, J39, J41, J42	Header, 2 pin, 100-mil spacing, 0.100 inch x 2 inch	PEC02SAAN	Sullins
2	Q1, Q2	Bipolar, NPN, 40 V, 200 mA, 200 mW, SC-75	MMBT3904TT1G	On Semi
2	Q3, Q4	MOSFET, N-channel, 60 V, 115 mA, 1.2 Ω, SOT23	2N7002-7-F	Diodes

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Table 3. UCD3138OL40EVM-032 List of Materials (continued)

QTY	REFDES	DESCRIPTION	PART NUMBER	MFR
2	R1, R11	Resistor, chip, 1/10 W, 1%, 100 Ω, 0805	Std	Std
4	R12, R13, R14, R20	Resistor, chip, 1/16 W, 5%, 33 Ω, 0603	Std	Std
4	R15, R16, R17, R45	Potentiometer, 3/8 cermet, single turn, right angle, 20 kΩ, 0.288 inch x 0.600 inch	3296Y-1-203 LF	Bourns
2	R2, R18	Resistor, chip, 1/10 W, 1%, 4.7 kΩ, 0603	Std	Std
3	R22, R23, R33	Resistor, chip, 1/16 W, 5%, 1.5 kΩ, 0603	Std	Std
7	R24, R25, R32, R42, R43, R46, R48	Resistor, chip, 1/16 W, 1%, 100 kΩ, 0603	Std	Std
4	R26, R27, R30, R31	Resistor, chip, 1/10 W, 1%, 2 kΩ, 0603	Std	Std
1	R28	Resistor, chip, 20k, 1/16 W, 5%, 22.6 kΩ, 0603	Std	Std
1	R29	Resistor, chip, 20k, 1/16 W, 5%, 44.2 kΩ, 0603	Std	Std
7	R3, R19, R21, R35, R40, R41, R47	Resistor, chip, 1/10 W, 1%, 10 kΩ, 0603	Std	Std
1	R34	Resistor, chip, 1/16 W, 1%, 10 kΩ, 0603	Std	Std
3	R36, R37, R38	Resistor, chip, 1/16 W, 1%, 1 kΩ, 0603	Std	Std
3	R39, R44, R49	Resistor, chip, 1/16 W, 5%, 10 kΩ, 0603	Std	Std
6	R4, R5, R7, R8, R9, R10	Resistor, chip, 1/16 W, 1%, 10 kΩ, 0603	Std	Std
1	R58	Resistor, chip, 200, 1/16 W, 1%, 0603	Std	Std
1	R59	Resistor, chip, 20k, 1/16 W, 1%, 0603	Std	Std
9	R6, R50, R51, R52, R53, R54, R55, R56, R57	Resistor, chip, 1/16 W, 1%, 0, 0603	Std	Std
1	S1	Switch, SPST, PB momentary, sealed washable, 0.245 inch x 0.251 inch	KT11P2JM34LFS	C & K
3	U1, U2, U3	Presicion, Low Noise, Low Quiescent Current Op-Amp, SOT23-5	OPA376AIDBVT	TI
1	U4	RS-232 Transceivers with AutoShutdown, SSOP-16	SN75C3221DBR	TI
1	U5	Micro-Power 100 mA LDO Regulator, SOT23-5	TPS76333DBVT	TI
1	XU1	Socket, 40 pin TH, QFN pack, clam-shell, 1.08 inch x 0.800 inch	40QN50S16060	Plastronics
1	U6	Digital Power Controller, QFN-40	UCD3138RHA	TI
1		PCB, FR-4, 0.062 inc, 6.000 inch x 4.000 inch	PWR031	any

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Appendix A Summary of Using Code Composer Studio v3.3

this appendix describes basic steps on 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 UCD3138

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 UCD3138 device, please select "ARM7 SIMULATOR BIG ENDIAN". Click "ADD" and then "Save & Quit".

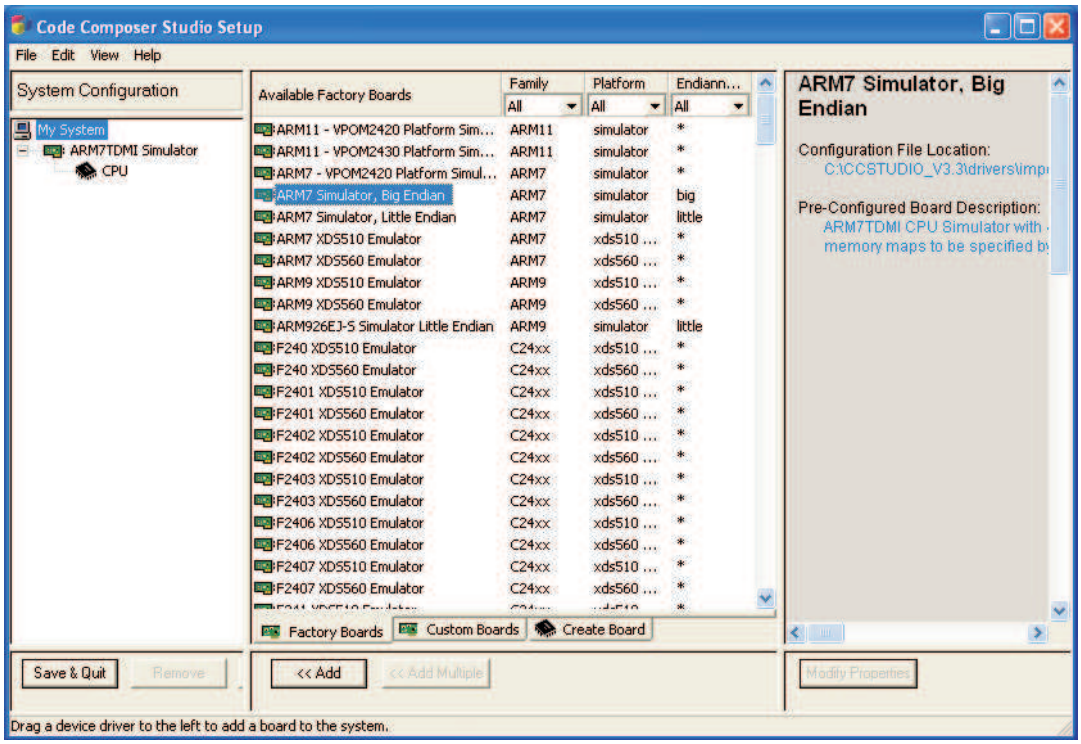


Figure 24. Setup Code Composer Studio v3.3 for the UCD3138

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 24, Click "ADD" and then "Save & Quit" for UCD3138 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 , Code Composer Studio Development Tools v3.3 – Getting Started Guide. The example below is to describe typical compile process for UCD3138 firmware. The project file name is “Cyclone.pjt” in a folder named “Training 02”. The final result is a file with extension “.x0”. As the project name is “Cyclone.pjt”, the final file name “Cyclone.x0” is chosen. “Cyclone.x0” is the final firmware code to be downloaded to the UCD3138 device memory for UCD3138 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 “Cyclone.pjt” from the directory where “Training 02” was saved. The following window appears shown in Figure 25.
3. Note that as project “Cyclone.pjt” has been created and orientated for UCD3138 functions, CCS can be launched without connecting an emulator.
4. From CCS project window, Right click on “Cyclone.pjt (Debug)” and then select “Build Options…” the window as shown in Figure 26 appears when the “Linker” tab is selected.
5. Figure 26 shows the project “Build Options” have been selected to create the file “Cyclone.out” from CCS.
6. The next step is to convert file “Cyclone.out” to “Cyclone.x0”. “Cyclone.x0” will be the final firmware code to be downloaded to the UCD3138 device memories. To convert “Cyclone.out” to “Cyclone.x0”, the first step is to click “General” tab under “Build Options for Cyclone.pjt (Debug)”, as Figure 27 shown, under the “Build Command”, confirm the file to be converted is “Cyclone.out”, then click ok to close “Build Options”.
7. Steps 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 28, select “Project M Rebuild All”. This generates the file “Cyclone.x0” based on “Cyclone.out”, and the file of “Cyclone.x0” is saved inside the folder where “Cyclone.pjt” is saved.

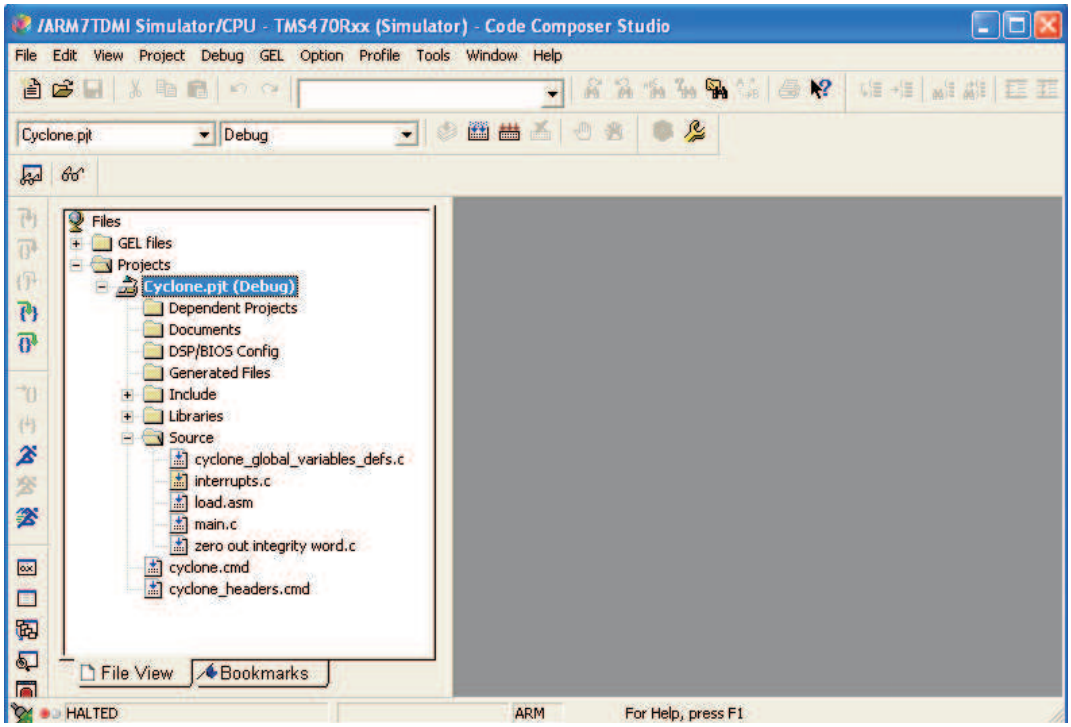


Figure 25. Open a Project File “Cyclone.pjt” – Initial Open

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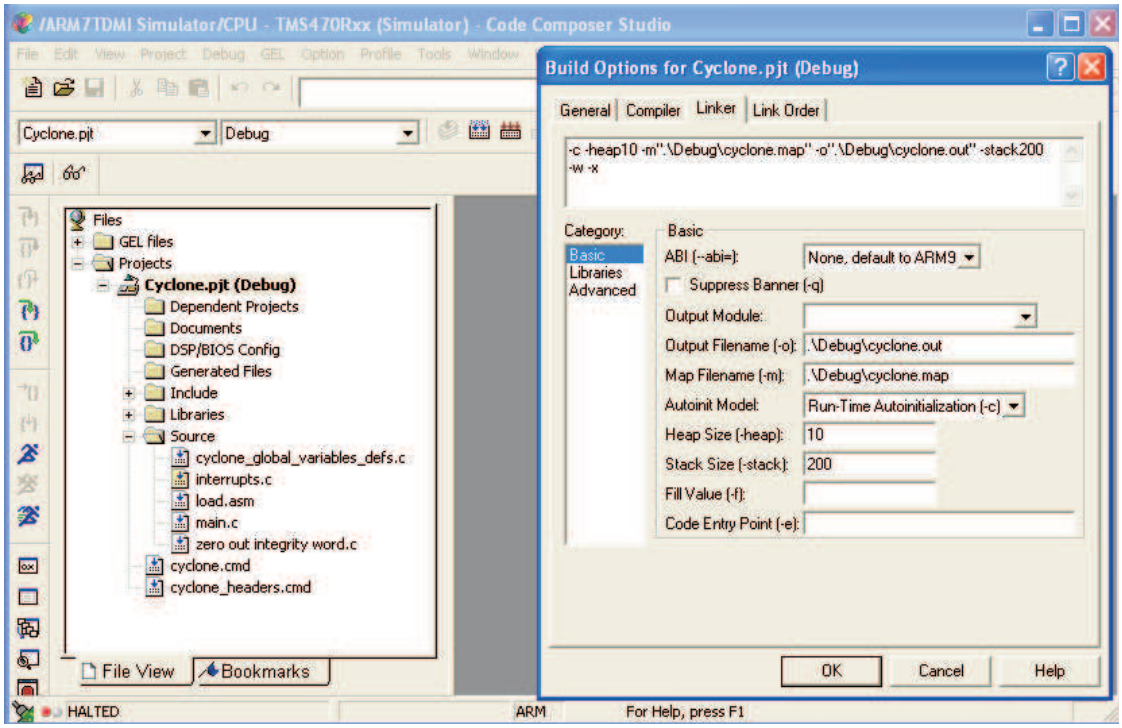


Figure 26. Open a Project File "Cyclone.pjt" – Build Options and Linker Tab

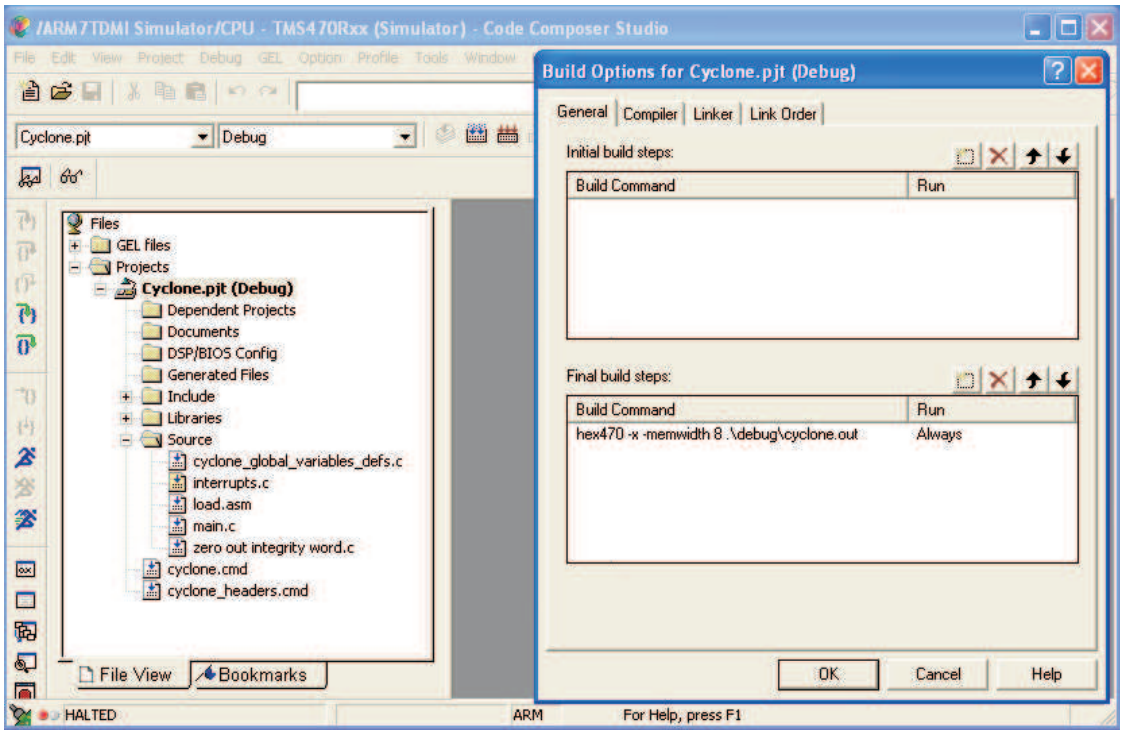


Figure 27. Open a Project File "Cyclone.pjt"- Build Options and General Tab

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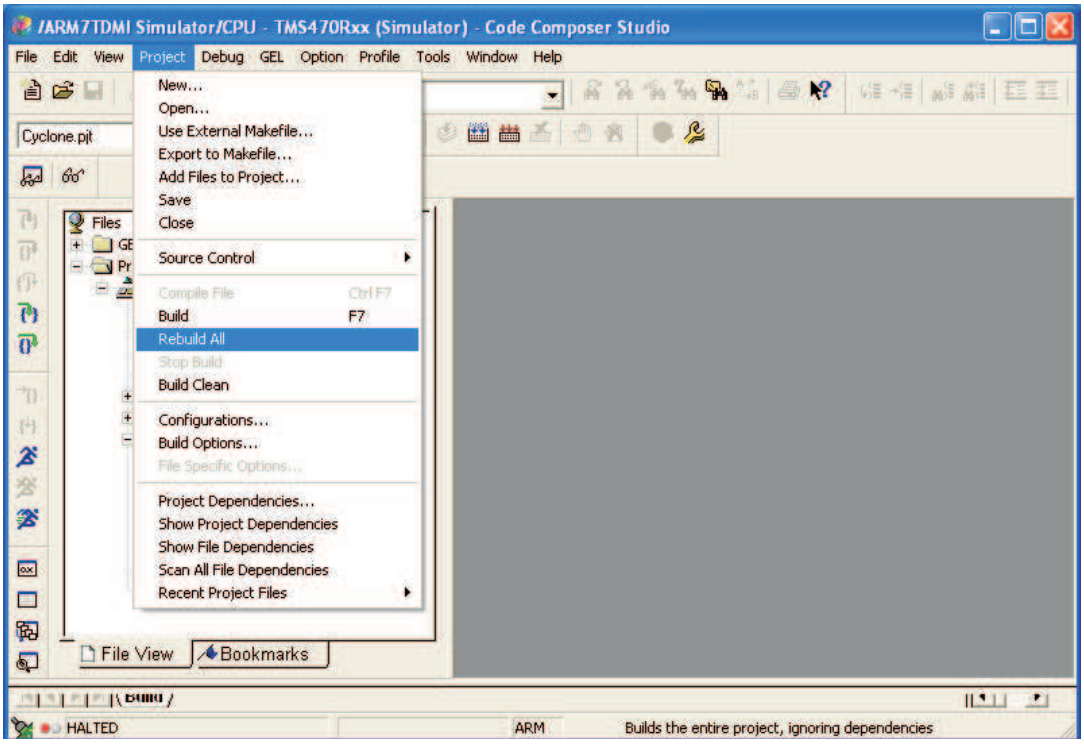


Figure 28. Open a Project File "Cyclone.pjt"- Rebuild All

A.3 References

1. UCD3138 Datasheet, *Highly Integrated Digital Controller for Isolated Power*, Texas Instruments Literature Number SLUSAP2, 2012
2. *UCD3138CC64EVM-030 Evaluation Module and User's Guide*, Texas Instruments Literature Number SLUU886, 2012
3. *UCD3138OL64EVM-031 Evaluation Module and User's Guide*, Texas Instruments Literature Number SLUUA10, 2012
4. TI Application Manual, *UCD3138 Digital Power Peripherals Programmer's Manual*, Texas Instruments Literature Number SLUU995
5. TI Application Manual, *UCD3138 Monitoring and Communications Programmer's Manual*, Texas Instruments Literature Number SLUU996,
6. TI Application Manual, *UCD3138 ARM and Digital System Programmer's Manual*, Texas Instruments Literature Number SLUU994
7. *UCD3138 Isolated Power Fusion GUI User Guide* (please contact TI)

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

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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.

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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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- Products that are shown with a "Y" under the "Available Supply" column have had all pre-conversion date inventories depleted and are EU RoHS compliant. –
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- Products with "RoHS Exempt" under this column are EU RoHS exempt by using an applicable exemption(s).

As of August 2010 to make identification of RoHS compliant EVMs easier, TI has provided labels on the outer EVM.

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   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.

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   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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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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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.

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