Using the LMP92066 Evaluation Module

User's Guide

Literature Number: SNAU153
MARCH 2014

Contents

LMP92066 Dual Temperature-Controlled DAC Evaluation Module

Introduction

The LMP92066EVM is designed for rapid evaluation of functionality and performance of the LMP92066 GaN and LDMOS PA Bias Controller.

Kit Components

ITEM	DESCRIPTION
LMP92066EVM	Evaluation Board LMP92066 device
USB2Any	Interface dongle – USB to I^2C bus
LMP92066 EVM GUI	Software. Available from the Texas Instruments website. Please contact your TI representative for access authorization. The installer and the application have been developed for Windows XP and Windows 7, 32- and 64-bit environments.

Evaluation Module – LMP92066EVM

The LMP92066EVM is a connectivity board: provisions are made for ease of interfacing LMP92066 to the lab test equipment and the I^2C bus controller. The only active device on the board is the LMP92066 device.

The EVM, by default, is powered from the USB2Any interface board, which in turn is powered from the host PC USB port. The user can provide external supplies via the SUPPLY terminal block. All digital and analog I/O is accessible via the dual row headers: J1 and J2.

CONNECTOR	DESCRIPTION
J1	Interface to the USB2Amy board. 11 – SDA. I^2C interface bidirectional data. 12 – SCL. I^2C interface clock input. 16 – 3.3V supply to the EVM. 17 – A0. By default not connected to the LMP92066 18 – A1. By default not connected to the LMP92066 19 – DRVEN0. 20 – DRVEN1 28 – 5.0V supply to EVM
J2	Analog outputs from LMP92066. 2 – A1 4 – A0 6 – DAC1 output 8 – FETDRV1 output 12 – FETDRV0 output 14 – DAC0 output
SUPPLY	External power supply block. 1 – VDD 2 – VIO 3 – GND 4 – VDDB 5 – VSSB

SELECTOR BLOCK	DESCRIPTION	FACTORY SETTING
J3	VDD source: 1-2: External via SUPPLY block 2-3: Provided by J2-28	2 - 3
J4	VIO source: 1-2: External via SUPPLY block 2-3: Provided by J2-16	2 - 3
J5	VDDB source: 1-2: External via SUPPLY block 2-3: Provided by J2-28	2 - 3
J6	VSSB source: 1-2: External via SUPPLY block 2-3: Local ground (GND)	2 - 3
J7	I^2C bus slave address A1 input control: No Shunt – A1 = N.C. 1-2 – A1 = HI 2-3 – A1 = LO	The I^2C slave address of the LMP92066 is set to A1 = LO, A0 = LO. This corresponds to the I^2C slave address = 0111111 = 0x3F
J8	I^2C bus slave address A1 input control: No Shunt – A0 = N.C. 1-2 – A0 = HI 2-3 – A0 = LO	
J9	DRVEN0 manual control: No Shunt – DRVEN0 controlled by J2-19 input 1-2 – DRVEN0 forced HI 2-3 – DRVEN0 forced LO	DRVEN0 is forced LO by a shunt, disabling the FETDRV0 output. **Remove the shunt to enable FETDRV0.**
J10	DRVEN1 manual control: No Shunt – DRVEN1 controlled by J2-20 input 1-2 – DRVEN1 forced HI 2-3 – DRVEN1 forced LO	DRVEN1 is forced LO by a shunt, disabling the FETDRV0 output. **Remove the shunt to enable FETDRV1.**

USB to I^2C interface – USB2Any

USB2Any is provided as an interface between the PC and the LMP92066EVM. This interface is user controlled via the application LMP92066EVM GUI.

USB2Any is provided as either enclosed or unenclosed unit.

The LMP92066EVM plugs in directly to USB2Any. For in-system evaluation of the LMP92066, a ribbon cable is provided for connecting of USB2Any to a target system equipped with a suitable header.

Figure 1. USBAny

User Software

The LMP92066EVM GUI application software is available as a download from the Texas Instruments website (www.ti.com). With this software and the USB2Any interface dongle the user will be able to fully exercise the functionality of the LMP92066, including:

- Read and Write operations from and to internal registers of the LMP92066.
- Control the DRVENx inputs of the LMP92066.
- Write data into the internal EEPROM.
- Plot and log, in real time, the Temperature Sensor output and DAC input data.
- Plot and log the VDACx vs Temperature transfer function.

1 Quick Start

1.1 Software Installation

To install the LMP92066 EVM GUI, run the setup.exe, a self-extracting archive that will install all the necessary components of the user application – this includes the LabView run-time environment. The setup.exe will also install Python 2.7, if it is not already present in the target system.

1.2 Kit Assembly

The EVM mates directly to the USB2Any via the 30-pin dual row header. Note that the EVM header spans the 3 headers on the USB2Any controller board.

After the boards are plugged in together, install the USB cable between the USB2Any and the host PC. Ensure that the 3-pin selectors J3 through J10 are in the factory default positions – see diagrams in Figure 10 and Figure 11 for reference. The factory default set up establishes the device I^2C slave address that is expected by the GUI default settings. It also allows the kit to operate from the power supply offered by the USB interface – no other power supplies are necessary at this point.

The figures below show the assembled kit for both enclosed and unenclosed versions of the USB2Any controller. Note that the SUPPLY block is left open.

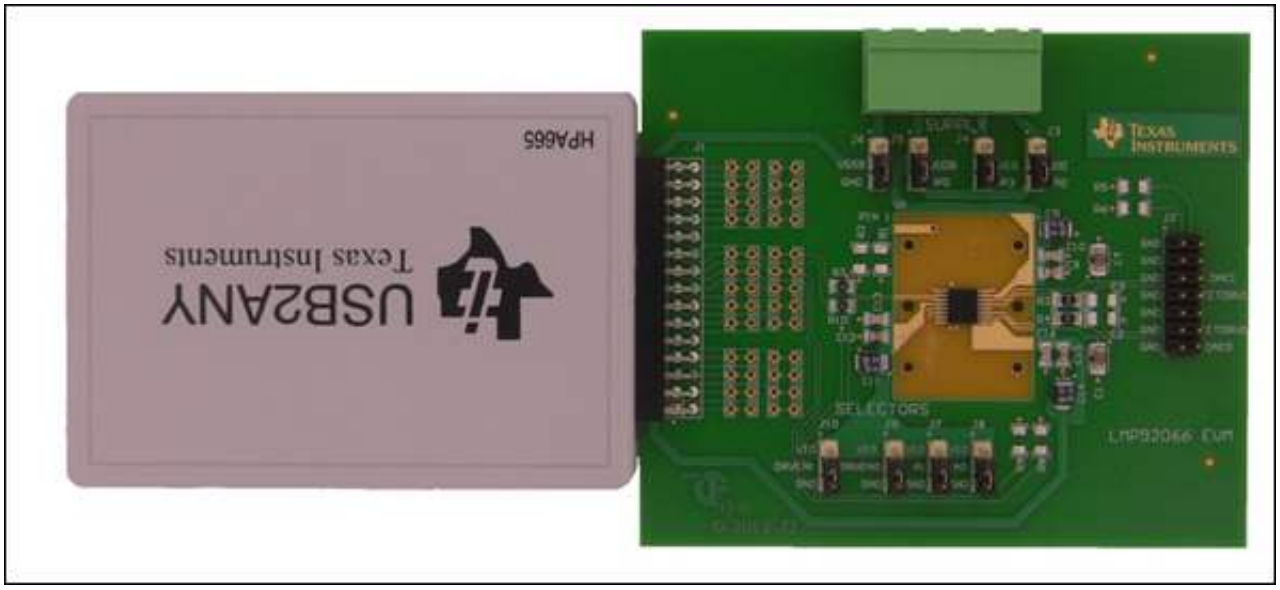

Figure 2.

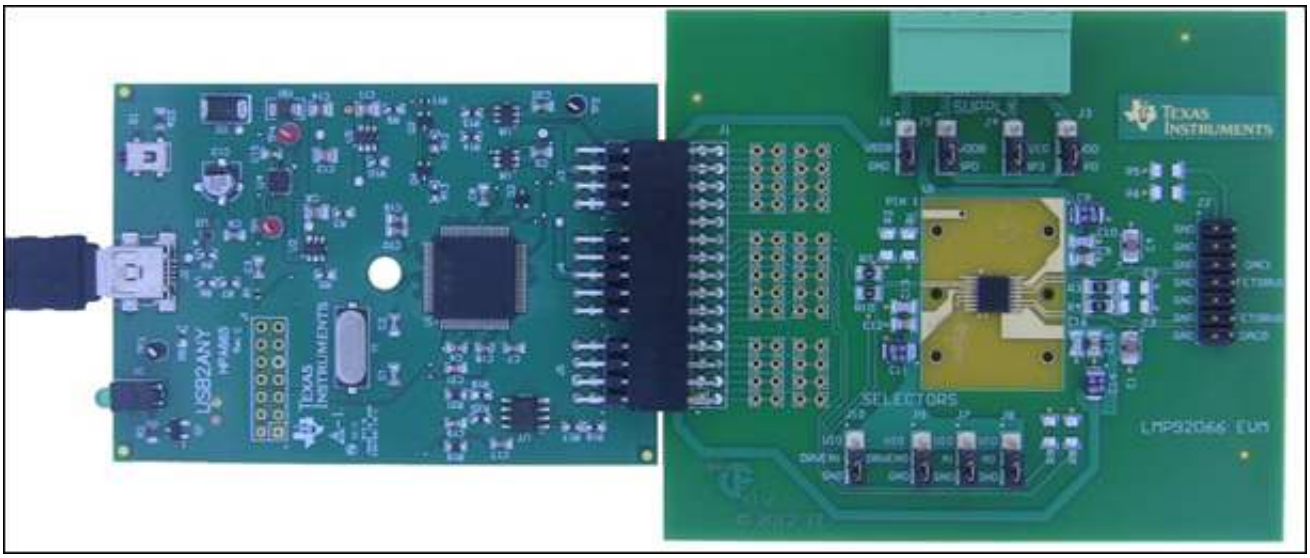

Figure 3.

1.3 Software Startup

The application program can be invoked through the START menu: look for LMP92066 EVM GUI in 'All Programs' tab. Alternatively, the executable can be found in the installation directory – default is C:/Program Files(86)/Texas Instruments/LMP92066 EVM GUI/LMP92066 EVM GUI.exe

GUI – LMP92066 Data Path Control

Upon start-up the application will search for the USB2Any/LMP92066EVM hardware and establish communication. When successfully initialized, the screen below will be shown.

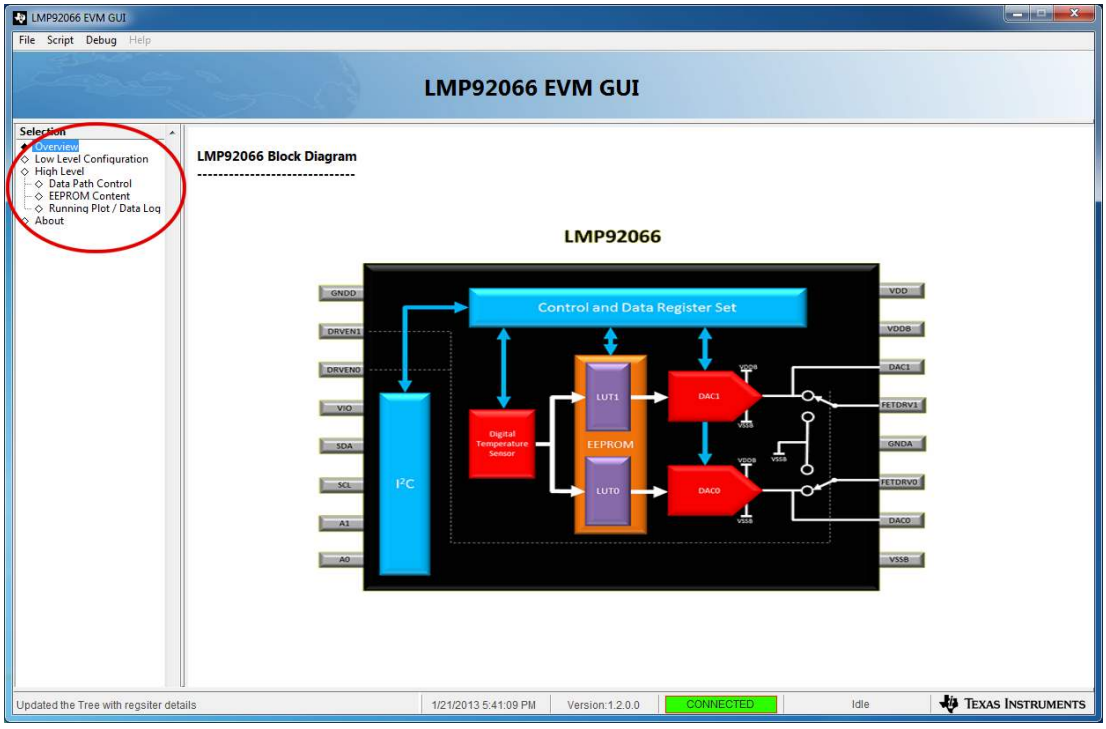

Figure 4. LMP92066 EVM GUI

The panel on the left of the main window shows a list of control pages available to the user. Upon selecting “Low Level Configuration” the following page will be shown.

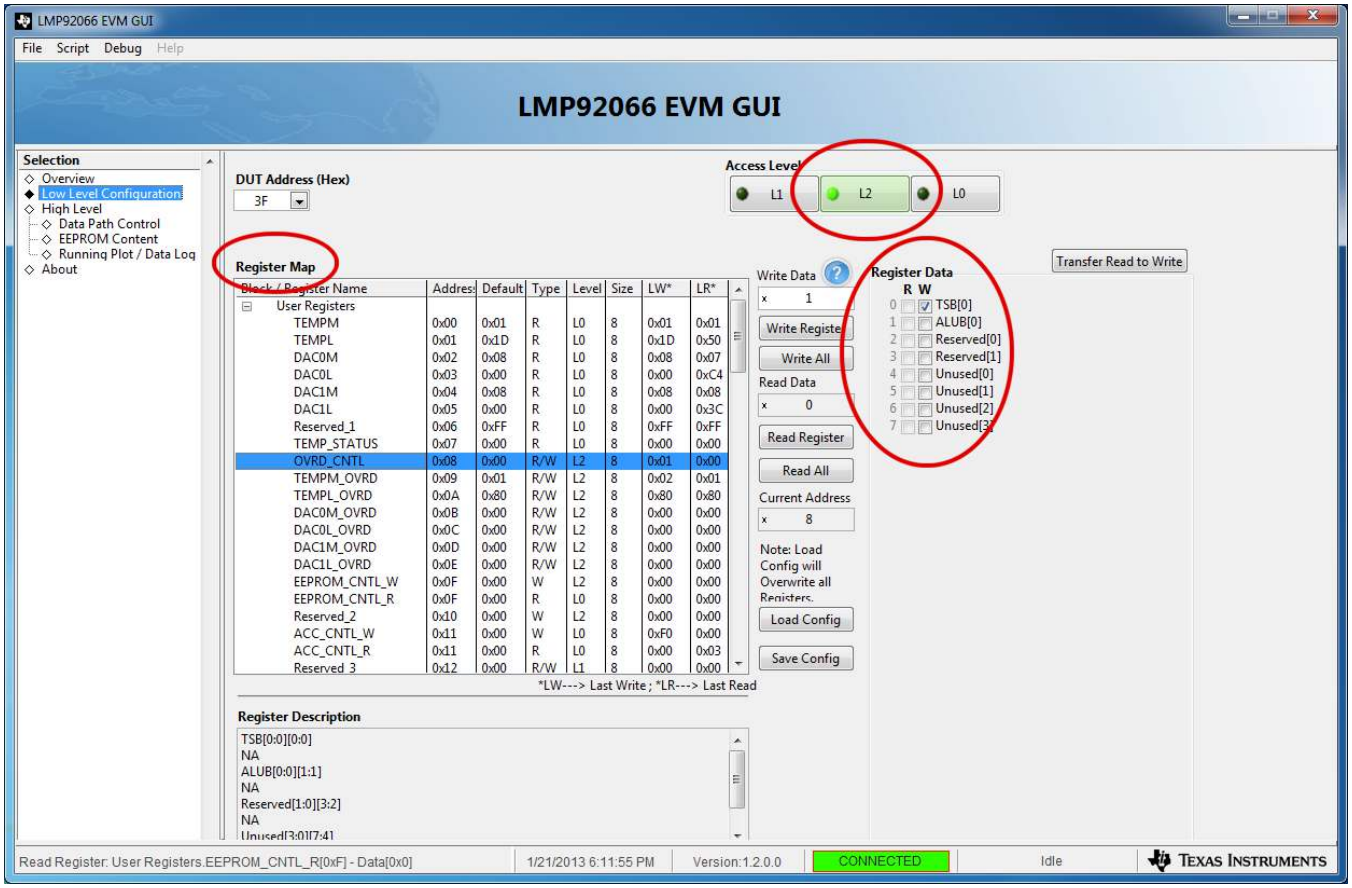

Figure 5.

The “Low Level Configuration” page gives direct access to the internal registers of the LMP92066. Selecting a line in the “Register Map” will bring up the “Register Data” set of controls, which lets the user set and un-set the individual bit fields. The new values are set to the device by clicking “Write Register” button. “Read Register” button will report the state of the selected LMP92066 register.

“Access Level” buttons send series of transfers that set the device’s memory Access Level. The default access level is “L0”, and it gives only READ access to all internal registers.

Click “L2” prior to leaving this control page.

Select “Data Path Control” from the panel on the left of the main window. The following page will be shown:

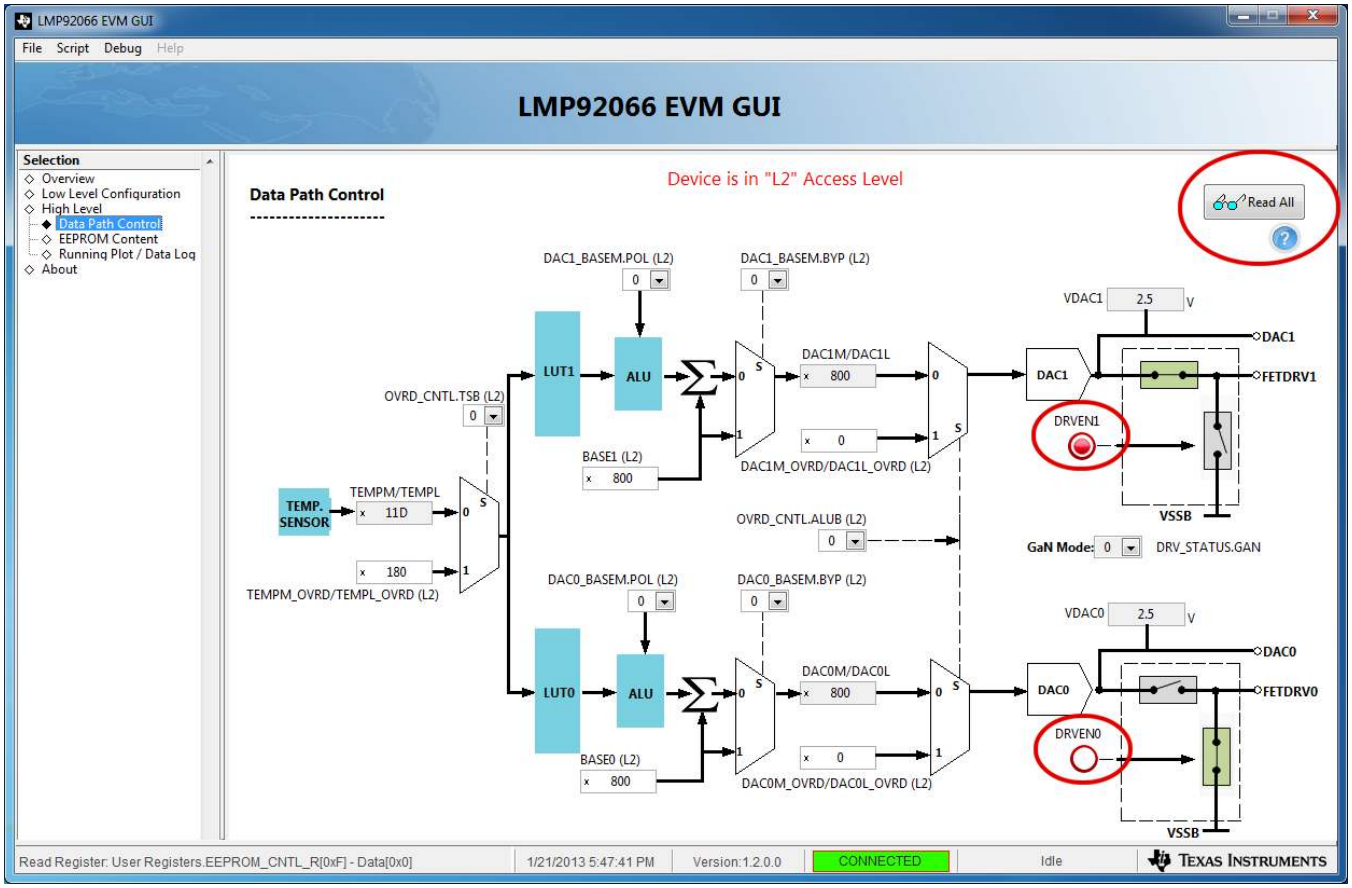

Figure 6.

This page gives an overview of the current state of the LMP92066. “Read All” button downloads current data from the device and updates the GUI screen. All controls with white background can be modified by the user and sent immediately to the device (left-click on the control, enter new HEX value, and press ENTER). Note that device must be in Access Level L2 to allow changes to the internal registers values on this page. Currently enabled Access Level is indicated at the top of the page. The controls with gray backgrounds are indicators only.

The 2 Radio Buttons “DRVEN0” and “DRVEN1” enable/disable the FETDRV0 and FETDRV1 outputs of LMP92066.

LUT Programming

Select “EEPROM Content” from the panel on the left of the main window. The following page will be shown:

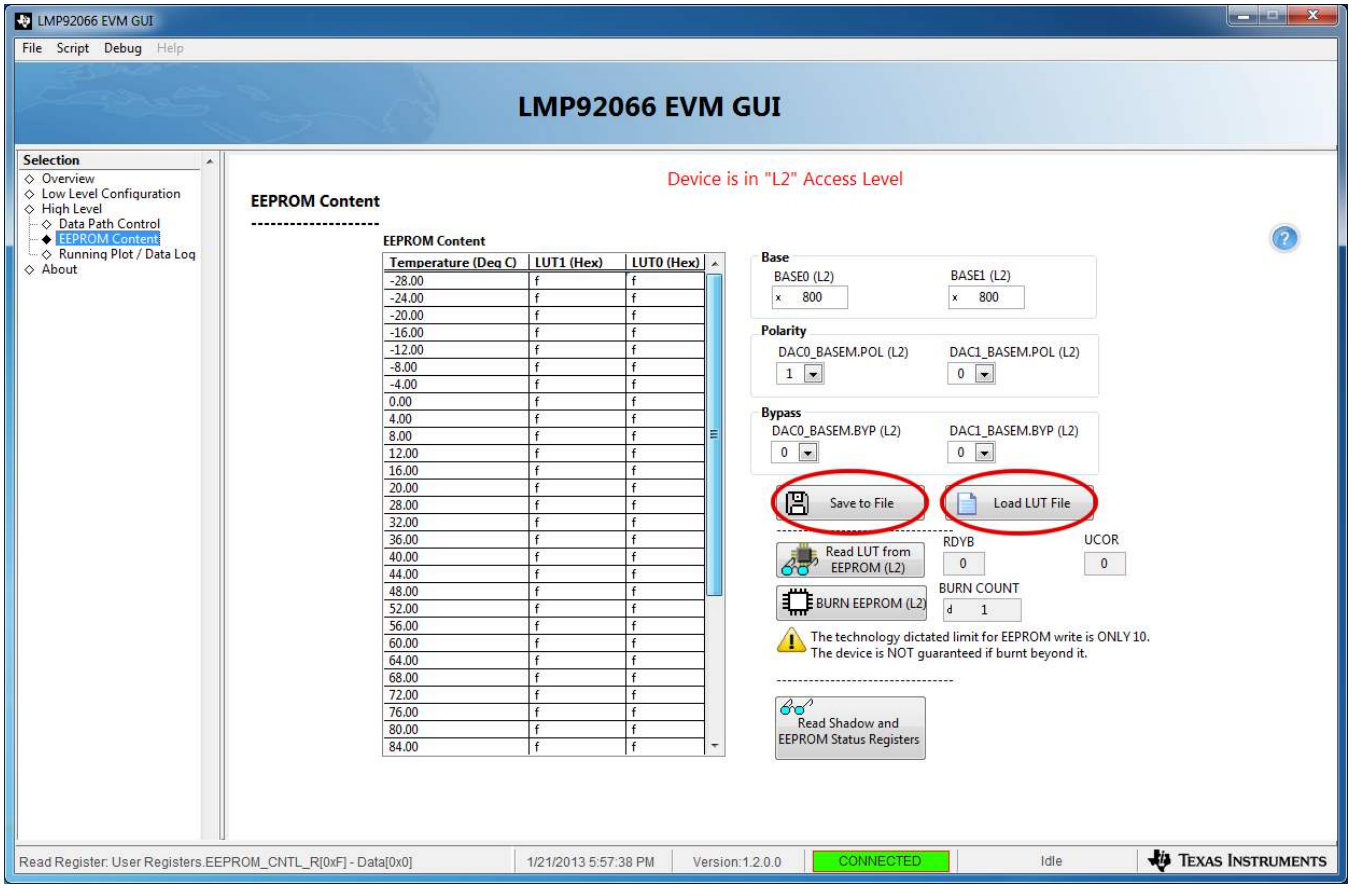

Figure 7.

The table in Figure 7 above shows the current content of the LUT in the operating memory of the device. This also reflects the EEPROM content after the initial power up.

The factory default for the EEPROM content is:

- DELx (increments) = 0
- BASEx = 0x800 (midscale)
- X.POL = 0 (monotonically increasing function)

The content of the table can be edited by double clicking on table values and entering a new HEX number (0 through F). In the example above all DELx entries were set to 0xF (maximum slope), and DAC0_BASEM.POL was set for monotonically decreasing function implementation.

Click “Save File” button to save the new LUT configuration in the text file on the host PC. The file names are the date stamps of when the file was created, and are stored in ‘C:/Program Data/Texas Instruments/LMP92066 EVM GUI/Logs/EEPROM/’ directory

Click “Load LUT File”. A file selection window will appear, already preset to the above listed directory. Select the file with the name corresponding to the time of save of interest. After selecting the file press “OK”, which will both read in the file into the GUI and send the LUT data to the operating memory of LMP92066.

At this point the new values of the LUT take effect in the signal path of LMP92066. Note that the EEPROM has not been written with new values, yet (no Burn has been performed). The LUT values can be validated/tested without committing them to EEPROM, through the use of the external text file.

To Burn the EEPROM, that is, to copy the data from the operating memory to the non-volatile memory, press “BURN EEPROM” button.

NOTE: At the time of writing this manual, Texas Instruments ensured the performance of the EEPROM for up to 10 write cycles (Burns).

Time Log

Select “Running Plot/Data Log” from the panel on the left of the main window. Select the “Running Plot & Data Log” tab if not already activated. The following page will be shown:

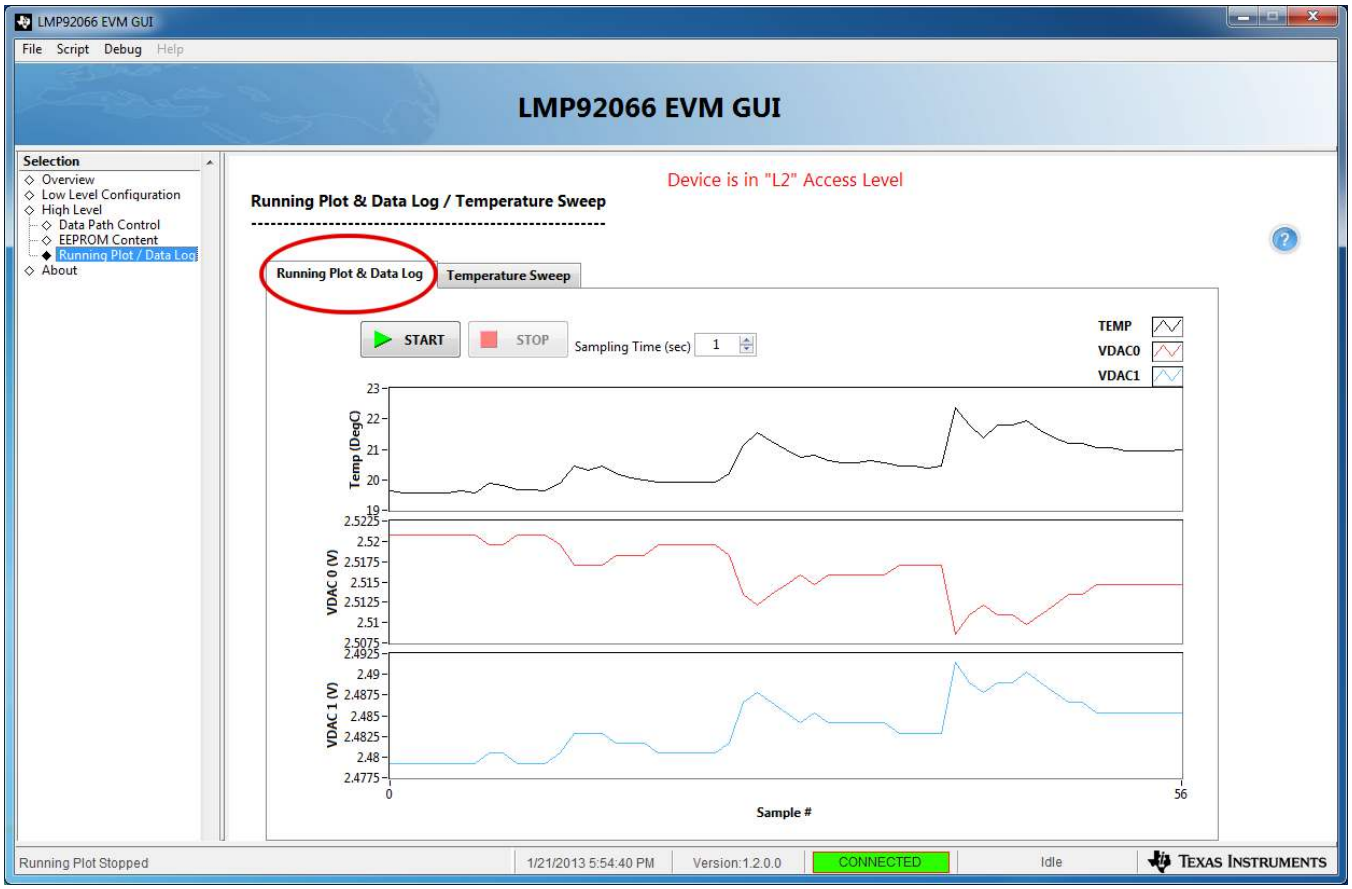

Figure 8.

The ‘START’ button begins the running plot (strip chart) of the Temperature sensor output and the corresponding V_{DACx} output values for the given LUT – as implemented in Section 1.4. The GUI reads the internal TEMPM/TEMPL, DAC0M/DAC0L, and DAC1M/DAC1L registers and computes the equivalent temperature (°C), and voltage at V_{DACx} outputs (here the assumption is made that the internal DAC reference is 5 V, and the DAC itself is ideal). The sampling interval can be set with the “Sampling Time” control.

“STOP” terminates the logging. At that time a text log file is created in the ‘C:/Program Data/Texas Instruments/LMP92066 EVM GUI/Logs/Datalog’ directory that contains the plot data.

At any time when the “Running Plot & Data Log” is executing, the user can select the “Data Path Control” page to verify the state of the device – press “Read All” to refresh the display. For example, the state of the OVRD_CNTL register (controls the OVERRIDE multiplexers in the signal path), and DACx_BASEM.BYP (controls the multiplexer at the output of the LUT/ALU/Sum) will affect the “Running Plot” output.

1.4 V_{DACx} vs Temperature Sweep

Select “Running Plot/Data Log” from the panel on the left of the main window. Select the “Temperature Sweep” tab. The following page will be shown:

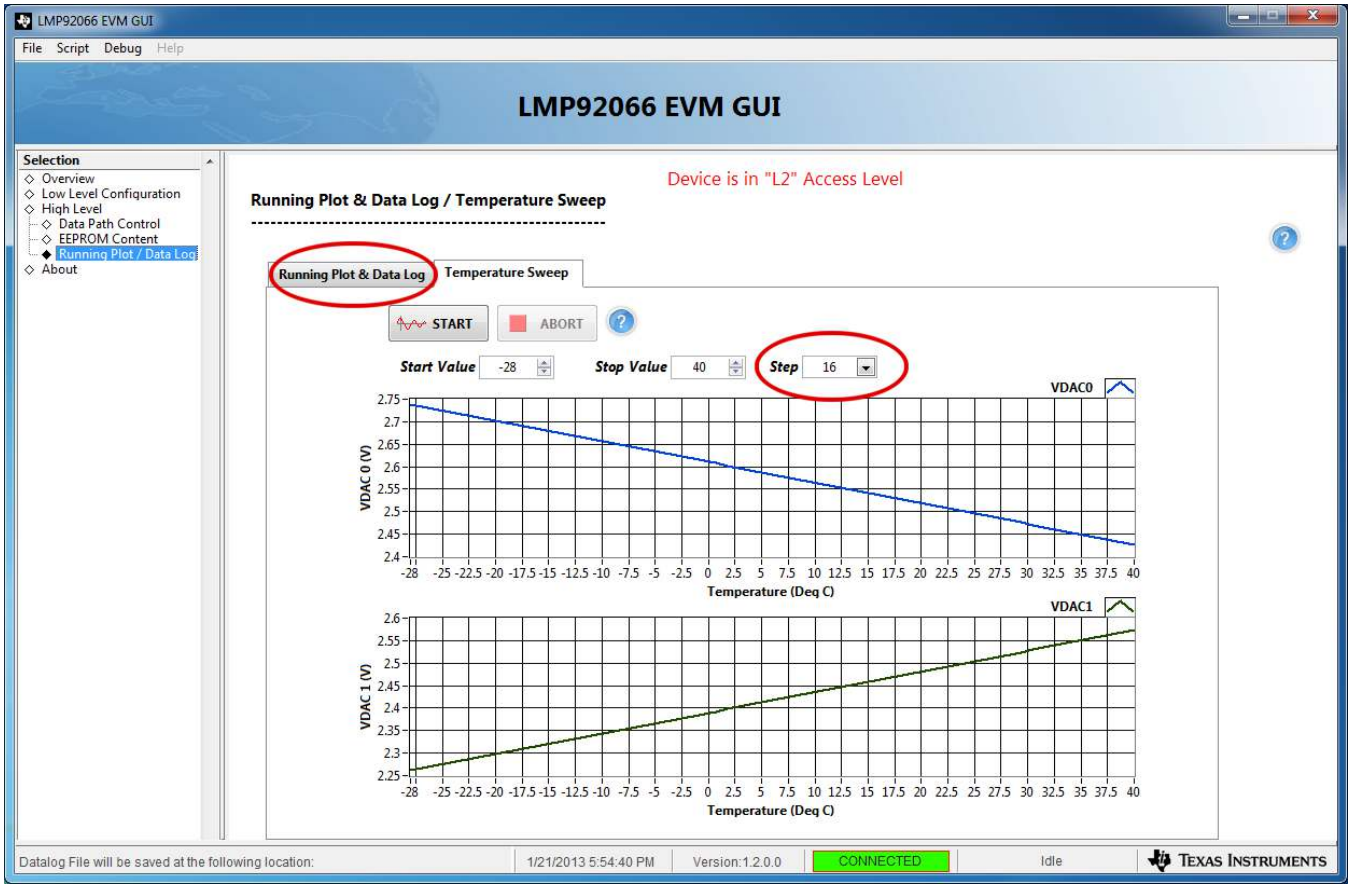

Figure 9.

“START” will begin the plot of the transfer function as it is implemented in the LUT. For each data point in the plot the program overrides the internal temperature sensor; that is, it injects a temperature value into the signal path, and reads back the resulting values presented as inputs to DAC0 and DAC1.

“Start Value” and “Stop Value” controls set the temperature span of the transfer function plot.

“Step” control sets the step size of the plot. This value is expressed in terms of LSB of the temperature sensor; that is, Step=1 is equivalent to 1/16th of °C (0.0625°C).

“STOP” terminates the plot routine.

When plot is completed, or when “STOP” is pressed, a text log file is created in the ‘C:/Program Data/Texas Instruments/LMP92066 EVM GUI/Logs/Datalog’ directory.

Board Layout

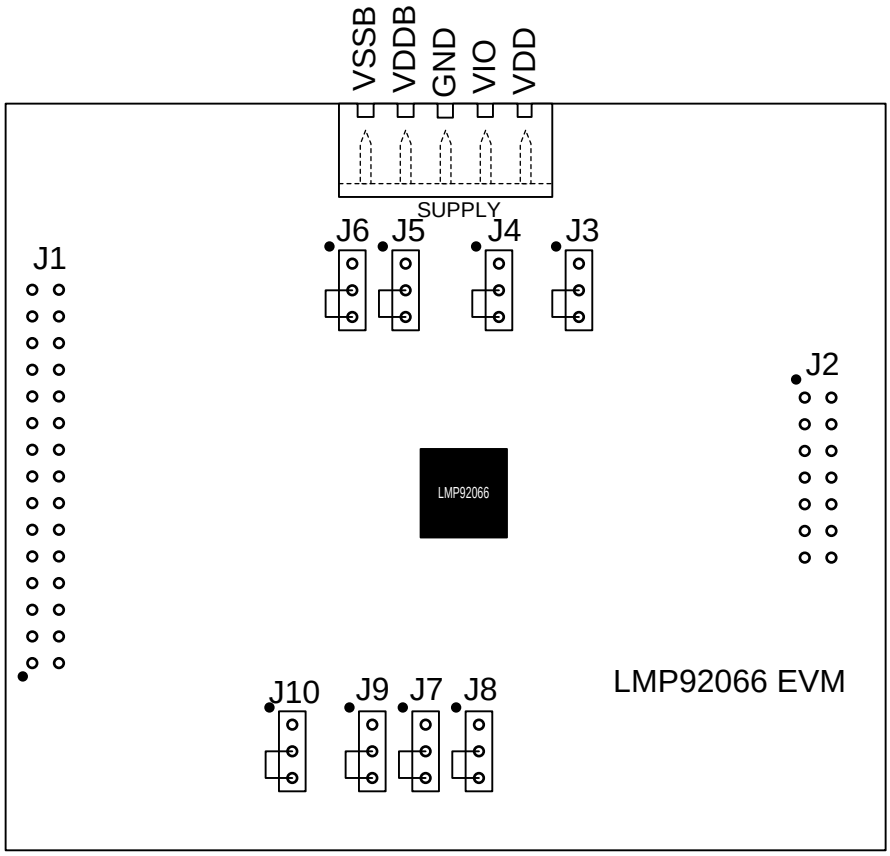

Figure 10. LMP92066EVM Board Layout

2 Schematic

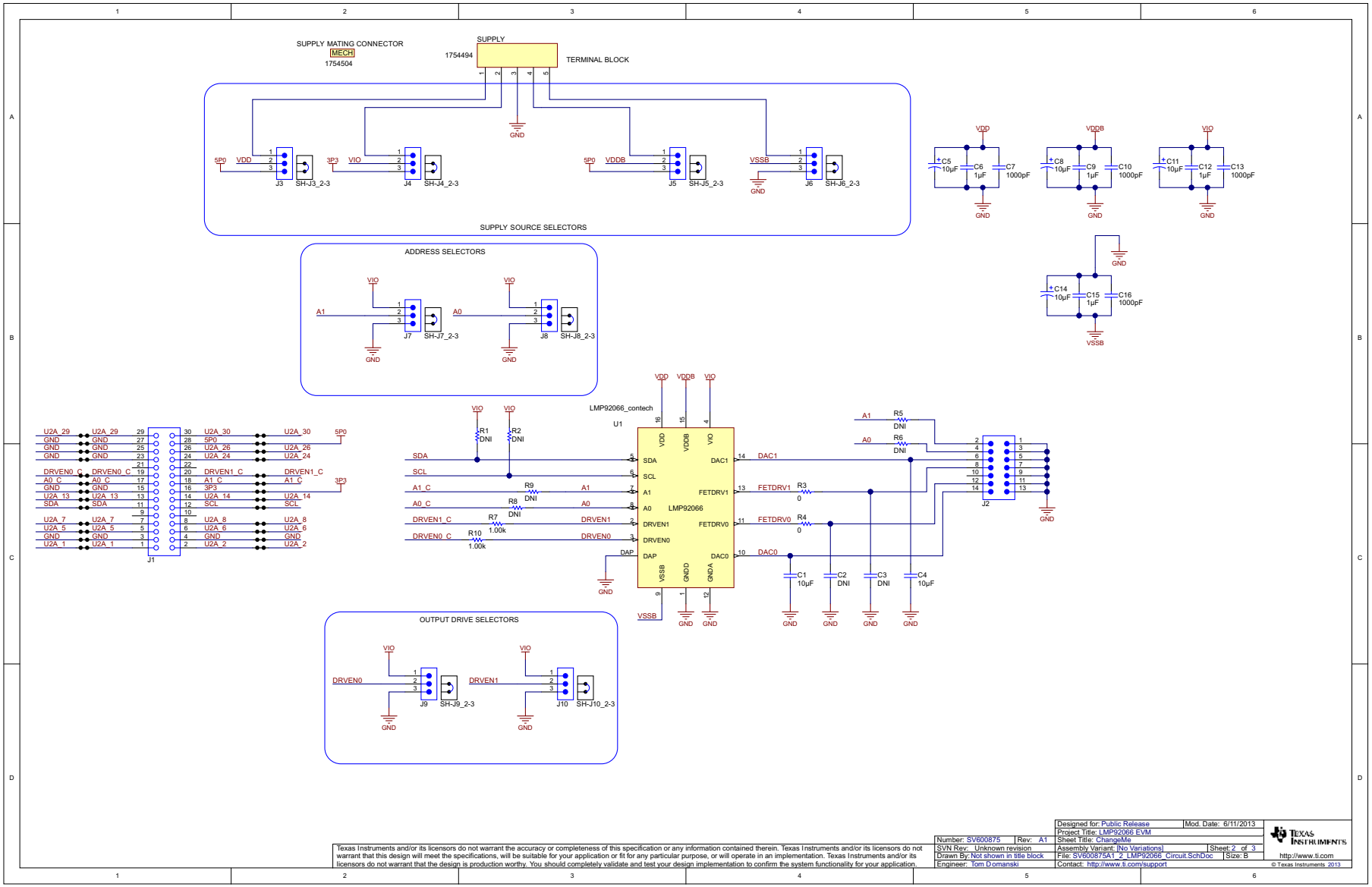

Figure 11. LMP92066EVM Schematic

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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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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