LM63, LM64, LM96x63 Evaluation Module User Guide

User's Guide

Literature Number: SNAU154
October 2013

LM63, LM64, LM96x3 Evaluation Module

The Texas Instruments LM63LM64LM96x3EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM63, LM64, LM96063, and LM96163. The LM63, LM64, LM96063, and LM96163 are industry-standard digital temperature sensors with integrated Sigma-Delta analog-to-digital converters and a digital I2C interface.

Topic **Page**

1 Introduction

The LM63 provides a 10-bit signed digital temperature reading with an accuracy of ±1°C from 60°C to 100°C and ±3°C from 25°C to 125°C. It has an ALERT/TACH pin that can be used in Comparator, Interrupt, or SMBus ALERT mode.

The LM64 provides a 10-bit signed digital temperature reading with an accuracy of ±1°C from 120°C to 140°C and ±3°C from 25°C to 140°C. It has an ALERT pin that can be used in Comparator, Interrupt, or SMBus ALERT mode. It has a T_CRIT pin that acts as a comparator, and an A0 pin which selects either a high or low I2C address. It also features 5 General Purpose Input Output (GPIO) and 5 General Purpose Default (GPD) pins that are user customizable.

The LM96063 provides a 10-bit signed digital temperature reading with an accuracy of ±0.75°C from 40°C to 105°C and ±1.5°C from 40°C to 125°C and ±3°C from 25°C to 125°C. It has an ALERT pin that can be used in Comparator, Interrupt, or SMBus ALERT mode. It has a T_CRIT pin that acts as a comparator.

The LM96163 is similar to the LM96063 with the addition of TruTherm compensation for small feature size transistors. It provides a 10-bit signed digital temperature reading with an accuracy of ±0.75°C from 50°C to 105°C and ±1.5°C from 40°C to 125°C and ±3°C from 25°C to 125°C. It has an ALERT pin that can be used in Comparator, Interrupt, or SMBus ALERT mode, and a T_CRIT pin that acts as a comparator.

The EVM contains one LM63, LM64, LM96063, and LM96163 digital temperature sensors. The EVM comes pre-assembled with the LM63, LM63, LM96063, and LM96163 and jumper headers that allow the end user to select different parameters such as slave address or input/output modes. The evaluation board communicates with the USB interface and is programmed via a PC running LabVIEW evaluation software.

Table 1. LM63LM64LM96x3 Evaluation Module Device and Package Configurations

SENSOR	IC	PACKAGE
U6	LM63CIMAX	SOIC-8
U7	LM64CILQ	WQFN-24
U8	LM96063CISD	WSON-10
U9	LM96163CISD	WSON-10

2 Board Connectors and Components

This section describes the jumpers and connectors on the LM63LM64LM96x63EVM, as well as software installation, and the proper set up, connection, and use of the LM63LM64LM96x63EVM.

2.1 Input/Output Connector Description and Components

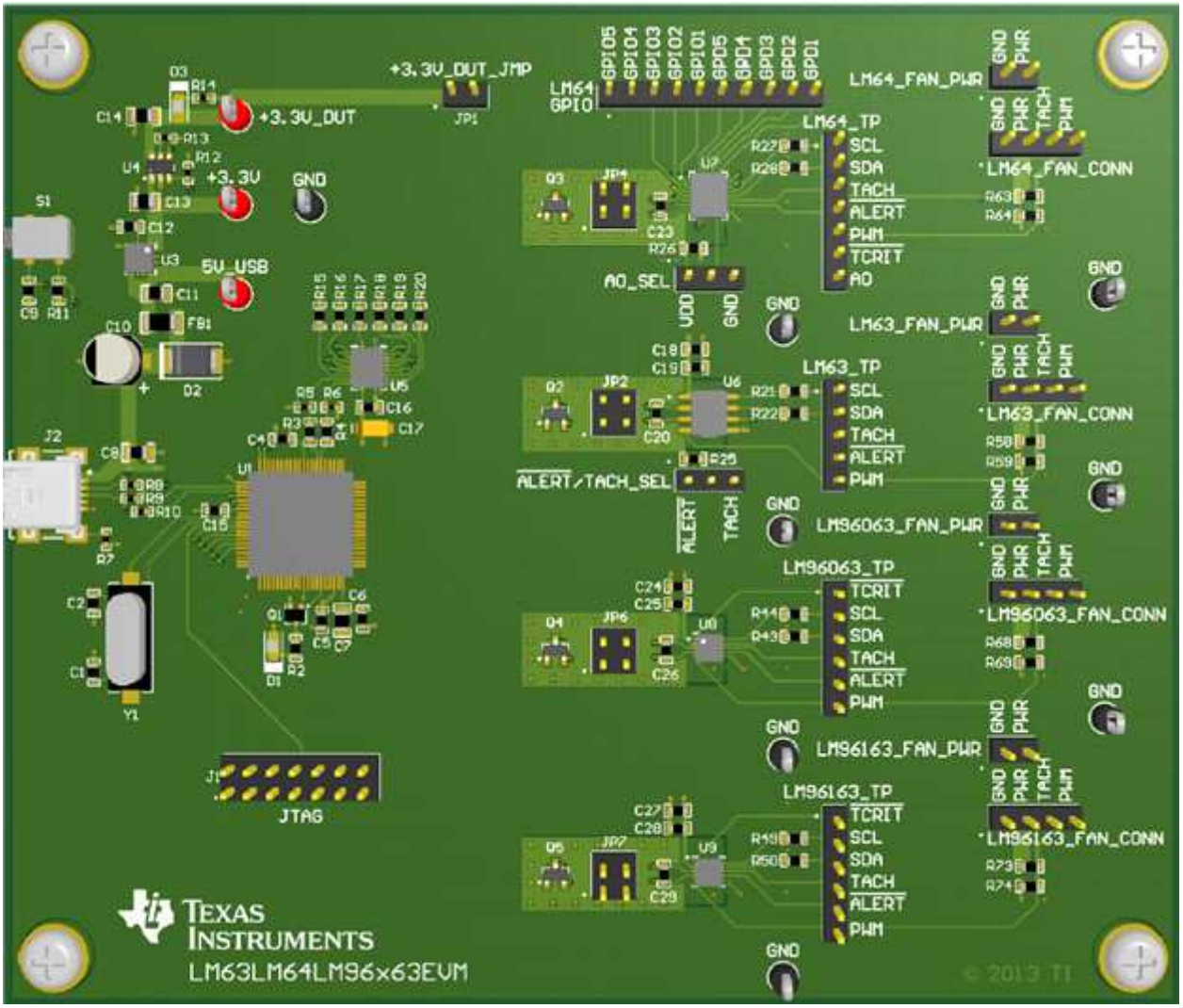

Figure 1. LM63LM64LM96x63EVM Board

2.1.1 Power Supply Input – VDD and GND

The power supply pin of all temperature sensors are connect to the +3.3V_DUT_JMP jumper. The EVM is powered by USB but it can be attached to an external power supply by connecting it to pin 2 of +3.3V_DUT_JMP jumper.

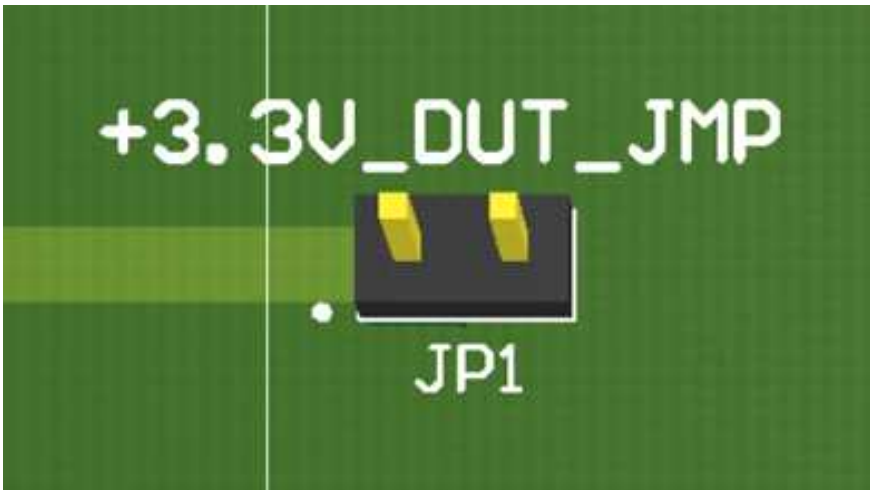

Figure 2. +3.3V_DUT_JMP Jumper

2.1.2 LM63 Test Point

The standard 100 mils header allows probing the LM63 signals including the I2C bus. The I2C bus is required two bus lines to communicate with the device: a serial data line (SDA) and a serial clock line (SCL). The $\overline{\text{ALERT}}$ pin is an active low comparator signal. The PWM pin sets the speed of the fan and the TACH pin reads the speed of the fan.

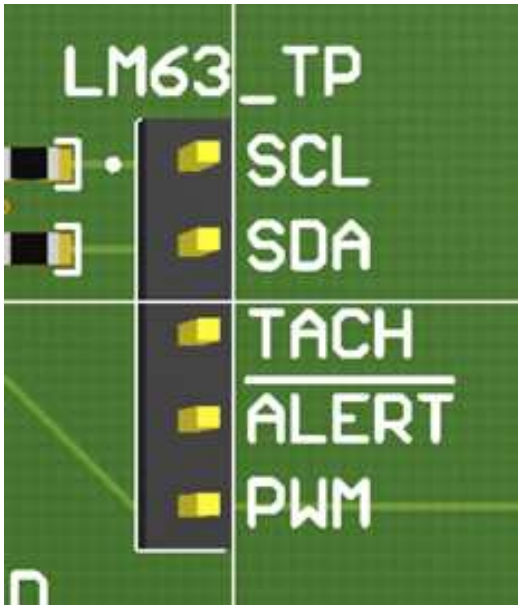

Figure 3. LM63 Test Points

2.1.3 LM63 ALERT/TACH Select Jumper

The $\overline{\text{ALERT}}$/TACH_SEL jumper allows setting $\overline{\text{ALERT}}$ / TACH pin as either an input TACH signal or an output $\overline{\text{ALERT}}$ signal. However, the $\overline{\text{ALERT}}$ / TACH pin is a multi-function that can be programmed via registers 0x03 or 0x09 bit 2.

Figure 4. LM63 ALERT/TACH Select Jumper

2.1.4 LM64 Test Point

The standard 100 mils header allows probing the LM64 signals including the I2C bus. The I2C bus is two required bus lines to communicate with the device: a serial data line (SDA) and a serial clock line (SCL). The A0 pin selects a high or low I2C slave address for the LM64. The $\overline{\text{ALERT}}$ and $\overline{\text{TCRIT}}$ pins are active low comparator signals. The PWM pin sets the speed of the fan and the TACH pin reads the speed of the fan.

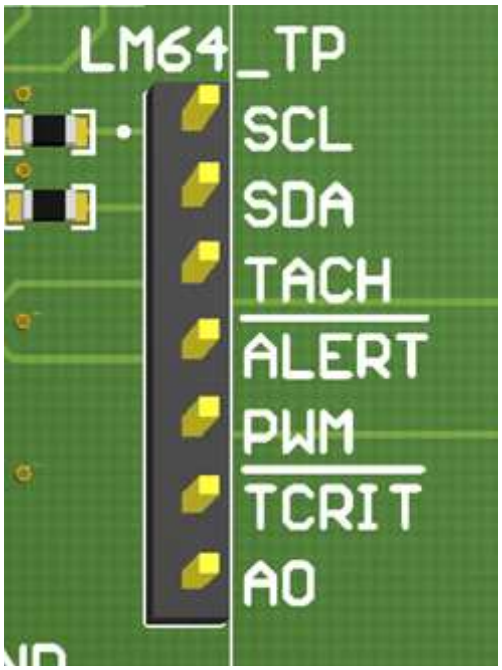

Figure 5. LM64 Test Points

2.1.5 LM64 A0 Select Jumper

The LM64 have two pre-programmed slave address. The A0_SEL jumper selects either a high or low I2C slave address for the LM64. Setting the jumper to VDD sets the I2C address of the LM64 to 0x4E and setting the jumper to GND sets the I2C address to 0x18. However, it was hardcoded to 0x18 slave address in the software GUI.

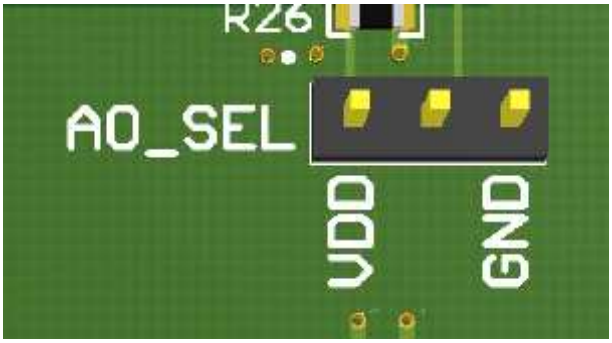

Figure 6. LM64 A0 Select Jumper

2.1.6 LM64 GPIO Test Point

The GPIO Test Point header allows probing the General Purpose Input Output (GPIO) pins and General Purpose Default (GPD) pins. The GPIO and GPD pins are pulled up to VDD with a 10kOhm resistor by default.

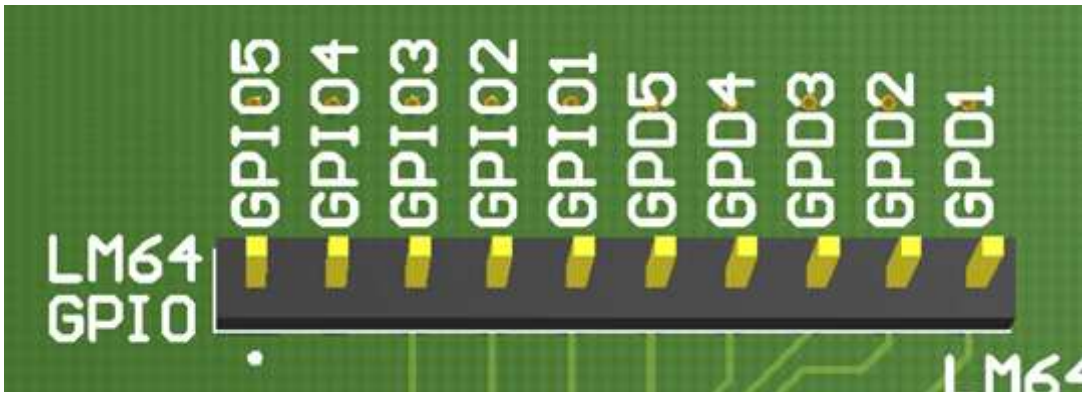

Figure 7. LM64 GPIO Test Points

2.1.7 LM96063 Test Point

The standard 100 mils header allows probing the LM96063 signals including the I2C bus. The I2C bus is required two bus lines to communicate with the device: a serial data line (SDA) and a serial clock line (SCL). The $\overline{\text{ALERT}}$ and $\overline{\text{TCRIT}}$ pins are active low comparator signals. The PWM pin sets the speed of the fan and the TACH pin reads the speed of the fan.

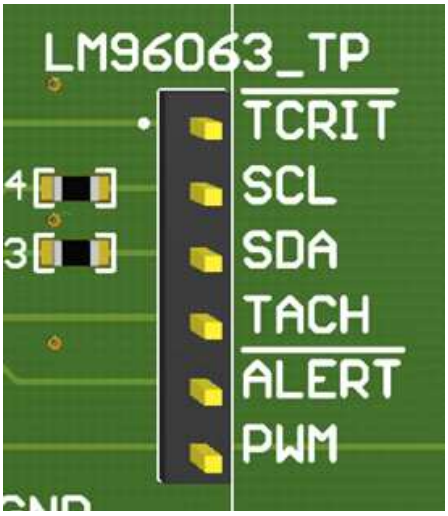

Figure 8. LM96063 Test Points

2.1.8 LM96163 Test Point

The standard 100 mils header allows probing the LM96163 signals including the I2C bus. The I2C bus is required two bus lines to communicate with the device: a serial data line (SDA) and a serial clock line (SCL). The $\overline{\text{ALERT}}$ and $\overline{\text{TCRIT}}$ pins are active low comparator signals. The PWM pin sets the speed of the fan and the TACH pin reads the speed of the fan.

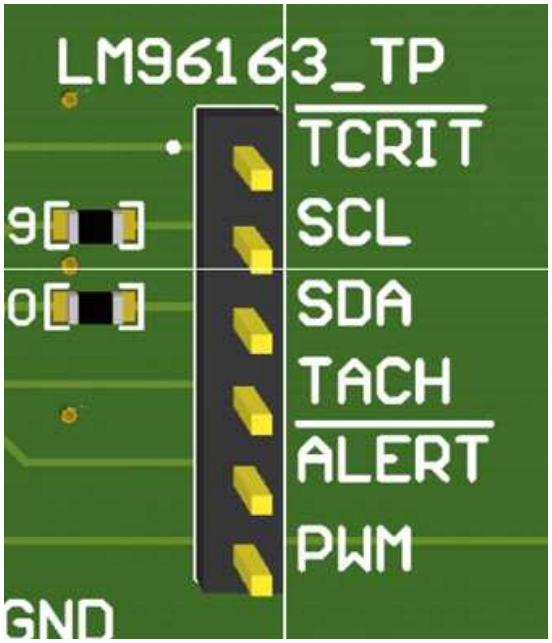

Figure 9. LM96163 Test Points

2.1.9 Diode Jumper – JP2, JP4, JP6, JP7

The Q2, Q3, Q4, and Q5 are the remote diodes where the LM63, LM64, LM96063, LM96163 sense their temperature. JP2, JP4, JP6, JP7 are used to connect the remote sensing diode to the temperature sensors by connecting pin 1-3 for D- and pin 2-4 for D+. The end user may remove these jumpers and attach his or her own diode.

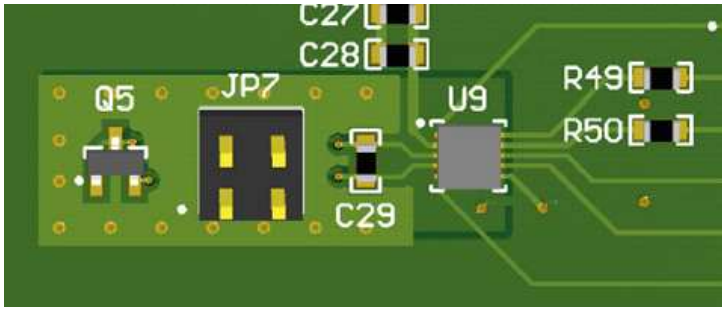

Figure 10. LM64 Diode Jumper

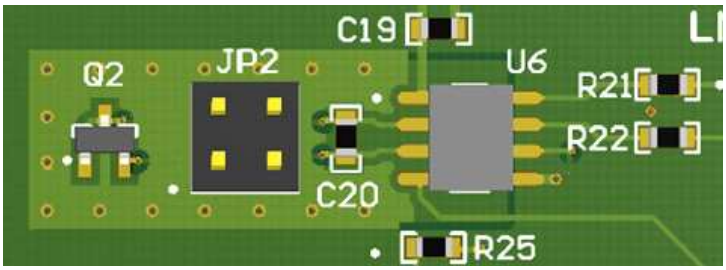

Figure 11. LM63 Diode Jumper

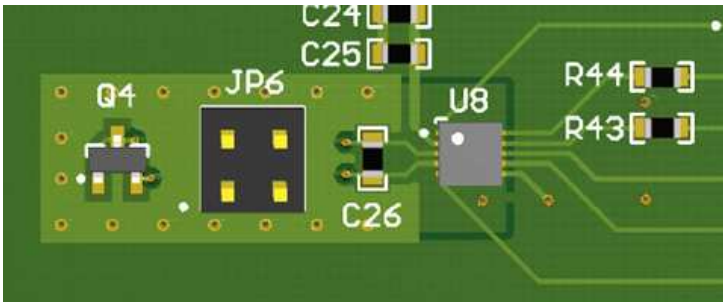

Figure 12. LM96063 Diode Jumper

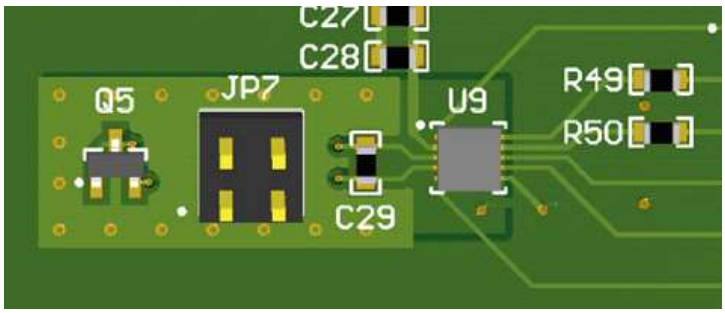

Figure 13. LM96163 Diode Jumper

2.1.10 LM63, LM64, LM96063, LM96163 Fan and External Power Connectors.

The LM63, LM64, LM96063, LM96163 Fan Connectors are used to connect a 4-pin fan to the LM63LM64LM96x63EVM board. The LM63, LM64, LM96063, LM96163 external power connectors are used to power the fan to its corresponding fan connectors. The connectors are to be powered with 5 V or 12 V from an external power supply.

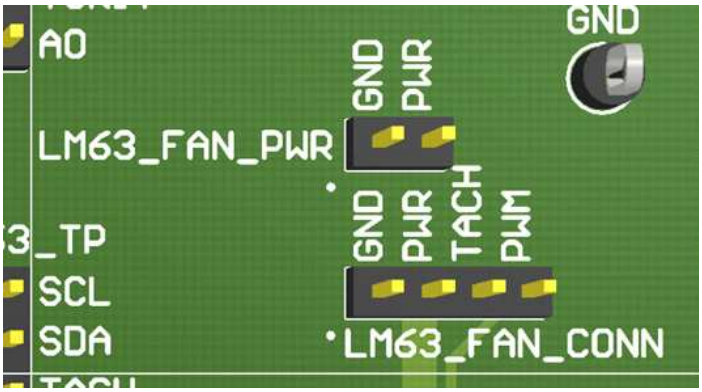

Figure 14. LM63 Fan Connector

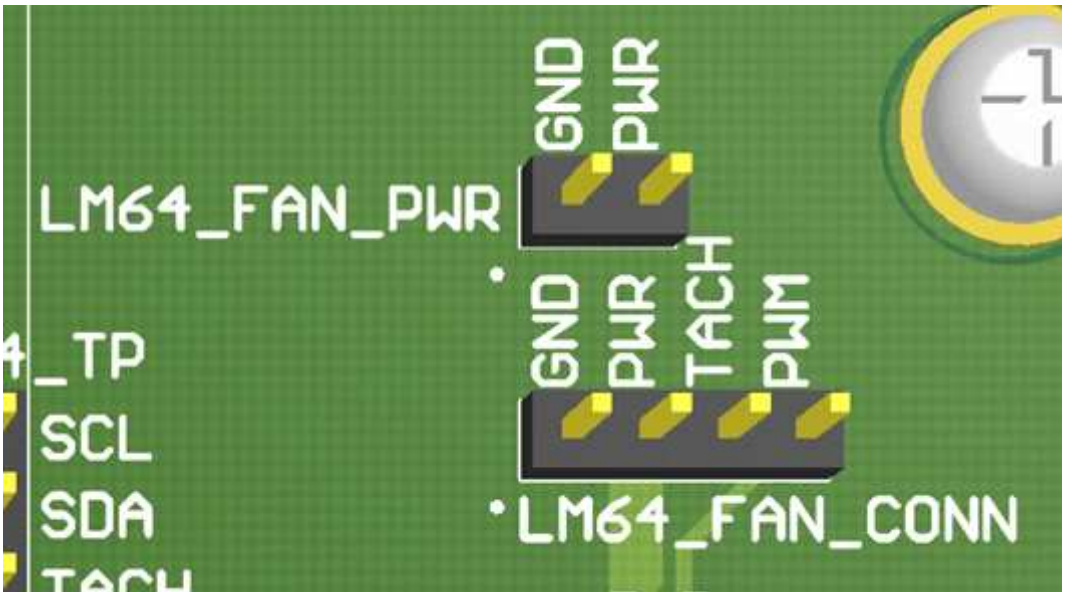

Figure 15. LM64 Fan Connector

Figure 16. LM96063 Fan Connector

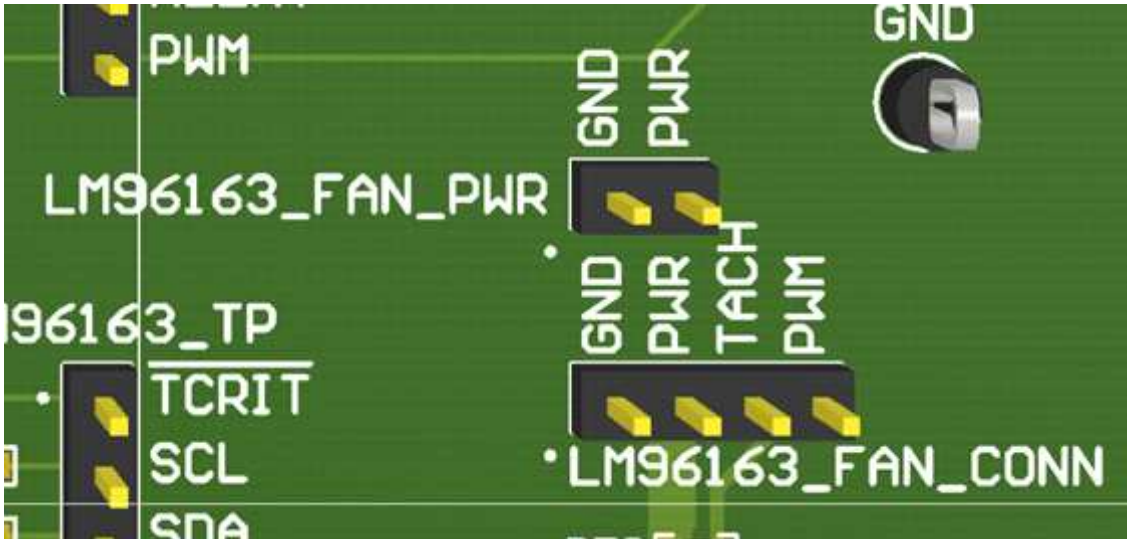

Figure 17. LM96163 Fan Connector

2.1.11 USB Connector

The USB Connector, J2, is a mini-USB port that is used to interface between a computer and the evaluation board

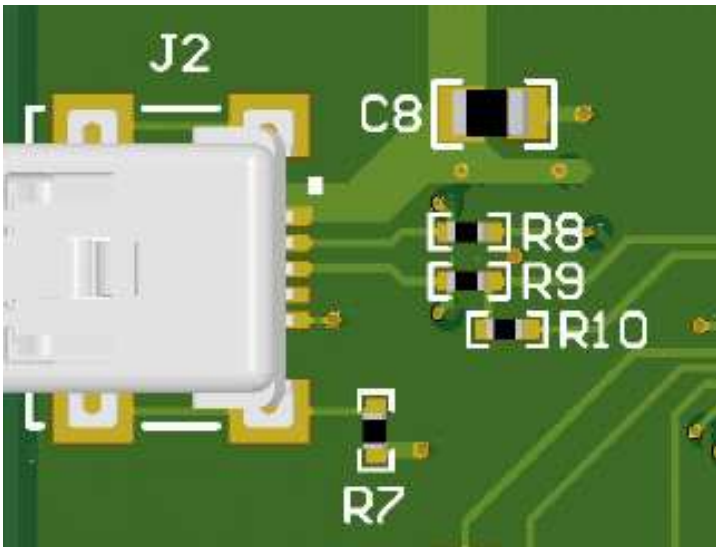

Figure 18. LM63LM64LM96x63 USB Connector

2.1.12 MSP430F5529 Microcontroller

The MSP430F5529 microcontroller, U1, is used to translate the USB signals to I2C signals. The MSP430F5529 is connected to a 24MHz crystal shown in Y1.

C1 and C2 are for filtering the 24MHz crystal's signals. C4, C5, C6, C7, C15 are bypass capacitors. Q1 is a transistor that allows the D1 LED to turn on or turn off.

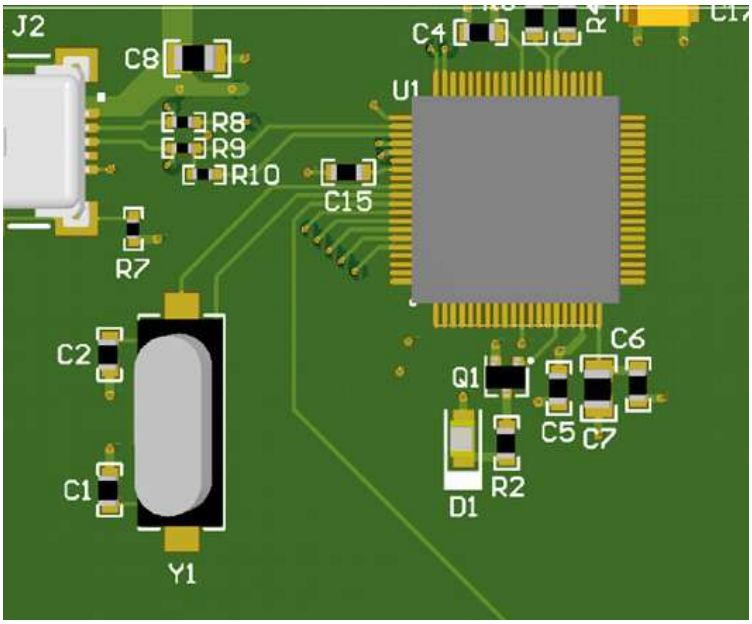

Figure 19. MSP430F5529 Microcontroller

2.1.13 PCA954A I2C Multiplexer

The PCA954A, U5, is a 1 to 4 bidirectional I2C line multiplexer. LM64, LM96063, and LM96163 have the same slave address of 0x4C so their I2C buses must be separated. This separation is done using the PCA954A I2C Multiplexer. The MSP430F5529 sends I2C commands to select the appropriate device, after the selection the microcontroller sends I2C signals to the DUT's as normal.

R5, R6, R15, R16, R17, R18, R19, R20 are pull up resistors are for the unused pins on the PCA954A. C16 and C17 are bypass capacitors of values 0.1uF and 10uF respectively. R3 and R4 are 0 ohm series resistors for the I2C lines.

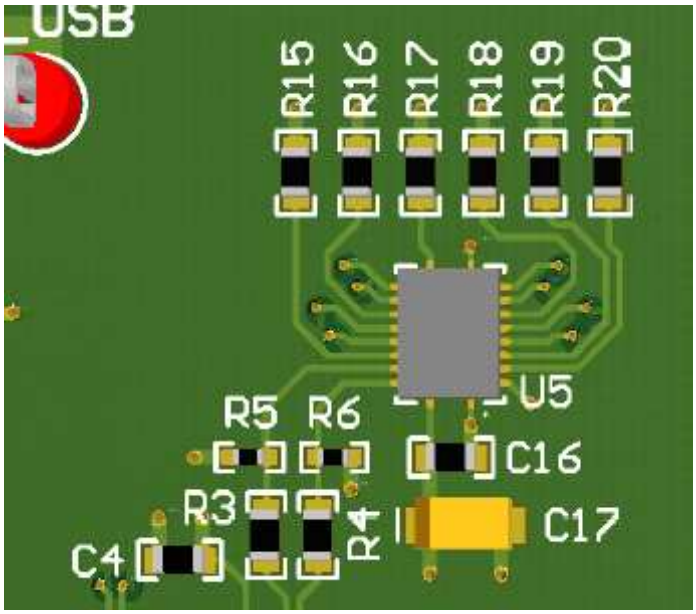

Figure 20. PCA954A I2C Multiplexer

2.1.14 Power Conversion

The LM63LM64LM96x63EVM has components that convert 5 V from the USB connection to 3.3 V via a LDO (U3, TPS7533DRB). A current limiting IC (U4, TPS2553DBV-1) is connected after the LDO and will tell the MSP430F5529 to shut down if current drawn from the DUT's exceeds the limit. There are 4 test points: 5V_USB for testing power from the USB connector, +3.3V for testing voltage after the LDO, +3.3_DUT for testing voltage after the LDO (TPS7533DRB) and current limiter (TPS2553DBV-1), and GND for reference.

D2 is a Zener diode with a breakdown voltage of 7.5 V used for over voltage protection. FB1 is a ferrite bead with an impedance of 90 Ω at 100 MHz.

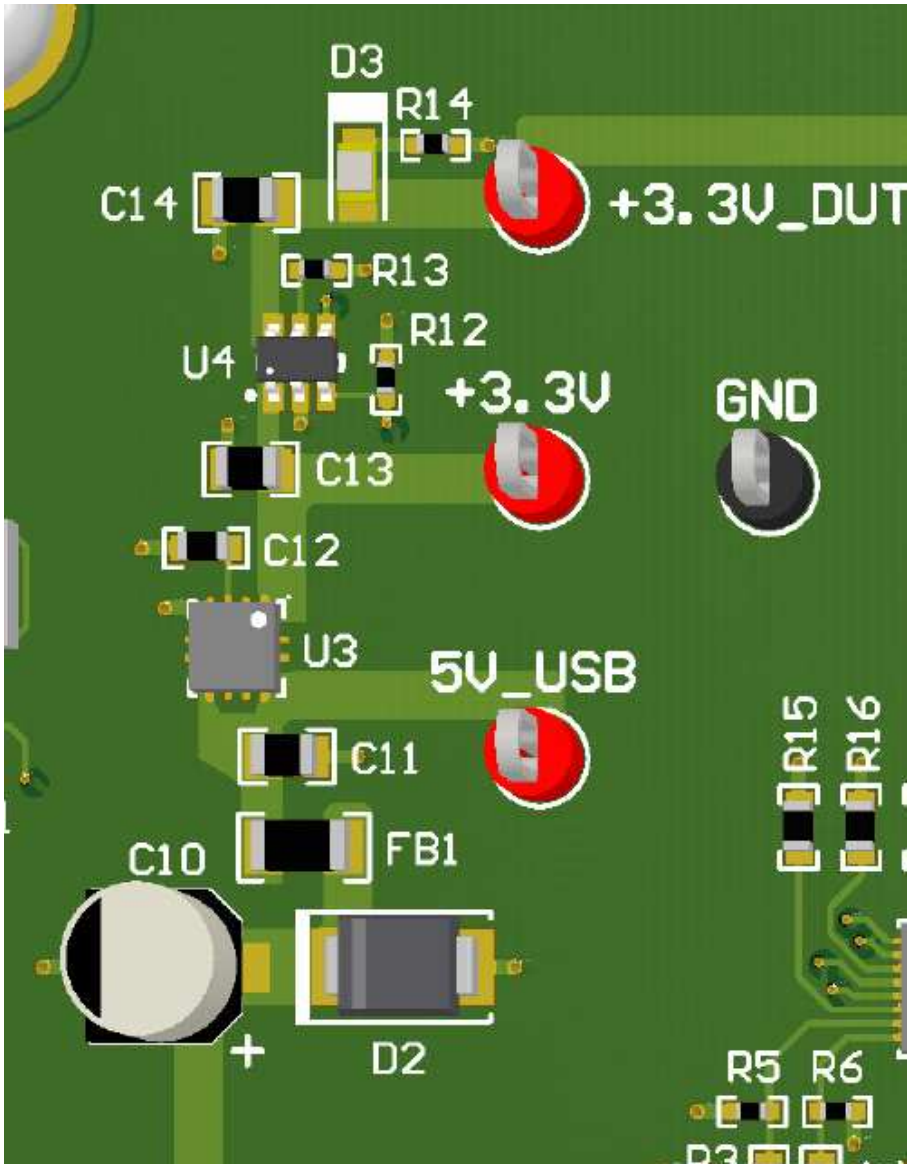

Figure 21. LM63LM64LM96x63 Power Conversion

3 Software Installation

Download the latest version of LM63LM64LM96x63EVM software from our website at http://www.ti.com/product/lm63. You must install the LM63LM64LM96x63EVM software before you connect the LM63LM64LM96x63EVM board to your PC.

To install the LM63LM64LM96x63EVM Software:

1. Click this link http://www.ti.com/product/lm63, scroll down to the “software” section, and download the latest LM63LM64LM96x63 evaluation software.
2. Unzip the downloaded file into a known directory, and run the “setup.exe” file located on the previous created folder. Follow the pop-screen instructions by clicking the “Next” button to install the software.

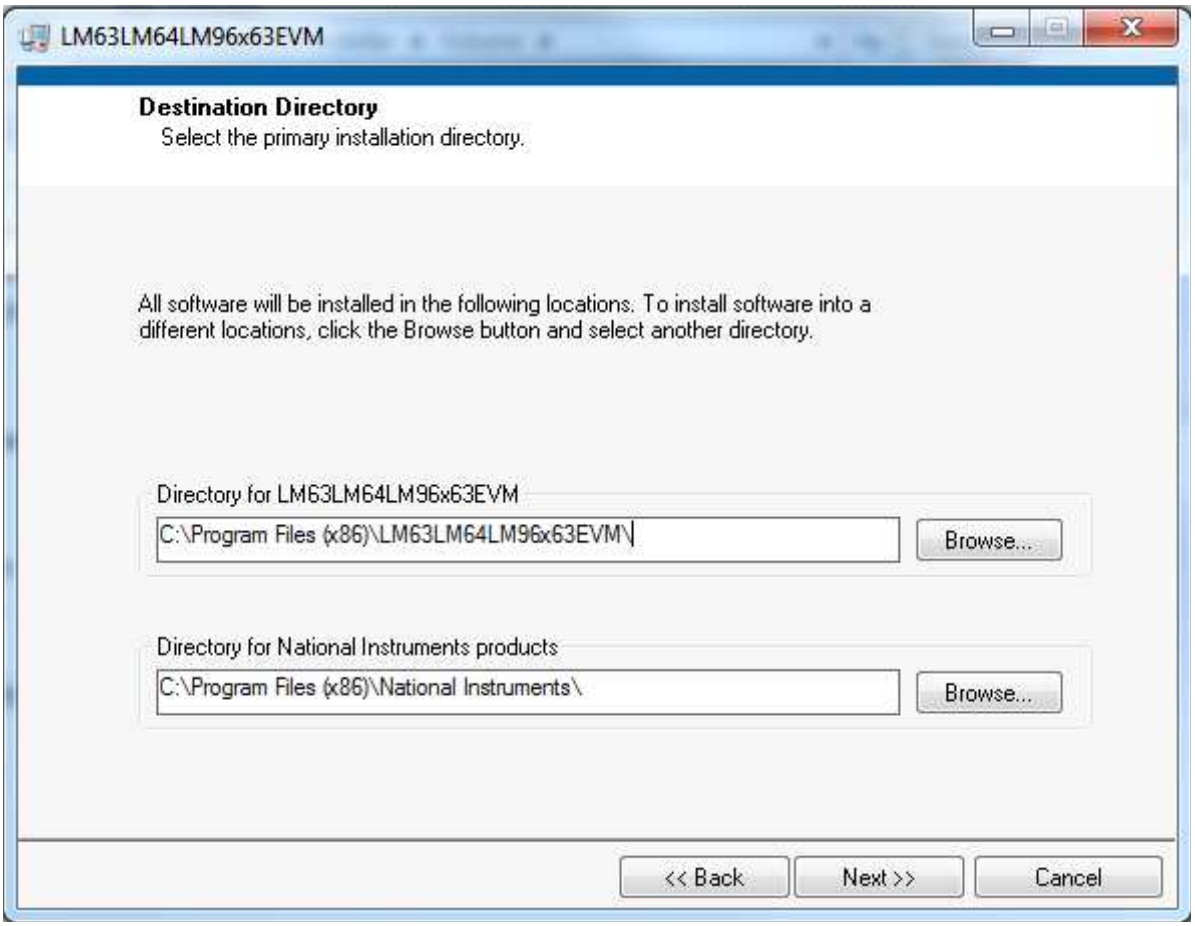

Figure 22. LM63LM64LM96x63 Installation Directory

3. When the installation is finished, please click “Finish” button.

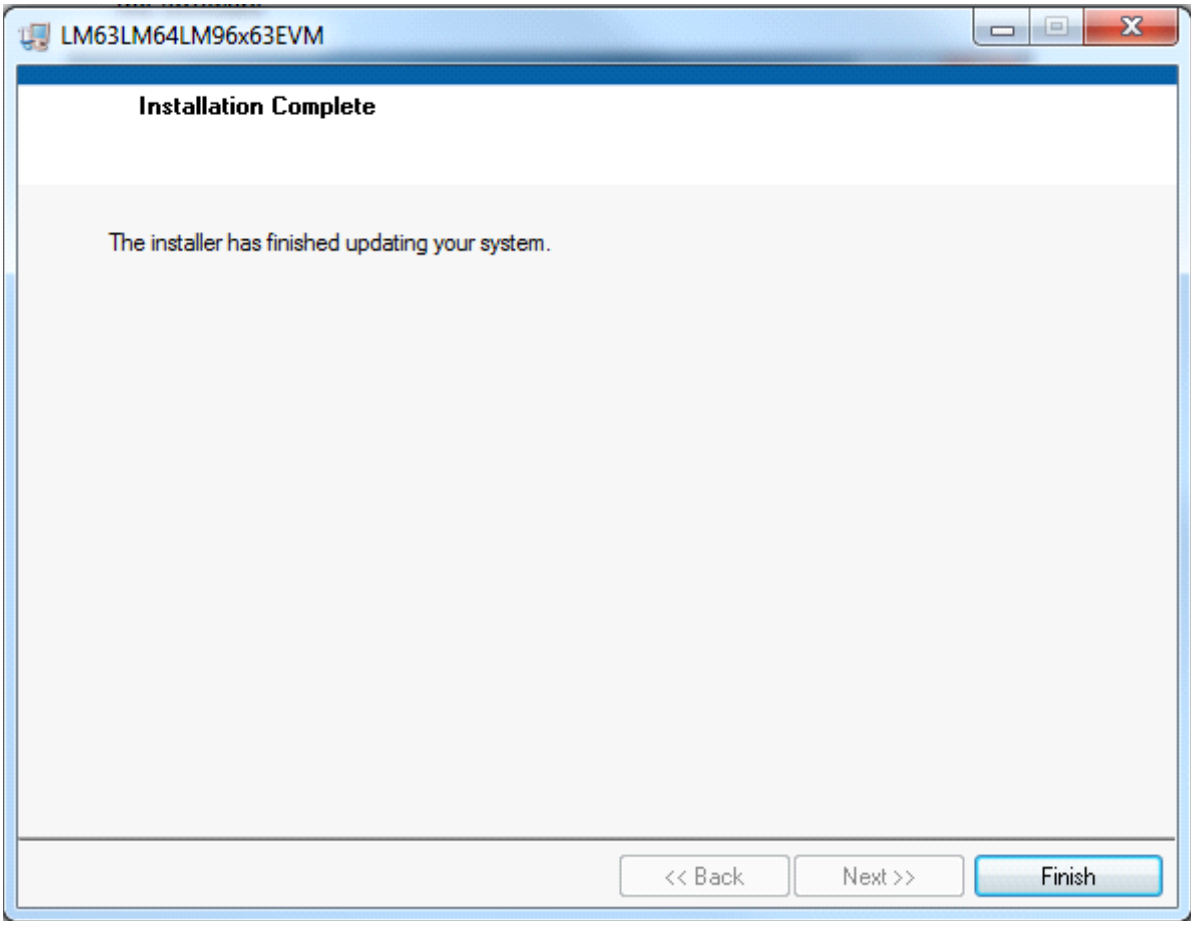

Figure 23. LM63LM64LM96x63 Installation Finish

4. Before launching the LM63LM64LM96x63EVM software, connect the LM63LM64LM96x63EVM board to a USB port of your PC. Go to Device Manager and find “MSP43-USB Example” (see Figure 24). Right click and select Update Driver Software.

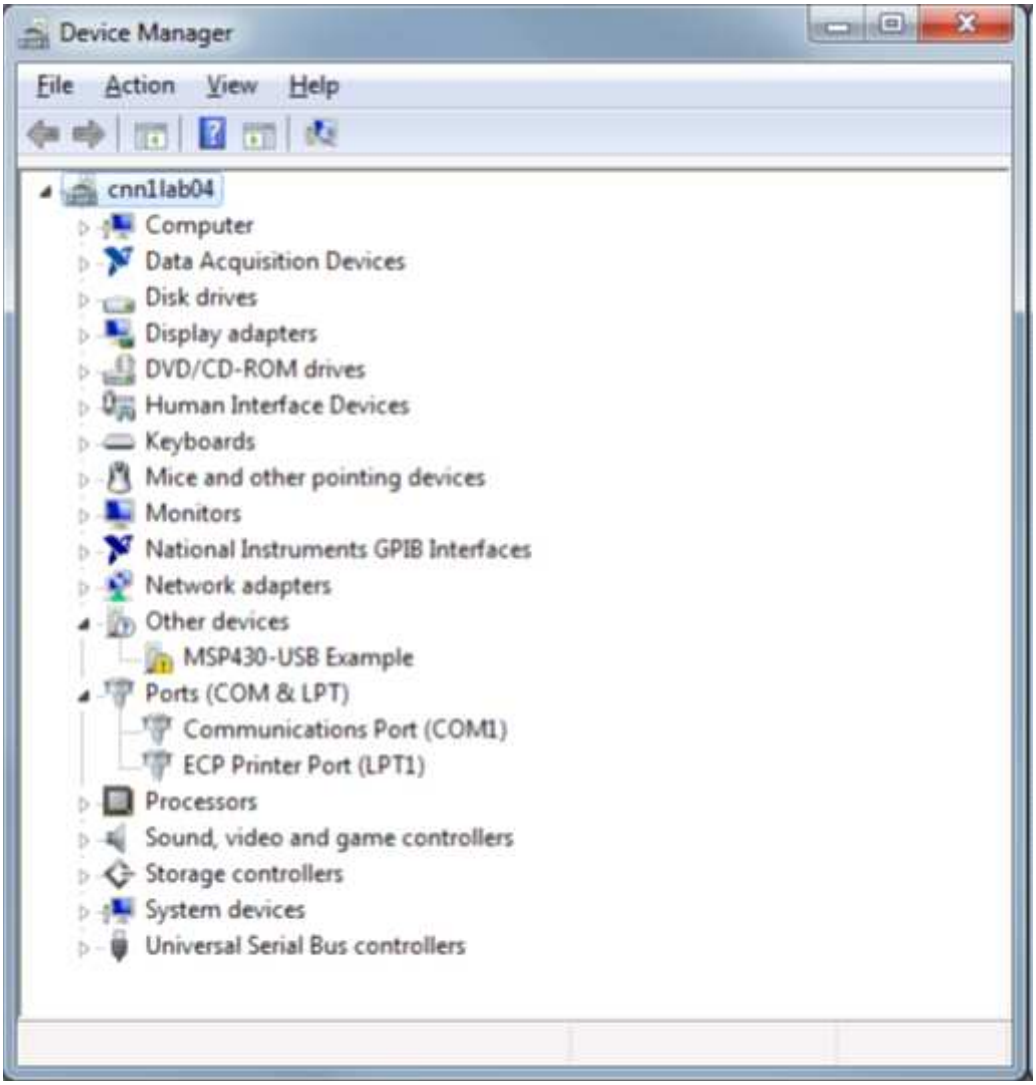

Figure 24. Update Driver Software

5. On the next screen, select the "**Browse my computer for driver software**" option and go to the directory of C:\Program Files (x86)\Texas Instruments\LM63LM64LM96x63\ LM63LM64LM96x63 Driver and select the "LM63LM64LM96x63_PID0x0925.inf" file.
6. If prompted with a warning window select "**Install this Driver Anyway**". Close the installation window when it is done. The device manager should now display an "LM63LM64LM96x63EVM" item followed by a COM port number.

Figure 25. Driver Authentication Warning

7. Close the installation window when it's done. The device manager should now display a "**LM63LM64LM96x63EVM(COM5)**" item followed by a COM port number. The EVM software is automatically selected as the COM port.

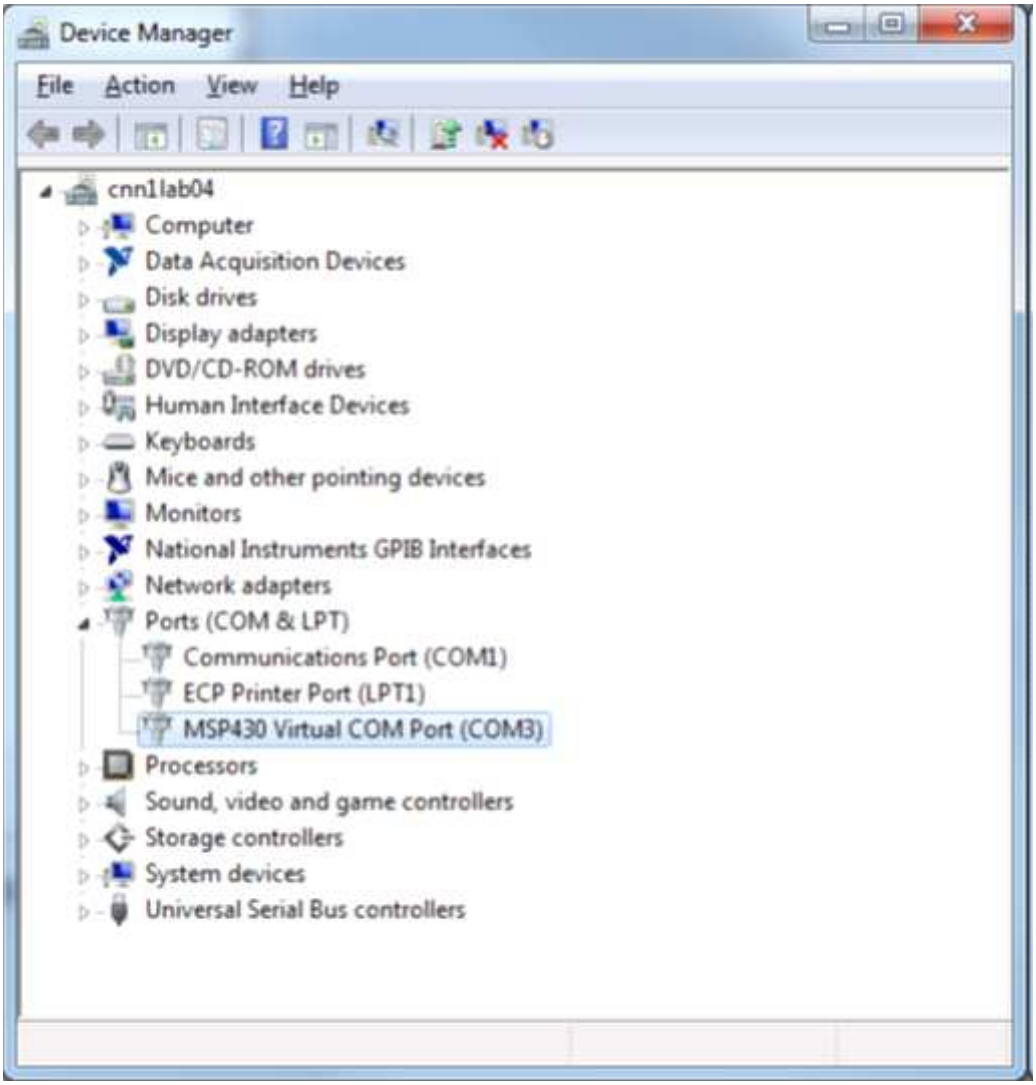

Figure 26. Example COM Port Number

4 Board Setup and Operation

1. For proper operation of the LM63LM64LM96x63EVM JP1 should be jumpered. This will allow the DUT's VDD to be sourced from an on-board 3.3 V regulator.
2. JP2, JP4, JP6, and JP7 should be jumpered to connect the MMBT3904's to their respective parts.
3. A0_SEL should be jumpered to GND for hardware selectable I2C address.
4. $\overline{\text{ALERT}}$/TACH_SEL should be jumpered to TACH to allow TACH signals to go into the LM63 part.

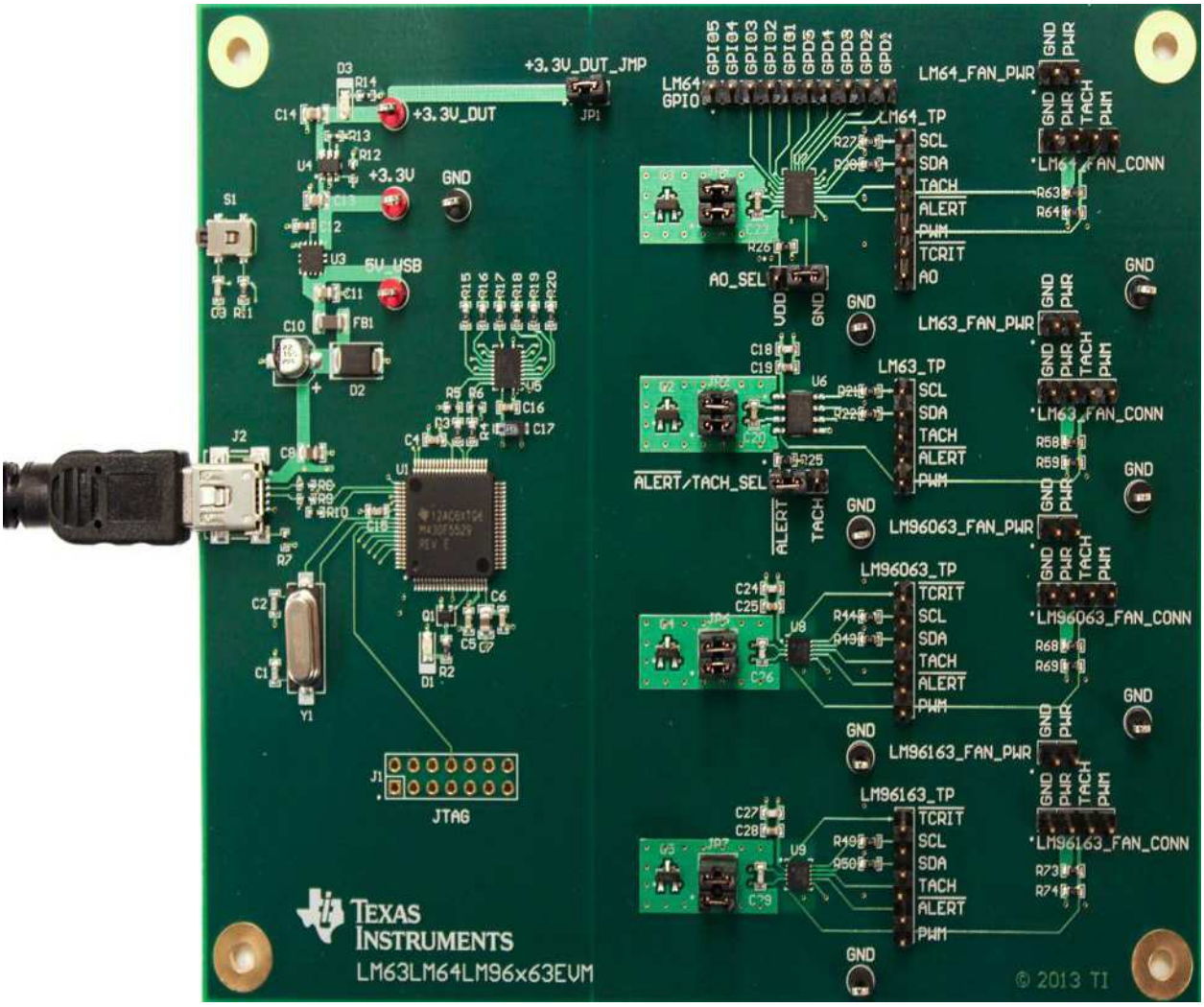

Figure 27. LM63LM64LM96x63EVM Hardware Connection

4.1 Launching the Software

1. The LM63LM64LM96x63EVM GUI software can be run by clicking on Start | All Program | Texas Instruments | LM63LM64LM96x63EVM. Launching the software will take you directly to the GUI where register settings can be changed and data can be logged to a .csv file. The default GUI that launches is the LM63. There is a pull down menu in which the user can select which part and GUI to use.

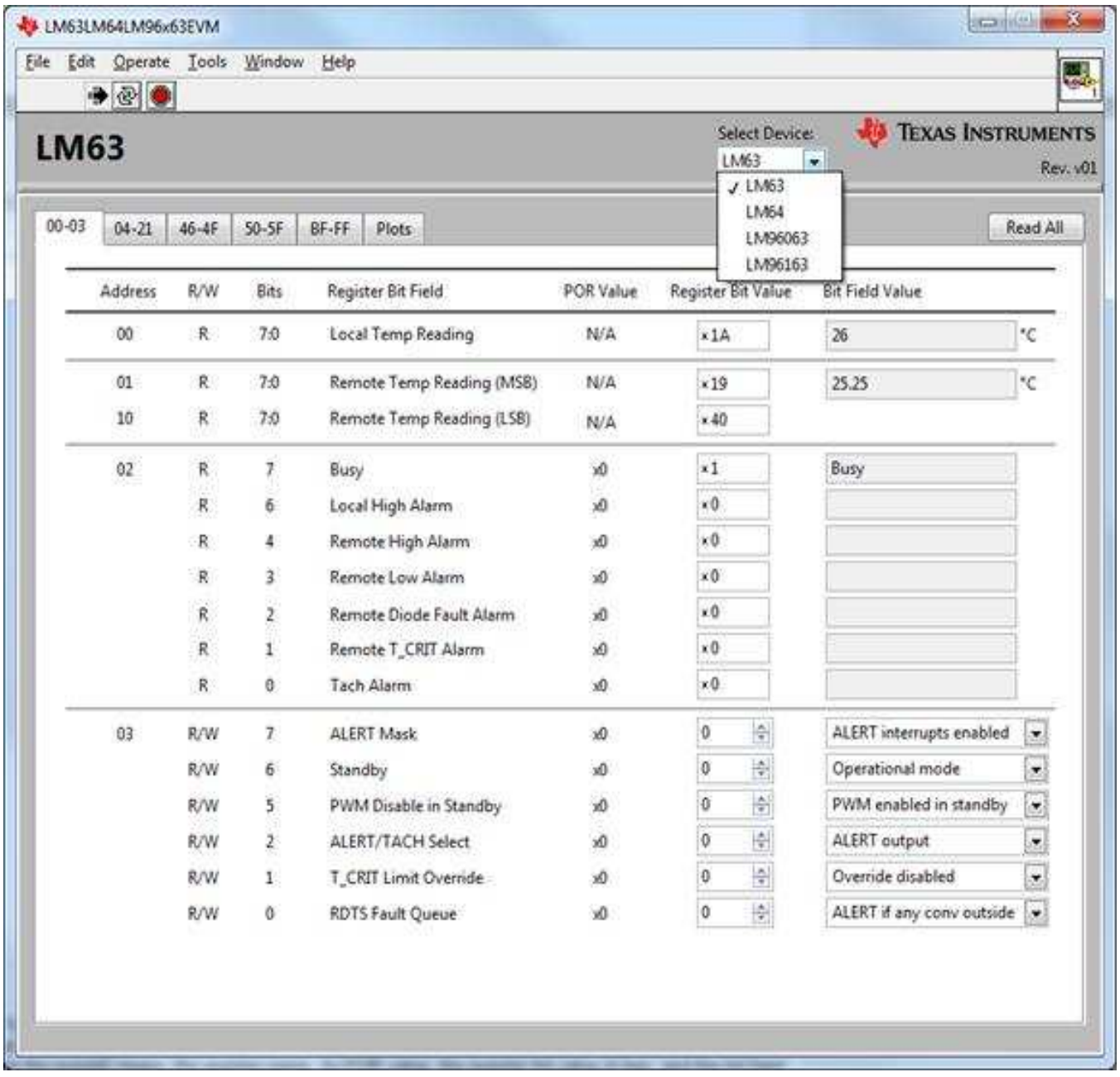

Figure 28. Part Select

2. The hexadecimal numbered tabs represent the register map associated with their respective part. Each tab shows the register address, whether the particular address is read, write, or read/write, the number of bits the register spans, the register name, its POR value, the register bit value in hex, and the bit field value. The user can change the register contents by either pressing the up and down buttons on the register bit value column or by selecting an option on the pull down menu in the bit field value column. A change in the register bit value will automatically change the bit field value to its corresponding value and vice versa with a change in the bit field value. The user can read back the register data by pressing the “Read All” button the upper right hand of the GUI. This will read all the register contents and update all the fields in the GUI.

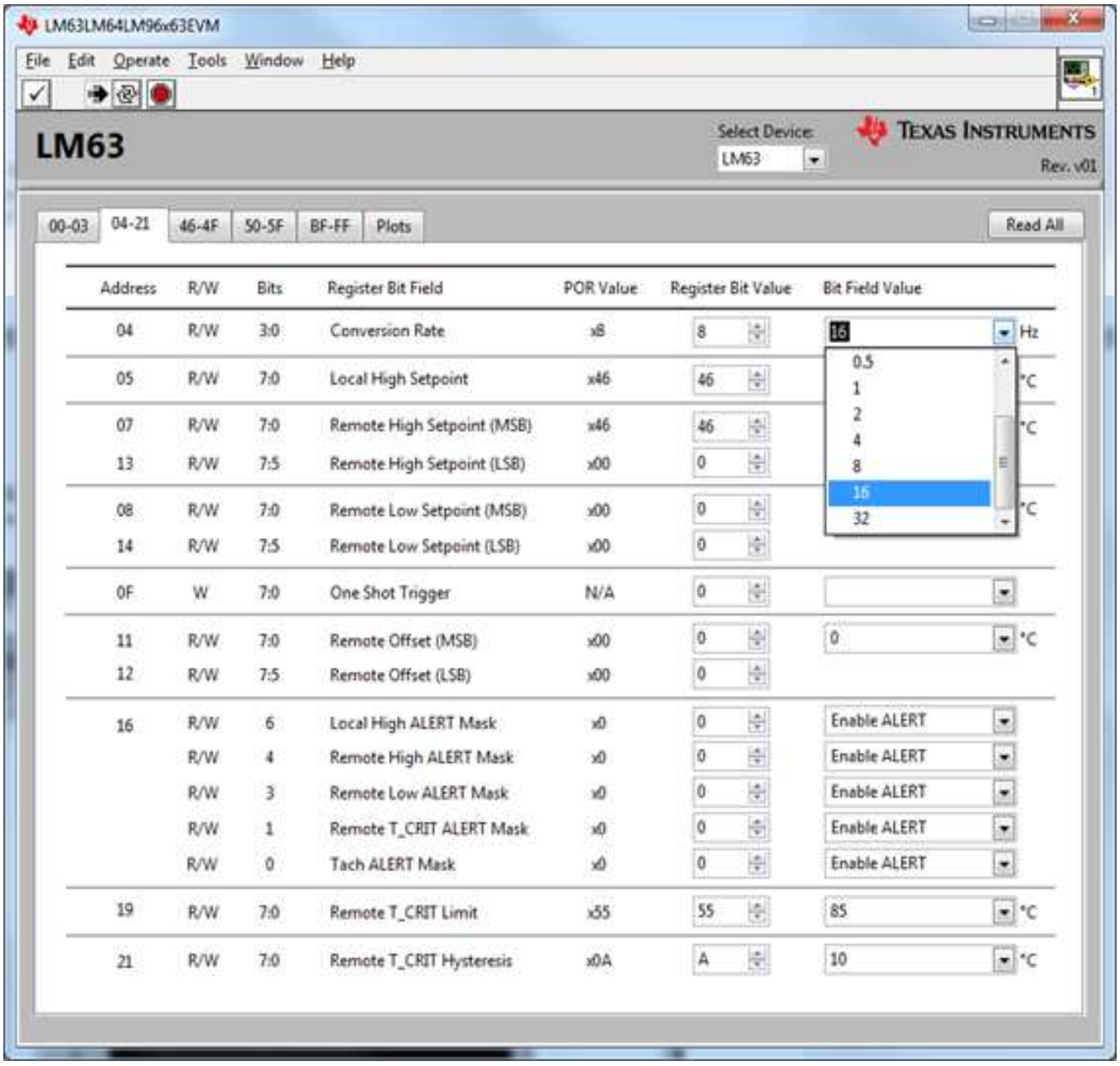

Figure 29. Selectable Fields in GUI

3. The “Plots” tab allows capturing and displaying the remote temperature, local temperature, and tachometer data. By default, the plotting will not start until the “Start” button is pressed. Click on the “Stop” button to stop the plotting. The temperature and tachometer data can be saved into an Excel file by checking the “Log” button before pressing the start button. A prompt will pop up allowing the user to choose the save location and file name.

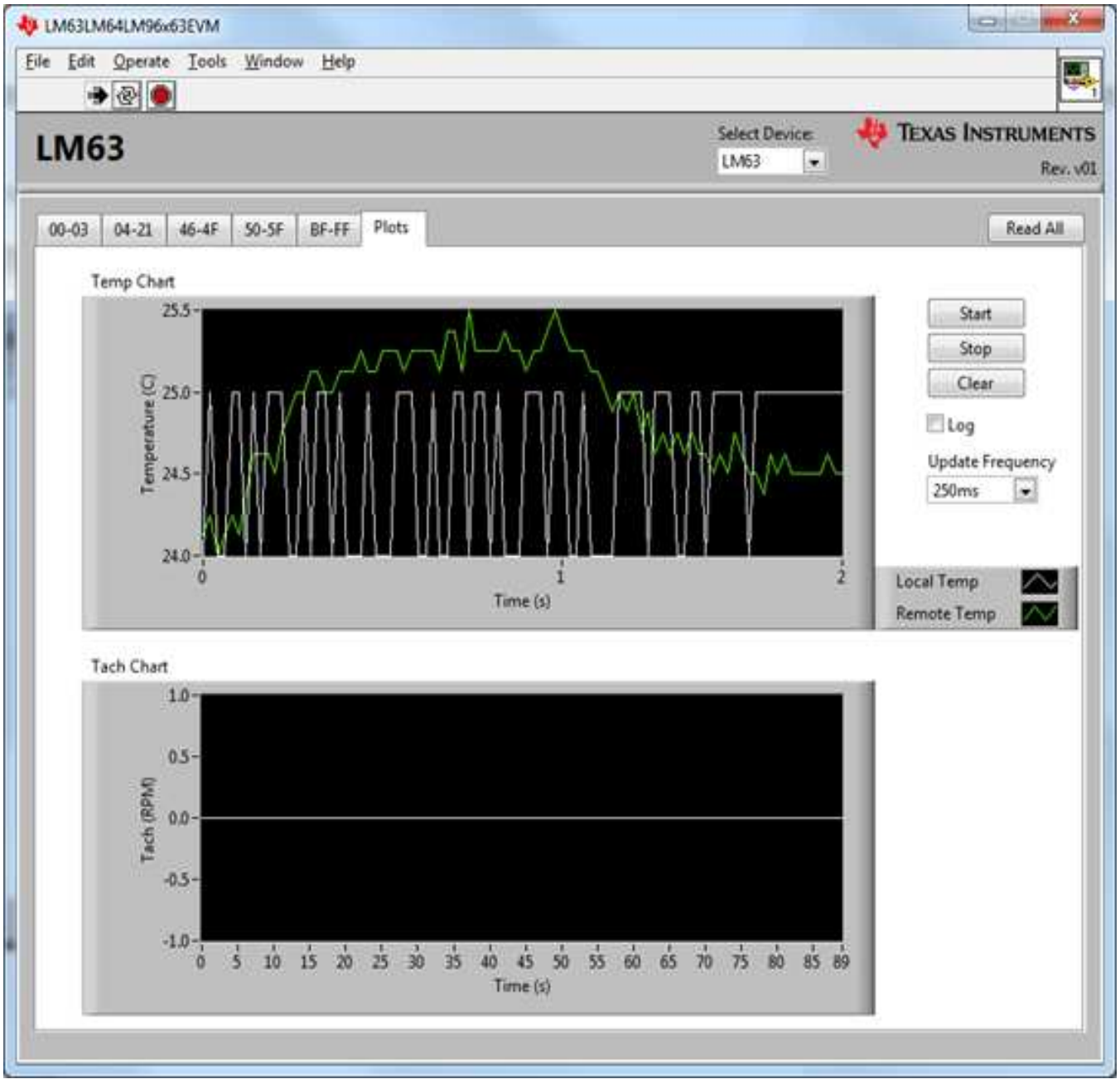

Figure 30. Plots Tab

5 Board Layout

Figure 31, Figure 32, Figure 33, Figure 34, and Figure 35 show the board layout for the LM63LM64LM96x63EVM.

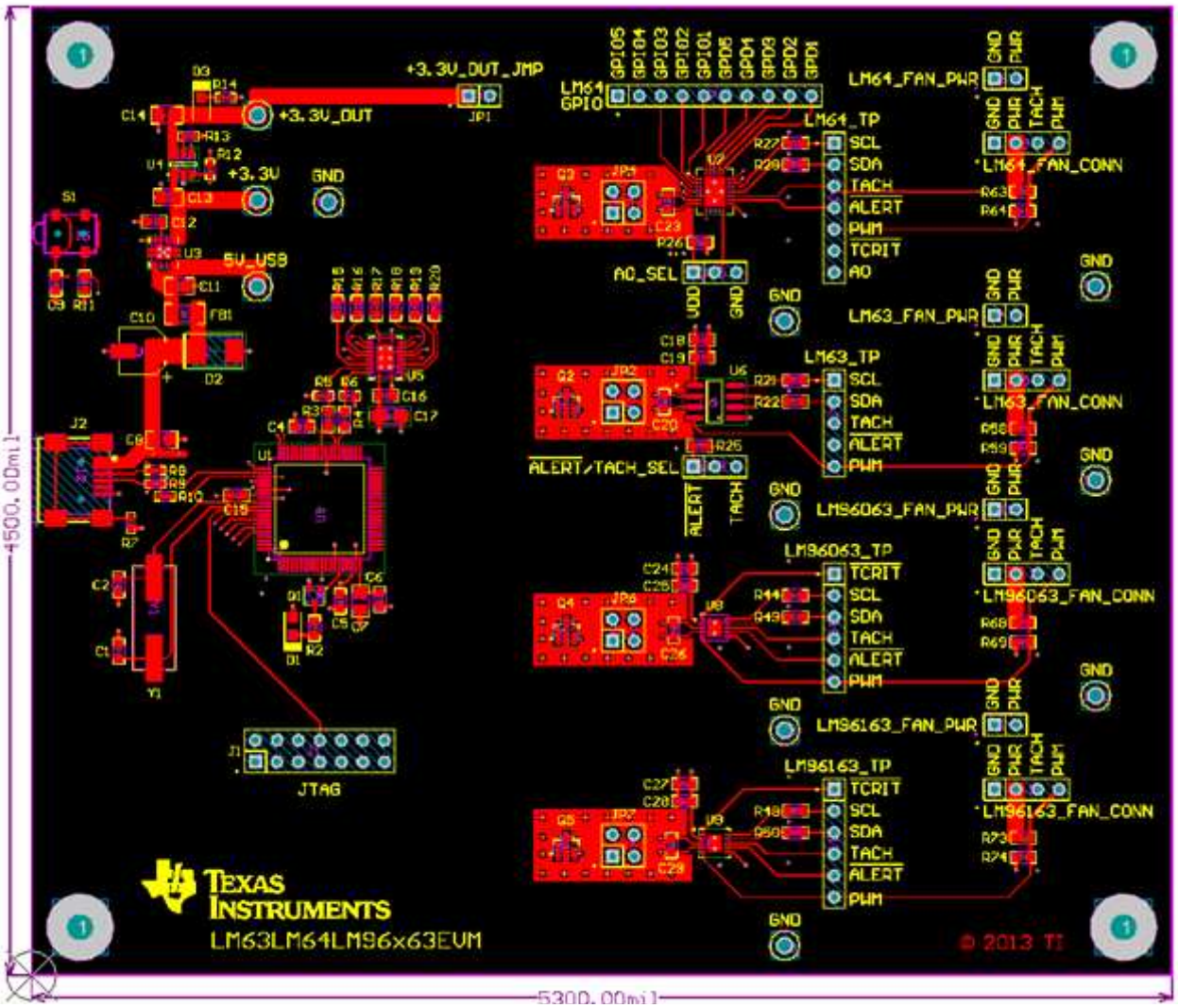

Figure 31. Top Assembly Layer

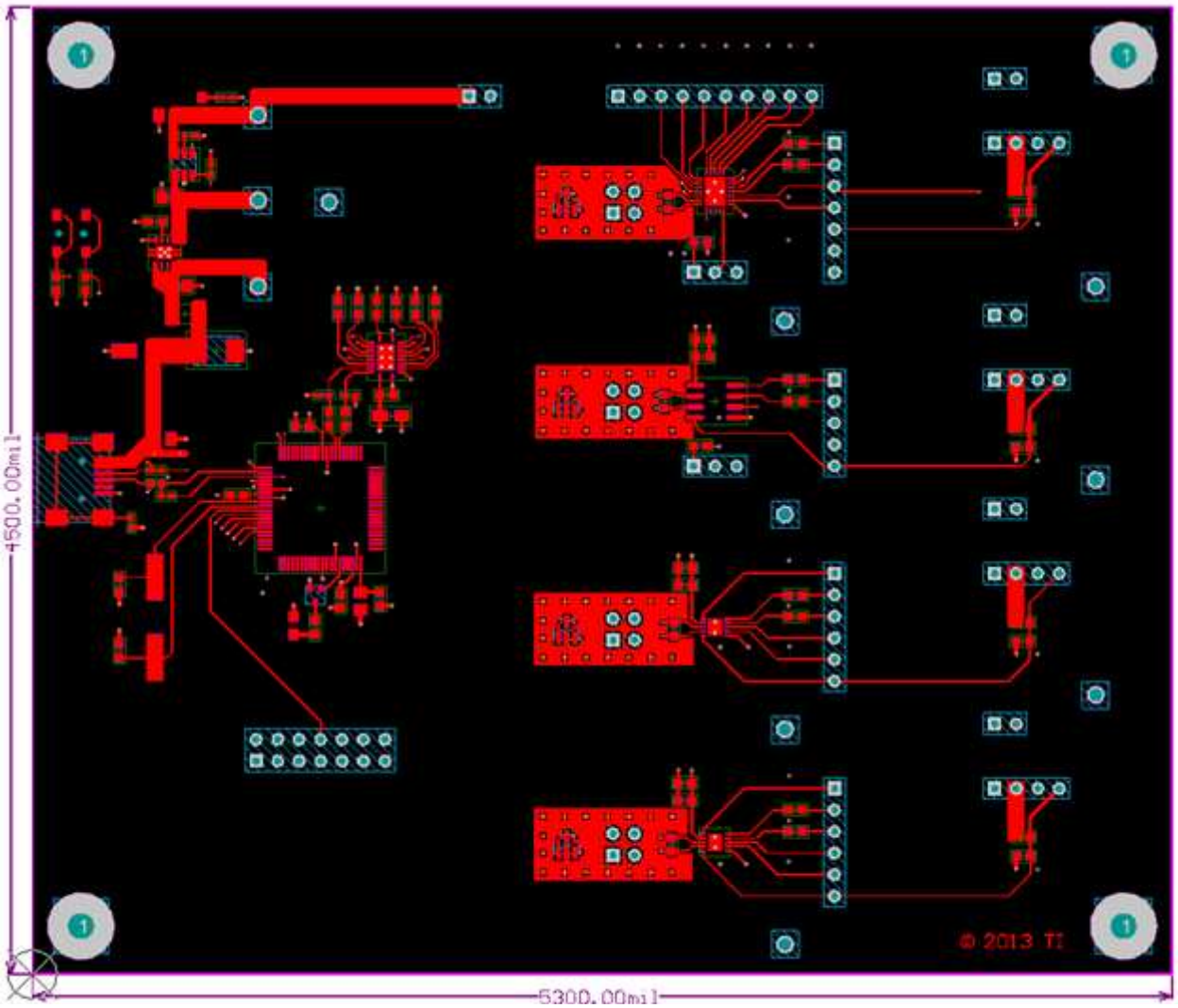

Figure 32. Top Layer Routing

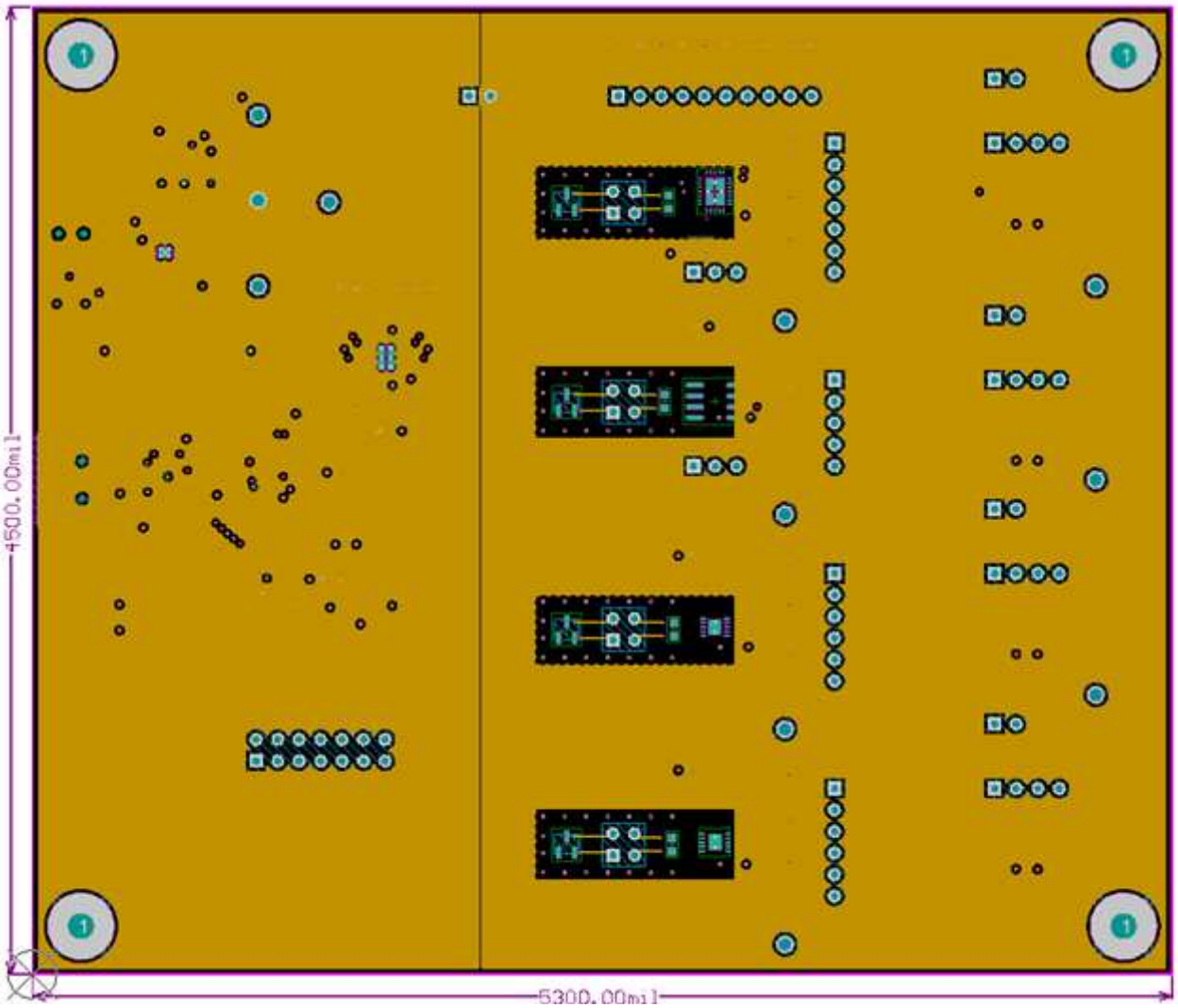

Figure 33. Power Layer Routing

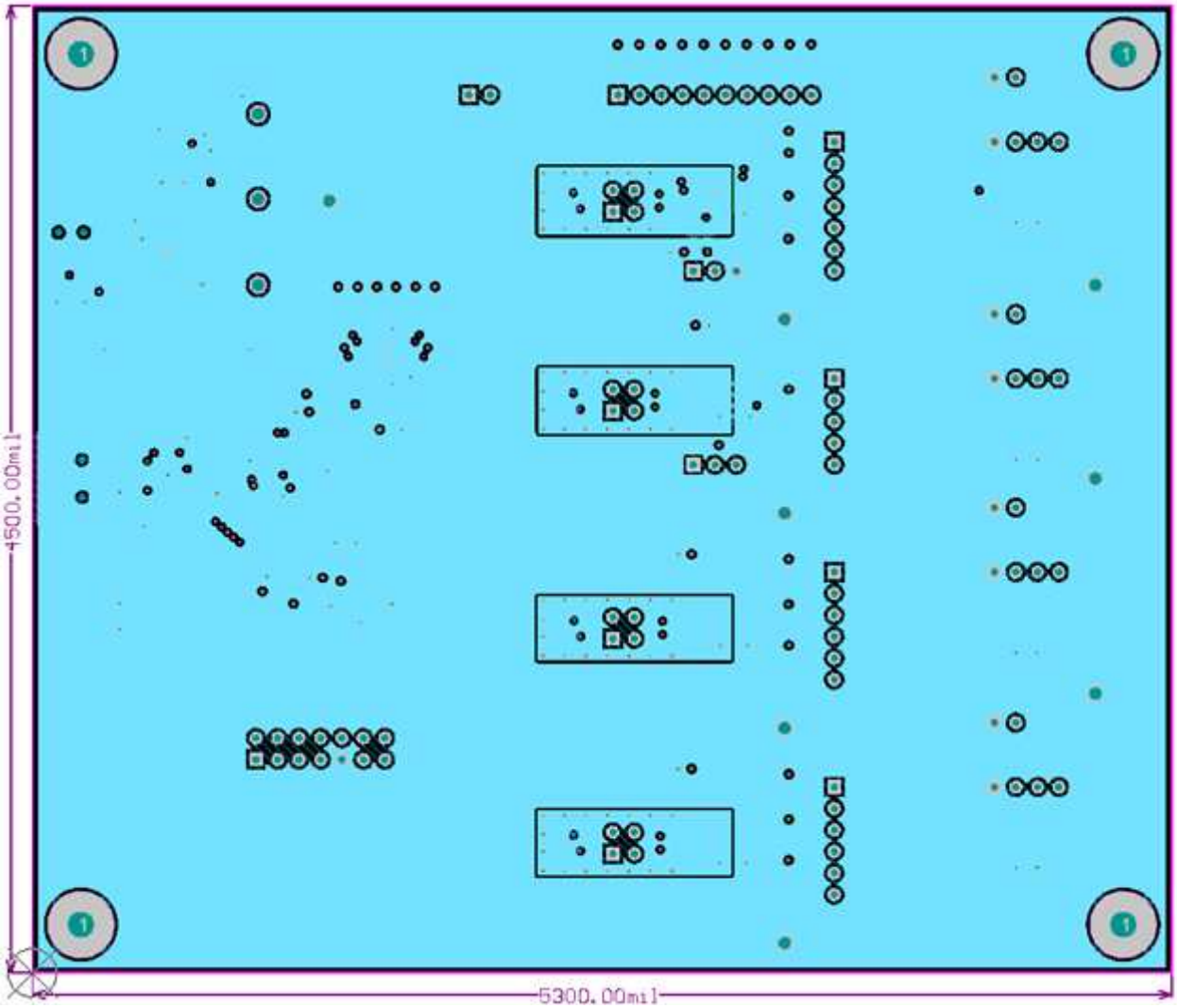

Figure 34. Ground Layer Routing

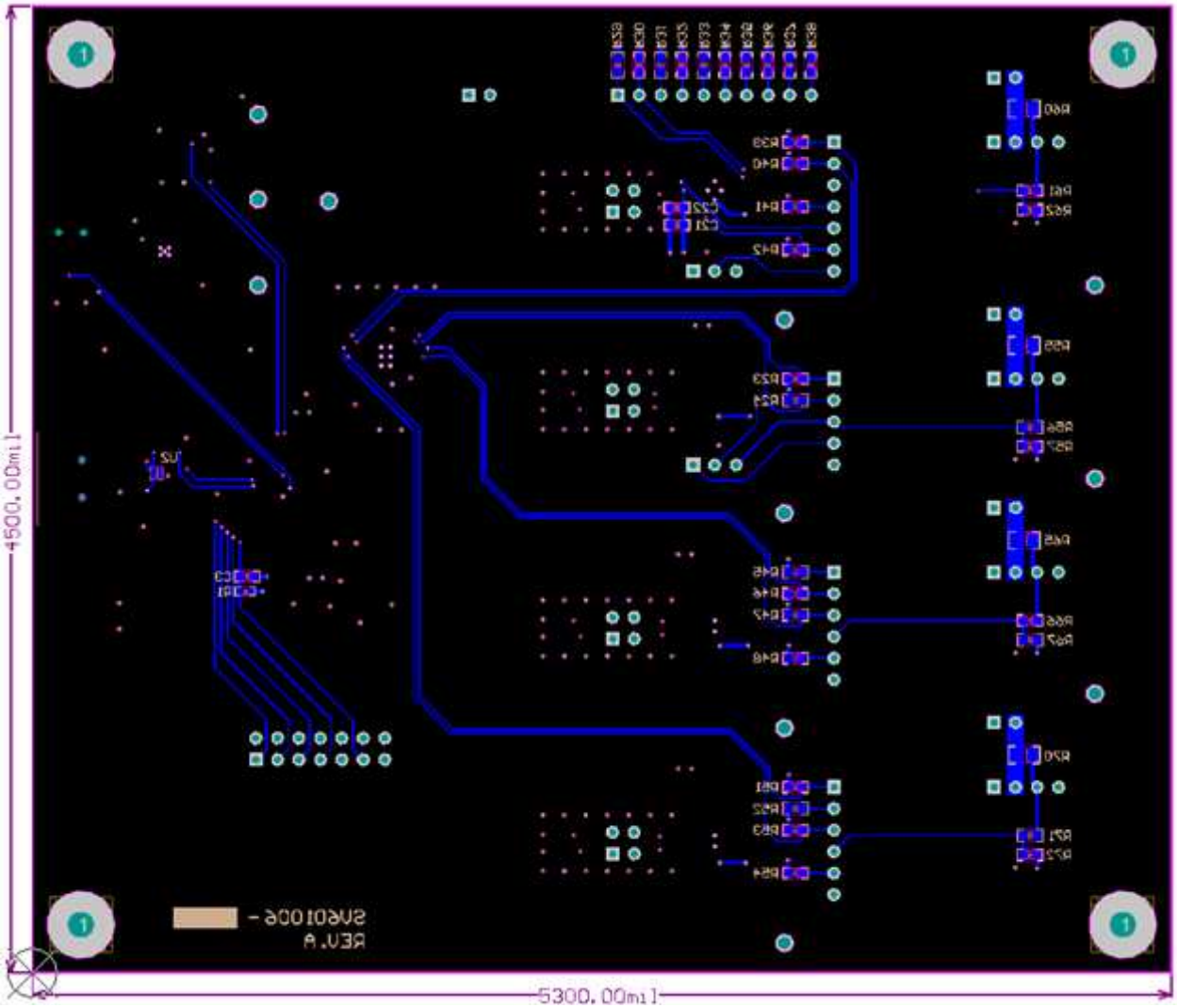

Figure 35. Bottom Layer Routing

6 Schematic

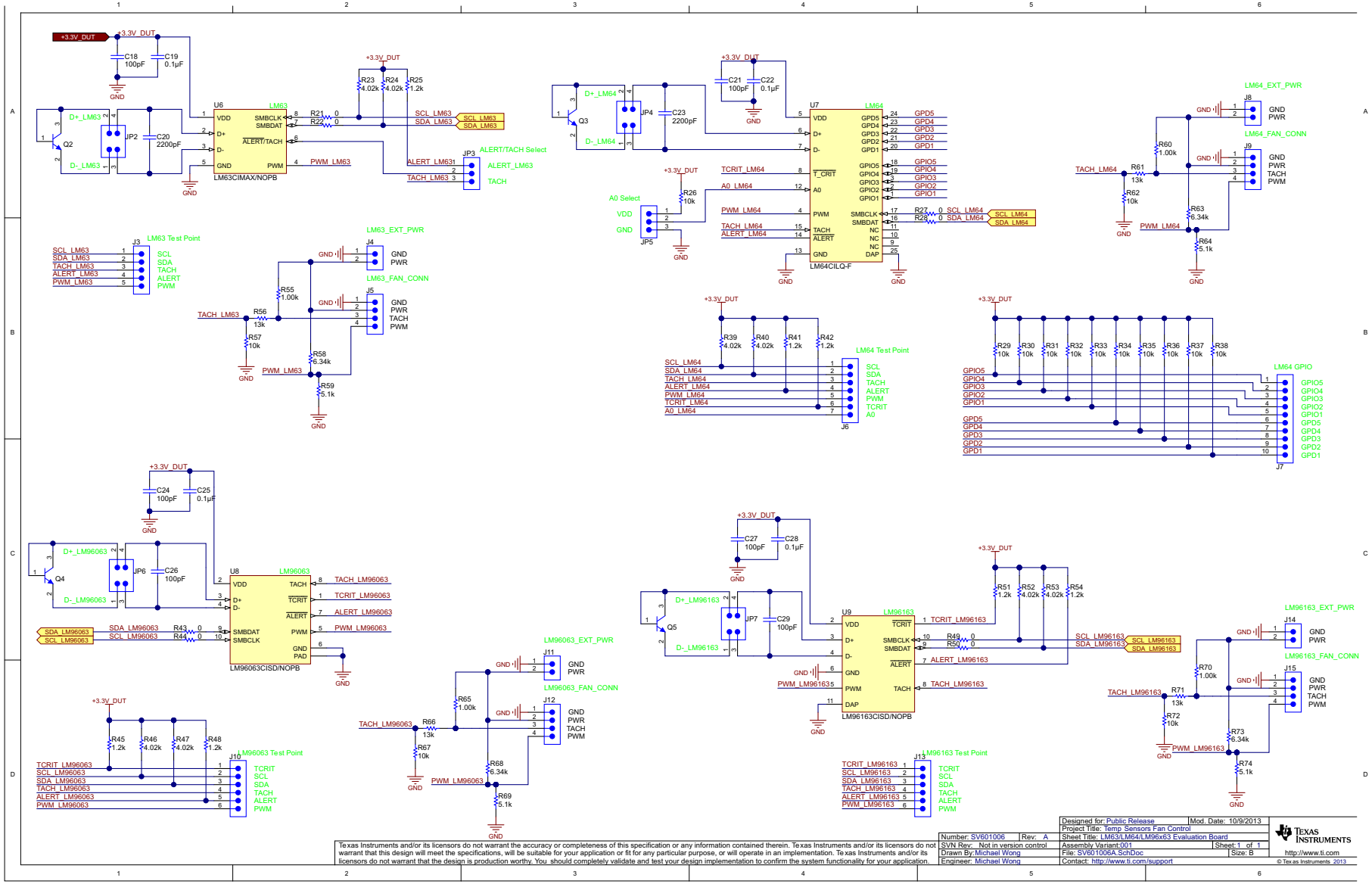

Figure 36. LM63LM64LM96x63EVM DUT Schematic

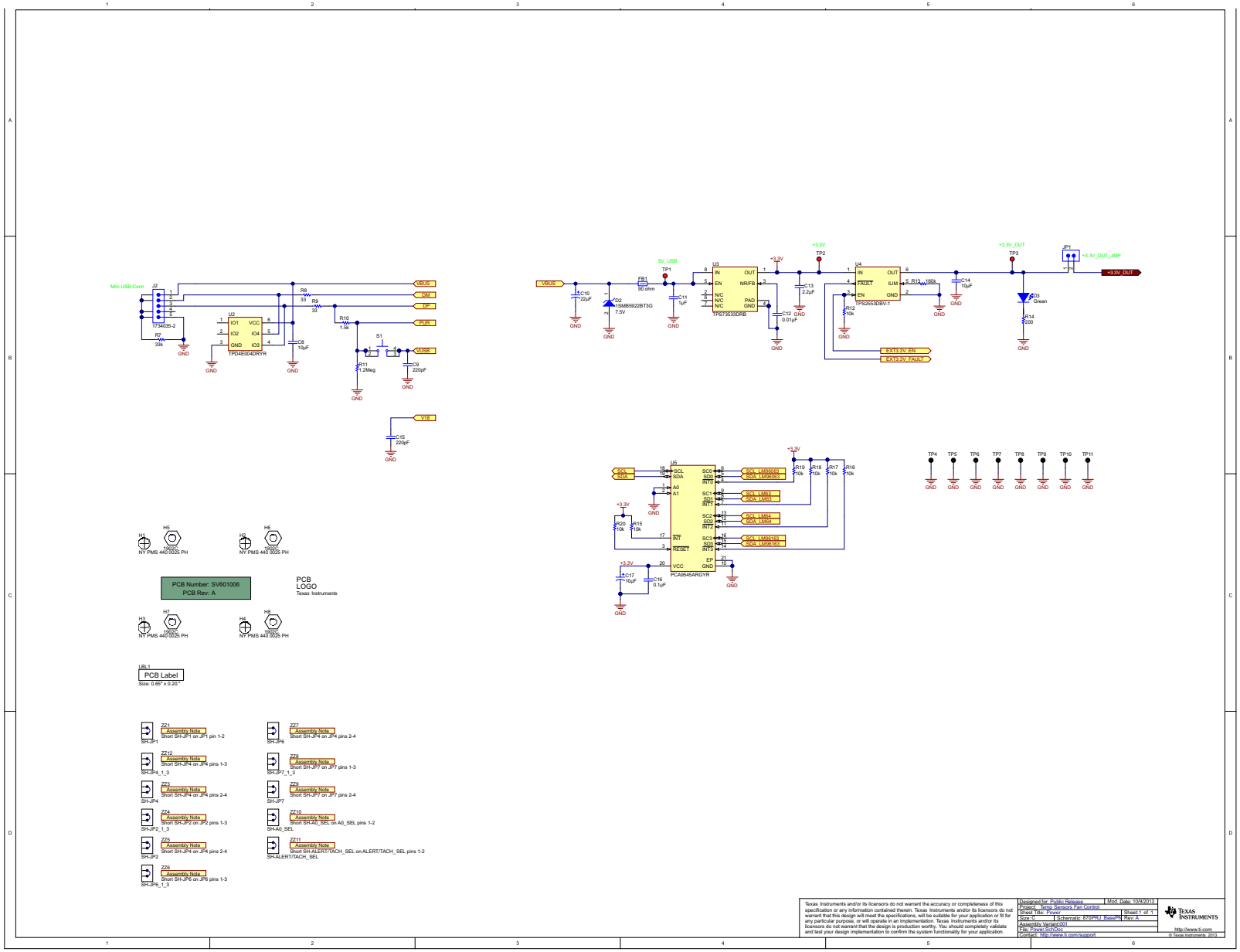

Figure 37. LM63LM64LM96x63EVM Power Schematic

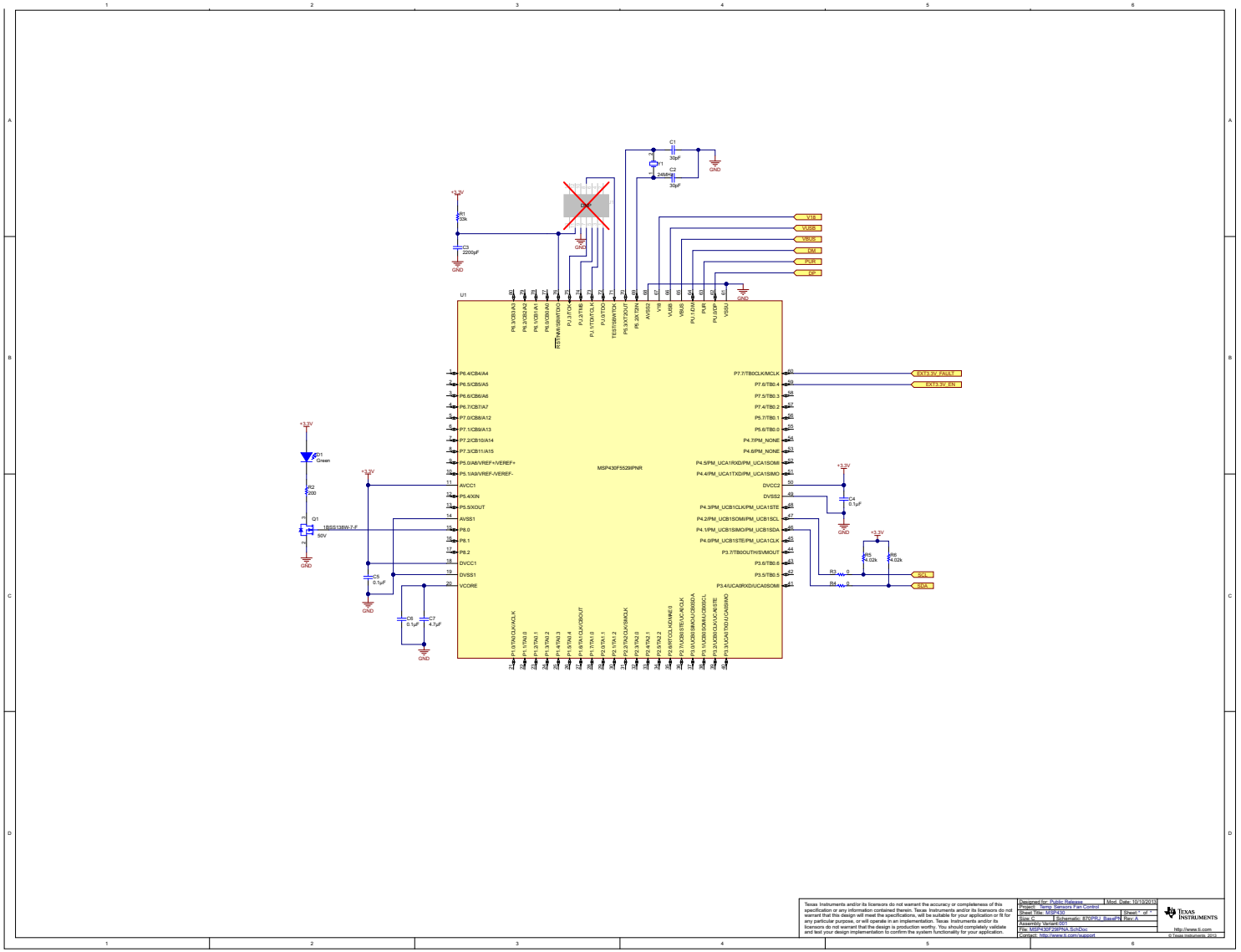

Figure 38. LM63LM64LM96x63EVM MSP430 Schematic

7 Bill of Materials

Table 2. LM63LM64LM96x63EVM Bill of Materials

Designator	Description	Manufacturer	Part Number	Quantity
EVM	LM63LM64LM96x63EVM	Texas Instruments	SV601006	1
C1, C2	CAP, CERM, 30 pF, 100V, ±5%, C0G/NP0, 0603	MuRata	GRM1885C2A300JA01D	2
C3	CAP, CERM, 2200 pF, 50 V, ±10%, X7R, 0603	Kemet	C0603X222K5RACTU	1
C4, C5, C6	CAP, CERM, 0.1 uF, 16V, ±5%, X7R, 0603	AVX	0603YC104JAT2A	3
C7	CAP, CERM, 4.7 uF, 10V, ±10%, X7R, 0805	Taiyo Yuden	LMK212B7475KG-T	1
C8, C14	CAP, CERM, 10 uF, 16 V, ±20%, X5R, 0805	AVX	0805YD106MAT2A	2
C9, C15	CAP, CERM, 220 pF, 50 V, ±1%, C0G/NP0, 0603	AVX	06035A221FAT2A	2
C10	CAP ALUM 22 uF 10 V 20% SMD	Panasonic - ECG	EEE-1AA220WR	1
C11	CAP, CERM, 1 uF, 16 V, ±10%, X7R, 0805	Taiyo Yuden	EMK212B7105KG-T	1
C12	CAP, CERM, 0.01 uF, 50 V, ±10%, X7R, 0603	TDK	C1608X7R1H103K	1
C13	CAP, CERM, 2.2 uF, 16 V, ±10%, X5R, 0805	AVX	0805YD225KAT2A	1
C16, C19, C22, C25, C28	CAP, CERM, 0.1 uF, 25 V, ±10%, X7R, 0603	AVX	06033C104KAT2A	5
C17	CAP, TA, 10 uF, 10V, ±20%, 3.4 Ω, SMD	Vishay-Sprague	293D106X0010A2TE3	1
C18, C21, C24, C26, C27, C29	CAP, CERM, 100 pF, 25 V, ±10%, X7R, 0603	AVX	06033C101KAT2A	6
C20, C23	CAP, CERM, 2200pF, 100 V, ±5%, X7R, 0603	AVX	06031C222JAT2A	2
D1, D3	LED, Green, SMD	Lite-On	LTST-C171GKT	2
D2	Diode, Zener, 7.5 V, 550 mW, SMB	ON Semiconductor	1SMB5922BT3G	1
FB1	1.5A Ferrite Bead, 90 Ω @ 100MHz, SMD	Steward	MI1206K900R-10	1
H1, H2, H3, H4	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead		NY PMS 440 0025 PH	4
H5, H6, H7, H8	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C	4
J2	Conn Rcpt Mini USB2.0 Type B 5POS SMD	TE Connectivity	1734035-2	1
J3	Header, TH, 100mil, 5x1, Gold plated, 230 mil above insulator	Samtec	TSW-105-07-G-S	1
J4, J8, J11, J14, JP1	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec	TSW-102-07-G-S	5
J5, J9, J12, J15	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec	TSW-104-07-G-S	4
J6	Header, TH, 100mil, 7x1, Gold plated, 230 mil above insulator	Samtec	TSW-107-07-G-S	1
J7	Header, TH, 100mil, 10x1, Gold plated, 230 mil above insulator	Samtec	TSW-110-07-G-S	1
J10, J13	Header, TH, 100mil, 6x1, Gold plated, 230 mil above insulator	Samtec	TSW-106-07-G-S	2

Table 2. LM63LM64LM96x63EVM Bill of Materials (continued)

Designator	Description	Manufacturer	Part Number	Quantity
JP2, JP4, JP6, JP7	Header, TH, 100mil, 2x2, Gold plated, 230 mil above insulator	Samtec	TSW-102-07-G-D	4
JP3, JP5	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec	TSW-103-07-G-S	2
LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10	1
Q1	MOSFET, N-CH, 50V, 0.2 A, SOT-323	Diodes Inc.	BSS138W-7-F	1
Q2, Q3, Q4, Q5	Transistor, NPN, 40V, 0.2 A, SOT-23	Fairchild Semiconductor	MMBT3904	4
R1, R7	RES, 33k Ω, 5%, 0.063W, 0402	Vishay-Dale	CRCW040233K0JNED	2
R2	RES, 200 Ω, 1%, 0. 1W, 0603	Vishay-Dale	CRCW0603200RFKEA	1
R3, R4, R21, R22, R27, R28, R43, R44, R49, R50	RES, 0 Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06030000Z0EA	10
R5, R6	RES, 4.02k Ω, 1%, 0.06 3W, 0402	Vishay-Dale	CRCW04024K02FKED	2
R8, R9	RES, 33 Ω, 5%, 0.063 W, 0402	Vishay-Dale	CRCW040233R0JNED	2
R10	RES, 1.5k Ω, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04021K50JNED	1
R11	RES, 1.2 Meg Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06031M20JNEA	1
R12	RES, 10k Ω, 5%, 0.063 W, 0402	Vishay-Dale	CRCW06031M20JNEA	1
R13	RES, 160k Ω, 5%, 0.063 W, 0402	Vishay-Dale	CRCW0402160KJNED	1
R14	RES, 200 Ω, 5%, 0.063 W, 0402	Vishay-Dale	CRCW0402200RJNED	1
R15, R16, R17, R18, R19, R20, R26, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R57, R62, R67, R72	RES, 10k Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060310K0JNEA	21
R23, R24, R39, R40, R46, R47, R52, R53	RES, 4.02k Ω, 1%, 0.1 W, 0603	Vishay-Dale	CRCW06034K02FKEA	8
R25, R41, R42, R45, R48, R51, R54	RES, 1.2k Ω, 5%, 0.1W, 0603	Vishay-Dale	CRCW06031K20JNEA	7
R55, R60, R65, R70	RES, 1.00k Ω, 1%, 0.25 W, 0805	Panasonic	ERJ-P06F1001V	4
R56, R61, R66, R71	RES, 13k Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060313K0JNEA	4
R58, R63, R68, R73	RES, 6.34k Ω, 1%, 0.1 W, 0603	Vishay-Dale	CRCW06036K34FKEA	4
R59, R64, R69, R74	RES, 5.1k Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06035K10JNEA	4
S1	Switch, Tactile, SPST-NO, SMT	Panasonic	EVQ-PSD02K	1
SH-A0_SEL, SH-ALERT/TACH_SEL, SH-JP1, SH-JP2, SH-JP2_1_3, SH-JP4, SH-JP4_1_3, SH-JP6, SH-JP6_1_3, SH-JP7, SH-JP7_1_3	Shunt, 2mm, Gold plated, Black	Samtec	2SN-BK-G	11
TP1, TP2, TP3	Test Point, Multipurpose, Red, TH	Keystone	5010	3
TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11	Test Point, Multipurpose, Black, TH	Keystone	5011	8
U1	IC MCU 16BIT 128K FLASH 80LQFP	Texas Instruments	MSP430F5529IPNR	1
U2	IC, 4-Chan ESD-Protection Array	Texas Instruments	TPD4E004DRYR	1
U3	500mA, Low Quiescent Current, Ultra-Low Noise, High PSRR Low-Dropout Linear Regulator, DRB0008A	Texas Instruments	TPS73533DRB	1

Table 2. LM63LM64LM96x63EVM Bill of Materials (continued)

Designator	Description	Manufacturer	Part Number	Quantity
U4	PRECISION ADJUSTABLE CURRENT-LIMITED POWER-DISTRIBUTION SWITCHES, DBV0006A	Texas Instruments	TPS2553DBV-1	1
U5	4-Channel I2C and SMBus Multiplexer with Interrupt Logic and Reset Function, 2.3 to 5.5 V, -40 to 85 °C, 20-pin VQFN (RGY), Green (RoHS & no Sb/Br)	Texas Instruments	PCA9545ARGYR	1
U6	±1ºC/±3ºC Accurate Remote Diode Digital Temperature Sensor with Integrated Fan Control, 8-pin Narrow SOIC, Pb-Free	Texas Instruments	LM63CIMAX/NOPB	1
U7	±1ºC Remote Diode Temperature Sensor with PWM Fan Control and 5 GPIO's, 25-pin LLP	Texas Instruments	LM64CILQ-F	1
U8	LM96063 Remote Diode Digital Temperature Sensor with Integrated Fan Control, DSC0010A	Texas Instruments	LM96063CISD/NOPB	1
U9	Remote Diode Digital Temperature Sensor with Integrated Fan Control and TruTherm BJT Transistor Beta Compensation Technology, 10-pin LLP, Pb-Free	Texas Instruments	LM96163CISD/NOPB	1
Y1	Crystal, 24.000MHz, 20 pF, SMD	ECS Inc.	ECS-240-20-5PX-TR	1
ZZ1, ZZ12	Short SH-JP1 on JP1 pin 1-2, Short SH-JP4 on JP4 pins 1-3			2

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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 EVMs for RF Products 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.

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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. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. 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.

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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.

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