DAC161S997EVM User's Guide

1 Introduction

The Texas Instruments DAC161S997EVM evaluation module (EVM) helps designers evaluate the operation and performance of the DAC161S997 4-20mA Loop Drive with SPI control. The EVM contains a low cost MSP430G2553 microcontroller which comes pre-loaded with firmware to communicate with the Labview based PC Software. A JTAG header is provided which can be used to program custom firmware. A general purpose header with SPI and microcontroller GPIOs is provided to ease development of sensor transmitters and other applications.

The EVM contains one DAC161S997 and is configured as Loop-Powered 2-Wire Transmitter (See Table 1).

Table 1. Device and Package Configurations

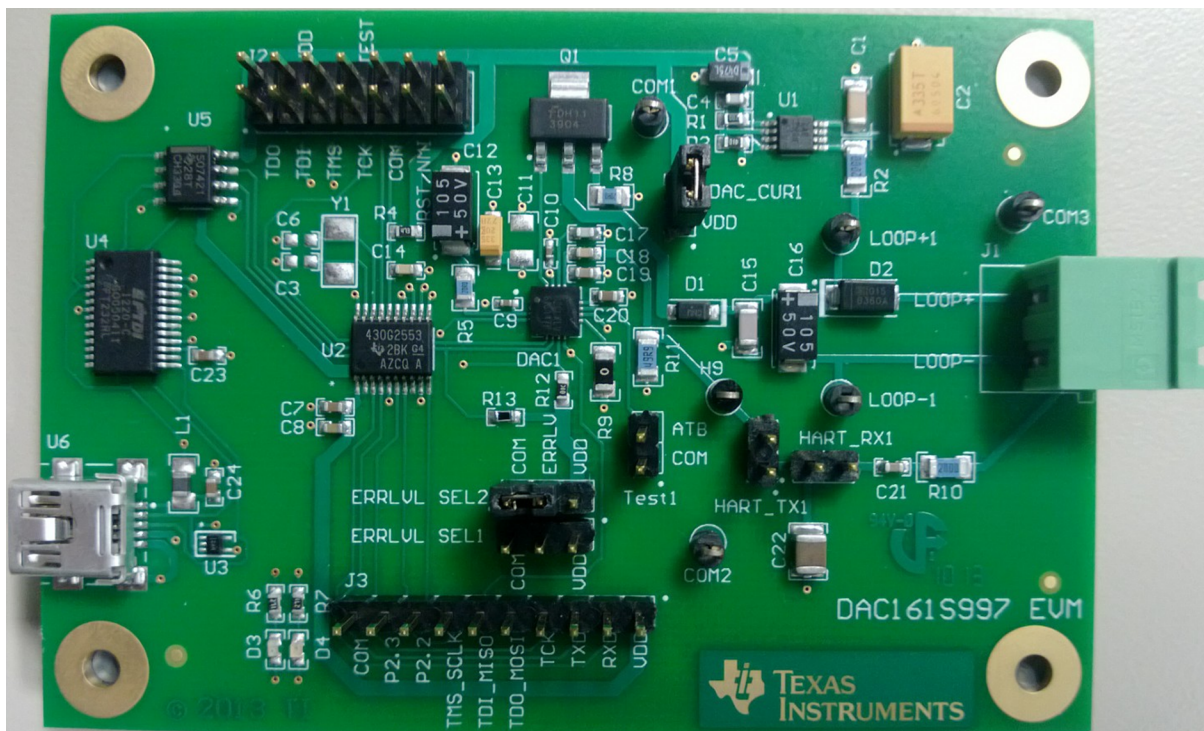| Converter	IC	Package
U2	DAC161S997	LLP-16

Figure 1.

2 EVM Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up, and use the DAC161S997EVM.

2.1 Input/Output Connector Description

1. J1 : Loop Connector. Loop+ and Loop- Pins.
2. J2 : JTAG Connector. Used to debug/flash on-board MSP430G2553
3. J3 : General Purpose I/O. Can be used to connect to a SPI-based Analog front end such as the LMP90100 from TI's SensorAFE family.
4. DAC_CUR: Power supply for DAC161S997. Short Pin1 and Pin2 to power-up DAC.
5. ERRLVL_SEL1: Pin2 connected to MSP430 (GPIO P2.4) for software control of Error level signal.
6. ERRLVL_SEL2: Pin2 connected to ERRLV pin of DAC161S997. Pin1 connected to COM and Pin3 Connected to VDD.
7. HART_TX1: HART transmit input connector. Can be connected to an external HART modem output.
8. HART_RX1: HART receive output connector. Can be connected to an external HART modem input.

2.2 EVM Connections

For proper operation of the DAC161S997EVM, first short the DAC_CUR pins and connect jumper between Pin1 and Pin2 of ERRLVL_SEL2 jumpers (the EVM is shipped in this configuration).

The EVM is powered through the Loop supply. Connect Loop+ pin of J1 to Positive of the supply and negative of the supply to positive terminal of ammeter and negative terminal of ammeter to Loop- pins. This configuration will supply power to EVM and can measure the Loop current.
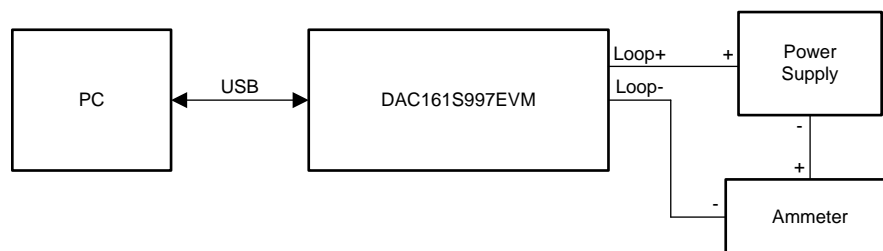

Figure 2. EVM Connection Diagram

3 Software Installation

It is recommended to use the latest version of DAC161S997 software; this can be downloaded from: http://www.ti.com/product/dac161s997. You must install the software before you connect the DAC161S997EVM to your PC.

To install the DAC161S997EVM software:

- Direct a browser to http://www.ti.com/products/dac161s997, then scroll down to the Tools & Software section to download the latest DAC161S997 software.
- Unzip the downloaded file from a known directory, and run the "setup.exe" in /TI_DAC161S997_Installer/Volume/
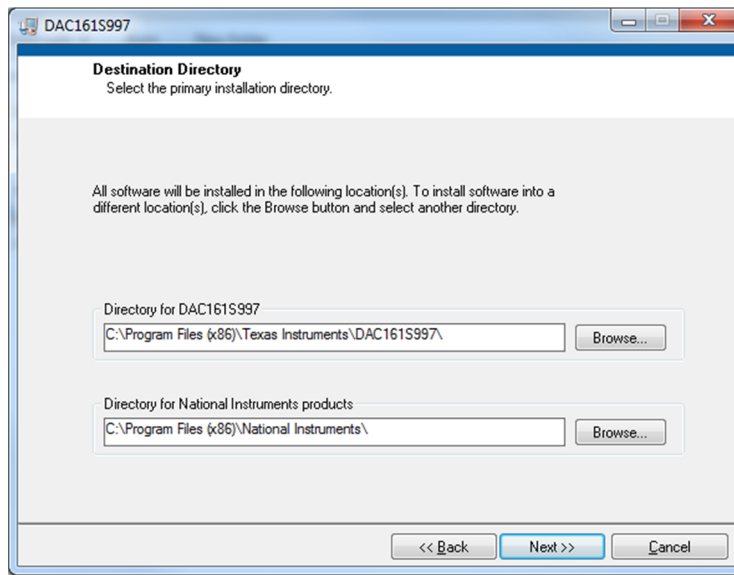
Figure 3.

- Click Next, read the license agreement and complete the first portion of the installation.
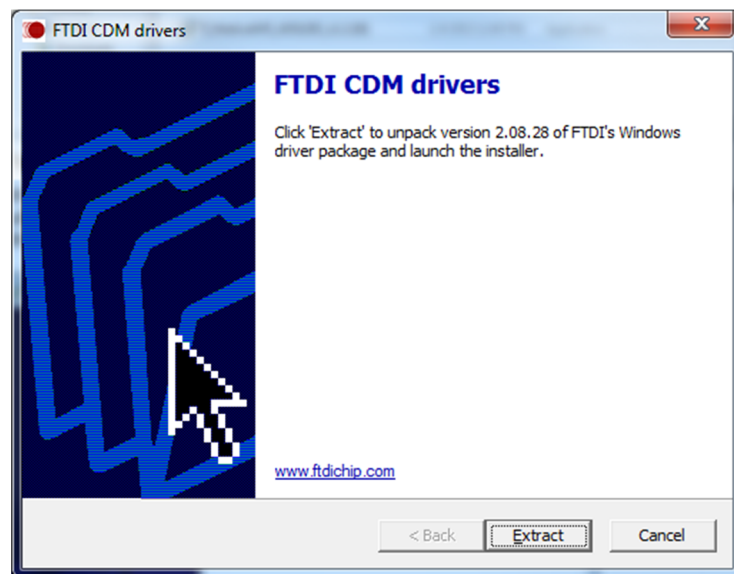- Next, the FTDI drivers are installed automatically.

Figure 4.

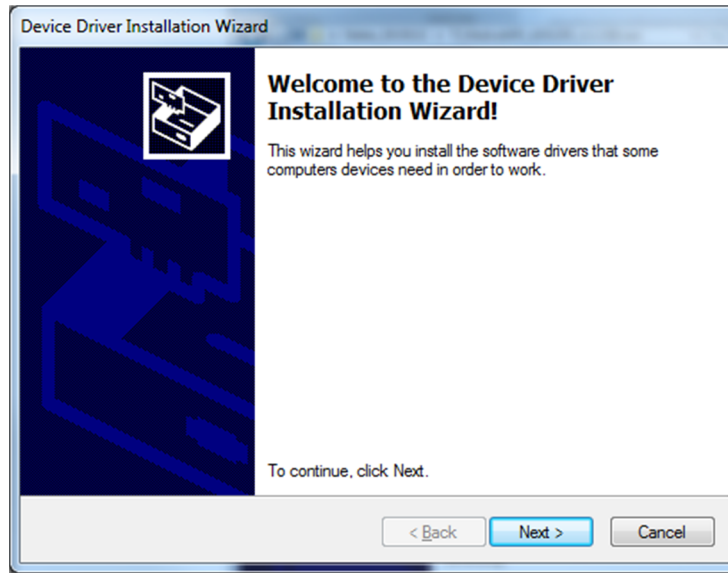- Click Extract and the following window will appear:

Figure 5.

- Click Next. Once the drivers are installed a Completing the Device Driver Installation Wizard window. Then, Click Finish to complete the installation.
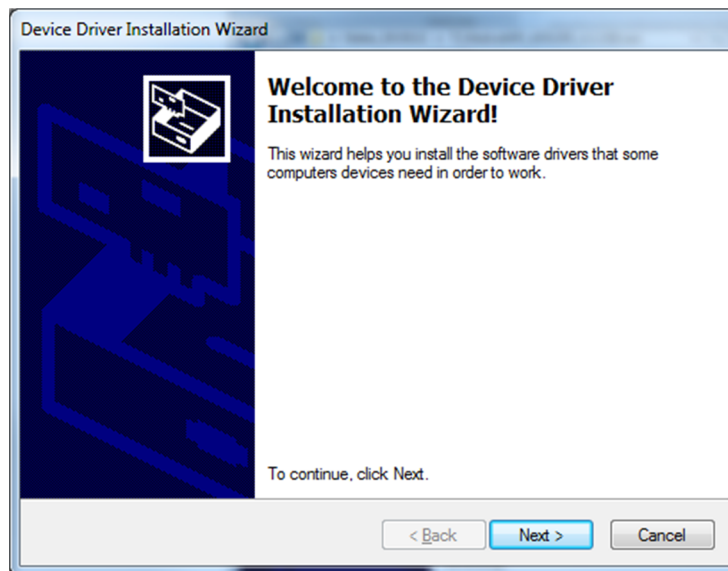

Figure 6.

- Before you launch the DAC161S997 Software, Connect connect the DAC161S997EVM to a USB port of your computer and connect the Loop supply voltage.
- Open the computer's "Device Manager" and verify that a new COM port named "USB Serial Port" has been added in the Ports(COM&LPT) section.
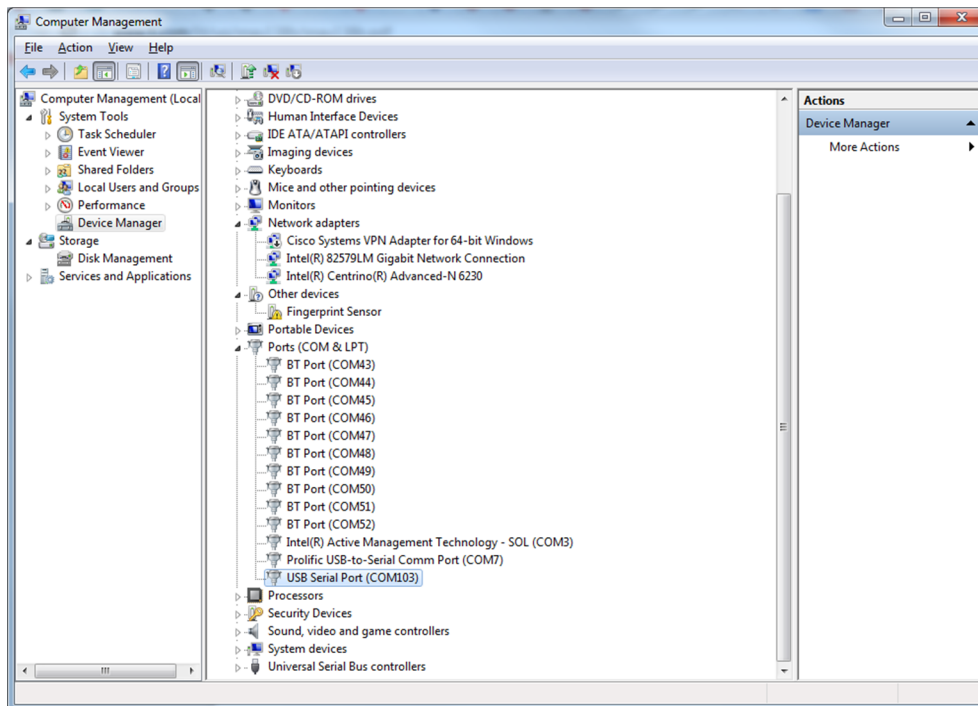
Figure 7.

- Make a note of the assigned COM port number; this number is needed to connect the PC to the DAC161S997EVM.
- Run the DAC161S997 Software and select the COM port that was assigned and click on connect.
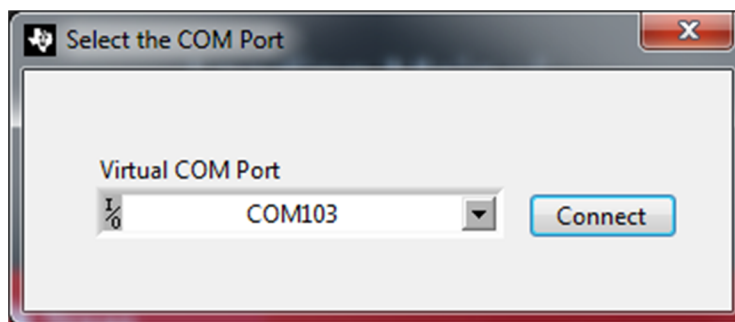

Figure 8.

- On start-up, the software retrieves all the DAC161S997 registers and updates the software accordingly.
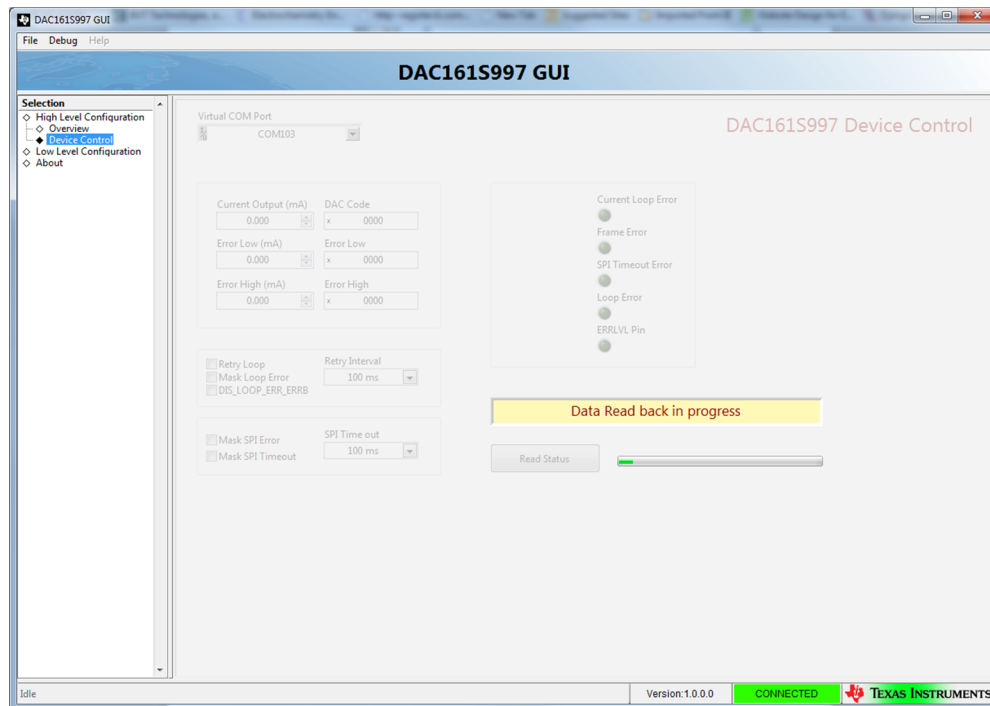
Figure 9.

- The DAC output current can be set in the Current Output field, and the Error current levels can also be set in the appropriate fields.
- Any error conditions are indicated and can be cleared when desired.
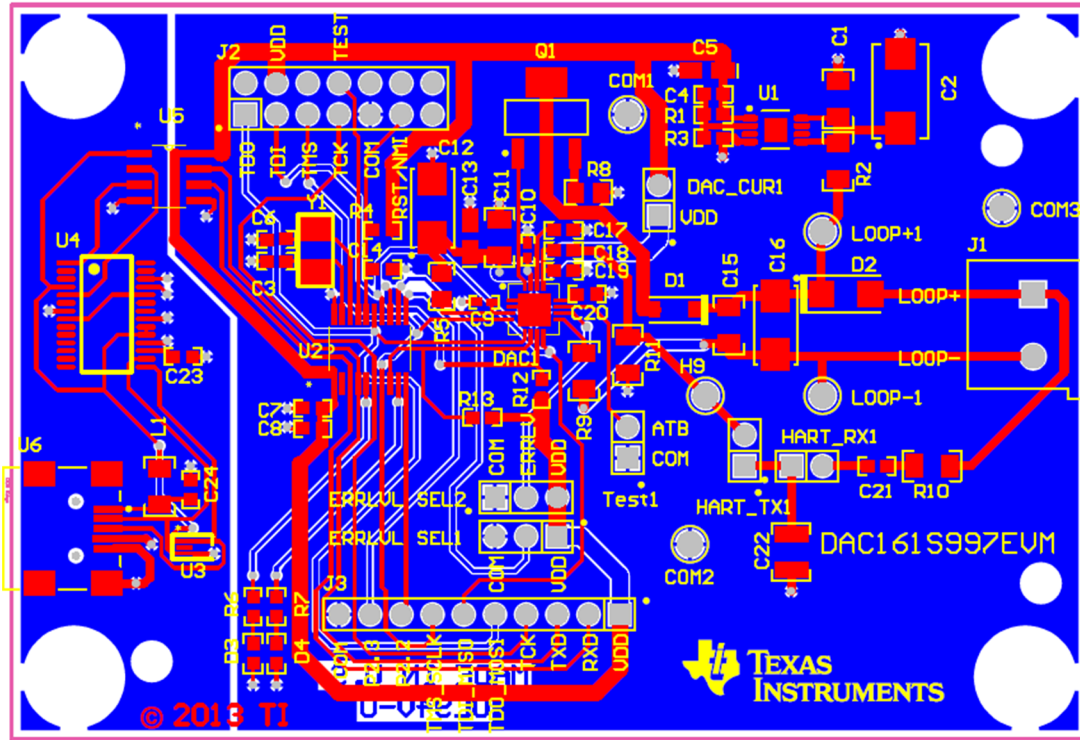- Individual registers can be set directly if desired.
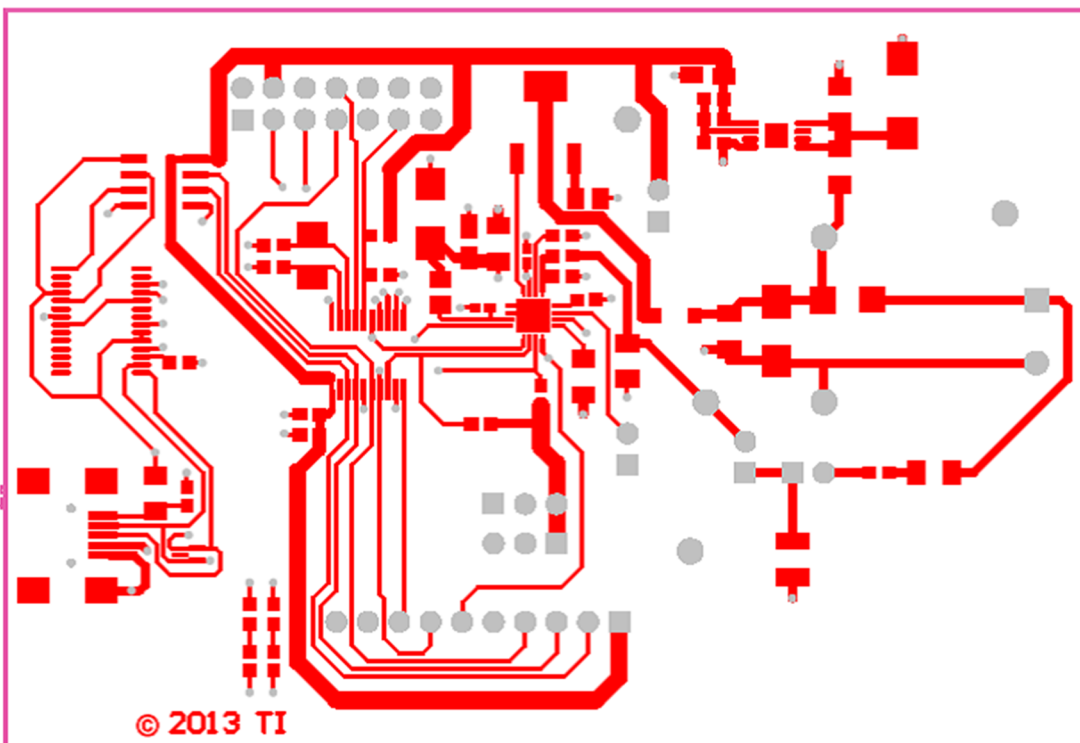
4 Board Layout

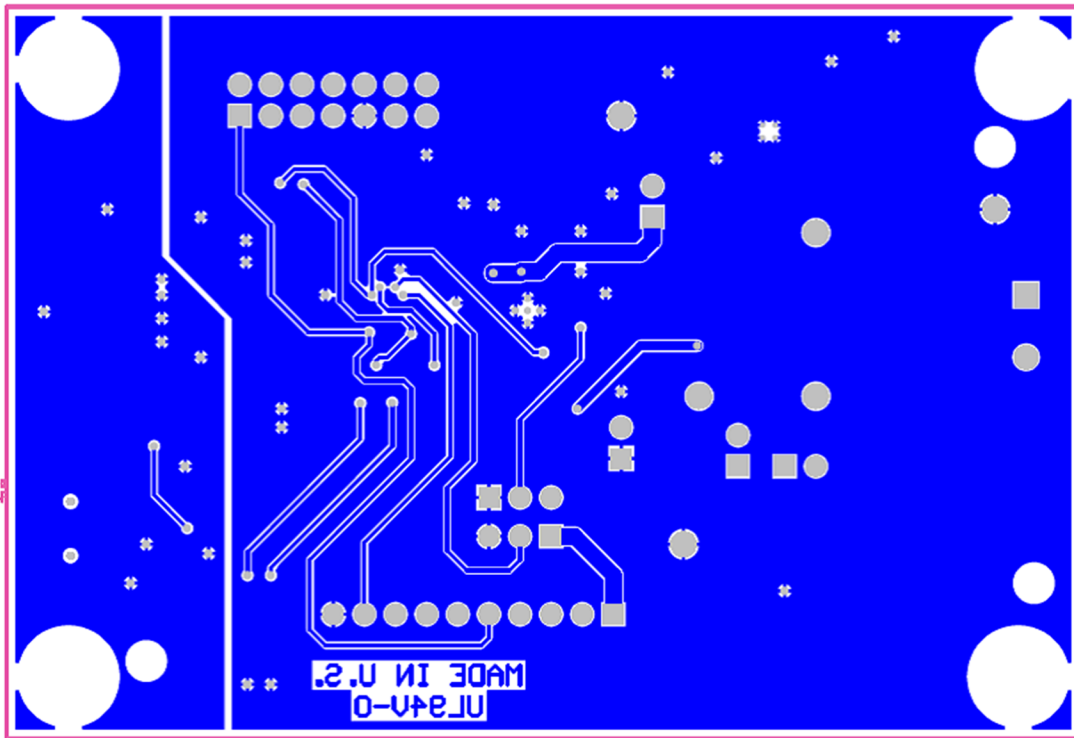**Figure 10. Top Assembly Layer**

Figure 11. Top Layer Routing

Figure 12. Bottom Layer Routing

5 Schematic

Figure 13. DAC161S997EVM Schematic

6   Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number
C1	1	0.1µF	CAP, CERM, 0.1uF, 50V, +/-5%, X7R, 1206	1206	C1206C104J5RACTU
C2	1	3.3µF	CAP, TANT, 3.3uF, 50V, +/-10%, 0.8 ohm, 7343-31 SMD	7343-31	TPSD335K050R0800
C4, C17	2	1000pF	CAP, CERM, 1000pF, 50V, +/-10%, C0G/NP0, 0603	603	06035A102KAT2A
C5	1	4.7µF	CAP, TANT, 4.7uF, 10V, +/-10%, 1.4 ohm, 3216-18 SMD	3216-18	T495A475K010ZTE1K4
C7, C23, C24	3	0.1µF	CAP CER 0.1UF 10V 10% X7R 0603	603	C0603C104K8RACTU
C8	1	10µF	CAP CER 10UF 10V 10% X5R 0603	603	C1608X5R1A106K
C9, C10	2	0.1µF	CAP, CERM, 0.1uF, 10V, +/-10%, X5R, 0402	402	C1005X5R1A104K
C12, C16	2	1µF	CAP, TANT, 1uF, 50V, +/-10%, 4.6 ohm, 6032-28 SMD	6032-28	293D105X9050C2TE3
C13	1	3.3µF	CAP, TANT, 3.3uF, 16V, +/-10%, 3.5 ohm, 3216-18 SMD	3216-18	TPSA335K016R3500
C14	1	2.2nF	CAP CER 2200PF 10V 5% X7R 0603	603	C0603C222J8RACTU
C15	1	0.01µF	CAP, CERM, 0.01uF, 50V, +/-5%, C0G/NP0, 1206	1206	C3216C0G1H103J
C18	1	6800pF	CAP, CERM, 6800pF, 50V, +/-5%, X7R, 0603	603	C0603C682J5RACTU
C19, C21	2	0.22µF	CAP, CERM, 0.22uF, 10V, +/-10%, X5R, 0603	603	C1608X5R1A224K
C20	1	0.39µF	CAP, CERM, 0.39uF, 10V, +/-10%, X5R, 0603	603	C0603C394K8PACTU
C22	1	2.2µF	CAP, CERM, 2.2uF, 100V, +/-10%, X7R, 1210	1210	HMK325B7225KN-T
COM1, COM2, COM3, H9, LOOP+1, LOOP-1	6	Black	Test Point, TH, Miniature, Black		5001
D1	1	3.9V	Diode, Zener, 3.9V, 500mW, SOD-123	SOD-123	MMSZ4686T1G
D2	1	0.7V	Diode, Schottky, 60V, 3A, SMA	SMA	B360A-13-F
D3	1		LED, [Color], [MountType]	603	LG L29K-G2J1-24-Z
D4	1		LED, [Color], [MountType]	603	SML-LX0603SRW-TR
DAC1	1		DAC161S997		DAC161P997SQ
DAC_CUR1, HART_RX1, HART_TX1, Test1	4		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator		TSW-102-07-G-S
ERRLVL SEL1, ERRLVL SEL2	2		Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator		TSW-103-07-G-S
J1	1	250V	CONN HEADER RT ANG 2POS 5.08MM		1759017
J2	1		Header, TH, 100mil, 7x2, Gold plated, 230 mil above insulator		TSW-107-07-G-D
J3	1		Header, TH, 100mil, 10x1, Gold plated, 230 mil above insulator		TSW-110-07-G-S
L1	1	40Ω	1A Ferrite Bead, 2 ohm @ 100MHz, SMD	1206	MI0805K400R-10
Q1	1		TRANSISTOR GP NPN 40V SOT-223	SOT-223	PZT3904
R1	1	158k	RES, 158k ohm, 1%, 0.1W, 0603	603	CRCW0603158KFKEA

Designator	Quantity	Value	Description	Package Reference	Part Number
R2, R10	2	200Ω	RES, 200 ohm, 1%, 0.25W, 1206	1206	CRCW1206200RFKEA
R3	1	100k	RES, 100k ohm, 1%, 0.1W, 0603	603	CRCW0603100KFKEA
R4	1	47k	RES 47K OHM 1/10W 5% 0603 SMD	603	ERJ-3GEYJ473V
R5, R8	2	20.0Ω	RES, 20.0 ohm, 1%, 0.125W, 0805	805	CRCW080520R0FKEA
R6, R7	2	270E	RES 270 OHM 1/10W 5% 0603 SMD	603	ERJ-3GEYJ271V
R9	1	0	RES, 0 ohm, 5%, 0.25W, 1206	1206	CRCW12060000Z0EA
R11	1	49.9Ω	RES, 49.9 ohm, 1%, 0.25W, 1206	1206	CRCW120649R9FKEA
R12	1	10.0k	RES, 10.0k ohm, 1%, 0.1W, 0603	603	CRCW060310K0FKEA
R13	1	330k	RES, 330k ohm, 5%, 0.1W, 0603	603	CRCW0603330KJNEA
SH-J1, SH-J2	2	1x2	Shunt, 100mil, Gold plated, Black		382811-6
U1	1		50 mA, 3 V TO 50 V, MICROPOWER, LOW-DROPOUT LINEAR REGULATOR	MSOP8	TPS79801-Q1
U2	1		IC MCU 16BIT 16KB FLASH 20TSSOP		MSP430G2553IPW20R
U3	1		IC ESD-PROT ARRAY 2CH SOT-5		TPD2E001DRLR
U4	1		IC USB FS SERIAL UART 28-SSOP		FT232RL-REEL
U5	1		Low-Power Dual Channel Digital Isolators		ISO7421ED
U6	1		CONN COM TYPE B MINI USB SMD 5P		65100516121
Y1	1	DNP	CRYSTAL 12.000MHZ 12PF SMD	2-SMD	7A-12.000MAAE-T
C3, C6	0	12pF	DNP	603	C0603C120K5GACTU
C11	0	A/R	DNP	1206	DNP

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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.

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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.

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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.

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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.

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

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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
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OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
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