DK-LM3S-DRV8312 BASEBOARD HARDWARE REFERENCE GUIDE

Medium Voltage Digital Motor Control Kit for Stellaris® Microcontrollers (DK-LM3S-DRV8312)

The Medium Voltage Digital Motor Control (DMC) kit (DK-LM3S-DRV8312), shown in Figure 1, provides a great way to learn and experiment with digital control of medium voltage brushless motors to increase efficiency of operation. This document describes the DRV8312 hardware, and explains the functions and locations of jumpers and connectors present on the board.

Figure 1. DK-LM3S-DRV8312 Kit (Stellaris® Version)

WARNING

This EVM is meant to be operated in a lab environment only and is not considered by Texas Instruments to be a finished end-product fit for general consumer use

This EVM must be used only by qualified engineers and technicians familiar with risks associated with handling high-voltage electrical and mechanical components, systems, and subsystems.

This equipment may be operated at voltages and currents that can result in electrical shock, fire hazard and/or personal injury if not properly handled or applied. Equipment must be used with necessary caution and appropriate safeguards employed to avoid personal injury or property damage.

It is the user's responsibility to confirm that the voltages and isolation requirements are identified and understood, prior to powering the board and or simulation. If powered with a supply other than the one included in the kit, do not touch the EVM or components connected to the EVM.

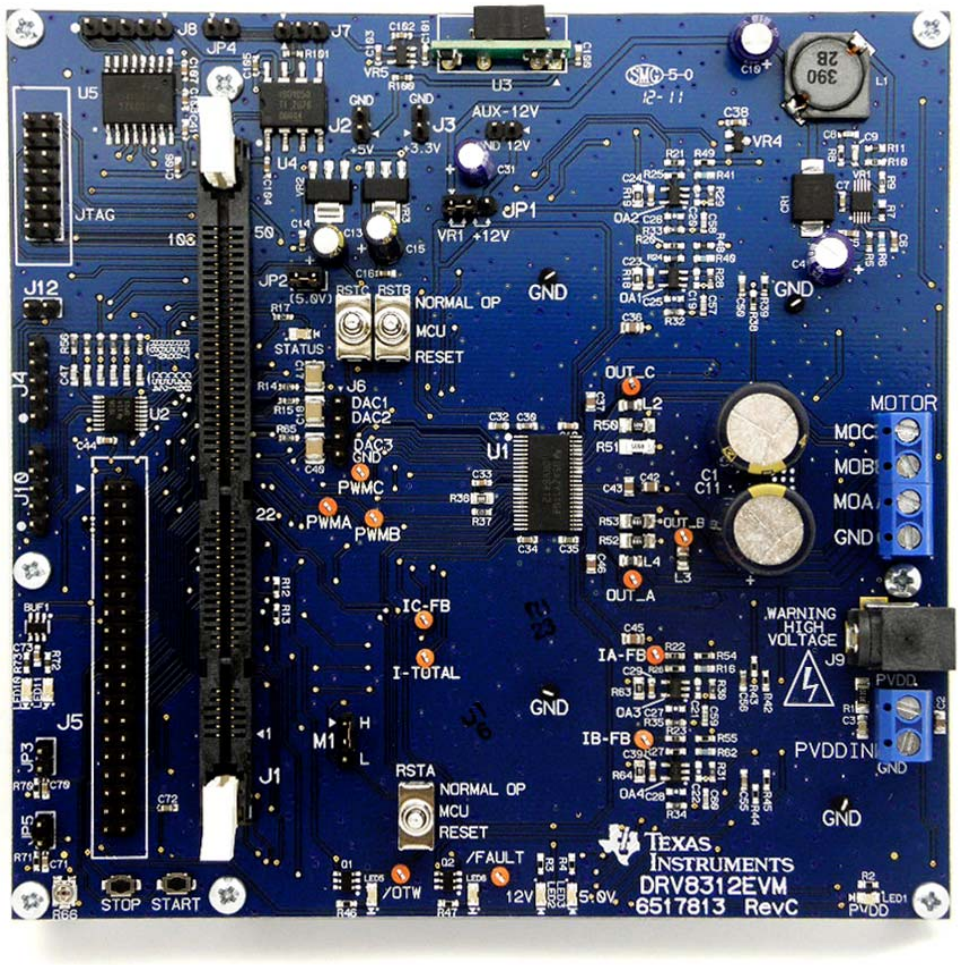

Figure 2. DRV8312 Baseboard

Kit Features

The kit has the following features

- Three-Phase Power Stage, DRV8312 capable of driving three-phase brushless DC motors and Permanent Magnet Synchronous Motors
  - 52.5 V DC max input voltage
  - 6.5 A peak with a 3.5 A max continuous output current per phase
  - Up to 500 khz driver switching frequency
- 24 V switching power supply with on-board regulation for powering other analog and digital circuitry
- Isolated CAN and SPI communication (controlCARD support-dependent)
- Closed-loop digital control with feedback using the Stellaris microcontroller's on-chip PWM and ADC peripherals

- JTAG connector for external emulators (not used with Stellaris microcontrollers)
- Quadrature Encoder Interface (QEI) available for speed and position measurement
- Hall-Sensor Interface for sensored three-phase motor control
- High precision, low-side current sensing using the Stellaris microcontroller's high-performance ADC, Texas Instruments' OPA365A high-speed op-amps, and Texas Instruments' REF3025 high precision voltage reference chip
- Three PWM DACs generated by low-pass filtering the PWM signals to observe the system variables on an oscilloscope to enable easy debug of control algorithms
- Over-current protection on the inverter stage, DRV8312

The software available with the kit is pre-optimized for the motors that are available with the kit. The software is open source, and therefore, can be easily modified to tune and run a different motor. The following motor is available with the kit:

Nema Size 17 BLDC Motor *(11A peak current ,* 4000RPM)	

WARNING: **Low-Switching Frequencies on the DRV8312**

When the DRV8312 runs at a low switching frequency (for example, less than 20 kHz with 47 nF bootstrap capacitor), the bootstrap capacitor voltage might not be able to maintain a proper voltage level for the high-side gate driver. A bootstrap capacitor under voltage protection circuit (BST_UVP) will start under this circumstance to prevent the potential failure of the high-side MOSFET.

In this circumstance, both the FAULT and OTW pins should pull low and the device should self-protect itself. The motor's inductance and the inverter's bootstrap capacitance will allow the DRV8312 to run efficiently until approximately 10 kHz (with margin). Setting the PWM switching frequency below 10 kHz may cause issues on the inverter output and is not recommended. See the DRV8312 data sheet for more information.

Hardware Overview

Figure 3 shows a typical motor drive system running from either a laboratory power supply or the 24 V supply delivered with the kit. The DRV8312-C2-KIT's motor control board has all the power and control blocks that constitute a typical motor drive system for a step motor or two brushed DC motors (Figure 5).

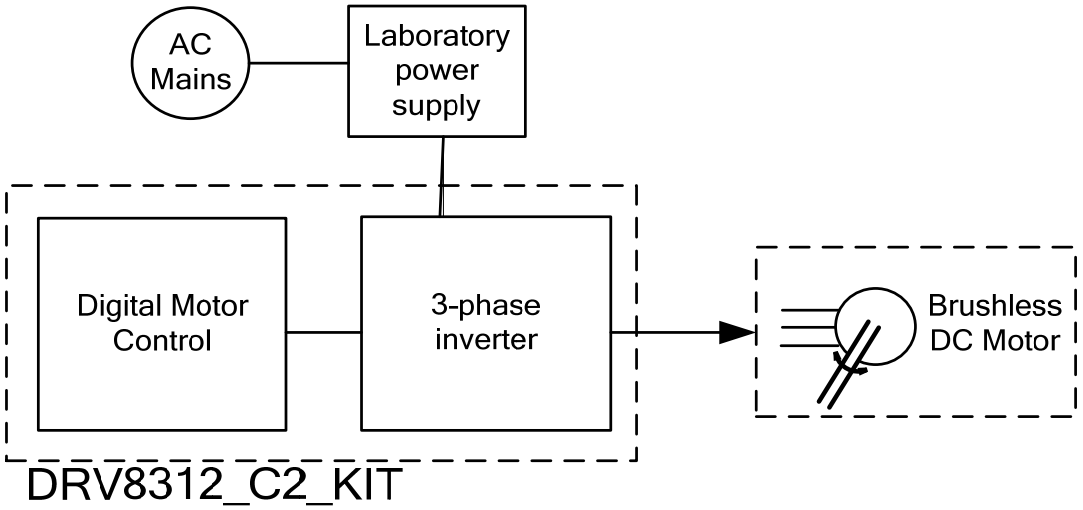

Figure 3. Typical Motor Drive System Block Diagram

Macro Blocks

The motor control board is divided into functional groups that enable a complete motor drive system. These functional groups are called macro blocks. This list describes the macro blocks that are present on the board and their functions::

- ISO controlCARD socket – Socket for a Stellaris or C2000 MCU-based controlCARD
- DC Bus Connection
  - J9 power entry jack - Connect the supplied +24 V power supply here
  - "PVDD/GND" Terminals – Connect an external lab supply here making sure to observe correct polarity
- Aux-12 V Control Power Entry – Connectors to optionally provide an external 12 V supply for logic and gate drive power. The 12 V supply can also be regulated on-board from the DC bus depending on the setting of JP1. Set to the "VR1" position to use the on-board regulator. Set to position "+12 V" to use the external regulator.
- DRV8312 – This module includes the DRV8312 Three-Phase PWM Motor Driver and all of the necessary external passive components.
- Current Sense – Low-side shunt current sensing on each half-bridge.
- Reset Switch – Individual reset for each half-bridge. Reset can be forced manually from the three-position switch or through a GPIO from the MCU. Setting switch in the down position, "RESET" disables the half-bridge outputs. Setting the switch in the middle position will allow control through a GPIO on the MCU. Setting the switch in the up position, "NORMAL OP" disables control from the MCU and enables the half-bridge outputs.

- Mode Jumper “M1” – DRV8312 mode can be set to select between cycle-by-cycle current limit or latched over-current.
- Quadrature Encoder Connections – Connections are available for an optional shaft encoder to interface to the MCU’s QEP peripheral.
- Hall Effect Sensor Connections – Connections are available for optional Hall Effect Sensors.

Figure 4 shows the position of the macro blocks on the board. All the PWMs and ADC signals which are the actuation and sense signals have designated test points on the board, which makes it easy for an application developer to try out new algorithms and strategies.

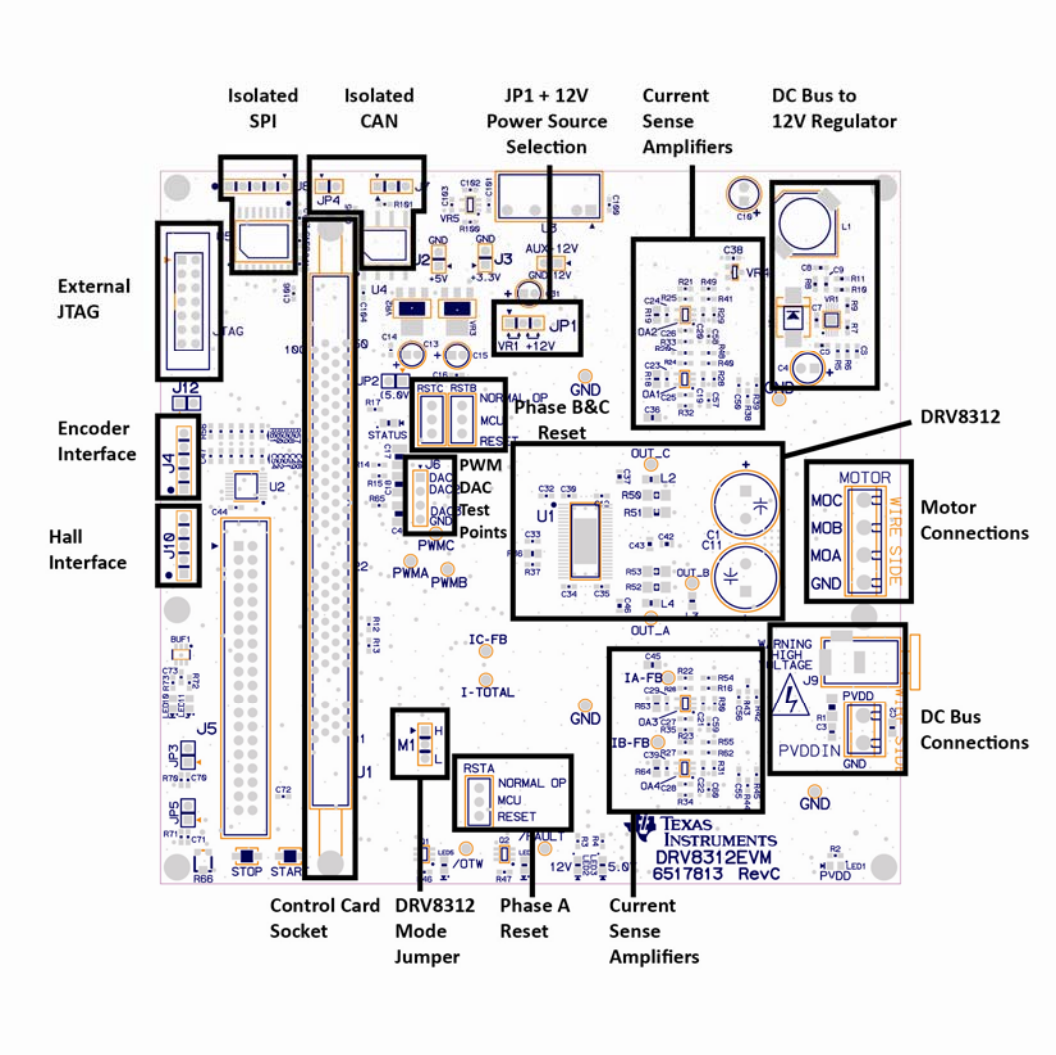

Figure 4. DRV8312-EVM Board Macros

Board Power

The board is separated into two power domains*: (1)the low voltage Controller Power domain powers the controller and the logic circuit present on the board, and (2) the medium voltage power delivery line that is used to carry the medium voltage and current such as the DC power for the Inverter (also referred to as DC Bus).

1) **Controller Power** comprised of the 12 V, 5 V, and 3.3 V that the board uses to power the controller and the logic and sensing circuit present on the board. This power can be sourced from two places (Jumper JP1 selects between the two):

- +12V **DC control power entry:** Connect an external bench supply with 1A current limit here
- **On board regulator, VR1:** +12V is regulated from DC bus power via an on-board buck regulator

2) **DC Bus Power** is the medium voltage line – up to 52.5V - that provides the voltage to the inverter stage to generate three phases to control the motor(s). Connect supplied 24 V regulator to J9.

For step-by-step instructions on configuring the DRV8312 baseboard for use with a Stellaris controlCARD, see the *DK-LM3S-DRV8312 Read Me First document*.

DRV8312 Functional Block Diagram

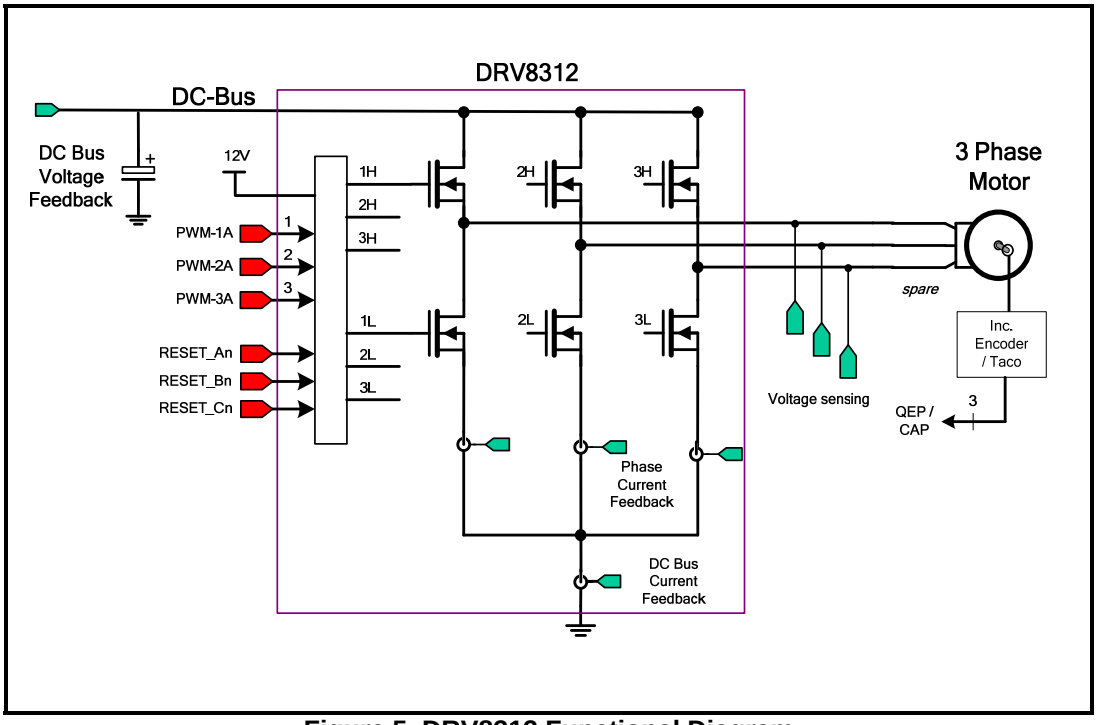

Figure 5. DRV8312 Functional Diagram

References

In addition to this document, the following references are included on the Stellaris controlCARD Development Kit CD and are also available for download at www.ti.com/stellaris:

- *Stellaris® LM3S818 controlCARD Module (MDL-LM3S818CNCD) README First*, publication MDL-LM3S818CNCD-RMF
- *Stellaris® LM3S818 controlCARD Module (MDL-LM3S818CNCD) User's Manual*, publication MDL-LM3S818CNCD-UM
- *Stellaris® Development and Evaluation Kits for Code Composer Studio™ Quickstart Guide*
- *Stellaris® LM3S818 Microcontroller Data Sheet*, publication DS-LM3S818
- StellarisWare Driver Library
- *StellarisWare Driver Library User's Manual*, publication SW-DRL-UG
- *Stellaris® DK-LM3S-DRV8312 InstaSPIN™-BLDC README First*, publication DK-LM3S-DRV8312-RMF
- *Medium Voltage Digital Motor Control Kit for Stellaris® Microcontrollers (DK-LM3S-DRV8312) Baseboard Hardware Reference Guide*, publication DK-LM3S-DRV8312-RG
- *Three-Phase PWM Motor Driver (DRV8312) Data Sheet*, publication SLES256
- *Sensorless Trapezoidal Control of BLDC Motors Using BEMF Integration (InstaSPIN™-BLDC) on Stellaris® Microcontrollers Application Note*, publication AN01289

Additional references include:

- The GUI and corresponding Stellaris code were developed by D3 Engineering. The GUI was created using Crosshairs Interface Designer from Crosshairs Embedded. There are links to each of the companies' web sites within the GUI. There is also information for downloading Crosshairs Interface Designer so that you can modify the GUI that comes with this kit. The More… tab gives a brief overview of the Interface Designer software.
  - Crosshairs Embedded: www.crosshairsembedded.com
  - D3 Engineering: www.d3engineering.com

Schematics

This section contains the schematics for the DK-LM3S-DRV8312 evaluation board:

- DRV8312 Evaluation Board (sheets 1 and 2)
- Power Inputs and Supplies (sheet 3)
- Isolation Circuit (sheet 4)
- Revision History (sheet 5)

DRV8312 EVALUATION BOARD

FROM J1

PWM_C
RESET_C~
RESET_B~
PWM_B
RESET_A~
PWM_A

U1 — DRV8312DDW

1	GVDD_C	GVDD_C	44
2	VDD	BST_C	43
3	NC	NC	42
4	NC	PVDD_C	41
5	PWM_C	PVDD_C	40
6	RESET_C	OUT_C	39
7	RESET_B	GND_C	38
8	M1	GND	37
9	M2	GND	36
10	M3	NC	35
11	VREG	NC	34
12	AGND	BST_B	33
13	GND	PVDD_B	32
14	OC_ADJ	OUT_B	31
15	PWM_B	GND_B	30
16	RESET_A	GND_A	29
17	PWM_A	OUT_A	28
18	FAULT	PVDD_A	27
19	NC	PVDD_A	26
20	NC	NC	25
21	OTW	BST_A	24
22	GVDD_B	GVDD_A	23

PowerPad

GVDD
C12 0.1000uF
C30 1.0000uF
C31 47.0000uF
C32 1.0000uF
C34 1.0000uF
C35 1.0000uF
PVDD
C36 0.1000uF
C37 0.1000uF
C42 0.1000uF
C43 0.1000uF
C45 0.1000uF
C46 0.1000uF
GND

PWMC
PWMB
PWMA
/FAULT
/OTW
RSTC
RSTB
RSTA
M1
VREG
AGND
R36 1.0000ohms
R37 30.0000Kohms

OUT_C L2 4.7000uH
OUT_B L3 4.7000uH
OUT_A L4 4.7000uH

ROUTED GROUND
(SHIELDED FROM GND PLANE)

IS-IhbC
IS-TOTAL
Shielded GND
IS-IhbB
IS-IhbA

R50 10.0000mohms
R51 5.0000ohms
R52 10.0000mohms
R53 10.0000mohms

STUFF OPTION

OA2 — OPA365AIDBV — C20 220.0000pF, C58 0.0010uF, C26 220.0000pF, R49 28.7000Kohms, R29 1.0000Kohms, R41 49.9000Kohms, R33 1.0000Kohms, R25 19.1000Kohms, C24 0.1000uF, R19 33.0000ohms, R21 0.0000ohms → TO J1 (IC-FB)

OA1 — OPA365AIDBV — C19 220.0000pF, C57 0.0010uF, C25 220.0000pF, R48 57.6000Kohms, R28 1.0000Kohms, R40 49.9000Kohms, R32 1.0000Kohms, R24 38.3000Kohms, C23 0.1000uF, R18 33.0000ohms, R20 0.0000ohms → TO J1 (I-TOTAL)

OA4 — OPA365AIDBV — C22 220.0000pF, C60 0.0010uF, C28 220.0000pF, R55 28.7000Kohms, R31 1.0000Kohms, R62 49.9000Kohms, R34 1.0000Kohms, R27 19.1000Kohms, C39 0.1000uF, R64 33.0000ohms, R23 0.0000ohms → TO J1 (IB-FB)

OA3 — OPA365AIDBV — C21 220.0000pF, C59 0.0010uF, C27 220.0000pF, R54 28.7000Kohms, R30 1.0000Kohms, R16 49.9000Kohms, R35 1.0000Kohms, R26 19.1000Kohms, C29 0.1000uF, R63 33.0000ohms, R22 0.0000ohms → TO J1 (IA-FB)

+2.5V, +3.3V, V+, V-, VOUT, +IN, -IN

R38 95.3000Kohms, R39 4.9900Kohms, C50 0.0470uF → TO J1 (ADC-Vhb3)
R42 95.3000Kohms, R43 4.9900Kohms, C56 0.0470uF → TO J1 (ADC-Vhb2)
R44 95.3000Kohms, R45 4.9900Kohms, C55 0.0470uF → TO J1 (ADC-Vhb1)

HIGH VOLTAGE WARNING
FOR VOLTAGE POTENTIALS OF 50V OR GREATER

OUTPUTS

MOTOR
MOC
MOB
MOA

OTW

Q1 ZXM62P03E6TA, +3.3V, LED5, R46 392.0000ohms, GND

FAULT

Q2 ZXM62P03E6TA, +3.3V, LED6, R47 392.0000ohms, GND

TI	PAGE INFO: DRV8312 EVALUATION BOARD	DATE MARCH 23, 2011	SCH REV C
	DESIGN LEAD RYAN KEHR	EDGE # 6517813	PCB REV D
		FILENAME DRV8312EVM_RevD	SHEET 1 OF 6
			DRAWN BY LDN

DRV8312 EVALUATION BOARD

FROM U1

ADC-Vhb1
ADC-Vhb2
ADC-Vhb3
FAULT
OTW
I-TOTAL
IC-FB
IB-FB
IA-FB

TO ISOLATION CIRCUIT

SPI-SOMI
SPI-STE
CAN-TX
CAN-RX
SPI-CLK
SPI-SIMO

TO U1

PWM_B
RESET_B
RESET_A
RESET_C
PWM_C
PWM_A

J1
J2
J5
J6
J12
JTAG
JP3
JP5
R70 4.9900Kohms
R71 4.9900Kohms
C70 0.1000uF
C71 0.1000uF
START
STOP
R14 470.0000ohms
C17 0.4700uF
R15 470.0000ohms
C18 0.4700uF
R65 470.0000ohms
C40 0.4700uF
R17 470.0000ohms
STATUS
TACH/SPEED INPUT
R66 60.0000Kohms BOURNS_3303W
C72 1.0000uF
R12 95.3000Kohms
R13 4.9900Kohms
BUF1 SN74LVC2G17DBV
R72 330.0000ohms
R73 330.0000ohms
LED10
LED11
C73 0.1000uF
U2 TXB0106PW
C41 0.1000uF
C44 0.1000uF
STUFF OPTION
R56 1.0000Kohms
R57 1.0000Kohms
R58 1.0000Kohms
R59 1.0000Kohms
R60 1.0000Kohms
R61 1.0000Kohms
ENCODER
J4
CAP
J10
C47 0.0010uF
C48 0.0010uF
C49 0.0010uF
C51 0.0010uF
C52 0.0010uF
C54 0.0010uF

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PAGE INFO: DRV8312 EVALUATION BOARD		DATE MARCH 23, 2011	SHEET 2 OF 6
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DRV8312 EVALUATION BOARD

MAIN POWER IN

HIGH VOLTAGE WARNING

PVDDIN, PVDD, C1 470.0000uF, C11 470.0000uF, GND

J9 SHUNT 3, SIGNAL 1, SHIELD, 2, GND

PVDD
NOM = 50V
MAX = 52.5V

EMI SNUBBER

PVDD, C2 0.1000uF, GND

PVDD, R1 3.3000ohms, C3 0.0100uF, GND

LED1 / LED2 / LED3

PVDD, LED1, R2 4.9900Kohms, GND

GVDD, LED2, R3 4.9900Kohms, GND

+5VD, LED3, R4 2.4900Kohms, GND

BOM ONLY

STANDOFFS

GND

GROUND TESTPOINTS

GND

EXTERNAL 12V INPUT

AUX-12V, 1, 2, GND

JP1

3, JP1, 1, 2, GVDD

1-2: GVDD = VR1
2-3: GVDD = AUX 12V

VR1 — TPS54160DGQ

C7 0.1000uF

1	BOOT	PH	10
2	VIN	GND	9
3	EN	COMP	8
4	SS/TR	VSENSE	7
5	RT/CLK	PWRGD	6

PVDD, C4 22.0000uF, GND; C5 0.0150uF, GND

R5 348.0000Kohms; R6 33.2000Kohms; C6 0.0150uF, GND

R7 205.0000Kohms, GND

R8 442.0000Kohms; C8 180.0000pF, GND; C9 12.0000pF, GND

CR1 30BQ100, GND

L1 39.0000uH

R10 10.0000Kohms; R11 681.0000ohms, GND

C10 100.0000uF, GND

VR1 PowerPad, GND

R9 10.0000Kohms

VR2 — UA78M05CDCY

GVDD, 1 VIN, 2 GND, VOUT 3, +5V, C13 47.0000uF, GND; C14 0.1000uF, GND

VR3 — TL1963A-33DCY

GVDD, 1 VIN, 2 GND, VOUT 3, +3.3V, C15 47.0000uF, GND; C16 0.1000uF, GND

VR4 — REF3025AIDBZ

+3.3V, C38 0.4700uF, GND

1 VIN, 3 GND, VOUT 2, +2.5V, GND

USER POWER ACCESS

+5V, J2 1, 2, GND

+3.3V, J3 1, 2, GND

TI

PAGE INFO: POWER INPUTS AND SUPPLIES		DATE MARCH 23, 2011	SCH REV C
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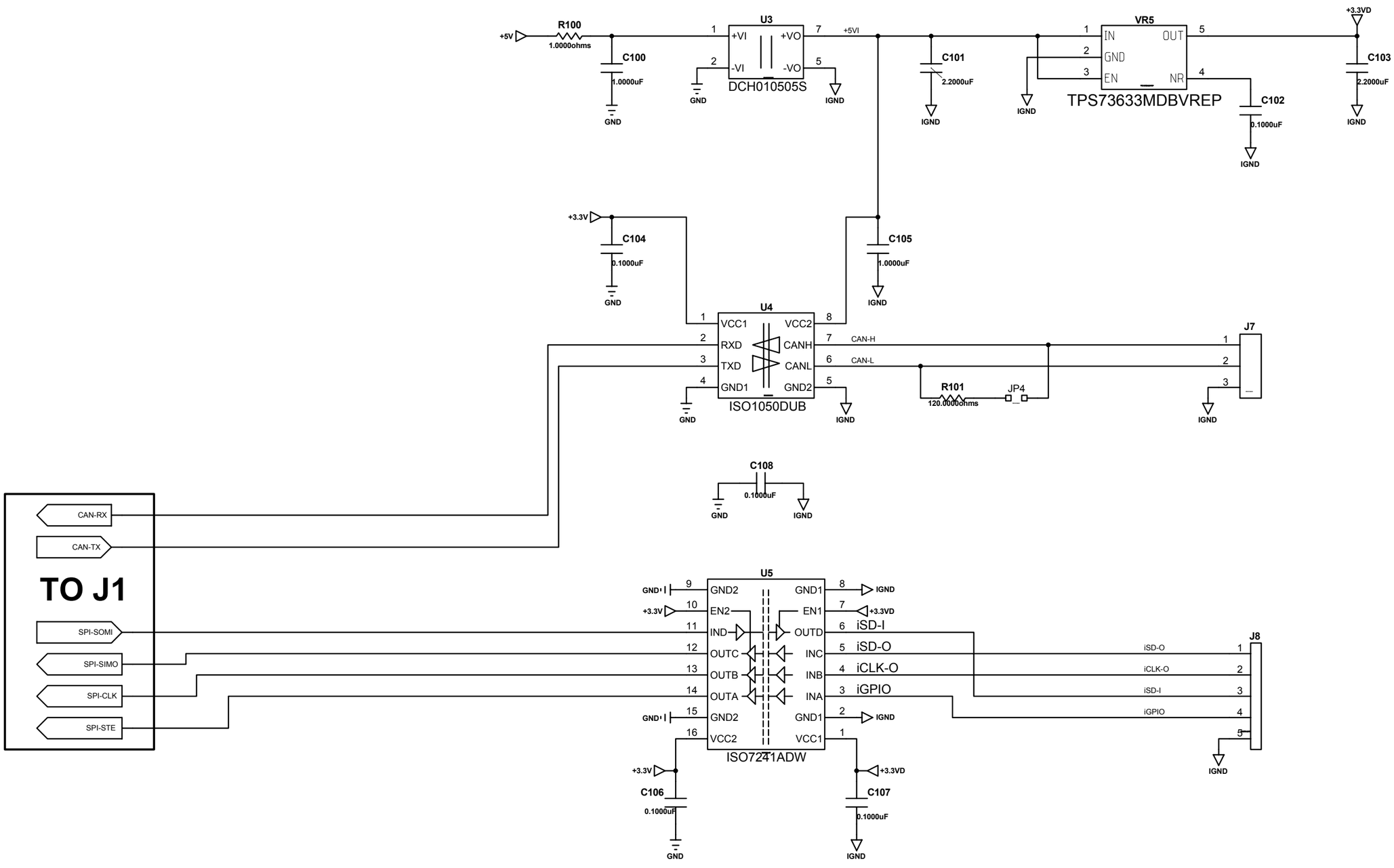
DRV8312 EVALUATION BOARD



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PAGE INFO: ISOLATION CIRCUIT		DATE MARCH 23, 2011	SHEET 4 OF 6
DESIGN LEAD RYAN KEHR	EDGE # 6517813	FILENAME DRV8312EVM_RevD	DRAWN BY LDN

DRV8312 EVALUATION BOARD

REVISION HISTORY

REVISION	DESCRIPTION	DATE	APPROVAL
A	INITIAL RELEASE	MAY 4, 2010	ML
B	1. DELETED OUTA, OUTB, OUTC. 2. ADDED OUTPUT CONNECTOR, TITLED MOTOR. 3. CONNECTED L2-2, L3-2 AND L4-2 TO MOTOR-1,2 AND 3, RESPECTIVELY. 4. DELETED PVDD, GND, +12V AND GND(GND2). 5. ADDED POWER CONNECTOR, VIN. 6. CONNECTED VIN-4 TO C1-1. 7. CONNECTED VIN-2,3 TO GND. 8. CONNECTED VIN-1 TO +12V. 9. ADDED TESTPOINTS TO IA-FB, IB-FB, IC-FB AND I-TOTAL. 10. ADDED 2 PIN HEADERS J2 AND J3 FOR USER POWER ACCESS. 11. CONNECTED J2-1,2 TO +5V AND GND. 12. CONNECTED J3-1,2 TO +3.3V AND GND. 13. COMBINED ENCODER AND CAP INTO ONE 2x5 HEADER, TITLED J4. 14. ADDED 3 PIN HEADER, JP3, LABELED TACH/SPEED INPUT. 15. CONNECTED JP3-1,2,3 TO +3.3V, J1-7 AND GND, RESPECTIVELY. 16. RENAMED S1 TO RSTA. 17. SWAPPED U1-29 AND U1-30. 18. ADDED 40 PIN HEADER, J5 AND CONNECTED PINS TO ACTIVE PINS OF J1. 19. ADDED SWITCHES, S1 AND S2 TO U1-76 AND U1-78. 20. COPIED DAC1 CIRCUIT, CALLED DAC3, AND CONNECTED TO J1-28. 21. CHANGED R24-R27 TO 33.0K OHMS. 22. CHANGED R28-R35, R56-R61 TO 1.00K OHMS. 23. CHANGED R48, R49, R54 AND R55 TO 49.9K OHMS. 24. ADDED ISOLATION CIRCUITS. 25. ADDED 12V CONNECTOR, J9. 26. CHANGED C4 TO 22UFD/100V. 27. CHANGED C5 AND C6 TO 100V.	MARCH 23, 2011	RK

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Such product safety design criteria shall include but not be limited to critical circuit creepages and clearances, component selection, ratings compatibility of controlled motor loads, and required protective means (ie output fusing) depending on the specific loads being controlled.

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REGULATORY COMPLIANCE INFORMATION

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

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

General Statement for EVMs including a radio

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

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

Caution

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

For EVMs annotated as IC – INDUSTRY CANADA Compliant

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

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

Concerning EVMs including radio transmitters

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

Concerning EVMs including detachable antennas

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

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

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

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

Concernant les EVMs avec appareils radio

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

Concernant les EVMs avec antennes détachables

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

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

【Important Notice for Users of this Product in Japan】

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

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

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

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http://www.tij.co.jp

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

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

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

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

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

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

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

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TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

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