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1 Introduction

1.1 Description

The DRV201EVM is an evaluation board to assist in evaluating the DRV201 IC as a voice coil motor (VCM) driver for camera autofocus.

The device is an advanced voice coil motor driver for camera Auto focus. It has integrated D/A converter for setting the VCM current. VCM current is controlled with a fixed frequency PWM controller or a linear mode driver. Current generation can be selected via I²C register. Device has integrated sense resistor for current regulation and the current can be controlled through I²C.

When changing the current in the VCM the lens ringing is compensated with an advanced ringing compensation function. Ringing compensation reduces the needed time for auto focus significantly. The device has also VCM short and open protection functions.

1.2 Applications

- Camera auto focus
- Camera Iris control

1.3 Features

- Configurable for linear or PWM mode VCM current generation
- High efficiency PWM current control for VCM
- Advanced ringing compensation
- Integrated 10-bit D/A converter for VCM current control
- Protection
 - Open and short-circuit detection on VCM pins
 - Undervoltage lockout (UVLO)
 - Thermal shutdown
 - Open and short circuit protection on VCM output
 - Internal current limit for VCM driver
- I²C interface
- Operating temperature range: -40°C to 85°C
- 6-ball WCSP package with 0.4-mm pitch
- Max die size: 0.8 mm x 1.48 mm
- Package height: 0.15 mm

2 System Overview

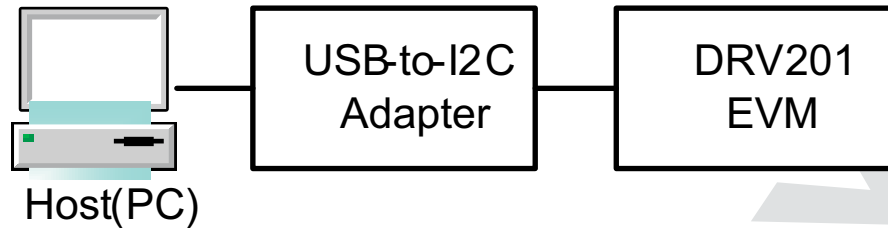


Figure 2. System Block Diagram

The system consists of these components:

- **Host (PC):** a Windows™ personal computer (PC) – used to configure and monitor the DRV201EVM. The GUI operates on the host. For the GUI to execute properly, the host needs to have the correct LabView™ RunTime version. If the host doesn't have the correct RunTime version it will be prompted during GUI installation. More information in GUI installation section.
- **USB-to-I²C adapter:** DRV201EVM uses the I²C interface for communication with the host. The TI-supplied USB-to-I²C adapter shown in [Figure 3](#). USB-to-GPIO adapter does the appropriate conversion so the host can use the USB interface for communication. USB-to-I²C adapter has a 3.3-V supply rail which is used to supply the EVM so no external power supply is needed.
- **DRV201EVM:** EVM board that houses the DRV201 and peripheral components.

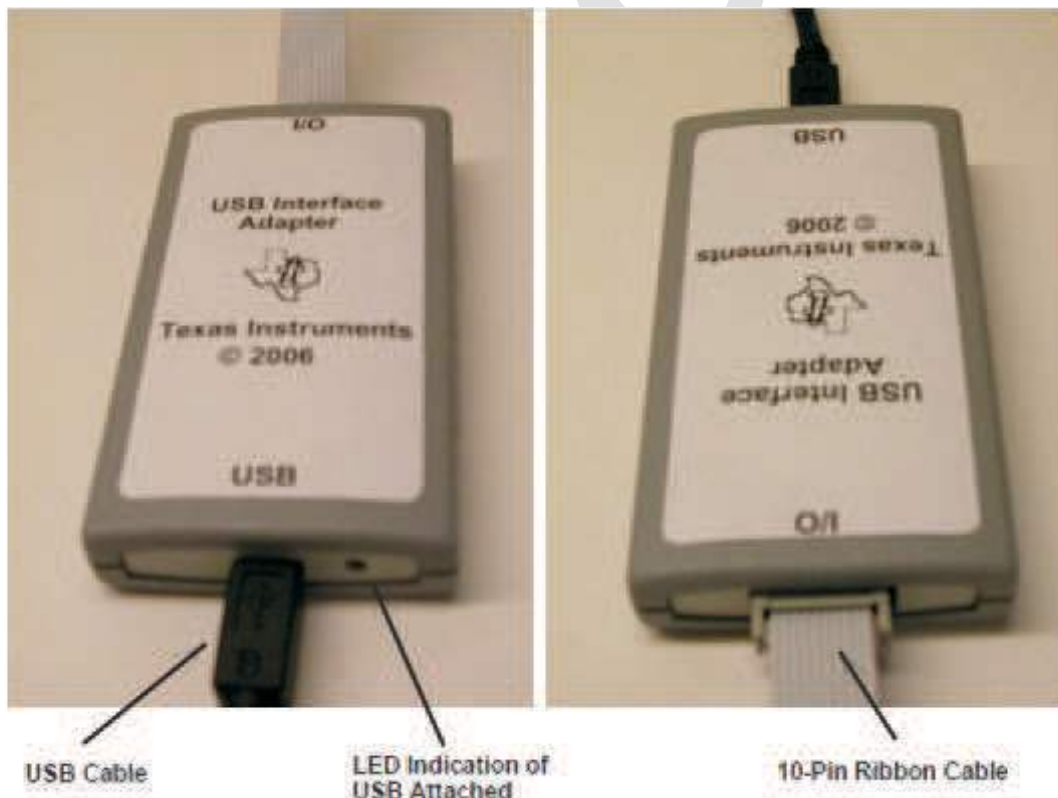


Figure 3. USB-to-GPIO Adapter

3 Hardware Overview

The DRV201EVM allows evaluation of the DRV201 IC as a voice coil motor (VCM) driver for camera autofocus. DRV201EVM has separate connections for I_{SOURCE} and I_{SINK} pins that can be used to connect to any VCM actuator or VCM in a camera module. If VCM actuator is not available there are on board mounted inductor and resistor available to model VCM.

The DRV201EVM can be configured and monitored through a Windows GUI application running on a PC. The GUI communicates with the DRV201EVM through the USB Interface Adapter (included with EVM kit), which acts as an I²C master for the board.

The DRV201EVM provides the following functionality:

- Programming of the DRV201 device.
- R_VCM and L_VCM are meant as a model of a typical VCM actuator electrical parameters.
- Driving either external VCM connected to I_{SOURCE} and I_{SINK} headers or using on board inductor and resistor (see jumper setting).
- Standard 400-kHz I²C communication via I²C connector to USB adapter for connection to a PC.
- Board can be supplied through the 3.3 V from the USB adapter or from an external power source (see jumper setting).

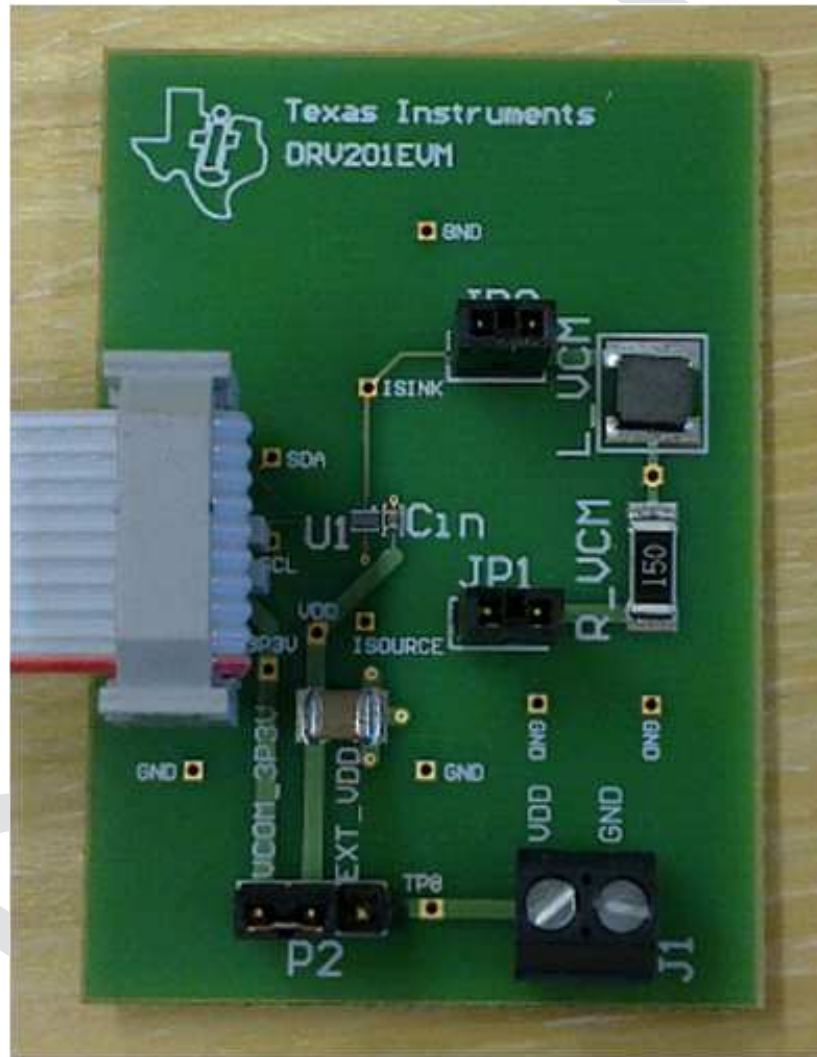


Figure 4. Connecting the ribbon cable to DRV201EVM pin one is marked on the EVM and with the red stripe in the ribbon cable.

3.1 Connectors

The DRV201EVM has connectors for power and I²C communications. J1 provides a possibility to power EVM from an external power supply (between 2.5 V and 4.8 V). USB adapter interface adapter has a 3.3-V power output that can be used to power the board so there is no need for external power source.

P1 header provides the I²C communication interface to the DRV201EVM. The USB Interface Adapter includes a ribbon cable that can be connected to P1. The adapter is connected to a Windows-based PC.

WARNING

When using external power DRV201EVM, it should be noted that the recommended supply range for DRV201 is from 2.5 V to 4.8 V.

3.2 Jumpers

The DRV201EVM operation can be configured using jumpers:

- Board power from external supply or USB interface adapter
- Driving on board inductor and resistor or external VCM actuator

See [Table 1](#) for descriptions and default settings for the jumpers on the DRV201EVM.

Table 1. DRV201EVM Jumpers

NUMBER	FUNCTION	DEFAULT SETTING
P2	Board power supply selection. Connect to pins 1-2 when using 3.3 V from the USB interface adapter and pins 2-3 if external power supply is used.	Pins 1-2 (power from USB interface adapter)
JP1 and JP2	R_VCM and L_VCM are connected between DRV201 pins I _{SOURCE} and I _{SINK} . If jumpers are not connected, VCM actuator can be connected between I _{SOURCE} and I _{SINK} .	JP1 and JP2 jumpers connected

3.3 Test Points

The DRV201EVM provides test points that can be used for evaluation. Important voltages can be monitored with a meter through the use of the test points.

3.4 EVM Operation

The DRV201EVM operates from either a USB interface adapter (through P1) or an external power supply (through J1). Jumper P2 can be used to select the power source as described in [Section 3.2](#). Use the following steps to set up the DRV201EVM.

1. Connect the USB interface adapter to the DRV201EVM P1 connector using the ribbon cable provided.
2. Plug the appropriate end of the USB cable into the adapter and the other end into your PC.

NOTE: If using an external power supply, connect jumper's pins 2-3 and use J1 to connect the power supply.

4 Software

The DRV201EVM comes with a Windows application that can be used to configure and monitor the EVM. The GUI can be used to configure all available options of the EVM such as programming, current settings, ringing compensation, VCM resonance frequency, open VCM, and short VCM.

The following section explains the procedure for installing the graphical user interface (GUI) onto a Windows based PC. A USB interface adapter is required to connect the EVM to a PC and should have been provided with the EVM.

Additional interfaces can be ordered through <http://focus.ti.com/docs/toolsw/folders/print/usb-to-gpio.html>.

4.1 Software Installation Instructions

To install the EVM software follow the steps outlined:

- Copy the DRV201EVM.zip to your computer and extract all files.
- Double-click on the setup.exe file in the \Installer\Volume\ directory.
- Follow the prompts to finish the installation.
- At the end of the installation, a reboot of your computer may be required.

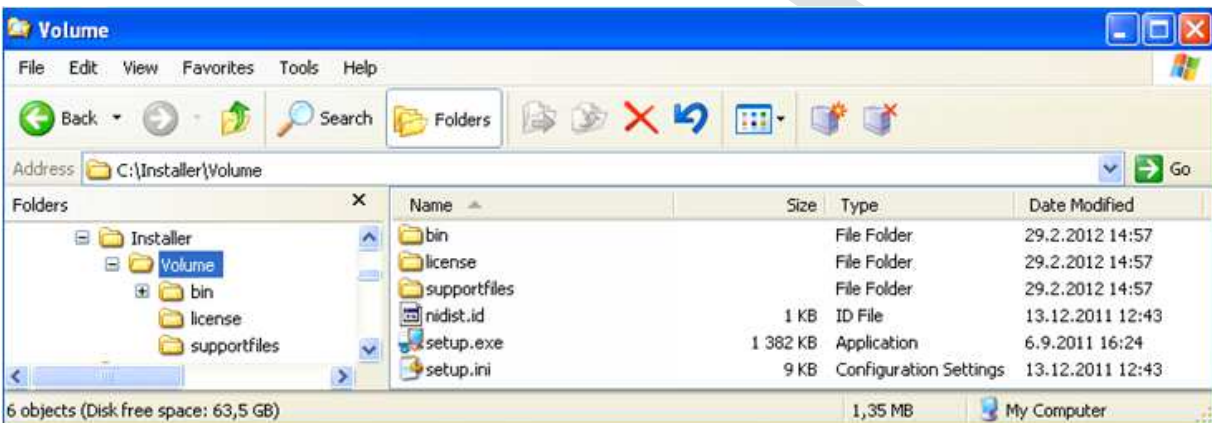


Figure 5. setup.exe File Located in the Volume Directory

I²C read/write commands may be made using the provided software. A dark grey block means the bit is 'high'. A white block means the bit is 'low'. A write may be performed simply by clicking on an individual bit or an entire register may be written by using the write command on the left side of the GUI.

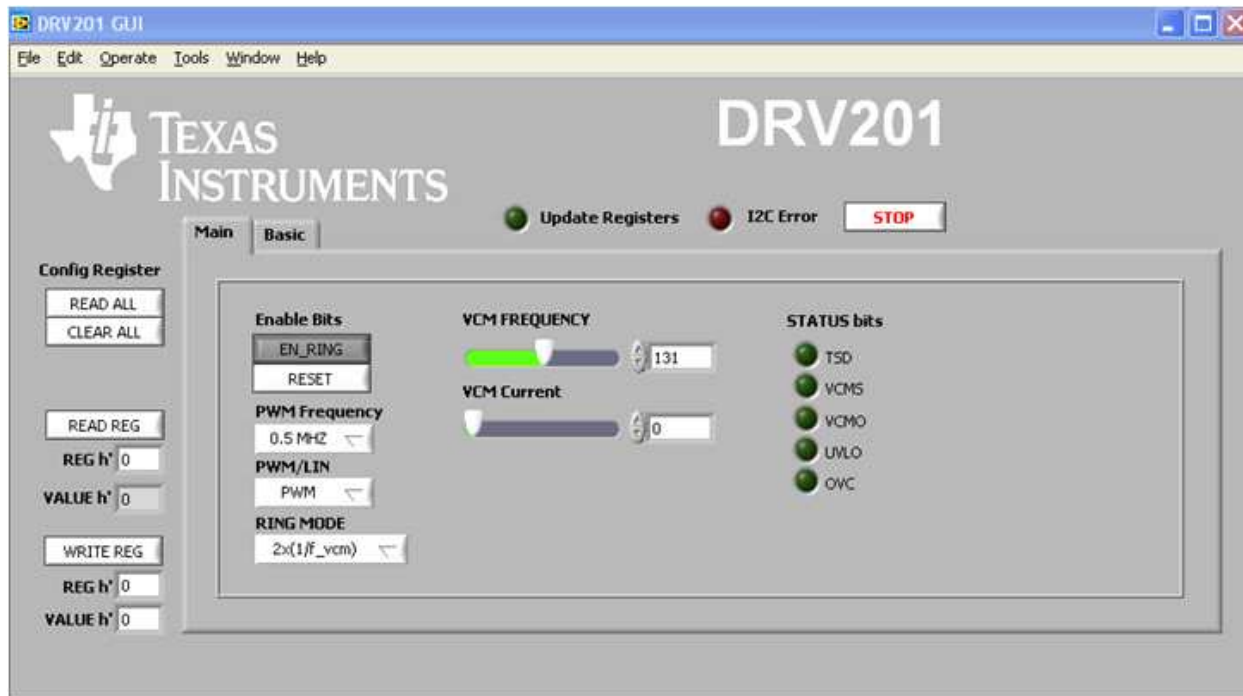


Figure 6. DRV201EVM GUI Main

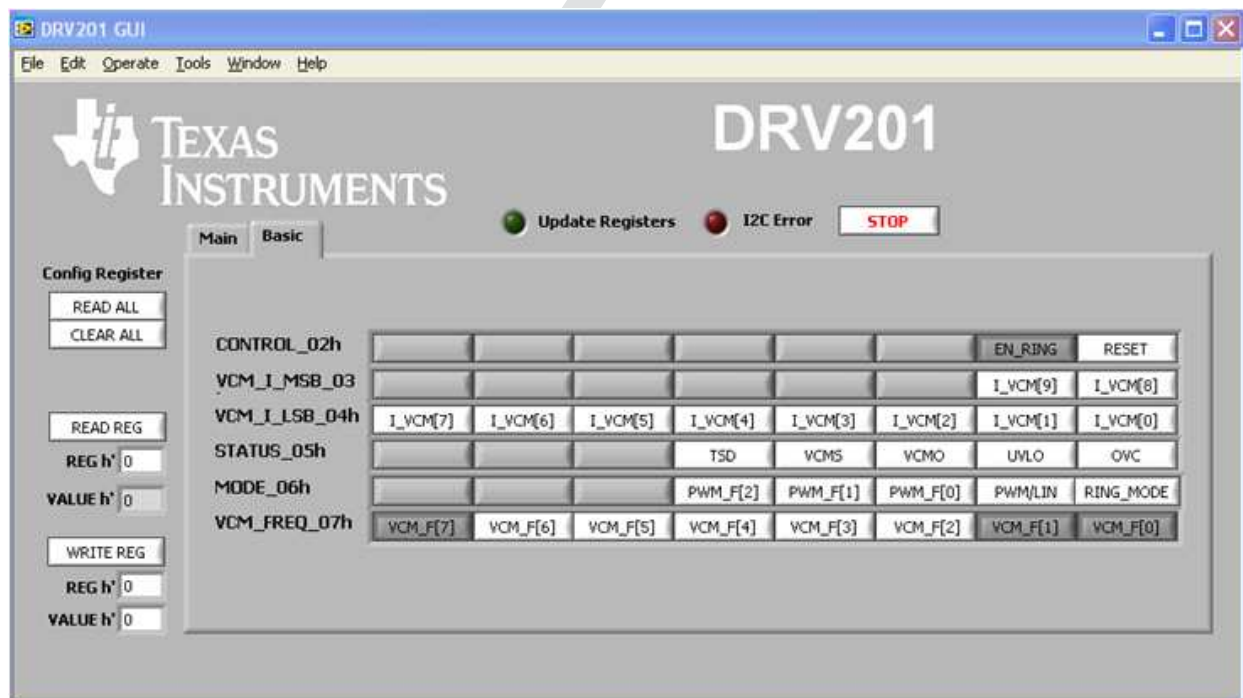
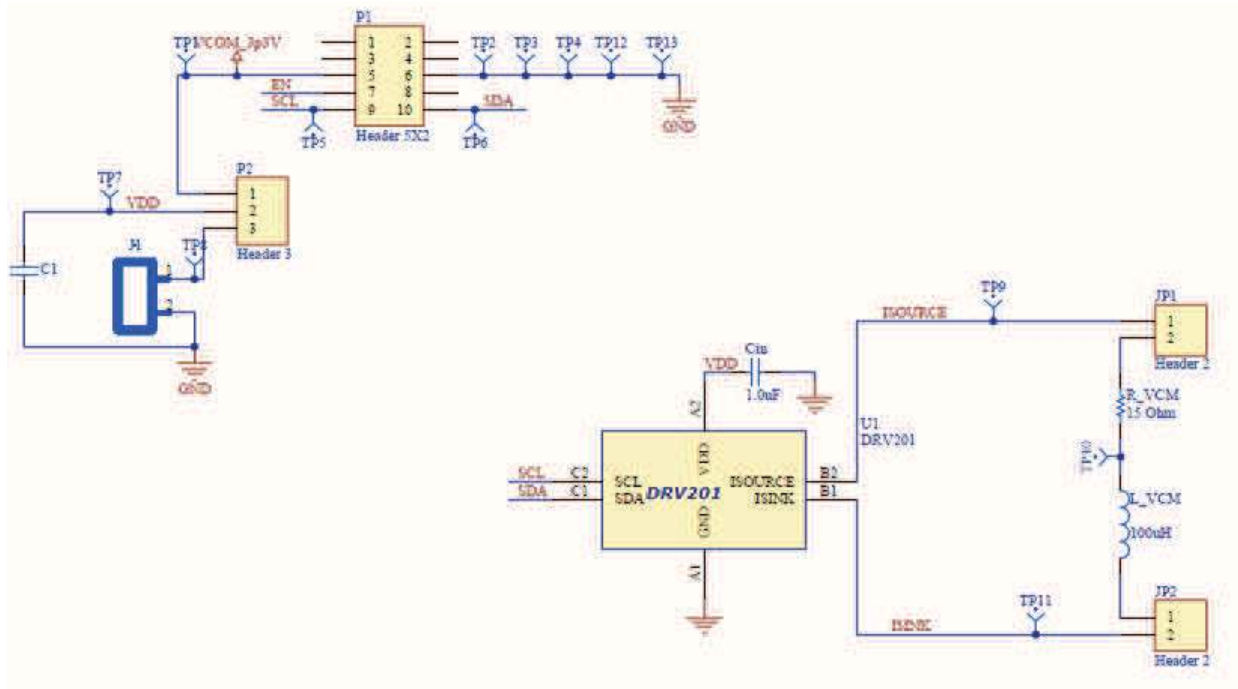


Figure 7. DRV201EVM GUI Basic

5 EVM Schematic



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6 PCB layout

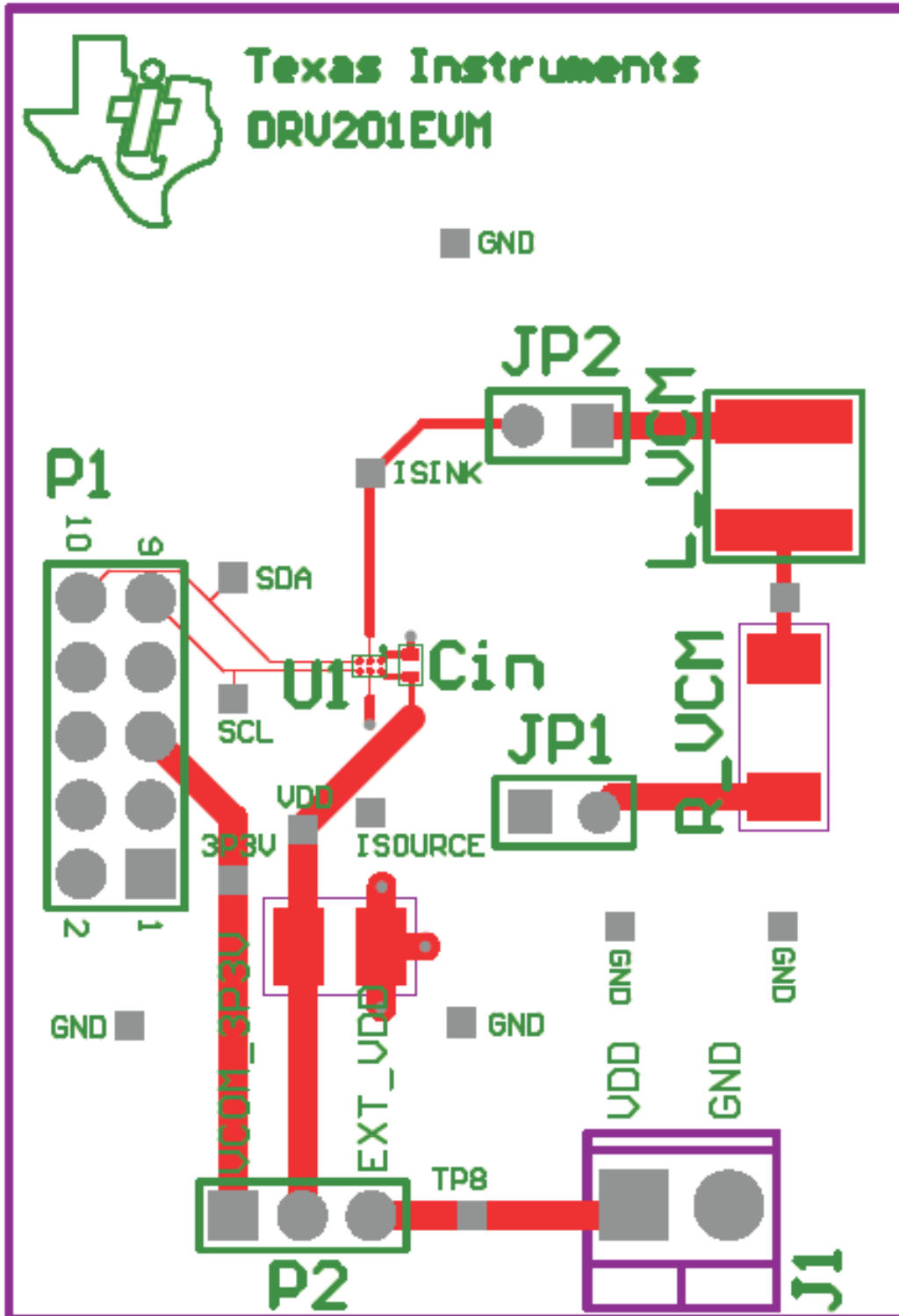


Figure 8. DRV201EVM Board Layer 1. (TOP)

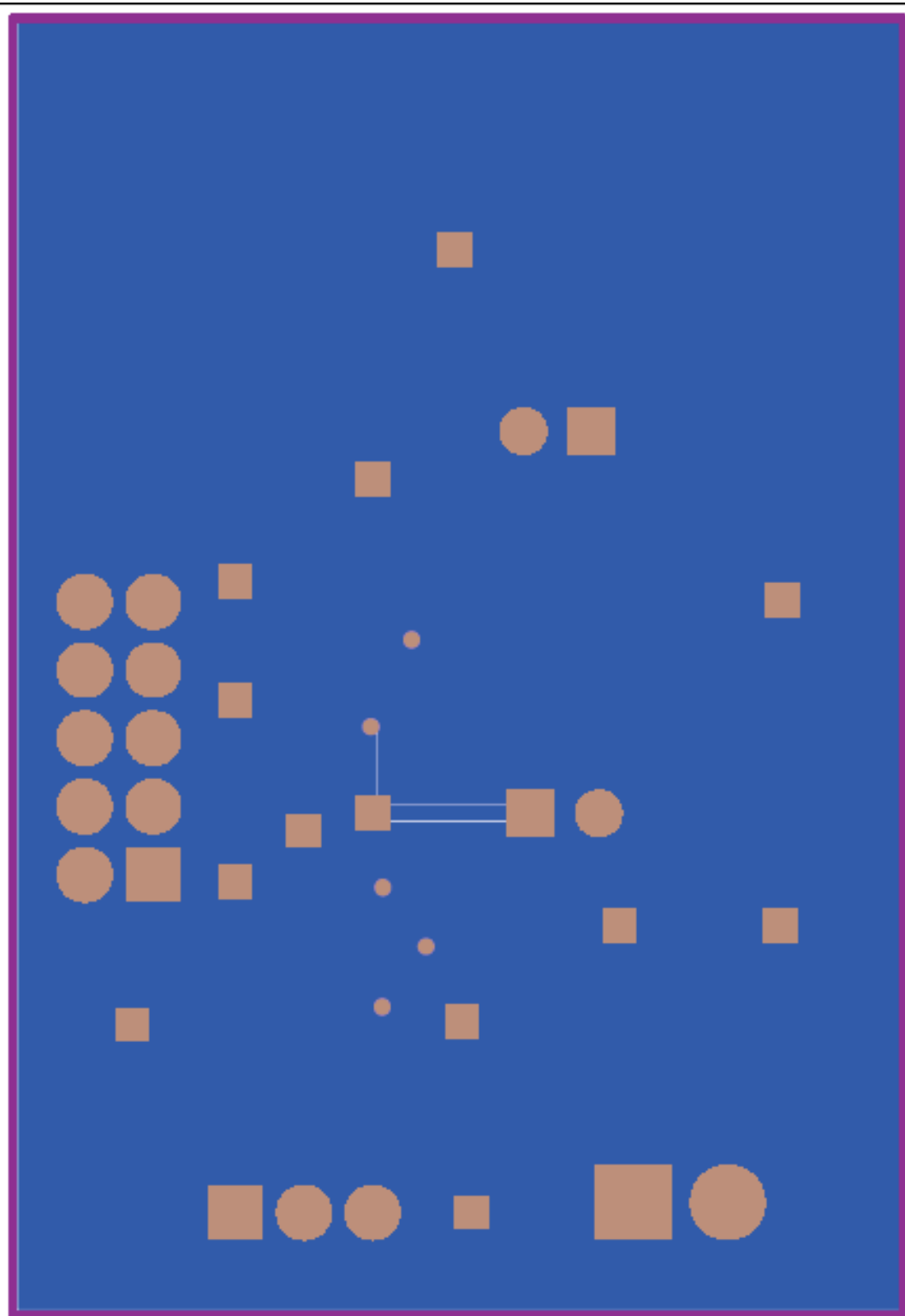


Figure 9. Board Layer 4. (BOTTOM)

7 Bill of Materials
Table 2. Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	Cin	1 μ F	Capacitor, Ceramic, 10V, X5R	0402	ECJ0EB1A105M	Panasonic
1	R_VCM	15 Ω	Resistance to model VCM	2010	MCR50JZHJ150	Rohm
1	L_LCVM	100 μ H	Inductance to model VCM		NR4018T101M	Taiyo Yuden
1	J1		Terminal Block	2 x 3.5 mm	ED555/2DS	On Shore
1	P1		Header, 2x5			
1	P2		Header, 1x3			
2	JP1, JP2		Header, 1x2			
4	U1		IC, Autofocus driver		DRV201	TI

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It is important to operate this EVM within the input voltage range of 2.5 V to 4.8 V and the output voltage range of 2.5 V to 4.8 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 85°C ambient. The EVM is designed to operate properly with certain components above 85°C ambient as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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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.

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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.

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.

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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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