

DRV8601ZQVEVM ERM/LRA Driver Evaluation Module

The DRV8601 ERM/LRA driver evaluation module is a complete, low-power and ultra-fast turn-on driver for Eccentric Rotating Mass (ERM) and Linear Resonant Actuator (LRA) types of haptic actuators. All components and the evaluation module are Pb-free. The evaluation module (EVM) consists of a DRV8601ZQV device and all necessary components to evaluate it.

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1 Introduction

This section provides an overview of the Texas Instruments (TI) DRV8601 ERM/LRA driver evaluation module (DRV8601ZQVEVM). It includes a description of the module and a list of EVM specifications.

1.1 DRV8601ZQVEVM Specifications

Operation at room temperature assumed.

Supply voltage range, V_{DD}	2.5 V to 5.5 V
Power supply current rating required	2.5 A
Input voltage, V_I	0 V- V_{DD}
Minimum load impedance, Z_L	6.4 Ω
Maximum continuous output current	400 mA

2 Operation

This section describes how to operate the DRV8601ZQVEVM.

2.1 Quick Start for Stand-Alone Operation

Use the following steps when operating the DRV8601ZQVEVM stand-alone or when connecting it to existing circuits or equipment.

2.1.1 Initial Configuration

The DRV8601ZQVEVM can be operated in two configurations. For a detailed description of each configuration, see the DRV8601ZQV data sheet.

1. Pseudo-Differential Feedback with Internal Reference - used when V_{DD} is equal to the maximum IN voltage
2. Differential Feedback with External Reference - used when V_{DD} is not equal to the maximum IN voltage

Table 1 describes how to modify the DRV8601ZQVEVM for the two configurations. Note that the voltages listed (IN, REFIN, and V_{DD}) must be used for proper operation. If alternate voltages are required, see the data sheet to select different passive components.

Table 1. Configuration Settings

No.	Configuration	JP1	R4	C4	R5	C5	R1	R2	R6	IN V_{MAX}	REFIN	V_{DD}
1	Pseudo-Differential Feedback with Internal Reference	2-3	100k	0.01 μ F ⁽¹⁾	DNP	DNP	49.9 k	-	-	3.3V	N/A	3.3V
2	Differential Feedback with External Reference (GAIN = 3.7 V/V)	1-2	100 k	0.01 μ F ⁽¹⁾	100 k	0.01 μ F ⁽¹⁾	27.4 k	53.6 k	53.6 k	1.8 V	1.8V	3.3V

⁽¹⁾ Choose C4 to set the corner frequency according to the equation $f_{3dB} = 1 / (2 \times \pi \times R4 \times C4)$. For configuration two, choose R5 = R4 and C5 = C4.

2.1.2 Power and Ground

For all three configurations:

1. Set the voltage of an external power supply between 2.5 V and 5.5 V and turn it OFF.
2. Attach the ground connection of the power supply to the GND header pin of the EVM, and then connect the positive supply to the VDD header pin. Verify that the connections are made to the correct header pins.

2.1.3 Inputs and Outputs

2.1.3.1 Vibration Input

1. Make sure that the signal source is set to the minimum level.
2. Connect the signal source to the IN header pin on the EVM.
3. Connect the actuator (ERM or LRA) between OUT+ and OUT-.

2.1.3.2 Enable Settings

The DRV8601ZQV has an active high enable pin EN. A high value on this pin places the device in the operating mode, and a low value on this pin places it in the shutdown mode. Press and hold pushbutton S1 to place the DRV8601ZQVEVM in the shutdown mode. Release pushbutton S1 to restart normal operation.

2.1.3.3 Gain Settings

DC gain of the device is given by $2 \times R4 / R1$ for the pseudo-differential configurations, and $R4 / R1$ for the differential configuration. R5, when used, must be well matched with R4 for proper performance. The DRV8601ZQVEVM is pre-configured for a pseudo-differential gain of 4 V/V and a differential gain of 2V/V.

2.2 Power Up

1. Verify the correct connections as described in Sections 2.1.
2. Verify the voltage setting of the power supply is between 2.5 V and 5.5 V, and turn on the power supply. Proper operation of the EVM begins.
3. Adjust the audio signal source as needed.

- (a) For LRAs, drive a PWM signal at the resonant frequency of the LRA. ensure that the low-pass corner frequency is beyond the resonant frequency of the LRA.
- (b) For ERMs, drive a PWM signal below 30 kHz.

3 Reference

This section includes the EVM PCB layout reference, schematic, and parts list.

3.1 DRV8601ZQVEVM PCB Layers

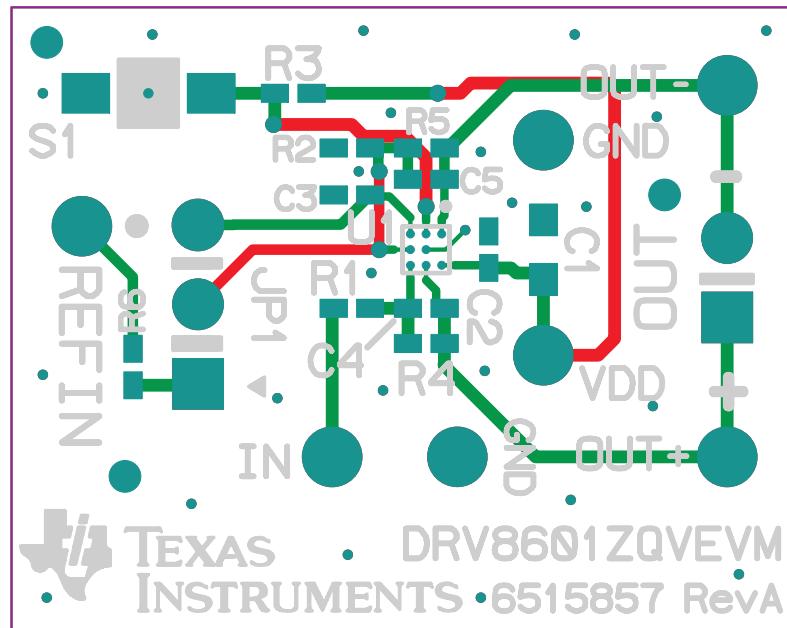


Figure 1. Top Layer

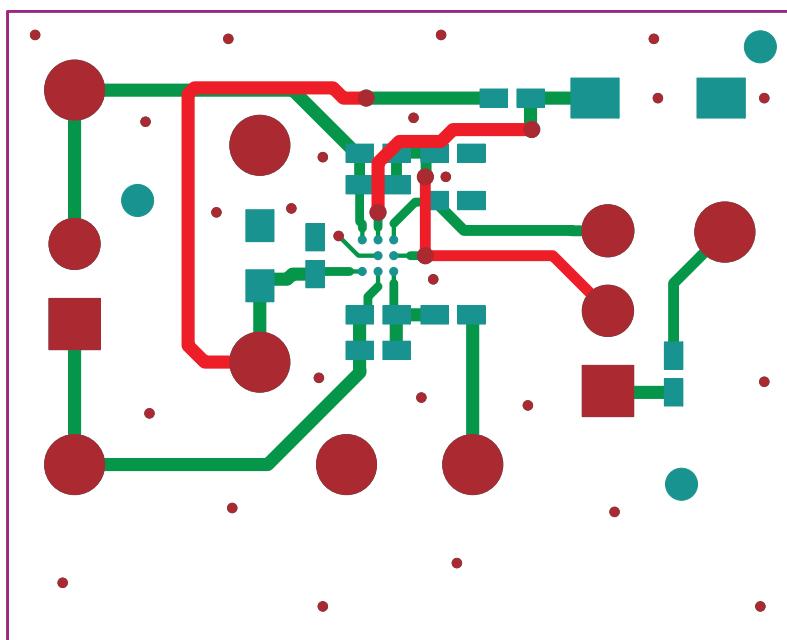


Figure 2. Bottom Layer

3.2 DRV8601ZQVEVM Schematic Diagram

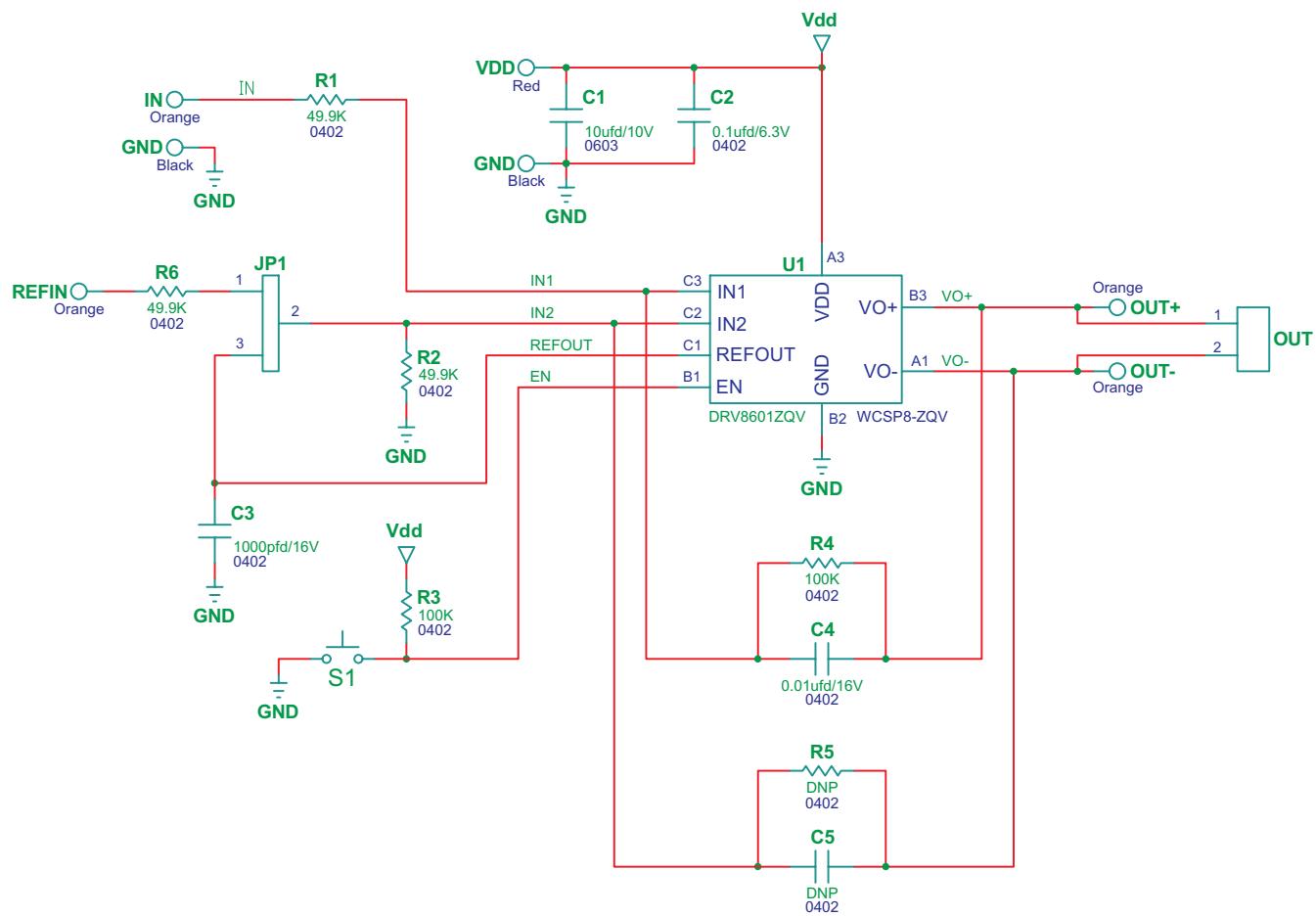


Figure 3. DRV8601ZQVEVM Schematic Diagram

3.3 DRV8601ZQVEVM Evaluation Module Parts List

Table 2. DRV8601ZQVEVM Parts List

Item	MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
TI-SEMICONDUCTORS							
1	DRV8601ZQV	1	U1	DRV8601ZQV	400mA DRIVER FOR DC MOTORS AND LINEAR VIBRATORS WCSP8-ZQV ROHS	Texas Instruments	Texas Instruments
CAPACITORS							
Item	MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
2	CC0402KRX7R7BB102	1	C3	311-1352-1	CAP SMD0402 CERM 1000pfd 16V 10% X7R ROHS	DIGI-KEY	Yageo
3	0402YC103KAT2A	1	C4	478-1114-1	CAP SMD0402 CERM 0.01ufd 16V 10% X7R ROHS	DIGI-KEY	AVX
4	C1005X5R0J104K	1	C2	445-1266-1	CAP SMD0402 CERM 0.1uFD 6.3V 10% X5R ROHS	DIGI-KEY	TDK Corp
5	ECJ-1VB1A106M	1	C1	PCC2479CT	CAP SMD0603 CERM 10uFD 10V 20% X5R ROHS	DIGI-KEY	Panasonic
RESISTORS							
Item	MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
6	ERJ-2RKF4992X	3	R1, R2, R6	P49.9KLCT	RESISTOR SMD0402 THK FLM 49.9K 1/16W 1% ROHS	DIGI-KEY	Panasonic
7	ERJ-2RKF1003X	2	R3, R4	P100KLCT	RESISTOR SMD0402 THK FLM 100K 1/16W 1% ROHS	DIGI-KEY	Panasonic
HEADERS AND JACKS							
Item	MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
8	PBC02SAAN	1	OUT	S1011E-02	HEADER THRU MALE 2 PIN 100LS GOLD ROHS	DIGI-KEY	SULLINS
9	PBC03SAAN	1	JP1	S1011E-03	HEADER THRU MALE 3 PIN 100LS GOLD ROHS	DIGI-KEY	SULLINS
TESTPOINTS AND SWITCHES							
Item	MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
10	5000	1	VDD	5000K	PC TESTPOINT, RED, ROHS	DIGI-KEY	Keystone Electronics
11	5001	2	GNDx2	5001K	PC TESTPOINT, BLACK, ROHS	DIGI-KEY	Keystone Electronics
12	5003	4	IN, OUT+, OUT-, REFIN	5003K	PC TESTPOINT, ORANGE, ROHS	DIGI-KEY	Keystone Electronics
13	TL1015AF160QG	1	S1	EG4344CT	SWITCH, MOM, 160G SMT 4X3MM ROHS	DIGI-KEY	E-SWITCH
SHUNTS							
Item	MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
14	SPC02SYAN	1	JP1	S9001	SHUNT, BLACK AU FLASH 0.100LS	DIGI-KEY	SULLINS
Component Count: 21							
COMPONENTS NOT ASSEMBLED							
C5, R5							

4 Related Documentation From Texas Instruments

- DRV8601 data sheet ([SLOS629](#)): Driver for DC Motors (ERMs) and Linear Vibrators (LRAs) with Ultra-Fast Turn-On.

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It is important to operate this EVM within the input voltage range of 2.5 V to 5 V and the output voltage range of 0 V to 5.5 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.

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NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 Japan

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<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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

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4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

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4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

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