DRV8876/74 Evaluation Module

This document is provided with the DRV887x family customer evaluation modules (EVM) as a supplement to the DRV8876, DRV8876-Q1, DRV8874, and DRV8874-Q1 datasheets. This user's guide describes the hardware implementation of the EVM.

CAUTION

Hot surface. Contact may cause burns. Do not Touch.

DRV8876EVM and DRV8876-Q1EVM are rated for power supply voltages between 4.5 VDC and 37 VDC max. The components can support peak output currents up to a maximum of 3.5 ADC. To maintain component temperatures below the 130°C rating of the printed circuit board material, TI requires that the continuous current of both channels be limited to 1.7 ADC (each) when operating for extended periods of time at an ambient temperature of 25°C.

DRV8874EVM and DRV8874-Q1EVM are rated for power supply voltages between 4.5 VDC and 37 VDC max. The components can support peak output currents up to a maximum of 6 ADC. To maintain component temperatures below the 130°C rating of the printed circuit board material, TI requires that the continuous current of both channels be limited to 3.3 ADC (each) when operating for extended periods of time at an ambient temperature of 25°C.

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1 PCB (Top-Assembly View)

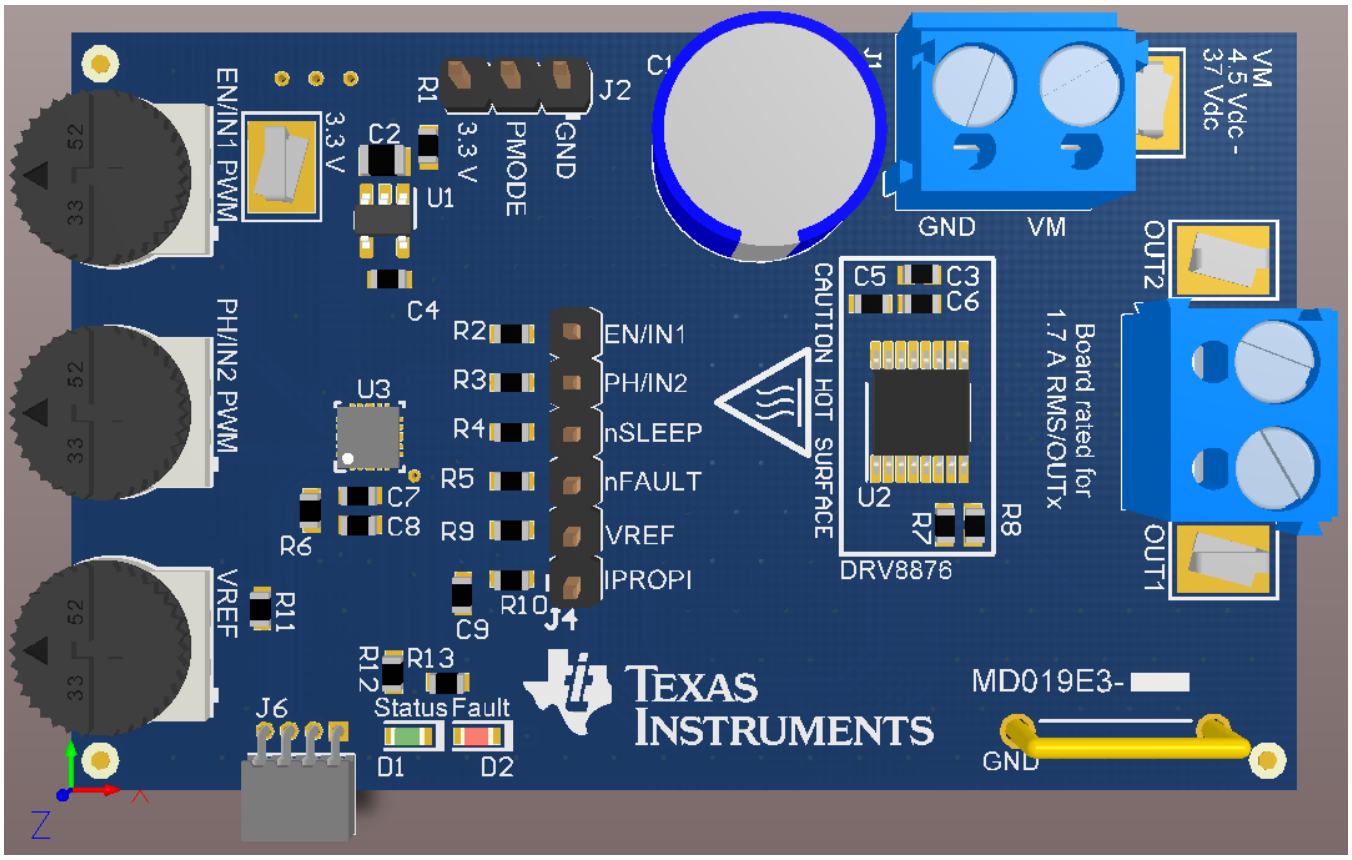

Figure 1. PCB (Top 3-D View)

2 Introduction

The DRV8876x/74xEVM is a complete solution for evaluating the DRV8876/74x H-bridge motor drivers. It includes an MSP430™ microcontroller that is preprogrammed to take input from two dedicated analog potentiometers for PWM speed control of one or two brushed DC motors. The jumper on the PMODE pin allows the user to select from the input modes of PH/EN (GND), PWM (3.3 V), and independent half-bridge control (Hi-Z). Power can be provided externally up to 37 V through the power header. To expand beyond the included firmware capability, the MSP430 MCU can be reprogrammed through the eZ-FET emulation circuit found in newer MSP430 Launchpads. We recommend the http://www.ti.com/tool/MSP-EXP430FR5969. Note that a four pin angled male header is required and must be soldered to J21 of this Launchpad from V+ pin to GND pin. We recommend a pin header with pin dimensions like 850-10-050-20-001000. The U1 MCU must be removed from the Launchpad.

NOTE: To test the DRV8876N functionality (no current sensing), replace R7 with a 0-Ohm resistor and set VREF to a voltage greater than 1 V. This will configure the DRV8876 to the same operation as the DRV8876N.

3 Power Connectors

The DRV8876/74xEVM uses a single header for power entry to the EVM board. Only a single power supply rail is necessary since an onboard 3.3-V regulator provides power to the MSP430. The minimum recommended VM voltage for the EVM is 4.5 V and the maximum is 37 V. For complete voltage range information of the driver itself, refer to the device.

As previously mentioned, the MSP430 comes preprogrammed to control basic DC motor operation. If changing the firmware via the external eZ-FET™ emulation tool, do not supply power to the VM connector on the EVM. The eZ-FET™ board provides the necessary power during programming when connected to the J6 connector. Note that a four pin angled male header is required and must be soldered to J21 of this Launchpad from V+ pin to GND pin. We recommend a pin header with pin dimensions like 850-10-050-20-001000. The U1 MCU must be removed from the Launchpad.

4 Test Points

The inputs and control signals between the MCU and the DRV8876/74 connect to the J4 header pins to use as test points for EN/IN1, PH/IN2, nSLEEP, nFAULT, VREF, and IPROPI signals. The resistors next to the headers (R2, R3, R4, R6, R10, and R11) can be removed to test the DRV8876/74 with external signals rather than the signals from the MCU. The MCU provides logic output signals to the EN/IN1, PH/IN2, and nSLEEP pins between 0 V and 3.3 V. The nFAULT signal pulls low during a fault condition from the DRV8876/74. When nFAULT is low, the Fault LED, D2, will turn on. The VREF potentiometer sets a reference voltage between 0 V and 3.3 V. The IPROPI signal voltage will be proportional to the current out of the IPROPI pin. On the EVM, the R_{IPROPI} resistor (R8) is 1.5 kΩ. For more information on IPROPI, refer to the DRV8876 and DRV8876-Q1 datasheets.

5 PMODE Jumper and Speed-Adjustment Potentiometers

The PMODE header and jumper allow the user to select from the input modes of PH/EN (GND), PWM (3.3 V), and independent half-bridge control (Hi-Z). PMODE must be selected prior to powering the EVM. The inputs to the DRV8876/74 are EN/IN1 and PH/IN2. The function of these inputs are IN1 and IN2 when the PMODE is 3.3 V (PWM mode) or Hi-Z (independent half-bridge mode). When PMODE is connected to ground (PH/EN control mode) the input function is a phase/enable (PH/EN) interface.

The MSP430 produces PWM signals for the EN/IN1 and PH/IN2 pins with duty cycles proportional to the voltage from the PWM potentiometers. The tables below show how to configure the potentiometers for each PMODE configuration.

NOTE: When switching between modes, completely power down the board before changing the PMODE jumper. Once powered down, turn both potentiometers completely counterclockwise so motor does not start turning immediately when the board is powered. After moving the PMODE jumper and setting the potentiometers, power up the board again to use the new mode.

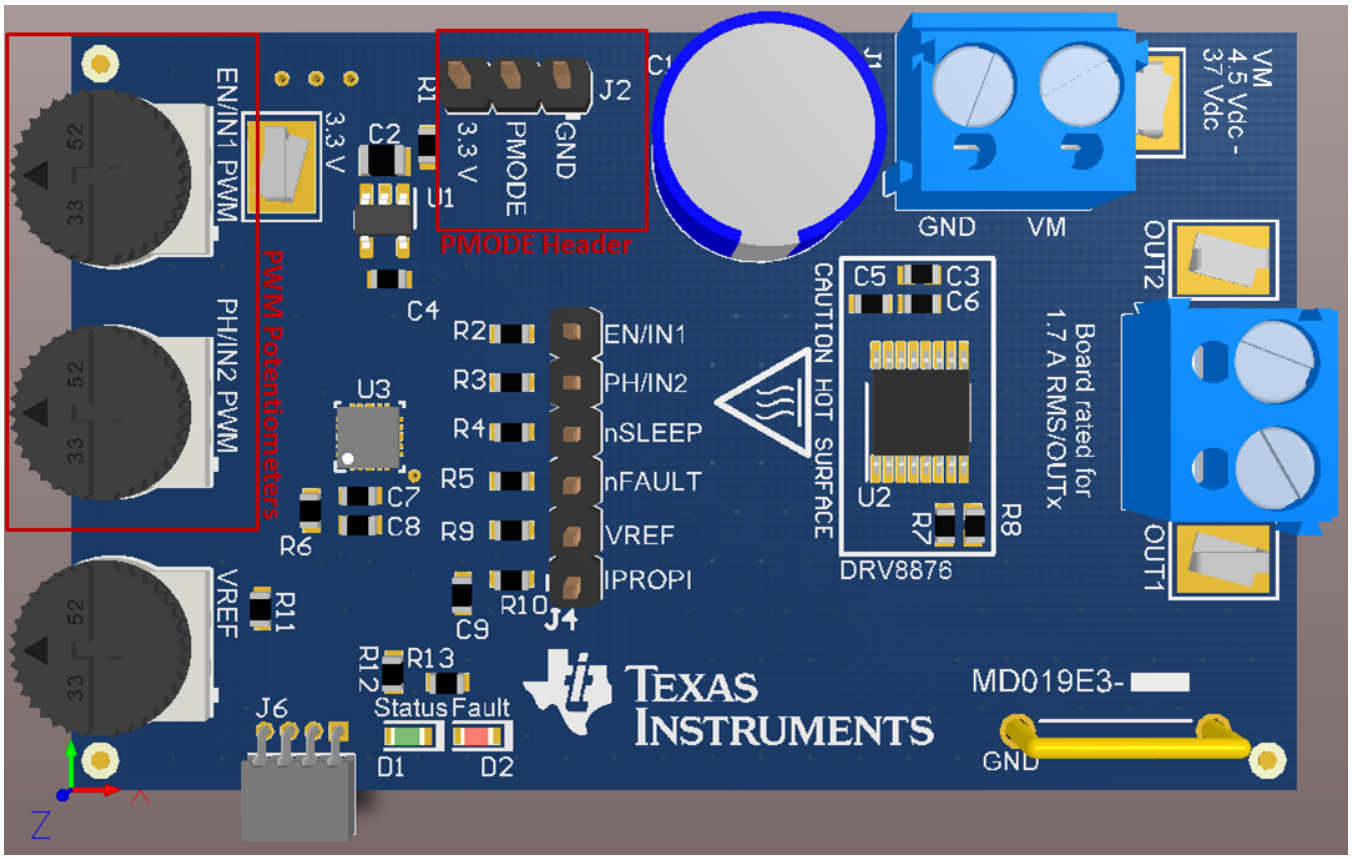

Figure 2. PMODE header and PWM Potentiometers

5.1 PH/EN Control Mode (PMODE = Logic Low)

When the PMODE pin is logic low on power up, the device latches into PH/EN mode (Figure 3). PH/EN mode allows for the H-bridge to be controlled with a speed and direction type of interface. The truth table for PH/EN mode is shown in Table 1. This method is best for bidirectional driving for one motor.

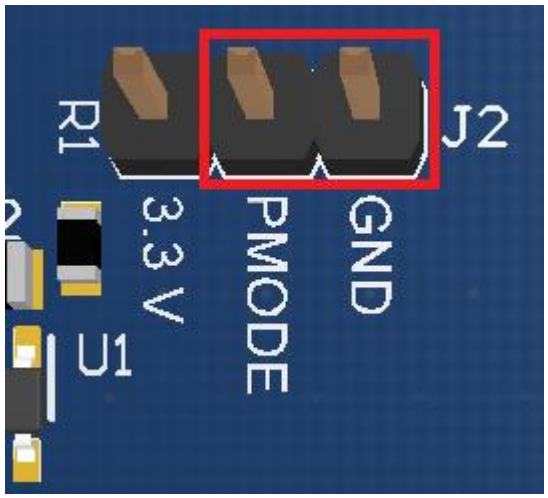

Figure 3. PMODE jumper configuration for PH/EN

Table 1. PH/EN Control Mode

EN	PH	OUT1	OUT2	DESCRIPTION
LOW - turn IN1 PWM Pot completely counterclock wise	X	L	L	Brake, (Low-Side Slow Decay)
PWM - set IN1 PWM pot in any position	LOW - turn IN2 PWM completely counterclock wise	L	H	Reverse (OUT2 → OUT1)
PWM - set IN1 PWM pot in any position	HIGH - turn IN2 PWM completely clockwise	H	L	Forward (OUT1 → OUT2)

5.2 PWM Control Mode (PMODE = Logic High)

When the PMODE pin is logic high on power up, the device latches into PWM mode (Figure 4). PWM mode allows for the H-bridge to enter the Hi-Z state without taking the nSLEEP pin logic low. The truth table for PWM mode is shown in Table 2. This method is best for bidirectional driving for one motor.

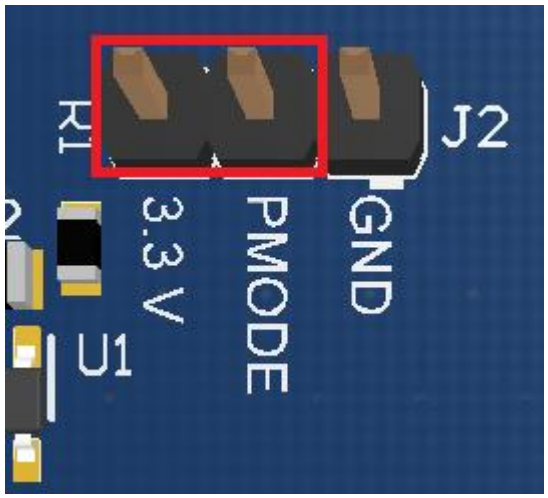

Figure 4. PMODE jumper configuration for PWM

Table 2. PWM Control Mode

IN1	IN2	OUT1	OUT2	DESCRIPTION
LOW - turn IN1 PWM completely counterclock wise	LOW - turn IN2 PWM completely counterclock wise	Hi-Z	Hi-Z	Coast, (H-Bridge Hi-Z)
LOW - turn IN1 PWM completely counterclock wise	PWM - set IN2 PWM pot in any position	L	H	Reverse (OUT2 → OUT1)
PWM - set IN1 PWM pot in any position	LOW - turn IN2 PWM completely counterclock wise	H	L	Forward (OUT1 → OUT2)
HIGH - turn IN1 PWM completely clockwise	HIGH - turn IN2 PWM completely clockwise	L	L	Brake, (Low-Side Slow Decay)

5.3 Independent Half-Bridge Control Mode (PMODE = Hi-Z)

When the PMODE pin is Hi-Z on power up, the device is latched into independent half-bridge control mode. This mode allows for each half-bridge to be directly controlled in order to support high-side slow decay or driving two independent loads. The truth table for independent half-bridge mode is shown in Table 3.

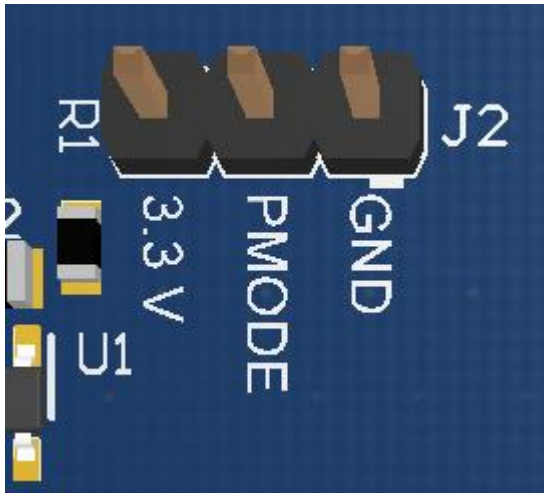

Figure 5. PMODE does not require a jumper for independant half-bridge mode

Table 3. Independent Half-Bridge Control Mode

INx	OUTx	DESCRIPTION
LOW - turn INx PWM completely counterclockwise	L	OUTx Low-Side On
PWM - set IN1 PWM pot in any position	H or PWM	OUTx High-Side On

6 Operation of the EVM

6.1 Dual Motor Operation

This mode allows for up to two motors to be controlled independently. Connect a DC motor across OUT1 and GND. If desired, connect an additional DC motor across OUT2 and GND. To reverse motor direction of one of the motors, replace the connection from that motor to GND with a connection from that motor to VM. This can be done with both motors if desired.

Use the following steps to operate the EVM with up to two motors with single direction speed control:

1. Connect a DC motor across OUT1 and GND. If desired, connect an additional DC motor across OUT2 and GND.
2. Adjust the potentiometer, IN1 PWM, to minimum voltage by turning the wheel counter-clockwise all the way. This minimizes the motor speed of the motor connected across OUT1. If using a second motor, perform this process with potentiometer IN2 PWM as well.
3. Remove the jumper from the PMODE header so the PMODE pin is Hi-Z.
4. Apply power to J1 header
5. Turn potentiometer, IN1 PWM, clockwise and the motor connected across OUT1 starts to turn. Continue adjusting, as desired, until the maximum speed is reached. If using a second motor perform this process with potentiometer IN2 PWM as well.
6. The direction of the motor turning can be reversed, if desired, by removing the connection from GND to the motor and connecting the motor to VM. If this is done, the potentiometer associated with controlling the motor will operate in reverse and thus should be turned all the way clockwise before powering on the board and then slowly turned counter-clockwise to speed up the motor.

6.2 Single Motor Operation

This mode allows for bidirectional control of one motor. Connect a DC motor across OUT1 and OUT2. Reversing direction os now controlled by the potentiometer. This is described in detail in Section 6.2.

Use the following steps to operate the EVM with a signal motor and bidirectional speed control:

1. Connect a motor across OUT1 and OUT2.
2. Use a jumper to connect the PMODE header to 3.3 V or GND to set the input mode to PWM control mode or PH/EN mode respectively.
3. Adjust both potentiometers, IN1 PWM and IN2 PWM, according to the table of the corresponding PMODE setting in Section 5.1.
4. Apply power to J1 header.
5. Control the motor direction and speed by adjusting the potentiometers according to the tables in Section 5.1.

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NOTE:

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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.

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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.

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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 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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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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