TPS62740EVM-186 Evaluation Module

This user's guide describes the characteristics, operation, and use of the Texas Instruments TPS62740 evaluation module (EVM). This EVM is designed to help the user easily evaluate and test the operation and functionality of the TPS62740. The EVM converts a 2.2-V to 5.5-V input voltage to a regulated output voltage that is set between 1.8 V and 3.3 V at up to 300 mA. The TPS62740 also includes a load switch and power good output, while having an ultra-low quiescent current of 360 nA. This user's guide includes setup instructions for the hardware, a printed-circuit board layout for the EVM, a schematic diagram, a bill of materials, and test results for the EVM.

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1 Introduction

The TPS62740 is a 300-mA, synchronous, step-down converter in a 2 x 3-mm, 10-pin SON package. The output voltage is fixed inside the device by the connection of the four VSELx pins.

1.1 Background

The TPS62740EVM-186 (PWR186-001) uses the TPS62740 device. The EVM operates with full-rated performance with an input voltage between 2.2 V and 5.5 V.

1.2 Performance Specification

Table 1 provides a summary of the TPS62740EVM-186 performance specifications. All specifications are given for an ambient temperature of 25°C and an input voltage of 3.6 V.

Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage		2.2	3.6	5.5	V
Output Voltage Setpoint	Programmable through the VSELx pins in 100 mV steps	1.8		3.3	V
Output Current	V_{IN} > 0.7 V + V_{OUT}	0		300	mA
Output Current	V_{IN} < 0.7 V + V_{OUT}	0		100	mA
Peak Efficiency	V_{IN} = 2.2 V; V_{OUT} = 1.8 V		92.5%		
Soft-Start Delay Time	Time from high EN to Start of V_{OUT} Ramp		10		ms

1.3 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate some modifications by the user. Additional input and output capacitors can be added. Finally, the loop response of the IC can be measured.

1.3.1 Input and Output Capacitors

C3 is provided for an additional input capacitor. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple.

C4 and C6 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response. The total output capacitance must remain within the recommended range in the data sheet for proper operation.

1.3.2 Loop Response Measurement

The loop response of the TPS62740EVM-186 can be measured with two simple changes to the circuitry. First, install a 10-Ω resistor across the pads in the middle of the back of the PCB. The pads are spaced to allow installation of an 0402-sized resistor. Second, cut the short section of trace between the via on the VOS pin and the output capacitor C2. This change is shown in Figure 1. With these changes, an ac signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added resistor. Details of measuring the control loop of DCS-Control devices are found in SLVA465.

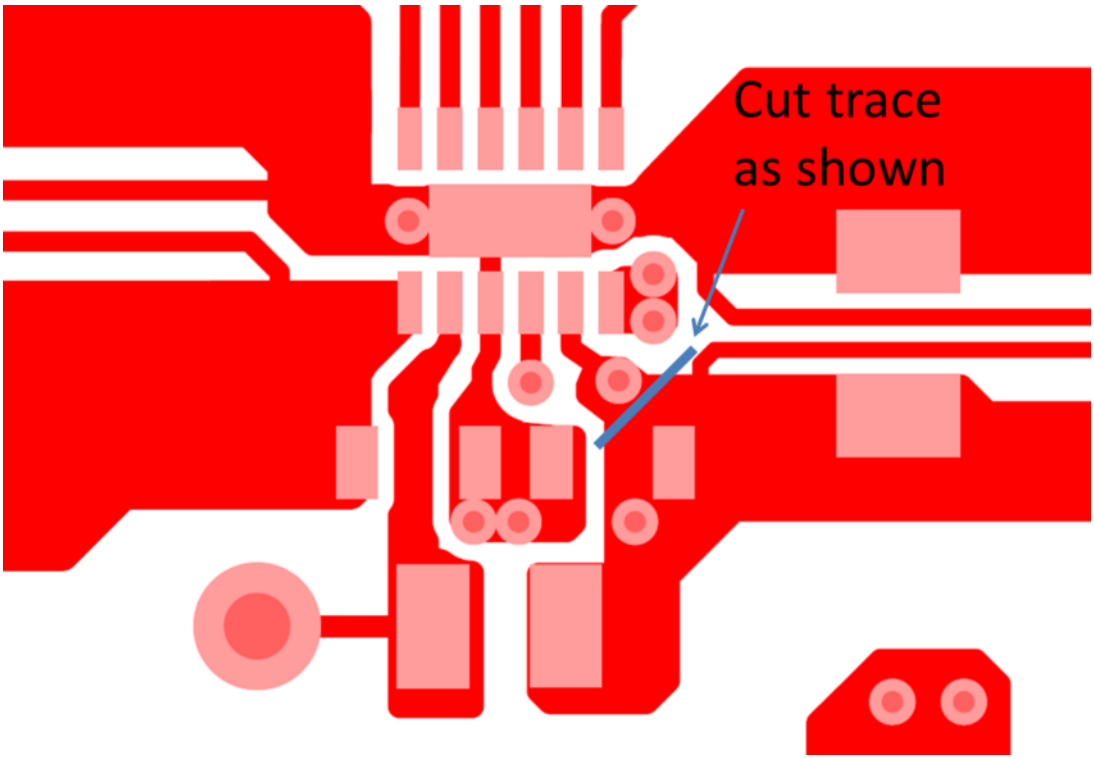

Figure 1. Loop Response Measurement Modification

2 Setup

This section describes how to properly use the TPS62740EVM-186.

2.1 Input/Output Connector Descriptions

J1 – VIN	Positive input connection from the input supply for the EVM.
J2 – S+/S-	Input voltage sense connections. Measure the input voltage at this point.
J3 – GND	Return connection from the input supply for the EVM.
J4 – VOUT	Output voltage connection.
J5 – S+/S-	Output voltage sense connections. Measure the output voltage at this point.
J6 – GND	Output return connection.
J7 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
J8 – LOAD	Load switch output connection.
J9 – S+/S-	Load switch output voltage sense connections. Measure the load switch output voltage at this point.
J10 – GND	Load switch output return connection.
JP1 – EN	EN pin input jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
JP2 – CTRL	CTRL pin input jumper. Place the supplied jumper across LOAD_ON and CTRL to activate (close) the internal load switch. Place the jumper across LOAD_OFF and CTRL to de-activate (open) the internal load switch.
JP3 through JP6 – VSELx	These four inputs set the output voltage. By connecting each pin high or low, the output voltage is programmed per Table 2. Do not leave any jumper open for proper operation.

Table 2 provides the output voltage settings for the TPS62740EVM-186. A 0 refers to logic low, while 1 refers to logic high.

Table 2. Output Voltage Settings

VOUT	VSEL 4	VSEL 3	VSEL 2	VSEL 1
1.8	0	0	0	0
1.9	0	0	0	1
2.0	0	0	1	0
2.1	0	0	1	1
2.2	0	1	0	0
2.3	0	1	0	1
2.4	0	1	1	0
2.5	0	1	1	1
2.6	1	0	0	0
2.7	1	0	0	1
2.8	1	0	1	0
2.9	1	0	1	1
3.0	1	1	0	0
3.1	1	1	0	1
3.2	1	1	1	0
3.3	1	1	1	1

2.2 Setup

To operate the EVM, set jumpers JP1 through JP6 to the desired positions per Section 2.1. Connect the input supply to J1 and J3 and connect the load to J4 and J6.

3 Common Efficiency Measurement Errors with Ultra-Low Iq Devices

Efficiency is a common measurement for a power supply. With an ultra-low quiescent current device, such as the TPS62740, measurement errors can have a large impact on the measured efficiency, especially at very low load currents (< 100 µA).

3.1 Efficiency Measurement Setup

To accurately measure the efficiency of the TPS62740EVM-186, use the setup described in SLVA236 Figure 6. The 'Additional Input Capacitor' referred to in that app note is not needed as C5 is already included on the TPS62740EVM-186. Any additional input capacitance is not recommended as it incurs increased leakage on the input which lowers the measured efficiency.

When measuring efficiency through the setup in SLVA236, special care must be taken to remove the current consumed by the measurement instruments from the efficiency calculations. Such measurement instruments typically include the input voltage and output voltage multimeters as well as the input power supply's remote sense lines (if it has this capability). The current into these points affects the measured efficiency at very light loads. Two possible methods to overcome this are: measuring the current into these points (measure the current into the multimeters and/or remote sense lines) and then subtracting this current from the efficiency calculation or simply removing these instruments from the test setup. At very light load currents, it is typically best to remove the remote sense lines of the input power supply and then measure the current into the input and output voltage multimeters to get the most accurate efficiency measurement.

3.2 Pull-Up and Pull-Down Resistors

In addition to the input capacitor and remote sense lines noted in Section 3.1, any pull-up or pull-down resistors can draw significant current and affect the measured efficiency. For example, if the VSEL2 pin were pulled up to the input voltage with a 1-MΩ resistor and the pin were tied low through JP4, this would draw an extra 3.6 µA from the input source at a 3.6-V input voltage. This would greatly affect the efficiency at very light loads. For this reason, no pull-up or pull-down resistors have been used on the TPS62740EVM-186. The final application circuit should ensure that all digital inputs to the TPS62740 are terminated either high or low and not left floating, per the device data sheet.

4 TPS62740EVM-186 Test Results

The TPS62740EVM-186 was used to take most of the data in the TPS62740 data sheet, SLVSB02. The only difference is the inductor used. This EVM was designed for the smallest solution size and uses a 0805-size inductor. The data sheet inductor achieves best efficiency but is 3 x 3 mm in size.

5 Board Layout

This section provides the TPS62740EVM-186 board layout and illustrations. The gerbers are available on the EVM product page: TPS62740EVM-186.

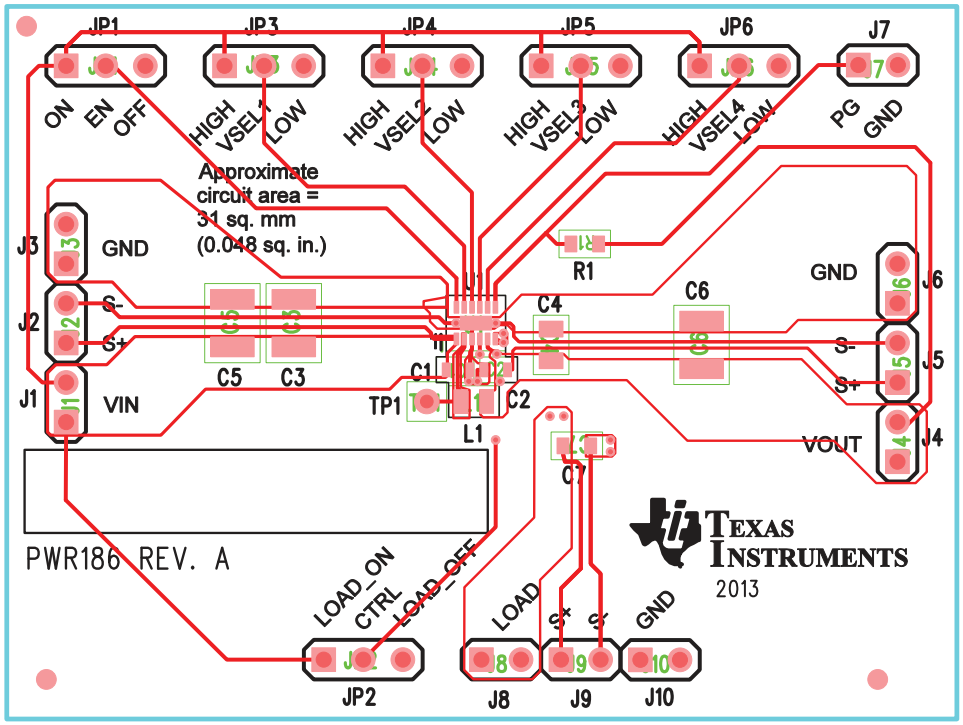

Figure 2. Assembly Layer

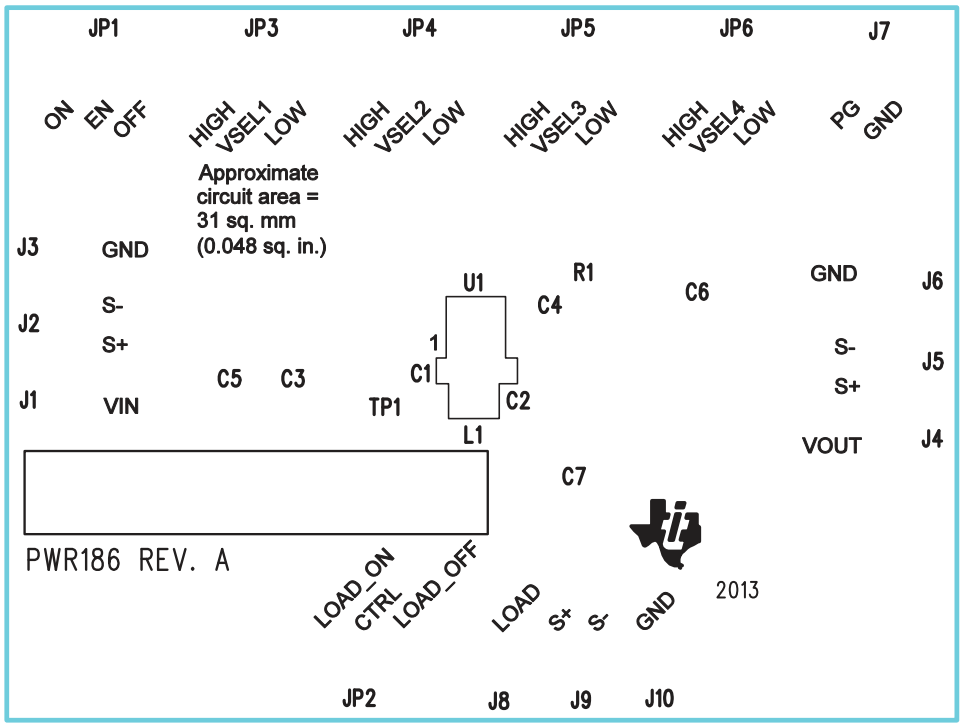

Figure 3. Top Silk Layer

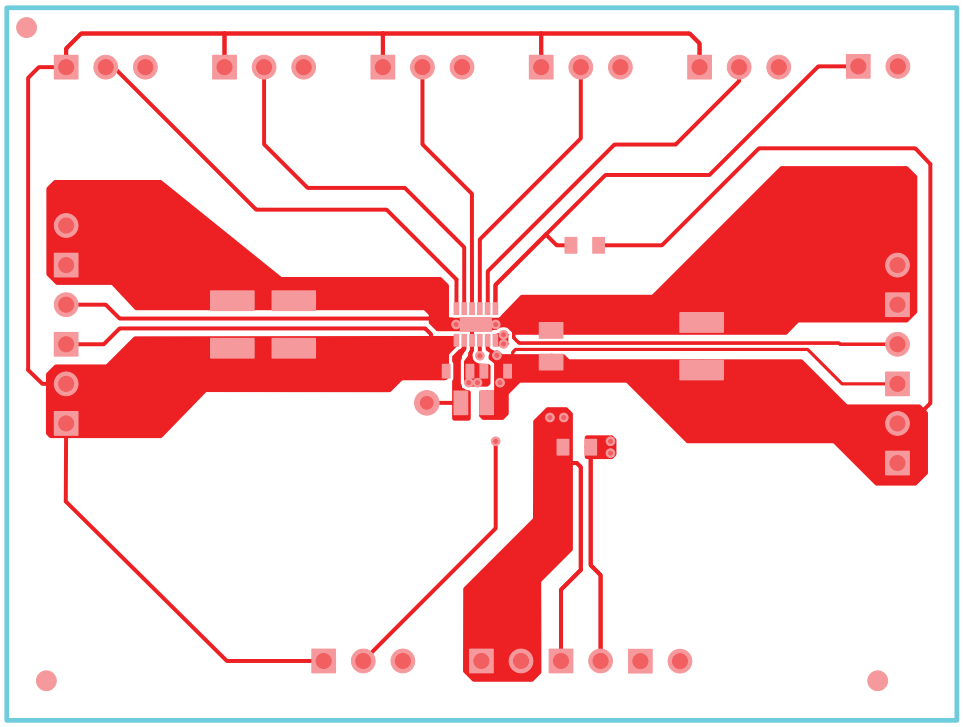

Figure 4. Top Layer

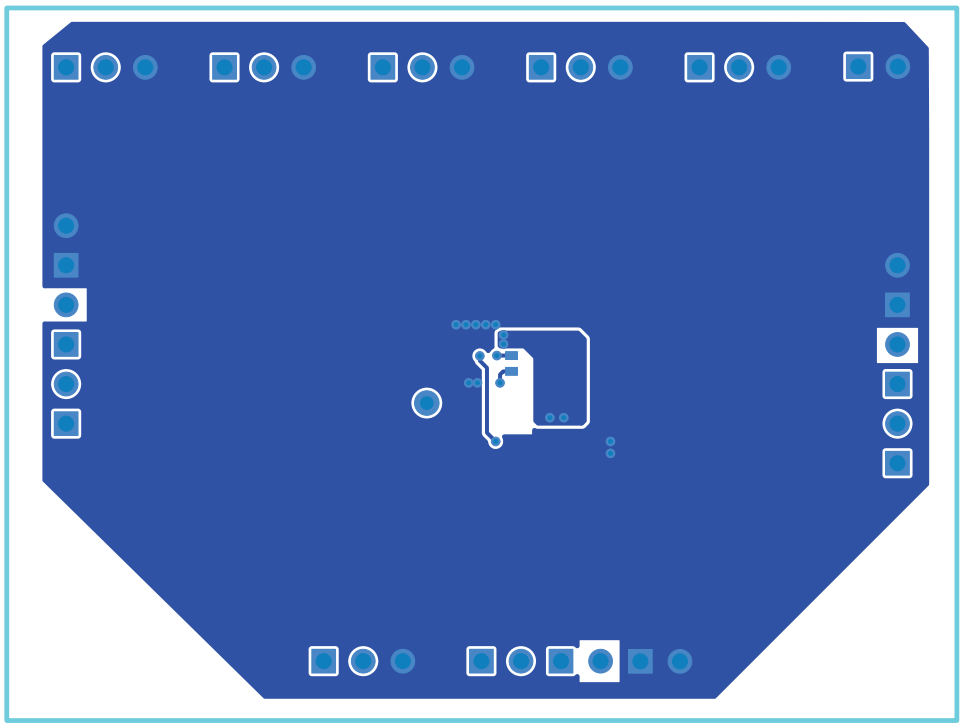

Figure 5. Bottom Layer

6 Schematic and Bill of Materials

This section provides the TPS62740EVM-186 schematic and bill of materials.

6.1 Schematic

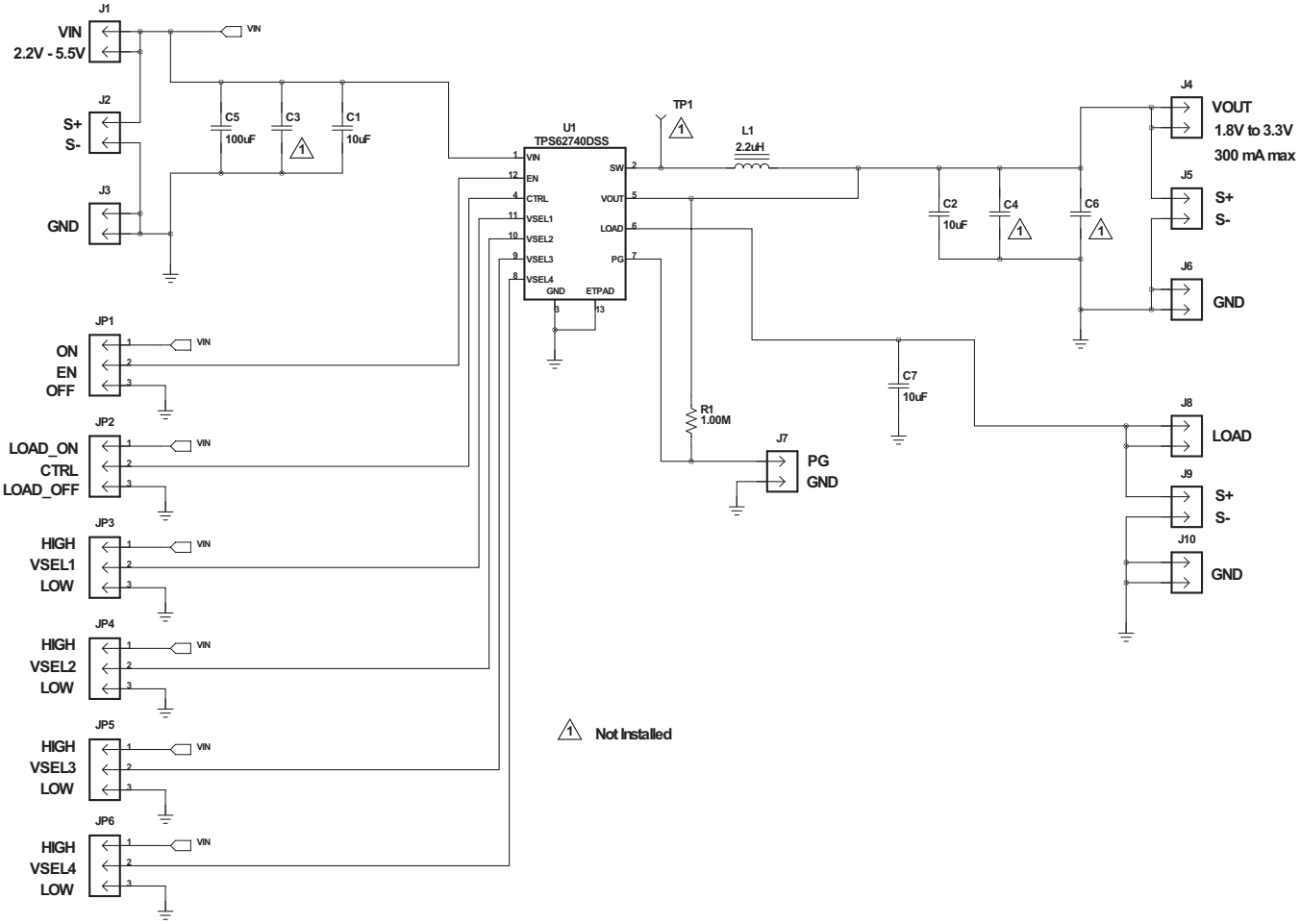

Figure 6. TPS62740EVM-186 Schematic

6.2 Bill of Materials

Table 3. TPS62740EVM-186 Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
3	C1, C2, C7	10uF	Capacitor, Ceramic, X5R, 6.3V, 20%	0603	GRM188R60J106ME84D	Murata
1	C5	100uF	Capacitor, Ceramic, X5R, 6.3V, 20%	1210	GRM32ER60J107ME20L	Murata
1	L1	2.2uH	Inductor, SMT, 0.7A, 230-mΩ	0805	MIPSZ2012D2R2	FDK
1	R1	1.00M	Resistor, Chip, 1/16W, 1%	0603	RC0603FR-071ML	Yageo
1	U1	TPS62740	IC, 360 nA I_Q Step Down Converter	2 mm x 3 mm	TPS62740DSS	TI

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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.

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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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- 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.

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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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