TPS92511EVM Evaluation Module

The TPS92511EVM evaluation module (EVM) helps designers evaluate the TPS92511 application circuit which drives a single LED string of 38 V with a current of 0.5 A. The TPS92511 is a constant-current LED driver that features a wide input voltage range, low component count (integrated MOSFET and sensing resistor), programmable switching frequency and LED current, and LED dimming. Only a few extra components are required if the EVM is designed for the EN 55022 class B standards.

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1 Detailed Description

The TPS92511EVM employs a floating buck topology and a proprietary Pulse-Level-Modulation control method for driving a single LED string. It is designed for the following specifications:

- Input voltage V_{IN} range: 43 V to 53 V, nominal 48 V
- Number of LEDs = 12
- LED string voltage = 38 V
- LED current I_{LED} = 0.5 A
- Switching frequency f_{SW} = 300 kHz

1.1 Typical Applications

The EVM is designed for the specifications listed in Section 1. For applications with a different input voltage and LED string voltage and current, please refer to the TPS92511 datasheet (SNVS901).

1.2 Connection Descriptions

This section describes the terminals and test points on the EVM.

1.2.1 VIN, PGND

These two terminals connect to a DC power supply with a nominal output voltage of 48 V dc. The leads to the supply should be keep short to minimize voltage drop, inductance and noise. Additional bulk capacitance between the VIN and GND pins should be considered if the leads are long.

1.2.2 LED+, LED-

These two terminals connect to an LED string of 12 LEDs with a string voltage of typically 38 V. The anode and cathode of the LED string should be connected to LED+ and LED–, respectively.

1.2.3 DIM

This terminal directly connects to the DIM pin of the TPS92511. Connecting this terminal to an external signal generator which provides a PWM dimming signal, implements PWM dimming. Pulling the terminal to ground stops the switching of the integrated MOSFET of the TPS92511 and as a result, turns off the LED string. The DIM pin is internally pulled high, therefore, leaving the terminal open turns on the LED string.

1.2.4 GND

This terminal provides a ground connection. Ground leads for signal generators or voltage probes may be connected to this terminal.

1.2.5 TP1

This test point is connected to the LX pin of the TPS92511. Probing the test point can monitor the switching node waveform.

2 Electrical Performance Specifications

The TPS92511EVM electrical performance specifications are detailed in Table 1.

Table 1. TPS92511EVM Electrical Performance Specifications

Parameter	Test Conditions	MIN	TYP	MAX	Units
Input Characteristics					
Input voltage V_{IN}		43	48	53	V
Input current I_{IN}	At V_{IN} = 48 V, I_{LED} = 0.5 A		0.42		A
Output Characteristics					
LED string voltage V_{LED}	At I_{LED} = 0.5 A		38		V
LED current, I_{LED}		480	500	520	mA
LED current regulation	Input voltage = 43 V to 53 V	–4		4	%
Systems Characteristics					
Switching frequency f_{SW}			300		kHz
Efficiency			95		%

3 TPS92511EVM Schematic

The TPS92511EVM schematic is illustrated in Figure 1.

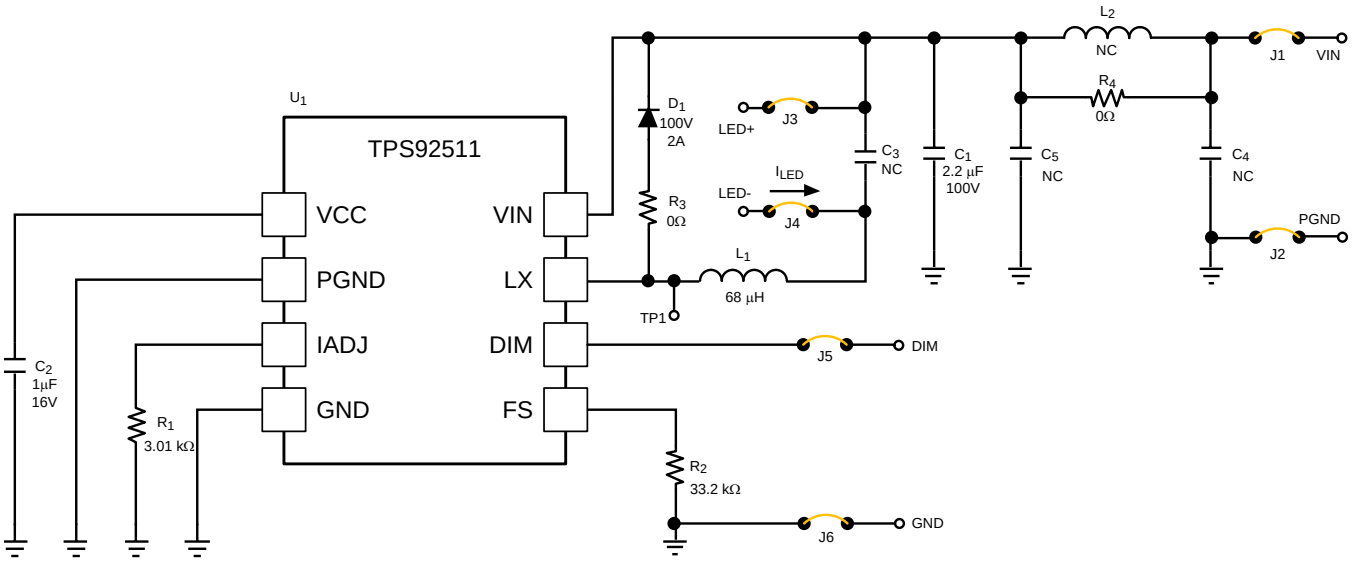

Figure 1. TPS92511EVM Schematic

4 Performance Data and Typical Characteristic Curves

Figure 2 through Figure 9 show typical performance curves for the TPS92511EVM.

4.1 Efficiency

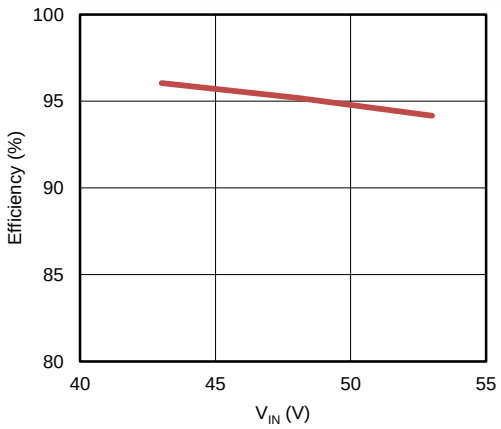

Figure 2. Efficiency

4.2 Line Regulation

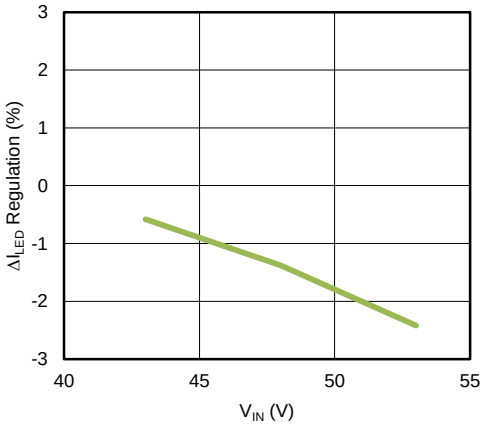

Figure 3. Line Regulation

4.3 Switch Node Voltage and LED Current Ripple

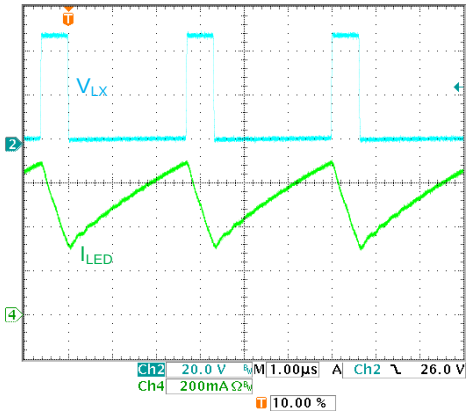

Figure 4. Switching and LED Current

4.4 PWM Dimming

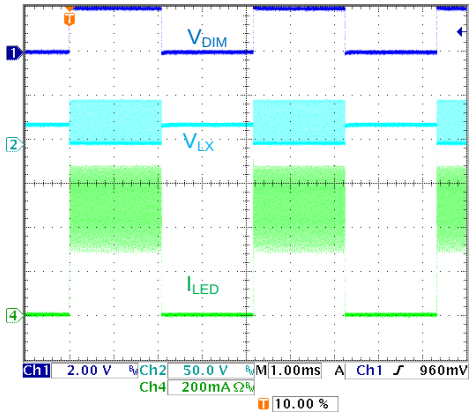

Figure 5. PWM Dimming, f_{PWM} = 240 Hz, Duty Cycle = 50%

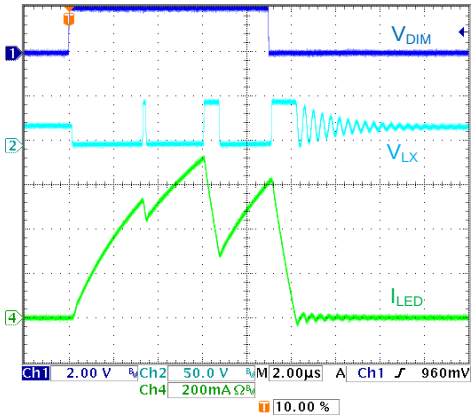

Figure 6. PWM Dimming, f_{PWM} = 240 Hz, Pulse Width = 9 µs

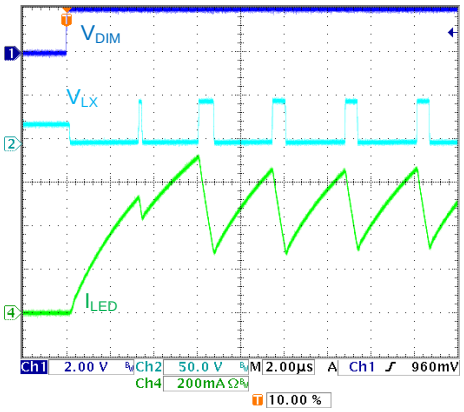

Figure 7. PWM Dimming, f_{PWM} = 240 Hz, Pulse Width = 500 µs

4.5 Start-up and Shut-down Response

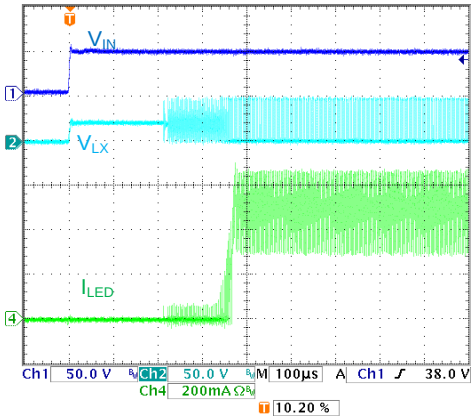

Figure 8. Start-up Waveform

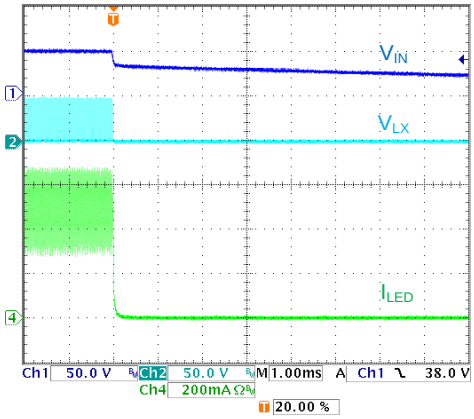

Figure 9. Shut-down Waveform

4.6 EMI Performance

Figure 10 and Figure 11 show the EMI performance of the TPS92511EVM with an input voltage of 48 V. As compared to Figure 1, the following components are modified:

- L_2: 10-µH, 0.8-A CDH3D13SHPNP-100MC
- C_4, C_5: 2.2-µF, 100-V GRM32ER72A225KA35L
- C_3: 1-µF, 50-V GRM188R61H105KAAL
- R_3: ferrite bean, 100-Ω at 100-MHz BLM18EG101TN1
- R_4: NC

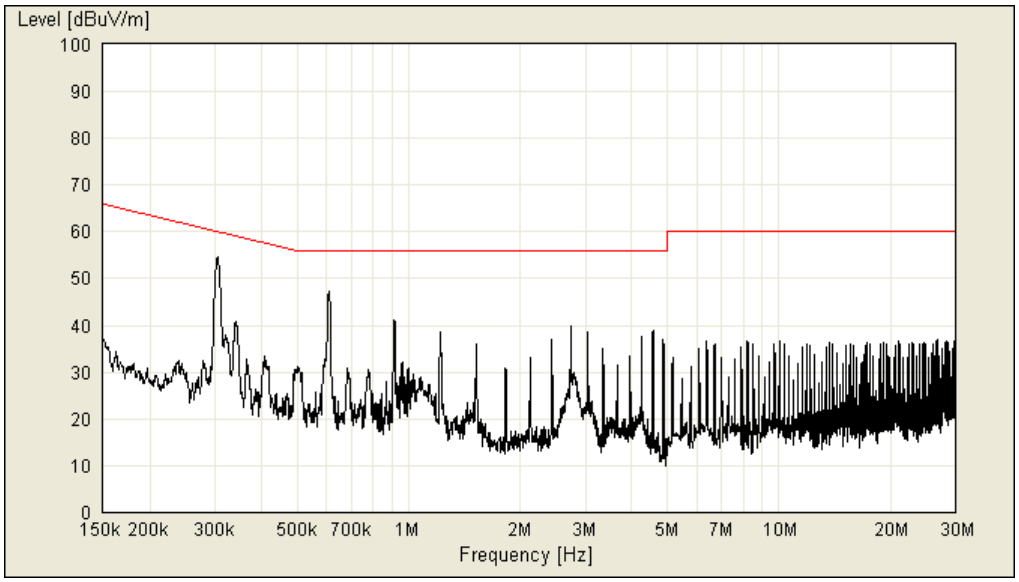

Figure 10. Peak Conductive EMI per EN55022 Class B Limits (Live)

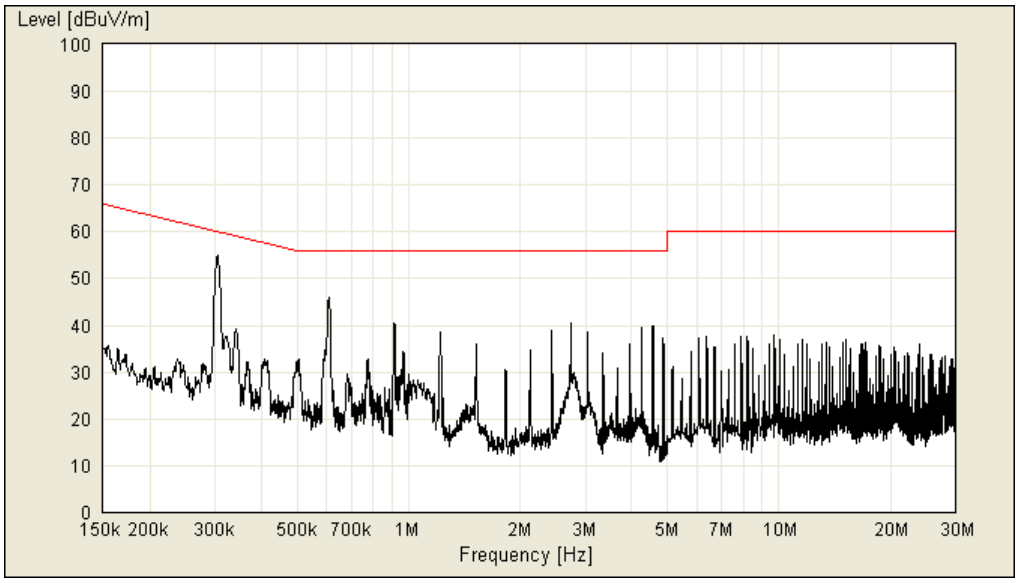

Figure 11. Peak Conductive EMI per EN55022 Class B Limits (Neutral)

5 TPS92511EVM PCB layout

Figure 12 and Figure 13 show the design of the TPS92511EVM printed circuit board.

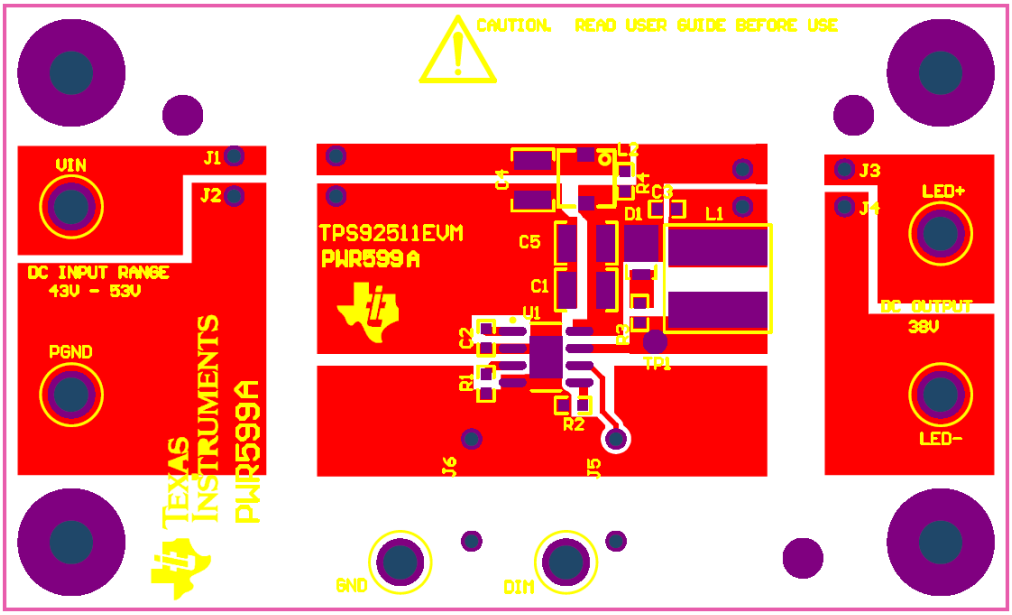

Figure 12. Top Layer and Top Overlay (Top View)

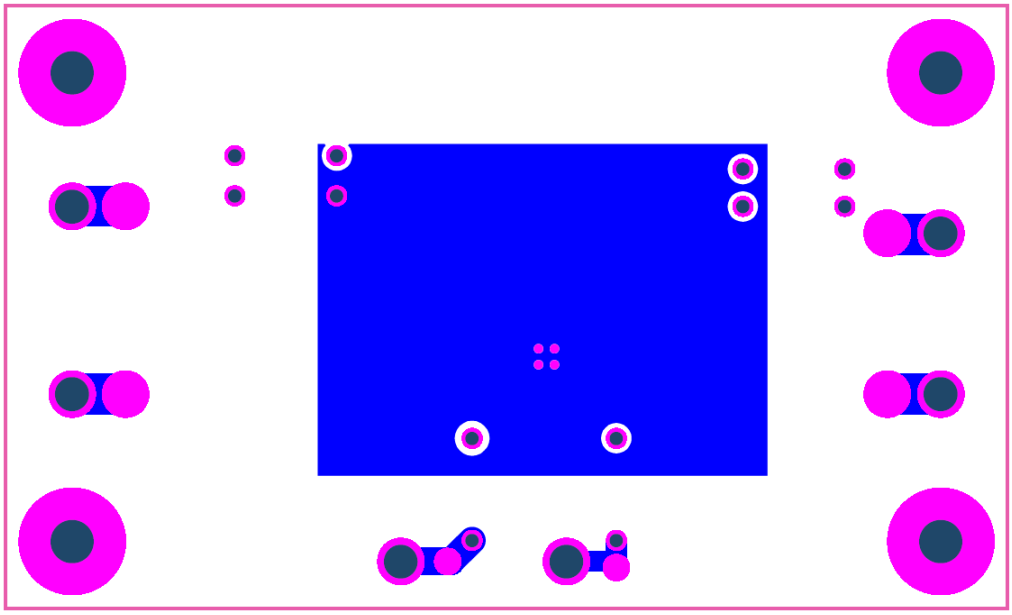

Figure 13. Bottom Layer and Bottom Overlay (Bottom View)

6 Bill of Materials

Table 2 lists the TPS92511EVM BOM.

Table 2. The TPS92511EVM Components List

Reference Designator	QTY	Value	Description	Size	MFR	Part Number
U1	1		TPS92511	DDA-8	TI	TPS92511DDA
C1	1	2.2 µF	Capacitor, Ceramic, 100 V, X7R	1210	muRata	GRM32ER72A225KA35L
C2	1	1 µF	Capacitor, Ceramic, 10V, X7R	0603	muRata	GRM55ER71H475MA01L
D1	1		Diode, Schottky, 100V, 2A	DO-220AA	Vishay	SS2PH10-M3
L1	1	68 µH	Inductor, Shielded Drum Core, Ferrite, 68 µH, 0.75A, 0.173Ω	6.7 mm x 3.8 mm x 6.7 mm	Sumida	CDRH6D38NP-680NC
R1	1	3.01 kΩ	Resistor, 1%, 0.1W	0603	Vishay-Dale	CRCW06033K01FKEA
R2	1	33.2 kΩ	Resistor, 1%, 0.1W	0603	Vishay-Dale	CRCW060333K2FKEA
R3, R4	2	0Ω	Resistor, 1%, 0.1W	0603	Vishay-Dale	CRCW06030000Z0EA
VIN, PGND, LED+, LED-, DIM, GND	6		Terminal, Turret, TH, Double	Keystone 1502-2	Keystone	1502-2
J1, J2, J3, J4, J5, J6	6		Jumper Wire, 300mil spacing, Orange, pkg of 200	300 mil Jumper Wire	3M	923345-03-C
C3, C4, C5	0		NC			
L2	0		NC			

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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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- *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*

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This device complies with Industry Canada license-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.

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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.

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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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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