User's Guide
SNVU569–June 2017

TPSM84203, TPSM84205, TPSM84212, Power Module Evaluation Module

This user's guide contains information for the TPSM84203EVM-888, TPSM84205EVM-888, and TPSM84212EVM-888 evaluation module (PWR888). Also included are the performance specifications, schematic, bill of materials, and layout of the EVM.

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Trademarks

1 Description

The TPSM84203, TPSM84205, and TPSM84212 are highly integrated, synchronous buck power modules that combine a 1.5-A DC/DC converter with power MOSFETs, a shielded inductor, some input and output capacitors, and passives into a 3-pin TO-220 footprint compatible package. The input voltage range is 4.5 V to 28 V. The output voltage is a fixed 3.3 V, 5.0 V, or 12.0 V.

This evaluation module is designed to demonstrate the ease-of-use and small printed circuit board area that may be achieved when designing with these power modules. Monitoring test points are provided to allow measurement of efficiency, power dissipation, input ripple, output ripple, line and load regulation, and transient response. The EVM uses a recommended PCB layout that maximizes thermal performance and minimizes output ripple and noise.

2 Getting Started

Figure 1 highlights the user interface items associated with the EVM. The polarized input power terminal block (J1) is used for connection to the host input supply. The polarized output power terminal block (J4) is used for connection to the load. These terminal blocks can accept up to 14 AWG wire.

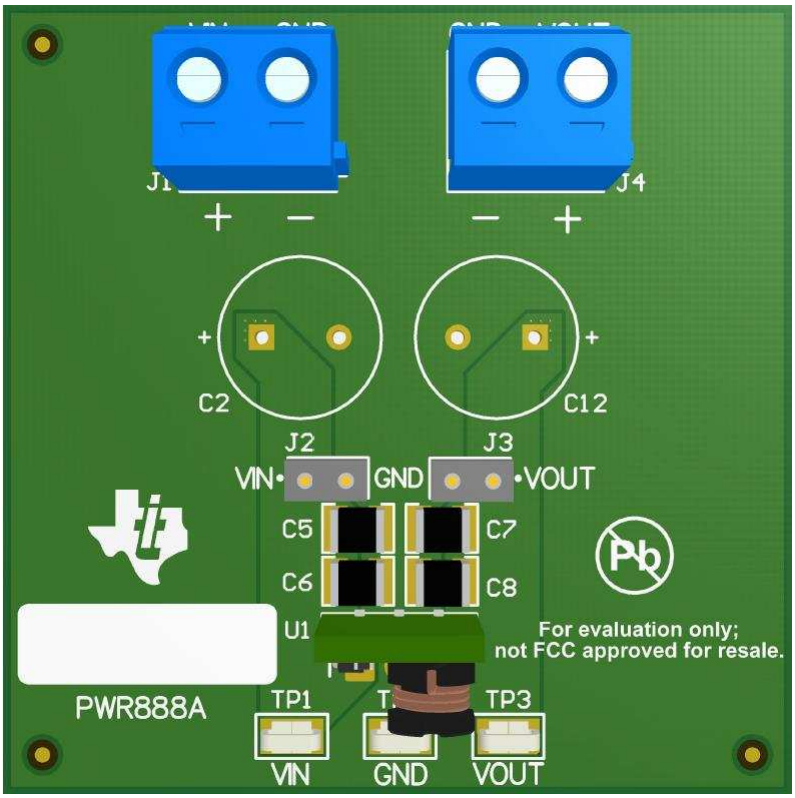

Figure 1. EVM User Interface

The VIN, GND, and VOUT Monitor test points (TP1, TP2, and TP3) located along the bottom edge of the PCB are intended to be used as voltage monitoring points where voltmeters can be connected to measure the input and output voltages. Do not use these VIN and VOUT monitoring test points as the input supply or output load connection points. The PCB traces connecting to these test points are not designed to support high currents.

The VIN Scope (J2) and VOUT Scope (J3) test points can be used to monitor VIN and VOUT waveforms with an oscilloscope. These test points are intended for use with un-hooded scope probes outfitted with a low-inductance ground lead (ground spring) mounted to the scope probe barrel. The two sockets of each test point are on 0.1 inch centers. The scope probe tip must be inserted into the socket labeled VIN or VOUT, and the scope probe ground lead must be inserted into the hole of the socket labeled GND.

The EVM is shipped with both input and output capacitance loaded on the board. Locations are provided on the board to add additional input and output capacitance. There are also pads on the bottom side of the EVM to add filters to the input or output if required.

NOTE: Refer to the product datasheet (TPS51367-1, SLVSCV7) for recommended operating conditions and absolute maximum ratings associated with this device.

3 Test Point Descriptions

Wire-loop test points and scope probe test points are provided as convenient connection points for digital voltmeters (DVM) or oscilloscope probes to aid in the evaluation of the device. A description of each test point follows:

Table 1. Test Points

VIN (TP1)	Input voltage monitor. Connect DVM across this point and PGND for measuring efficiency.
VOUT (TP3)	Output voltage monitor. Connect DVM to this point and PGND for measuring efficiency.
GND (TP2)	Input and output voltage monitor grounds. Reference the VIN and VOUT DVMs to these ground points.
VIN MON (J2)	Input voltage scope monitor. Connect an oscilloscope to this set of points to measure input ripple voltage.
VOUT MON (J3)	Output voltage scope monitor. Connect an oscilloscope to this set of points to measure output ripple voltage and transient response.

4 Operation Notes

To operate the EVM, apply a valid input voltage. For the TPSM84203, the input voltage range is 4.5 V to 28 V. For the TPSM84205, the input voltage range is 7.0 V to 28 V. For the TPSM84212, the input voltage range is 14.5 V to 28 V. The power supply providing the input voltage must be rated for sufficient input current.

The TPSM84203, TPSM84205, and TPSM84212 are all 1.5-A devices. When connecting the EVM to the external load, use wiring capable of safely handling 1.5 A of output current.

The EVM includes both input and output capacitors. The EVM includes footprints for adding additional input and output capacitors to the EVM. Adding additional capacitance will improve transient response. The actual capacitance required will depend on the input and output voltage conditions of the particular application, along with the desired transient response. Refer to the product datasheet for further information on input and output capacitance and transient response.

Additionally, the bottom of the board includes footprints for adding additional filtering components to both the input and output. By removing resistors R1 and R2, a filter inductor or bead can be placed on the larger pads along side R1 and R2 and the pads for C1 and C11 can be used to add an additional capacitor.

5 Performance Data

V_{IN} = 12 V, F_{sw} = 500 kHz, C_{OUT} = 4x 47 µF ceramic plus 2x 470 µF polymer

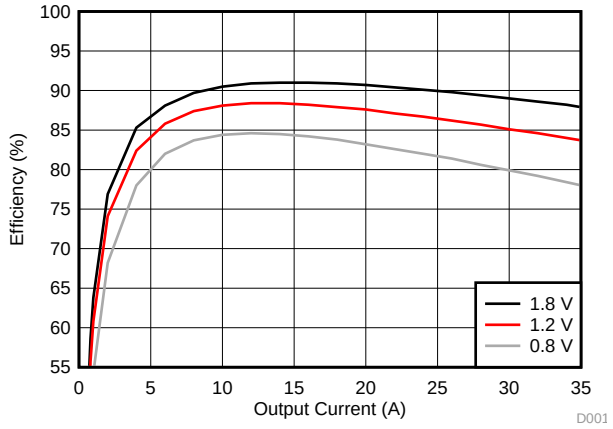

Figure 2. Efficiency

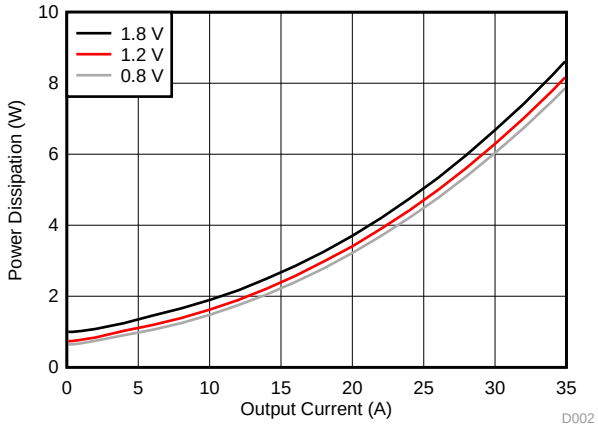

Figure 3. Power Dissipation

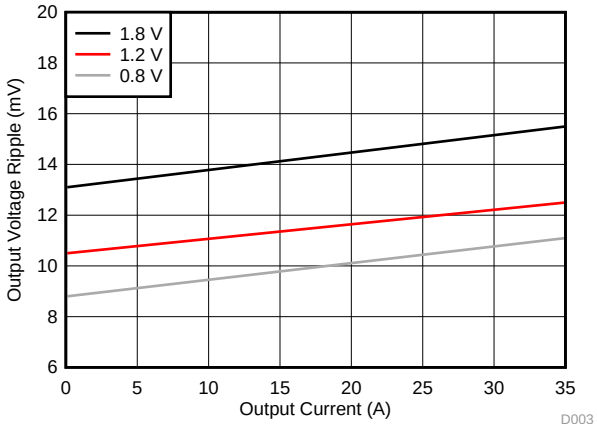

Figure 4. Output Voltage Ripple

6 Schematic

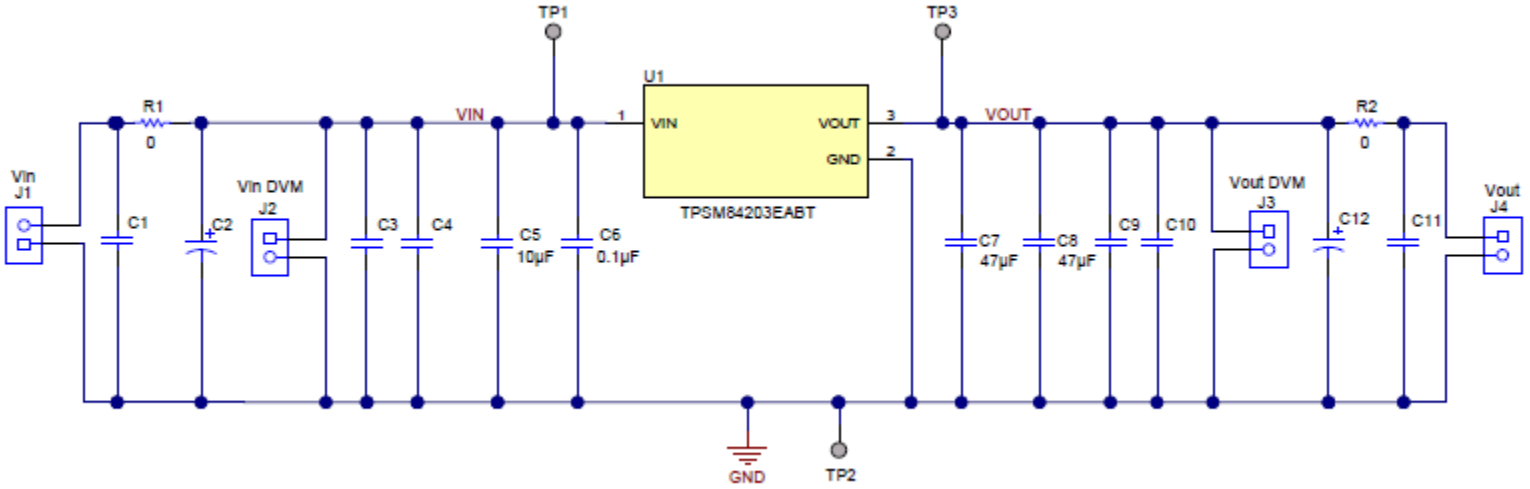

Figure 5. TPSM842xxEVM Schematic

7 Bill of Material

Table 2. TPSM842xxEVM-888 Bill of Material

DESIGNATOR	QUANTITY	DESCRIPTION	PART NUMBER	MANUFACTURER
PCB	1	Printed Circuit Board	PWR888	Any
U1	1	3.3 V Output, 1.5 A Power Module	TPSM84203EAB	Texas Instruments
		5.0 V Output, 1.5 A Power Module	TPSM84205EAB	
		12.0 V Output, 1.5 A Power Module	TPSM84212EAB	
C5	1	CAP, CERM, 10 µF, 50 V, +/- 20%, X7R, 1210	GRM32ER71H106MA12	MuRata
C6	1	CAP, CERM, 0.1 µF, 250 V, +/- 10%, X7R, 1210	GRM32DR72E104KW01L	MuRata
C7, C8	2	CAP, CERM, 47 µF, 16 V, +/- 20%, X5R, 1210	GRM32ER61C476ME15L	MuRata
J1, J4	2	Terminal Block, 5.08 mm, 2x1, Brass, TH	ED120/2DS	On-Shore Technology
J2, J3	2	Socket Strip, 2x1, 100mil, Black, Tin, TH	310-43-102-41-001000	Mill-Max
R1, R2	2	RES, 0, 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
TP1, TP2, TP3	3	Test Point, Miniature, SMT	5019	Keystone
C1, C3, C4, C9, C10, C11	0	CAP, CERM, 1210	1210	Any
C2, C12	0	CAP, AL, TH	D10xL16mm	Any

8 PCB Layout

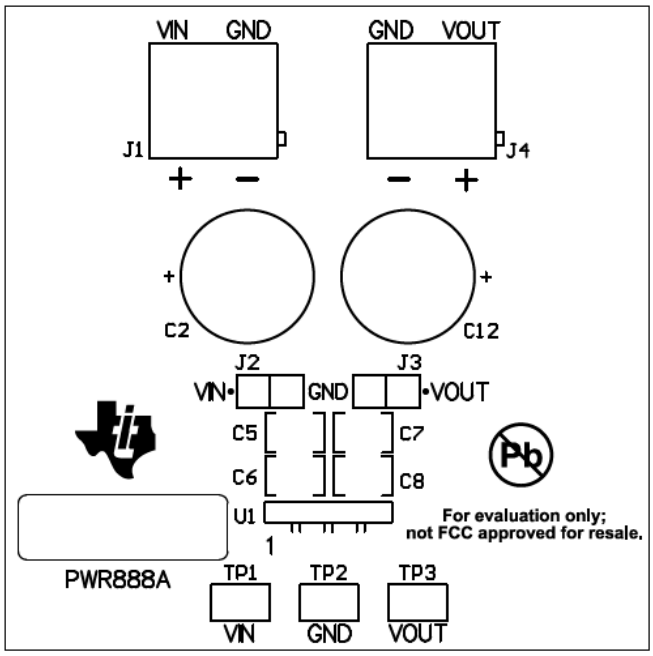

Figure 6. Top Components (Top View)

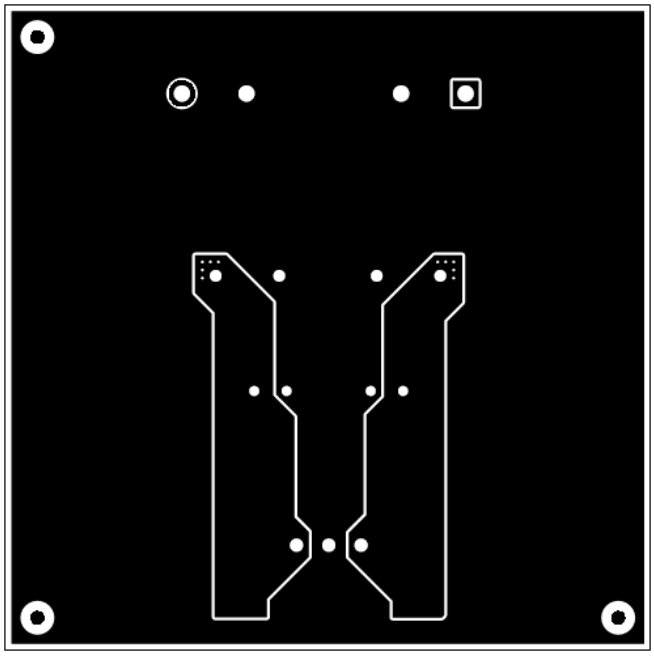

Figure 7. Topside Copper (Top View)

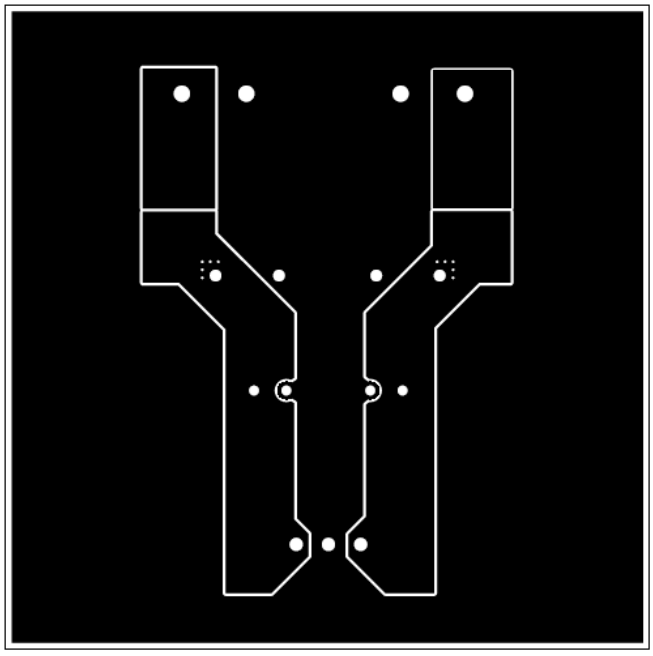

Figure 8. Bottomside Copper (Top View)

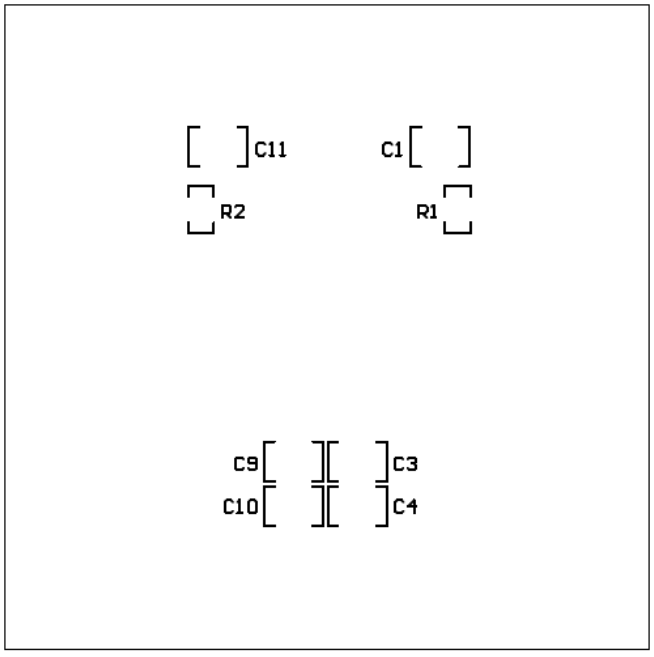

Figure 9. Bottom Components (Bottom View)

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

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

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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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10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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