EVM User's Guide: TPS7H3024EVM-CVAL

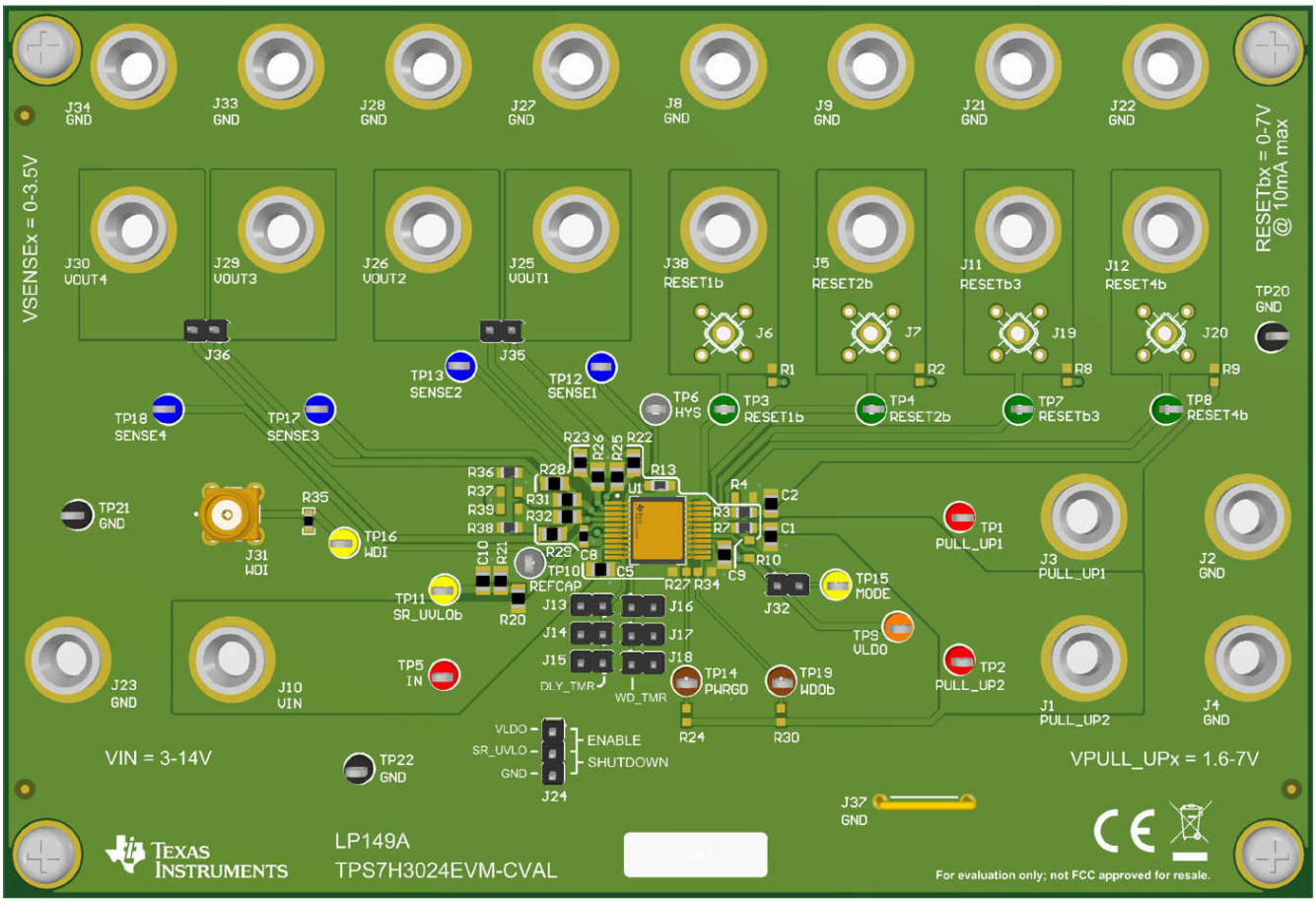
TPS7H3024EVM-CVAL Evaluation Module (EVM)

Description

The TPS7H3024EVM-CVAL demonstrates the operation of a single TPS7H3024-SP supervisor (ceramic package). The board provides footprints that can be populated with additional components to allow for testing of customized configurations.

Features

- Flexible configuration options, including capability to sense negative rails
- Customizable timers, sense thresholds, sense hysteresis, sense mode selection, and turn on/off thresholds



EVM Board

1 Evaluation Module Overview

1.1 Introduction

The TPS7H3024EVM-CVAL is the Evaluation Module (EVM) for the ceramic package option of the TPS7H3024 and provides a platform to electrically evaluate its features. This user's guide provides details about the EVM, including the configuration, schematics, and BOM.

The EVM is designed to provide flexibility in configuring the device under different conditions, through footprints for external components and multiple connection options for monitored external rails and RESETb signal outputs. By default, the device on the EVM is configured as shown in TPS7H3024EVM-CVAL Default Configuration and Default EVM Schematic. To configure the device in a different configuration, please refer to the TPS7H3024 data sheet to calculate the values of the passives around the device that needs to be changed.

1.2 Kit Contents

- EVM board (1)
- EVM Kit User Guide (1)

1.3 Specification

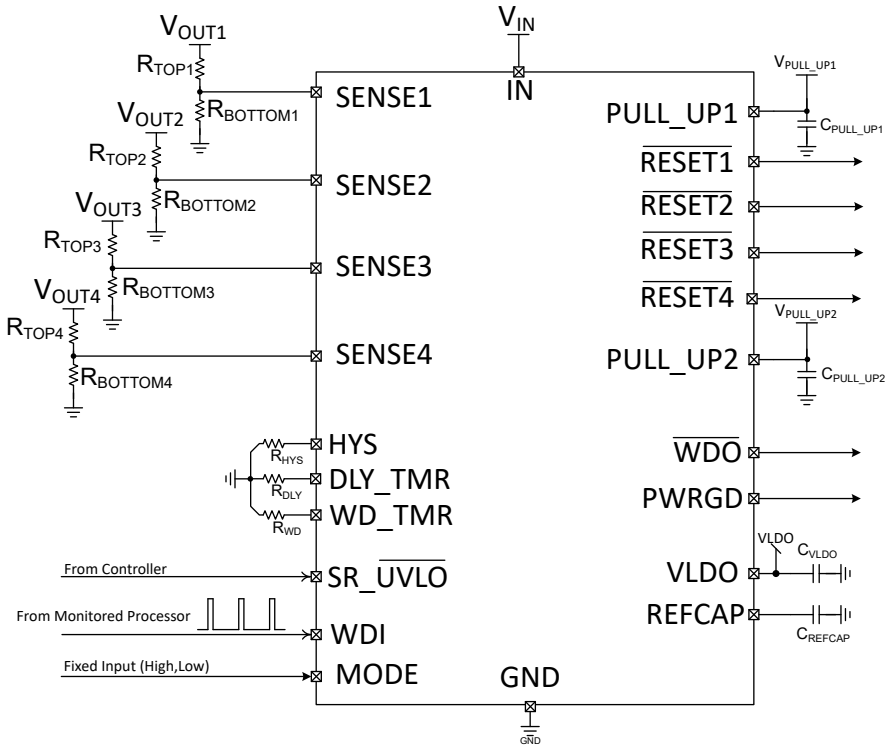


Figure 1-1. Default Configuration Simplified Schematic

Table 1-1. Default EVM Configuration

Specification	Value	Description
Input Voltage VIN	12V	Falls within the recommended device input voltage range of 3V to 14V.
Turn On Threshold	10.3V	VIN rising/falling value that turns the device ON/OFF. Set by: R20 = 10 kΩ R21 = 620 Ω
Turn Off Threshold	8.6V	
PULL_UP1 Voltage	1.8V	Voltage used by all RESETb outputs. Falls within the recommended device input voltage range of 1.6V to 7V.

Table 1-1. Default EVM Configuration (continued)

Specification	Value	Description
PULL_UP2 Voltage	1.8V	Voltage used by WDOb and PWRGD outputs. Falls within the recommended device input voltage range of 1.6V to 7V.
VOUT1 VRISE Threshold	2.22V (89 % of 2.5V)	Rising and falling voltage thresholds where the monitored VOUT rail is considered IN or OUT of regulation, respectively. Set by: R22 = 5.17 kΩ R25 = 1.91 kΩ
VOUT1 VFALL Threshold	2.10V (84 % of 2.5V)	
VOUT2 VRISE Threshold	3.46 V (105 % of 3.3V)	Rising and falling voltage thresholds where the monitored VOUT rail is considered IN or OUT of regulation, respectively. Set by: R23 = 5.49 kΩ R26 = 1.15 kΩ
VOUT2 VFALL Threshold	3.33 V (101 % of 3.3V)	
VOUT3 VRISE Threshold	0.79 V (99 % of 0.8V)	Rising and falling voltage thresholds where the monitored VOUT rail is considered IN or OUT of regulation, respectively. Set by: R28 = 1.33 kΩ R31 = 4.12 kΩ
VOUT3 VFALL Threshold	0.76 V (95 % of 0.8V)	
VOUT4 VRISE Threshold	1.99 V (111 % of 1.8V)	Rising and falling voltage thresholds where the monitored VOUT rail is considered IN or OUT of regulation, respectively. Set by: R29 = 3.74 kΩ R32 = 1.62 kΩ
VOUT4 VFALL Threshold	1.90 V (106 % of 1.8V)	
RESETb Delay Time tDLY_TMR	12.5 ms	Programmable time delay between when the condition for a RESETb signal to go HIGH is met and when the signal actually transitions. Set by: R15 = 619 kΩ J14 shunted
Watchdog Timer tWD_TMR	1 s	Programmable timer that sets the amount of time allowed netween rising edges sensed at the WDI pin in order for WDOb to remain HIGH. If the timer expires, the WDOb output will go low until the next sensed rising edge at WDI. Set by: R18 = 118 kΩ J17 shunted

1.3.1 Alternate Board Configurations

The TPS7H3024EVM-CVAL board allows Channel 3 and 4 to be configured for sensing negative rails. This is done by removing a 0-ohm resistor that connects from the SENSEx resistor dividers to GND and replacing it with a 0-ohm resistor that instead sets VLDO as the reference. The datasheet contains more detailed information and equations for how to select appropriate resistor values when using this configuration.

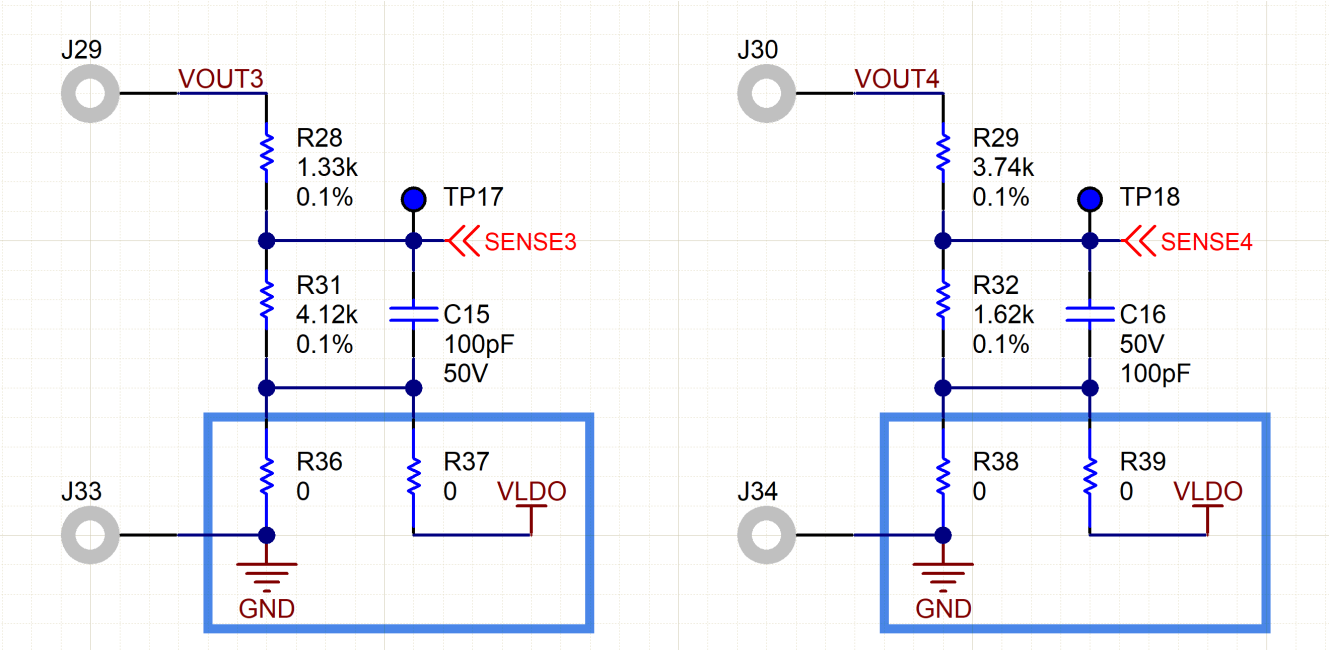


Figure 1-2. Negative Rail Sensing Circuitry

1.4 Device Information

The TPS7H3024 is an integrated, 3V to 14V, four-channel radiation-hardness-assured power-supply supervisor with watchdog. An accurate 599.7mV ± 1% threshold voltage and a 599.7mV ± 3% hysteresis current provide programmable monitoring voltages. A global programmable delay timer is programmed via a single resistor. In addition a PWRGD output is provided to monitor the global power tree status. The device also incorporates a positive edge detection watchdog timer to monitor an external processor for coherent execution. External faults can be propagated to the system by using the SR_UVLO input. A standard microcircuit drawing (SMD) is available for the QMLV, 5962R2420601VXC.

2 Hardware

2.1 Power Requirements

The TPS7H3024EVM-CVAL board requires 3 power rails (VIN, VPULL_UP1, and VPULL_UP2) to be externally provided by power supplies. These can be separate or shared as long as the voltage ranges of each are respected. The test results shown in this user guide were performed with 1 power supply used for VIN and 1 power supply shared by VPULL_UP1 and VPULL_UP2.

- 3V ≤ VIN ≤ 14V
- 1.6V ≤ VPULL_UPx ≤ 7V

2.2 Important Usage Notes

It is important to calculate the expected maximum SENSEx voltage both before and after the SENSEx hysteresis current has been added, since the hysteresis current increases the voltage at the SENSEx node.

2.3 Connector Descriptions

Primary Device		
Designator	**Function**	
J10	VIN	Power input connector for VIN.
TP5		Test point
J3	PULL_UP1	Power input connector for PULL_UP1.
TP1		Test point
J1	PULL_UP2	Power input connector for PULL_UP2.
TP2		Test point
J2, J4, J23	GND	Power input connector for GND.
TP20, TP21, TP22, J37		Test point
J25	VOUT1	Input connector for an external VOUT rail to be monitored by SENSE1.
J27	GND	
TP12	SENSE1	Test point
J26	VOUT2	Input connector for an external VOUT rail to be monitored by SENSE2.
J28	GND	
TP13	SENSE2	Test point
J29	VOUT3	Input connector for an external VOUT rail to be monitored by SENSE3.
J33	GND	
TP17	SENSE3	Test point
J30	VOUT4	Input connector for an external VOUT rail to be monitored by SENSE4.
J34	GND	
TP18	SENSE4	Test point
J35	VOUT1 & VOUT2	Shunt to connect VOUT1 and VOUT2 nodes for shared sensing.
J36	VOUT3 & VOUT4	Shunt to connect VOUT3 and VOUT4 nodes for shared sensing.
TP3	RESET1b	Test point
J6		Probe test point
J38		Output connector for RESET1b.
J8	GND	

Primary Device		
Designator	**Function**	
TP4	RESET2b	Test point
J7		Probe test point
J5		Output connector for RESET2b.
J9	GND	
TP7	RESET3b	Test point
J19		Probe test point
J11		Output connector for RESET3b.
J21	GND	
TP8	RESET4b	Test point
J20		Probe test point
J12		Output connector for RESET4b.
J22	GND	
J13, J14, J15	DLY_TMR	Shunt for DLY_TMR resistor configuration.
J16, J17, J18	WD_TMR	Shunt for REG_TMR resistor configuration.
TP16	WDI	Test point
J31		Probe test point
TP15	MODE	Test point
J32		Shunt for MODE selection.
TP6	HYS	Test point
TP11	SR_UVLOb	Test point
J24		Shunt for convenient enable/disable.
TP19	WDOb	Test point
TP14	PWRGD	Test point
TP9	VLDO	Test point
TP10	REFCAP	Test point

3 Implementation Results

Test results are shown below for the following features:

1. Enable and Disable
2. Undervoltage and Overvoltage sensing (MODE=0)
3. Window and Overvoltage sensing (MODE=1)
4. WDOb behavior

3.1 Default Configuration Results

The following tests were performed using the TPS7H3024EVM-CVAL in the default configuration with VIN=12V and PULL_UP1=PULL_UP2=1.8V.

3.2 Enable and Disable

VIN≥10.3V puts SR_UVLOb above the $V_{TH\_SR\_UVLOb\_RISING}$ threshold to enable the device. Voltages at the monitored rails were already in regulation when enable occured.

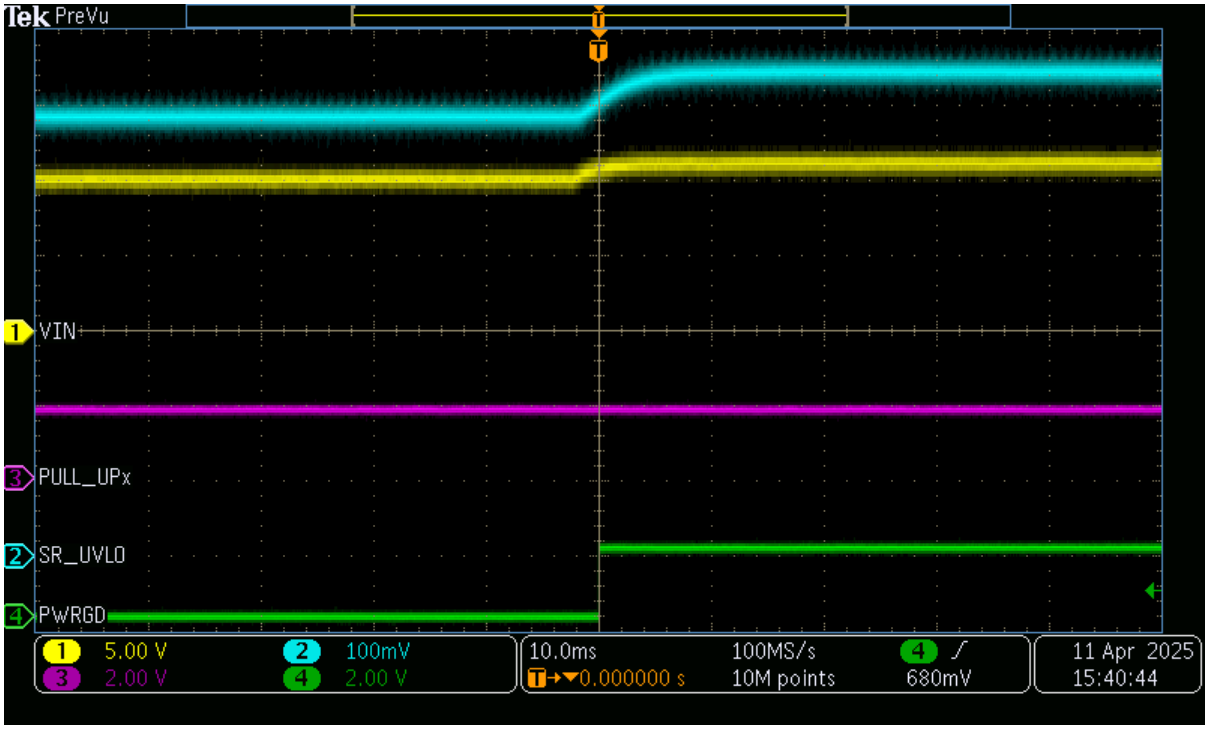


Figure 3-1. Enable using VIN resistor network to SR_UVLOb

VIN≤8.6V puts SR_UVLOb below the $V_{TH\_SR\_UVLOb\_FALLING}$ threshold to disable the device. Voltages at the monitored rails were in regulation during this test.

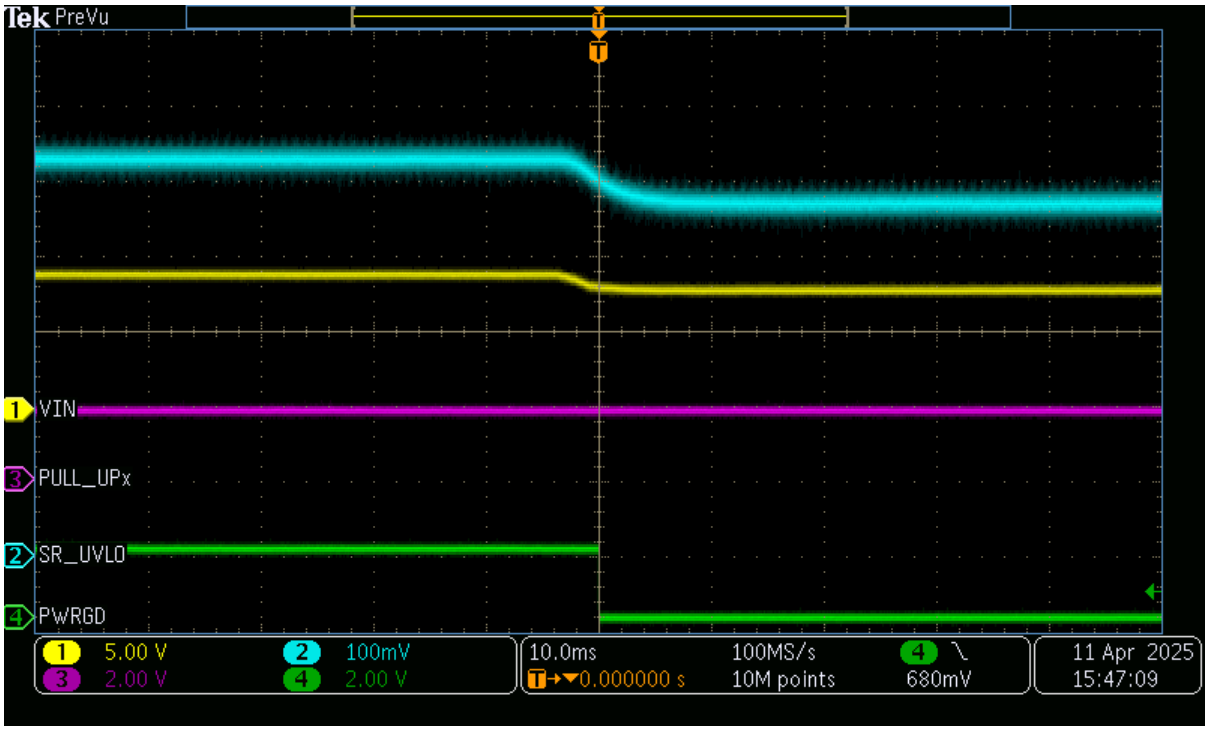


Figure 3-2. Disable using VIN resistor network to SR_UVLOb

3.3 Undervoltage and Overvoltage Monitoring (MODE=0)

For the following tests, J32 is left open to ground the MODE pin to select 2x Undervoltage + 2x Overvoltage monitoring mode. Voltages are kept in regulation for the pair of channels not shown in the scope capture. Different DLY_TMR settings are shown.

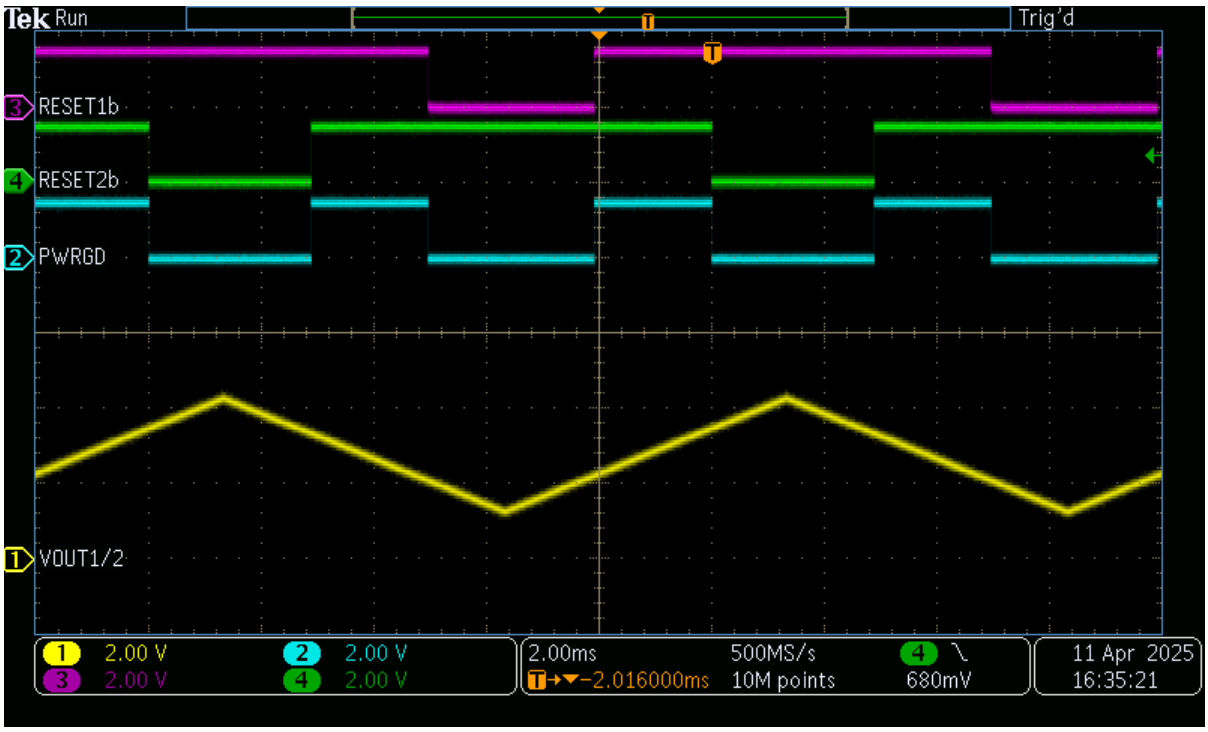


Figure 3-3. Channel 1/2 Regulation Monitoring with DLY_TMR floating

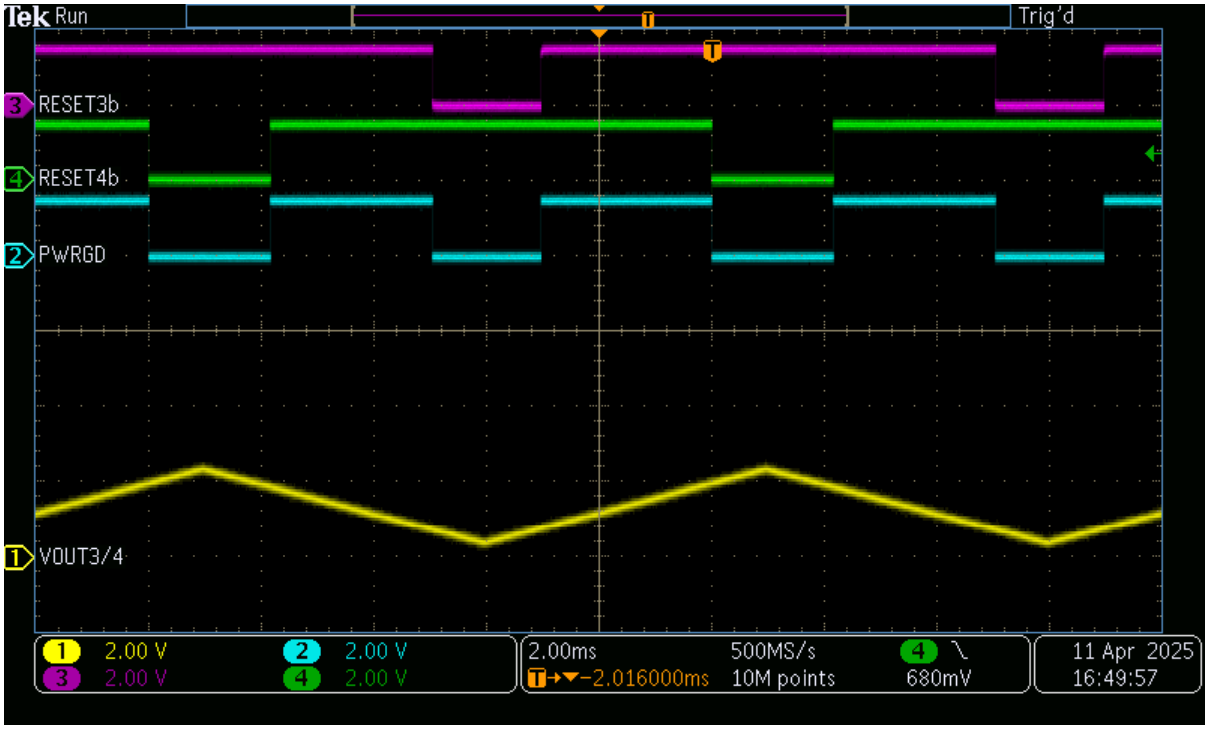


Figure 3-4. Channel 3/4 Regulation Monitoring with DLY_TMR floating

Figure 3-5. Channel 3/4 Enter Regulation with DLY_TMR=619kOhms

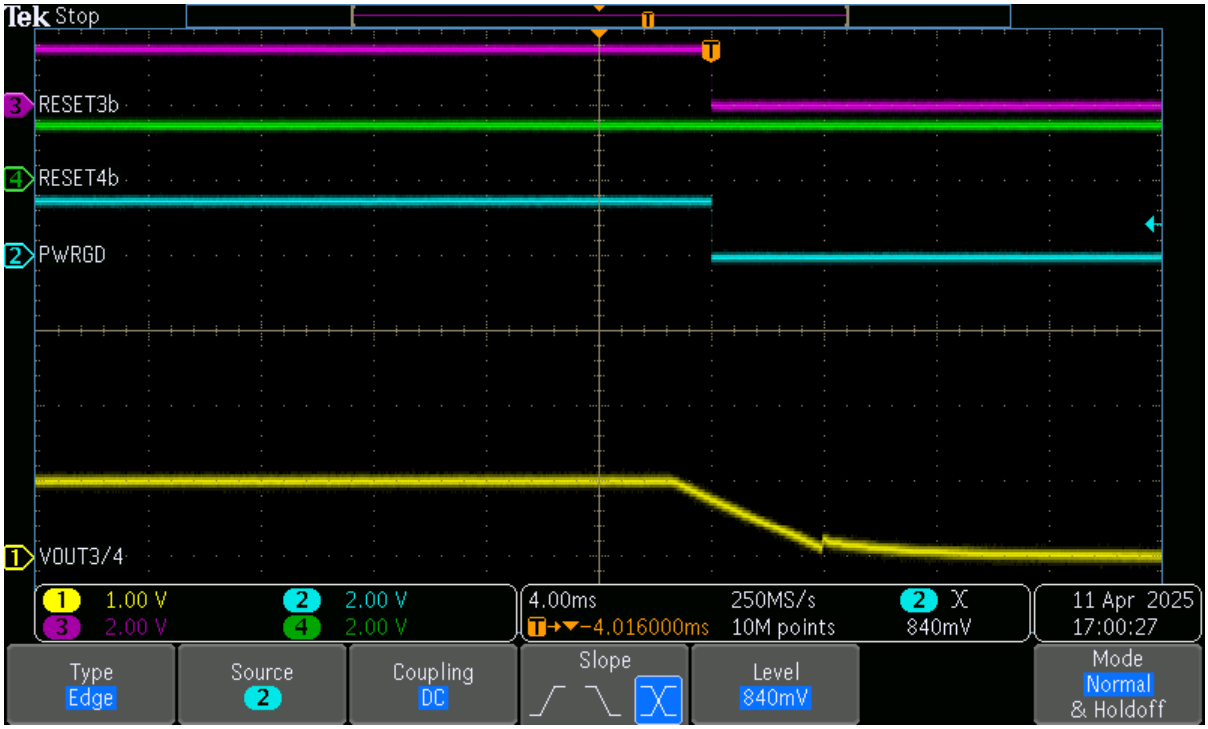


Figure 3-6. Channel 3/4 Leave Regulation with DLY_TMR=619kOhms

3.4 Window and Overvoltage Monitoring (MODE=1)

For the following tests, J32 is shunted to hold the MODE pin HIGH to select 2x Window + 2x Overvoltage monitoring mode. Voltages are kept in regulation for the pair of channels not shown in the scope capture.

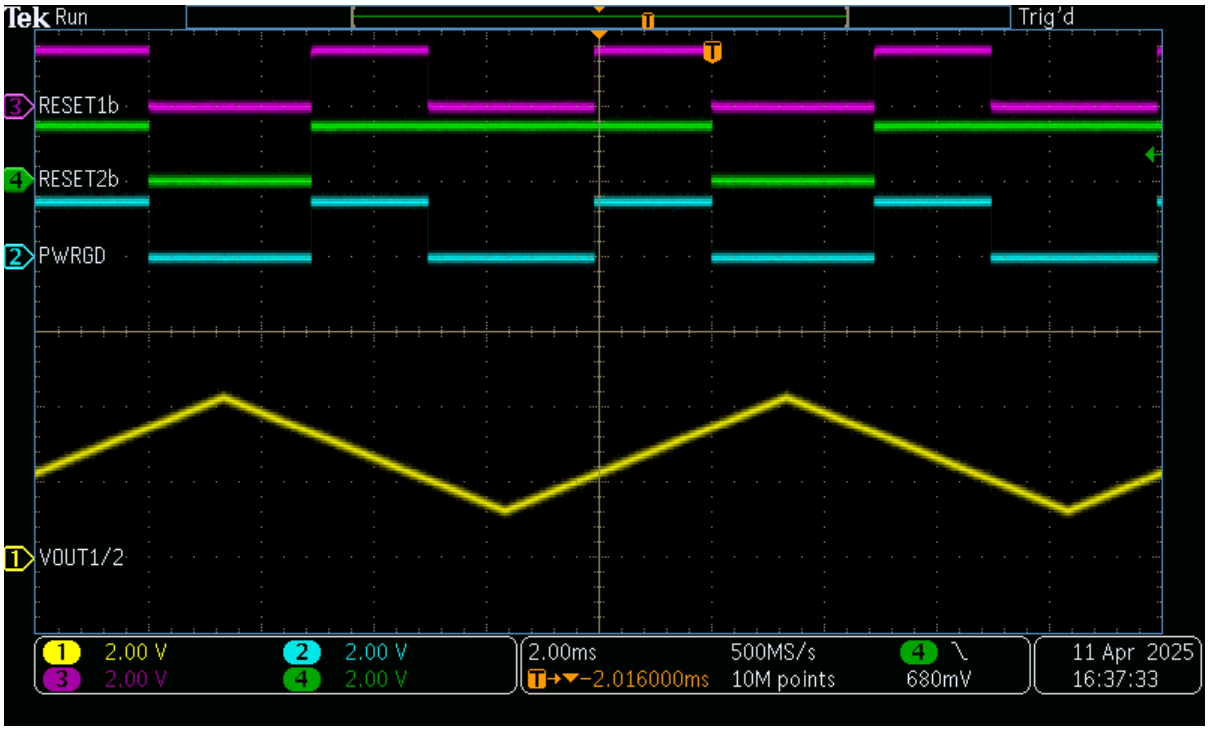


Figure 3-7. Channel 1/2 Regulation Monitoring with DLY_TMR Floating

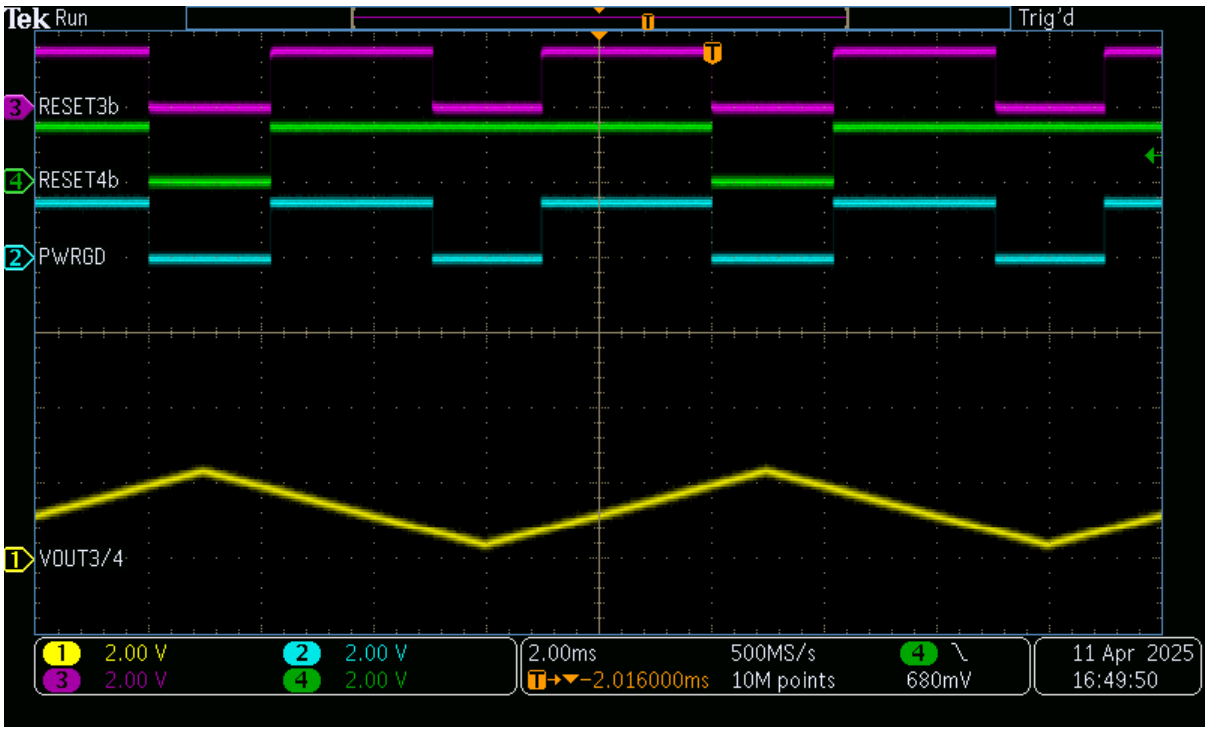


Figure 3-8. Channel 3/4 Regulation Monitoring with DLY_TMR Floating

3.5 WDOb

The following tests were performed with all monitored rails in regulation unless stated otherwise. Multiple WD_TMR settings are shown, as well as a scenario where at least one monitored rail is not in regulation (indicated by PWRGD).

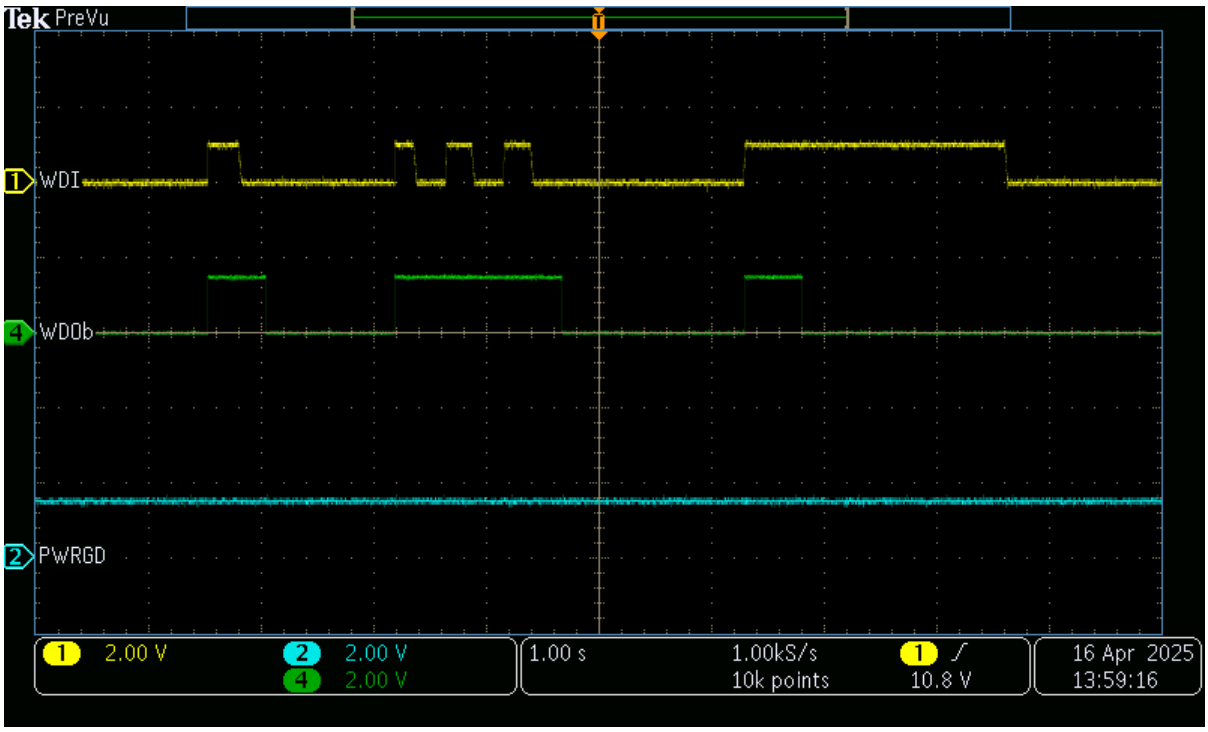


Figure 3-9. WD_TMR = 56.2kOhms

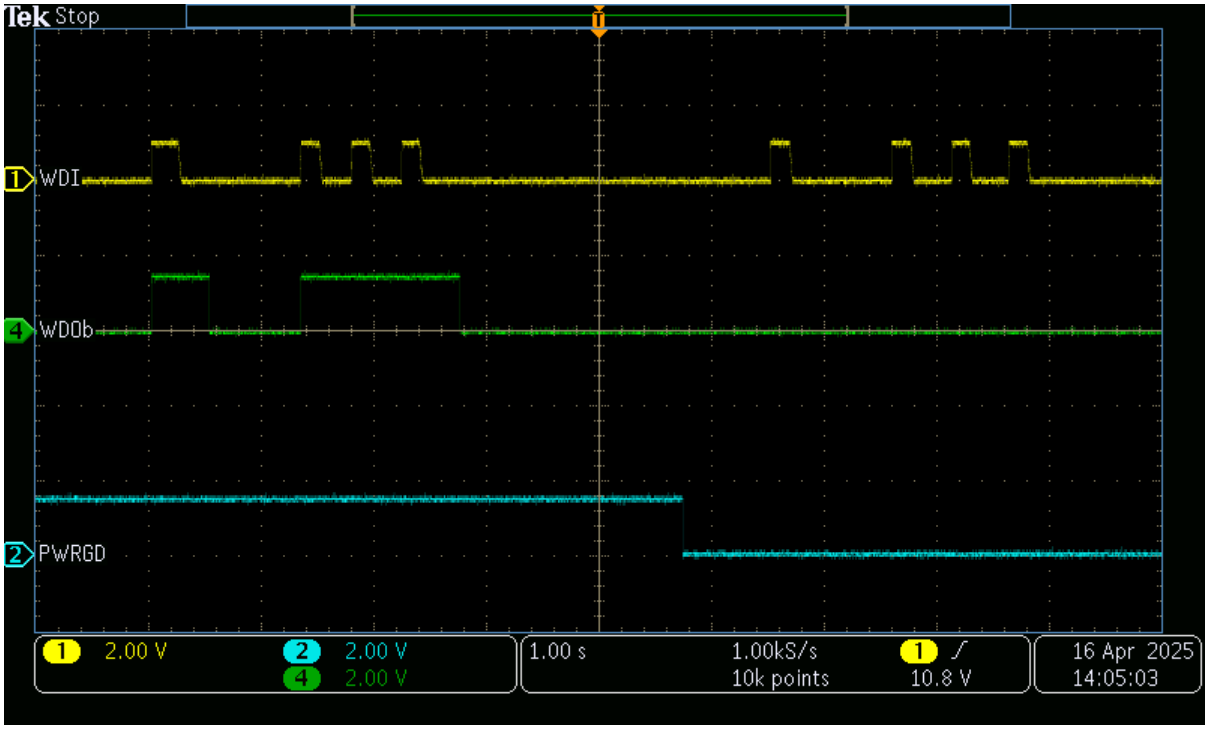


Figure 3-10. WD_TMR = 56.2kOhms when PWRGD indicates Channel 1/2 is no longer in regulation

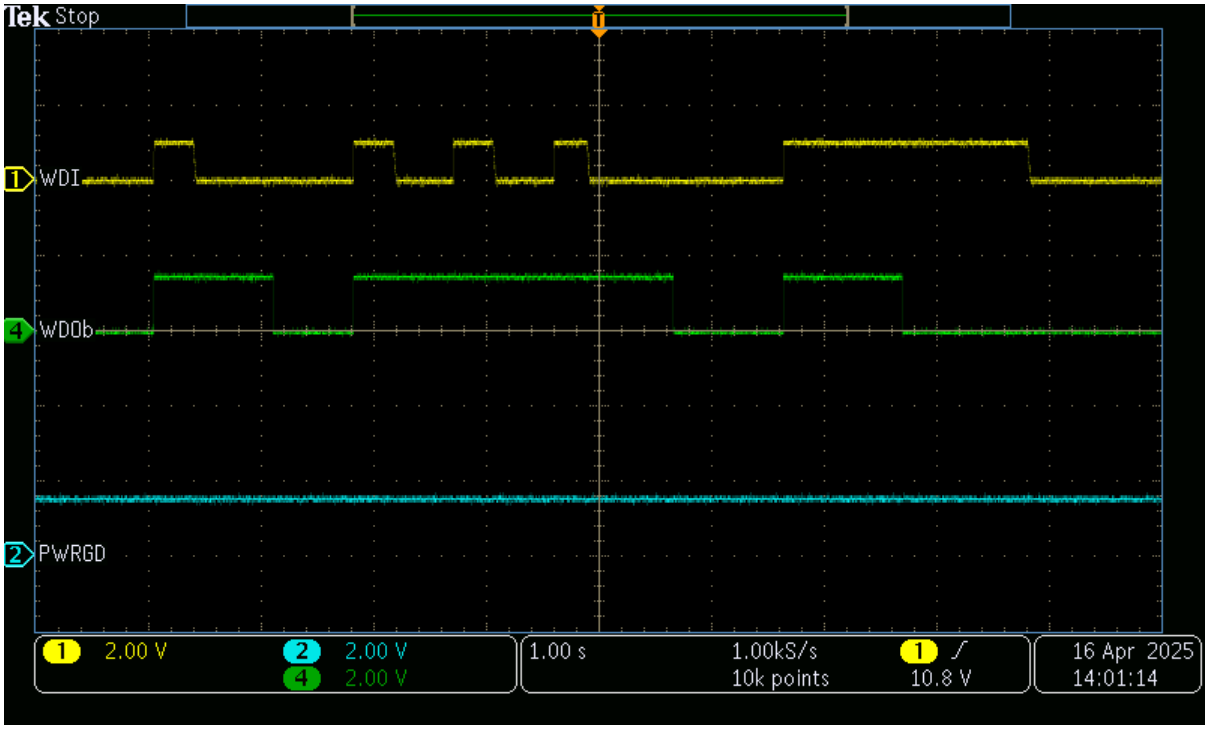


Figure 3-11. WD_TMR = 118kOhms

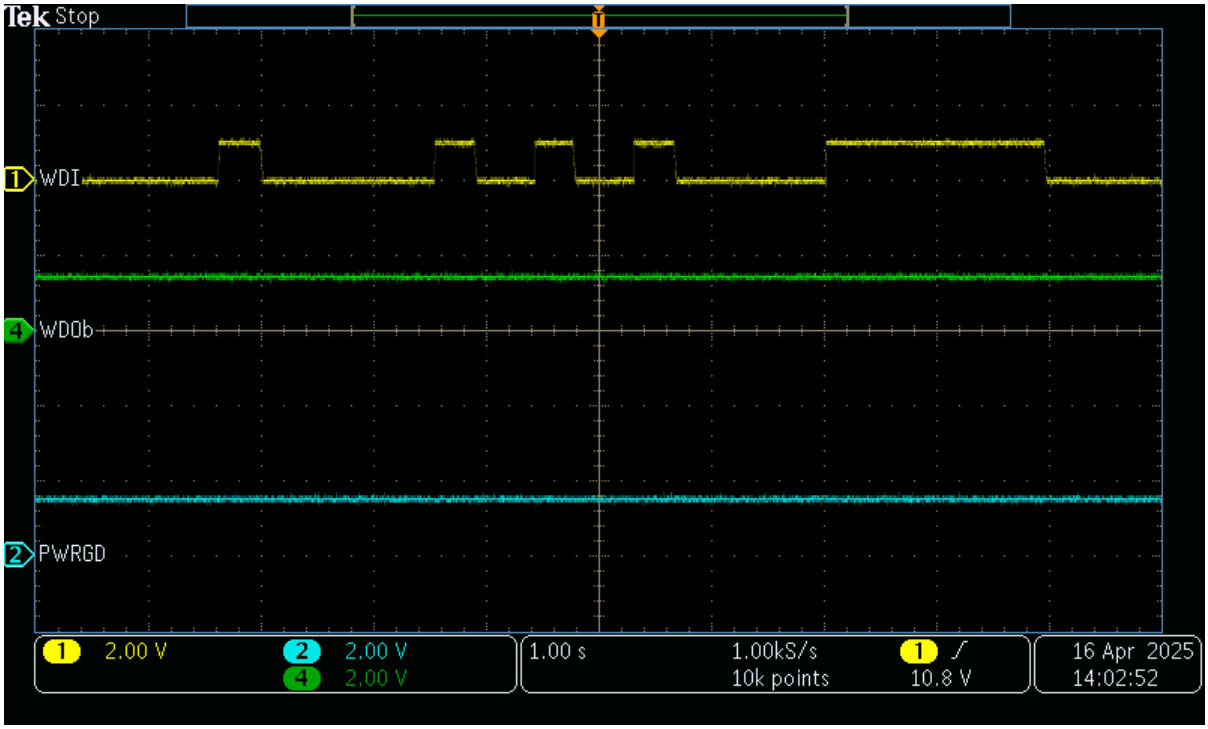


Figure 3-12. WD_TMR Floating

4 Hardware Design Files

4.1 Schematics

Default EVM Schematic

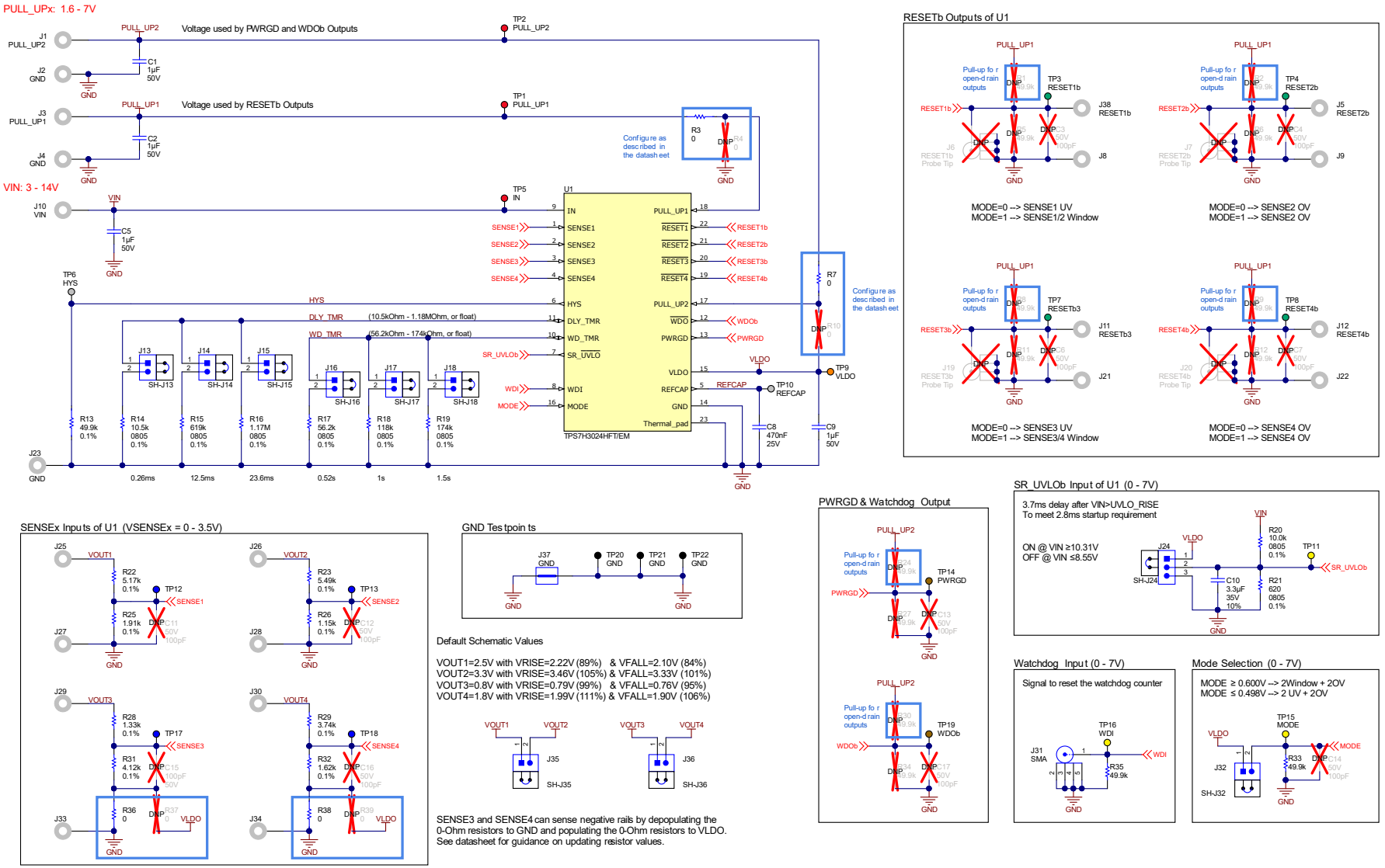


Figure 4-1. Default EVM Schematic

4.2 PCB Layouts

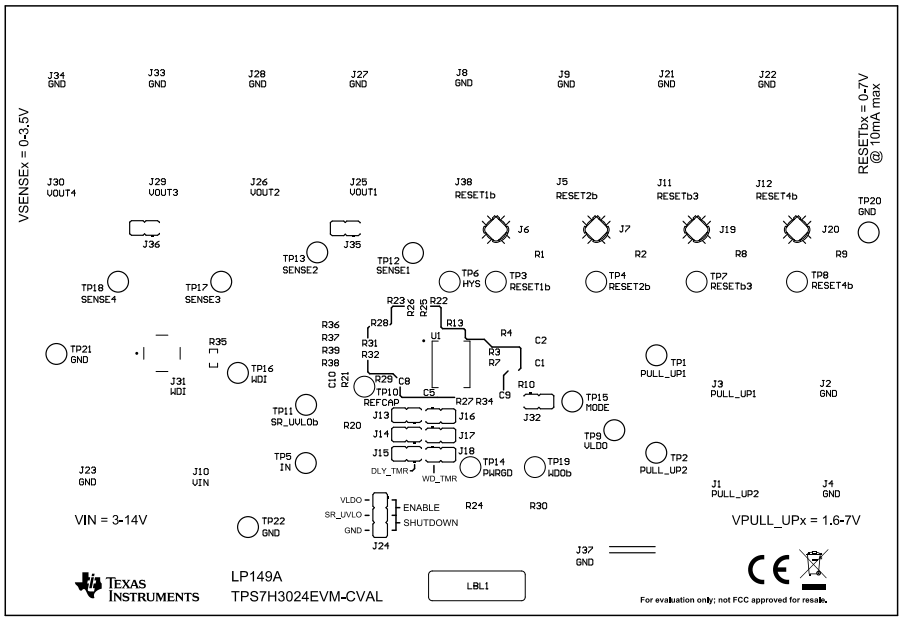


Figure 4-2. Top Overlay

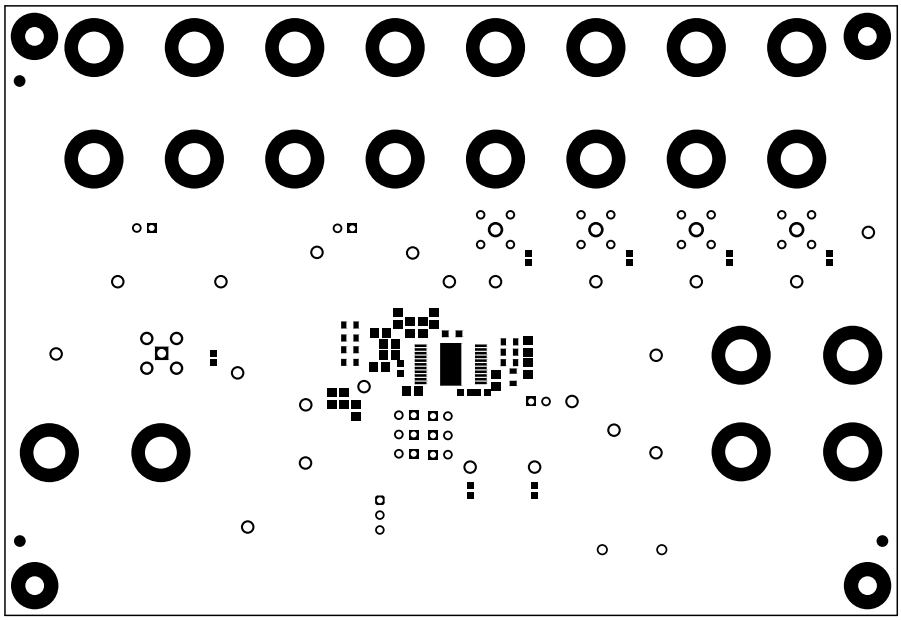


Figure 4-3. Top Solder Mask

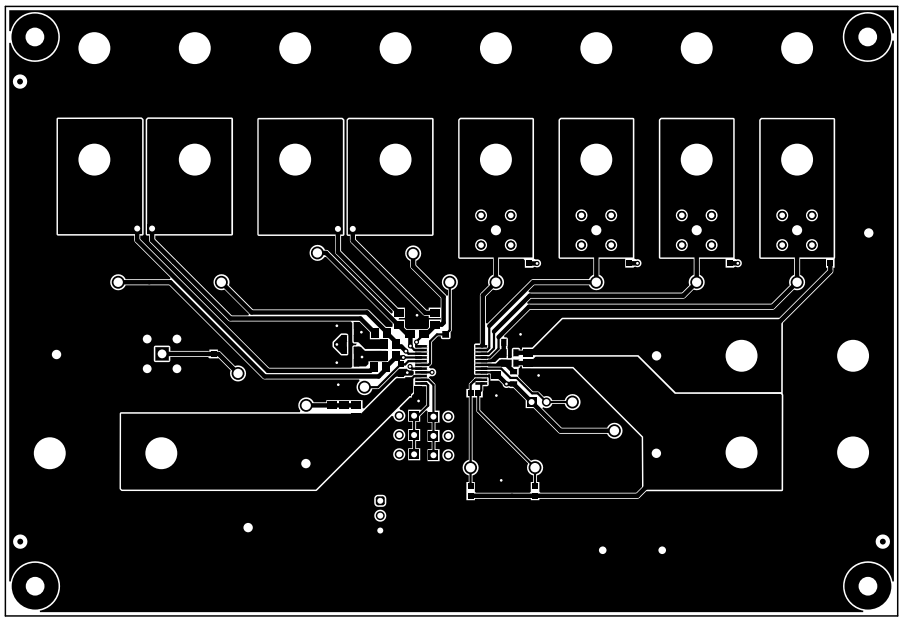


Figure 4-4. Layer 1 (Top)

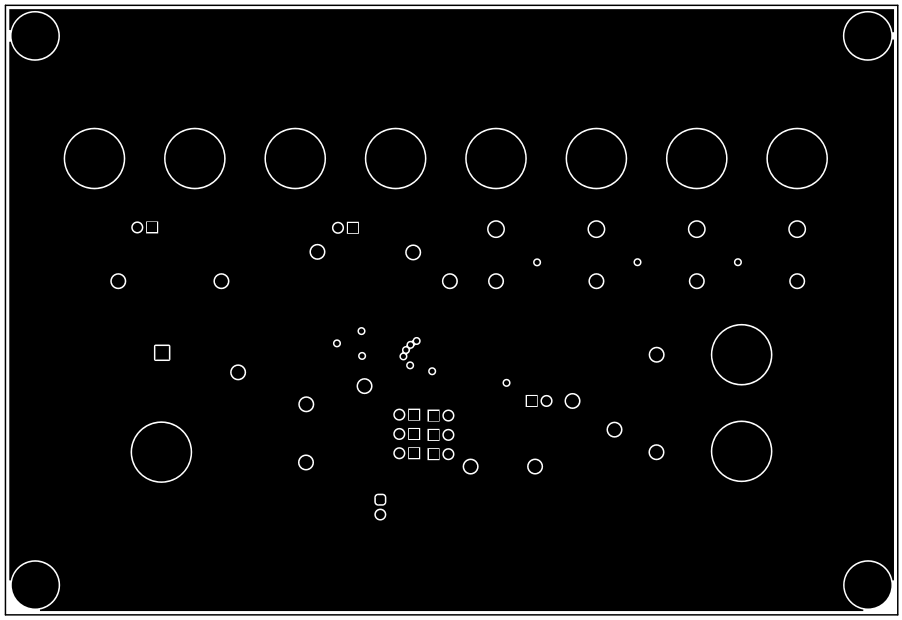


Figure 4-5. Layer 2

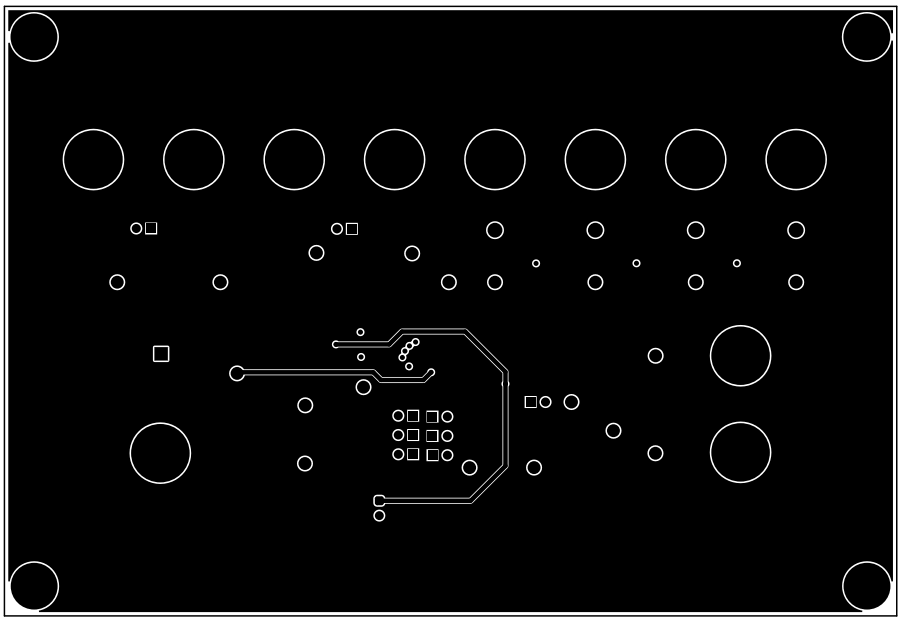


Figure 4-6. Layer 3

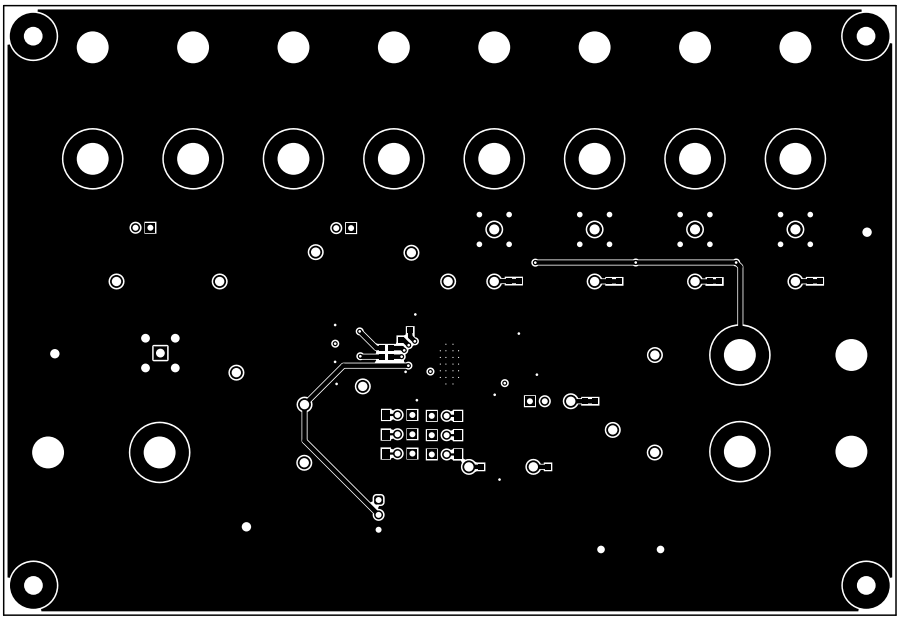


Figure 4-7. Layer 4 (Bottom)

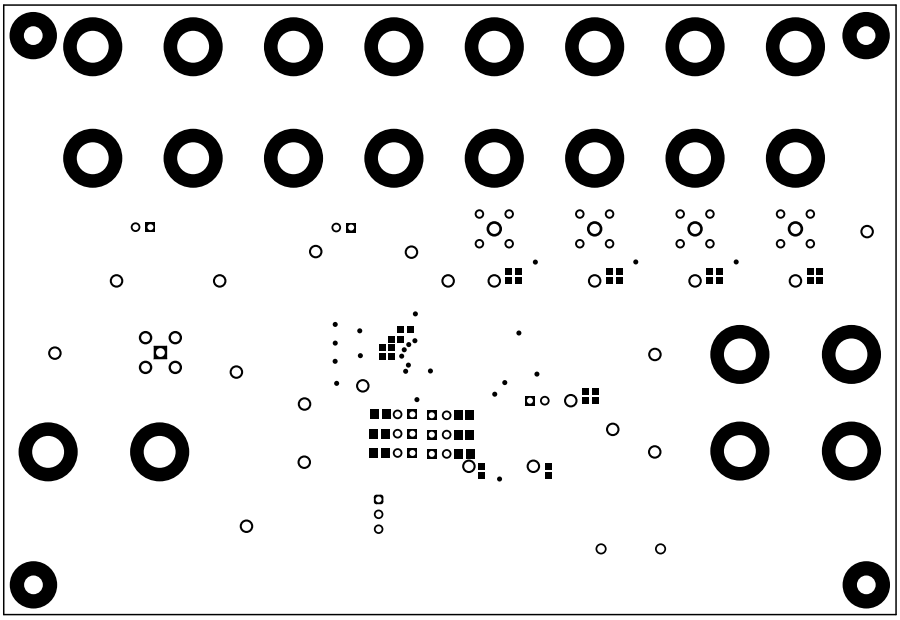


Figure 4-8. Bottom Solder Mask

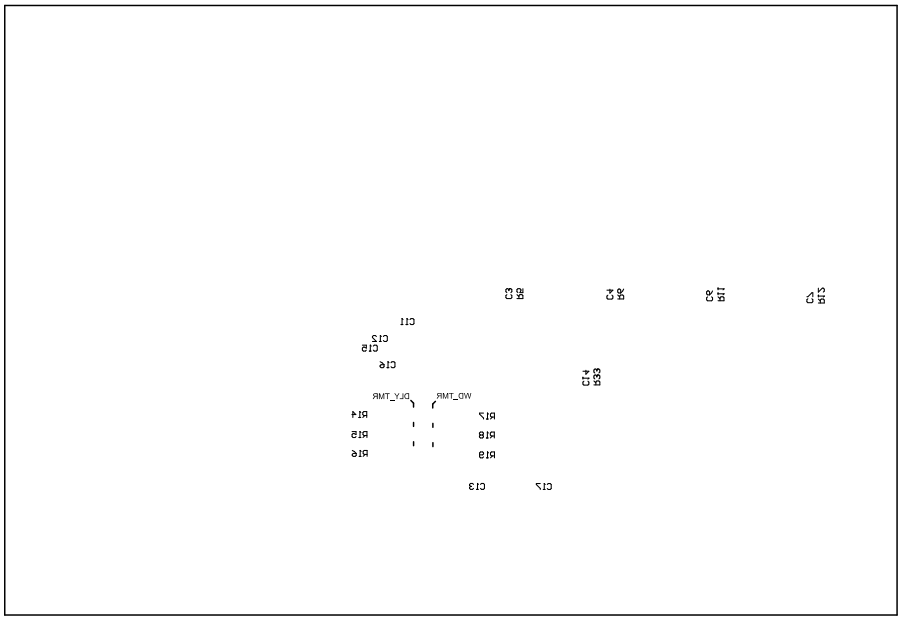


Figure 4-9. Bottom Overlay

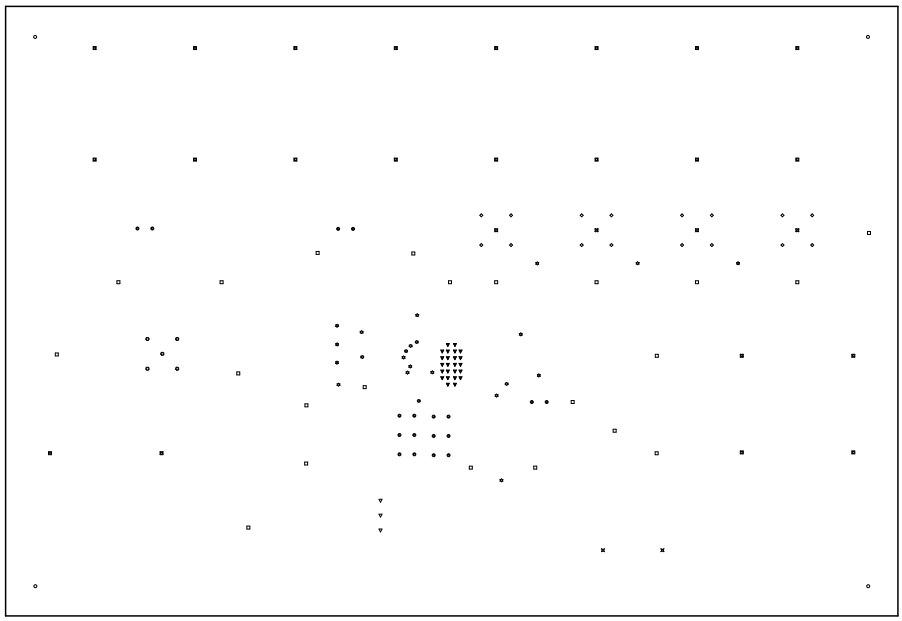


Figure 4-10. Drill Drawing

4.3 Bill of Materials (BOM)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2, C5, C9	4	1uF	CAP, CERM, 1 uF, 50 V, +/- 10%, X7R, 0805	0805	08055C105KAT2A	AVX
C8	1	0.47uF	CAP, CERM, 0.47 uF, 25 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	GCM188R71E474KA64D	MuRata
C10	1	3.3uF	CAP, CERM, 3.3 uF, 35 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805	CGA4J1X7R1V335K125AC	TDK
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J3, J4, J5, J8, J9, J10, J11, J12, J21, J22, J23, J25, J26, J27, J28, J29, J30, J33, J34, J38	22		Standard Banana Jack, Uninsulated, 5.5mm	Keystone_575-4	575-4	Keystone
J13, J14, J15, J16, J17, J18, J32, J35, J36	9		Header, 2.54mm, 2x1, Tin, TH	Header, 2.54mm, 2x1, TH	22284023	Molex
J24	1		Header, 2.54mm, 3x1, Tin, TH	Header, 2.54mm, 3x1, Tin, TH	22284030	Molex
J31	1		SMA Connector Receptacle, Female Socket 50Ohm Through Hole Solder	PTH_RF_CONN	733910060	Molex
J37	1		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Shorting Plug, 10.16mm spacing, TH	D3082-05	Harwin
R3, R7, R36, R38	4	0	RES SMD 0 OHM JUMPER 1/8W 0805	0805	RC0805FR-070RL	Yageo
R13	1	49.9k		0805	ERA-6AEB4992V	Panasonic
R14	1	10.5k		0805	RG2012P-1052-B-T5	Susumu Co Ltd
R15	1	619k		0805	RT0805BRD07619KL	Yageo
R16	1	1.17Meg		0805	RT0805BRD071M17L	Yageo
R17	1	56.2k		0805	RG2012P-5622-B-T5	Susumu Co Ltd
R18	1	118k		0805	RT0805BRD07118KL	Yageo
R19	1	174k		0805	RT0805BRD07174KL	Yageo
R20	1	10.0k		0805	MCU0805MD1002BP100	Vishay/Beyschlag
R21	1	620		0805	RG2012P-621-B-T5	Susumu Co Ltd
R22	1	5.17k		0805	RT0805BRD075K17L	Yageo
R23	1	5.49k		0805	RT0805BRD075K49L	Yageo
R25	1	1.91k		0805	RT0805BRD071K91L	Yageo

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
R26	1	1.15k		0805	RT0805BRD071K15L	Yageo
R28	1	1.33k		0805	RT0805BRD071K33L	Yageo
R29	1	3.74k		0805	RT0805BRD073K74L	Yageo
R31	1	4.12k		0805	RT0805BRD074K12L	Yageo
R32	1	1.62k		0805	RT0805BRD071K62L	Yageo
R33, R35	2	49.9k		0603	RC0603FR-0749K9L	Yageo
SH-J13, SH-J14, SH-J15, SH-J16, SH-J17, SH-J18, SH-J24, SH-J32, SH-J35, SH-J36	10		CONN JUMPER S2 (1 x 2) Position Shunt Connector Black Open Top 0.100" (2.54mm) GoldHORTING .100" GOLD	Jumper	QPC02SXGN-RC	Sullins
TP1, TP2, TP5	3		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP3, TP4, TP7, TP8	4		Test Point, Multipurpose, Green, TH	Green Multipurpose Testpoint	5126	Keystone
TP6, TP10	2		Test Point, Multipurpose, Grey, TH	Grey Multipurpose Testpoint	5128	Keystone
TP9	1		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone
TP11, TP15, TP16	3		Test Point, Multipurpose, Yellow, TH	Yellow Multipurpose Testpoint	5014	Keystone
TP12, TP13, TP17, TP18	4		Test Point, Multipurpose, Blue, TH	Blue Multipurpose Testpoint	5127	Keystone
TP14, TP19	2		Test Point, Multipurpose, Brown, TH	Brown Multipurpose Testpoint	5125	Keystone
TP20, TP21, TP22	3		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1	1		Radiation-Hardness-Assured, 14V, 4-Channel Supervisor with Watchdog	CFP22	TPS7H3024HFT/EM	Texas Instruments
C3, C4, C6, C7, C11, C12, C13, C14, C15, C16, C17	0	100pF	CAP, CERM, 100 pF, 50 V,+/- 1%, C0G/NP0, 0603	0603	C0603C101F5GACTU	Kemet
J6, J7, J19, J20	0		Compact Probe Tip Circuit Board Test Points, TH, 25 per	TH Scope Probe	131-5031-00	Tektronix
R1, R2, R5, R6, R8, R9, R11, R12, R24, R27, R30, R34	0	49.9k	RES, 49.9 k, 1%, 0.1 W, 0603	0603	RC0603FR-0749K9L	Yageo
R4, R10, R37, R39	0	0	RES SMD 0 OHM JUMPER 1/8W 0805	0805	RC0805FR-070RL	Yageo

5 Compliance Information

5.1 Compliance and Certifications

- Texas Instruments, TPS7H3024EVM-CVAL EU RoHS Declaration of Conformity (DoC)

6 Related Documentation

- Texas Instruments, Standard Terms for Evaluation Modules

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

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

3 *Regulatory Notices:*

3.1 *United States*

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.

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 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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

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

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

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.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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