INA300EVM User's Guide

This user's guide describes the INA300 evaluation module (EVM). This document discusses the set-up and operating instructions, schematic, printed circuit board (PCB) design, and bill of materials. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the INA300EVM.

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1 Overview

The INA300 is a high common-mode, precision, bidirectional, current-sensing comparator that can be configured to detect overcurrent conditions through the voltage developed across a shunt resistor. Operating from a single power supply from 2.7 V to 5.5 V, the INA300 can be configured to detect shunt voltages from 0 V to 250 mV in the presence of common-mode voltages from 0 V to 36 V. The INA300EVM allows for easy user configuration of the INA300 device by using jumpers. The following features can be programmed in this manner:

- Enable and disable,
- Latch mode and transparent mode,
- Delay (10 µs, 50 µs, and 100 µs),
- Hysteresis (2 mV, 5 mV, and 10 mV), and
- Threshold set by a single resistor or an external voltage source.

The comparator threshold comes factory programmed at 200 mV and can be easily customized anywhere within its operating range by replacing a single, pin-socketed resistor. On-board connectors allow for user control of all inputs and outputs with a microprocessor, pattern generator, or digital-to-analog converter (DAC). Test points are available for all signals, thus making design verification fast and easy.

For a more detailed description of the INA300, refer to the product data sheet (SBOS613) available from the Texas Instruments web site at www.ti.com. Support documents are listed in the *Related Documentation from Texas Instruments* section.

1.1 Information About Cautions and Warnings

This document contains caution and warning statements.

CAUTION

Applying more than 40 V to the IN+ or IN– pins may result in damage to the INA300EVM.

Applying more than 6 V to VDD may result in damage to the INA300EVM.

Applying more than VDD + 0.3 V or less than GND – 0.3 V to any other terminal connection may result in damage to the INA300EVM.

WARNING

This equipment is intended for use in a laboratory test environment only. To prevent personal injury, the use of safety glasses is recommended.

Use of this equipment must be performed by qualified personnel trained in electronics theory and understand the risks and hazards of the assembly to be tested.

A caution statement describes a situation that could potentially damage your software or equipment. A warning statement describes a situation that could potentially cause injury. The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

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1.2 Related Documentation from Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the INA300EVM. This document is available from the TI web site under literature number SBOS613. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site at http://www.ti.com, or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Document	Literature Number
INA300 Product Data Sheet	SBOS613

1.3 If You Need Assistance

If you have questions about the INA300 evaluation module, post a question in the amplifiers forum at http://e2e.ti.com Include *INA300EVM* in the subject heading.

Hardware Description

The INA300EVM consists of a double-sided printed circuit board (PCB) populated with an INA300 device, connectors for power, ground, signal input and output terminals, test points, jumpers, a light-emitting diode (LED) to monitor the Alert pin status, and power-supply bypass capacitors. A footprint for a passive input filter is also provided. Figure 1 shows an overview of the INA300EVM.

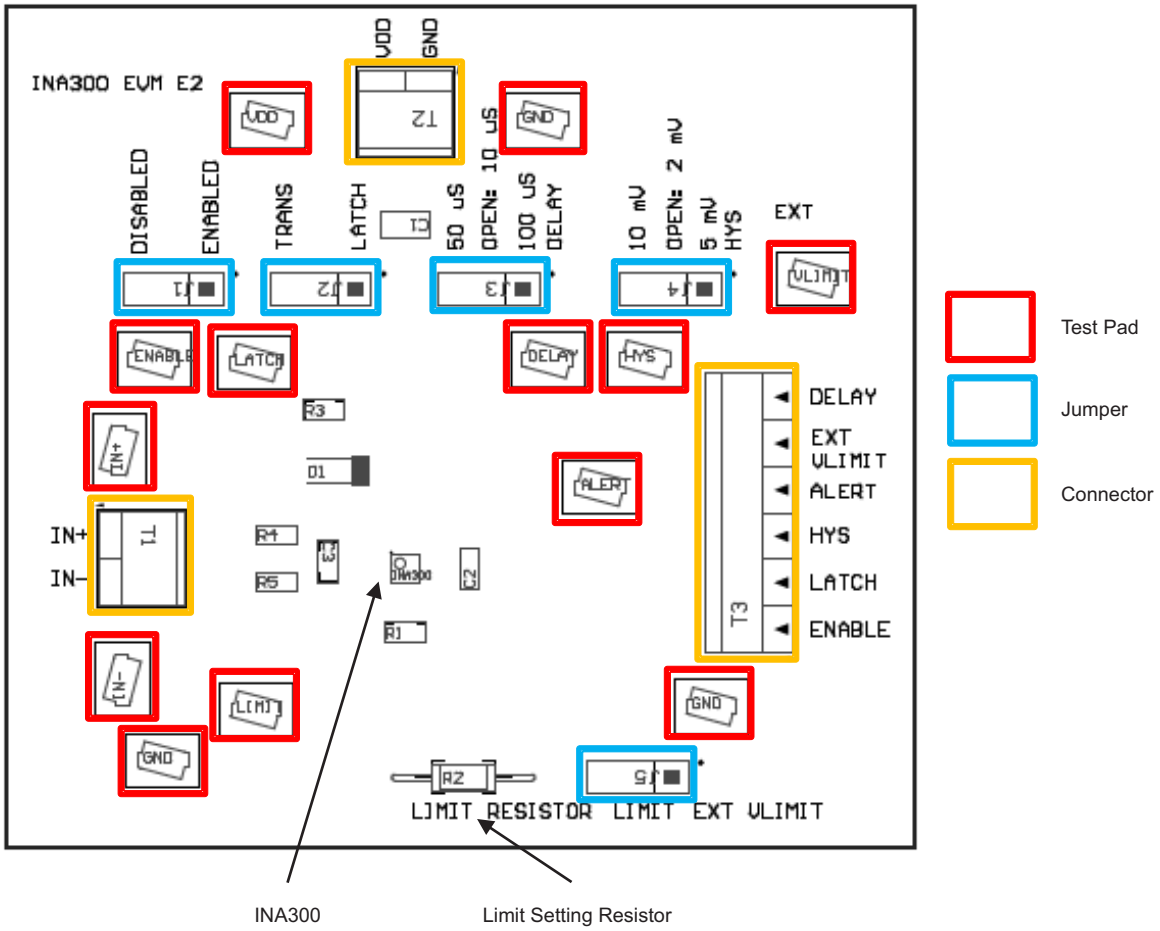


Figure 1. INA300EVM Overview

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Configuring and Using the INA300EVM

The INA300EVM is fully assembled, factory tested, and ready to use. For fast evaluation of the INA300 device, the INA300EVM can be configured as shown in Figure 2.

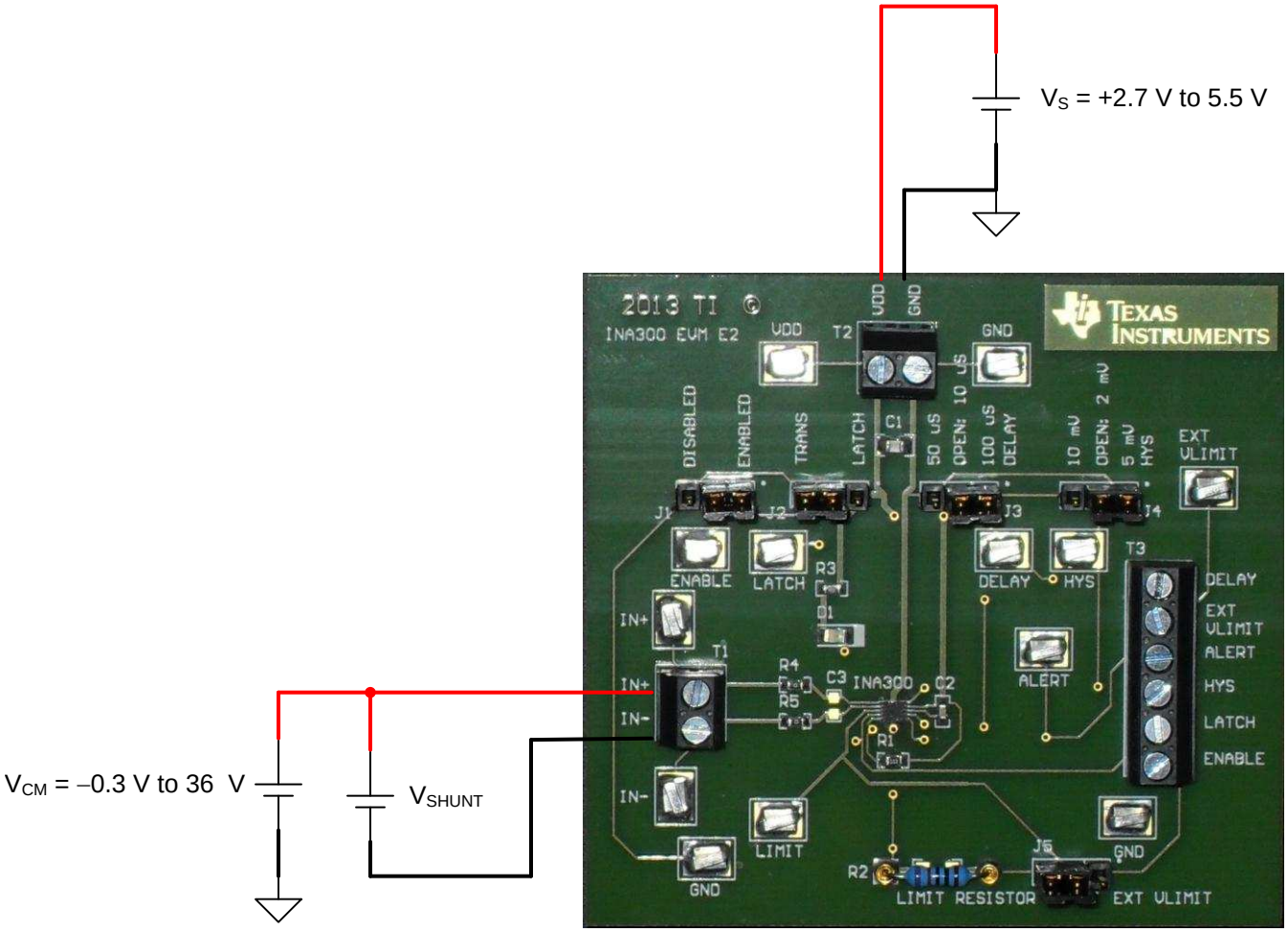


Figure 2. Connecting the INA300EVM with Voltage Sources

Power-Supply Connections

Connect a power supply (see Figure 2) to connector T2 to supply power to the INA300EVM. This power supply must be within the range of +2.7 V to +5.5 V and must be connected to the VDD terminal of connector T2. Connect the GND terminal of connector T2 to ground.

Differential Input Voltage Connections Using a Shunt Resistor

These connections are established by using a voltage source to create the shunt voltage at the input.

Connect a voltage source between the IN+ and IN– inputs at connector T1 as shown in Figure 2. This shunt voltage source provides the differential input to the INA300. The INA300 compares the value of this differential input to the value set by the limit resistor or external voltage source. The INA300 alerts if the limit setting is exceeded. The alert is monitored by a red LED on the INA300EVM.

Common-Mode Input Voltage Connections

Connect a voltage source between the +IN connection at connector T1 and ground as shown in Figure 2. This common-mode voltage source must be within the range of –0.3 V to +36 V.

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Differential Input Voltage Connections

These connections are established by using a shunt resistor to create the shunt voltage at the input.

Configuring the differential input to the INA300EVM as a shunt resistor in series with a load may be more suitable in some evaluations than configuring the differential input to the INA300EVM as a voltage source; see Figure 2. Figure 3 shows the connections for a high-side current comparator using the INA300EVM.

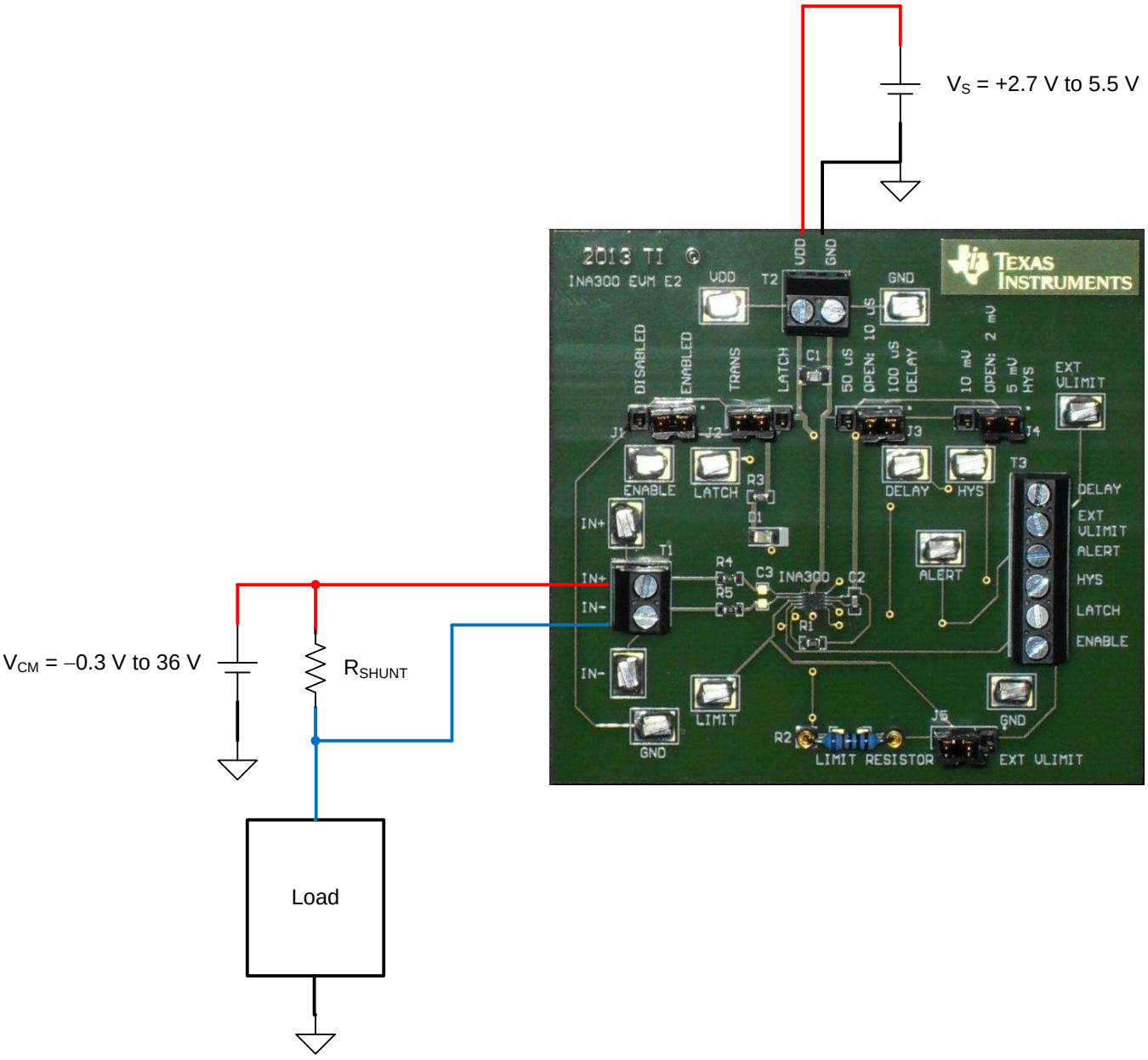


Figure 3. Connecting the INA300EVM as a High-Side Current Comparator

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Setting the Input Threshold Voltage

The INA300 is a voltage comparator. The comparator threshold voltage is set by the value of the voltage applied to the Limit pin on the INA300. On the INA300EVM, a resistor is connected to the output of the Limit pin and ground. The output of the Limit pin is a constant current sourced from an internal, precision, band-gap voltage reference. The typical value of this current source is 20 µA. The INA300EVM comes configured from the factory with a 10-kΩ resistor connected to the Limit pin. The voltage developed across this resistor is given by Equation 1.

$$V_{LIMIT} = 20\ \mu A \times R_{LIMIT} \quad (1)$$

where:

- R_{LIMIT} = 10 kΩ and
- V_{LIMIT} = 200 mV.

Configuring the INA300EVM Jumpers

The INA300EVM includes five jumpers to quickly configure the INA300. These jumpers are the enable/disable jumper, transparent/latch jumper, delay jumper, hysteresis jumper, and limit jumper. Table 1 describes the jumper operation on the INA300EVM.

Table 1. Jumper Functionality

Jumper Name	Middle Pin Connection	Function When Connected To:				
		VDD	GND	FLOAT	Limit Resistor	External V_{LIMIT}
J1	ENABLE	Enabled[1]	Disabled	Enabled	—	—
J2	LATCH	Latch	Transparent[1]	Transparent	—	—
J3	DELAY	100 µs[1]	50 µs	10 µs	—	—
J4	HYS	10 mV	5 mV[1]	2 mV	—	—
J5	LIMIT	—	—	—	Threshold voltage determined by R_{LIMIT} × 20 µA[1]	Threshold voltage input from external DAC or voltage source

(1) EVM default configuration.

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Enable/Disable Jumper

The INA300EVM uses a jumper-configurable connection that enables or disables the INA300. Figure 4 shows the location of the enable/disable jumper (J1). The INA300EVM PCB is clearly marked for easy configuration. Connecting the jumper to ground disables the INA300; connecting the jumper to VDD enables the INA300. The INA300EVM comes enabled from the factory by default. If the jumper is left floating or removed, the INA300 defaults to the enabled state. Refer to Figure 5 for detailed operation of the enable/disable jumper.

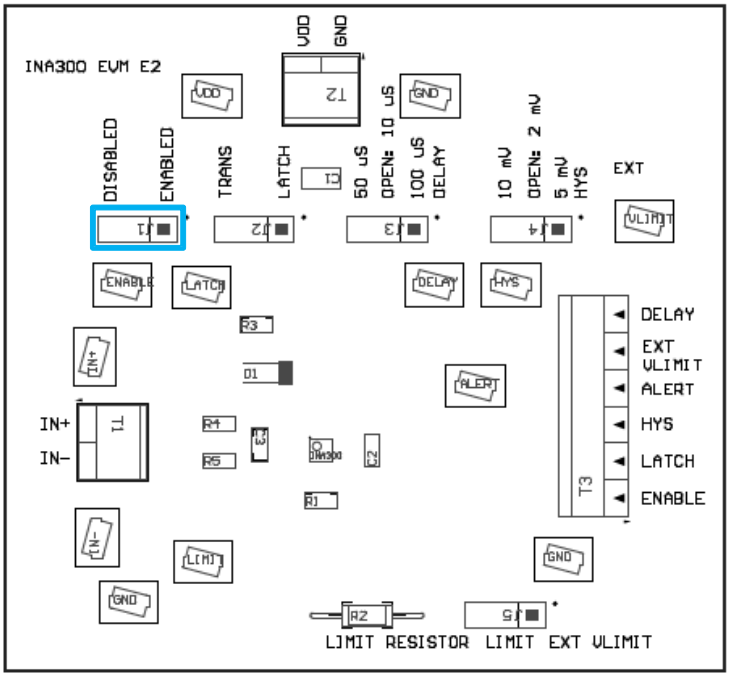


Figure 4. Enable/Disable Jumper Location

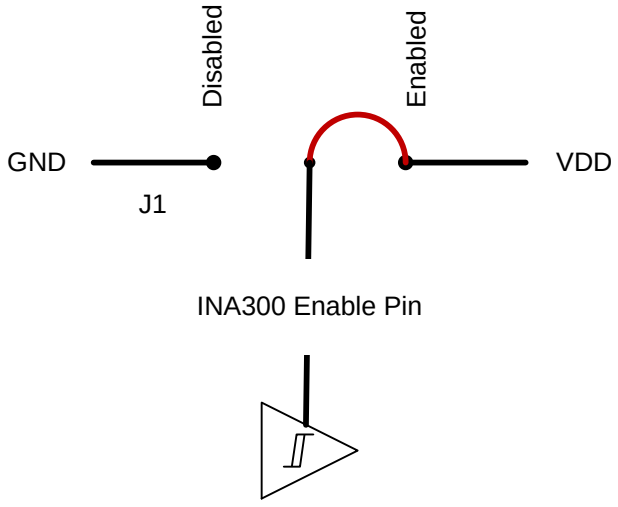


Figure 5. Enable/Disable Schematic Connections

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Transparent/Latch Jumper

The INA300EVM uses a jumper-configurable connection that enables either transparent or latched mode operation in the INA300. Figure 6 shows the location of the transparent/latch jumper (J2). The INA300EVM PCB is clearly marked for easy configuration. Connecting the jumper to ground configures the INA300 in transparent mode; connecting the jumper to VDD configures the INA300 in latch mode. The INA300EVM comes configured in transparent mode from the factory by default. If the jumper is left floating or removed, the INA300 defaults to the transparent state. Refer to Figure 7 for detailed operation of the transparent/latch jumper.

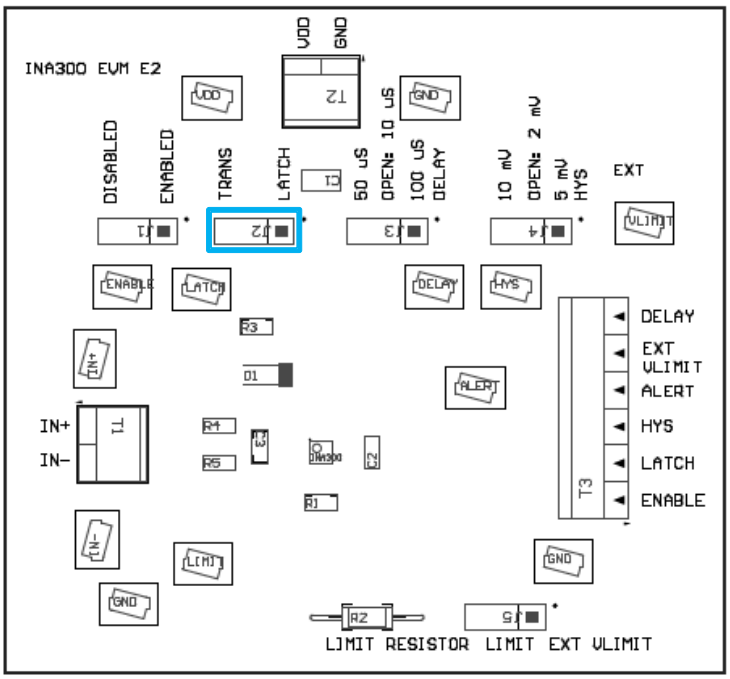


Figure 6. Transparent/Latch Jumper

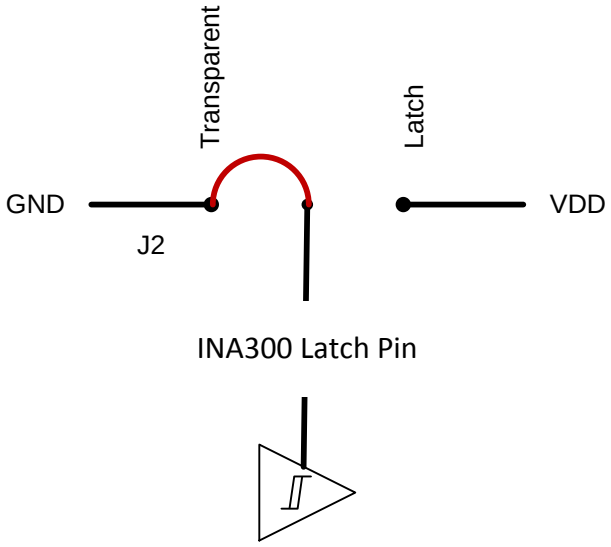


Figure 7. Transparent/Latch Schematic Connections

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Delay Jumper

The INA300EVM uses a jumper-configurable connection that allows for programming a delay into the INA300 response. Figure 8 shows the location of the delay jumper (J3). The INA300EVM PCB is clearly marked for easy configuration. Connecting the jumper to ground configures the INA300 for a 50-µs delay; connecting the jumper to VDD configures the INA300 for a 100-µs delay. If the jumper is left floating or removed, the INA300 defaults to a 10-µs delay. The INA300EVM comes configured for a 100-µs delay from the factory by default. Refer to Figure 9 for detailed operation of the delay jumper.

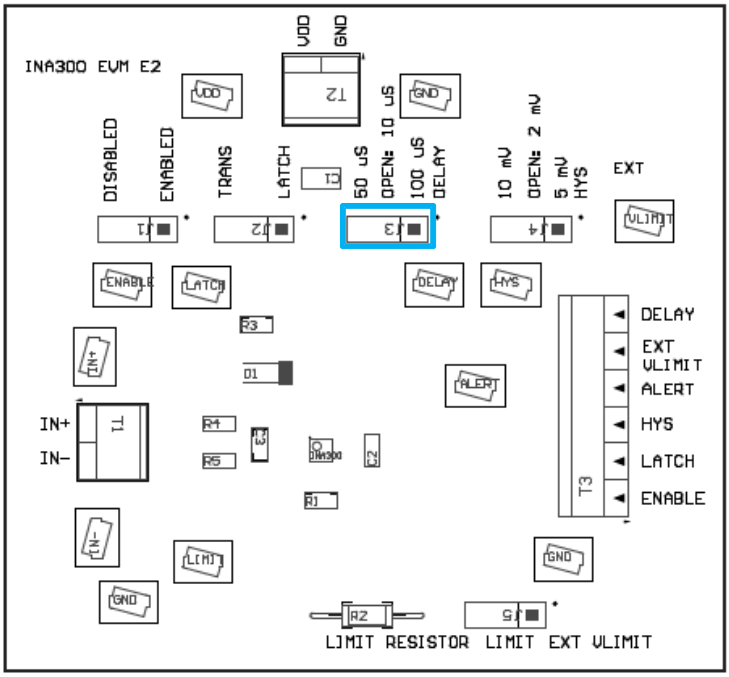


Figure 8. Delay Jumper Location

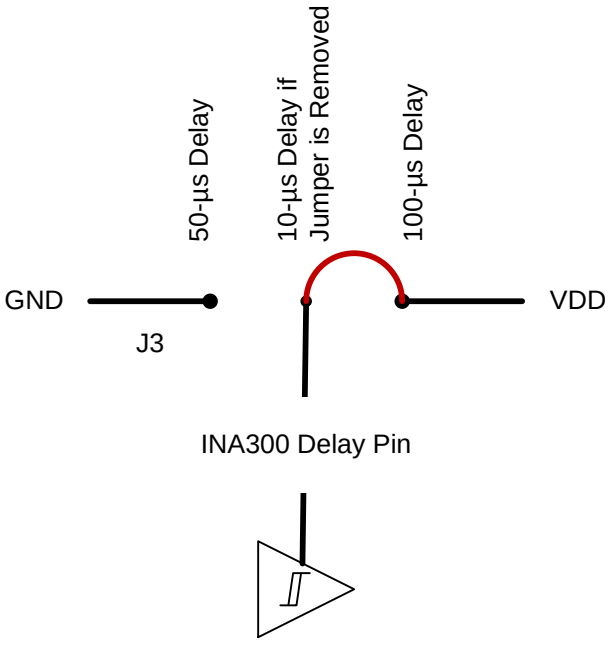


Figure 9. Delay Schematic Connections

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Hysteresis Jumper

The INA300EVM uses a jumper-configurable connection that allows for programming hysteresis into the INA300 response. Figure 10 shows the location of the hysteresis jumper (J4). The INA300EVM PCB is clearly marked for easy configuration. Connecting the jumper to ground configures the INA300 for a 5-mV hysteresis; connecting the jumper to VDD configures the INA300 for a 10-mV hysteresis. If the jumper is left floating or removed, the INA300 defaults to a 2-mV hysteresis. The INA300EVM comes configured for a 5-mV hysteresis from the factory by default. Refer to Figure 11 for detailed operation of the hysteresis jumper.

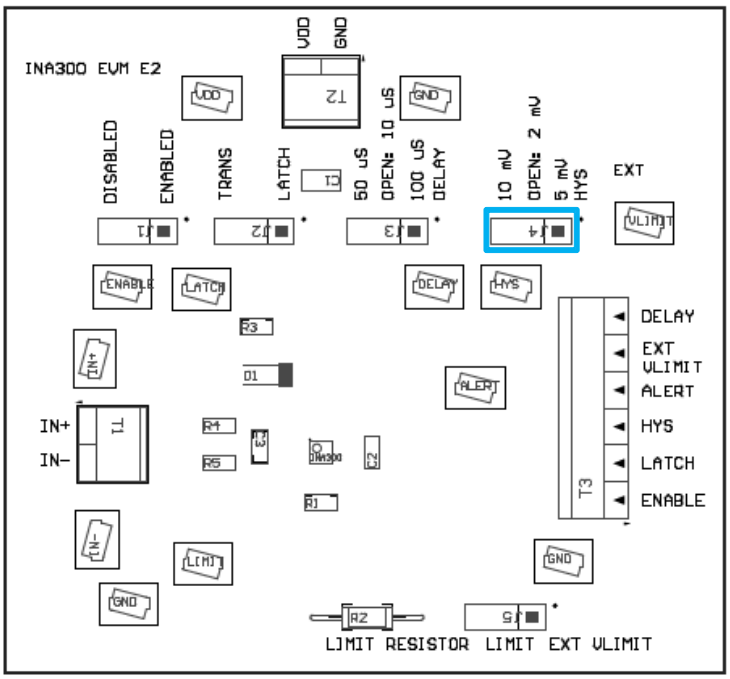


Figure 10. Hysteresis Jumper Location

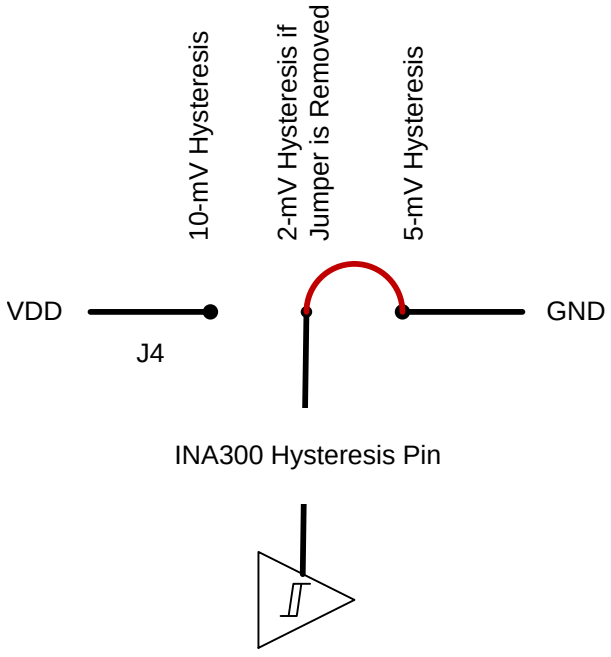


Figure 11. Hysteresis Schematic Connections

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Limit Jumper

The INA300EVM uses a jumper-configurable connection that uses either a resistor or an external voltage source, such as a DAC (not included on the INA300EVM), as the input to the limit pin. Figure 12 shows the location of the limit jumper (J5). The INA300EVM PCB is clearly marked for easy configuration. The middle pin of the limit jumper is connected directly to the INA300 limit pin. The jumper connects the limit pin to either R_{LIMIT} on the INA300EVM PCB or to connector T3, which can be connected to an external voltage source. If the limit jumper is left floating or removed, the INA300 limit pin saturates to an internal power rail of approximately 1.3 V, which is outside the 0-V to 250-mV normal operating range of the limit pin. Leaving the limit pin floating during operation does not damage the INA300, but is not recommended. The INA300EVM comes configured from the factory for use with the R_{LIMIT} resistor by default. Refer to Figure 13 for detailed operation of the limit jumper.

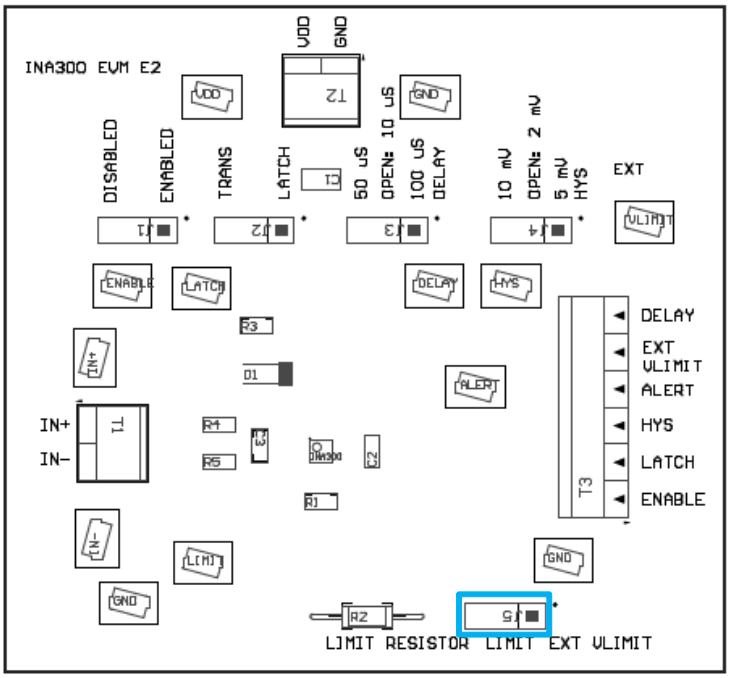


Figure 12. Limit Jumper Location

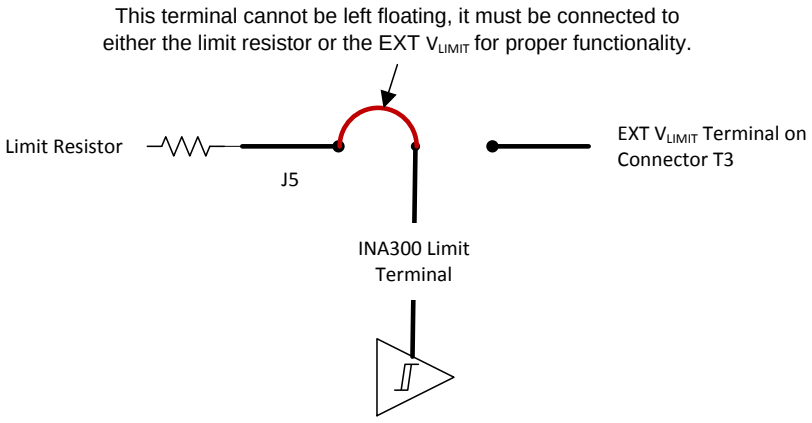


Figure 13. Limit Schematic Connections

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Optional Input Filter

The INA300EVM is designed to accommodate a user-configurable, first-order, low-pass, passive input filter. Figure 14 shows the location and construction of the filter. The INA300EVM comes populated with two 0-Ω resistors (R4 and R5). However, the filter capacitor is not installed.

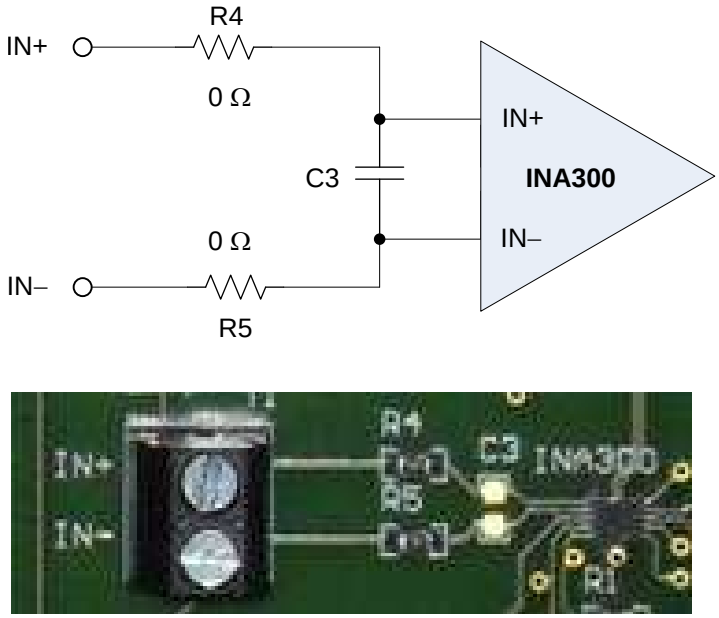


Figure 14. Low-Pass, Passive Input Filter

To implement an input filter, replace the two 0-Ω resistors (R4 and R5) with equal value resistors of up to 10 Ω. Select capacitor C3 according to Equation 2.

$$C3 = \frac{1}{2 \times \pi \times (R4 + R5) \times f_{3dB}} \quad (2)$$

where:

- f_{3dB} is the desired cutoff frequency

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INA300EVM Schematic, PCB, and BOM

This section includes the INA300EVM schematic, printed circuit board, and bill of materials.

INA300EVM Schematic Diagram

Figure 15 shows a schematic of the INA300EVM.

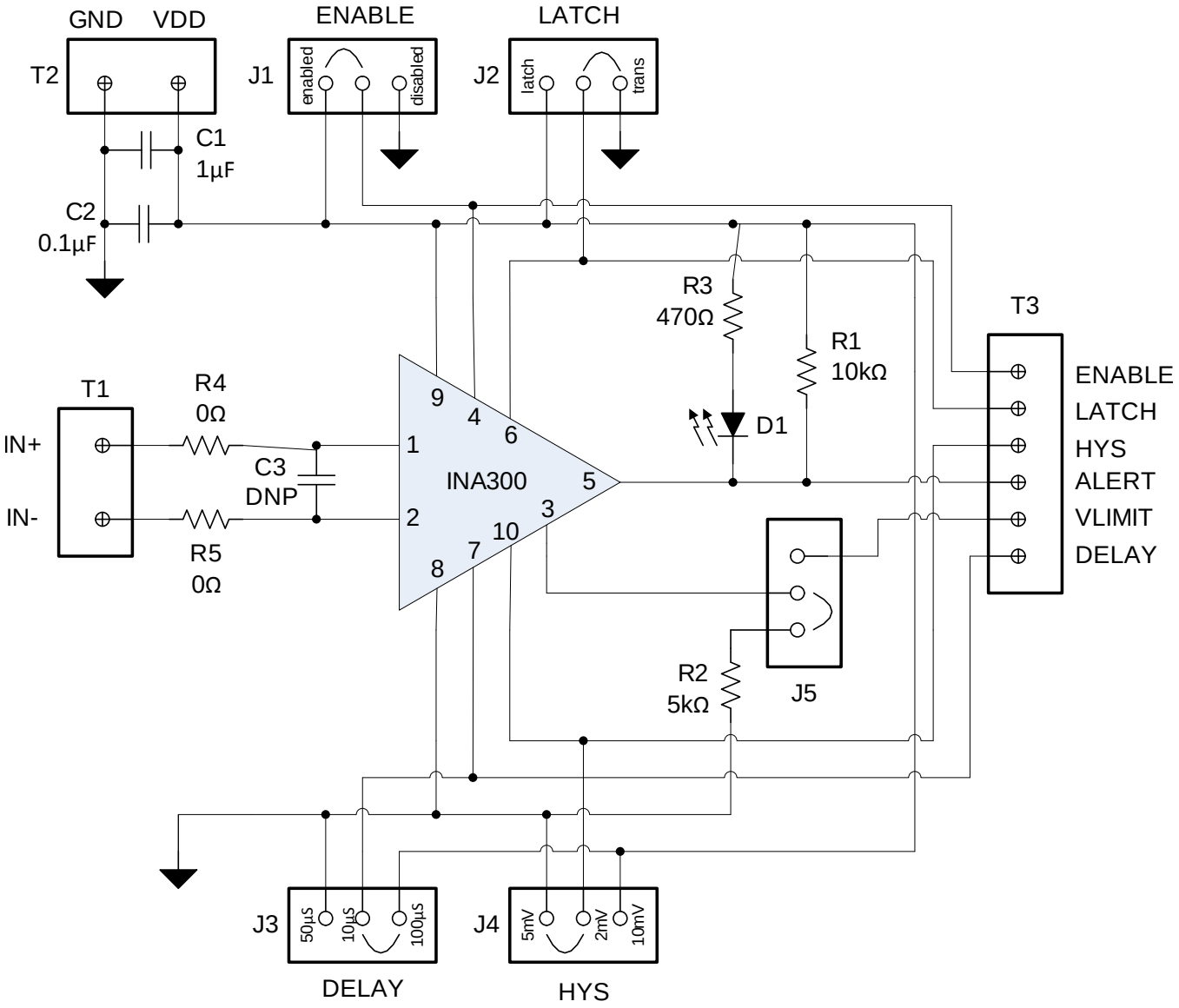


Figure 15. INA300EVM Schematic

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INA300EVM Printed Circuit Board (PCB)

Figure 16 to Figure 22 show different views of the INA300EVM PCB.

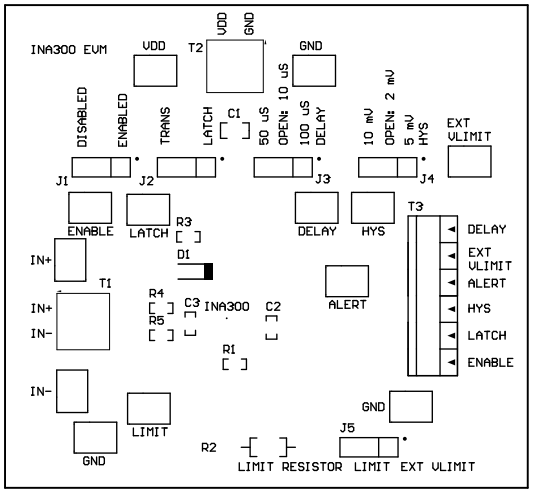


Figure 16. INA300EVM Top Overlay

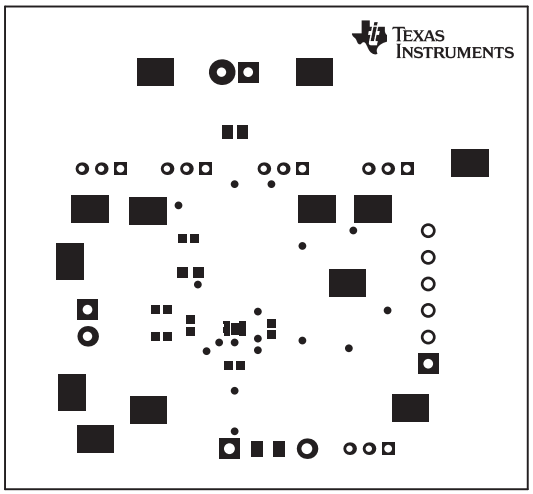


Figure 17. INA300EVM Top Solder Mask

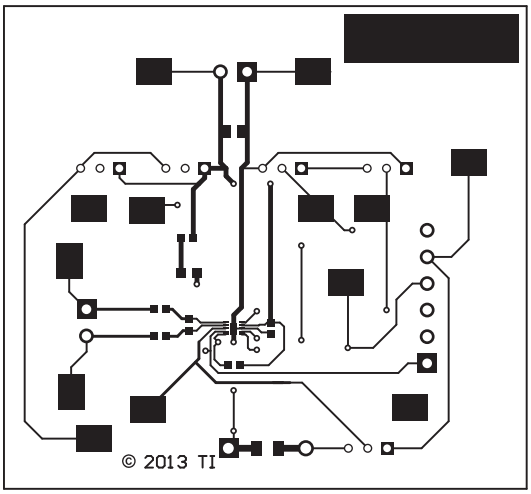


Figure 18. INA300EVM Top Layer

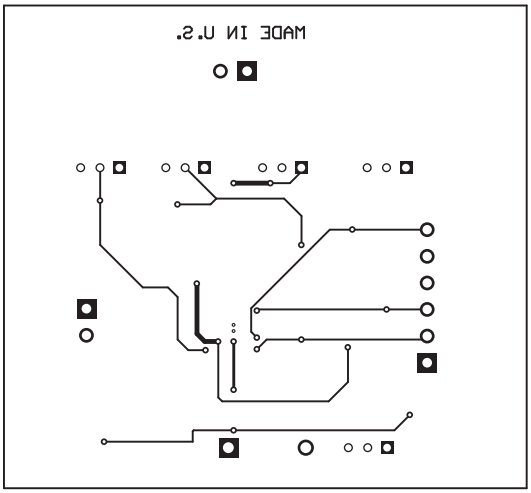


Figure 19. INA300EVM Bottom Layer

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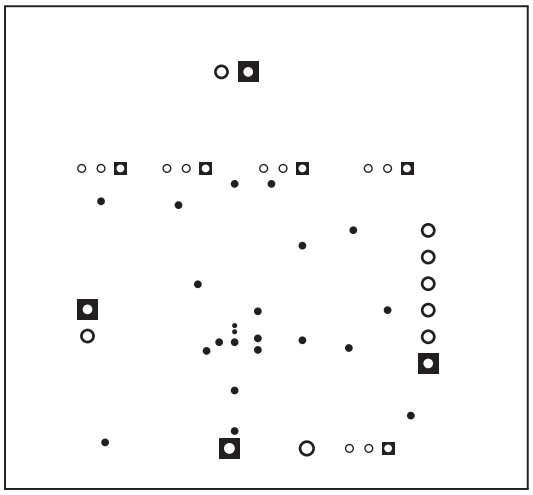


Figure 20. INA300EVM Bottom Solder Mask

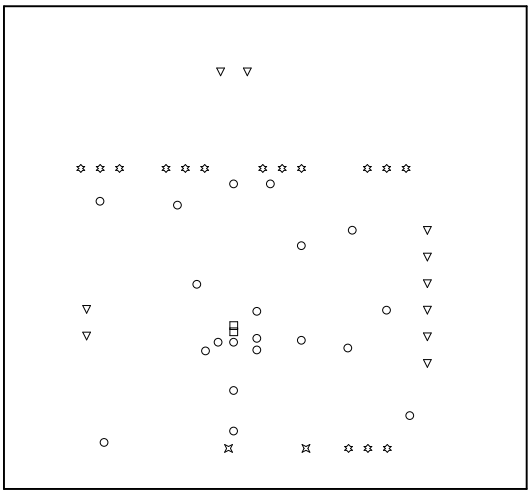


Figure 21. INA300EVM Drill Drawing

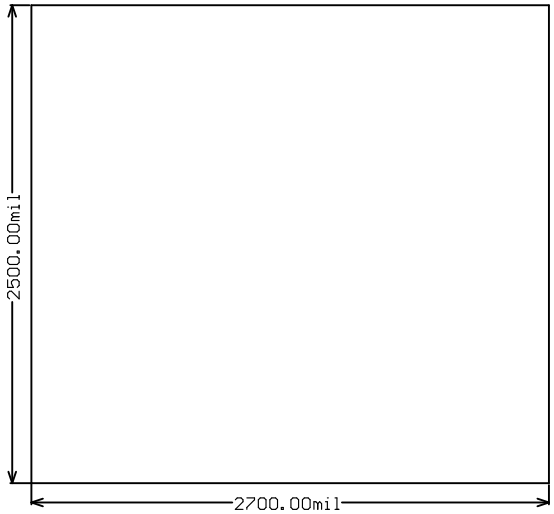


Figure 22. INA300EVM Board Dimensions

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INA300EVM Bill of Materials (BOM)

The INA300EVM bill of materials is listed in Table 2.

Table 2. Bill of Materials

Qty	Value	Ref Des	Description	Package Reference	Vendor	Part Number
13	SMT	ALERT, DELAY, ENABLE, GND, HYS, IN+, IN–, LATCH, LIMIT, VDD, VLIMIT	Test point, compact, SMT	Testpoint, Keystone, Compact	Keystone	5016
1	1 µF	C1	Capacitor, ceramic, 1 µF, 25 V, ±10%, X5R, 0805	0805	AVX	08053D105KAT2A
2	0.1 µF	C2, C3	Capacitor, ceramic, 0.1 µF, 25 V, ±10%, X5R, 0603	0603	AVX	06033D104KAT2A
1	Red	D1	LED, red, SMD	LED_0805	Lite-On	LTST-C170KRKT
4	—	H1-H4	Bumpon, hemisphere, 0.44 × 0.20, black	Black bumpon	3M	SJ-5003 (BLACK)
1	—	INA300	High or low side, bidirectional, zero-drift series, current sense comparator, DSQ0010A	QFN-10, 2 mm × 2 mm	Texas Instruments	INA300AIDSQ
5	—	J1-J5	Header, TH, 100 mil, 3 × 1, gold plated, 230 mil above insulator	TSW-103-07-G-S	Samtec, Inc	TSW-103-07-G-S
5	—	J1-J5	Strip, female socket, 1 × 2, open top, 0.100	Strip	TE Connectivity	2-382811-1
1	—	LBL1	Thermal transfer printable labels, 0.650" W × 0.200" H, 10000 per roll	PCB label, 0.650" H × 0.200" W	Brady	THT-14-423-10
1	—	R1	Resistor, 10 kΩ, 5%, 0.1 W, [0603]	0603	Stackpole	RMCF0603JT10K0
1	10 kΩ	R2	Resistor, 10 kΩ, 0.1%, 0.25 W, axial	Axial	Yageo	MFP-25BRD52-10K
1	10 kΩ	R3	Resistor, 470 Ω, 5%, 0.1 W, [0603]	0603	Vishay-Dale	CRCW0603470RJNEA
2	470 Ω	R4, R5	Resistor, 0 Ω, x%, x W, [PackageReference]	0603	Panasonic Electronic Components	ERJ-3GEY0R00V
2	0 Ω	T1, T2	Terminal block, 6 A, 3.5 mm pitch, 2-pos, TH	7.0 × 8.2 × 6.5 mm	On-Shore Technology, Inc	ED555/2DS
1	—	T3	Terminal block, 6 A, 3.5 mm pitch, 6-pos, TH	20.5 × 8.2 × 6.5 mm	On-Shore Technology, Inc	ED555/6DS

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EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

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.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 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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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI’s recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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