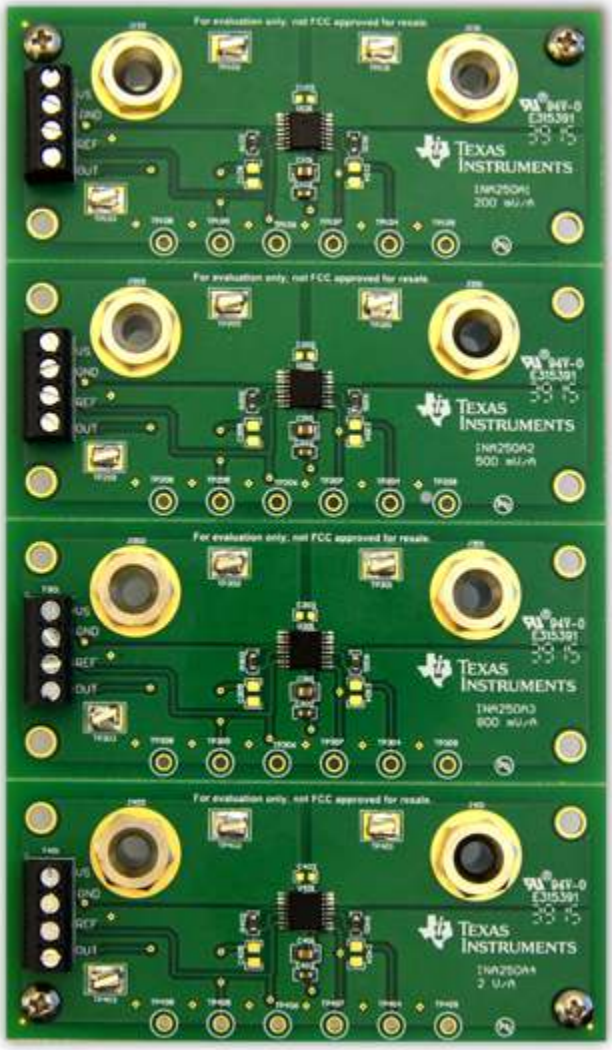
INA250AxEVM User's Guide



This user's guide describes the characteristics, operation, and use of the INA250AxEVM evaluation module. It discusses how to set up and configure the hardware and reviews various aspects of the hardware operation. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the INA250AxEVM. This document also includes an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM. NOTE: This user guide is for the new revision of the EVM board. For users of the original-version EVM board, see the previous EVM user's guide, SBOU153.

Contents

List of Figures

List of Tables

1 Overview

The INA250 is a family of voltage-output current-shunt monitors that integrate an internal shunt resistor to enable high-accuracy current measurements. The INA250 family of devices consists of the INA250A1, INA250A2, INA250A3, and INA250A4 (all referred to as INA250Ax).

The INA250AxEVM consists of one PCB with an option to cut out four individual PCBs. Each of the PCB cutouts consists of the INA250Ax device (where Ax is A1, A2, A3 and A4, for boards 1 through 4, respectively), banana-jack terminals, screw terminals, and test points for external hardware connections.

1.1 INA250EVM Kit Contents

Table 1 summarizes the contents of the INA250EVM kit. Contact the Texas Instruments Product Information Center nearest you if any component is missing. It is highly recommended that you also check the INA250 device product folder on the TI web site at www.ti.com for any further information regarding this product.

Table 1. INA250AxEVM Kit Contents

Item	Quantity
INA250 test board	1

1.2 Related Documentation from Texas Instruments

The following document provides information regarding Texas Instruments' integrated circuits used in the assembly of the INA250AxEVM. This user's guide is available from the TI web site under literature number SBOU153. 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 are be available from 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.

Table 2. Related Documentation

Document	Literature Number
INA250 product data sheet	SBOS511

2 Hardware

Each of the PCBs on the INA250AxEVM requires a 2.7-V to 36-V power supply connected between the VS and GND screw terminals. Alternately, the power supply can also be connected between test points TPx08 (VS) and TPx03 (GND) or TPx09 (GND).

The INA250Ax family of devices have an integrated shunt of value 2 mΩ between the SH+ and SH– pins. Connect a –0.1-V to +36-V supply in series with banana plugs Jx01 (IN+) and Jx02 (IN–), or test points TPx01 (IN+) and TPx02 (IN–), to provide a path for current flowing through the integrated shunt resistor. Use a voltmeter on the OUT screw terminal or test point TPx07 to measure the voltage output of the INA250Ax.

For the following components, x = 1 to 4.

Cx01 and Cx02 are supply bypass capacitors for the INA250Ax.

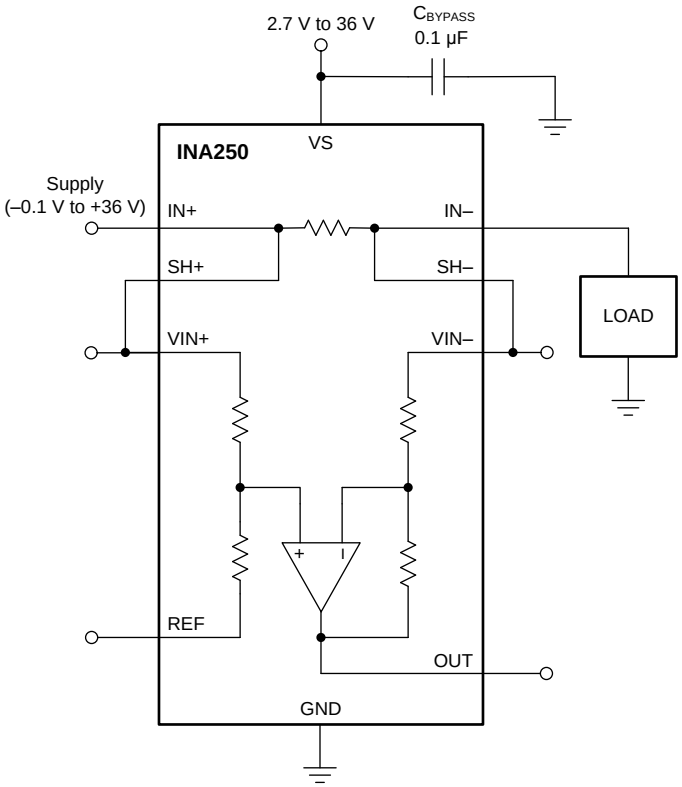
Rx01 is a 0-Ω resistor that ties SH+ to VIN+.

Rx02 is a 0-Ω resistor that ties SH– to VIN–.

Components Rx01, Rx02, Cx03, Cx04, and Cx05 can be added or replaced to provide optional filtering of the voltages out of the SH+ and SH– pins, and into the VIN+ and VIN– pins of the INA250Ax.

2.1 Theory of Operation

A block diagram of the INA250Ax test board hardware is shown in Figure 1.The INA250Ax test board contains a four-port, screw terminal block to connect to the supply (VS), ground (GND), reference (REF) and output (OUT) pins of the INA250Ax. There are ten test points located on each of the four PCB boards that access the IN+ (TPx01), IN– (TPx02), VIN+ (TPx04), VIN– (TPx05), REF (TPx06), OUT (TPx07), VS (TPx08), and GND (TPx03 and TPx09) pins of the device. Minimal support circuitry is included on the PCB, and can be removed or bypassed as needed.



NOTE: One block diagram shown for all four EVM boards. Block diagram is functionally equivalent for all four EVM boards.

Figure 1. INA250Ax Test Board Block Diagram

2.2 Features

The INA250AxEVM provides basic functional evaluation of this device family. The fixture layout is not intended for electromagnetic compatibility (EMC) testing.

The INA250AxEVM PCB provides the following features:

- Ease of access to device pins with test points
- Multiple signal connection options
- Board layout and construction that supports 15-A current through the device across the full –40°C to +125°C temperature range (see *Section 3.2*)
- Unpopulated component pads for optional input filtering with differential filter capacitor option included

Refer to the INA250 product data sheet, SBOS511, for comprehensive information about this family of current sense amplifiers.

2.3 Quick-Start Setup and Use

Follow these procedures to setup and use the INA250EVM:

1. Connect an external dc supply voltage between 2.7 V and 36 V to the VS screw terminal or test point TPx08, and connect the ground reference of that supply to the GND screw terminal or test point TPx03 or TPx09.
2. Connect an external dc supply voltage between 0 V and 18 V (referenced to the ground of the INA250Ax) to the REF screw terminal or test point TPx06.
3. Connect a current source across the Jx01 and Jx02 banana jacks, or across the IN+ (TPx01) and IN– (TPx02) test points, to provide current flowing through the integrated 2-mΩ shunt resistor. The common-mode voltage on the IN+ and IN– pins must be between –0.1 V and +36 V (referenced to the GND pin).

2.4 Current Input

The current flowing across the IN+ and IN– pins develops a differential voltage across the 2-mΩ shunt and is amplified by the current shunt amplifier. The current flowing across this integrated shunt is multiplied by the current gain of the INA250A1 (200 mV/A), INA250A2 (500 mV/A), INA250A3 (800 mV/A) or INA250A4 (2 V/A). Do not use this integrated shunt resistor as a stand-alone component. See the *Integrated Shunt Resistor* section of the INA250 data sheet (SBOS511) for more information.

3 Schematic, PCB Layout, and Bill of Materials

3.1 Schematic

Figure 2 shows the complete schematic of the INA250Ax test board. Components Rx01, Rx02, Cx03, Cx04, and Cx05 can be optionally added and replaced for an input filter. Keep the filter resistors to under 10 Ω to avoid excessive additional gain error. Banana jack terminals Jx01 and Jx02 give access to the IN+ and IN– pins, respectively. The VS, GND, REF, and OUT pins are accessed through screw terminal block Tx01, or through test points TPx08, TPx03 or TPx09, TPx06 and TPx07, respectively. All pins except for the shunt resistor Kelvin-connection pins (SH+ and SH–) are accessible using test points. The SH+ and SH– pins are initially shorted to VIN+ and VIN– using 0-Ω resistors Rx01 and Rx02, respectively.

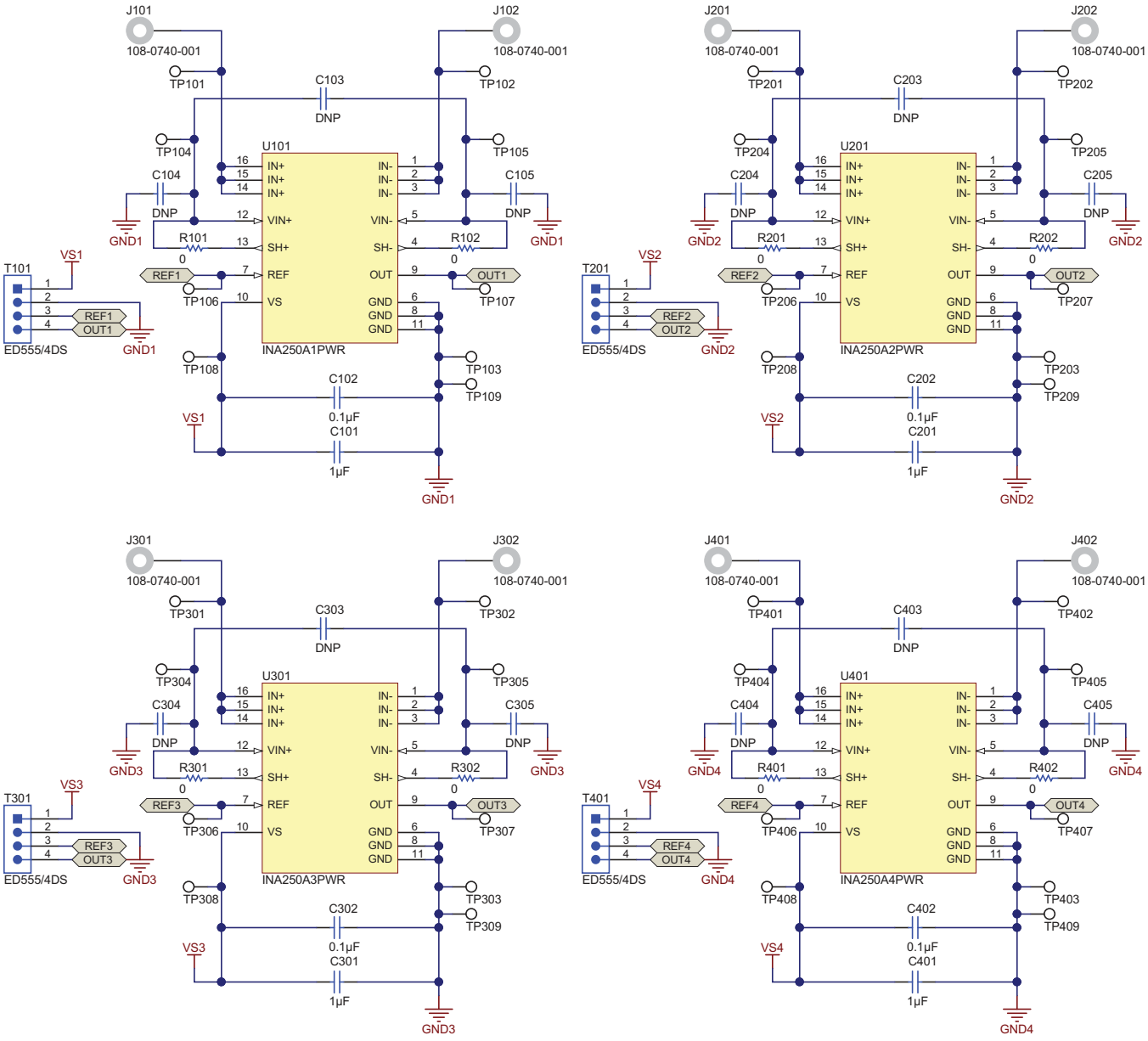


Figure 2. INA250Ax Test Board Schematic

3.2 PCB Layout

Figure 3 shows the component placement on the top layer of the test board. The two-layer EVM PCB measures 3.2-in × 5.5-in and is fabricated with a 1-oz copper pour. The bottom layer has no components but contains a solid copper ground plane that provides a low-impedance path for return currents.

The top layer of the PCB consists of power planes tied to the IN+ and IN– pins. These power planes are approximately 1.472-in × 0.553-in each. The INA250 is rated to support a 10-A continuous current over temperature. Enhance the current handling capability by using proper layout techniques that facilitate heat dissipation. Combine the large power planes at the IN+ and IN– pins. Use a 2-oz copper pour to improve the heat-dissipation capabilities, and thus increase the continuous-load current capacity.

Using the INA250AxEVM board with this robust layout and airflow, the INA250 device safely accommodates up to 15 A of current over the entire –40°C to +125°C temperature range. Figure 4 and Figure 5 show the top and bottom layers, respectively, of the test board.

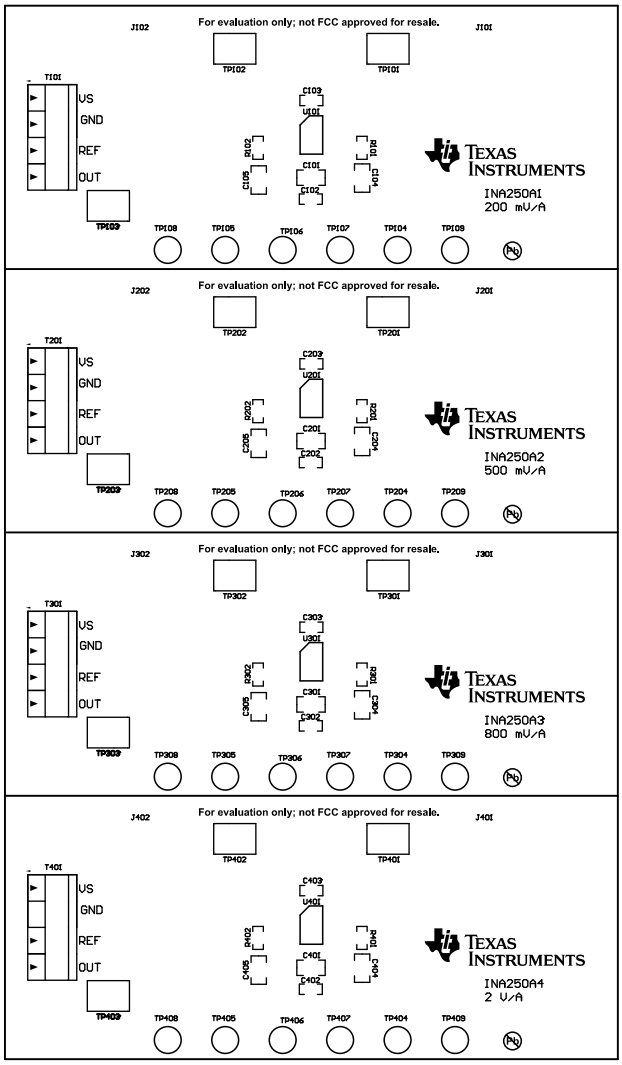


Figure 3. PCB Component Placement

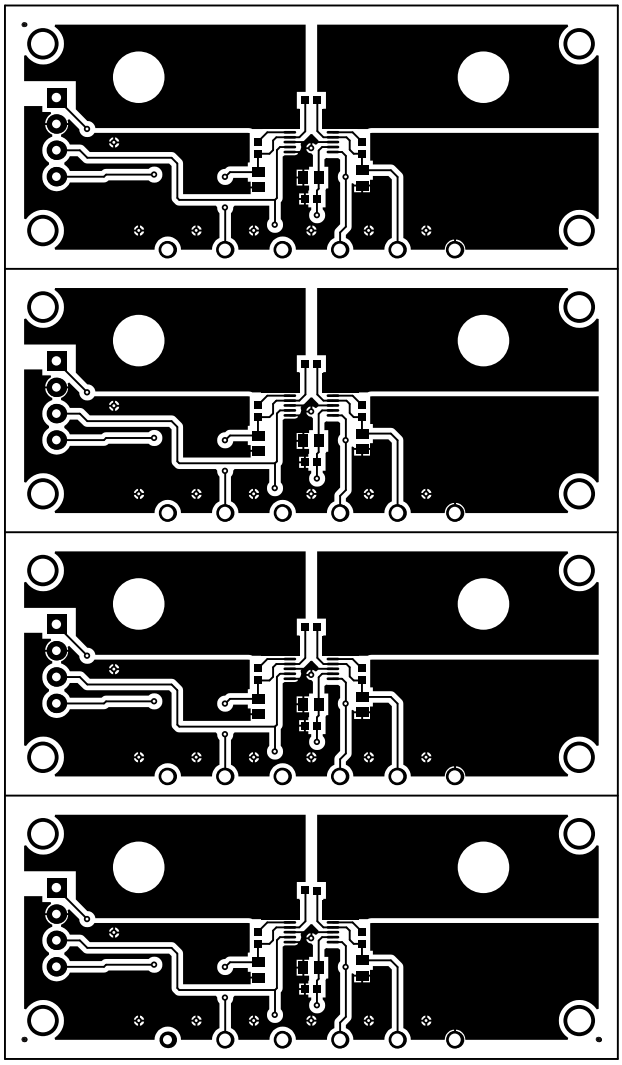


Figure 4. PCB Top Layer

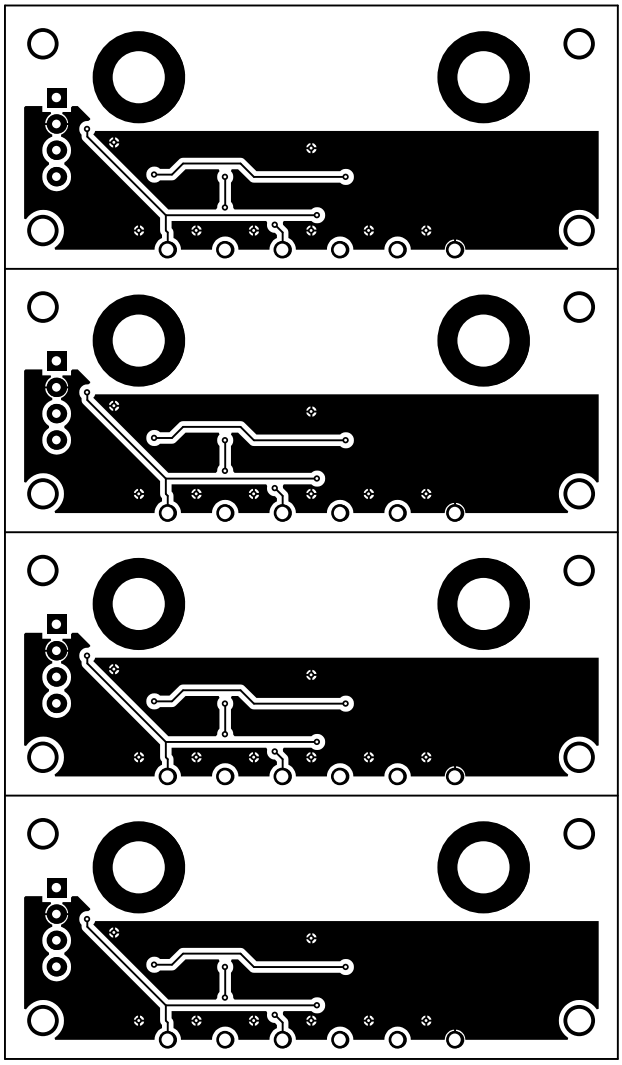


Figure 5. PCB Bottom Layer

3.3 Bill of Materials

Table 3 lists the bill of materials (BOM) for the INA250 test board.

Table 3. INA250Ax Test Board BOM

Quantity	RefDes	Description	Part Number	Manufacturer
4	C101, C201, C301, C401	CAP, CERM, 1uF, 50V, +/-10%, X7R, 0805	CL21B105KBFNNNE	Samsung Electro-Mechanics America, Inc
4	C102, C202, C302, C402	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	C1608X7R1H104K080AA	TDK Corporation
4	C103, C203, C303, C403	CAP, CERM, 0.1uF, 25V, +/-10%, X5R, 0603	06033D104KAT2A	AVX
8	C104, C105, C204, C205, C304, C305, C404, C405	CAP, CERM, 0.1uF, 25 V, +/-10%, X7R, 0805	08053C104KAT2A	AVX
24	TP104, TP105, TP106, TP107, TP108, TP109, TP204, TP205, TP206, TP207, TP208, TP209, TP304, TP305, TP306, TP307, TP308, TP309, TP404, TP405, TP406, TP407, TP408, TP409	Test Point, Multipurpose, White, TH	5012	Keystone
8	J101, J102, J201, J202, J301, J302, J401, J402	Standard Banana Jack, Uninsulated, 15A	108-0740-001	Emerson Network Power
8	R101, R102, R201, R202, R301, R302, R401, R402	RES, 0 ohm, 0603	ERJ-3GEY0R00V	Panasonic Electronic Components
4	T101, T201, T301, T401	Terminal Block, 6A, 3.5mm Pitch, 4-Pos, TH	ED555/4DS	On-Shore Technology
12	TP101, TP102, TP103, TP201, TP202, TP203, TP301, TP302, TP303, TP401, TP402, TP403	Test Point, Compact, SMT	5016	Keystone
1	U101	36-V, Low- or High-Side, Bidirectional, Zero-Drift Current-Shunt Monitor with Precision Integrated Shunt Resistor, PW0016A	INA250A1PW	Texas Instruments
1	U201	36-V, Low- or High-Side, Bidirectional, Zero-Drift Current-Shunt Monitor with Precision Integrated Shunt Resistor, PW0016A	INA250A2PW	Texas Instruments
1	U301	36-V, Low- or High-Side, Bidirectional, Zero-Drift Current-Shunt Monitor with Precision Integrated Shunt Resistor, PW0016A	INA250A3PW	Texas Instruments
1	U401	36-V, Low- or High-Side, Bidirectional, Zero-Drift Current-Shunt Monitor with Precision Integrated Shunt Resistor, PW0016A	INA250A4PW	Texas Instruments

Revision History

Changes from Original (May 2015) to A Revision	Page
• Changed user guide to include three additional devices (INA250A1, INA250A3, and INA250A4) to the existing INA250A2.	1

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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