INA1x9ハイサイド計測電流シャント・モニタ

1 特長

- 完全なユニポーラ・ハイサイド電流測定回路
- 広い電源電圧範囲と同相電圧範囲
- INA139：2.7V～40V
- INA169：2.7V～60V
- 独立した電源電圧と同相入力電圧
- 1つの抵抗器でゲインを設定可能
- 低い静止電流: 60µA (標準値)
- 5ピン、SOT-23パッケージ

2 アプリケーション

- 電流シャント測定:
  - 自動車、電話、コンピュータ
- ポータブル・システムやバッテリ・バックアップ・システム
- バッテリ充電器
- パワー・マネージメント
- 携帯電話
- 高精度電流源

3 概要

INA139とINA169は、ハイサイド・ユニポーラ電流シャント・モニタです。同相入力電圧範囲が広く、高速で、静止電流が小さく、小型のSOT-23パッケージに格納されているため、さまざまな用途に使用できます。

同相入力と電源電圧は独立しており、許容電圧範囲は、INA139の場合は2.7V～40V、INA169の場合は2.7V～60Vです。静止電流がわずかに60µAと小さいため、電流測定シャントのどちらの側にも電源を接続でき、誤差を最小限に抑えることができます。

本デバイスは差動入力電圧を電流出力に変換します。1～100以上の範囲で任意のゲインを設定できる外付けの負荷抵抗器を使用してこの電流が逆に変換され、電圧値が得られます。本回路は電流シャント測定向けに設計されていますが、測定やレベルシフトなど有効なさまざまなアプリケーションにご使用ください。

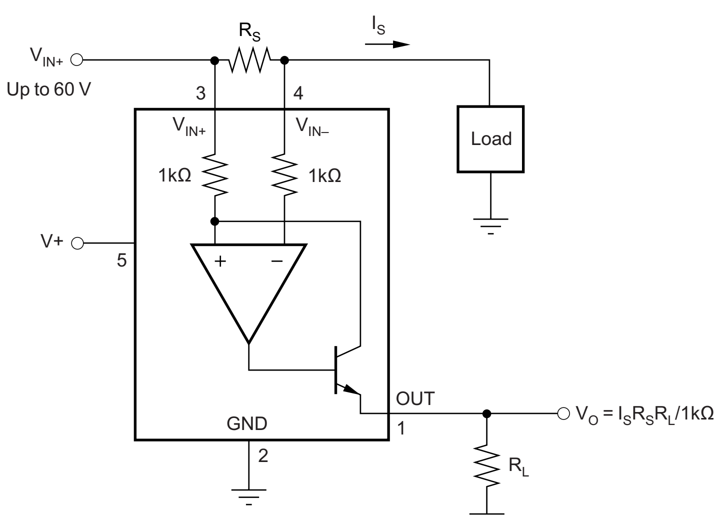
INA139とINA169はどちらも、5ピンのSOT-23パッケージで供給されます。INA139デバイスは-40℃～+125℃、INA169は-40℃～+85℃の温度範囲で動作が規定されています。

製品情報(1)

型番	パッケージ	本体サイズ(typ)
INA139	SOT-23 (5)	2.90mm×1.60mm
INA169	SOT-23 (5)	2.90mm×1.60mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

代表的なアプリケーション回路



目次

4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision E (December 2015) から Revision F に変更 **Page**

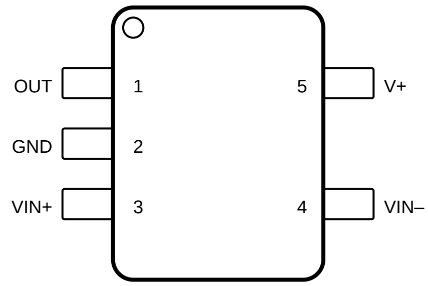
- 「*概要*」セクションでINA139の最大温度仕様を+85℃から+125℃に 変更 ... 1
- 「*概要*」セクションでINA139デバイスの最大温度仕様を+85℃から+125℃に 変更 ... 1
- 表紙の「*代表的なアプリケーション回路*」グラフィックを更新し、Copyright 2017を追加 ... 1
- Updated pinout diagram in *Pin Configurations and Functions* section ... 3
- Reformatted *Recommended Operating Conditions* table ... 4
- Changed common-mode rejection minimum value from 100 dB to 99 dB in the *Electrical Characteristics* table ... 6
- Changed offset voltage maximum value from ±1 mV to ±1.5 mV in the *Electrical Characteristics* table ... 6
- Changed INA139 nonlinearity error maximum value from ±0.1% to ± 0.13% in the *Electrical Characteristics* table ... 6
- Changed maximum value of INA139 temperature range specification from 85°C to 125°C in the *Electrical Characteristics* table ... 6
- 追加 updated copyright statement to *Functional Block Diagram* ... 9

Revision D (November 2005) から Revision E に変更 **Page**

- 「*ESD定格*」表、「*機能説明*」セクション、「*デバイスの機能モード*」セクション、「*アプリケーションと実装*」、「*電源に関する推奨事項*」セクション、「*レイアウト*」、「*デバイスおよびドキュメントのサポート*」セクション、「*メカニカル、パッケージ、および注文情報*」セクション 変更 ... 1

5 Pin Configuration and Functions

**DBV Package
5-Pin SOT-23
Top View**



Not to scale

Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
GND	2	—	Ground
OUT	1	O	Output current
VIN+	3	I	Positive input voltage
VIN–	4	I	Negative input voltage
V+	5	I	Power supply voltage

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Supply voltage, V_S	INA139	–0.3	60	V
	INA169	–0.3	75	V
Analog inputs, INA139	Common-mode (2)	–0.3	60	V
	Differential $(V_{IN+}) – (V_{IN–})$	–40	2	V
Analog inputs, INA169	Common-mode (2)	–0.3	75	V
	Differential $(V_{IN+}) – (V_{IN–})$	–40	2	V
Analog input, out (2)		–0.3	40	V
Input current into any pin			10	mA
Operating temperature, T_A		–55	125	°C
Junction temperature, T_J			150	°C
Storage temperature, T_{stg}		–65	125	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The input voltage at any pin may exceed the voltage shown if the current at that pin is limited to 10 mA.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±1000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
V+	Power-supply voltage	INA139	2.7	5	40	V
		INA169	2.7	5	60	
	Common-mode voltage	INA139	2.7	12	40	V
		INA169	2.7	12	60	

6.4 Thermal Information

THERMAL METRIC[1]		INA1x9 DBV (SOT-23) 5 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	168.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	73.8	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	28.1	°C/W
ψ_{JT}	Junction-to-top characterization parameter	2.5	°C/W
ψ_{JB}	Junction-to-board characterization parameter	27.6	°C/W

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

6.5 Electrical Characteristics

INA139: all other characteristics at T_A = –40°C to +125°C, V_+ = 5 V, V_{IN+} = 12 V, and R_{OUT} = 25 kΩ, unless otherwise noted
INA169: all other characteristics at T_A = –40°C to +85°C V_+ = 5 V, V_{IN+} = 12 V, and R_{OUT} = 25 kΩ, unless otherwise noted

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
INPUT						
Full-scale sense voltage	$V_{SENSE} = V_{IN+} - V_{IN-}$			100	500	mV
Common-mode input range	INA139		2.7		40	V
	INA169		2.7		60	
Common-mode rejection	INA139: V_{IN+} = 2.7 V to 40 V, V_{SENSE} = 50 mV		99	115		dB
	INA169: V_{IN+} = 2.7 V to 60 V, V_{SENSE} = 50 mV		100	120		dB
Offset voltage (1) RTI	INA139			±0.2	±1.5	mV
	INA169			±0.2	±1	
vs. temperature	T_{MIN} to T_{MAX}			1		µV/°C
vs power supply (V+)	INA139: V+ = 2.7 V to 40 V, V_{SENSE} = 50 mV			0.5	10	µV/V
	INA169: V+ = 2.7 V to 60 V, V_{SENSE} = 50 mV			0.1	10	µV/V
Input bias current				10		µA
OUTPUT						
Transconductance vs temperature	V_{SENSE} = 10 mV – 150 mV		990	1000	1010	µA/V
	V_{SENSE} = 10 mV			10		nA/°C
Nonlinearity error	V_{SENSE} = 10 mV to 150 mV	INA139		±0.01%	±0.13%	
		INA169		±0.01%	±0.1%	
Total output error	V_{SENSE} = 100 mV			±0.5%	±2%	
Output impedance				1 || 5		GΩ || pF
Voltage output	Swing to power supply, V+			(V+) – 0.9	(V+) – 1.2	V
	Swing to common-mode, V_{CM}			V_{CM} – 0.6	V_{CM} – 1	
FREQUENCY RESPONSE						
Bandwidth	R_{OUT} = 10 kΩ			440		kHz
	R_{OUT} = 20 kΩ			220		kHz
Settling time (0.1%)	5-V step, R_{OUT} = 10 kΩ			2.5		µs
	5-V step, R_{OUT} = 20 kΩ			5		µs
NOISE						
Output-current noise density				20		pA/√Hz
Total output-current noise	BW = 100 kHz			7		nA RMS
POWER SUPPLY						
Operating range, V+	INA139		2.7		40	V
	INA169		2.7		60	V
Quiescent current	V_{SENSE} = 0, I_O = 0			60	125	µA
TEMPERATURE RANGE						
Specification, T_{MIN} to T_{MAX}	INA139		–40		125	°C
	INA169		–40		85	°C
Operating			–55		125	°C
Storage			–65		150	°C
Thermal resistance, θ_{JA}				200		°C/W

(1) Defined as the amount of voltage (V_{SENSE}) to drive the output to zero.

6.6 Typical Characteristics

at T_A = 25°C, V+ = 5 V, V_{IN+} = 12 V, and R_L = 125 kΩ, unless otherwise noted.

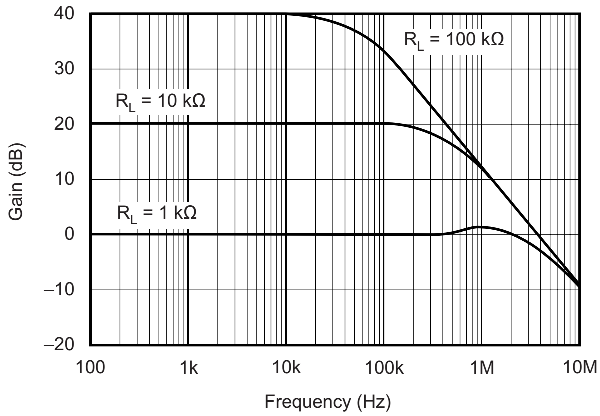


図 1. Gain vs Frequency

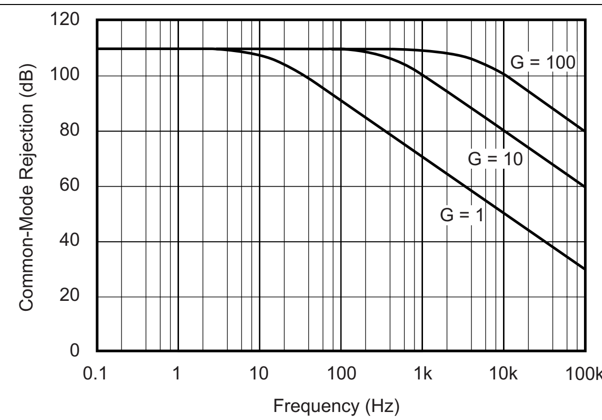


図 2. Common-Mode Rejection vs Frequency

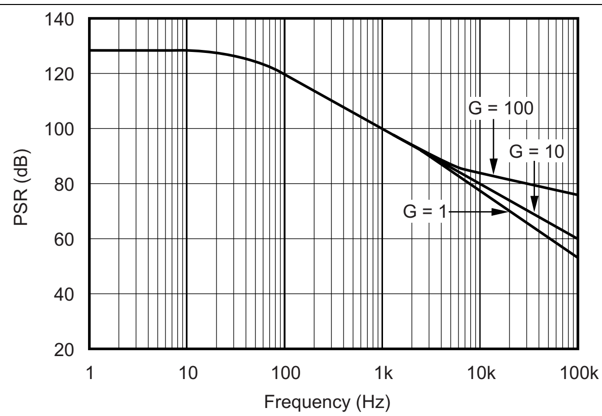


図 3. Power-Supply Rejection vs Frequency

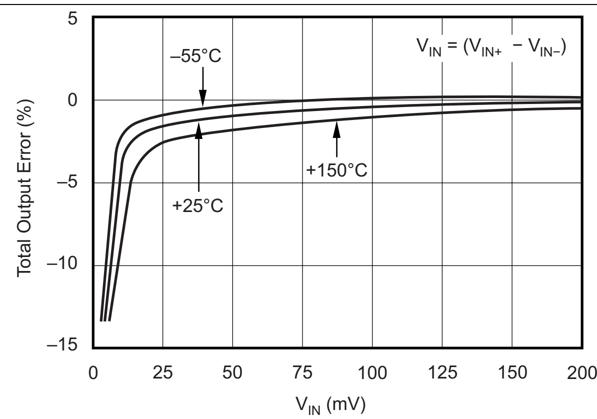
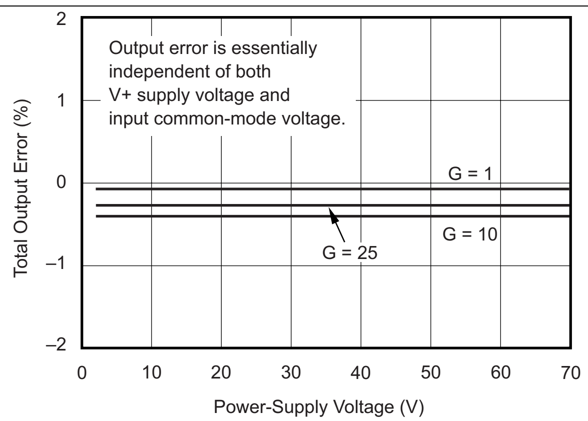


図 4. Total Output Error vs V_{IN}



Output error is essentially independent both of V+ supply voltage and input common-mode voltage.

図 5. Total Output Error vs Power-Supply Voltage

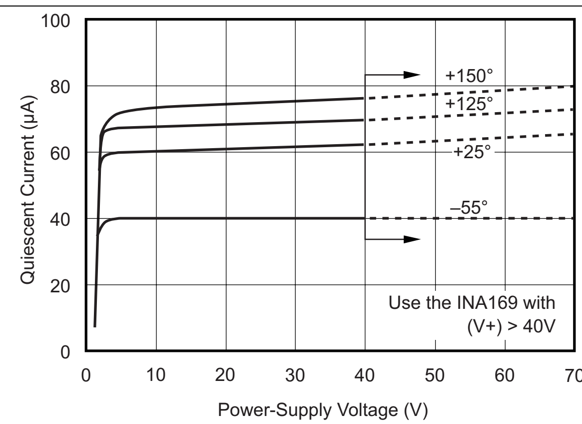


図 6. Quiescent Current vs Power-Supply Voltage

Typical Characteristics (continued)

at T_A = 25°C, V+ = 5 V, V_{IN+} = 12 V, and R_L = 125 kΩ, unless otherwise noted.

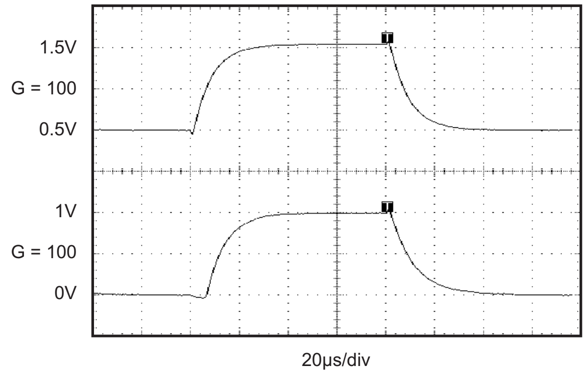


図 7. Step Response

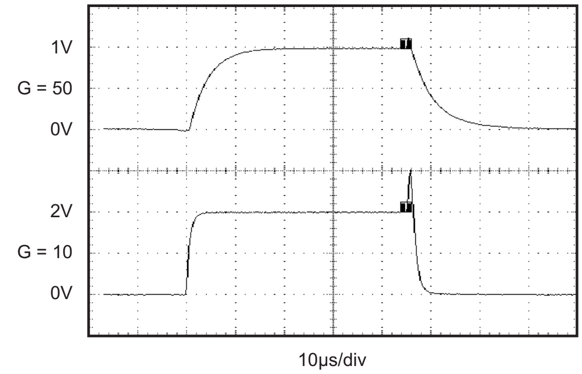


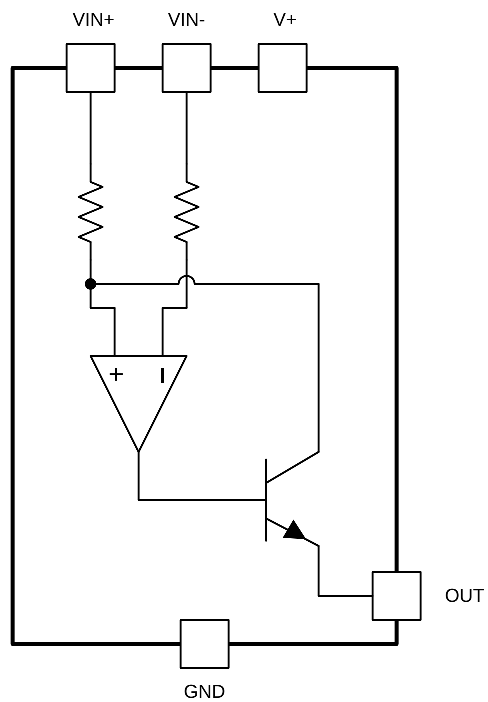
図 8. Step Response

7 Detailed Description

7.1 Overview

The INA139 and INA169 devices are comprised of a high voltage, precision operational amplifier, precision thin film resistors trimmed in production to an absolute tolerance and a low noise output transistor. The INA139 and INA169 devices can be powered from a single power supply and their input voltages can exceed the power supply voltage. The INA139 and INA169 devices are ideal for measuring small differential voltages, such as those generated across a shunt resistor in the presence of large, common-mode voltages. See the *Functional Block Diagram*, which illustrates the functional components within both the INA139 and INA169 devices.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Output Voltage Range

The output of the INA139 is a current, which is converted to a voltage by the load resistor (R_L). The output current remains accurate within the *compliance voltage range* of the output circuitry. The shunt voltage and the input common-mode and power-supply voltages limit the maximum possible output swing. The maximum output voltage compliance is limited by the lower of 式 1 and 式 2.

$$V_{OUTMAX} = (V+) - 0.7\ V - (V_{IN+} - V_{IN-}) \quad (1)$$

or whichever is lower

$$V_{OUTMAX} = V_{IN-} - 0.5\ V \quad (2)$$

Feature Description (continued)

7.3.2 Bandwidth

Measurement bandwidth is affected by the value of the load resistor (R_L). High gain produced by high values of R_L yield a narrower measurement bandwidth (see the *Typical Characteristics* graphs). For widest possible bandwidth, keep the capacitive load on the output to a minimum. Reduction in bandwidth due to capacitive load is shown in the *Typical Characteristics* graphs.

If bandwidth limiting (filtering) is desired, a capacitor can be added to the output (see 図 12). This does not cause instability.

7.4 Device Functional Modes

For proper operation the INA139 and INA169 devices must operate within their specified limits. Operating either device outside of their specified power supply voltage range or their specified common-mode range results in unexpected behavior and is not recommended. Additionally operating the output beyond their specified limits with respect to power supply voltage and input common-mode voltage will also produce unexpected results. See the *Electrical Characteristics* table for device specifications.

8 Application and Implementation

注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

8.1.1 Operation

図 9 illustrates the basic circuit diagram for both the INA139 and INA169. Load current I_S is drawn from supply V_S through shunt resistor R_S. The voltage drop in shunt resistor V_S is forced across R_{G1} by the internal operational amplifier, causing current to flow into the collector of Q1. The external resistor R_L converts the output current to a voltage, V_{OUT}, at the OUT pin.

The transfer function for the INA139 is given by 式 3:

$$I_O = g_m \left(V_{IN+} - V_{IN-}\right)$$

where

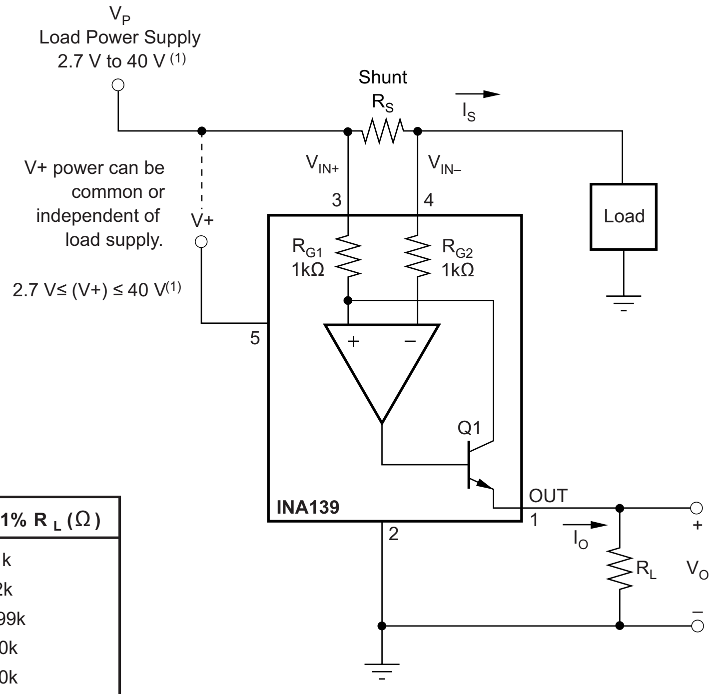
- g_m = 1000 µA/V (3)

In the circuit of 図 9, the input voltage ($V_{IN+} - V_{IN-}$) is equal to $I_S \times R_S$ and the output voltage(V_{OUT}) is equal to $I_O \times R_L$. The transconductance (g_m) of the INA139 is 1000 µA/V. The complete transfer function for the current measurement amplifier in this application is given by 式 4:

$$V_{OUT} = \left(I_S\right)\left(R_S\right)(1000\ \mu A / V)\left(R_L\right) \quad (4)$$

The maximum differential input voltage for accurate measurements is 0.5 V, which produces a 500-µA output current. A differential input voltage of up to 2 V will not cause damage. Differential measurements (pins 3 and 4) must be unipolar with a more-positive voltage applied to pin 3. If a more-negative voltage is applied to pin 3, the output current, I_O, is zero, but it will not cause damage.

Application Information (continued)



VOLTAGE GAIN	EXACT R_L (Ω)	NEAREST 1% R_L (Ω)
1	1k	1k
2	2k	2k
5	5k	4.99k
10	10k	10k
20	20k	20k
50	50k	49k
100	100k	100k

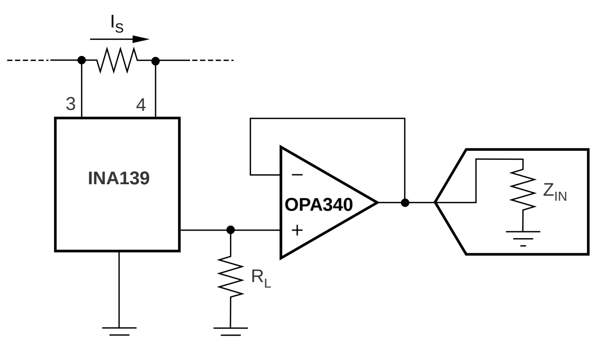
(1) For the INA169 device, maximum V_P and V+ voltage is 60 V.

図 9. Basic Circuit Connections

8.2 Typical Applications

The INA139 is designed for current shunt measurement circuits, as shown in 図 9, but its basic function is useful in a wide range of circuitry. A creative engineer will find many unforeseen uses in measurement and level shifting circuits. A few ideas are illustrated in 図 14 through 図 18.

8.2.1 Buffering Output to Drive an ADC



(1) Buffer of amp drives the A/D converter without effecting gain

図 10. Buffering Output to Drive the A/D Converter

8.2.1.1 Design Requirements

Digitize the output of the INA139 or INA169 devices using a 1-MSPS analog-to-digital converter (ADC).

Typical Applications (continued)

8.2.1.2 Detailed Design Procedure

8.2.1.2.1 Selecting R_S and R_L

In 図 9 the value selected for the shunt resistor (R_S) depends on the application and is a compromise between small-signal accuracy and maximum permissible voltage loss in the measurement line. High values of R_S provide better accuracy at lower currents by minimizing the effects of offset, while low values of R_S minimize voltage loss in the supply line. For most applications, best performance is attained with an R_S value that provides a full-scale shunt voltage of 50 mV to 100 mV; maximum input voltage for accurate measurements is 500 mV.

R_L is selected to provide the desired full-scale output voltage. The output impedance of the INA139 and INA169 OUT terminal is very high, which permits using values of R_L up to 100 kΩ with excellent accuracy. The input impedance of any additional circuitry at the output must be much higher than the value of R_L to avoid degrading accuracy.

Some analog-to-digital converters (ADCs) have input impedances that significantly affect measurement gain. The input impedance of the ADC can be included as part of the effective R_L if the input can be modeled as a resistor to ground. Alternatively, an operational amplifier can be used to buffer the ADC input, as shown in 図 10. The INA139 and INA169 are current output devices, and have an inherently large output impedance. The output currents from the amplifier are converted to an output voltage through the load resistor (R_L) connected from the amplifier output to ground. The ratio of the load resistor value to that of the internal resistor value determines the voltage gain of the system.

In many applications, digitizing the output of the INA139 or INA169 devices is required. This is accomplished by connecting the output of the amplifier to an ADC. It is very common for an ADC to have a dynamic input impedance. If the INA139 or INA169 output is connected directly to an ADC input, the input impedance of the ADC is effectively connected in parallel with the gain setting resistor (R_L.) This parallel impedance combination affects the gain of the system and the impact on the gain is difficult to estimate accurately. A simple solution that eliminates the paralleling of impedances, simplifying the gain of the circuit is to place a buffer amplifier (such as the OPA340) between the output of the INA139 or INA169 devices and the input to the ADC.

図 10 illustrates this concept. A low-pass filter can be placed between the OPA340 output and the input to the ADC. The filter capacitor is required to provide any instantaneous demand for current required by the input stage of the ADC. The filter resistor is required to isolate the OPA340 output from the filter capacitor to maintain circuit stability. The values for the filter components vary according to the operational amplifier used for the buffer and the particular ADC selected. For more information regarding the design of the low-pass filter, see the *16-bit 1-MSPS Data Acquisition Reference Design for Single-Ended Multiplexed Applications* TI Precision Design.

図 11 shows the expected results when driving an analog-to-digital converter at 1 MSPS with and without buffering the INA139 or INA169 output. Without the buffer, the high impedance of the INA139 or INA169 reacts with the input capacitance and sample and hold (S/H) capacitance of the analog-to-digital converter and does not allow the S/H to reach the correct final value before the S/H resets and the next conversion starts. Adding the buffer amplifier significantly reduces the output impedance driving the S/H and allows for higher conversion rates than can be achieved without adding the buffer.

Typical Applications (continued)

8.2.1.3 Application Curve

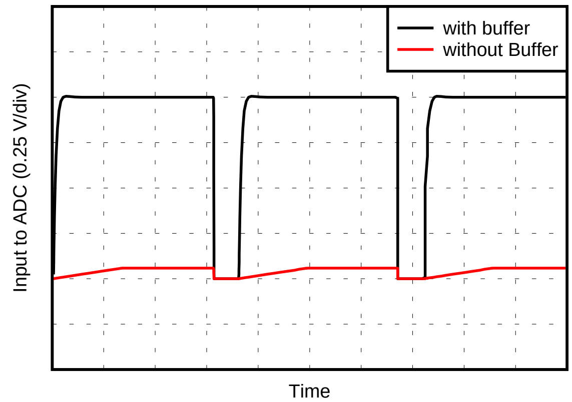


図 11. Driving an ADC With and Without a Buffer

8.2.2 Output Filter

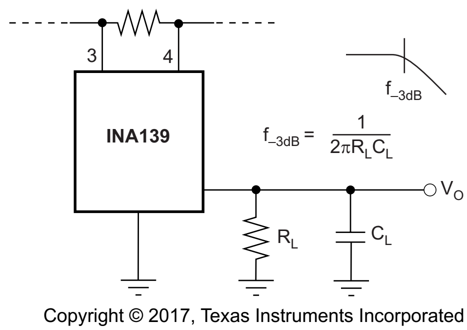


図 12. Output Filter

8.2.2.1 Design Requirements

Filter the output of the INA139 or INA169 devices.

8.2.2.2 Detailed Design Procedure

A low-pass filter can be formed at the output of the INA139 or INA169 devices simply by placing a capacitor of the desired value in parallel with the load resistor. First, determine the value of the load resistor required to achieve the desired gain. See the table in 図 9. Next, determine the capacitor value that results in the desired cutoff frequency according to the equation shown in 図 12. 図 13 illustrates various combinations of gain settings (determined by R_L) and filter capacitors.

Typical Applications (continued)

8.2.2.3 Application Curve

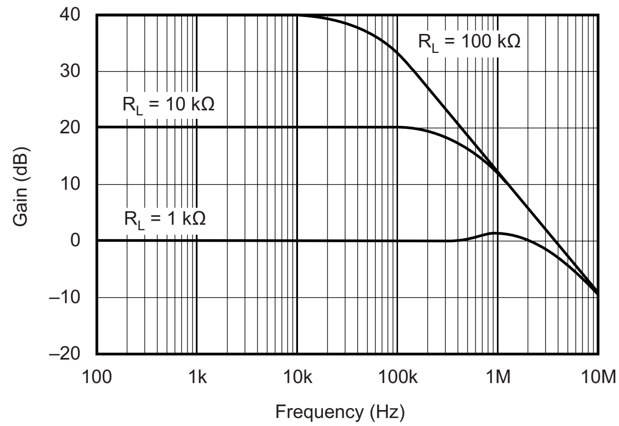
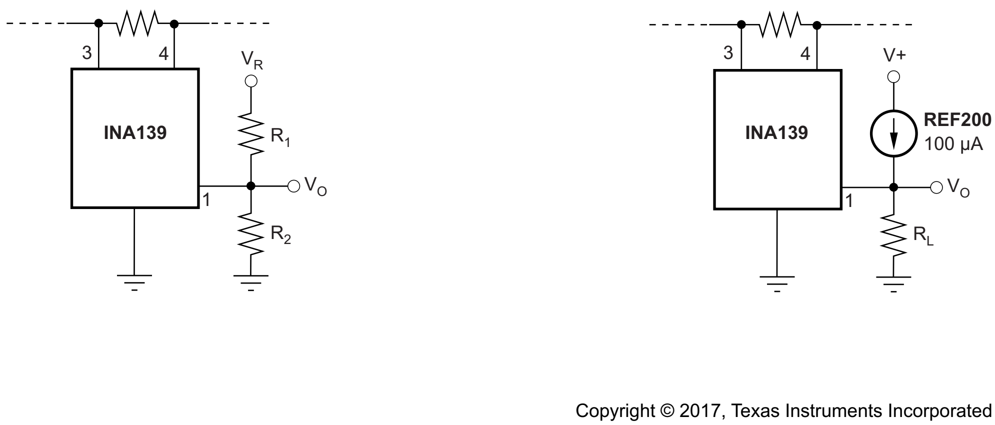


図 13. Gain vs Frequency

8.2.3 Offsetting the Output Voltage

For many applications using only a single power supply, it may be required to level shift the output voltage away from ground when there is no load current flowing in the shunt resistor. Level shifting the output of the INA139 or INA169 devices is easily accomplished by one of two simple methods shown in 図 14. The method on the left hand side of 図 14 illustrates a simple voltage divider method. This method is useful for applications that require the output of the INA139 or INA169 devices to remain centered with respect to the power supply at zero load current through the shunt resistor. Using this method the gain is determined by the parallel combination of R_1 and R_2, while the output offset is determined by the voltage divider ratio R_1 and R_2. For applications that may require a fixed value of output offset independent of the power supply voltage, TI recommends using the current source method shown on the right hand side of 図 14 . With this method, a REF200 constant current source is used to generate a constant output offset. Using this method. the gain is determined by R_L and the offset is determined by the product of the value of the current source and R_L.



(1) Gain set by $R_1 \parallel R_2$. Output offset = $(V_R) R_2 / (R_1 + R_2)$ using resistor divider.

(2) Gain set by R_L. Output offset = 100 µA × R_L (independent of V+) using current source.

図 14. Offsetting the Output Voltage

Typical Applications (continued)

8.2.4 Bipolar Current Measurement

The INA139 or INA169 devices can be configured as shown in 図 15 in applications where measuring current bi-directionally is required. Two INA devices are required connecting their inputs across the shunt resistor as shown in 図 15. A comparator, such as the TLV3201, is used to detect the polarity of the load current. The magnitude of the load current is monitored across the resistor connected between ground and the connection labeled *Output*. In this example the 20-kΩ resistor results in a gain of 20 V/V. The 10-kΩ resistors connected in series with the INA139 or INA169 output current are used to develop a voltage across the comparator inputs. Two diodes are required to prevent current flow into the INA139 or INA169 output, as only one device at a time is providing current to the *Output* connection of the circuit. The circuit functionality is illustrated in 図 16.

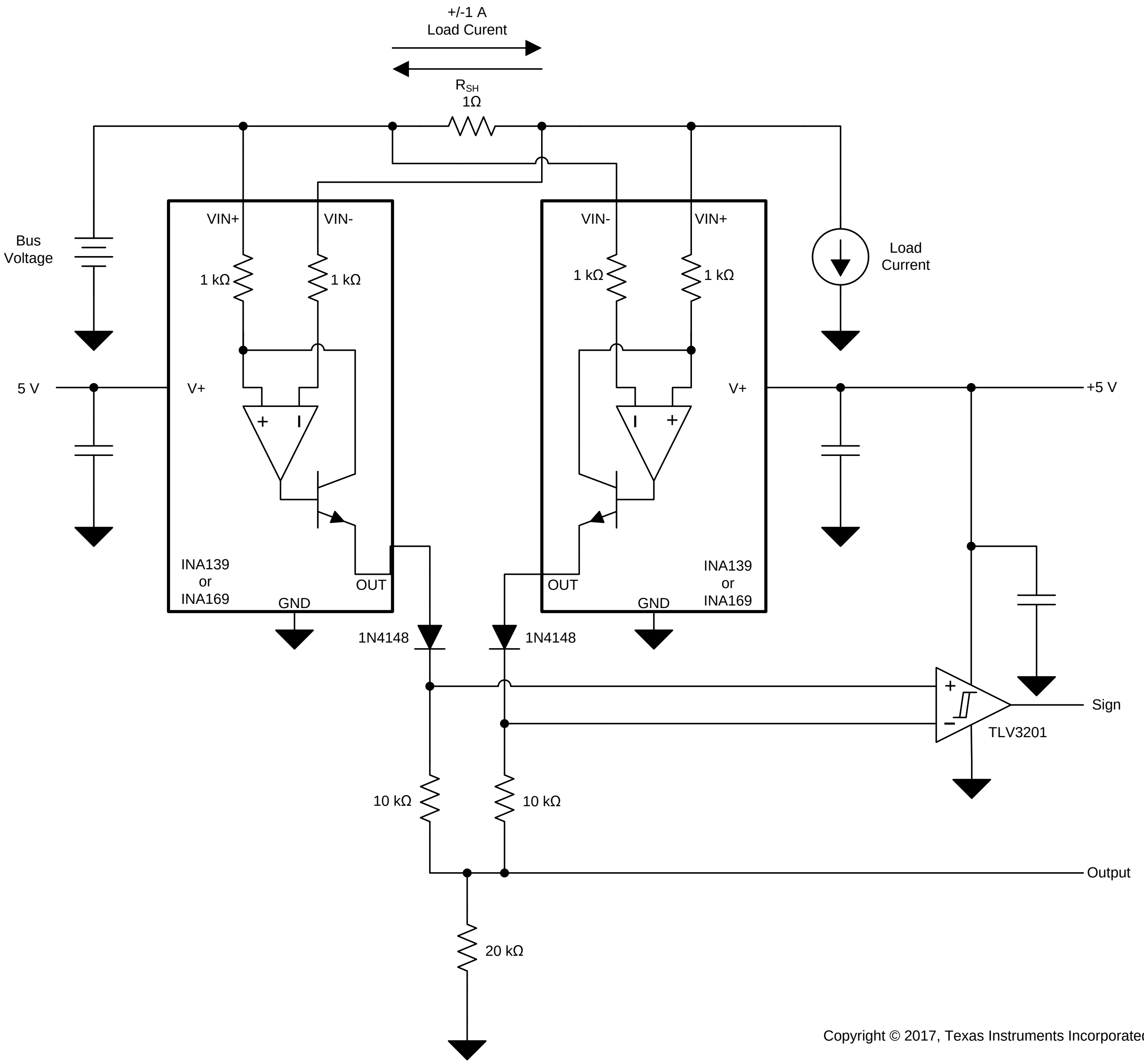


図 15. Bipolar Current Measurement

Typical Applications (continued)

8.2.4.1 Application Curve

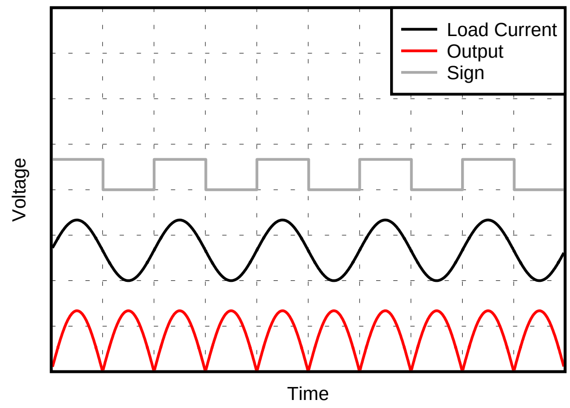


図 16. Bipolar Current Measurement Results (Arbitrary Scale)

8.2.5 Bipolar Current Measurement Using a Differential Input of the A/D Converter

The INA139 or INA169 devices can be used with an ADC such as the ADS7870 programmed for differential mode operation. 図 17 illustrates this configuration. In this configuration, the use of two devices allows for bidirectional current measurement. Depending upon the polarity of the current, one of the devices provides an output voltage while the other output is zero. In this way, the ADC reads the polarity of current directly, without requiring additional circuitry.

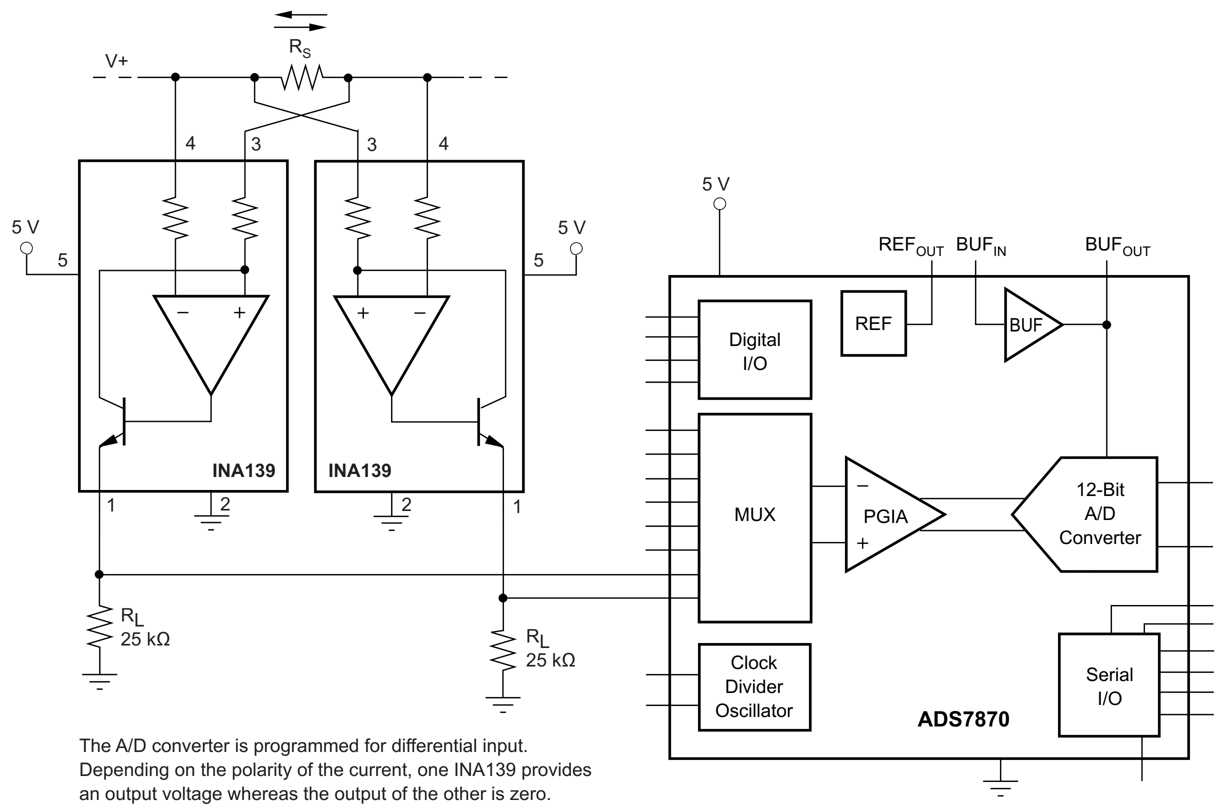


図 17. Bipolar Current Measurement Using a Differential Input of the A/D Converter

Typical Applications (continued)

8.2.6 Multiplexed Measurement Using Logic Signal for Power

Multiple loads can be measured as illustrated in 図 18. In this configuration, each INA139 or INA169 device is powered by the digital I/O from the ADS7870. Multiplex each device by switching the desired I/O on or off.

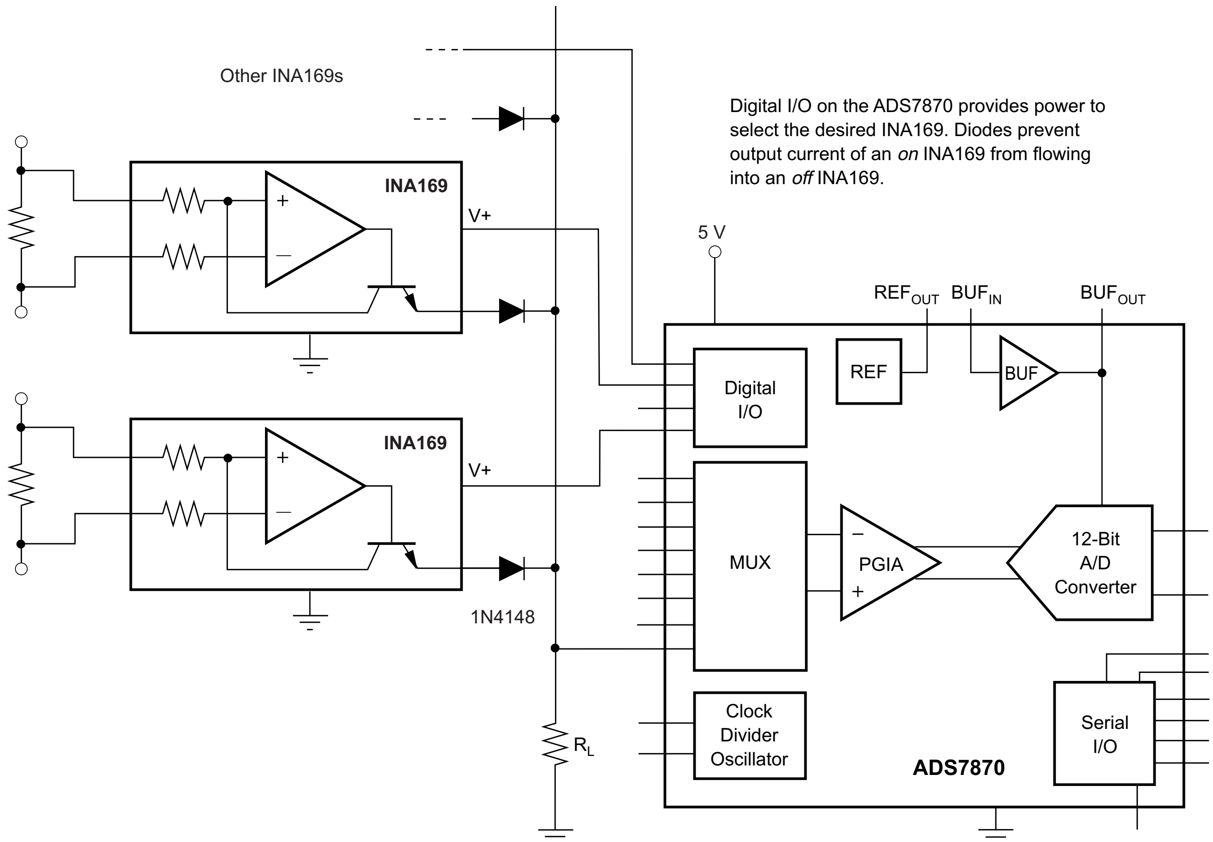


図 18. Multiplexed Measurement Using Logic Signal for Power

9 Power Supply Recommendations

The input circuitry of the INA139 can accurately measure beyond the power-supply voltage (V+). For example, the V+ power supply can be 5 V, whereas the load power supply voltage is up to 40 V (or 60 V with the INA169). However, the output voltage range of the OUT terminal is limited by the lesser of the two voltages (see the *Output Voltage Range* section). TI recommends placing a 0.1-µF capacitor near the V+ pin on the INA139 or INA169. Additional capacitance may be required for applications with noisy supply voltages.

10 Layout

10.1 Layout Guidelines

図 19 shows the basic connection of the INA139. The input pins (V_{IN+} and $V_{IN–}$) must be connected as closely as possible to the shunt resistor to minimize any resistance in series with the shunt resistance. The output resistor, R_L, is shown connected between pin 1 and ground. Best accuracy is achieved with the output voltage measured directly across R_L. This is especially important in high-current systems where load current could flow in the ground connections, affecting the measurement accuracy.

No power-supply bypass capacitors are required for stability of the INA139. However, applications with noisy or high-impedance power supplies may require decoupling capacitors to reject power-supply noise; connect the bypass capacitors close to the device pins.

10.2 Layout Example

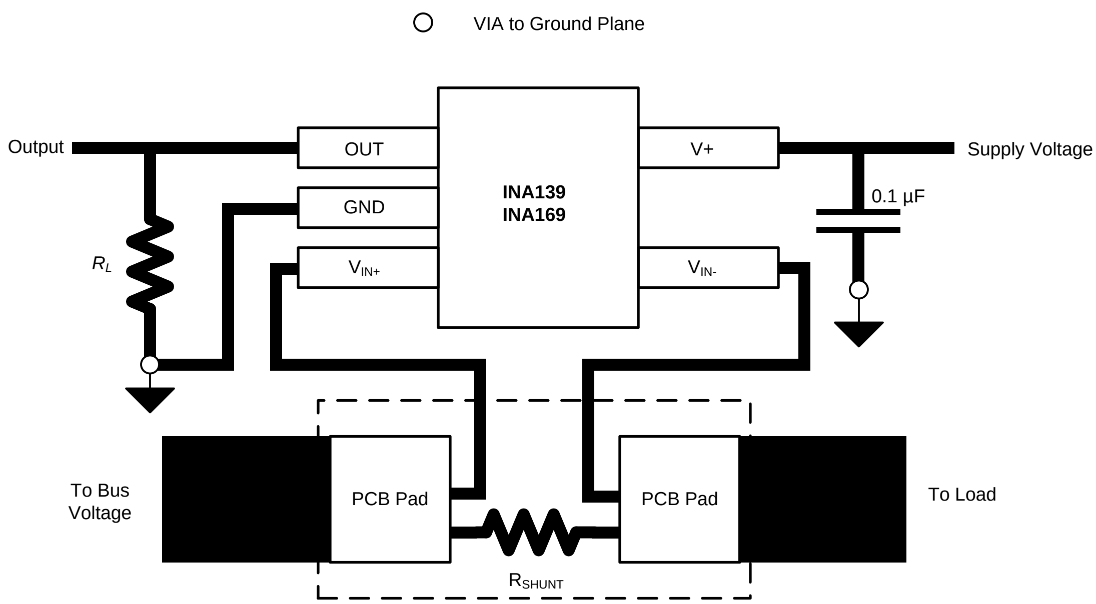


図 19. Typical Layout Example

11 デバイスおよびドキュメントのサポート

11.1 関連リンク

次の表に、クイック・アクセス・リンクを示します。カテゴリには、技術資料、サポートおよびコミュニティ・リソース、ツールとソフトウェア、およびサンプル注文またはご購入へのクイック・アクセスが含まれます。

表 1. 関連リンク

製品	プロダクト・フォルダ	ご注文はこちら	技術資料	ツールとソフトウェア	サポートとコミュニティ
INA139	ここをクリック	ここをクリック	ここをクリック	ここをクリック	ここをクリック
INA169	ここをクリック	ここをクリック	ここをクリック	ここをクリック	ここをクリック

11.2 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

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設計サポート ***TIの設計サポート*** 役に立つE2Eフォーラムや、設計サポート・ツールをすばやく見つけることができます。技術サポート用の連絡先情報も参照できます。

11.3 商標

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11.4 静電気放電に関する注意事項

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11.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
INA139NA/250	ACTIVE	SOT-23	DBV	5	250	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	E39	Samples
INA139NA/3K	ACTIVE	SOT-23	DBV	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	E39	Samples
INA169NA/250	ACTIVE	SOT-23	DBV	5	250	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	A69	Samples
INA169NA/3K	ACTIVE	SOT-23	DBV	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	A69	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF INA139, INA169 :

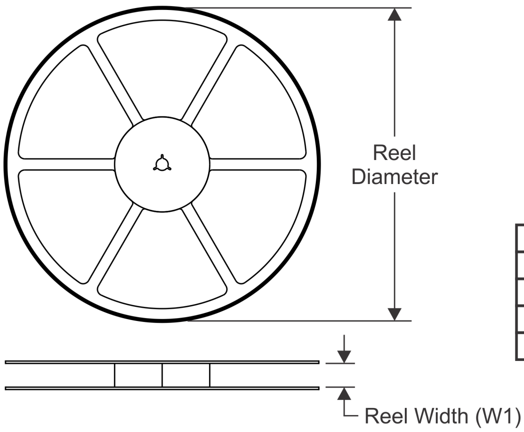
- Automotive : INA139-Q1, INA169-Q1

NOTE: Qualified Version Definitions:

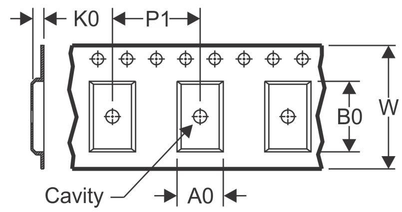
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

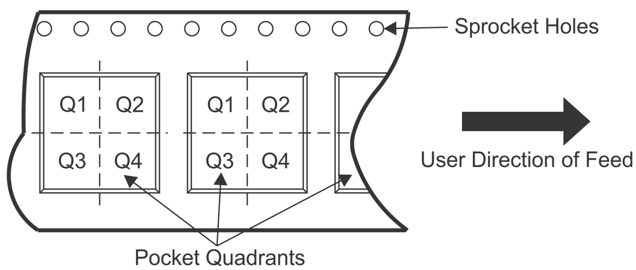


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

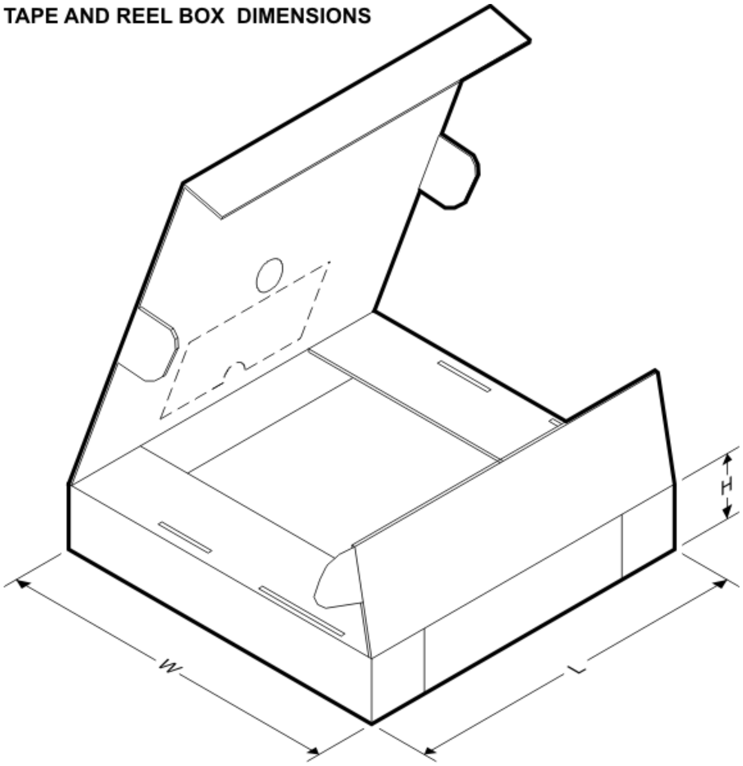
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

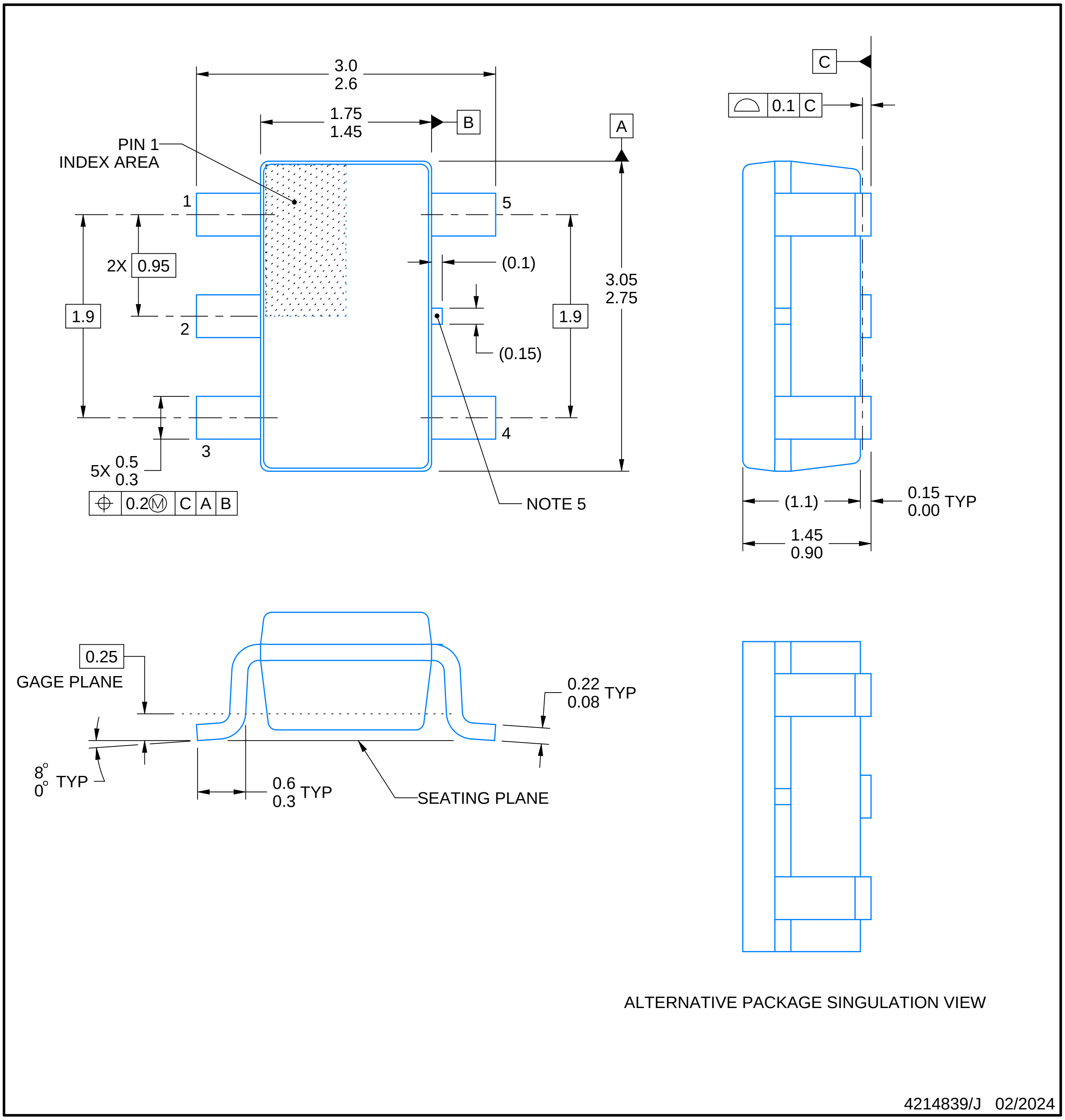
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
INA139NA/250	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
INA139NA/3K	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
INA169NA/250	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
INA169NA/3K	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



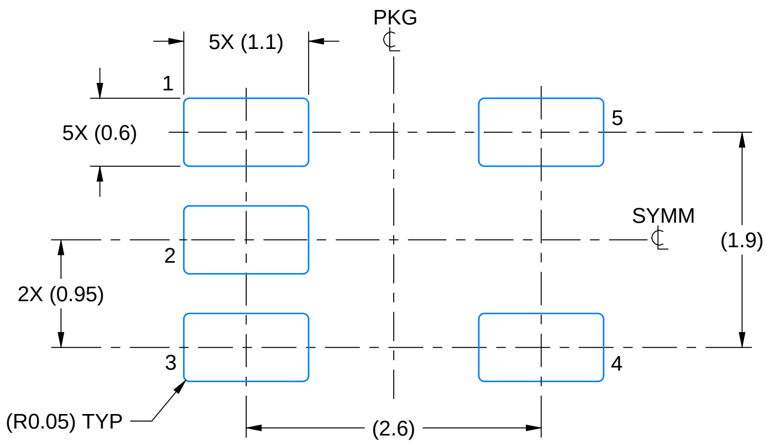
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
INA139NA/250	SOT-23	DBV	5	250	180.0	180.0	18.0
INA139NA/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0
INA169NA/250	SOT-23	DBV	5	250	180.0	180.0	18.0
INA169NA/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0

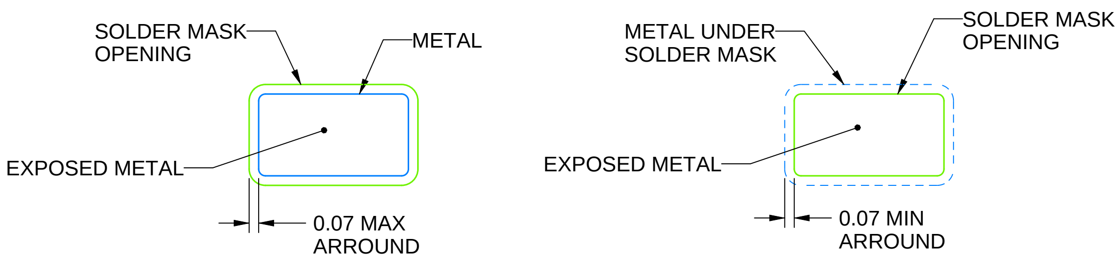


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



NON SOLDER MASK DEFINED (PREFERRED)

SOLDER MASK DEFINED

SOLDER MASK DETAILS

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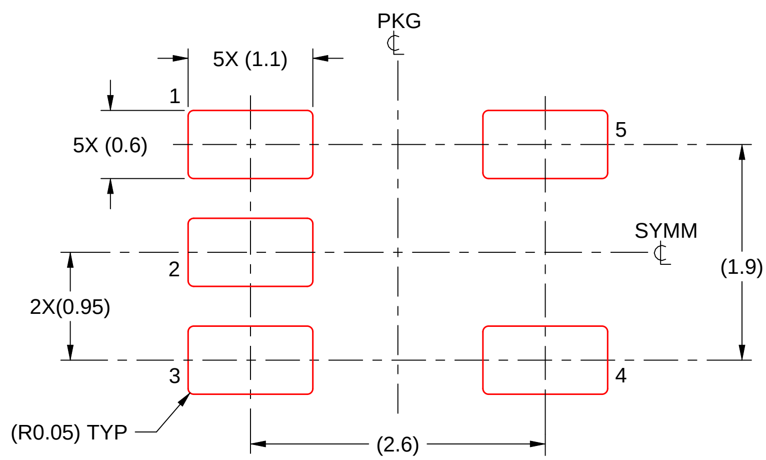
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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