100V, High-Side, Current-Sense Amplifiers with Voltage Output

1 FEATURES

- **Ideal for High-Voltage Current Monitoring Applications**
  - **Wide 5V to 100V Input Common-Mode Range**
  - **Independent Operating Supply Voltage**
- **High Accuracy and Low Quiescent Current Support Precision Application Requirements**
  - **±0.1% Full-Scale Accuracy**
  - **Low 100µV Input Offset Voltage**
  - **Four Gain Versions Available**
    - **20V/V (RSA4080A/RSA4081A)**
    - **50V/V (RSA4080B/RSA4081B)**
    - **60V/V (RSA4080C/RSA4081C)**
    - **100V/V (RSA4080D/RSA4081D)**
  - **106µA Supply Current (RSA4080)**
  - **115µA Supply Current (RSA4081)**
- **Flexible Current Sensing Supports Monitoring of Charge and Discharge of Batteries**
  - **Bidirectional (RSA4081) or Unidirectional (RSA4080) I_{SENSE}**
  - **Reference Input for Bidirectional OUT (RSA4081)**
- **Micro Size Packages: SOP8, MSOP8**

2 APPLICATIONS

- **Automotive (12V, 24V, or 42V Batteries)**
- **48V Telecom and Backplane Current Measurement**
- **Bidirectional Motor Control**
- **Power-Management Systems**
- **Avalanche Photodiode and PIN-Diode Current Monitoring**
- **General System/Board-Level Current Sensing**
- **Precision High-Voltage Current Sources**

3 DESCRIPTIONS

The RSA408X are high-side, current-sense amplifiers with an input voltage range that extends from 5V to 100V making them ideal for telecom, automotive, backplane, and other systems where high-voltage current monitoring is critical. The RSA4080 is designed for unidirectional current-sense applications and the RSA4081 allows bidirectional current sensing. The RSA4081 single output pin continuously monitors the transition from charge to discharge and avoids the need for a separate polarity output. The RSA4081 requires an external reference to set the zero-current output level (V_{SENSE} = 0V). The charging current is represented by an output voltage from V_{REF} to V_{CC}, while discharge current is given from V_{REF} to GND.

For maximum versatility, the 100V input voltage range applies independently to both supply voltage (V_{CC}) and common-mode input voltage (V_{RS+}). High-side current monitoring does not interfere with the ground path of the load being measured, making the RSA408X particularly useful in a wide range of high-voltage systems.

The combination of four gain versions (20V/V, 50V/V, 60V/V, 100V/V= A, B, C, D suffix) and a user-selectable, external sense resistor sets the full-scale current reading and its proportional output voltage. The RSA408X offer a high level of integration, resulting in a simple, accurate, and compact current-sense solution.

The RSA408X is available in Green SOP8 and MSOP8 packages. It operates over an ambient temperature range of -40°C to 125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RSA408X	SOP8	4.90mm x 3.90mm
	MSOP8	3.00mm×3.00mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

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4 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

Version	Change Date	Change Item
A.0	2024/08/12	Preliminary version completed
A.1	2024/08/22	Initial version completed
A.2	2024/10/30	1. Update Max Operating Voltage Range: 100V 2. Update Electrical Characteristics and Typical Characteristics

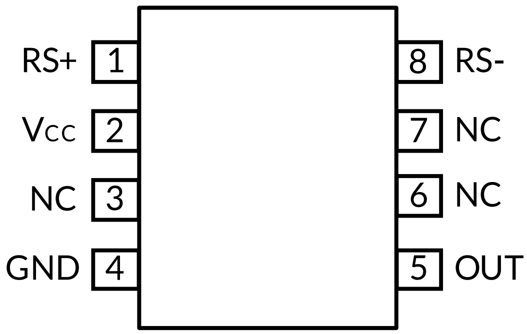
5 PACKAGE/ORDERING INFORMATION [1]

Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking [2]	MSL [3]	Package Qty
RSA4080AXK	SOP8	8	1	-40°C ~125°C	RSA4080A	MSL1	Tape and Reel,4000
RSA4080BXK	SOP8	8	1	-40°C ~125°C	RSA4080B	MSL1	Tape and Reel,4000
RSA4080CXK	SOP8	8	1	-40°C ~125°C	RSA4080C	MSL1	Tape and Reel,4000
RSA4080DXK	SOP8	8	1	-40°C ~125°C	RSA4080D	MSL1	Tape and Reel,4000
RSA4081AXK	SOP8	8	1	-40°C ~125°C	RSA4081A	MSL1	Tape and Reel,4000
RSA4081BXK	SOP8	8	1	-40°C ~125°C	RSA4081B	MSL1	Tape and Reel,4000
RSA4081CXK	SOP8	8	1	-40°C ~125°C	RSA4081C	MSL1	Tape and Reel,4000
RSA4081DXK	SOP8	8	1	-40°C ~125°C	RSA4081D	MSL1	Tape and Reel,4000
RSA4080AXM	MSOP8	8	1	-40°C ~125°C	RSA4080A	MSL1	Tape and Reel,4000
RSA4080BXM	MSOP8	8	1	-40°C ~125°C	RSA4080B	MSL1	Tape and Reel,4000
RSA4080CXM	MSOP8	8	1	-40°C ~125°C	RSA4080C	MSL1	Tape and Reel,4000
RSA4080DXM	MSOP8	8	1	-40°C ~125°C	RSA4080D	MSL1	Tape and Reel,4000
RSA4081AXM	MSOP8	8	1	-40°C ~125°C	RSA4081A	MSL1	Tape and Reel,4000
RSA4081BXM	MSOP8	8	1	-40°C ~125°C	RSA4081B	MSL1	Tape and Reel,4000
RSA4081CXM	MSOP8	8	1	-40°C ~125°C	RSA4081C	MSL1	Tape and Reel,4000
RSA4081DXM	MSOP8	8	1	-40°C ~125°C	RSA4081D	MSL1	Tape and Reel,4000

NOTE:
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.
(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.
(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F, Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

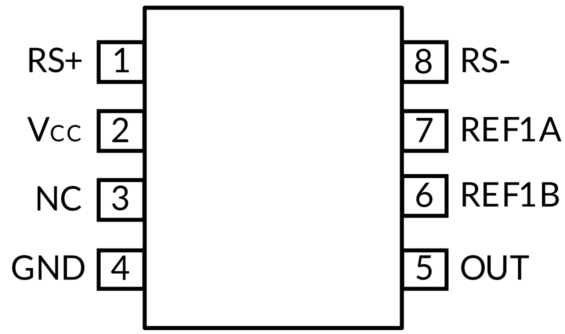
6 PIN CONFIGURATION AND FUNCTIONS

TOP VIEW



RSA4080

TOP VIEW



RSA4081

Pin Description

NAME	PIN SOP8/MSOP8		I/O (1)	DESCRIPTION
	RSA4080	RSA4081		
RS+	1	1	I	Power connection to the external-sense resistor.
V_{CC}	2	2	P	Supply Voltage Input. Decouple V_{CC} to GND with at least a 0.1µF capacitor to bypass line transients.
NC	3,6,7	3	-	No Connection. No internal connection. Leave open or connect to ground.
GND	4	4	-	Ground
OUT	5	5	O	Voltage Output. For the unidirectional RSA4080, V_{OUT} is proportional to V_{SENSE}. For the bidirectional RSA4081, the difference voltage (V_{OUT} - V_{REF}) is proportional to V_{SENSE} and indicates the correct polarity.
REF1B	-	6	I	Reference Voltage Input: Connect REF1B to REF1A or to GND.
REF1A	-	7	I	Reference Voltage Input: Connect REF1A and REF1B to a fixed reference voltage (V_{REF}). V_{OUT} is equal to V_{REF} when V_{SENSE} is zero.
RS-	8	8	I	Load connection to the external sense resistor.

(1) I = Input, O = Output, P=Power.

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
Voltage	V_{CC} to GND		-0.3	110	V
	RS+, RS- to GND		-6	110	
	OUT to GND		-0.3V to the lesser of +20V or (V_{CC}+0.3V)		
	REF1A, REF1B to GND (RSA4081 Only)		-0.3V to the lesser of +13.5V or (V_{CC}+0.3V)		
	Differential Input Voltage (V_{RS+} - V_{RS-})		-110	110	V
Current	Current into Any Pin		-10	10	mA
	Output short-circuits to GND (2)		Continuous		
θ_{JA}	Package thermal impedance (3)	SOP8		110	°C/W
		MSOP8		170	
Temperature	Operating range, T_A		-40	125	°C
	Junction, T_J (4)		-40	150	
	Storage, T_{stg}		-65	150	
	Lead Temperature (soldering, 10s)			300	
	Soldering Temperature (reflow)			260	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
(2) Short-circuit to ground, one amplifier per package.
(3) The package thermal impedance is calculated in accordance with JESD-51.
(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

7.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM), ANSI/ESDA/JEDEC JS001-2017	±4000	V
		Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2018	±1500	

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

7.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	5		100	V
T_A	Operating range	-40		125	°C

7.4 Electrical Characteristics

(V_{CC} = V_{RS+} = 5V to 100V, V_{REF1A} = V_{REF1B} = 5V, V_{SENSE} = (V_{RS+} - V_{RS-}) = 0V, unless otherwise noted. Typical values are at T_A = +25°C, Full = -40°C to 125°C.) (1) (2)

SYMBOL	PARAMETER	CONDITIONS		T_J	MIN(3)	TYP(4)	MAX(3)	UNIT
V_{CC}	Operating Voltage Range			25°C	5		100	V
CMVR	Common-Mode Range (5)			25°C	5		100	V
I_{CC}	Supply Current	V_{CC}=V_{RS+}=76V, V_{SENSE}=10mV, no load	RSA4080	25°C		106	140	µA
				Full			150	
		V_{CC}=V_{RS+}=76V, no load	RSA4081	25°C		115		
				Full			160	
I_{RS+}, I_{RS-}	Leakage Current	V_{CC}=0V, V_{RS+}=76V		25°C		0.01	0.5	µA
				Full			2	
I_{RS+}, I_{RS-}	Input Bias Current	V_{CC}=V_{RS+}=76V		25°C		4	6	µA
				Full			8	
V_{SENSE}	Full-Scale Sense Voltage (6)	RSA4080A/RSA4081A		Full		±250		mV
		RSA4080B/RSA4081B		Full		±120		mV
		RSA4080C/RSA4081C		Full		±100		mV
		RSA4080D/RSA4081D		Full		±50		mV
A_V	Gain	RSA4080A/RSA4081A		25°C		20		V/V
		RSA4080B/RSA4081B		25°C		50		
		RSA4080C/RSA4081C		25°C		60		
		RSA4080D/RSA4081D		25°C		100		
ΔAV	Gain Accuracy (7)	V_{CC}=V_{RS+}=48V		25°C	-0.5	±0.1	0.5	%
				Full	-0.6		0.6	
V_{OS}	Input Offset Voltage (8)	V_{CC}=V_{RS+}=48V		25°C	-0.4	±0.1	0.4	mV
				Full	-0.6		0.6	
CMRR	Common-Mode Rejection Ratio (9)	V_{CC}=48V, V_{RS+}=5V to 76V		25°C	125	140		dB
				Full	120			
PSRR	Power-Supply Rejection Ratio (9)	V_{RS+}=48V, V_{CC}=5V to 76V		25°C	125	135		dB
				Full	120			
V_{CC}-V_{OH}	OUT High Voltage	V_{CC}=5V, V_{RS+}=48V, V_{REF1A}=V_{REF1B}=2.5V, I_{OUT} (sourcing)=+500µA (10)		25°C		93	125	mV
				Full			180	
V_{OL}	OUT Low Voltage	V_{CC}=V_{RS+}=48V, V_{REF1A}=V_{REF1B}=2.5V, V_{SENSE}=-1000mV	I_{OUT} (sinking) =10µA	25°C		2.3	7	mV
				Full			10	
			I_{OUT} (sinking) =500µA	25°C		110	140	mV
				Full			250	
V_{REF}-V_{GND} (RSA4081 Only) (11)	REF1A = REF1B Input Voltage Range	Inferred from REF1A rejection ratio, V_{REF1A}=V_{REF1B}		25°C	1.5		6	V
V_{REF1A}-V_{GND} (RSA4081 Only)	REF1A Input Voltage Range	Inferred from REF1A rejection ratio, V_{REF1B}=V_{GND}		25°C	3		12	V
	REF1A Rejection Ratio	V_{CC}=V_{RS+}=48V, V_{SENSE}=0V, V_{REF1A}=V_{REF1B}=1.5V to 6V		25°C		125		dB
				Full		107		
	REF/REF1A Ratio	V_{REF1A}=10V, V_{REF1B}=V_{GND}, V_{CC}=V_{RS+}=48V		25°C		0.5		
				Full	0.497		0.503	
	REF1A Input Impedance	V_{REF1B}=V_{GND}		25°C		300		kΩ

BW	Bandwidth	$V_{CC}=V_{RS+}=48V$, $V_{OUT}=0.4Vpp$	25°C		180		kHz
	OUT Settling Time to 1% of Final Value	$V_{OUT}=200mV$ to 2V	25°C		20		µs
		$V_{OUT}=2V$ to 200mV	25°C		20		µs
	Capacitive-Load Stability	No sustained oscillations	25°C		500		pF
	Power-Up Time	$V_{CC}=V_{RS+}=48V$, $V_{OUT}=2V$ (12)	25°C		60		µs
	Saturation Recovery Time (13)	$V_{CC}=5V$, $V_{RS+}=48V$	25°C		20		µs

NOTE:

(1) All devices are 100% production tested at T_A = +25°C. All temperature limits are guaranteed by design.

(2) V_{REF} is defined as the average voltage of V_{REF1A} and V_{REF1B}. REF1B is usually connected to REF1A or GND. V_{SENSE} is defined as V_{RS+} - V_{RS-}.

(3) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(4) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

(5) The common-mode range at the low end of 5V applies to the most positive potential at RS+ or RS-. Depending on the polarity of V_{SENSE} and the device's gain, either RS+ or RS- can extend below 5V by the device's typical full-scale value of V_{SENSE}.

(6) Negative V_{SENSE} applies to RSA4081 only.

(7) V_{SENSE} is:
RSA4080A, 10mV to 250mV
RSA4080B, 10mV to 120mV
RSA4080C, 10mV to 100mV
RSA4080D, 10mV to 50mV
RSA4081A, -125mV to +125mV
RSA4081B, -60mV to +60mV
RSA4081C, -50mV to +50mV
RSA4081D, -25mV to +25mV

(8) For RSA4080 V_{OS} is measured as (V_{OUT}/A_V) - V_{SENSE} at V_{SENSE}=10mV. For RSA4081 V_{OS} is measured as (V_{OUT} - V_{REF})/A_V at V_{SENSE} = 0V.

(9) V_{SENSE} is:
RSA4080A/RSA4080B/RSA4080C/RSA4080D, 10mV
RSA4081A/RSA4081B/RSA4081C/RSA4081D, 0V
V_{REF1B} = V_{REF1A} = 2.5V

(10) For RSA4080, Output voltage is internally clamped not to exceed the lesser of +11.5V or V_{CC}
For RSA4081, Output voltage is internally clamped not to exceed the lesser of +18V or V_{CC}

(11) V_{REF} range should be between GND+1.5V and V_{CC}-1.5V, and MAX is 6V.

(12) Output settles to within 1% of final value.

(13) The device will not experience phase reversal when overdriven.

7.5 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

V_{CC}=V_{RS+}=48V, V_{REFA}=V_{REFB}=5V, V_{SENSE} = 0V, C_{LOAD} = 20pF, R_{LOAD}=∞, T_A = +25°C, unless otherwise noted.

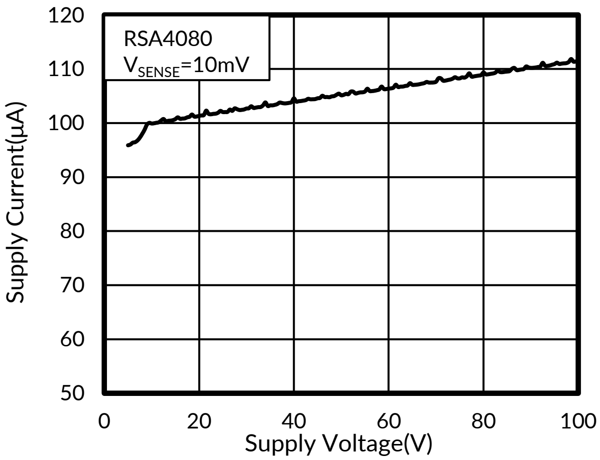


Figure 1. Supply Current vs Supply Voltage (V_{CC})

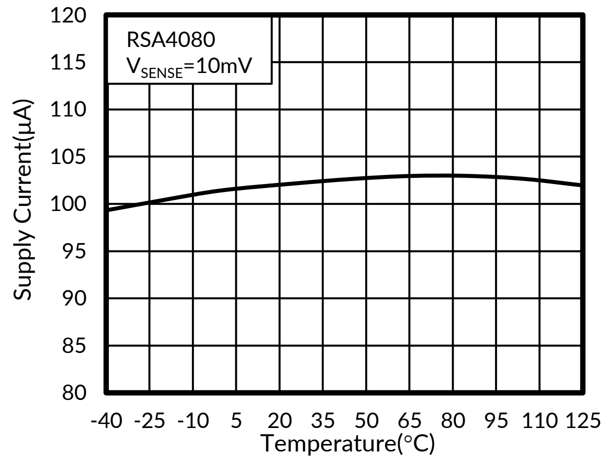


Figure 2. Supply Current vs Temperature

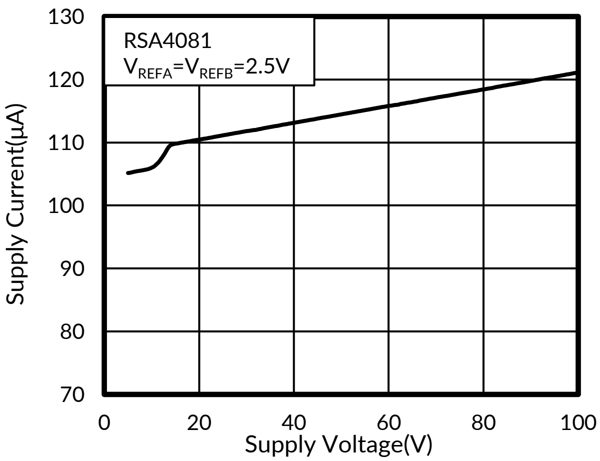


Figure 3. Supply Current vs Supply Voltage (V_{CC})

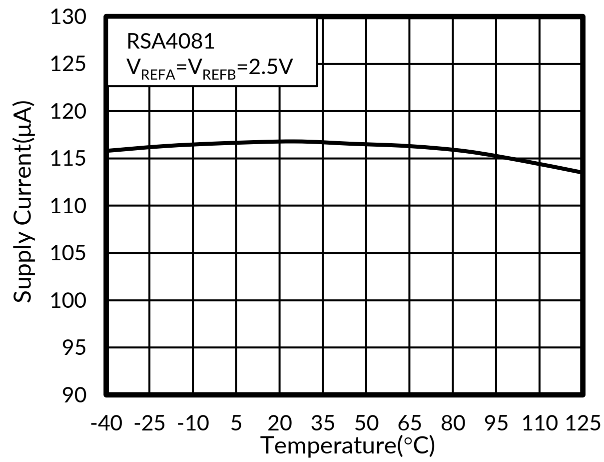


Figure 4. Supply Current vs Temperature

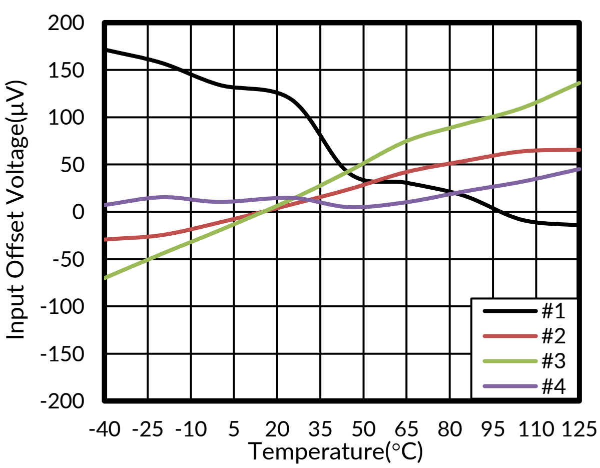


Figure 5. Input Offset Voltage (V_{OS}) vs Temperature

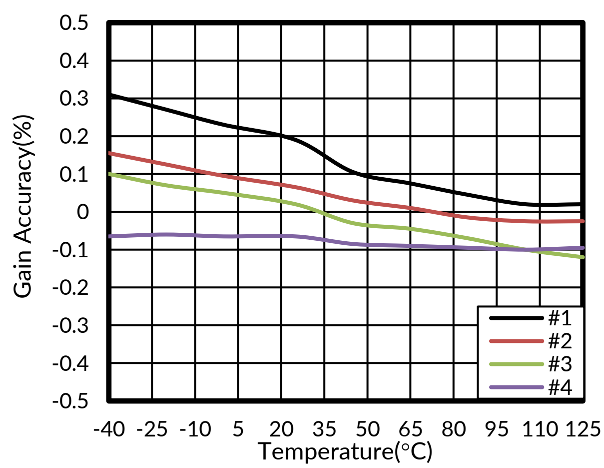


Figure 6. Gain Accuracy vs Temperature

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

V_{CC}=V_{RS+}=48V, V_{REFA}=V_{REFB}=5V, V_{SENSE} = 0V, C_{LOAD} = 20pF, R_{LOAD}=∞, T_A = +25°C, unless otherwise noted.

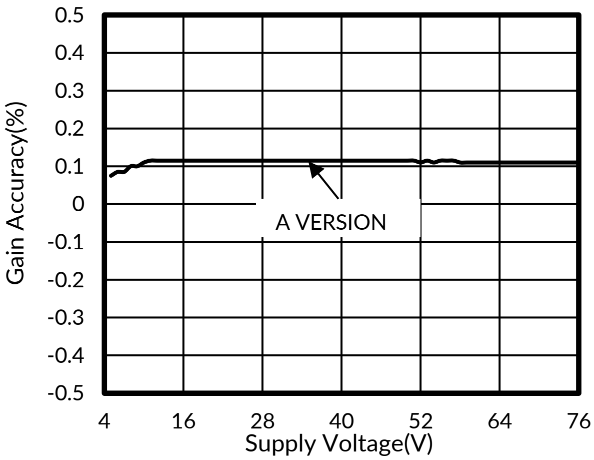


Figure 7. Gain Accuracy vs Supply Voltage (V_{CC})

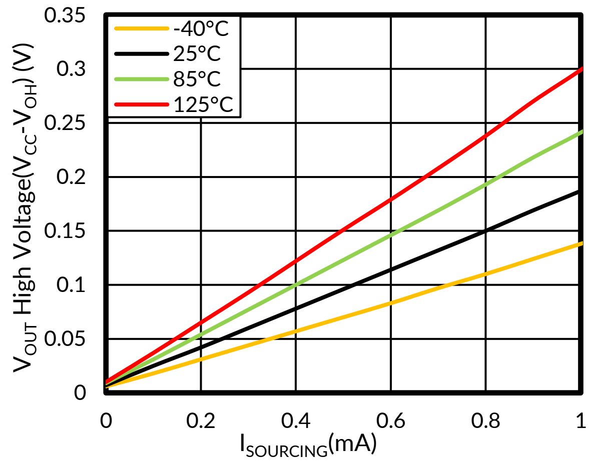


Figure 8. V_{OUT} High Voltage vs I_{OUT} (Sourcing)

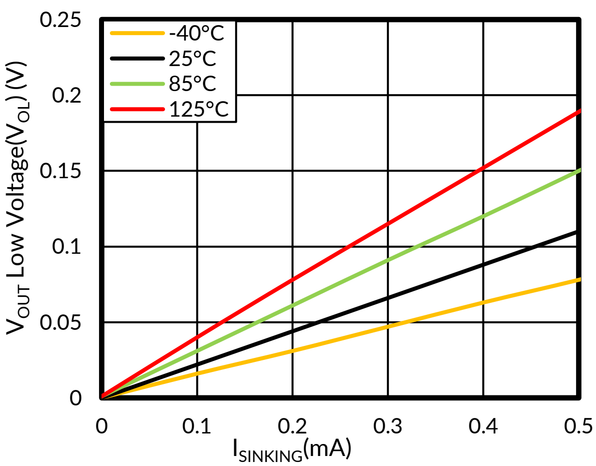


Figure 9. V_{OUT} Low Voltage vs I_{OUT} (Sinking)

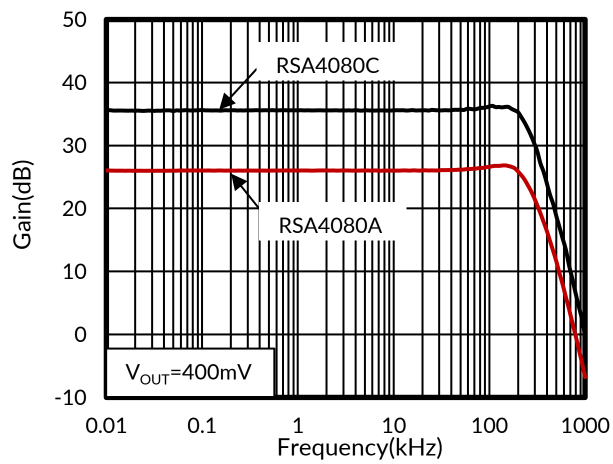


Figure 10. Small-Signal Gain vs Frequency

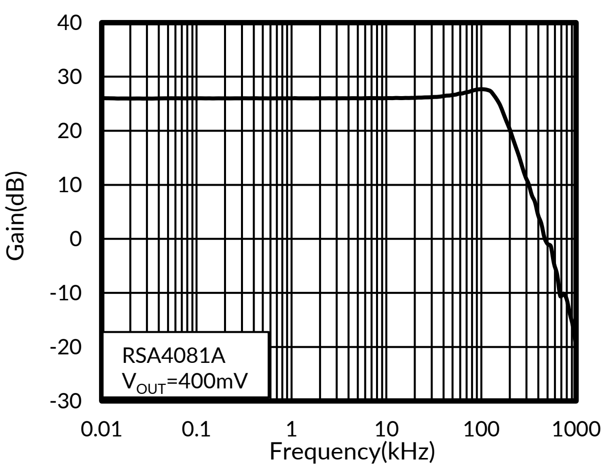


Figure 11. Small-Signal Gain vs Frequency

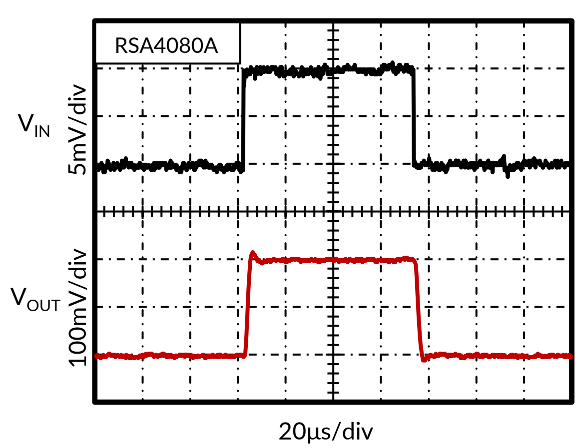


Figure 12. Small-Signal Transient Response

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

V_{CC}=V_{RS+}=48V, V_{REFA}=V_{REFB}=5V, V_{SENSE} = 0V, C_{LOAD} = 20pF, R_{LOAD}=∞, T_A = +25°C, unless otherwise noted.

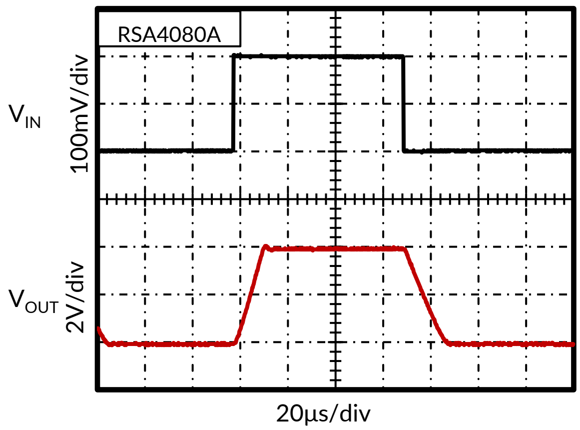


Figure 13. Large-Signal Transient Response

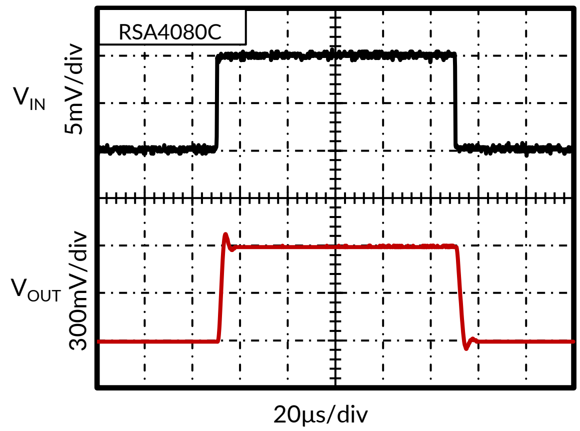


Figure 14. Small-Signal Transient Response

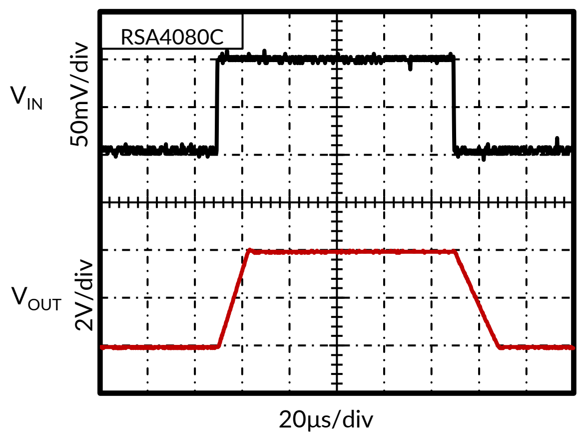


Figure 15. Large-Signal Transient Response

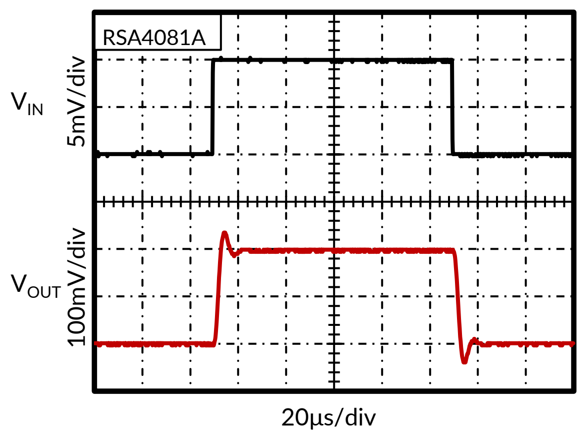


Figure 16. Small-Signal Transient Response

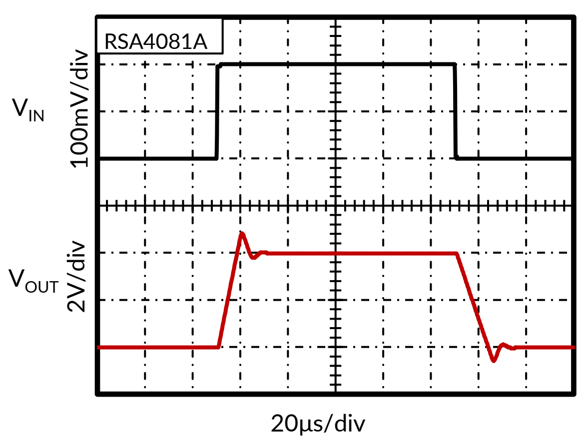


Figure 17. Large-Signal Transient Response

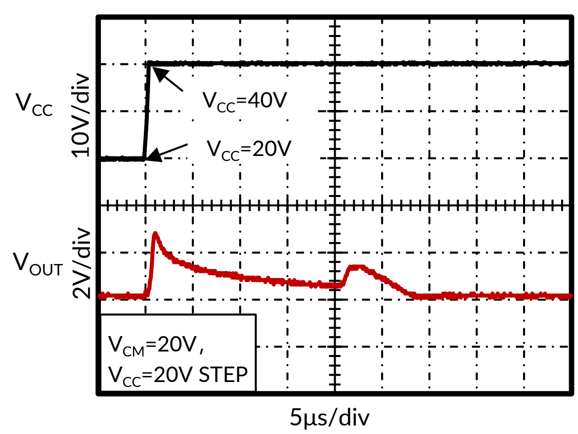


Figure 18. V_{CC}-TRANSIENT RESPONSE

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

V_{CC}=V_{RS+}=48V, V_{REFA}=V_{REFB}=5V, V_{SENSE} = 0V, C_{LOAD} = 20pF, R_{LOAD}=∞, T_A = +25°C, unless otherwise noted.

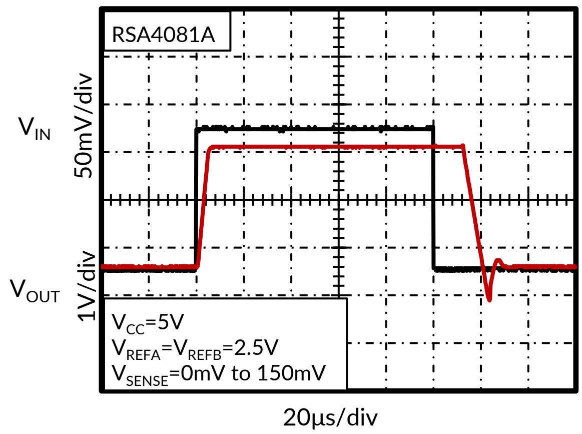


Figure 19. Positive Overload Recovery

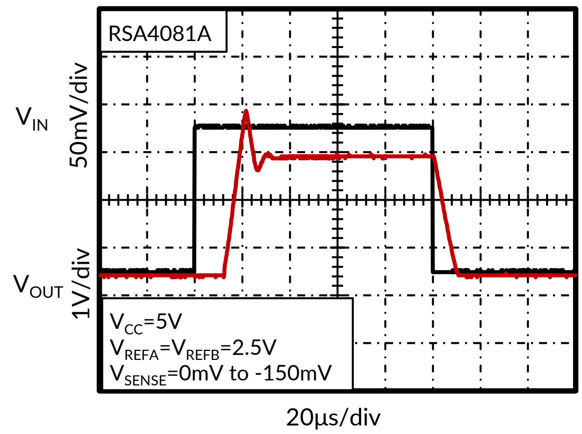


Figure 20. Negative Overload Recovery

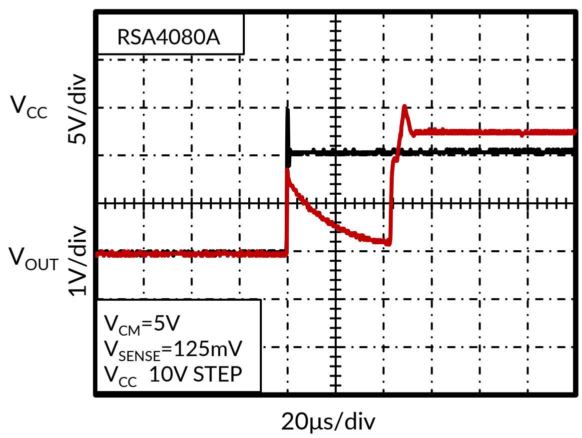


Figure 21. STARTUP DELAY

8 DETAILED DESCRIPTION

The RSA408X unidirectional and bidirectional high-side, current-sense amplifiers feature a 5V to 100V input common-mode range that is independent of supply voltage. This feature allows the monitoring of current out of a battery as low as 5V and also enables high-side current sensing at voltages greater than the supply voltage (V_{CC}). The RSA408X monitors current through a current-sense resistor and amplifies the voltage across the resistor. The RSA4080 senses current unidirectionally, while the RSA4081 senses current bidirectionally.
The 100V input voltage range of the RSA408X applies independently to both supply voltage (V_{CC}) and common-mode, input-sense voltage (V_{RS+}). High-side current monitoring does not interfere with the ground path of the load being measured, making the RSA408X particularly useful in a wide range of high-voltage systems.
Battery-powered systems require a precise bidirectional current-sense amplifier to accurately monitor the battery's charge and discharge. The RSA4081 charging current is represented by an output voltage from V_{REF} to V_{CC}, while discharge current is given from V_{REF} to GND. Measurements of OUT with respect to V_{REF} yield a positive and negative voltage during charge and discharge, as illustrated in Figure 22 for the RSA4081A.

8.1 Current Monitoring

The RSA4080 operates as follows: current from the source flows through R_{SENSE} to the load (Figure 21), creating a sense voltage, V_{SENSE}. Since the internal-sense amplifier's inverting input has high impedance, negligible current flows through RG2 (neglecting the input bias current). Therefore, the sense amplifier's inverting input voltage equals V_{SOURCE} - (I_{LOAD})(R_{SENSE}). The amplifier's open-loop gain forces its noninverting input to the same voltage as the inverting input. Therefore, the drop across RG1 equals V_{SENSE}. The internal current mirror multiplies I_{RG1} by a current gain factor, β, to give $I_{A2} = \beta \times I_{RG1}$. Amplifier A2 is used to convert the output current to a voltage and then sent through amplifier A3. Total gain = 20V/V for RSA4080A, 50V/V for the RSA4080B, 60V/V for the RSA4080C, and 100V/V for the RSA4080D.
The RSA4081 input stage differs slightly from the RSA4080 (Figure 22). Its topology allows for monitoring of bidirectional currents through the sense resistor. When current flows from RS+ to RS-, the RSA4081 matches the voltage drop across the external sense resistor, R_{SENSE}, by increasing the current through the Q1 and RG1. In this way, the voltages at the input terminals of the internal amplifier A1 are kept constant and an accurate measurement of the sense voltage is achieved. In the following amplifier stages of the RSA4081, the output signal of amplifier A2 is level- shifted to the reference voltage (V_{REF} = V_{REF1A} = V_{REF1B}), resulting in a voltage at the output pin (OUT) that swings above V_{REF} voltage for positive-sense volt-ages and below V_{REF} for negative-sense voltages. V_{OUT} is equal to V_{REF} when V_{SENSE} is equal to zero. Set the full-scale output range by selecting R_{SENS}E and the appropriate gain version of the RSA408X.

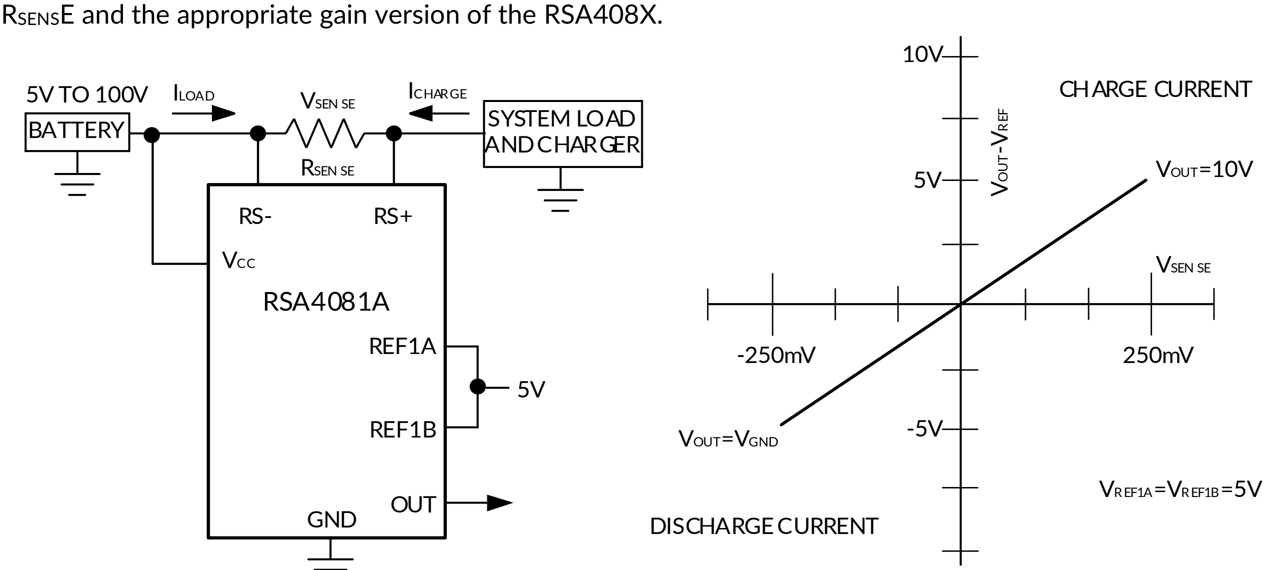


Figure 22. RSA4081A OUT Transfer Curve

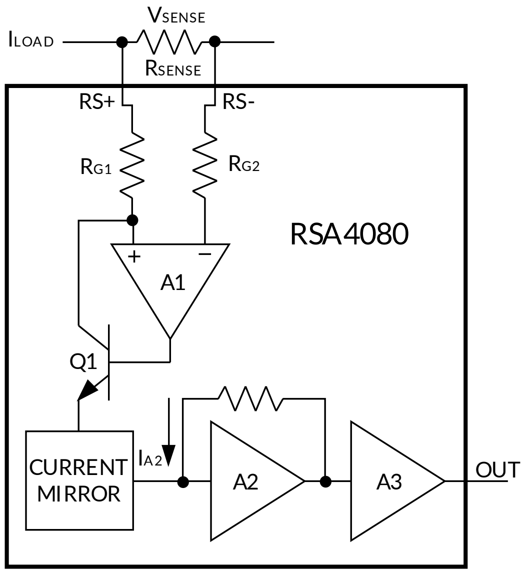


Figure 23. RSA4080 Functional Diagram

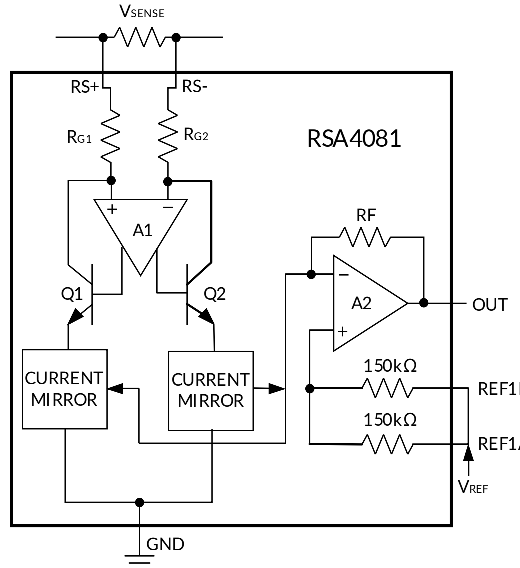


Figure 24. RSA4081 Functional Diagram

8.2 External References (RSA4081)

For the bidirectional RSA4081, the V_{OUT} reference level is controlled by REF1A and REF1B. V_{REF} is defined as the average voltage of V_{REF1A} and V_{REF1B}. Connect REF1A and REF1B to a low-noise, regulated voltage source to set the output reference level. In this mode, V_{OUT} equals V_{REF1A} when V_{SENSE} equals zero (see Figure 23).
Alternatively, connect REF1B to ground, and REF1A to a low-noise, regulated voltage source. In this case, the output reference level (V_{REF}) is equal to V_{REF1A} divided by two. V_{OUT} equals $V_{REF1A}/2$ when V_{SENSE} equals zero.
In either mode, the output swings above the reference voltage for positive current-sensing ($V_{RS+} > V_{RS-}$). The output swings below the reference voltage for negative current-sensing ($V_{RS+} < V_{RS-}$).

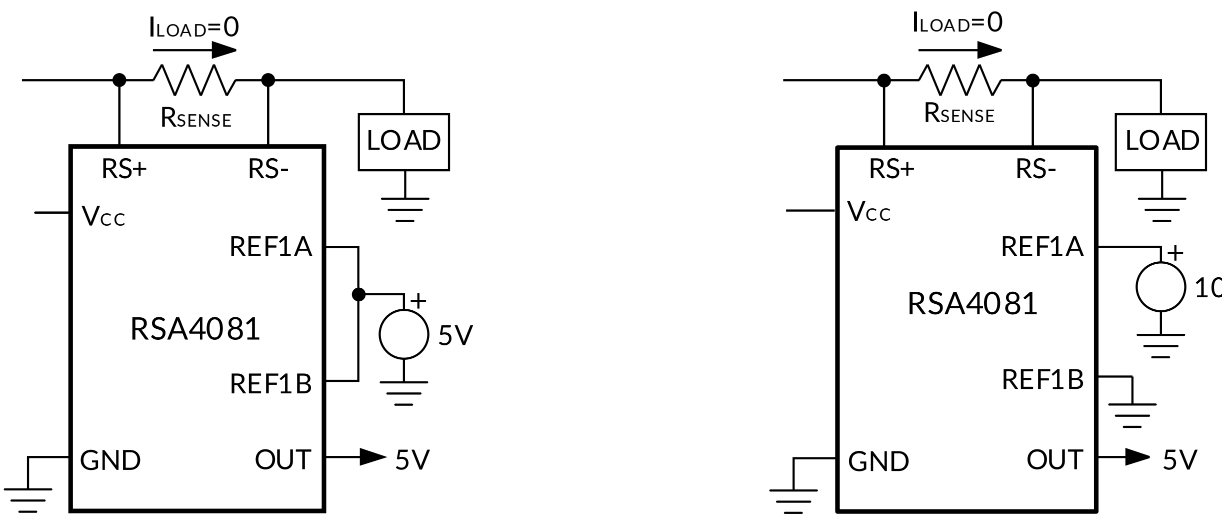


Figure 25. RSA4081 Reference Inputs

9 APPLICATIONS INFORMATION

9.1 Choosing the Sense Resistor

Choose R_{SENSE} based on the following criteria:

Voltage Loss: A high R_{SENSE} value causes the power-source voltage to degrade through IR loss. For minimal voltage loss, use the lowest R_{SENSE} value.

- Accuracy: A high R_{SENSE} value allows lower currents to be measured more accurately. This is due to offsets becoming less significant when the sense voltage is larger. For best performance, select R_{SENSE} to provide approximately 250mV (gain of 20V/V), 120mV (gain of 50V/V), 100mV (gain of 60V/V) or 50mV (gain of 100V/V) of sense voltage for the full-scale current in each application.
- Efficiency and Power Dissipation: At high current levels, the I^2R losses in R_{SENSE} can be significant. Take this into consideration when choosing the resistor value and its power dissipation (wattage) rating. Also, the sense resistor's value might drift if it is allowed to heat up excessively.
- Inductance: Keep inductance low if I_{SENSE} has a large high-frequency component. Wire-wound resistors have the highest inductance, while metal film is somewhat better. Low-inductance, metal-film resistors are also available. Instead of being spiral- wrapped around a core, as in metal-film or wire-wound resistors, they are a straight band of metal and are available in values under 1Ω.

Because of the high currents that flow through R_{SENSE}, take care to eliminate parasitic trace resistance from causing errors in the sense voltage. Either use a four-terminal current-sense resistor or use Kelvin (force and sense) PC board layout techniques.

9.2 Dynamic Range Consideration

Although the RSA4081 have fully symmetrical bidirectional V_{SENSE} input capability, the output voltage range is usually higher from REF to V_{CC} and lower from REF to GND (unless the supply voltage is at the lowest end of the operating range). Therefore, the user must consider the dynamic range of current monitored in both directions and choose the supply voltage and the reference voltage (REF) to make sure the output swing above and below REF is adequate to handle the swings without clipping or running out of headroom.

9.3 Power-Supply Bypassing and Grounding

For most applications, bypass V_{CC} to GND with a 0.1µF ceramic capacitor. In many applications, V_{CC} can be connected to one of the current monitor terminals (RS+ or RS-). Because V_{CC} is independent of the monitored voltage, V_{CC} can be connected to a separate regulated supply.

If V_{CC} will be subject to fast-line transients, a series resistor can be added to the power-supply line of the RSA408X to minimize output disturbance. This resistance and the decoupling capacitor reduce the rise time of the transient. For most applications, 1kΩ in conjunction with a 0.1µF bypass capacitor work well.

The RSA408X require no special considerations with respect to layout or grounding. Consideration should be given to minimizing errors due to the large charge and discharge currents in the system.

9.4 Power Management

The bidirectional capability of the RSA4081 makes it an excellent candidate for use in smart battery packs. In the application diagram (Figure 24), the RSA4081 monitors the charging current into the battery as well as the discharge current out of the battery. The microcontroller stores this information, allowing the system to query the battery's status as needed to make system power-management decisions.

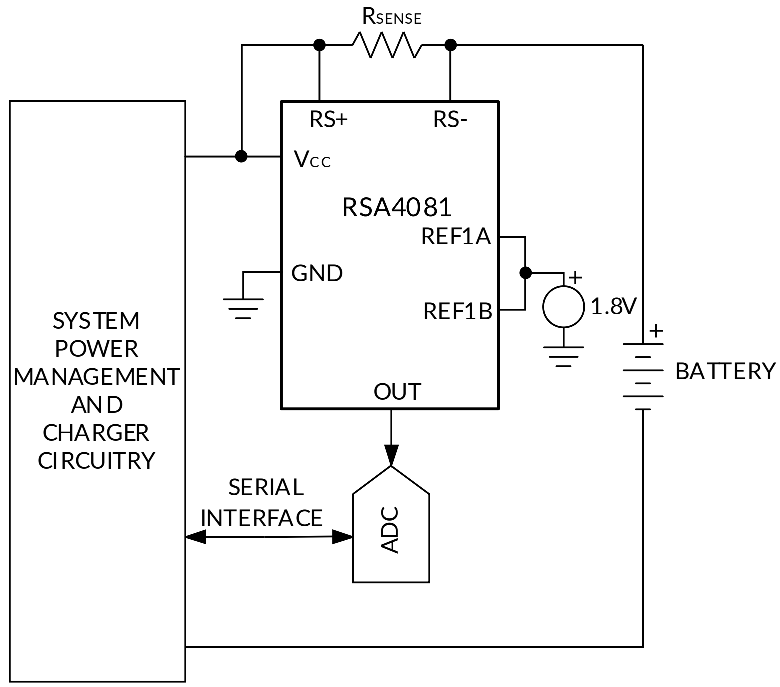
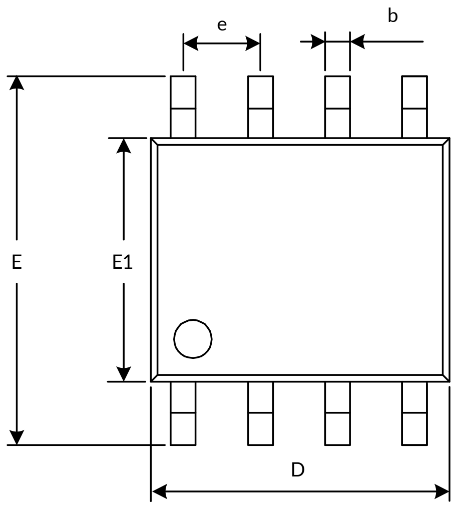
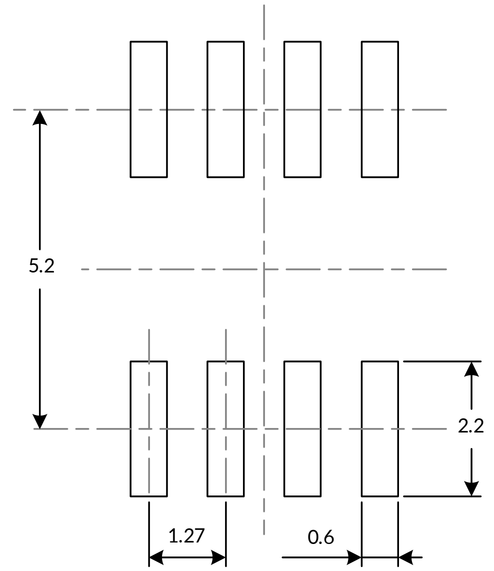


Figure 26. RSA4081 Used in Smart-Battery Application

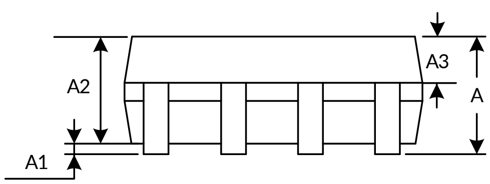
10 PACKAGE OUTLINE DIMENSIONS

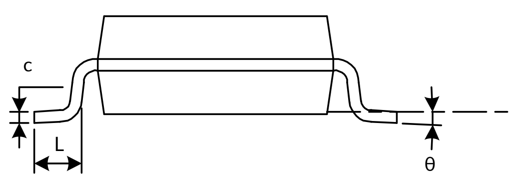
SOP8 [3]





RECOMMENDED LAND PATTERN (Unit: mm)



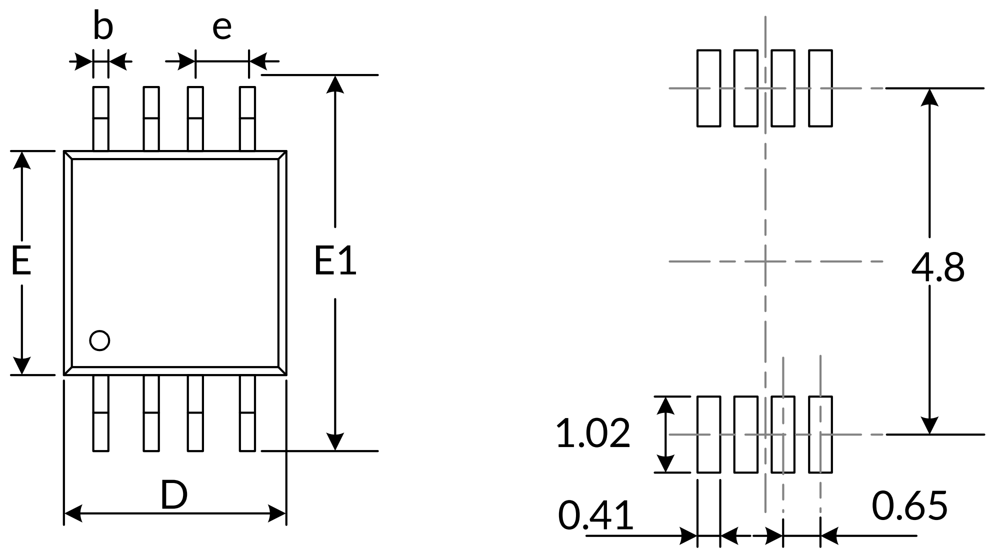


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A [1]		1.750		0.069
A1	0.100	0.225	0.004	0.009
A2	1.300	1.500	0.051	0.059
A3	0.600	0.700	0.024	0.028
b	0.390	0.470	0.015	0.019
c	0.200	0.240	0.008	0.009
D [1]	4.800	5.000	0.189	0.197
e	1.270 (BSC) [2]		0.050 (BSC) [2]	
E	5.800	6.200	0.228	0.244
E1 [1]	3.800	4.000	0.150	0.157
L	0.500	0.800	0.020	0.031
θ	0°	8°	0°	8°

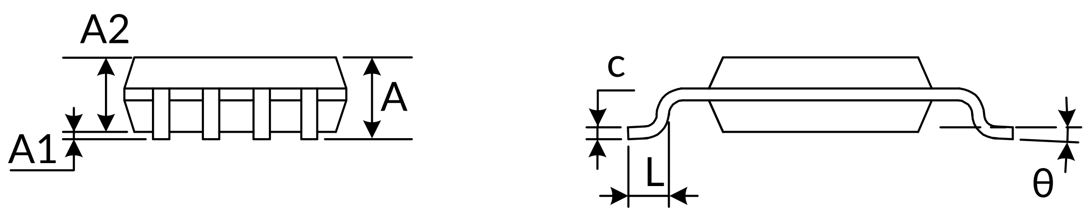
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

MSOP8 [3]



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A [1]	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D [1]	2.900	3.100	0.114	0.122
e	0.650(BSC) [2]		0.026(BSC) [2]	
E [1]	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

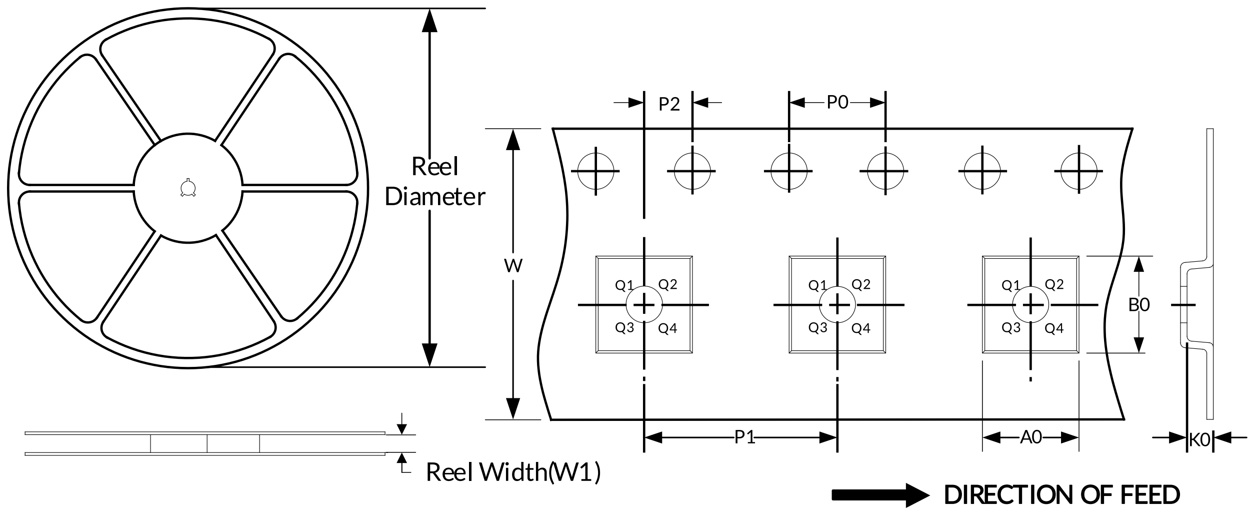
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

11 TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOP8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
MSOP8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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