



**AOS**  
**SEMICONDUCTOR**

## 产品规格说明书

Product Data Sheet

### AOS408xx

WEB | [www.aossemi.cn](http://www.aossemi.cn) 



电源管理IC



通信接口芯片



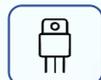
二三极管



LDO稳压器



逻辑器件



MOSFETs



运算放大器



显示驱动



MCU单片机



光电器件



### DESCRIPTIONS

The AOSA408X 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 AOSA4080 is designed for unidirectional current-sense applications and the AOSA4081 allows bidirectional current sensing.

The AOSA4081 single output pin continuously monitors the transition from charge to discharge and avoids the need for a separate polarity output. The AOSA4081 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 ( $V_{RS+}$ ). Highside current monitoring does not interfere with the ground path of the load being measured, making the AOSA408X particularly useful in a wide range of highvoltage systems.

The combination of four gain versions (20V/V, 50V/V, 60V/V, 100V/V= A, B, C, D suffix) and a userselectable, external sense resistor sets the full-scale current reading and its proportional output voltage.

The AOSA408X offer a high level of integration, resulting in a simple, accurate, and compact currentsense solution.

The AOSA408X is available in Green SOP8 and MSOP8 packages. It operates over an ambient temperature range of -40°C to 125°C.

### 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

- $\pm 0.1\%$  Full-Scale Accuracy
- Low 100 $\mu V$  Input Offset Voltage
- Four Gain Versions Available
  - 20V/V (AOSA4080A/AOSA4081A)
  - 50V/V (AOSA4080B/AOSA4081B)
  - 60V/V (AOSA4080C/AOSA4081C)
  - 100V/V (AOSA4080D/AOSA4081D)

106 $\mu A$  Supply Current (AOSA4080)

115 $\mu A$  Supply Current (AOSA4081)

Flexible Current Sensing Supports Monitoring of Charge and Discharge of Batteries

- Bidirectional (AOSA4081) or Unidirectional (AOSA4080) ISENSE
- Reference Input for Bidirectional OUT (AOSA4081)

Micro Size Packages: SOP8, MSOP8

### 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

### Device Information <sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE(NOM)
AOSA408X	SOP8	4.90mm × 3.90mm
	MSOP8	3.00mm × 3.00mm

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



## PACKAGE/ORDERING INFORMATION

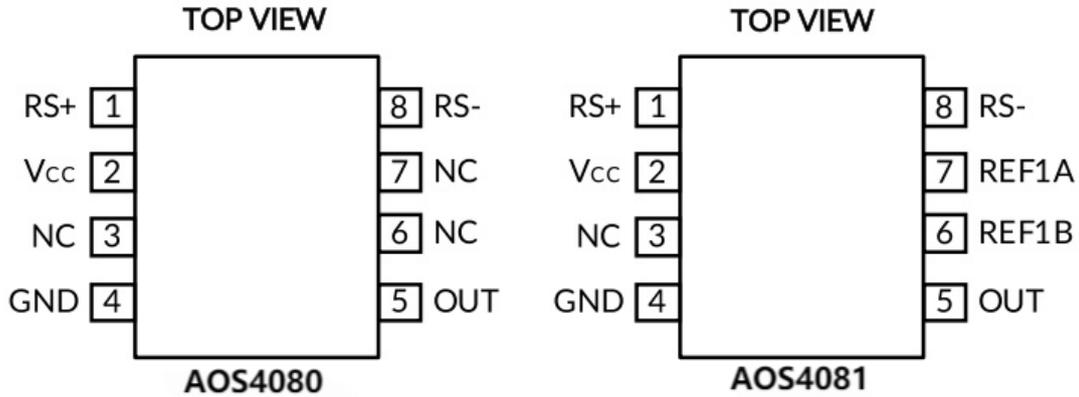
Orderable Device	Package Type	Pin	Channel	Op Temp( )	Device Marking <sup>(2)</sup>	MSL <sup>(3)</sup>	Package Qty
AOSA4080AXK	SOP8	8	1	-40 ~125	AOSA4080A	MSL1	Tape and Reel , 4000
AOSA4080BXK	SOP8	8	1	-40 ~125	AOSA4080B	MSL1	Tape and Reel , 4000
AOSA4080CXK	SOP8	8	1	-40 ~125	AOSA4080C	MSL1	Tape and Reel , 4000
AOSA4080DXK	SOP8	8	1	-40 ~125	AOSA4080D	MSL1	Tape and Reel , 4000
AOSA4081AXK	SOP8	8	1	-40 ~125	AOSA4081A	MSL1	Tape and Reel , 4000
AOSA4081BXK	SOP8	8	1	-40 ~125	AOSA4081B	MSL1	Tape and Reel , 4000
AOSA4081CXK	SOP8	8	1	-40 ~125	AOSA4081C	MSL1	Tape and Reel , 4000
AOSA4081DXK	SOP8	8	1	-40 ~125	AOSA4081D	MSL1	Tape and Reel , 4000
AOSA4080AXM	MSOP8	8	1	-40 ~125	AOSA4080A	MSL1	Tape and Reel , 4000
AOSA4080BXM	MSOP8	8	1	-40 ~125	AOSA4080B	MSL1	Tape and Reel , 4000
AOSA4080CXM	MSOP8	8	1	-40 ~125	AOSA4080C	MSL1	Tape and Reel , 4000
AOSA4080DXM	MSOP8	8	1	-40 ~125	AOSA4080D	MSL1	Tape and Reel , 4000
AOSA4081AXM	MSOP8	8	1	-40 ~125	AOSA4081A	MSL1	Tape and Reel , 4000
AOSA4081BXM	MSOP8	8	1	-40 ~125	AOSA4081B	MSL1	Tape and Reel , 4000
AOSA4081CXM	MSOP8	8	1	-40 ~125	AOSA4081C	MSL1	Tape and Reel , 4000
AOSA4081DXM	MSOP8	8	1	-40 ~125	AOSA4081D	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) AOS 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 AOS if your end application is quite critical to the preconditioning setting or if you have special requirement.



PIN CONFIGURATION AND FUNCTIONS (Top View)



PIN DESCRIPTION

NAME	PIN		I/O <sup>(1)</sup>	DESCRIPTION
	SOP8/MSOP8			
	AOSA4080	AOSA4081		
RS+	1	1	I	Power connection to the external-sense resistor.
VCC	2	2	P	Supply Voltage Input. Decouple VCCto 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	0	Voltage Output. For the unidirectional AOSA4080, VOUTis proportional to VSENSE. For the bidirectional AOSA4081, the difference voltage (VOUT-VREF) is proportional to VSENSEand 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 (VREF). VOUTis equal to VREFwhen VSENSEis zero.
RS-	8	8	I	Load connection to the external sense resistor.

(1) I = Input, 0 = Output, P=Power.



Specifications

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
Voltage	V <sub>CC</sub> to GND	-0.3	110	V
	RS+, RS- to GND	-6	110	
	OUT to GND	-0.3V to the lesser of +20V or (V <sub>CC</sub> +0.3V)		
	REF1A, REF1B to GND(AOSA4081 Only)	-0.3V to the lesser of +13.5V or (V <sub>CC</sub> +0.3V)		
	Differential Input Voltage (V <sub>RS+</sub> -V <sub>RS-</sub> )	-110	110	V
Current	Current into Any Pin	-10	10	mA
	Output short-circuits to GND <sup>(2)</sup>	Continuous		
J <sub>A</sub>	Package thermal impedance <sup>(3)</sup>	SOP8	110	/W
		MSOP8	170	
Temperature	Operating range, T <sub>A</sub>	-40	125	
	Junction, T <sub>J</sub> <sup>(4)</sup>	-40	150	
	Storage, T <sub>stg</sub>	-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<sub>J(MAX)</sub>, R<sub>J A</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any ambient temperature is P<sub>D</sub>=(T<sub>J(MAX)</sub>-T<sub>A</sub>) / R<sub>J A</sub>. All numbers apply for packages soldered directly onto a PCB.



### ESD Ratings

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

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human-Body Model (HBM), ANSI/ESDA/JEDEC JS001-2017	± 3000	V
		Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2018	± 1000	



### 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.

### Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	5		100	V
T <sub>A</sub>	Operating range	-40		125	



**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  $T_A = +25^{\circ}C$ , Full =  $-40^{\circ}C$  to  $125^{\circ}C$ .)<sup>(1)(2)</sup>

SYMBOL	PARAMETER	CONDITIONS		TJ	MIN <sup>(3)</sup>	TYP <sup>(4)</sup>	MAX <sup>(3)</sup>	UNIT
$V_{CC}$	Operating Voltage Range			25	5		100	V
CMVR	Common-Mode Range <sup>(5)</sup>			25	5		100	V
$I_{CC}$	Supply Current	$V_{CC} = V_{RS+} = 76V$ , $V_{SENSE} = 10mV$ , no load	AOSA4080	25		106	140	$\mu A$
			Full I				150	
		AOSA4081	25		115			
			Full I			160		
$I_{RS+}, I_{RS-}$	Leakage Current	$V_{CC} = 0V, V_{RS+} = 76V$		25		0.01	0.5	$\mu A$
		Full I				2		
$I_{RS+}, I_{RS-}$	Input Bias Current	$V_{CC} = V_{RS+} = 76V$		25		4	6	$\mu A$
		Full I				8		
$V_{SENSE}$	Full-Scale Sense Voltage <sup>(6)</sup>	AOSA4080A/AOSA4081A		Full I		$\pm 250$		mV
		AOSA4080B/AOSA4081B		Full I		$\pm 120$		mV
		AOSA4080C/AOSA4081C		Full I		$\pm 100$		mV
		AOSA4080D/AOSA4081D		Full I		$\pm 50$		mV
$A_v$	Gain	AOSA4080A/AOSA4081A		25		20		V/V
		AOSA4080B/AOSA4081B		25		50		
		AOSA4080C/AOSA4081C		25		60		
		AOSA4080D/AOSA4081D		25		100		
$A_v$	Gain Accuracy <sup>(7)</sup>	$V_{CC} = V_{RS+} = 48V$		25	-0.5	$\pm 0.1$	0.5	%
		Full I			-0.6		0.6	
$V_{OS}$	Input Offset Voltage <sup>(8)</sup>	$V_{CC} = V_{RS+} = 48V$		25	-0.4	$\pm 0.1$	0.4	mV
		Full I			-0.6		0.6	
CMRR	Common-Mode Rejection Ratio <sup>(9)</sup>	$V_{CC} = 48V, V_{RS+} = 5V$ to $76V$		25	125	140		dB
		Full I			120			
PSRR	Power-Supply Rejection Ratio <sup>(9)</sup>	$V_{RS+} = 48V, V_{CC} = 5V$ to $76V$		25	125	135		dB
		Full I			120			
$V_{CC} - V_{OH}$	OUT High Voltage	$V_{CC} = 5V, V_{RS+} = 48V$ , $V_{REF1A} = V_{REF1B} = 2.5V$ , $I_{OUT(sourcing)} = +500\mu A$ <sup>(10)</sup>		25		93	125	mV
		Full I				180		
$V_{OL}$	OUT Low Voltage	$V_{CC} = V_{RS+} = 48V$ , $V_{REF1A} = V_{REF1B} = 2.5V$ , $V_{SENSE} = -1000mV$	$I_{OUT(sinking)} = 10\mu A$	25		2.3	7	mV
				Full I				
		$I_{OUT(sinking)} = 500\mu A$	25		110	140	mV	
			Full I			250		
$V_{REF1A} - V_{GND}$ (AOSA4081 Only) <sup>(11)</sup>	$REF1A = REF1B$ Input Voltage Range	Inferred from $REF1A$ rejection ratio, $V_{REF1A} = V_{REF1B}$		25	1.5		6	V



$V_{REF1A}-V_{GND}$ (AOSA4081 Only)	REF1A Input Voltage Range	Inferred from REF1A rejection ratio, $V_{REF1B}=V_{GND}$	25	3		12	V
	REF1A Rejection Ratio	$V_{CC}=V_{RS+}=48V, V_{SENSE}=0V,$ $V_{REF1A}=V_{REF1B}=1.5V$ to 6V	25		125		dB
			25		107		
	REF/REF1A Ratio	$V_{REF1A}=10V, V_{REF1B}=V_{GND},$ $V_{CC}=V_{RS+}=48V$	25		0.5		
25			0.497		0.503		
	REF1A Input Impedance	$V_{REF1B}=V_{GND}$	25		300		k
BW	Bandwidth	$V_{CC}=V_{RS+}=48V, V_{OUT}=0.4V_{pp}$	25		180		kHz
	OUT Settling Time to 1% of Final Value	$V_{OUT}=200mV$ to 2V	25		20		$\mu s$
		$V_{OUT}=2V$ to 200mV	25		20		$\mu s$
	Capacitive-Load Stability	No sustained oscillations	25		500		pF
	Power-Up Time	$V_{CC}=V_{RS+}=48V, V_{OUT}=2V$ <sup>(12)</sup>	25		60		$\mu s$
	Saturation Recovery Time <sup>(13)</sup>	$V_{CC}=5V, V_{RS+}=48V$	25		20		$\mu s$

NOTE:

- (1) All devices are 100% production tested at  $T_A = +25^\circ C$ . All temperature limits are guaranteed by design.
- (2)  $V_{REF}$  is defined as the average voltage of  $V_{REF1A}$  and  $V_{REF1B}$ .  $V_{REF1B}$  is usually connected to  $V_{REF1A}$  or GND.  $V_{SENSE}$  is defined as  $V_{RS+}-V_{RS-}$ .
- (3) Limits are 100% production tested at  $25^\circ C$ . 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  $R_{S+}$  or  $R_{S-}$ . Depending on the polarity of  $V_{SENSE}$  and the device's gain, either  $R_{S+}$  or  $R_{S-}$  can extend below 5V by the device's typical full-scale value of  $V_{SENSE}$ .
- (6) Negative  $V_{SENSE}$  applies to AOSA4081 only.
- (7)  $V_{SENSE}$  is: AOSA4080A, 10mV to 250mV  
 AOSA4080B, 10mV to 120mV  
 AOSA4080C, 10mV to 100mV  
 AOSA4080D, 10mV to 50mV  
 AOSA4081A, -125mV to +125mV AOSA4081B, -60mV to +60mV  
 AOSA4081C, -50mV to +50mV  
 AOSA4081D, -25mV to +25mV
- (8) For AOSA4080  $V_{CC}$  is measured as  $(V_{OUT}/A_V) - V_{SENSE}$  at  $V_{SENSE}=10mV$ . For AOSA4081  $V_{OS}$  is measured as  $(V_{OUT}-V_{REF})/A_V$  at  $V_{SENSE} = 0V$ .



(9)  $V_{SENSE}$  is:

AOSA4080A/AOSA4080B/AOSA4080C/AOSA4080D, 10mV AOSA4081A/AOSA4081B/AOSA4081C/  
AOSA4081D, 0V  $V_{REF1B} = V_{REF1A} = 2.5V$

(10) For AOSA4080, Output voltage is internally clamped not to exceed the lesser of +11.5V or  $V_{CC}$

For AOSA4081, 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.



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.

$V_{CC}=V$

$V_{REFA}=V_{REFB}=5V$ ,  $V_{SENSE}=0V$ ,  $C_{LOAD}=20pF$ ,  $R_{LOAD}=\infty$ ,  $T_A=+25^{\circ}C$ , unless otherwise noted.

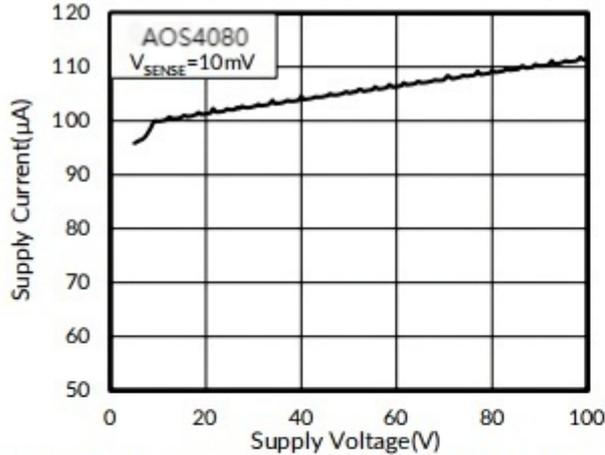


Figure 1. Supply Current vs Supply Voltage ( $V_{CC}$ )

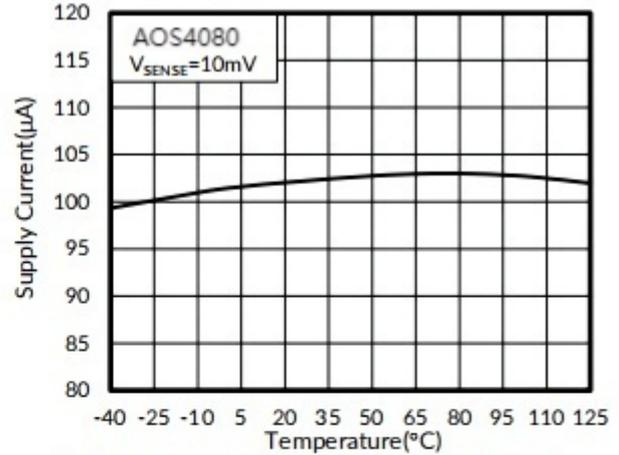


Figure 2. Supply Current vs Temperature

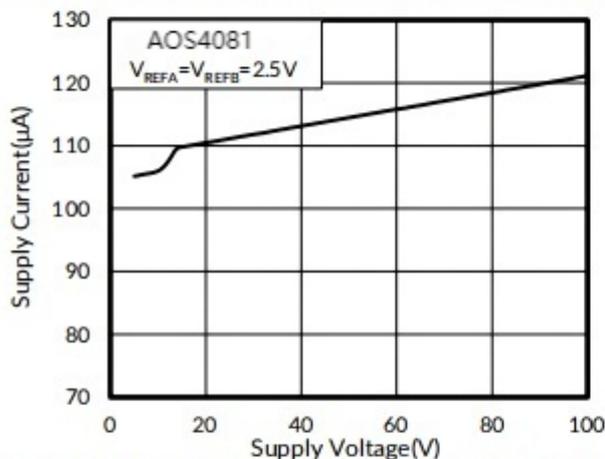


Figure 3. Supply Current vs Supply Voltage ( $V_{CC}$ )

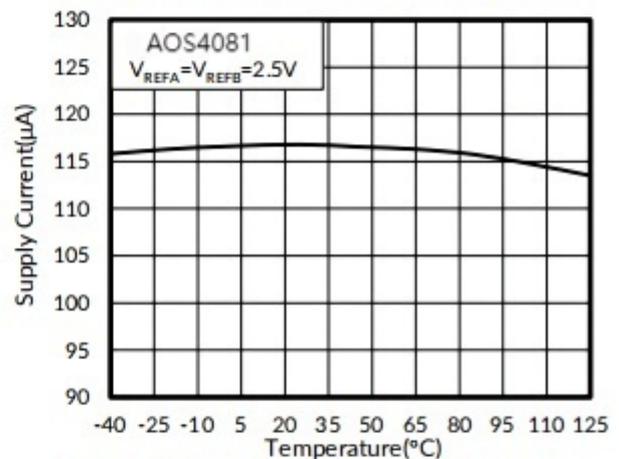


Figure 4. Supply Current vs Temperature

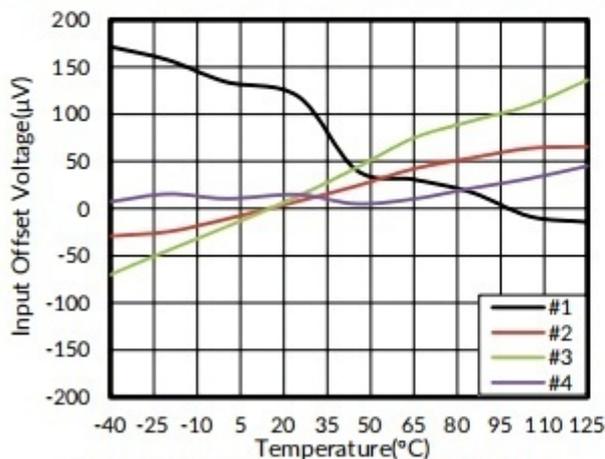


Figure 5. Input Offset Voltage ( $V_{OS}$ ) vs Temperature

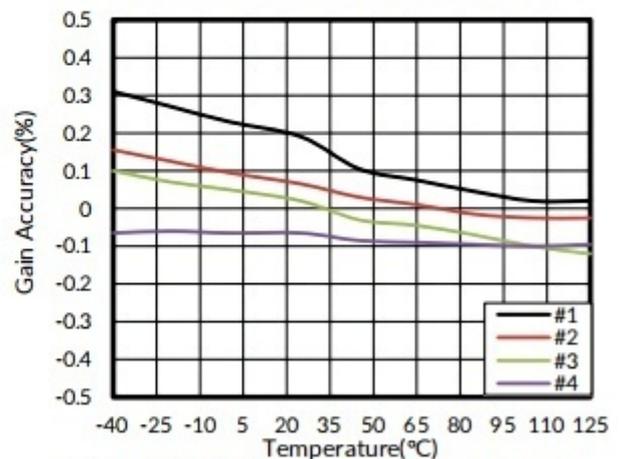


Figure 6. Gain Accuracy vs Temperature



### 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.  $V_{CC}=V_{RS+}=48V$ ,  $V_{REFA}=V_{REFB}=5V$ ,  $V_{SENSE}=0V$ ,  $C_{LOAD}=20pF$ ,  $R_{LOAD}=\infty$ ,  $T_A=+25^{\circ}C$ , unless otherwise noted.

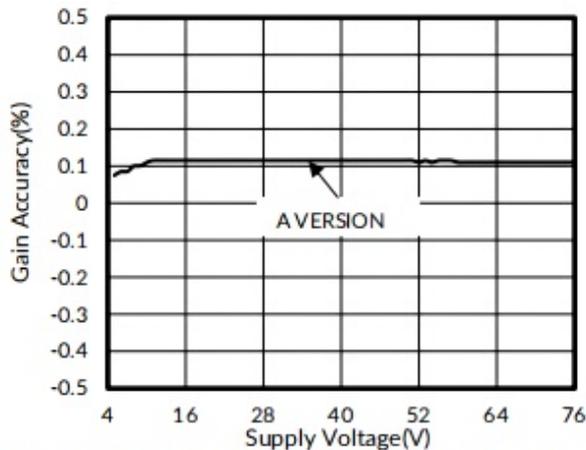


Figure 7. Gain Accuracy vs Supply Voltage ( $V_{CC}$ )

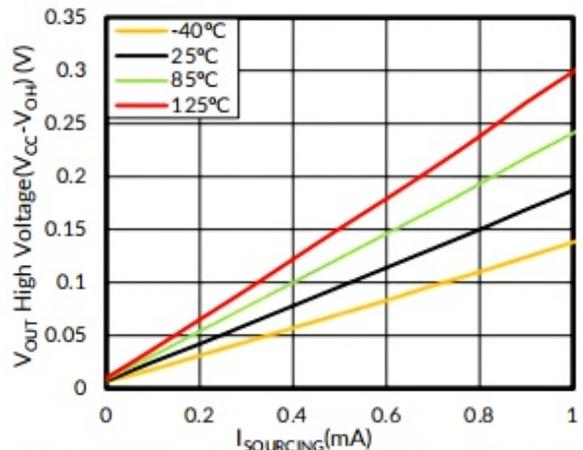


Figure 8.  $V_{OUT}$  High Voltage vs  $I_{OUT}$  (Sourcing)

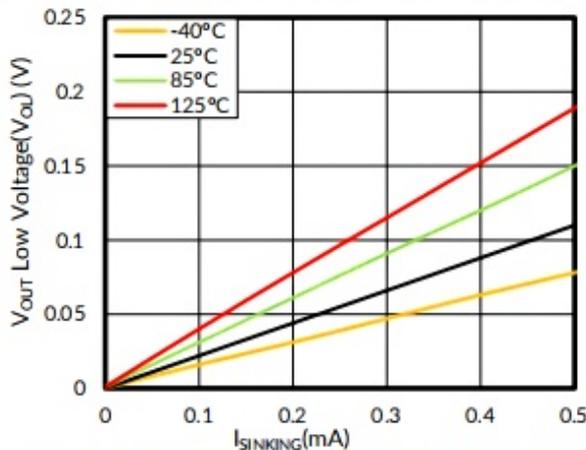


Figure 9.  $V_{OUT}$  Low Voltage vs  $I_{OUT}$  (Sinking)

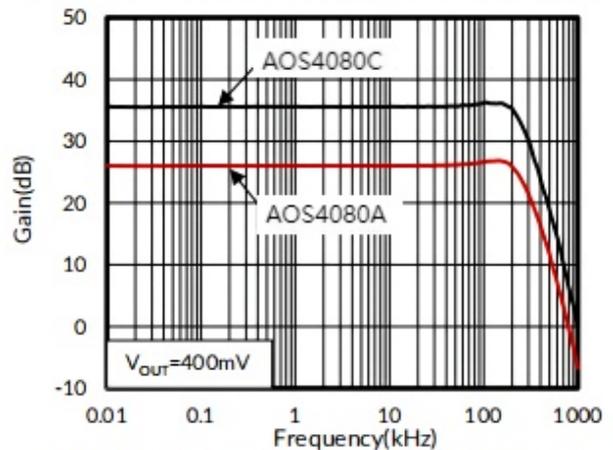


Figure 10. Small-Signal Gain vs Frequency

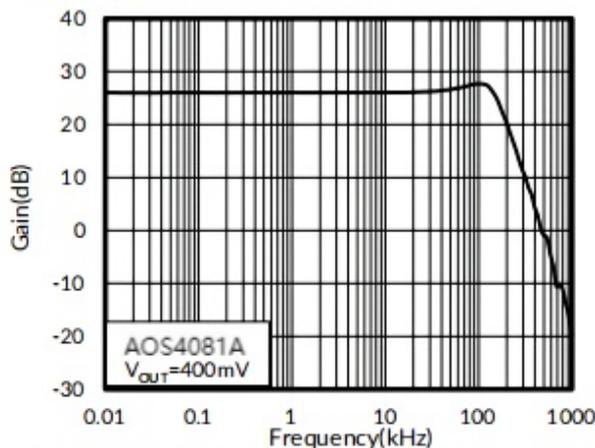


Figure 11. Small-Signal Gain vs Frequency

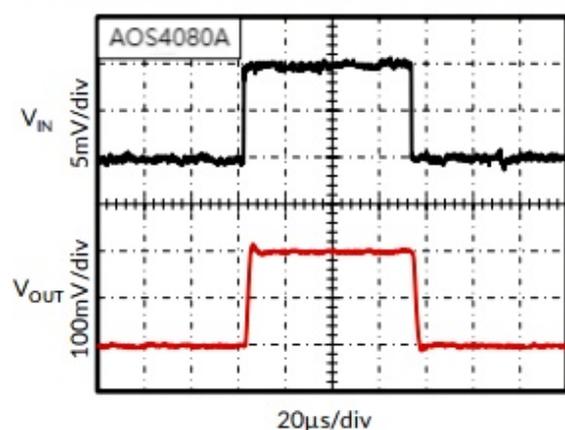


Figure 12. Small-Signal Transient Response



### 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.

$V_{CC}=V_{RS+}=48V$ ,  $V_{REFA}=V_{REFB}=5V$ ,  $V_{SENSE}=0V$ ,  $C_{LOAD}=20pF$ ,  $R_{LOAD}=\infty$ ,  $T_A=+25^{\circ}C$ , unless otherwise noted.

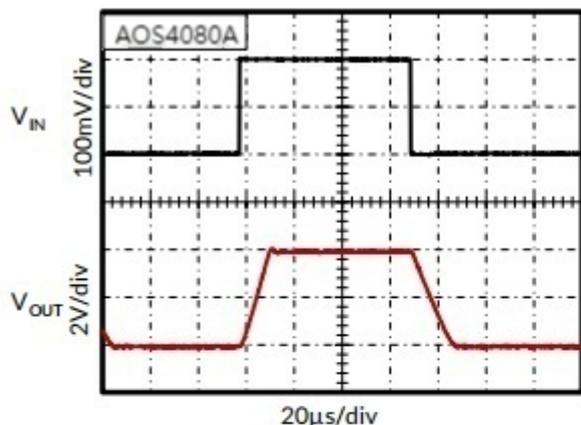


Figure 13. Large-Signal Transient Response

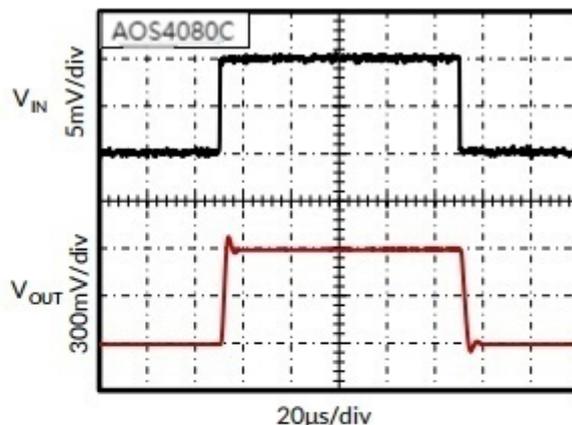


Figure 14. Small-Signal Transient Response

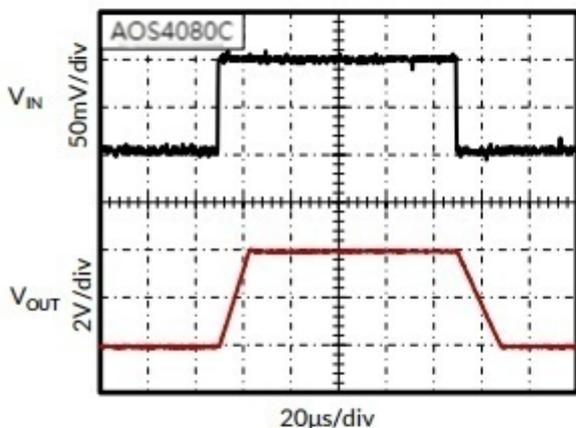


Figure 15. Large-Signal Transient Response

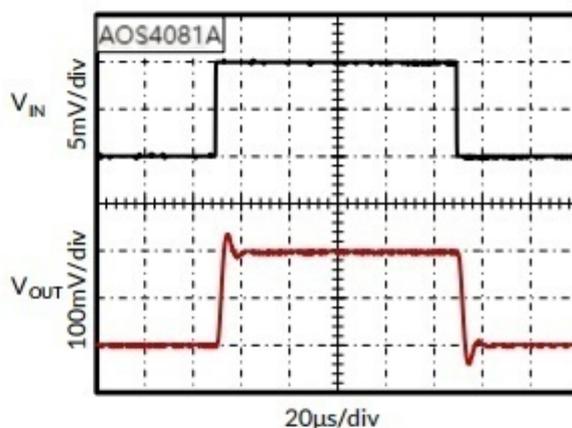


Figure 16. Small-Signal Transient Response

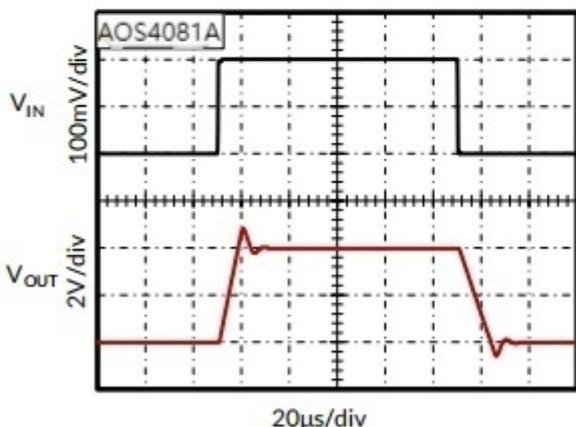


Figure 17. Large-Signal Transient Response

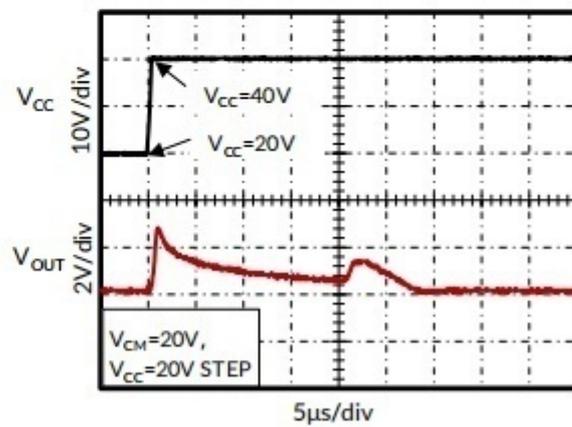


Figure 18. V<sub>CC</sub>-TRANSIENT RESPONSE



### 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.

$V_{CC}=V_{RS+}=48V$ ,  $V_{REFA}=V_{REFB}=5V$ ,  $V_{SENSE}=0V$ ,  $C_{LOAD}=20pF$ ,  $R_{LOAD}=\infty$ ,  $T_A=+25^{\circ}C$ , unless otherwise noted.

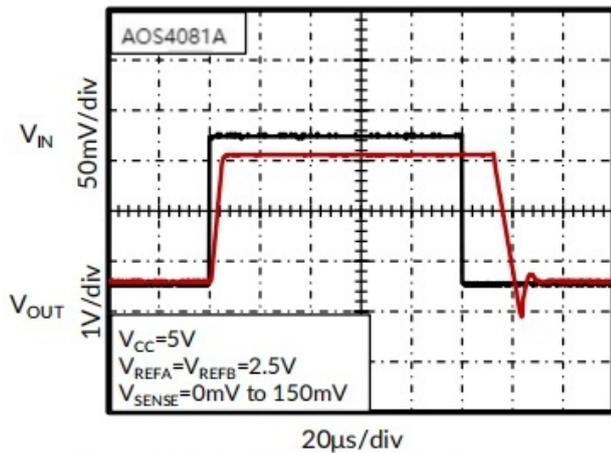


Figure 19. Positive Overload Recovery

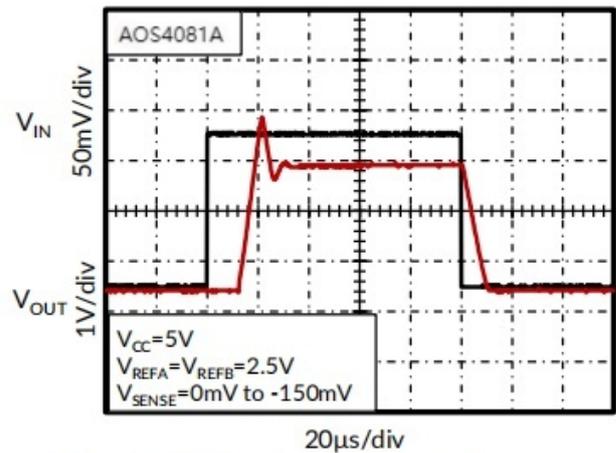


Figure 20. Negative Overload Recovery

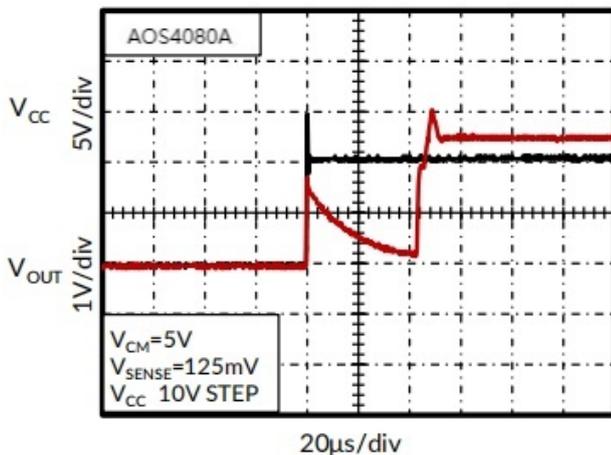


Figure 21. STARTUP DELAY



## DETAILED DESCRIPTION

The AOSA408X 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 (VCC). The AOSA408X monitors current through a current-sense resistor and amplifies the voltage across the resistor. The AOSA4080 senses current unidirectionally, while the AOSA4081 senses current bidirectionally.

The 100V input voltage range of the AOSA408X applies independently to both supply voltage (VCC) and commonmode, input-sense voltage (VRS+). High-side current monitoring does not interfere with the ground path of the load being measured, making the AOSA408X 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 AOSA4081 charging current is represented by an output voltage from VREF to VCC, while discharge current is given from VREF to GND. Measurements of OUT with respect to VREF yield a positive and negative voltage during charge and discharge, as illustrated in Figure 22 for the AOSA4081A.

### Current Monitoring

The AOSA4080 operates as follows: current from the source flows through RSENSE to the load (Figure 21), creating a sense voltage, VSENSE. 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 VSOURCE - (ILOAD)(RSENSE). The amplifier's open-loop gain forces its noninverting input to the same voltage as the inverting input. Therefore, the drop across RG1 equals VSENSE. The internal current mirror multiplies IRG1 by a current gain factor,  $\beta$ , 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 AOSA4080A, 50V/V for the AOSA4080B, 60V/V for the AOSA4080C, and 100V/V for the AOSA4080D. The AOSA4081 input stage differs slightly from the AOSA4080 (Figure 22). Its topology allows for monitoring of bidirectional currents through the sense resistor. When current flows from RS+ to RS-, the AOSA4081 matches the voltage drop across the external sense resistor, RSENSE, 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 AOSA4081, the output signal of amplifier A2 is level-shifted to the reference voltage (VREF = VREF1A = VREF1B), resulting in a voltage at the output pin (OUT) that swings above VREF voltage for positive-sense voltages and below VREF for negative-sense voltages. VOUT is equal to VREF when VSENSE is equal to zero. Set the full-scale output range by selecting RSENSE and the appropriate gain version of the AOSA408X.

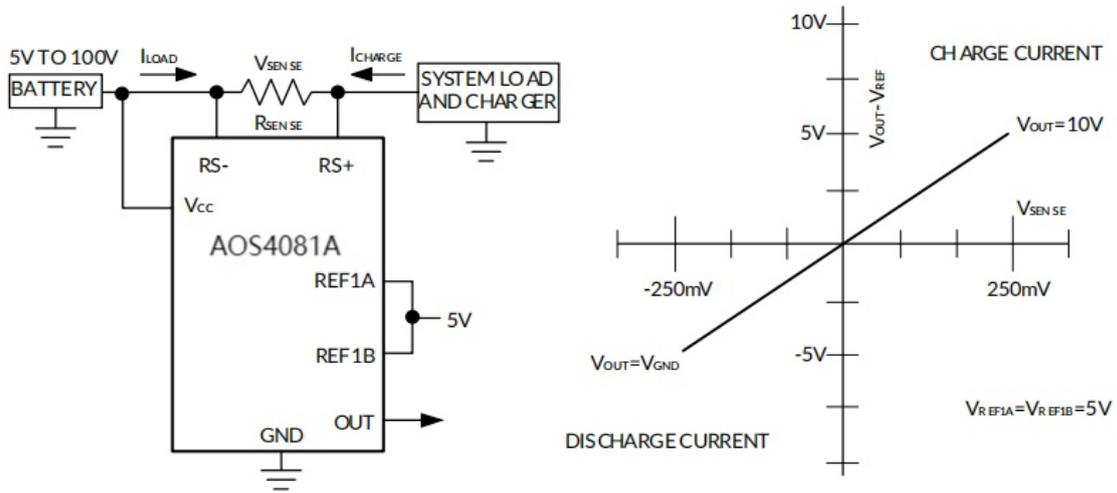


Figure 22. AOSA4081A OUT Transfer Curve

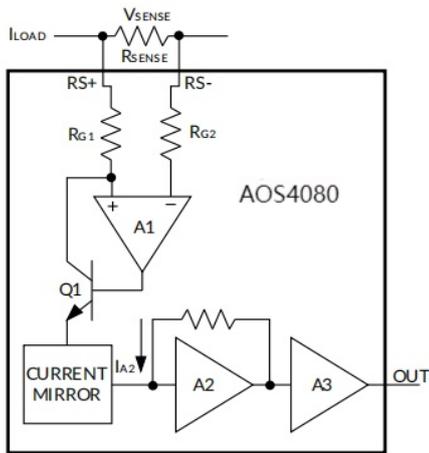


Figure 23. AOSA4080 Functional Diagram

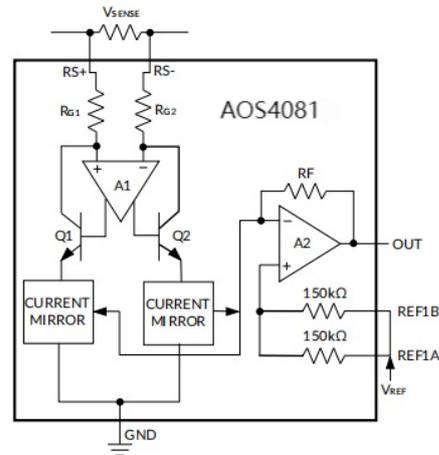


Figure 24. AOSA4081 Functional Diagram



### External References (AOSA4081)

For the bidirectional AOSA4081, the VOUT reference level is controlled by REF1A and REF1B. VREF is defined as the average voltage of VREF1A and VREF1B. Connect REF1A and REF1B to a low-noise, regulated voltage source to set the output reference level. In this mode, VOUT equals VREF1A when VSENSE 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 (VREF) is equal to VREF1A divided by two. VOUT equals VREF1A/2 when VSENSE equals zero.

In either mode, the output swings above the reference voltage for positive current-sensing ( $VRS+ > VRS-$ ). The output swings below the reference voltage for negative current-sensing ( $VRS+ < VRS-$ ).

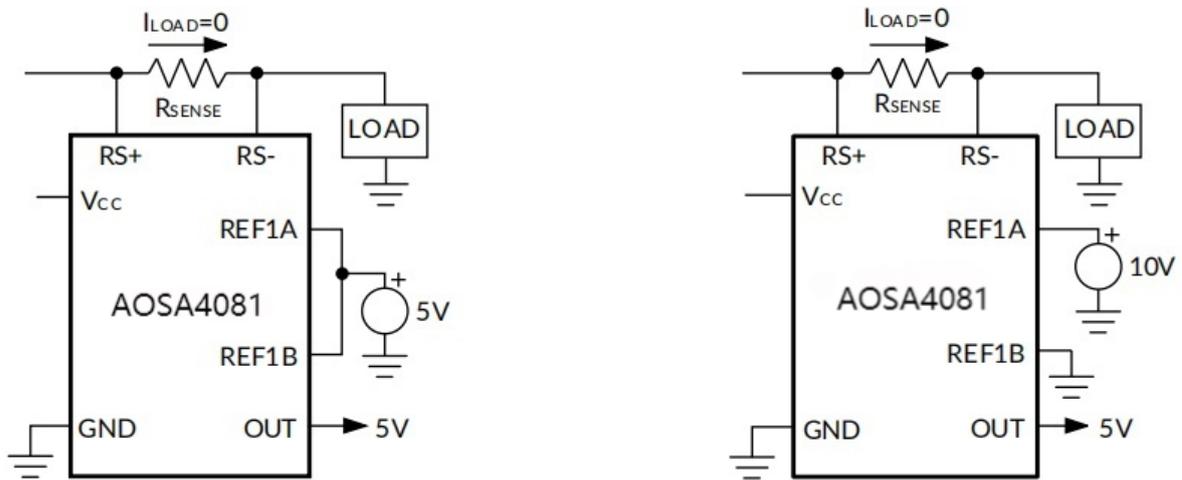


Figure 25. AOSA4081 Reference Inputs



## APPLICATIONS INFORMATION

### Choosing the Sense Resistor

Choose RSENSE based on the following criteria:

**Voltage Loss:** A high RSENSE value causes the power-source voltage to degrade through IR loss. For minimal voltage loss, use the lowest RSENSE value.

**Accuracy:** A high RSENSE 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 RSENSE 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<sup>2</sup>R losses in RSENSE 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 ISENSE 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 1  $\mu$ .

Because of the high currents that flow through RSENSE, 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.

### Dynamic Range Consideration

Although the AOSA4081 have fully symmetrical bidirectional VSENSE input capability, the output voltage range is usually higher from REF to VCC 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.

### Power-Supply Bypassing and Grounding

For most applications, bypass VCC to GND with a 0.1 $\mu$ F ceramic capacitor. In many applications, VCC can be connected to one of the current monitor terminals (RS+ or RS-). Because VCC is independent of the monitored voltage, VCC can be connected to a separate regulated supply.

If VCC will be subject to fast-line transients, a series resistor can be added to the power-supply line of the AOSA408X to minimize output disturbance. This resistance and the decoupling capacitor reduce the rise time of the transient. For most applications, 1k  $\Omega$  in conjunction with a 0.1 $\mu$ F bypass capacitor work well.

The AOSA408X 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.



### Power Management

The bidirectional capability of the AOSA4081 makes it an excellent candidate for use in smart battery packs. In the application diagram (Figure 24), the AOSA4081 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.

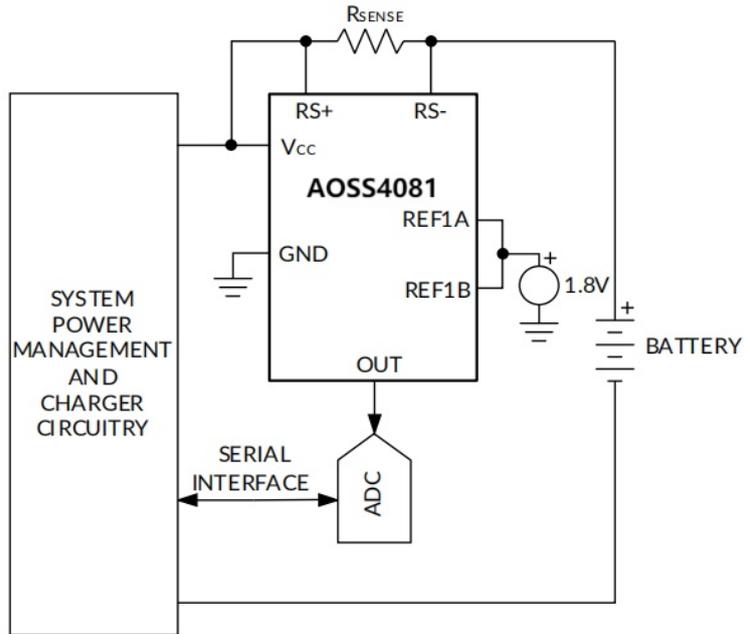
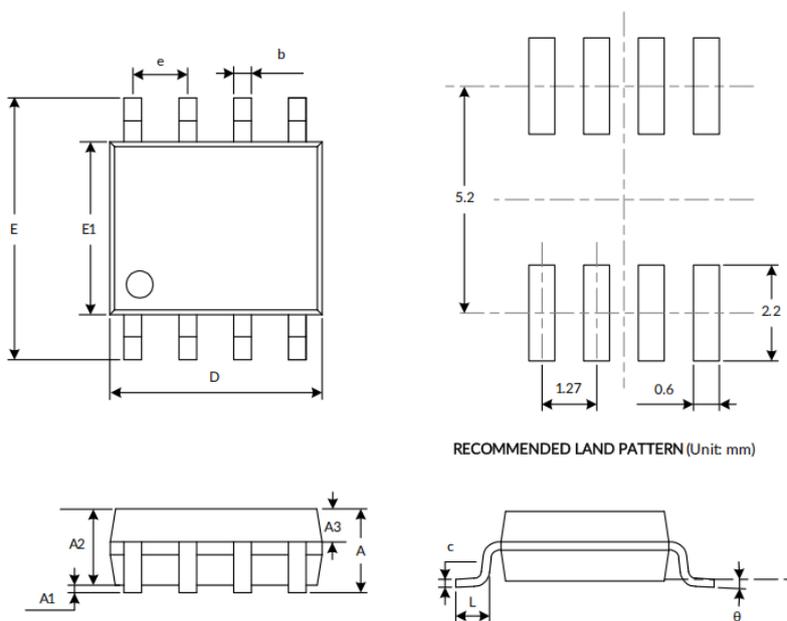


Figure 26. AOSA4081 Used in Smart-Battery Application



PACKAGE OUTLINE DIMENSIONS  
SOP8<sup>(3)</sup>



RECOMMENDED LAND PATTERN (Unit: mm)

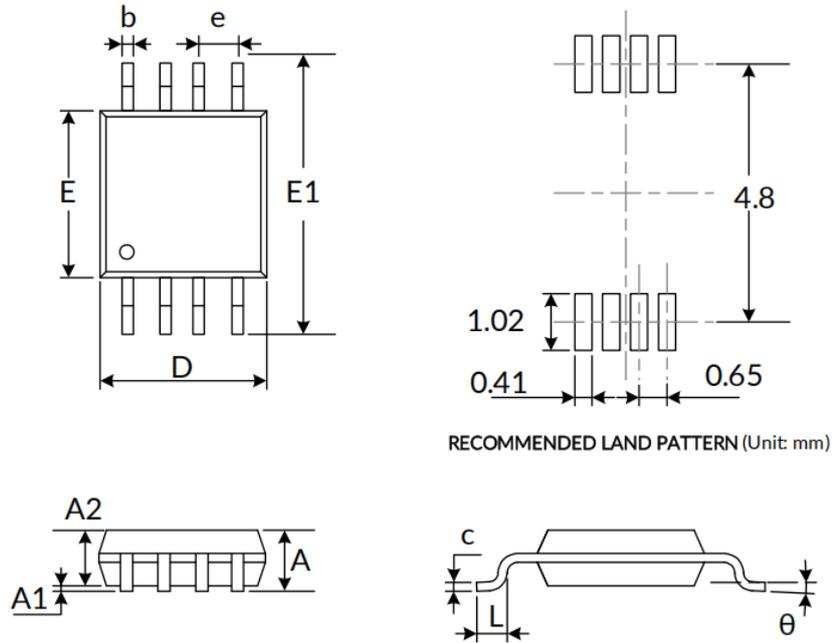
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>		1.750		0.069
A1	0.100	0.225	0.004	0.009
A2	1.300	1.500	0.051	0.059
A3	0.600	0.700	0.024	0.028
b	0.390	0.470	0.015	0.019
c	0.200	0.240	0.008	0.009
D <sup>(1)</sup>	4.800	5.000	0.189	0.197
e	1.270 (BSC) <sup>(2)</sup>		0.050 (BSC) <sup>(2)</sup>	
E	5.800	6.200	0.228	0.244
E1 <sup>(1)</sup>	3.800	4.000	0.150	0.157
L	0.500	0.800	0.020	0.031
	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<sup>(3)</sup>



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>	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 <sup>(1)</sup>	2.900	3.100	0.114	0.122
e	0.650(BSC) <sup>(2)</sup>		0.026(BSC) <sup>(2)</sup>	
E <sup>(1)</sup>	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
	0°	6°	0°	6°

NOTE:

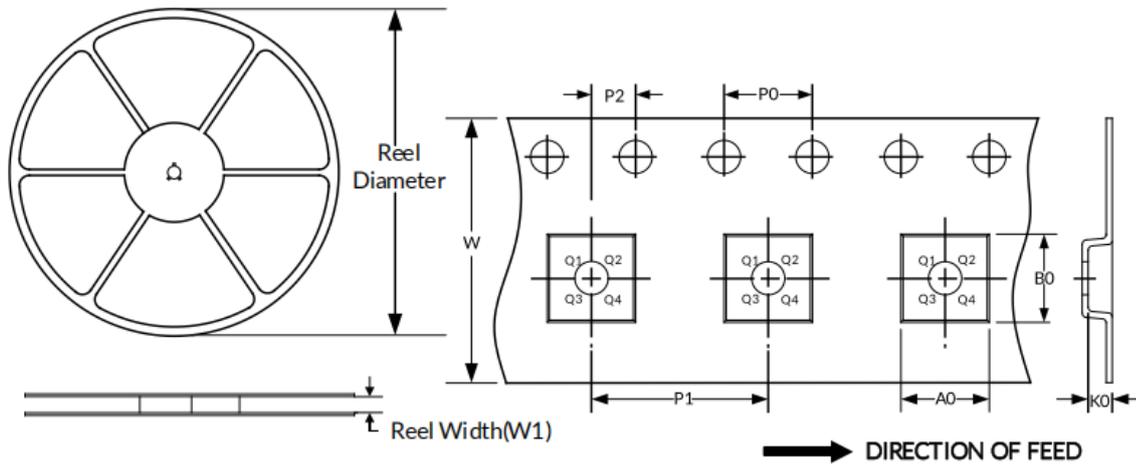
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.



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.