

40V, 10MHz Rail-to-Rail Output Zero Drift Operational Amplifier

1 FEATURES

- **Low Offset Voltage: $\pm 3\mu\text{V}$**
- **Low Bias Current**
- **Gain Bandwidth Product: 10MHz**
- **Rail-to-Rail Output**
- **High Slew Rate: 11V/ μs**
- **Low Quiescent Current: 1.7mA (TYP)**
- **Supply Voltage Range: 3.2V to 40V**
- **Over-Temperature Protection**
- **Low Noise: 8nV/ $\sqrt{\text{Hz}}$ at 1kHz**
- **Differential Input Voltage Up to Supply Rail, can Work as Comparator**
- **Extended Temperature: -40°C to 125°C**
- **Micro SIZE PACKAGES: SOT23-5, SOP8, MSOP8, SOP14 and TSSOP14**

2 APPLICATIONS

- **Sensors**
- **Photodiode Amplification**
- **Active Filters**
- **Test Equipment**
- **Driving A/D Converters**
- **Industrial Control**

3 DESCRIPTIONS

The RS868X is a low noise, low offset voltage and high voltage operational amplifier, which can be designed into a wide range of applications. The RS868X has a gain-bandwidth product of 10MHz, a slew rate of 11V/ μs and a quiescent current of 1.7mA at wide power supply range.

The RS868X is designed to provide optimal performance in low noise systems. It provides rail-to rail output swing into heavy loads.

The RS868X has over-temperature protection feature to guarantee the chip safe. The output of RS868X will enter high impedance when die temperature reach around 160°C and will recover the function when the die temperature down to around 140°C.

The RS868X is available in Green SOT23-5, SOP8, MSOP8, SOP14 and TSSOP14 packages. It operates over an ambient temperature range of -40°C to 125°C under single power supplies of 3.2V to 40V or dual power supplies of $\pm 1.6\text{V}$ to $\pm 20\text{V}$.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RS8681	SOT23-5	1.60mm × 2.92mm
	SOP8	4.90mm × 3.90mm
RS8682	SOP8	4.90mm × 3.90mm
	MSOP8	3.00mm×3.00mm
RS8684	SOP14	8.65mm × 3.90mm
	TSSOP14	5.00mm×4.40mm

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

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Preliminary version

4 REVISION HISTORY

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

VERSION	Change Date	Change Item
A.0	2025/10/22	Preliminary version completed
A.0.1	2025/11/18	Update Electrical Characteristics

Preliminary version

5 PACKAGE/ORDERING INFORMATION ⁽¹⁾

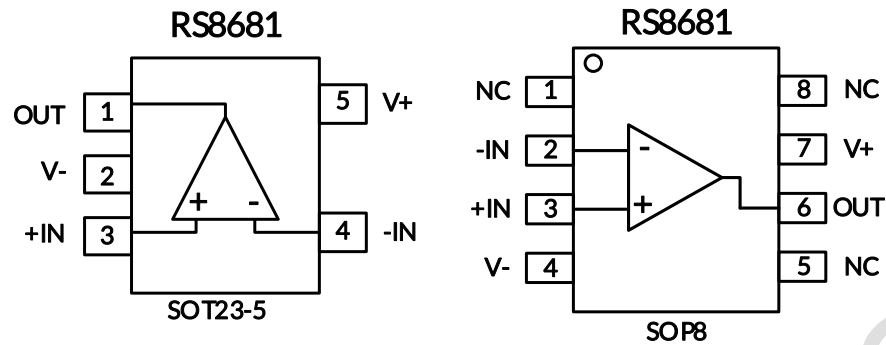
Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking ⁽²⁾	MSL ⁽³⁾	Package Qty
RS8681XF	SOT23-5	5	1	-40°C ~125°C	8681	MSL1	Tape and Reel,3000
RS8681XK	SOP8	8	1	-40°C ~125°C	RS8681	MSL1	Tape and Reel,4000
RS8682XK	SOP8	8	2	-40°C ~125°C	RS8682	MSL1	Tape and Reel,4000
RS8682XM	MSOP8	8	2	-40°C ~125°C	RS8682	TBD	Tape and Reel, 4000
RS8684XP	SOP14	14	4	-40°C ~125°C	RS8684	MSL3	Tape and Reel,4000
RS8684XQ	TSSOP14	14	4	-40°C ~125°C	RS8684	MSL3	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.

Preliminary version

6 PIN CONFIGURATION AND FUNCTIONS (TOP VIEW)

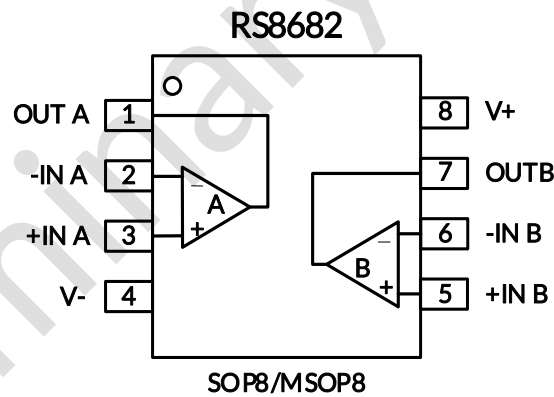


Pin Description

NAME	PIN		I/O ⁽¹⁾	DESCRIPTION
	SOT23-5	SOP8		
OUT	1	6	O	Output
V-	2	4	-	Negative (lowest) power supply
+IN	3	3	I	Positive (noninverting) input
-IN	4	2	I	Negative (inverting) input
V+	5	7	-	Positive (highest) power supply
NC ⁽²⁾	-	1,5,8	-	No internal connection (can be left floating)

(1) I = Input, O = Output.

(2) There is no internal connection. Typically, GND is the recommended connection to a heat spreading plane.

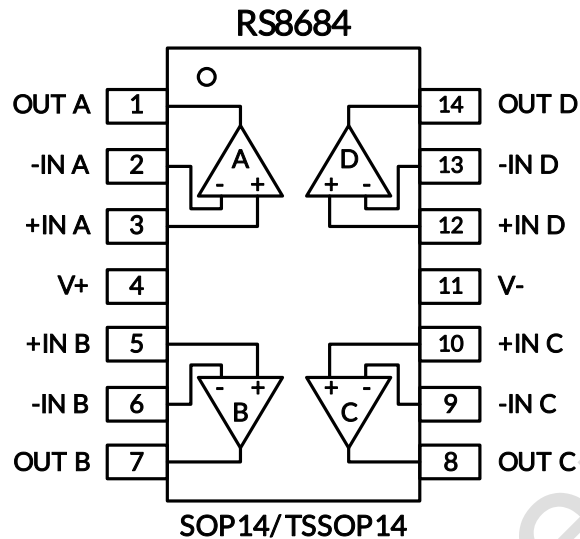


Pin Description

NAME	PIN		I/O ⁽¹⁾	DESCRIPTION
	SOP8/MSOP8			
-INA	2		I	Inverting input, channel A
+INA	3		I	Noninverting input, channel A
-INB	6		I	Inverting input, channel B
+INB	5		I	Noninverting input, channel B
OUTA	1		O	Output, channel A
OUTB	7		O	Output, channel B
V-	4		-	Negative (lowest) power supply
V+	8		-	Positive (highest) power supply

(1) I = Input, O = Output.

Pin Configuration and Functions (Top View)



Pin Description

NAME	PIN	I/O ⁽¹⁾	DESCRIPTION
	SOP14/TSSOP14		
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
-INB	6	I	Inverting input, channel B
+INB	5	I	Noninverting input, channel B
-INC	9	I	Inverting input, channel C
+INC	10	I	Noninverting input, channel C
-IND	13	I	Inverting input, channel D
+IND	12	I	Noninverting input, channel D
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
OUTC	8	O	Output, channel C
OUTD	14	O	Output, channel D
V-	11	-	Negative (lowest) power supply or ground (for single supply operation)
V+	4	-	Positive (highest) power supply

(1) I = Input, O = Output.

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT	
Voltage	Supply, $V_S=(V+) - (V-)$		42	V	
	Signal input pin ⁽²⁾	(V-) - 0.3	(V+) + 0.3		
	Signal output pin ⁽³⁾	(V-) - 0.3	(V+) + 0.3		
	Differential input voltage	(V-) - (V+)	(V+) - (V-)		
Current	Signal input pin ⁽²⁾	-10	10	mA	
	Signal output pin ⁽³⁾	-10	10	mA	
	Output short-circuits ⁽⁴⁾	Continuous			
θ_{JA}	Package thermal impedance ⁽⁵⁾	SOT23-5		230	°C/W
		SOP8		110	
		MSOP8		170	
		SOP14		105	
		TSSOP14		90	
Temperature	Operating range, T_A	-40	125	°C	
	Junction, T_J ⁽⁶⁾	-40	150		
	Storage, T_{stg}	-65	150		
	Lead temperature (Soldering, 10sec)		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) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.

(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.3V beyond the supply rails should be current-limited to ± 10 mA or less.

(4) Short-circuit to ground, one amplifier per package.

(5) The package thermal impedance is calculated in accordance with JESD-51.

(6) 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), JESD22-a114	± 2000	V
		Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2022	± 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.

7.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
Supply voltage, $V_S=(V+) - (V-)$	Single-supply	3.2	40	V
	Dual-supply	± 1.6	± 20	

7.4 Electrical Characteristics

At $T_A = +25^\circ\text{C}$, $V_S = 40\text{V}$, $V_{CM} = V_S/2$, $R_L = 10\text{k}\Omega$, Full ⁽⁹⁾ = -40°C to 125°C , unless otherwise noted ⁽¹⁾

PARAMETER	CONDITIONS	T_A	RS868X			UNIT	
			MIN ⁽²⁾	TYP ⁽³⁾	MAX ⁽²⁾		
POWER SUPPLY							
V_S	Operating Voltage Range	Full	3.2		40	V	
I_Q	Quiescent Current per Amplifier	$V_S = 3.2\text{V}$	25°C		1.7	2.1	mA
			Full			2.3	
		$V_S = 40\text{V}$	25°C		1.9	2.3	
			Full			2.5	
PSRR	Power-Supply Rejection Ratio	$V_S = 3.2\text{V}$ to 40V	25°C	130	150	dB	
			Full	120			
INPUT							
V_{OS}	Input Offset Voltage	$V_S = 3.2\text{V}$, $V_{CM} = 0\text{V}$	25°C	-10	± 3	10	μV
			Full	-30		30	
		$V_S = 40\text{V}$, $V_{CM} = 0\text{V}$	25°C	-10	± 3	10	μV
			Full	-30		30	
$V_{OS} T_C$	Input Offset Voltage Drift	Full		± 0.1		$\mu\text{V}/^\circ\text{C}$	
IB	Input Bias Current ^{(4) (5)}	$V_S = 40\text{V}$, $V_{CM} = 20\text{V}$	25°C	-500	± 100	500	pA
			Full	-3000		3000	
I_{OS}	Input Offset Current ⁽⁴⁾	$V_S = 40\text{V}$, $V_{CM} = 20\text{V}$	25°C		± 100		pA
			Full	-3000		3000	
I_{IN}	Different Input Current	$V_S = 40\text{V}$, $V_{ID} = 40\text{V}$	25°C		0.5	3	μA
C_{IN}	Input Capacitance	Differential Mode	25°C		5		pF
		Common Mode	25°C		3		pF
A _{OL}	Open-loop Voltage Gain	$R_{LOAD} = 10\text{k}\Omega$, $V_{OUT} = -19.5\text{V}$ to 19.5V	25°C	130	150		dB
			Full	120			dB
V_{CM}	Common-Mode Voltage Range	Full	(V-)-0.1		(V+)-1.8	V	
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0$ to 38.2V	25°C	130	150		dB
			Full	120			
OUTPUT							
V_{OH}	Output Swing from Positive Rail	$R_{LOAD} = 10\text{k}\Omega$ to $V_S/2$	25°C		95	150	mV
V_{OL}	Output Swing from Negative Rail	$R_{LOAD} = 10\text{k}\Omega$ to $V_S/2$	25°C		60	150	mV
I_{SC}	Short-Circuit Current ^{(6) (7)}	Source	25°C	50	75		mA
		Sink	25°C	90	130		
AC Specifications							
SR	Slew Rate ⁽⁸⁾	G=1, 10V Step	25°C		11		V/ μs
GBW	Gain-Bandwidth Product		25°C		10		MHz
t_s	Settling Time, 0.1%	G=1, 10V Step	25°C		5		μs
t_{OR}	Overload Recovery Time		25°C		300		ns
PM	Phase Margin	$R_L = 10\text{k}\Omega$, $C_L = 50\text{pF}$	25°C		60		°
GM	Gain Margin	$R_L = 10\text{k}\Omega$, $C_L = 50\text{pF}$	25°C		10		dB

NOISE							
En	Input Voltage Noise	$V_s = 5V, f = 0.1\text{Hz to }10\text{Hz}$	25°C		0.25		μVpp
en	Input Voltage Noise Density ⁽⁴⁾	$f = 0.1\text{kHz}$	25°C		9		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$	25°C		8		
		$f = 10\text{kHz}$	25°C		8		
THD+N	Total Harmonic Distortion and Noise	$f = 1\text{kHz}, G = 1, R_L = 10\text{k}\Omega, V_{\text{OUT}} = 6\text{Vrms}$			0.0003		%
Thermal Protection							
T _{SHDN}	Thermal Shutdown Temperature				160		°C
ΔT_{SHDN}	Thermal Shutdown Hysteresis				20		

NOTE:

- (1) Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device.
- (2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
- (3) 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.
- (4) This parameter is ensured by design and/or characterization and is not tested in production.
- (5) Positive current corresponds to current flowing into the device.
- (6) The maximum power dissipation is a function of $T_{\text{J(MAX)}}$, $R_{\theta\text{JA}}$, and T_{A} . The maximum allowable power dissipation at any ambient temperature is $P_{\text{D}} = (T_{\text{J(MAX)}} - T_{\text{A}}) / R_{\theta\text{JA}}$. All numbers apply for packages soldered directly onto a PCB.
- (7) Short circuit test is a momentary test.
- (8) Number specified is the slower of positive and negative slew rates.
- (9) Specified by characterization only.

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.

At $T_A = +25^\circ\text{C}$, $V_S = \pm 18\text{V}$, $V_{CM} = V_S/2$, $R_L = 10\text{k}\Omega$, unless otherwise specified.

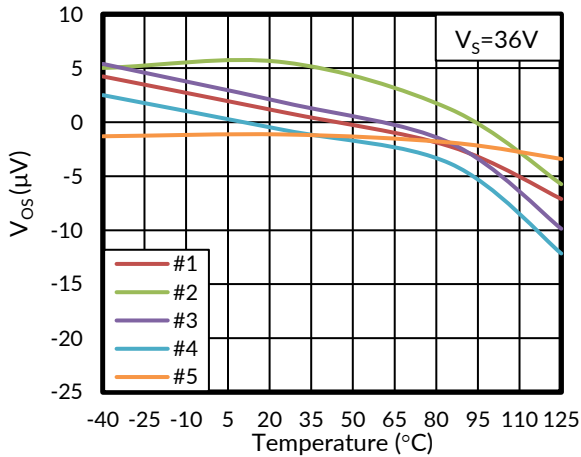


Figure 1. Offset Voltage vs Temperature

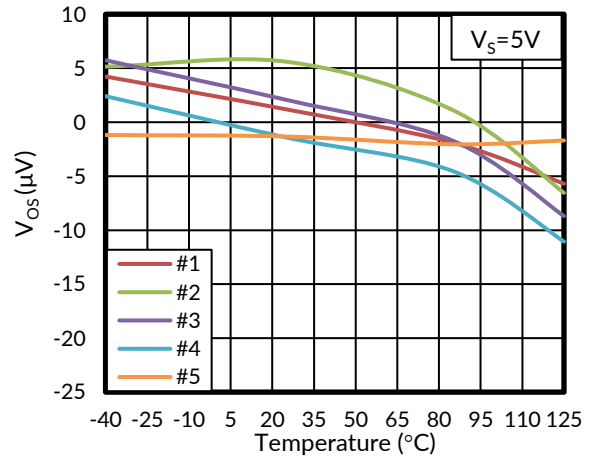


Figure 2. Offset Voltage vs Temperature

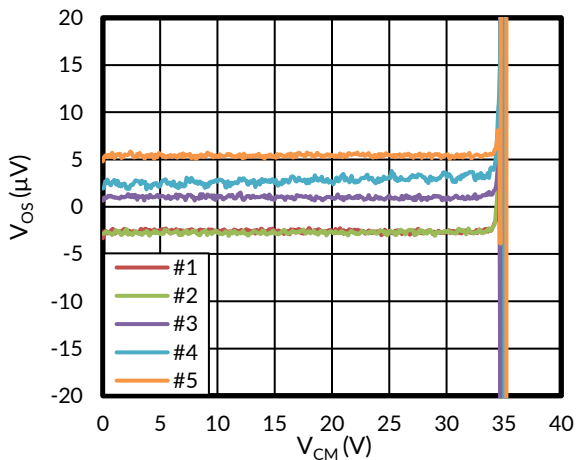


Figure 3. Offset Voltage vs Common Mode Voltage

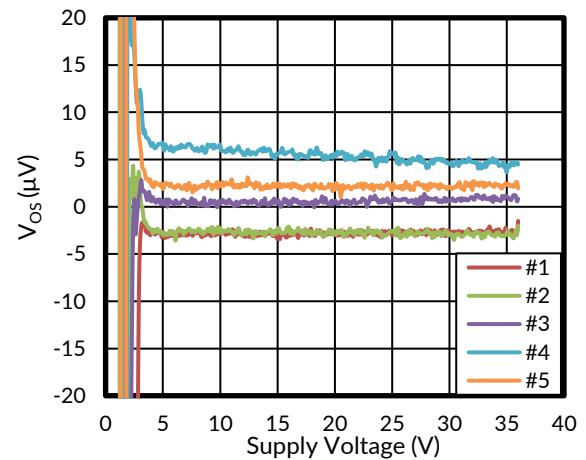


Figure 4. Offset Voltage vs Supply Voltage

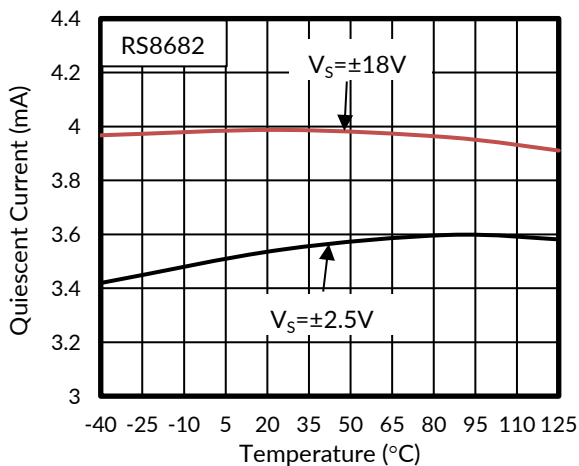


Figure 5. Quiescent Current vs Temperature

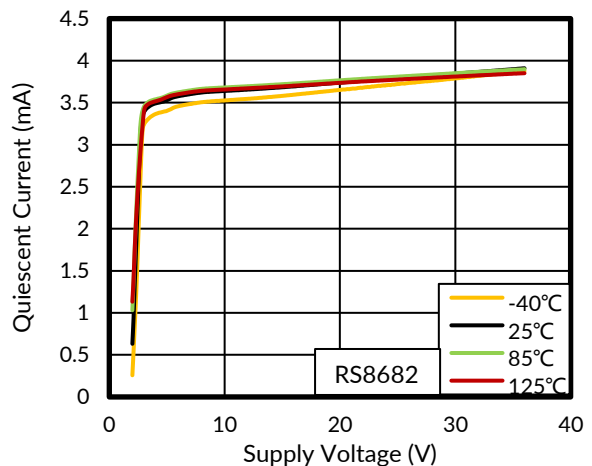


Figure 6. Quiescent Current vs Supply Voltage

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.

At $T_A = +25^\circ\text{C}$, $V_S = \pm 18\text{V}$, $V_{CM} = V_S/2$, $R_L = 10\text{k}\Omega$, unless otherwise specified.

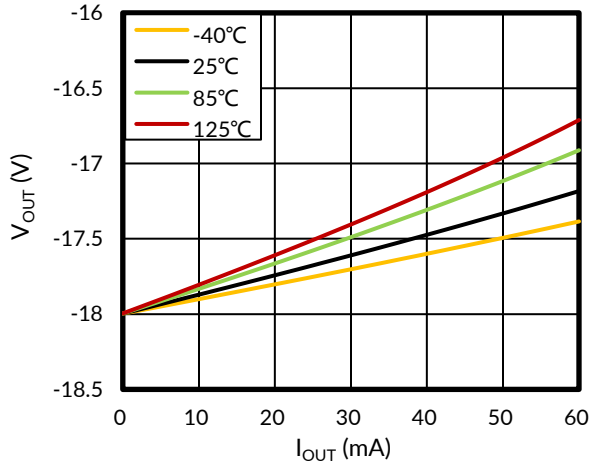


Figure 7. V_{OUT} vs I_{OUT} , Sink

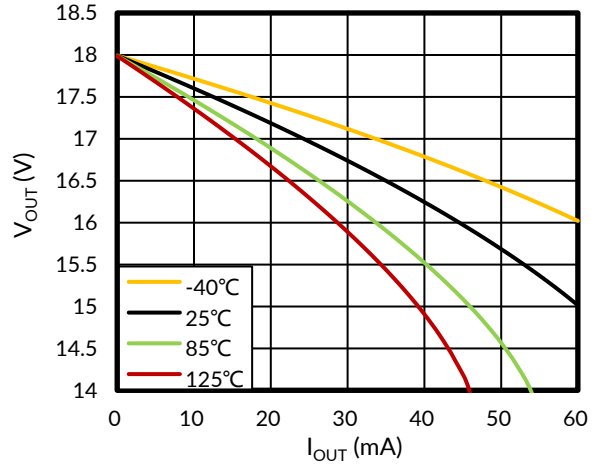


Figure 8. V_{OUT} vs I_{OUT} , Source

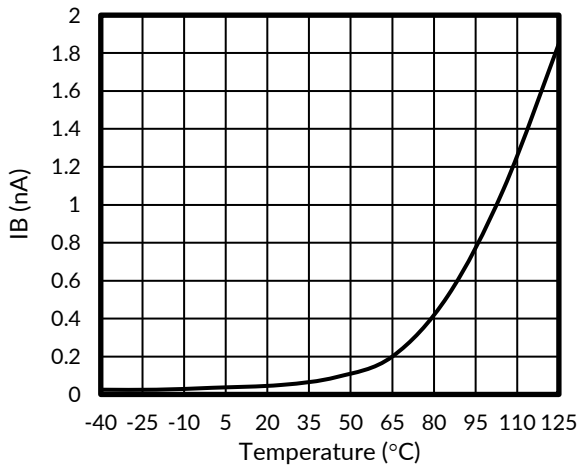


Figure 9. Input Bias Current vs Temperature

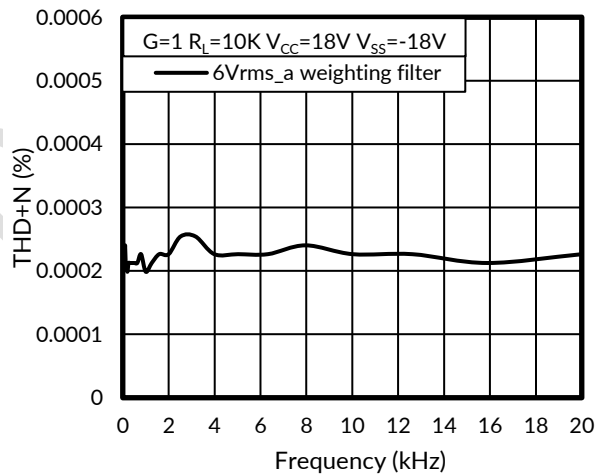


Figure 10. THD+N vs Frequency

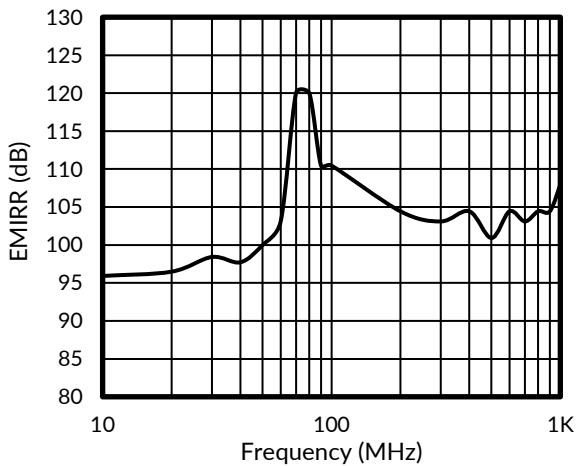


Figure 11. EMIRR vs Frequency

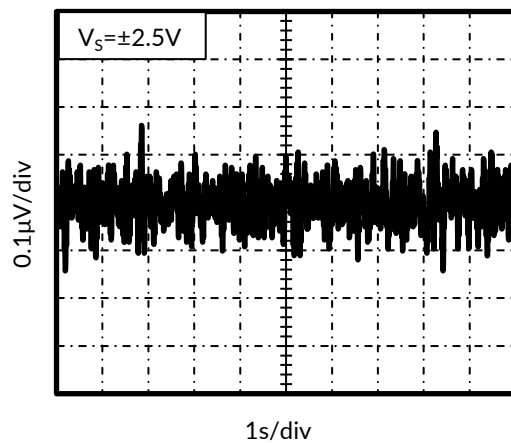


Figure 12. 0.1Hz to 10Hz Input Voltage Noise

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.

At $T_A = +25^\circ\text{C}$, $V_S = \pm 18\text{V}$, $V_{CM} = V_S/2$, $R_L = 10\text{k}\Omega$, unless otherwise specified.

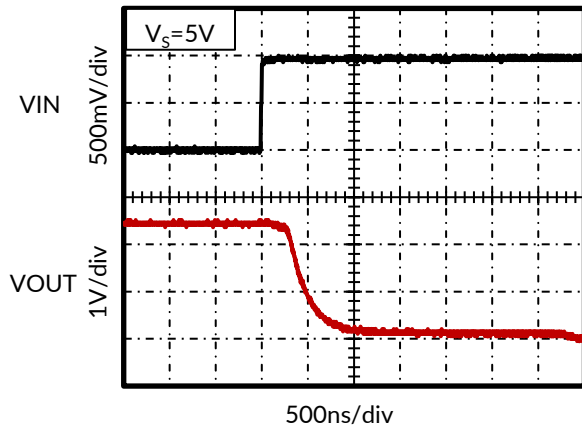


Figure 13. Positive Overload Recovery

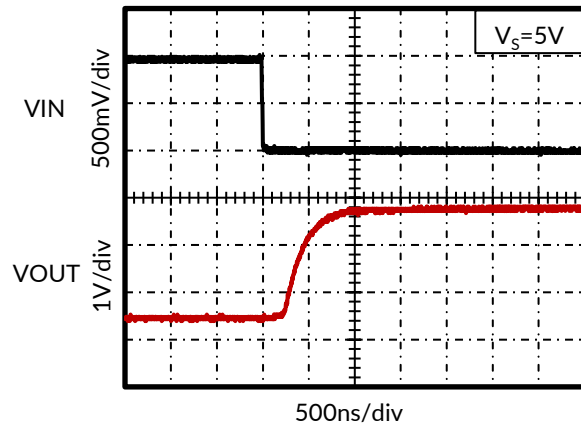


Figure 14. Negative Overload Recovery

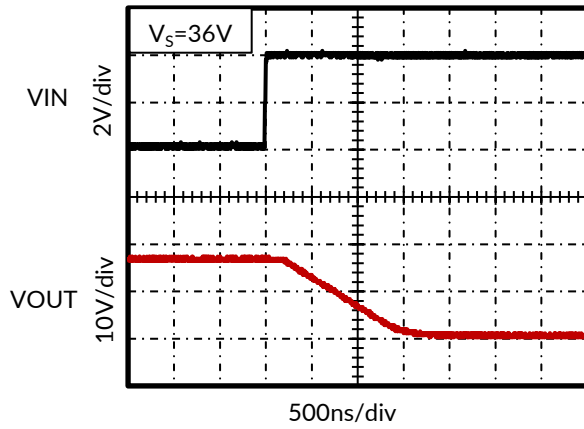


Figure 15. Positive Overload Recovery

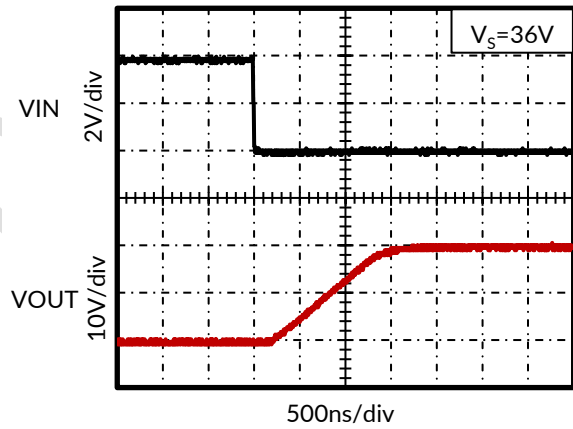


Figure 16. Negative Overload Recovery

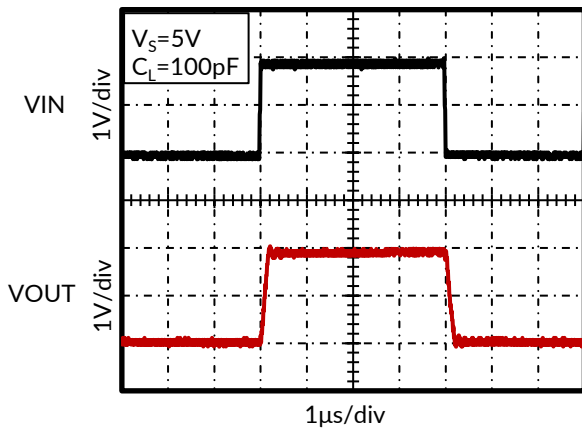


Figure 17. Large Signal Step Response

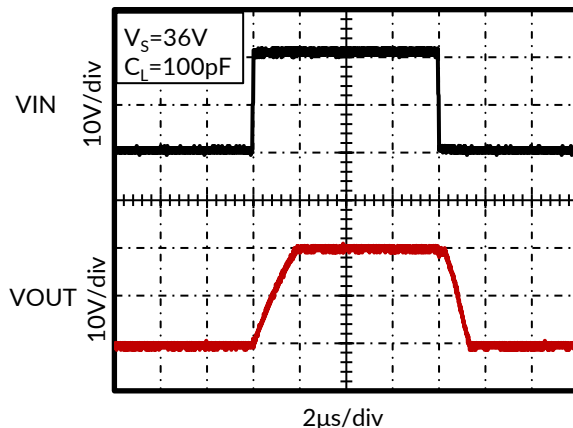


Figure 18. Large Signal Step Response

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.

At $T_A = +25^\circ\text{C}$, $V_S = \pm 18\text{V}$, $V_{CM} = V_S/2$, $R_L = 10\text{k}\Omega$, unless otherwise specified.

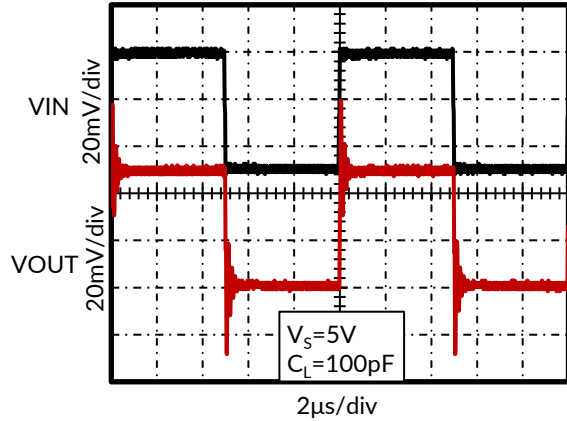


Figure 19. Small Signal Step Response

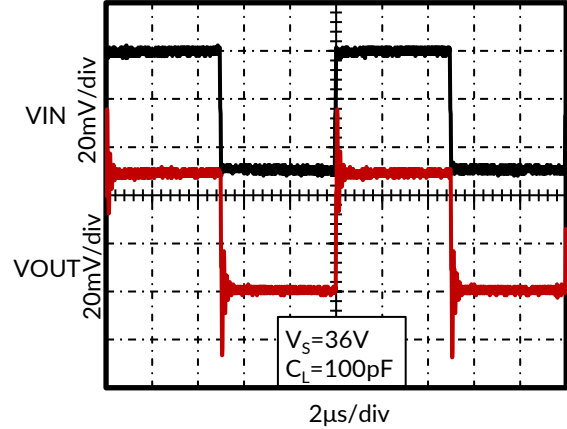


Figure 20. Small Signal Step Response

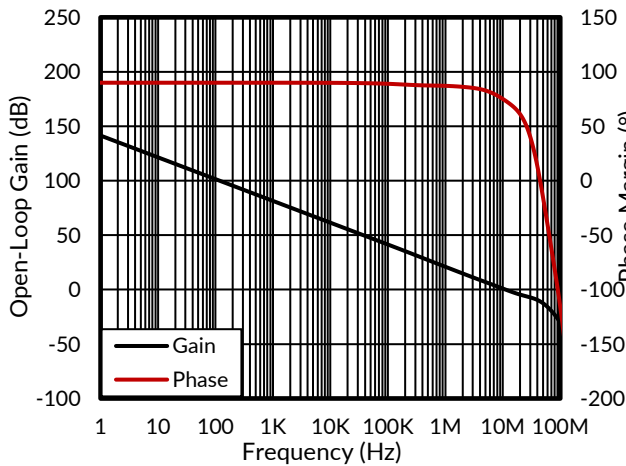


Figure 21. Open-Loop Gain and Phase vs Frequency

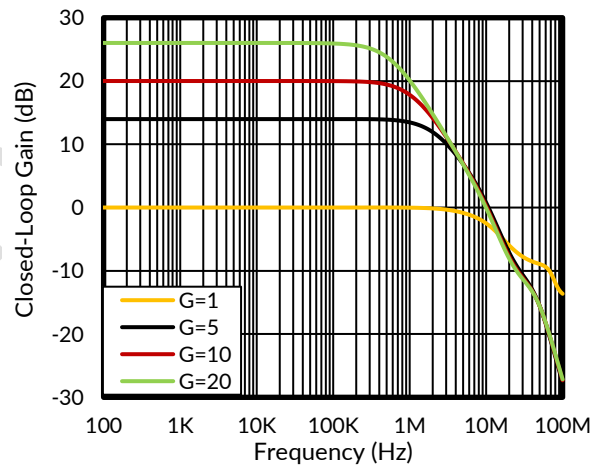


Figure 22. Closed-Loop Gain vs Frequency

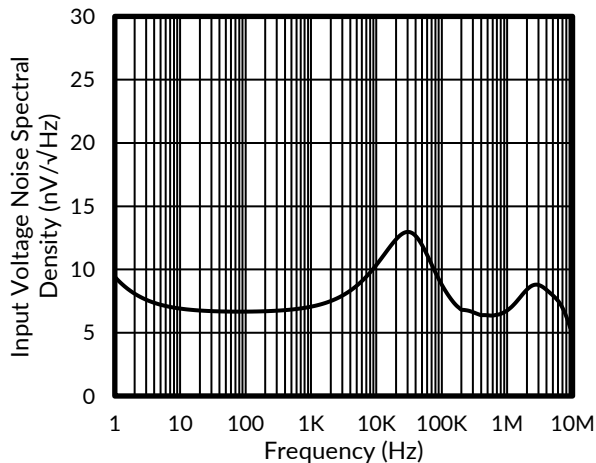


Figure 23. Input Voltage Noise Spectral Density vs Frequency

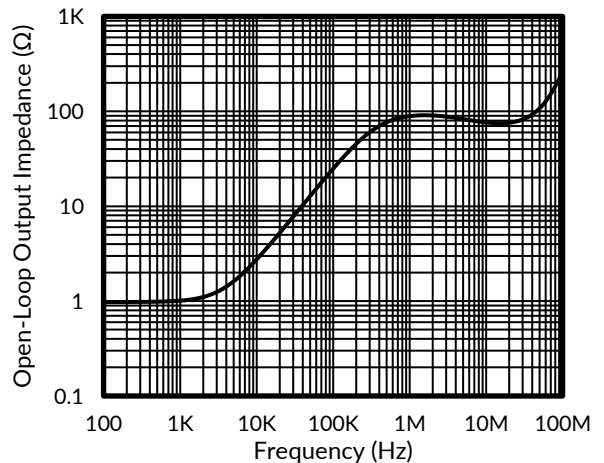
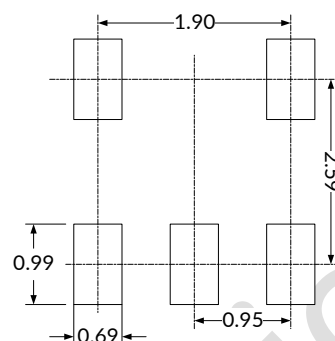
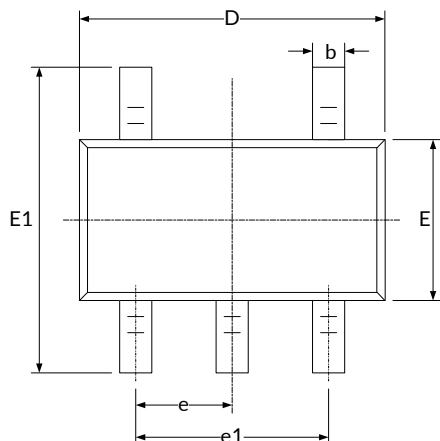
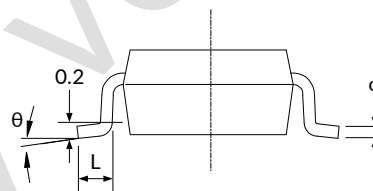
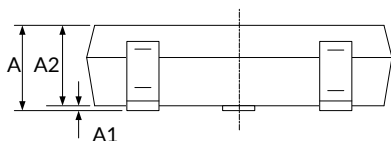


Figure 24. Open-Loop Output Impedance vs Frequency

8 PACKAGE OUTLINE DIMENSIONS

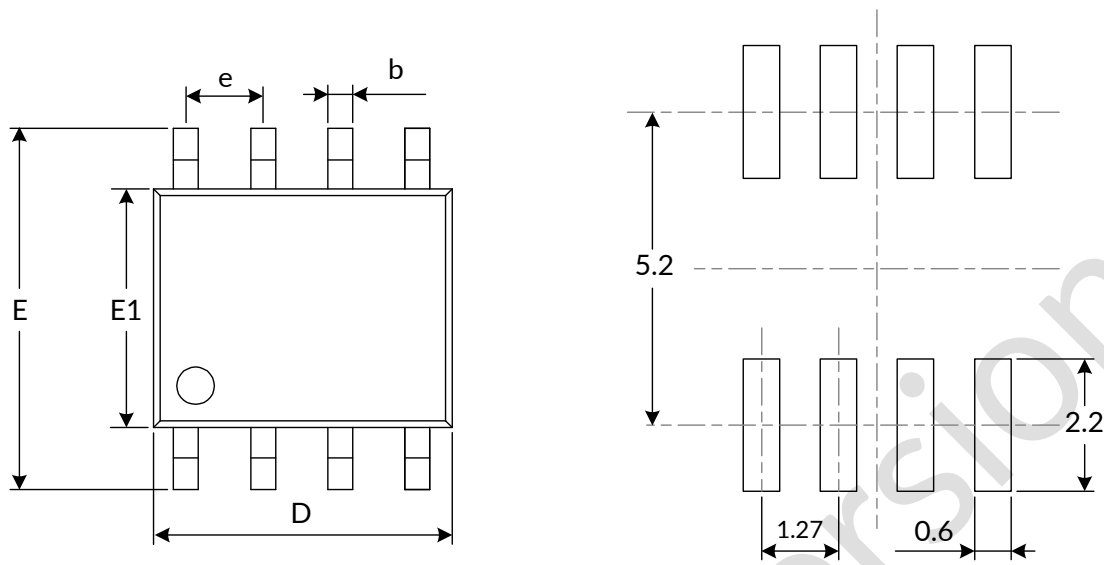
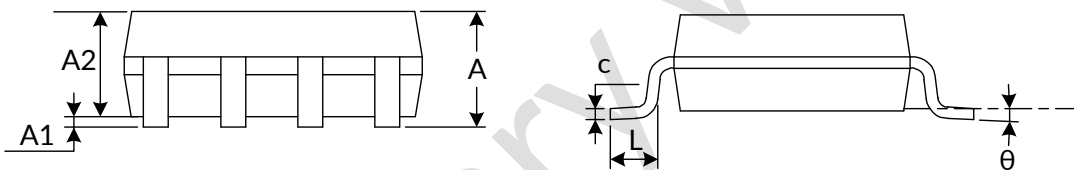
SOT23-5⁽³⁾


RECOMMENDED LAND PATTERN (Unit: mm)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D ⁽¹⁾	2.820	3.020	0.111	0.119
E ⁽¹⁾	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC) ⁽²⁾		0.037(BSC) ⁽²⁾	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

NOTE:

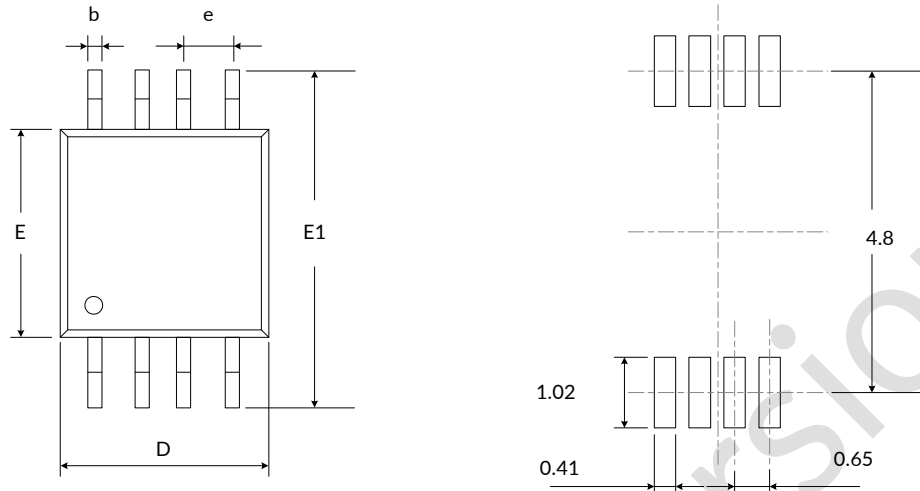
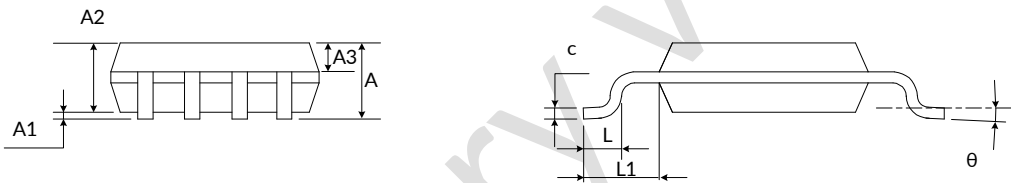
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

SOP8⁽³⁾

RECOMMENDED LAND PATTERN (Unit: mm)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
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	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

NOTE:

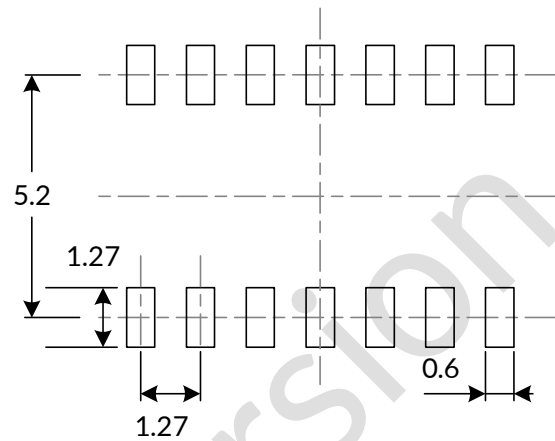
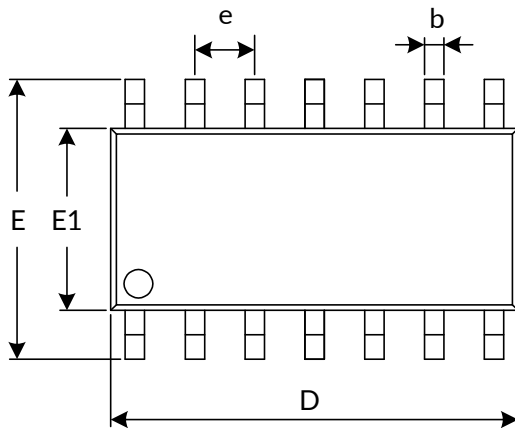
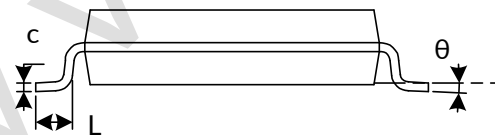
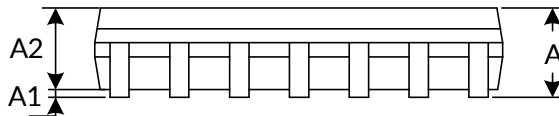
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

MSOP8 (4)

RECOMMENDED LAND PATTERN (Unit: mm)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
A3	0.300	0.400	0.012	0.016
b	0.280	0.360	0.011	0.014
c	0.150	0.190	0.006	0.007
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	4.700	5.100	0.185	0.200
L	0.400	0.700	0.016	0.027
L1	0.950(REF) ⁽³⁾		0.037(REF) ⁽³⁾	
θ	0°	8°	0°	8°

NOTE:

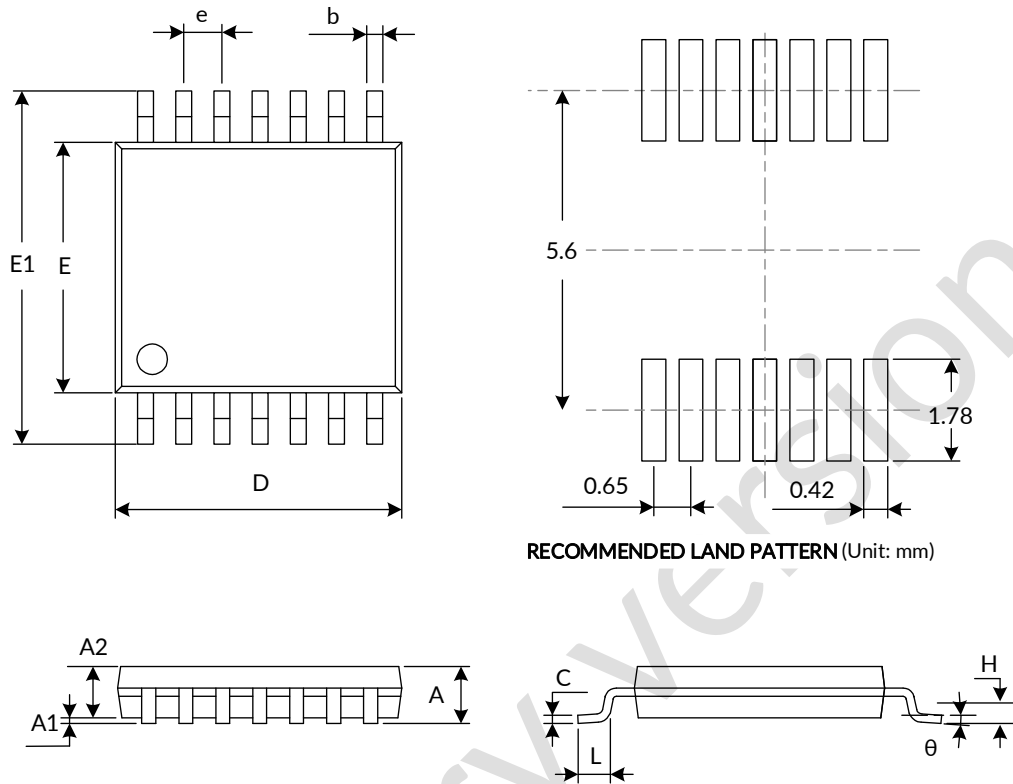
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. REF is the abbreviation for Reference.
4. This drawing is subject to change without notice.

SOP14 (3)

RECOMMENDED LAND PATTERN (Unit: mm)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D ⁽¹⁾	8.450	8.850	0.333	0.348
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	0.400	1.270	0.016	0.050
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.

TSSOP14 (3)

RECOMMENDED LAND PATTERN (Unit: mm)

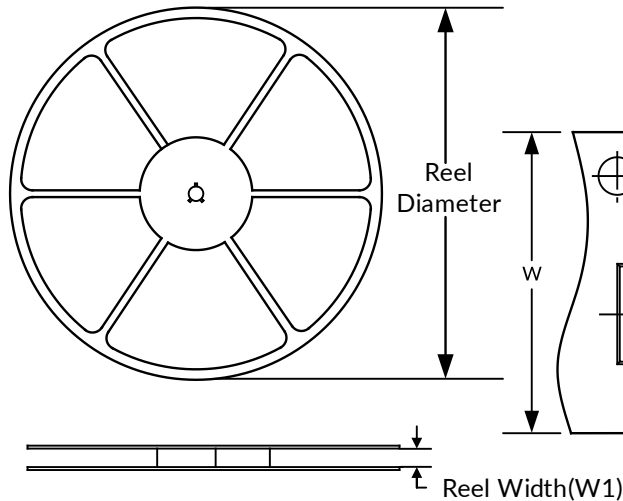
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D ⁽¹⁾	4.860	5.100	0.191	0.201
E ⁽¹⁾	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC) ⁽²⁾		0.026(BSC) ⁽²⁾	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

NOTE:

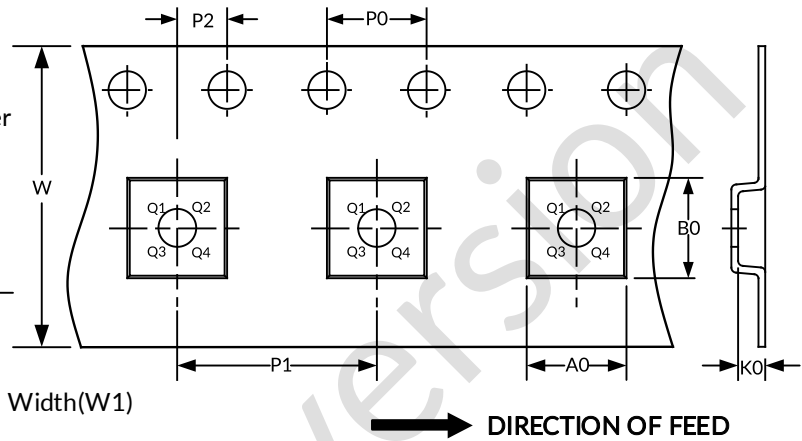
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

9 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
SOT23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
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
SOP14	13"	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TSSOP14	13"	12.4	6.95	5.60	1.20	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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Preliminary version