32V, 3.8MHz Rail-to-Rail Output CMOS Operational Amplifier

1 FEATURES

- **Qualified for Automotive Applications**
- **AEC-Q100 Qualified with the Grade 1**
- **High Gain Bandwidth: 3.8MHz**
- **Input Offset Voltage: ±0.2mV (Typical)**
- **Quiescent Current: 0.44mA/Amp**
- **Rail to Rail Output**
- **Supply Range: 3V to 32V**
- **Specified Up To +125°C**
- **Micro Size Packages: SOP8, TSSOP14**

2 APPLICATIONS

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

3 DESCRIPTIONS

The RS844X-Q1 families of products offer high voltage (32V) operation and rail-to-rail output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (3.8MHz) and slew rate of 15V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

The input can operate normally within the negative power rail to 1.5V below of the positive power rail. Input signals beyond the supply rails do not cause phase reversal. The RS844X-Q1 families of operational amplifiers are specified at the full temperature range of −40°C to 125°C under single power supplies of 3V to 32V or dual power supplies of ±1.5V to ±16V.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RS8442-Q1	SOP8	4.90mm x 3.90mm
RS8444-Q1	TSSOP14	5.00mm x 4.40mm

(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	2024/07/16	Preliminary version completed
A.1	2024/12/10	Initial version completed

5 PACKAGE/ORDERING INFORMATION (1)

Orderable Device	Package Type	Pin	Channel	Lead finish/Ball material (2)	MSL Peak Temp (3)	Op Temp(°C)	Device Marking (4)	Package Qty
RS8442XK-Q1	SOP8	8	2	SN	MSL1-260°-Unlimited	-40°C ~125°C	RS8442	Tape and Reel,4000
RS8444XQ-Q1	TSSOP14	14	4	NiPdAu	MSL1-260°-Unlimited	-40°C ~125°C	RS8444	Tape and Reel,4000

NOTE:

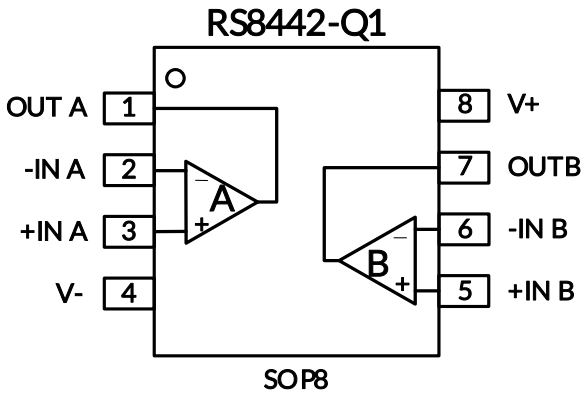
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

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

(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.

(4) 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.

6 PIN CONFIGURATION AND FUNCTIONS (TOP VIEW)

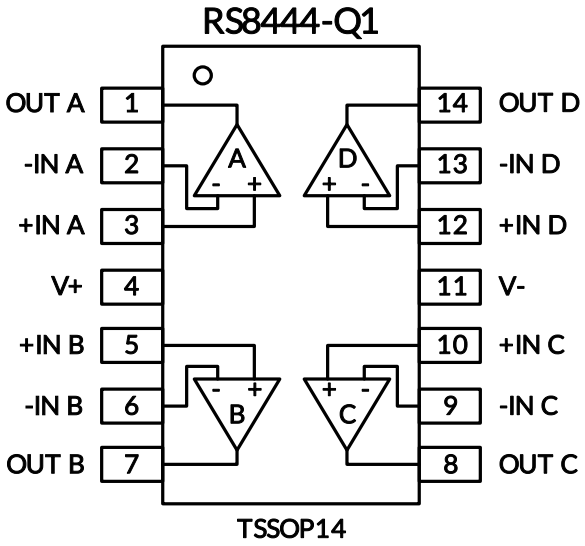


Pin Description

NAME	PIN	I/O (1)	DESCRIPTION
	SOP8		
-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 or ground (for single supply operation)
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
	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, Vs=(V+) - (V-)		-0.3	36	V
	Signal input pin (2)		(V-)-0.2	(V+) +0.2	
	Signal output pin (3)		(V-)-0.2	(V+) +0.2	
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)	SOP8		110	°C/W
		TSSOP14		90	
Temperature	Operating range, T_A		-40	125	°C
	Junction, T_J (6)		-40	150	
	Storage, T_{stg}		-55	150	

(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 0.2V 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 0.2V beyond the supply rails should be current-limited to ±10mA 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), per AEC Q100-002 (1)	±2000	V
		Charged-Device Model (CDM), per AEC Q100-011	±1000	
		Latch-Up (LU), per AEC Q100-004	±100	mA

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
Supply voltage，Vs= (V+) - (V-)	Single-supply	3		32	V
	Dual-supply	±1.5		±16	

7.4 ELECTRICAL CHARACTERISTICS

(At T_A = +25°C, Vs=3V to 32V, R_L = 10kΩ connected to V_S/2, and V_{OUT} = V_S/2, V_{CM} = V_S/2, Full [9] = -40°C to 125°C, unless otherwise noted.) [1]

PARAMETER		CONDITIONS	T_J	RS844X-Q1			UNITS
				MIN[2]	TYP[3]	MAX[2]	
POWER SUPPLY							
Vs	Operating Voltage Range		25°C	3		32	V
I_Q	Quiescent Current Per Amplifier	Vs=±2.5V, Io=0mA	25°C		0.44	0.7	mA
			Full			0.8	
		Vs=±16V, Io=0mA	25°C		0.52	0.8	
			Full			0.9	
PSRR	Power-Supply Rejection Ratio	Vs=5V to 32V	25°C	90	120		dB
			Full	85			
INPUT							
Vos	Input Offset Voltage	V_S=5V to 32V, V_{CM}= V_S/2	25°C	-1	±0.2	1	mV
			Full	-2		2	
Vos Tc	Input Offset Voltage Average Drift		Full		2		μV/°C
IB	Input Bias Current [4] [5]	V_{CM}=0V	25°C		±10		pA
I_{OS}	Input Offset Current [5]	V_{CM}=0V	25°C		±10		pA
V_{CM}	Common-Mode Voltage Range	Vs= ±16V	25°C	(V-)		(V+)-1.5	V
			Full	(V-)		(V+)-2	
CMRR	Common-Mode Rejection Ratio	Vs= ±16V, V_{CM}=-16V to 14.5V	25°C	85	120		dB
		Vs= ±16V, V_{CM}=-16V to 14V	Full	80			
OUTPUT							
A_{OL}	Open-Loop Voltage Gain	R_L=10KΩ, Vo=(V-)+0.6V to (V+)-0.6V	25°C	105	120		dB
			Full	100			
V_{OH}	Output Swing	Vs=±16V, R_L=10KΩ	25°C	15.7			V
			Full	15.6			
V_{OL}			25°C			-15.7	V
			Full			-15.6	
I_{SC}	Short-circuit current [6] [7]	V_S=±5V	25°C	15	43		mA
			Full	10			
FREQUENCY RESPONSE							
SR	Slew Rate [8]	G=+1, C_L=100pF	25°C		15		V/μs
GBW	Gain-Bandwidth Product		25°C		3.8		MHz
ts	Settling Time,0.01%	V_S=±2.5V, G=+1, C_L=100pF, Step=2V	25°C		1.5		μs
PM	Phase Margin	V_S = 32V, R_L=10K, C_L=100pF	25°C		60		°
GM	Gain Margin	V_S = 32V, R_L=10K, C_L=100pF	25°C		15		dB
t_{OR}	Overload Recovery Time	V_{IN}·Gain≥V_S, G=11	25°C		0.5		μs
t_{ON}	Turn On Time		25°C		8.5		μs
NOISE							
En	Input Voltage Noise	f = 0.1Hz to 10Hz, Vs=±2.5V	25°C		13.5		μVpp
en	Input Voltage Noise Density	f = 1KHz	25°C		30		nV/$\sqrt{\text{Hz}}$

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) Positive current corresponds to current flowing into the device.
(5) This parameter is ensured by design and/or characterization and is not tested in production.
(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 PD = ($T_{J(MAX)}$ - T_A) / $R_{\theta JA}$. 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°C, Vs=±16V, R_L = 10kΩ connected to $V_S/2$, V_{OUT} = $V_S/2$, unless otherwise noted.

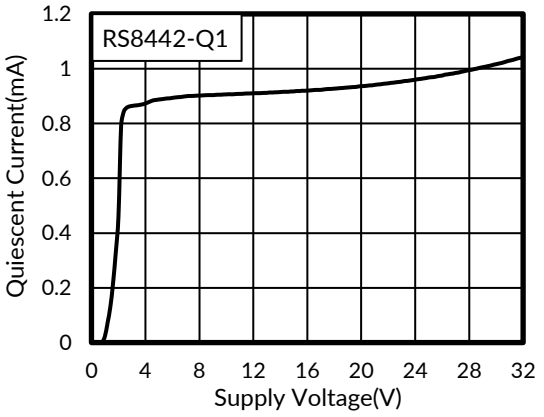


Figure 1. Supply Voltage vs Quiescent Current

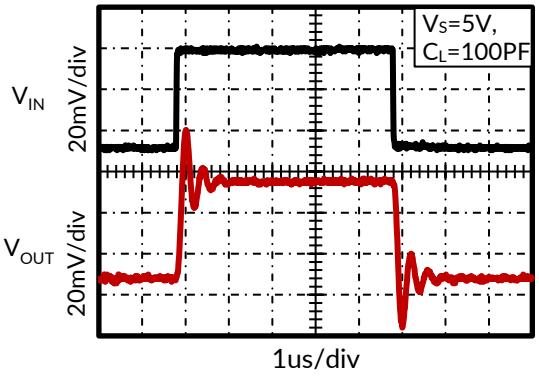


Figure 2. SMALL-SIGNAL STEP RESPONSE

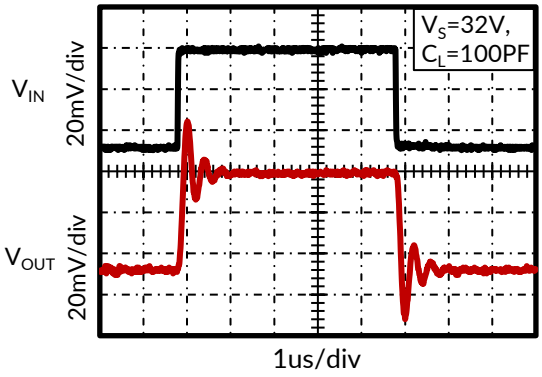


Figure 3. SMALL-SIGNAL STEP RESPONSE

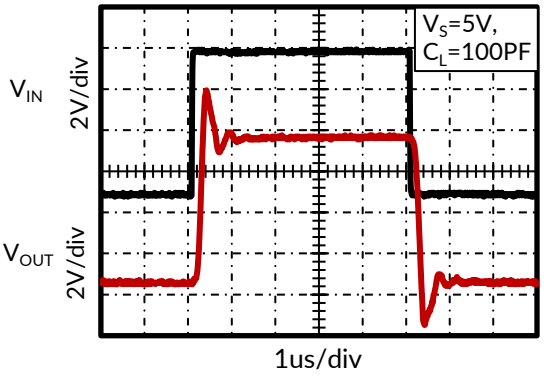


Figure 4. LARGE-SIGNAL STEP RESPONSE

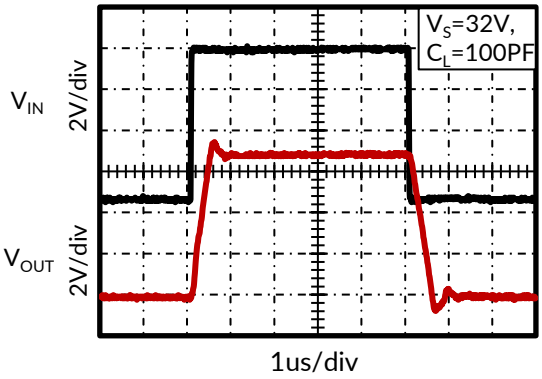


Figure 5. LARGE-SIGNAL STEP RESPONSE

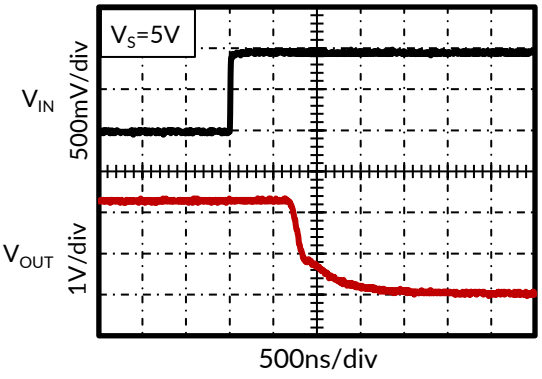


Figure 6. Positive Overload Recovery

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°C, Vs=±16V, R_L = 10kΩ connected to $V_S/2$, V_{OUT} = $V_S/2$, unless otherwise noted.

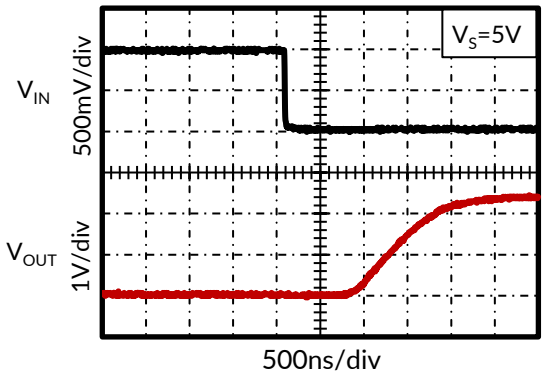


Figure 7. Negative Overload Recovery

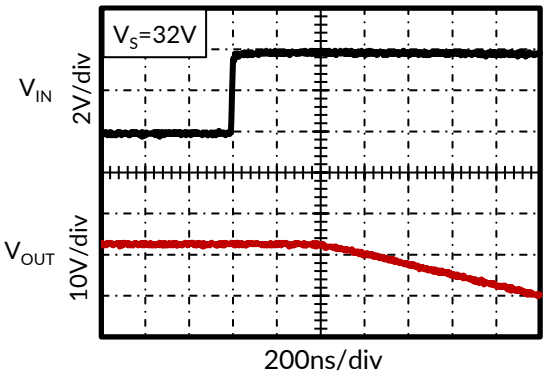


Figure 8. Positive Overload Recovery

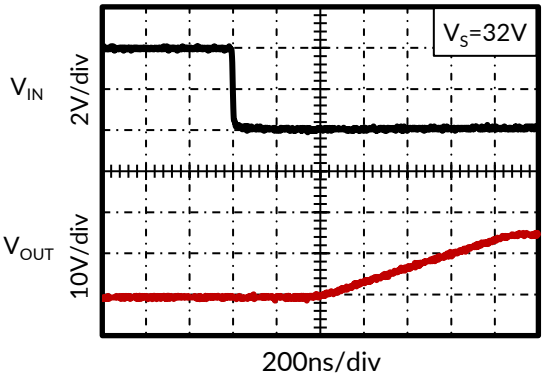
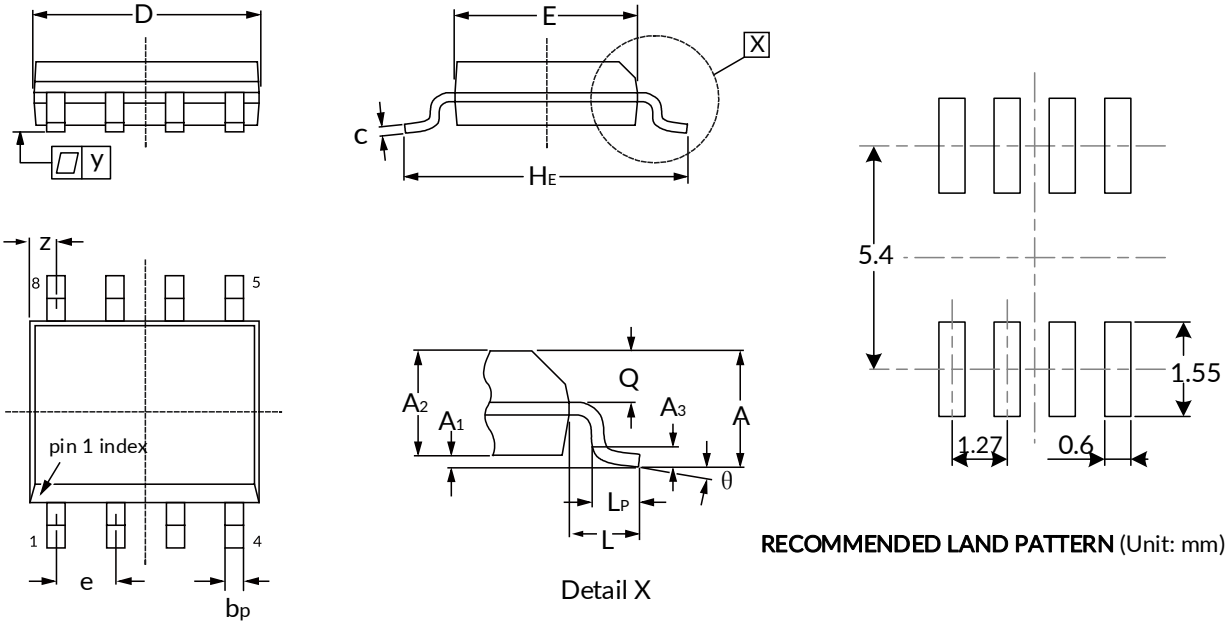


Figure 9. Negative Overload Recovery

8 PACKAGE OUTLINE DIMENSIONS

SOP8 (2)



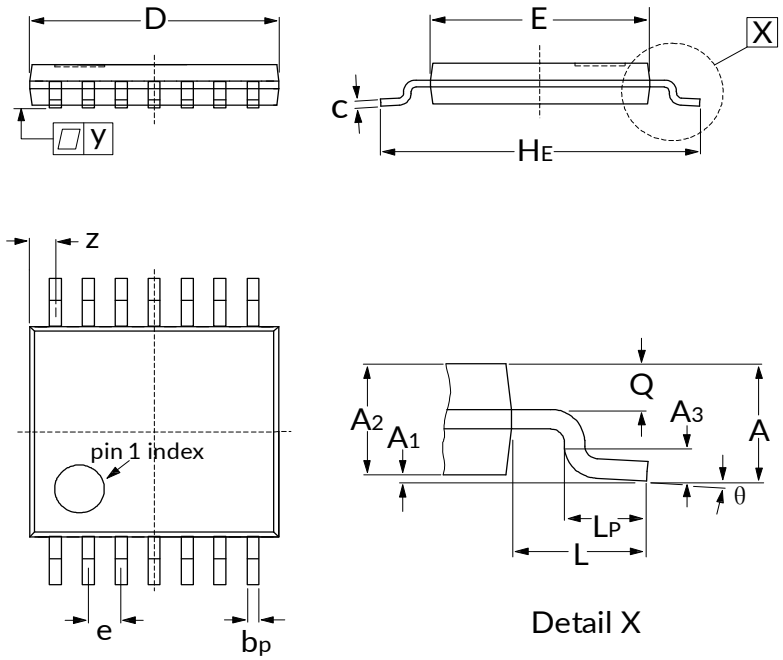
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.750		0.069
A_1	0.100	0.250	0.004	0.010
A_2	1.250	1.450	0.049	0.057
A_3	0.25		0.010	
b_p	0.360	0.490	0.014	0.019
c	0.190	0.250	0.007	0.010
D (1)	4.800	5.000	0.190	0.200
E (1)	3.800	4.000	0.150	0.160
H_E	5.800	6.200	0.228	0.244
e	1.270		0.050	
L	1.05		0.041	
L_P	0.400	1.000	0.016	0.039
Q	0.600	0.700	0.024	0.028
Z	0.300	0.700	0.012	0.028
y	0.1		0.004	
θ	0°	8°	0°	8°

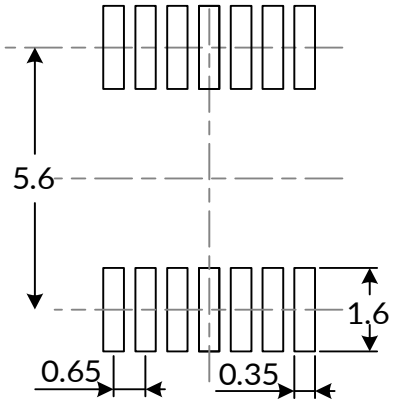
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. This drawing is subject to change without notice.

TSSOP14 (2)



Detail X



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.100		0.043
A_1	0.050	0.150	0.002	0.006
A_2	0.800	0.950	0.031	0.037
A_3	0.25		0.010	
b_p	0.190	0.300	0.007	0.012
c	0.100	0.200	0.004	0.008
D (1)	4.900	5.100	0.193	0.201
E (1)	4.300	4.500	0.169	0.177
H_E	6.200	6.600	0.244	0.260
e	0.650		0.026	
L	1		0.039	
L_P	0.500	0.750	0.020	0.030
Q	0.300	0.400	0.012	0.016
Z	0.380	0.720	0.015	0.028
y	0.1		0.004	
θ	0°	8°	0°	8°

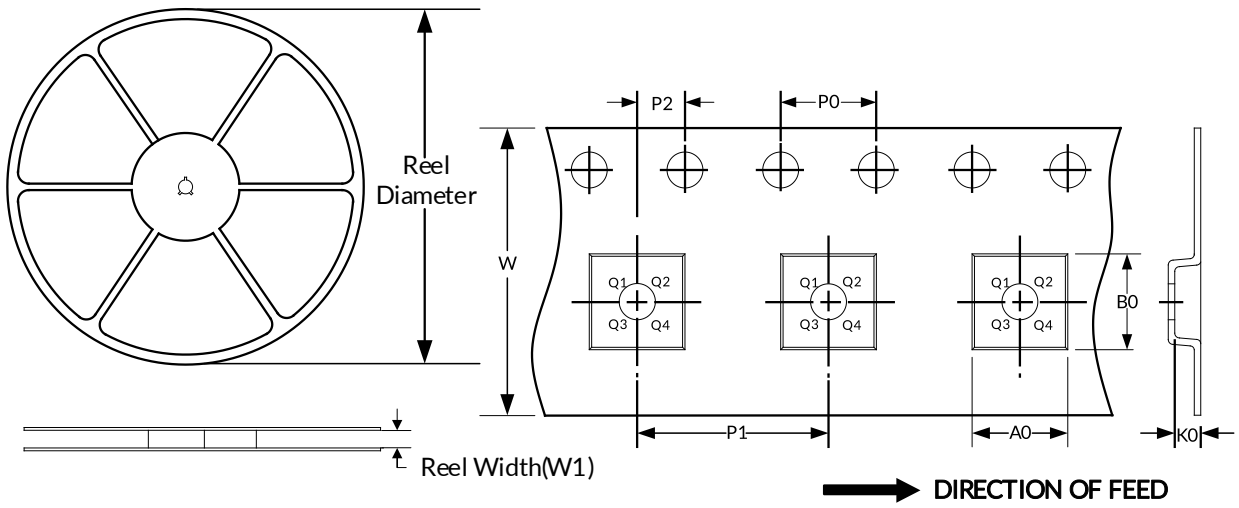
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. 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 W1(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
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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