

Features

- Supply Voltage: 2.7 V to 40 V
- Rail-to-rail input and output (RRIO)
- Low Supply Current: 1 mA per channel
- Low Offset Voltage:
 - $\pm 450 \mu\text{V}$ Maximum at 25°C
 - $\pm 800 \mu\text{V}$ Maximum at -40°C to $+125^\circ\text{C}$
- Low Input Bias Current: $\pm 1 \text{ nA}$ at 25°C
- Unit-Gain Bandwidth: 6 MHz
- Slew Rate: $20 \text{ V}/\mu\text{s}$
- Low Noise: $15 \text{ nV}/\sqrt{\text{Hz}}$ at 1 kHz
- Excellent THD + N: 0.005%
- AEC-Q100 Qualified for Automotive Applications
 - Grade 1: -40°C to $+125^\circ\text{C}$ T_A

Applications

- On-board (OBC) and Wireless Charger
- HEV/EV Inverter and Motor Control
- Automotive Body Electronics
- Automotive Lighting

Description

The TPA155xQ family (TPA1551Q, TPA1552Q and TPA1554Q) is a family of high-voltage (40V) RRIO general-purpose operational amplifiers. These devices offer excellent DC precision and AC performance, including rail-to-rail input/output, low offset ($\pm 800 \mu\text{V}$, maximum at -40°C to 125°C), high bandwidth (6 MHz) and high slew rate ($20 \text{ V}/\mu\text{s}$).

The TPA155xQ family is available in standard packages (such as SOT23-5, SOP8, MSOP8, TSSOP8, TSSOP14, and SOP14).

Device Table

Device	Package	Body Size
TPA1551Q-S5TR-S	SOT23-5	2.9 mm $\times$ 1.6 mm
TPA1552Q-SO1R-S	SOP8	4.9 mm $\times$ 3.9 mm
TPA1552Q-VS1R-S	MSOP8	3.0 mm $\times$ 3.0 mm
TPA1552Q-TS1R-S	TSSOP8	3.0 mm $\times$ 4.4 mm
TPA1554Q-SO2R-S	SOP14	8.65 mm $\times$ 3.9 mm
TPA1554Q-TS2R-S	TSSOP14	5.0 mm $\times$ 4.4 mm

Typical Application Circuit

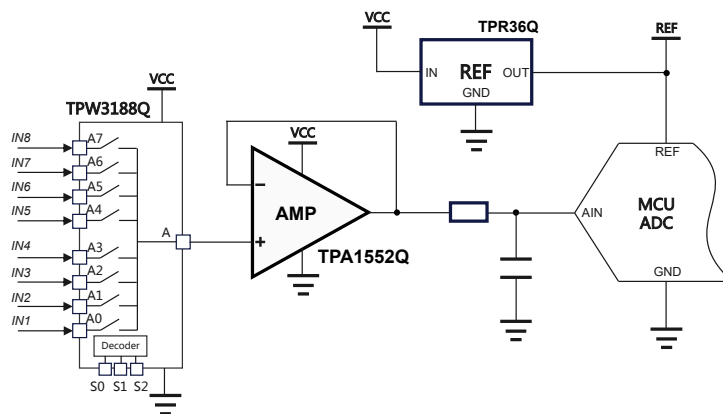


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Revision History

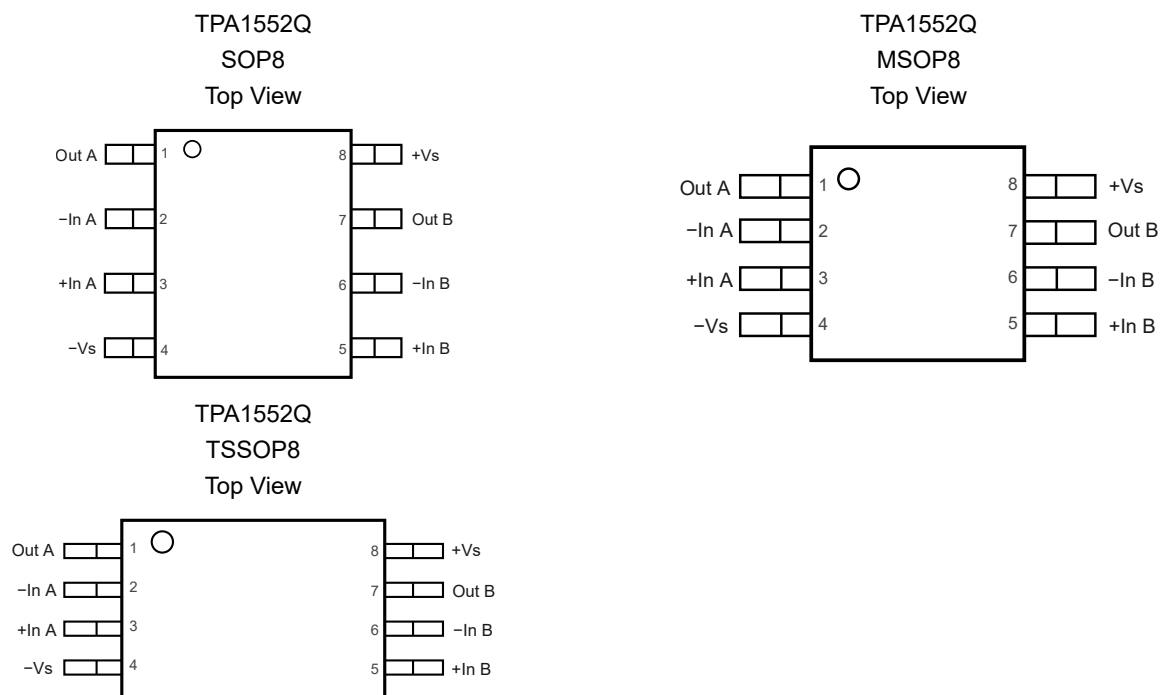
Date	Revision	Notes
2026-07-23	Rev.A.0	Initial version.

Pin Configuration and Functions

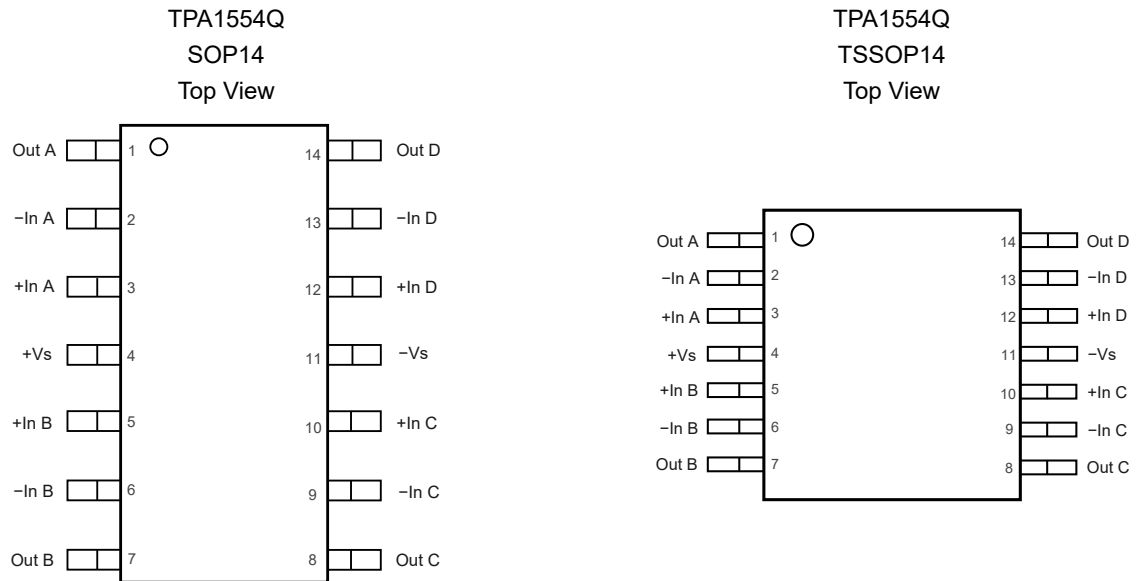


Table 1. Pin Functions: TPA1551Q/TPA1551UQ

Pin No.		Name	I/O	Description
TPA1551Q	TPA1551UQ			
1	4	Out	O	Output
2	2	-Vs	-	Negative power supply
3	1	+In	I	Non-inverting input
4	3	-In	I	Inverting input
5	5	+Vs	-	Positive power supply


Table 2. Pin Functions: TPA1552Q

Pin No.			Name	I/O	Description
SOP8	MSOP8	TSSOP8			
1	1	1	Out A	O	Output
2	2	2	-In A	I	Inverting input
3	3	3	+In A	I	Non-inverting input
4	4	4	-Vs		Negative power supply
5	5	5	+In B	I	Non-inverting input
6	6	6	-In B	I	Inverting input
7	7	7	Out B	O	Output
8	8	8	+Vs		Positive power supply


Table 3. Pin Functions: TPA1554Q

Pin No.		Name	I/O	Description
SOP14	TSSOP14			
1	1	Out A	O	Output
2	2	-In A	I	Inverting input
3	3	+In A	I	Non-inverting input
4	4	+Vs		Positive power supply
5	5	+In B	I	Non-inverting input
6	6	-In B	I	Inverting input
7	7	Out B	O	Output
8	8	Out C	O	Output
9	9	-In C	I	Inverting input
10	10	+In C	I	Non-inverting input
11	11	-Vs		Negative power supply
12	12	+In D	I	Non-inverting input
13	13	-In D	I	Inverting input
14	14	Out D	O	Output

Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter		Min	Max	Unit
	Supply Voltage, (+V _S) – (–V _S)		42	V
	Input Voltage	(–V _S) – 0.5	(+V _S) + 0.5	V
	Differential Input Voltage	(–V _S) – (+V _S)	(+V _S) – (–V _S)	V
	Input Current: +IN, –IN ⁽²⁾	–10	10	mA
	Output Voltage	(–V _S) – 0.5	(+V _S) + 0.5	V
	Output Short-Circuit Duration ⁽³⁾		Infinite	
T _J	Maximum Junction Temperature		150	°C
T _A	Operating Temperature Range	–40	125	°C
T _{STG}	Storage Temperature Range	–65	150	°C
T _L	Lead Temperature (Soldering, 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

(2) The inputs are protected by ESD-protection diodes to each power supply. If the input extends more than 300 mV beyond the negative power supply, the input current should be limited to less than 10 mA.

(3) A heat sink may be required to keep the junction temperature below the absolute maximum rating. This depends on the power dissipation of the application. The thermal resistance varies with the amount of PC board metal connected to the package.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	AEC-Q100-002	2	kV
CDM	Charged Device Model ESD	AEC-Q100-011	1	kV

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
V _S	Supply Voltage, (+V _S) – (–V _S)	2.7		40	V
T _A	Operating Temperature Range	–40		125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-5	250	81	°C/W
SOP8	158	43	°C/W

Package Type	θ_{JA}	θ_{JC}	Unit
MSOP8	210	45	$^{\circ}\text{C/W}$
TSSOP8	191	44	$^{\circ}\text{C/W}$
SOP14	120	36	$^{\circ}\text{C/W}$
TSSOP14	180	35	$^{\circ}\text{C/W}$

Electrical Characteristics

All test conditions: $V_S = 36\text{ V}$, $V_{CM} = 18\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
V _S	Supply Voltage Range	(+V _S) – (–V _S)	2.7		40	V
I _Q	Quiescent Current per Amplifier	V _S = 5 V		1	1.5	mA
		V _S = 5 V, T _A = –40°C to 125°C			1.8	mA
		V _S = 36 V		1	1.5	mA
		V _S = 36 V, T _A = –40°C to 125°C			1.8	mA
PSRR	Power Supply Rejection Ratio	V _S = 2.7 V to 40 V	100	120		dB
		V _S = 2.7 V to 40 V, T _A = –40°C to 125°C	96			dB
Input Characteristics						
V _{OS}	Input Offset Voltage	V _S = 5 V, V _{CM} = 2.5 V	–450	±50	450	μV
		V _S = 5 V, V _{CM} = 2.5 V, T _A = –40°C to 125°C	–800		800	μV
		V _S = 36 V, V _{CM} = 18 V	–450	±50	450	μV
		V _S = 36 V, V _{CM} = 18 V, T _A = –40°C to 125°C	–800		800	μV
V _{OS} TC	Input Offset Voltage Drift	T _A = –40°C to 125°C		2		μV/°C
I _B	Input Bias Current	V _S = 36 V, V _{CM} = 18 V	–1000	±10	1000	pA
		V _S = 36 V, V _{CM} = 18 V T _A = –40°C to 125°C	–4000		4000	pA
I _{OS}	Input Offset Current	V _S = 36 V, V _{CM} = 18 V	–1000	±10	1000	pA
		V _S = 36 V, V _{CM} = 18 V T _A = –40°C to 125°C	–2000		2000	pA
C _{IN}	Input Capacitance	Differential mode		10		pF
		Common mode		6		pF
A _V	Open-Loop Voltage Gain	V _{OUT} = 0.1 V to 35.9 V	120	140		dB
		V _{OUT} = 0.1 V to 35.9 V, T _A = –40°C to 125°C	115			dB
V _{CMR}	Common-Mode Input Voltage Range	T _A = –40°C to 125°C	(–V _S) – 0.1		(+V _S) + 0.1	V
CMRR	Common-Mode Rejection Ratio	V _{CM} = – 0.1 V to 34 V	100	120		dB
		V _{CM} = – 0.1 V to 34 V, T _A = –40°C to 125°C	96			dB
		V _{CM} = –0.1 V to 36.1 V	60	80		dB
		V _{CM} = –0.1 V to 36.1 V, T _A = –40°C to 125°C	55			dB

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
EMIRR	EMI Rejection Ratio	V _S = 30 V, f = 1000 MHz		60		dB
Output Characteristics						
V _O	Output Swing from Power Supply Rail	R _L = 10 kΩ to V _S / 2		50	60	mV
		R _L = 10 kΩ to V _S / 2 T _A = -40°C to 125°C			100	mV
		R _L = 2 kΩ to V _S / 2		200	250	mV
		R _L = 2 kΩ to V _S / 2 T _A = -40°C to 125°C			500	mV
		R _L = 2 kΩ to (-V _S), V _S = 5 V		2.5	5	mV
		R _L = 2 kΩ to (-V _S), V _S = 5 V T _A = -40°C to 125°C			5	mV
I _{SC}	Output Short-Circuit Current	V _S = 36 V, Source Current		60		mA
		T _A = -40°C to 125°C		55		mA
		V _S = 36 V, Sink Current		60		mA
		T _A = -40°C to 125°C		55		mA
AC Specifications						
GBW	Gain-Bandwidth Product			6		MHz
SR	Slew Rate	G = 1, 10-V step		20		V/μs
t _{OR}	Overload Recovery			250		ns
t _S	Settling Time, 0.1%	G = 1, 10-V step		2		μs
	Settling Time, 0.01%			2.5		μs
PM	Phase Margin	R _L = 10 kΩ, C _L = 100 pF		60		°
GM	Gain Margin	R _L = 10 kΩ, C _L = 100 pF		10		dB
X _{TALK}	Crosstalk	f = 100 kHz, Only for 2CH and 4CH		100		dB
Noise Performance						
E _N	Input Voltage Noise	f = 0.1 Hz to 10 Hz		1		μV _{rms}
e _N	Input Voltage Noise Density	f = 1 kHz		15		nV/√Hz
i _N	Input Current Noise	f = 1 kHz		2		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1 kHz, G = 1, R _L = 10 kΩ, V _{OUT} = 1 V _{RMS}		0.005		%

(1) Provided by design simulation.

Typical Performance Characteristics

All test conditions: $V_S = 36\text{ V}$, $T_A = +25^\circ\text{C}$, unless otherwise noted.

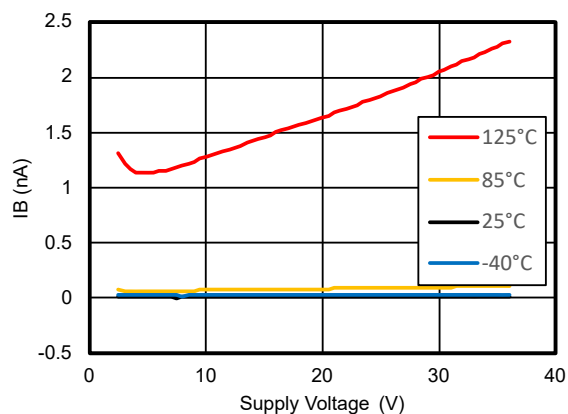


Figure 1. I_B vs. Supply Voltage

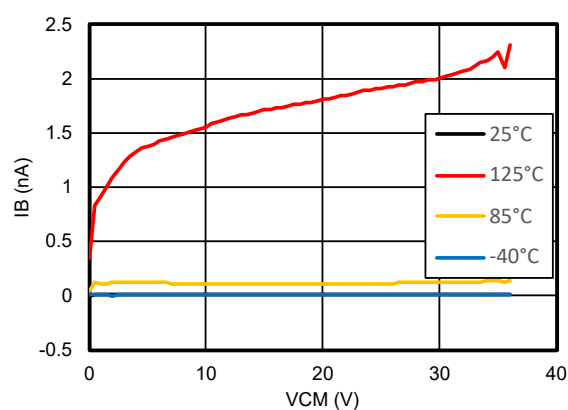


Figure 2. I_B vs. Common-Mode Voltage

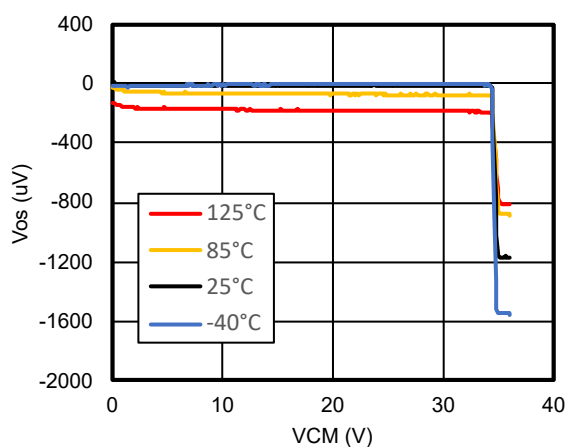


Figure 3. V_{os} vs. Common-Mode Voltage

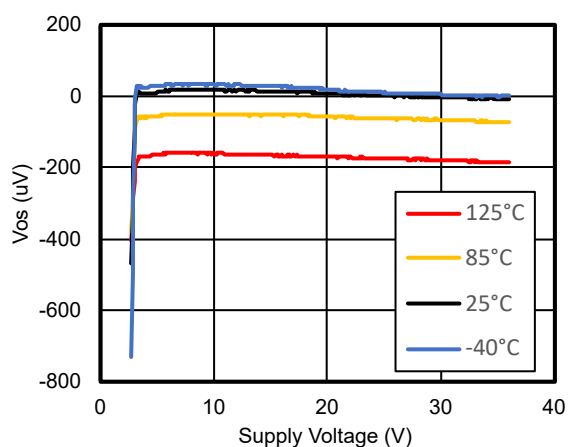


Figure 4. V_{os} vs. Supply Voltage

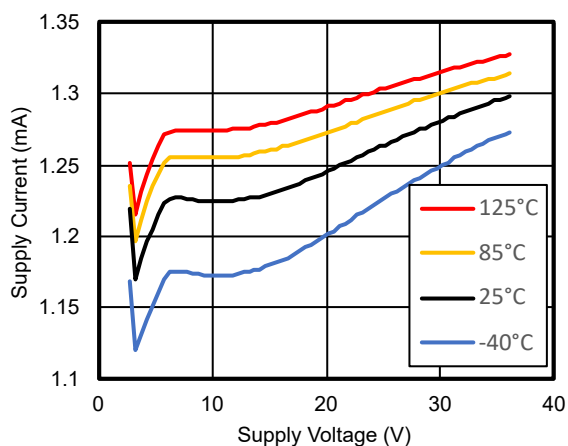


Figure 5. Supply Current vs. Supply Voltage, per ch

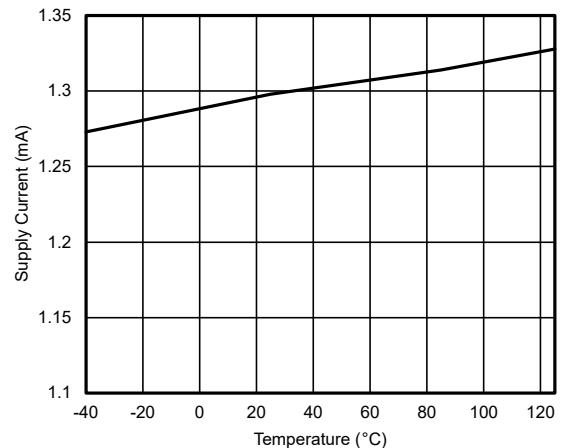
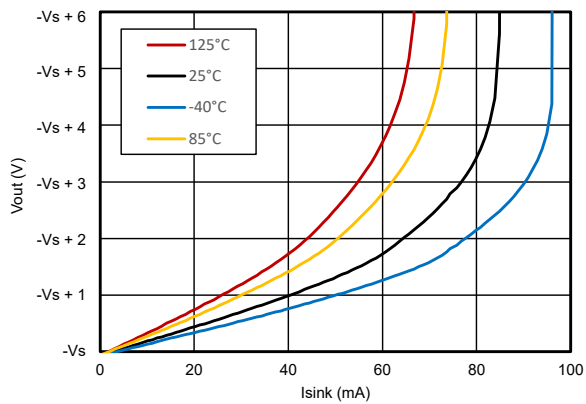
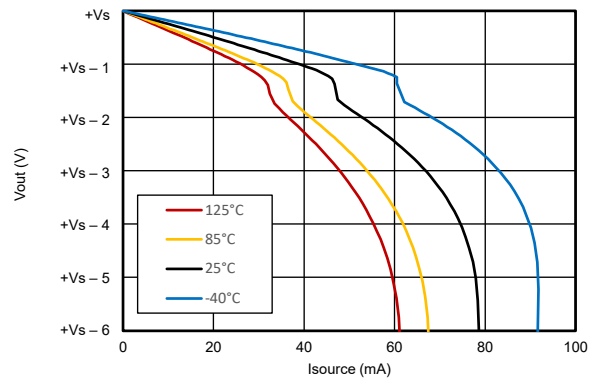
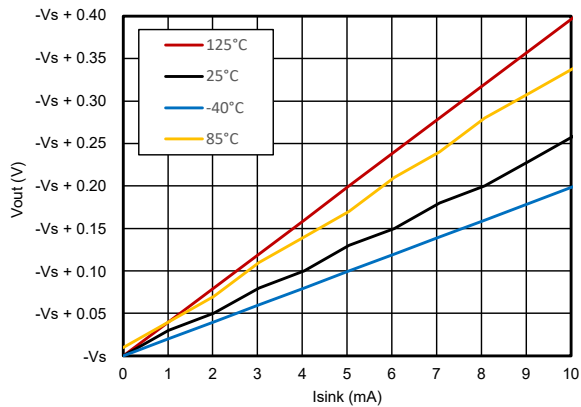
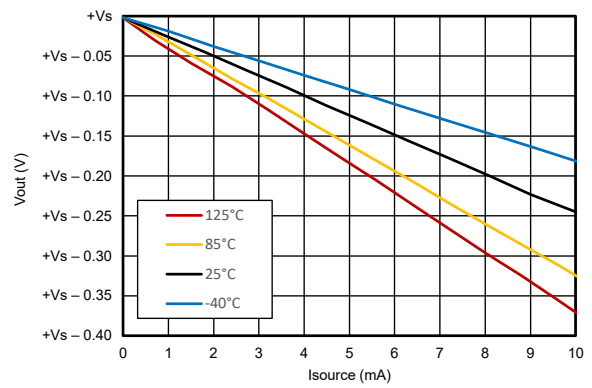
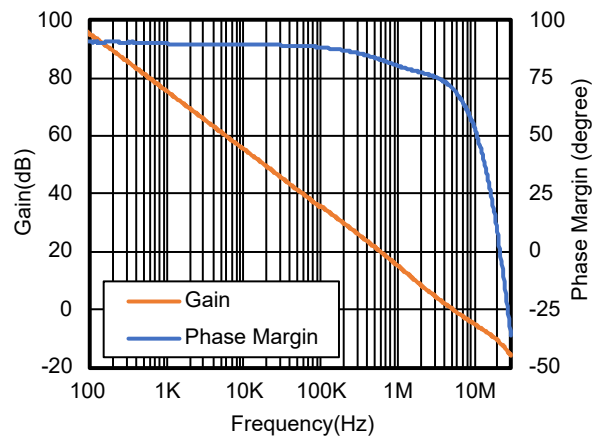
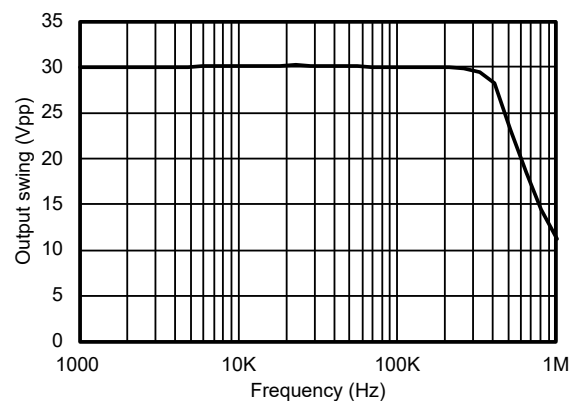
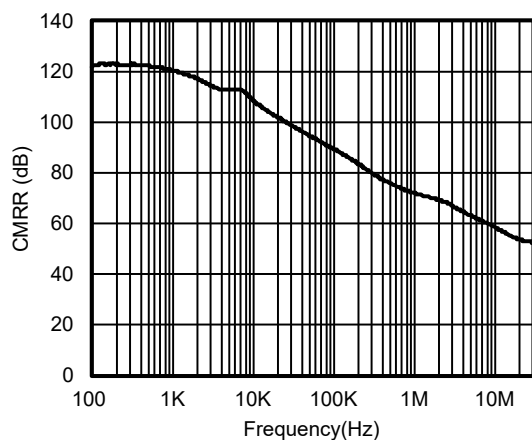
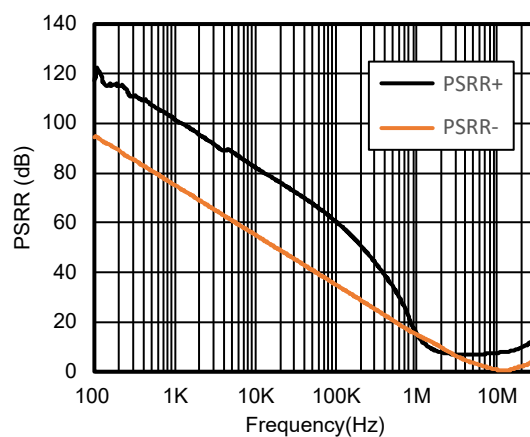
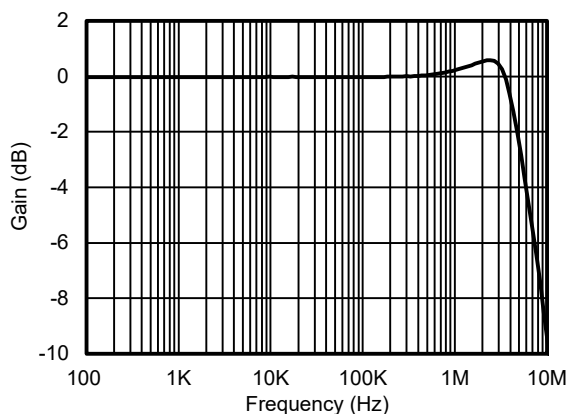
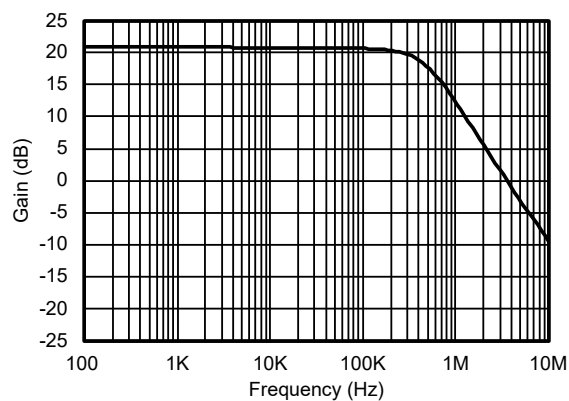
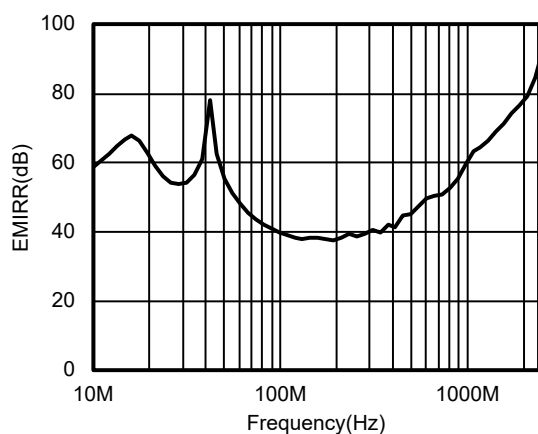
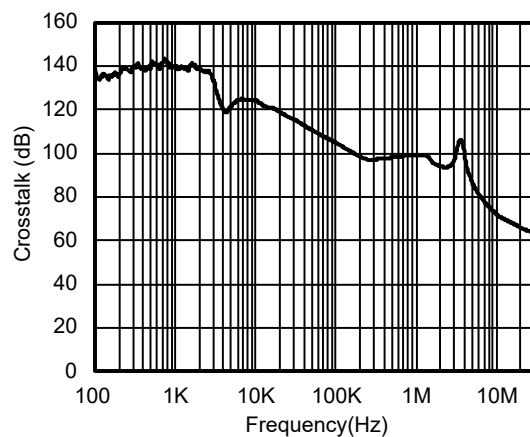


Figure 6. Supply Current vs. Temperature, per ch


Figure 7. I_{sink} vs. V_{OUT}

Figure 8. I_{source} vs. V_{OUT}

Figure 9. I_{sink} vs. V_{OUT}

Figure 10. I_{source} vs. V_{OUT}

Figure 11. Open-Loop Gain and Phase vs. Frequency

Figure 12. Output Swing vs. Frequency


Figure 13. CMRR vs. Frequency

Figure 14. PSRR vs. Frequency

Figure 15. Closed Loop Gain G = 1 vs. Frequency

Figure 16. Closed Loop Gain G = 11 vs. Frequency

Figure 17. EMIRR vs. Frequency

Figure 18. Channel Crosstalk vs. Frequency

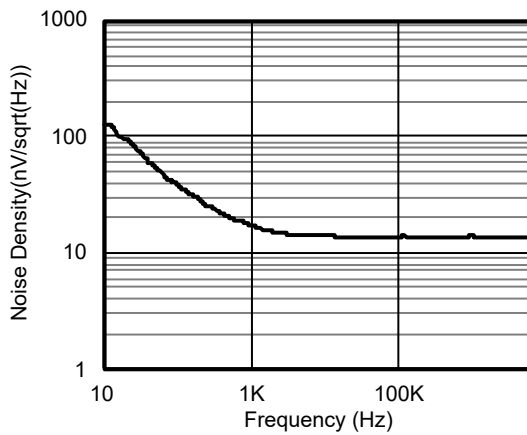


Figure 19. Input Voltage Noise Spectral Density vs. Frequency

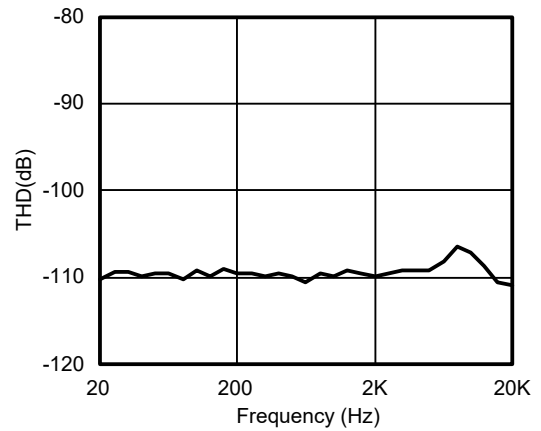


Figure 20. THD vs. Frequency

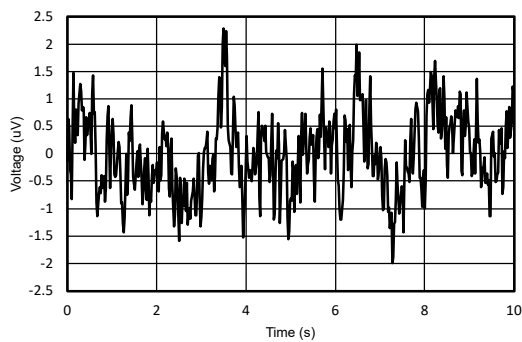


Figure 21. 0.1-Hz to 10-Hz Voltage Noise

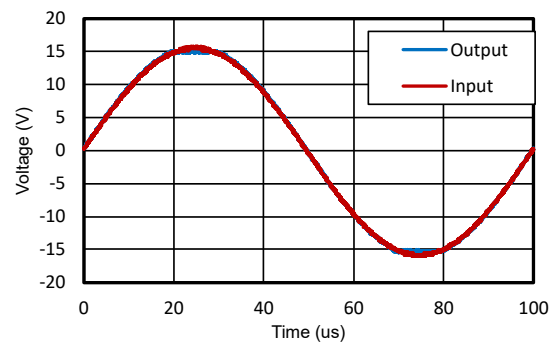


Figure 22. Input Phase Reversal

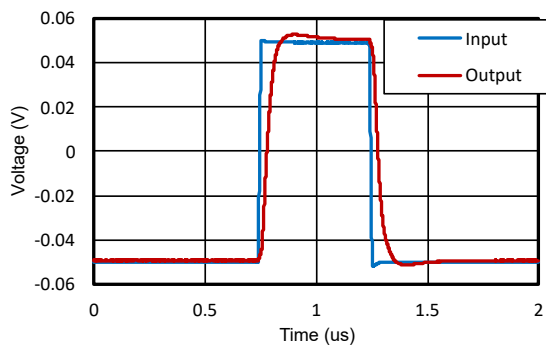


Figure 23. 100-mV Small-Signal Step Response

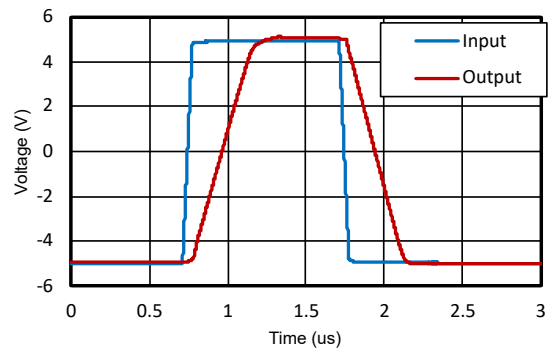
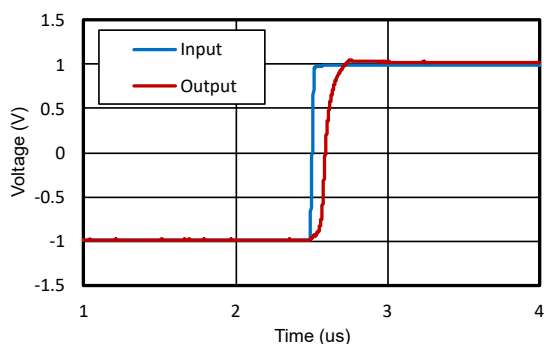
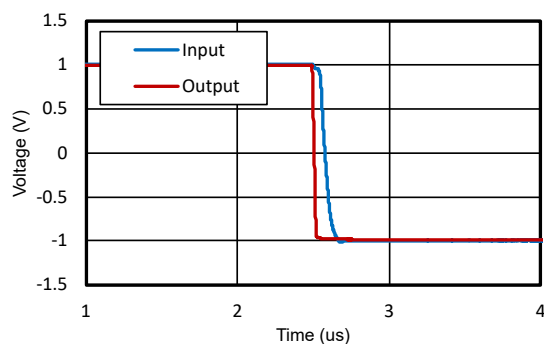
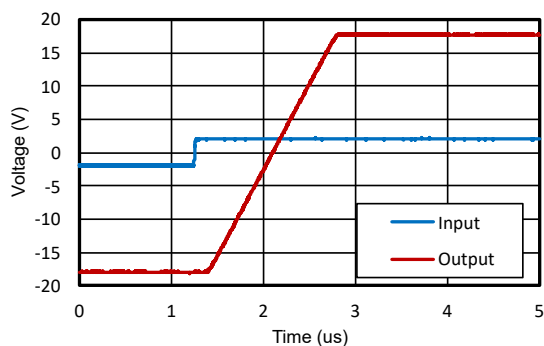
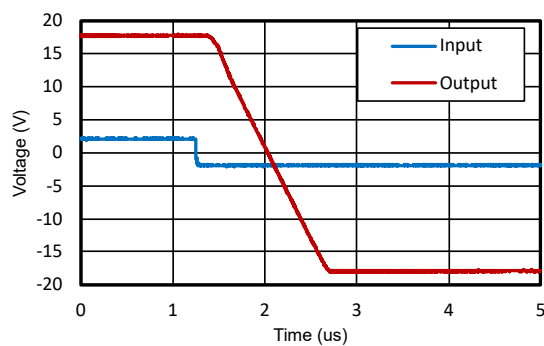
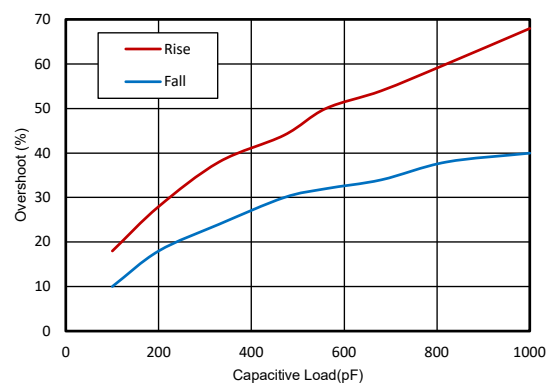


Figure 24. 10-V Large-Signal Step Response


Figure 25. Positive Slew Rate

Figure 26. Negative Slew Rate

Figure 27. Overload Recovery Rise

Figure 28. Overload Recovery Fall

Figure 29. Small-Signal Overshoot vs. Capacitive Load

Detailed Description

Overview

The TPA155xQ series op amps can operate on a single-supply voltage (2.7 V to 40 V), or a split-supply voltage (± 1.35 V to ± 20 V), making them highly versatile and easy to use. The power-supply pins should have local bypass ceramic capacitors (typically 0.01 μ F to 0.1 μ F). Parameters that can exhibit variance with regard to operating voltage or temperature are presented in the Typical Characteristics.

Functional Block Diagram

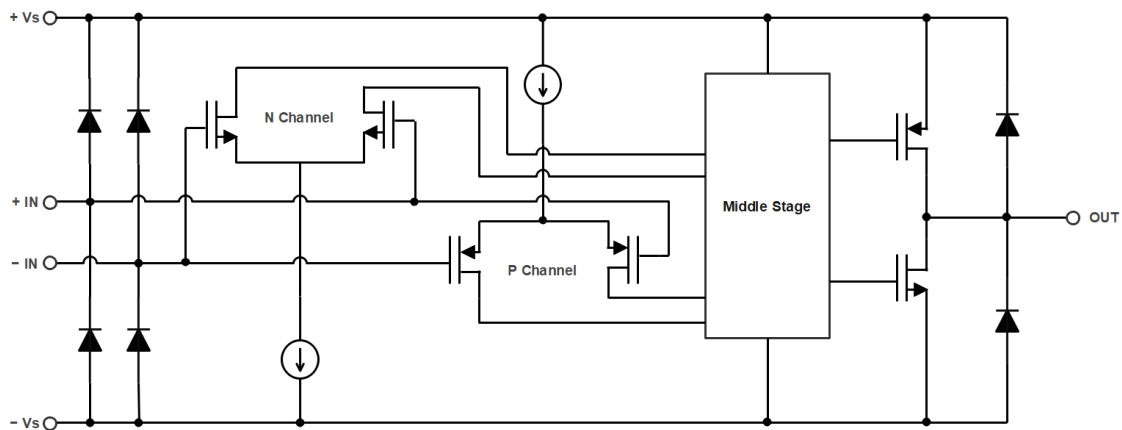


Figure 30. Functional Block Diagram

Feature Description

Operating Voltage

The series is designed for single supply operation from 2.7 V to 40 V or dual supply operation from ± 1.35 V to ± 20 V.

The recommended operating voltage conditions are as follows:

Power supply voltage ($+V_S$) – ($-V_S$): 2.7 V to 40 V. The power supply voltage can support the following three scenarios:

- Single supply;
- Dual supplies with equal voltage values;
- Various voltage configurations, as long as the voltage range of ($+V_S$) – ($-V_S$) is within 2.7 V to 40 V.

For example, if operating with a single supply, ($-V_S$) = 0 V, ($+V_S$) can support 2.7 V to 40 V. If using dual supplies with equal absolute values, the minimum voltage is ± 1.35 V, and the maximum voltage is ± 20 V. It can even support other voltage configurations, such as ($-V_S$) = 100 V, ($+V_S$) = 136 V, or ($-V_S$) = -6 V, ($+V_S$) = 30 V, and so on.

Input Common-Mode Voltage Range

The TPA155xQ series is designed as a true rail-to-rail input/output operational amplifier with an input common-mode voltage range that extends 100 mV beyond either supply rail, as [Figure 31](#) shows. The wide range is achieved with paralleled complementary N-channel and P-channel differential input pairs.

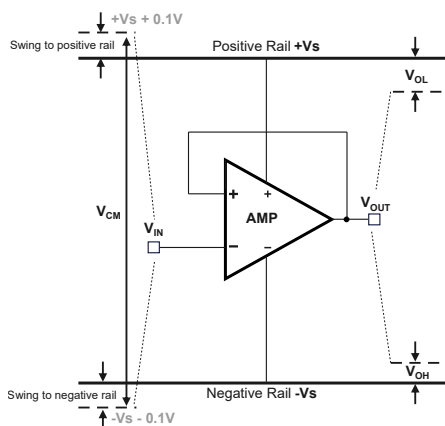


Figure 31. Input Common Mode Voltage Range of Operational Amplifier

When the input is driven beyond its linear common-mode range, the output does not phase-reverse, as [Figure 22](#) shows; instead, its output limits to the appropriate rail. This is achieved because the TPA155xQ series incorporates internal phase-reversal protection.

Electrical Overstress

Electrical overstress (EOS) events usually occur at the input pins of the amplifier. As shown in [Figure 32](#), ESD protection diodes are connected from each input pin to the positive and negative supply pins.

Compared with a 5-V general-purpose low-voltage amplifier, a 40-V high-voltage amplifier (such as the TPA155xQ series) can withstand more severe EOS events, owing to its higher-voltage process technology.

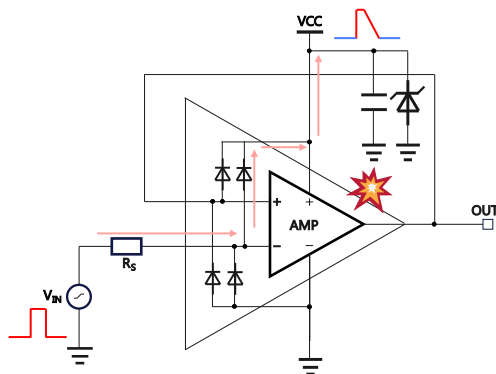


Figure 32. EOS Event in a Buffer Configuration

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

Low-Side Current Sensing

Figure 33 Low-Side Current Sensing shows the device configured as a difference amplifier in a current sensing application. V_{BIAS} can be used to add bias voltage for bidirectional current sensing. R_1 and R_F set the gain, and the R_F and C_F set the cut-off frequency.

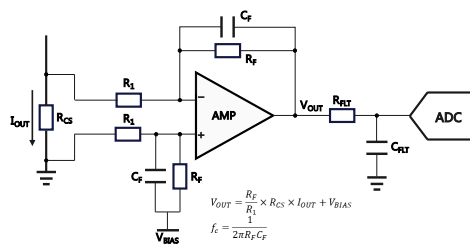


Figure 33. Low-Side Current Sensing

Driving Capacitive Load

The TPA155xQ series can drive a capacitor up to 1 nF directly. To drive a larger load capacitor in unity-gain configurations, an additional isolated resistor R_{ISO} (5Ω to 100Ω) should be added. R_{ISO} modifies the open-loop gain of the system to increase the phase margin for better stability.

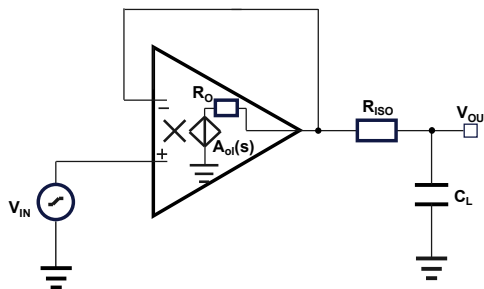
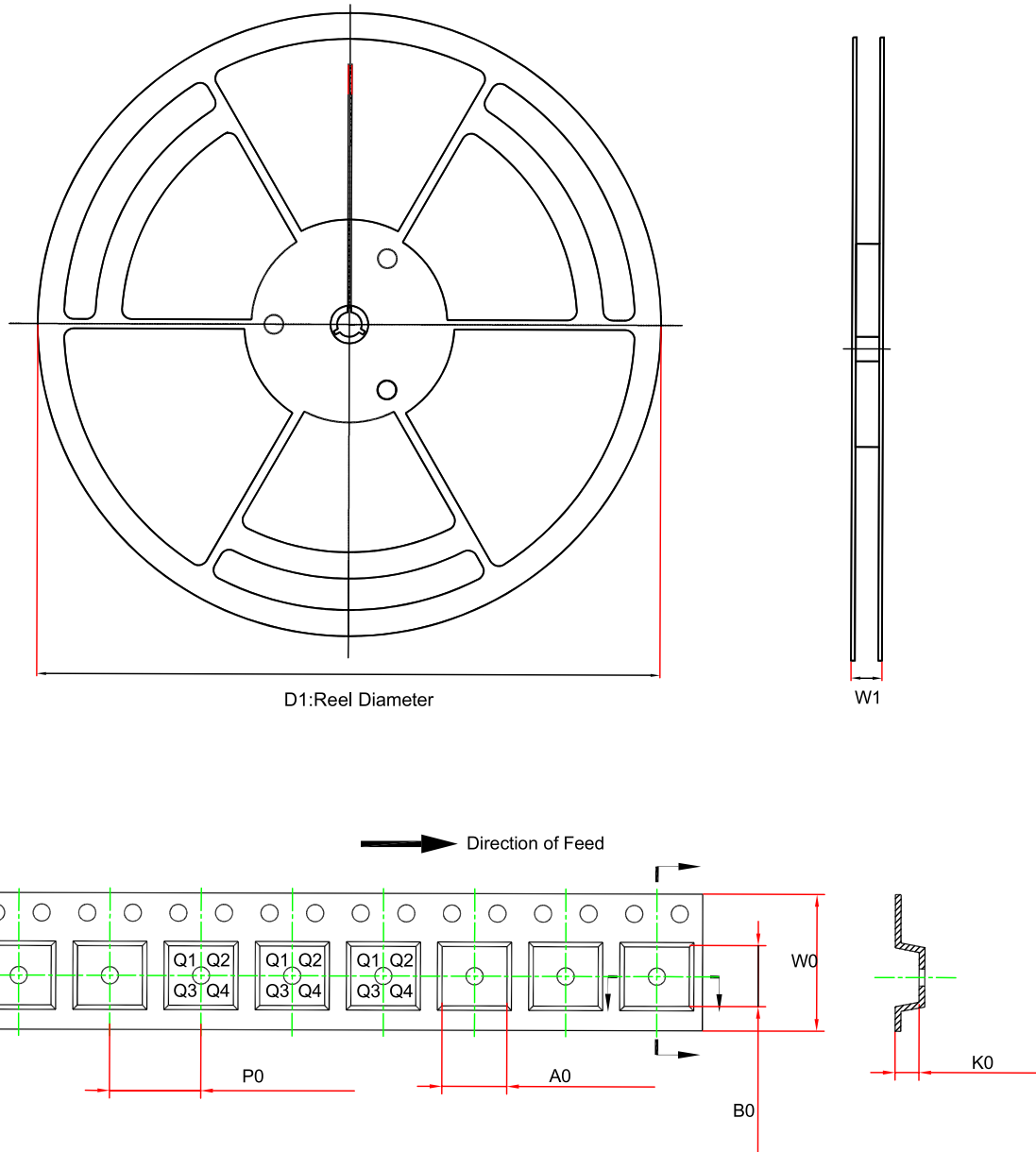


Figure 34. Isolated Resistor for Driving Capacitive Load

Power Supply Recommendations

Place 0.1-μF bypass capacitors close to the power supply pins to reduce coupling errors from the noisy or high-impedance power supplies.

Tape and Reel Information

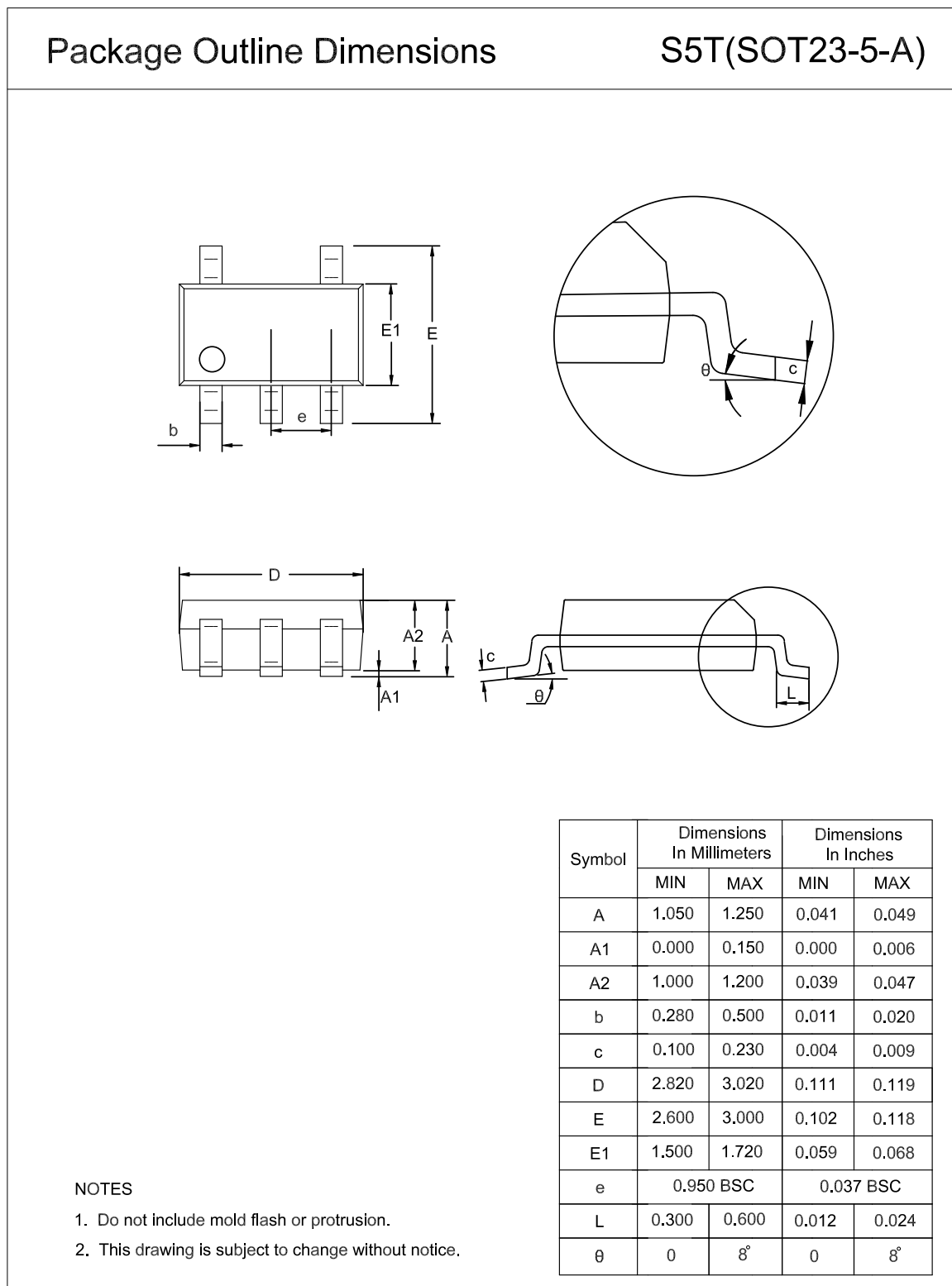


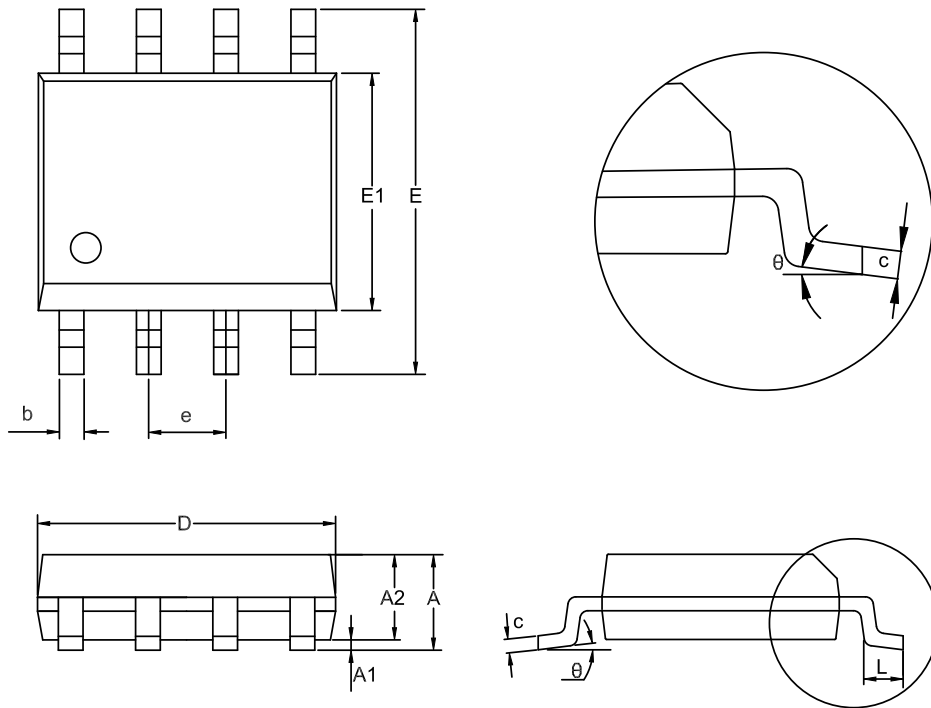
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) ⁽¹⁾	B0 (mm) ⁽¹⁾	K0 (mm) ⁽¹⁾	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA1551Q-S5TR-S	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TPA1551UQ-S5TR-S	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TPA1552Q-SO1R-S	SOP8	330	17.6	6.5	5.4	2	8	12	Q1
TPA1552Q-VS1R-S	MSOP8	330	17.6	5.3	3.4	1.3	8	12	Q1
TPA1552Q-TS1R-S	TSSOP8	330	17.6	6.8	3.4	1.2	8	12	Q1
TPA1554Q-SO2R-S	SOP14	330	21.6	6.5	9.15	1.8	8	16	Q1
TPA1554Q-TS2R-S	TSSOP14	330	17.6	6.8	5.5	1.3	8	12	Q1

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

SOT23-5

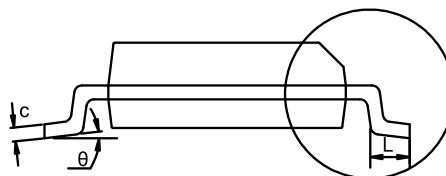
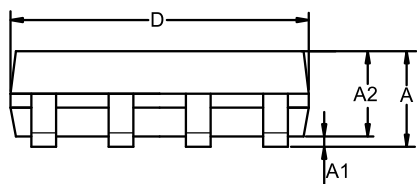
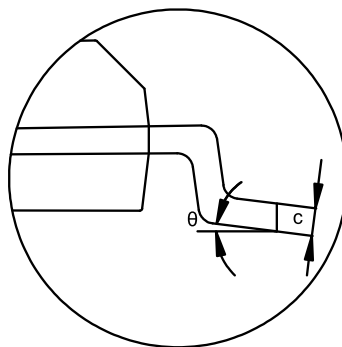
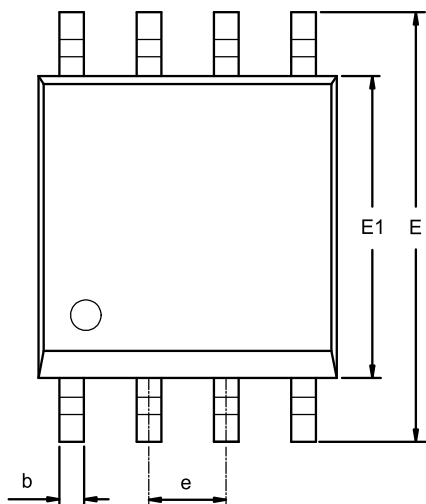


SOP8
Package Outline Dimensions
SO1(SOP-8-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

NOTES

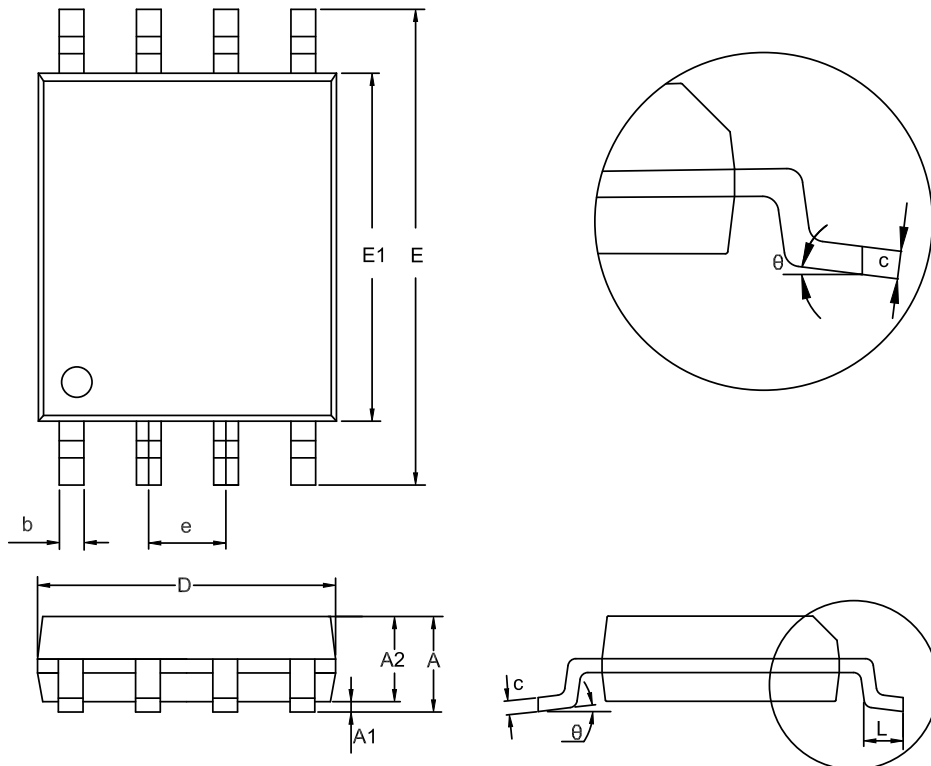
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

MSOP8
Package Outline Dimensions
VS1(MSOP-8-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	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	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0	8°	0	8°

NOTES

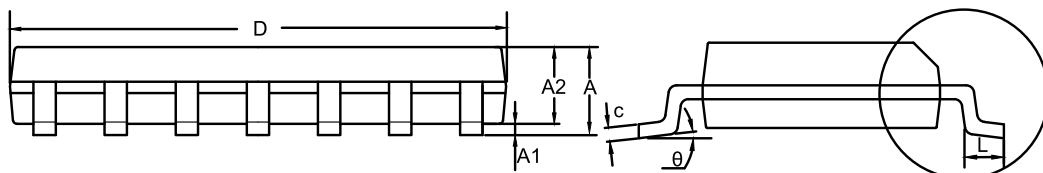
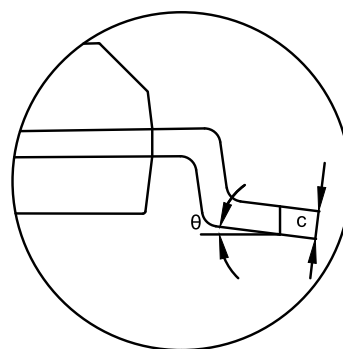
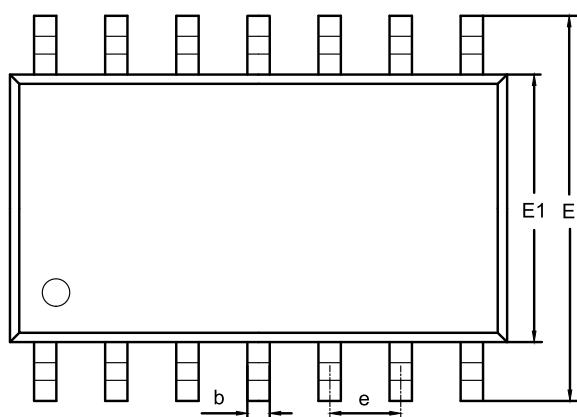
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

TSSOP8
Package Outline Dimensions
TS1(TSSOP-8-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	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	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

NOTES

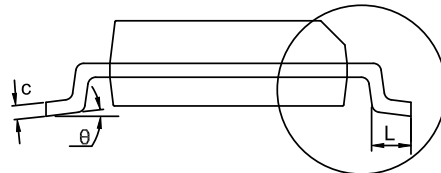
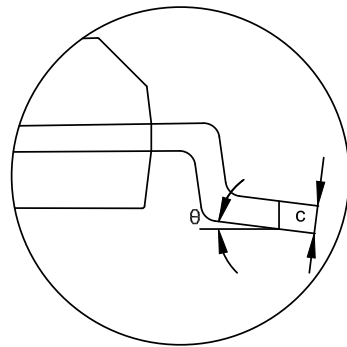
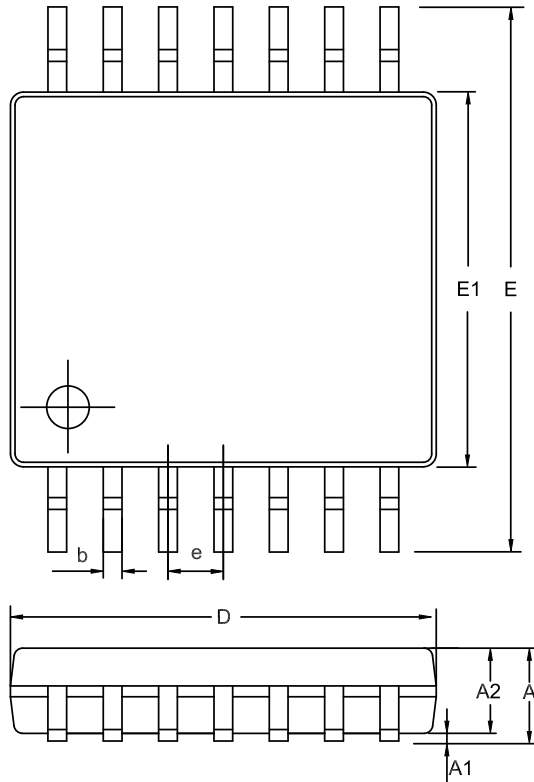
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

SOP14
Package Outline Dimensions
SO2(SOP-14-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

TSSOP14
Package Outline Dimensions
TS2(TSSOP-14-A)

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	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	4.900	5.100	0.193	0.201
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA1551Q-S5TR-S ⁽¹⁾	-40 to 125°C	SOT23-5	ABL	1	Tape and Reel, 3000	Green
TPA1551UQ-S5TR-S ⁽¹⁾	-40 to 125°C	SOT23-5	ABM	1	Tape and Reel, 3000	Green
TPA1552Q-SO1R-S	-40 to 125°C	SOP8	A1552	1	Tape and Reel, 4000	Green
TPA1552Q-VS1R-S ⁽¹⁾	-40 to 125°C	MSOP8	A1552	1	Tape and Reel, 3000	Green
TPA1552Q-TS1R-S ⁽¹⁾	-40 to 125°C	TSSOP8	A1552	1	Tape and Reel, 3000	Green
TPA1554Q-SO2R-S ⁽¹⁾	-40 to 125°C	SOP14	A1554	1	Tape and Reel, 2500	Green
TPA1554Q-TS2R-S	-40 to 125°C	TSSOP14	A1554	1	Tape and Reel, 3000	Green

(1) For future products, contact the 3PEAK factory for more information and samples.

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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