36-V, 1-MHz, 0.7-V/μs Operational Amplifier

Features

- Supply Voltage: 4.5 V to 36 V
- Rail-to-Rail Output
- Bandwidth: 1 MHz
- Slew Rate: 0.7 V/μs
- Excellent EMI Suppress Performance
- Offset Voltage: ±150 μV Maximum
- Offset Voltage Temperature Drift: 2 μV/°C
- Low Noise: 30 nV/√Hz at 1 kHz
- Operating Temperature Range: −40°C to 125°C

Applications

- Instrumentation
- Active Filters, ASIC Input or Output Amplifier
- Sensor Interface
- Motor Control
- Industrial Control

Description

The TP07A is the newest high supply voltage amplifier with low offset, low power, and stable high-frequency response. It incorporates 3PEAK's proprietary and patented design techniques to achieve excellent AC performance with 1-MHz bandwidth, 0.7 V/μs slew rate, and low distortion while drawing a quiescent current of only 900 μA per amplifier. The input common-mode voltage range extends to V−, and the outputs swing rail-to-rail. The TP07A can be used as a plug-in replacement for commercially available op amps to reduce power and improve the input/output range and performance.

The combination of features makes the TP07A an ideal choice for industrial control and instrumentation.

Table of Contents

Revision History

Date	Revision	Notes
2018-12-21	Rev.Pre.0	Pre-released version.
2020-12-21	Rev.A.0	Initial version.
2024-12-18	Rev.A.1	The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. • Updated to a new datasheet format. • Updated to a new format of Package Outline Dimensions. • Updated the Tape and Reel Information. • Added PIN Configuration and Functions.

Pin Configuration and Functions

TP07A
SOP8
Top View

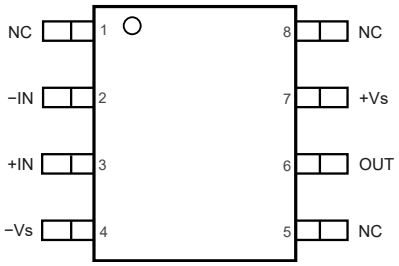


Table 1. Pin Functions: TP07A

Pin No.	Name	I/O	Description
1	NC		Not connect
2	−IN	I	Inverting input
3	+IN	I	Non-inverting input
4	$-V_S$		Negative power supply
5	NC		Not connect
6	OUT	O	Output
7	$+V_S$		Positive power supply
8	NC		Not connect

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, $(+V_S) - (-V_S)$		40	V
	Input Voltage	$(-V_S) - 0.3$	$(+V_S) + 0.3$	V
	Differential Input Voltage		$(+V_S) - (-V_S)$	V
	Input Current: +IN, −IN (2)	−10	10	mA
	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 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. This depends on the power supply voltage and how many amplifiers are shorted. The thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	MIL-STD-883H Method 3015.8	2	kV
CDM	Charged Device Model ESD	JEDEC-EIA/JESD22-C101E	1	kV

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	158	43	°C/W

Electrical Characteristics

All test conditions: V_S = 30 V, T_A = 25°C, R_L = 10 kΩ, unless otherwise noted.

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
Power Supply							
V_S	Supply Voltage Range			4.5		36	V
I_Q	Quiescent Current per Amplifier	V_S = 30 V			900	1600	μA
			−40°C to 125°C			1800	μA
PSRR	Power Supply Rejection Ratio	V_S = 4.5 V to 36 V		100	120		dB
			−40°C to 125°C	95			dB
Input Characteristics							
V_{OS}	Input Offset Voltage	V_S = 30 V, V_{CM} = 15V		−150	50	150	μV
			−40°C to 125°C	−650		650	μV
		V_S = 25 V, V_{CM} = 12.5 V		−150	50	150	μV
			−40°C to 125°C	−650		650	μV
V_{OS} TC	Input Offset Voltage Drift		−40°C to 125°C		2		μV/°C
I_B	Input Bias Current				25		pA
			−40°C to 85°C		80		pA
			−40°C to 125°C		1000		pA
I_{OS}	Input Offset Current				25		pA
I_{IN}	Differential Input Current	V_S = 36 V, V_{ID} = 36 V			10	200	nA
			−40°C to 125°C		100	300	nA
C_{IN}	Input Capacitance	Differential mode			5		pF
		Common mode			2.5		pF
A_V	Open-Loop Voltage Gain	V_S = 30 V, V_{OUT} = 0.5 V to 29,5 V		100	120		dB
			−40°C to 125°C	90			dB
V_{CMR}	Common-Mode Input Voltage Range			(−V_S)		(+V_S) − 1.5	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0.5 V to 28.5 V		100	120		dB
			−40°C to 125°C	95			dB
Output Characteristics							
V_{OH}	Output Swing from Positive Rail	R_{LOAD} = 100 kΩ to V_S / 2			15	30	mV
			−40°C to 125°C			50	mV
		R_{LOAD} = 10 kΩ to V_S / 2			60	90	mV
			−40°C to 125°C			140	mV
V_{OL}	Output Swing from Negative Rail	R_{LOAD} = 100 kΩ to V_S / 2			10	20	mV
			−40°C to 125°C			30	mV
		R_{LOAD} = 10 kΩ to V_S / 2			35	50	mV

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
			−40°C to 125°C			90	mV
I_{SC}	Output Short-Circuit Current				60		mA
AC Specifications							
GBW	Gain-Bandwidth Product				1		MHz
SR	Slew Rate	G = 1		0.3	0.7		V/μs
			−40°C to 125°C	0.1			V/μs
t_{OR}	Overload Recovery				2		μs
t_S	Settling Time, 0.1%	G = −1, 10-V step			15		μs
	Settling Time, 0.01%				20		μs
PM	Phase Margin	V_S = 36 V, R_L = 10 kΩ, C_L = 100 pF			50		°
GM	Gain Margin	V_S = 36 V, R_L = 10 kΩ, C_L = 100 pF			10		dB
Noise Performance							
E_N	Input Voltage Noise	f = 0.1 Hz to 10 Hz			2		μV_{RMS}
e_N	Input Voltage Noise Density	f = 1 kHz			30		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} = 6 V_{RMS}			0.002		%
Thermal Shutdown							
	Thermal Shutdown Temperature				170		°C
	Recover Temperature				150		°C

Typical Performance Characteristics

All test conditions: V_S = 30 V, T_A = 25°C, R_L = 10 kΩ, unless otherwise noted.

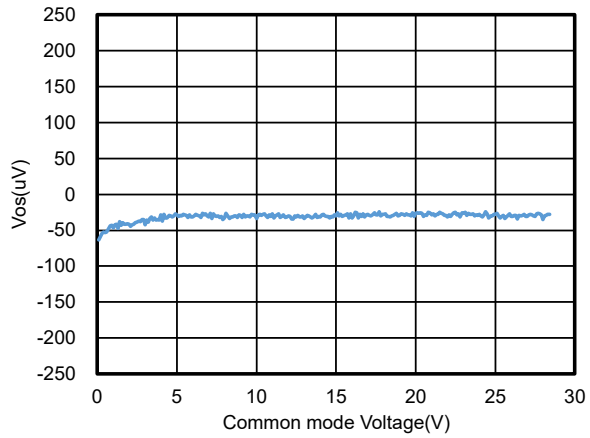


Figure 1. Offset Voltage vs. Common-Mode Voltage

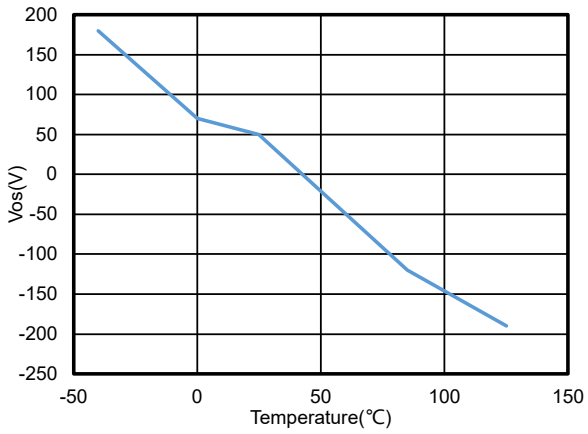


Figure 2. V_{OS} vs. Temperature

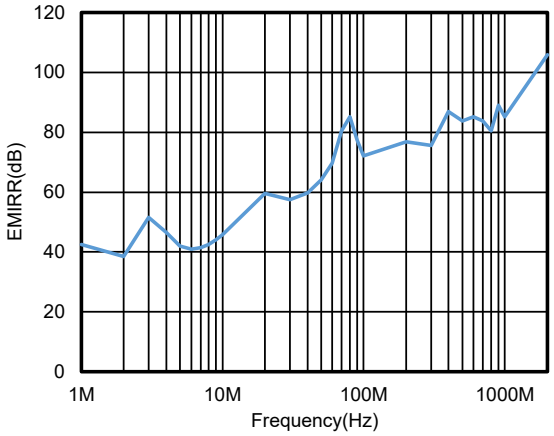


Figure 3. EMIRR vs. Frequency

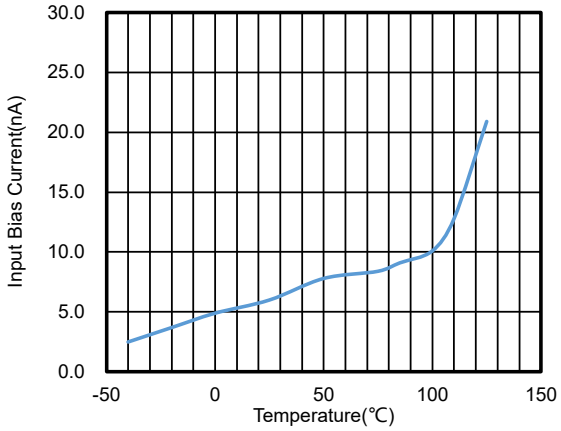


Figure 4. Input Current in Large V_{DM} vs. Temperature

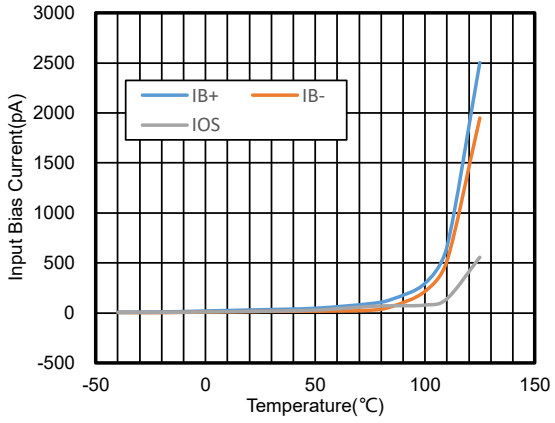


Figure 5. I_B vs. Temperature, −40 to 125°C

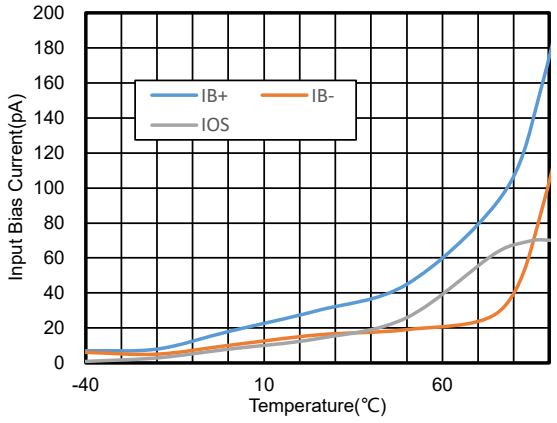


Figure 6. I_B vs. Temperature, −40 to 90°C

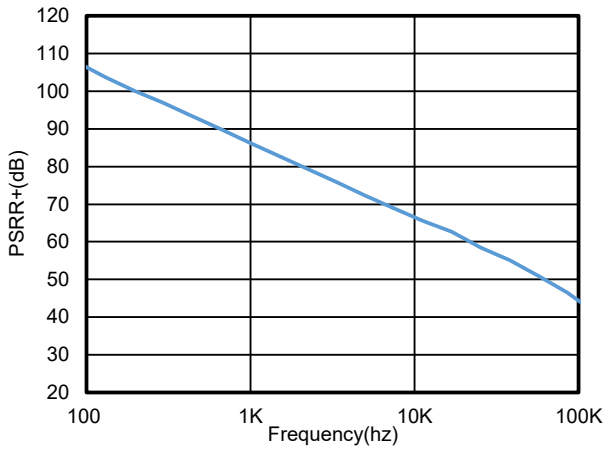


Figure 7. PSRR+ vs. Frequency

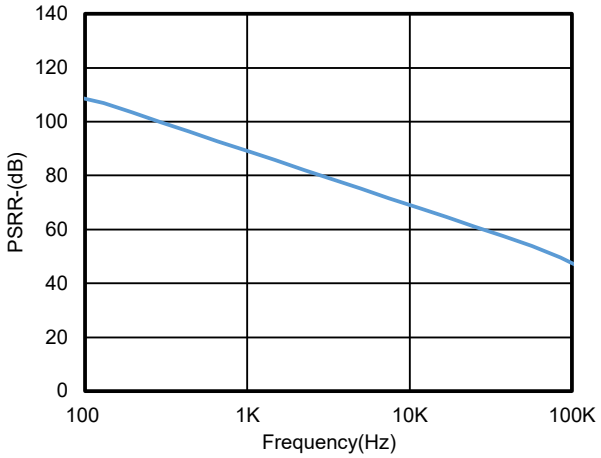


Figure 8. PSRR− vs. Frequency

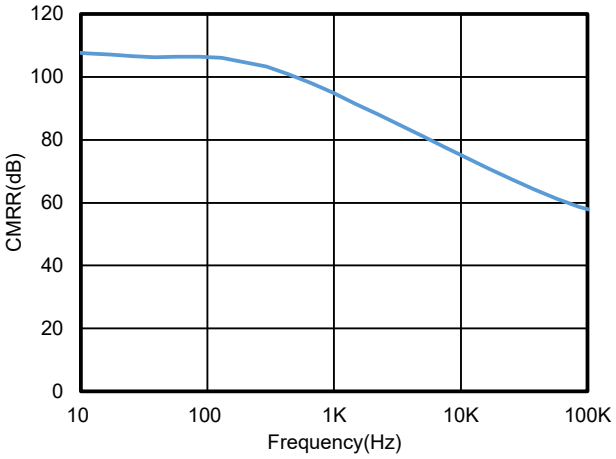


Figure 9. CMRR vs. Frequency

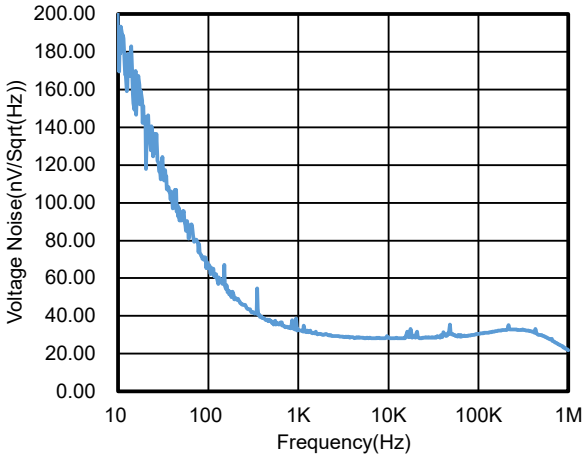


Figure 10. Voltage Noise Spectral Density vs. Frequency

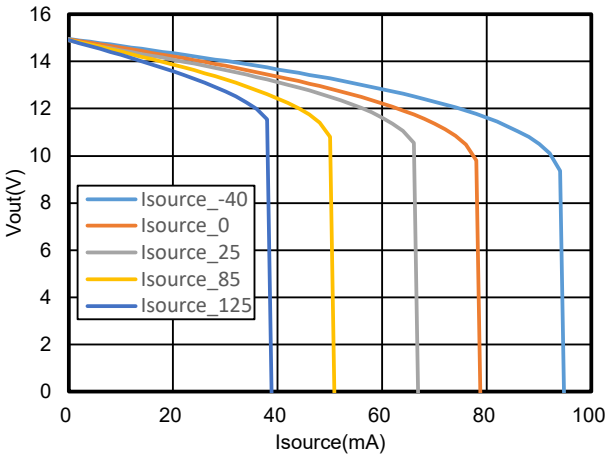


Figure 11. Positive Output Voltage vs. Output Current

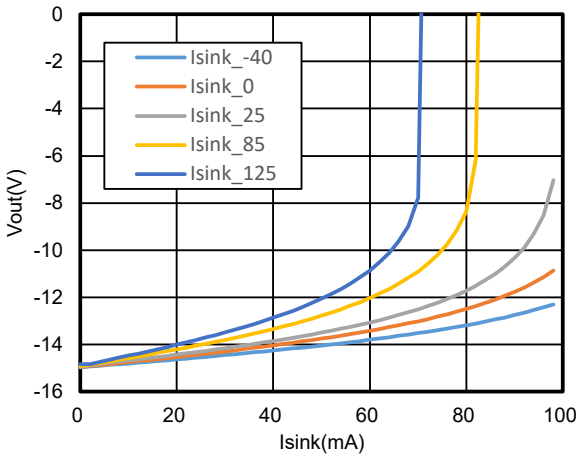


Figure 12. Negative Output Voltage vs. Output Current

Figure 13. Positive Overload Recovery

Voltage: 5 V/div for Output, Time: 10 μs/div

$G = 10$, V_{REF} = GND; V_{IN} = 5 V_{PP}

Figure 14. Negative Overload Recovery

Voltage: 5 V/div for Output, Time: 10 μs/div

$G = 10$, V_{REF} = GND; V_{IN} = 5 V_{PP}

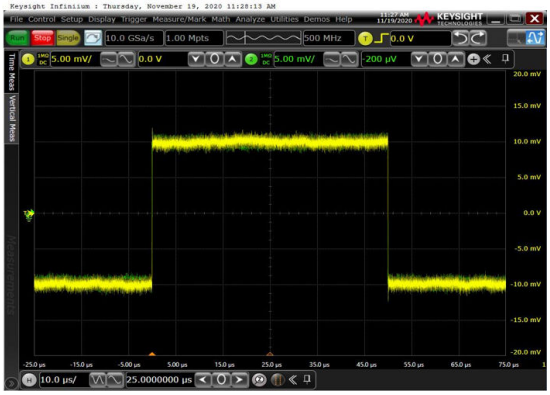


Figure 15. 20-mV Signal Step Response

Voltage: 5 mV/div, Time: 10 μs/div

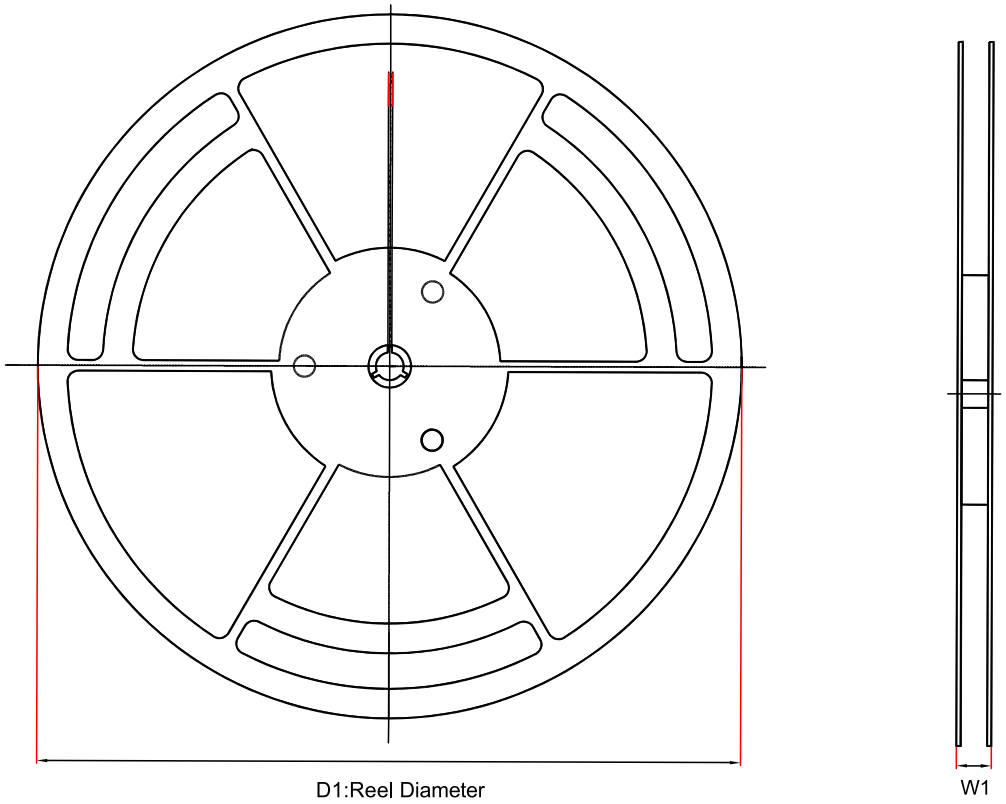
R_L = 2 kΩ, C_L = 100 pF, G = 1

Figure 16. 10-V Signal Step Response

Voltage: 5 V/div, Time: 100 μs/div

R_L = 2 kΩ, C_L = 100 pF, G = 1

Tape and Reel Information



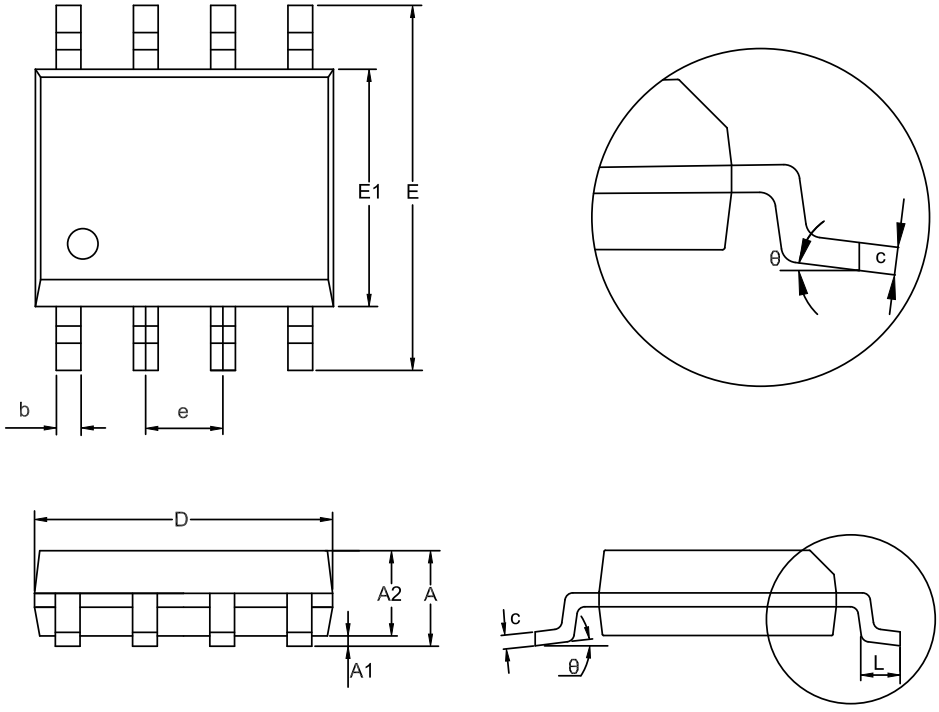
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TP07A-SR	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1

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

Package Outline Dimensions

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.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TP07A-SR	−40 to 125°C	SOP8	TP07A	3	Tape and Reel, 4000	Green

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

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