36-V, 6-MHz, 20-V/μs Operational Amplifier

Features

- Supply Voltage: 4.5 V to 36 V
- Rail-to-Rail Output
- Bandwidth: 6 MHz
- Slew Rate: 20 V/μs
- Excellent EMI Suppress Performance
- Offset Voltage: ±100 μV (Max)
- Offset Voltage Temperature Drift: 2 μV/°C
- Low Noise: 25 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 TP17 is a series of the newest high supply voltage amplifiers with low offset, low power, and stable high-frequency response. The series incorporates 3PEAK's proprietary and patented design techniques to achieve excellent AC performance with 6-MHz bandwidth, 20-V/μs slew rate, and low distortion while drawing only 1500 μA of quiescent current per amplifier. The input common-mode voltage range extends to $-V_S$, and the outputs swing rail-to-rail. The TP17 series can be used as plug-in replacements for commercially available op amps to reduce power consumption, extend the input/output range, and improve performance.

The combination of features makes the TP17 series an ideal choice for industrial control, instrumentation.

Table of Contents

Revision History

Date	Revision	Notes
2018-04-21	Rev.Pre.0	Pre-released version.
2018-10-05	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 the Package Outline Dimensions. • Updated the Tape and Reel Information.

Pin Configuration and Functions

TP17
SOP8
Top View

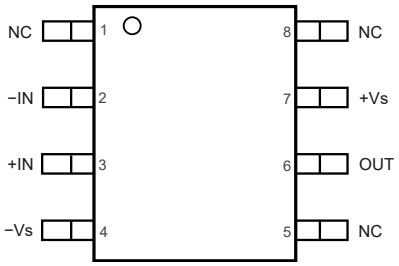


Table 1. Pin Functions: TP17

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	ANSI/ESDA/JEDEC JS-001 (1)	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	1	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

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			1.5	2	mA
			−40°C to 125°C			3	mA
PSRR	Power Supply Rejection Ratio	V_S = 4.5 V to 36 V		105	130		dB
			−40°C to 125°C	100			dB
Input Characteristics							
V_{OS}	Input Offset Voltage	V_S = 30 V, V_{CM} = 15 V		−100	50	100	μV
			−40°C to 85°C	−400		400	μV
			−40°C to 125°C	−600		600	μV
		V_S = 25 V, V_{CM} = 12.5 V		−100	50	100	μV
			−40°C to 85°C	−400		400	μV
			−40°C to 125°C	−600		600	μV
		V_S = 5 V, V_{CM} = 2.5 V		−150	50	150	μV
			−40°C to 85°C	−500		500	μV
			−40°C to 125°C	−600		600	μV
V_{OS} TC	Input Offset Voltage Drift		−40°C to 125°C		1		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}	Different Input Current	V_S = 36 V, V_{ID} = 36 V			10	100	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		120	130		dB
			−40°C to 125°C	105			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	125		dB
			−40°C to 125°C	95			dB
Output Characteristics							
	Output Swing from Positive Rail	R_{LOAD} = 100 kΩ to V_S / 2			5	15	mV
			−40°C to 85°C			30	mV

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
			−40°C to 125°C			40	mV
		R_{LOAD} = 10 kΩ to V_S / 2			50	80	mV
			−40°C to 85°C			120	mV
			−40°C to 125°C			130	mV
	Output Swing from Negative Rail	R_{LOAD} = 100 kΩ to V_S / 2			5	10	mV
			−40°C to 85°C			20	mV
			−40°C to 125°C			25	mV
		R_{LOAD} = 10 kΩ to V_S / 2			40	50	mV
			−40°C to 85°C			80	mV
			−40°C to 125°C			100	mV
I_{SC}	Output Short-Circuit Current	Source current		20	32		mA
		Sink current		15	25		mA
AC Specifications							
GBW	Gain-Bandwidth Product				6		MHz
SR	Slew Rate	G = 1, 10-V step		13	20		V/μs
			−40°C to 125°C	10			V/μs
t_{OR}	Overload Recovery				100		ns
t_S	Settling Time, 0.1%	G = 1, 10-V step			0.5		μs
	Settling Time, 0.01%				0.8		μs
PM	Phase Margin	V_S = 36 V, R_L = 10 kΩ, C_L = 100 pF			60		°
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			25		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}			0.0005		%
Thermal Shutdown							
	Thermal Shutdown Temperature				170		°C
	Recover Temperature				150		°C

Typical Performance Characteristics

All test conditions: V_S = ±15 V, V_{CM} = 0 V, R_L = 10 kΩ, unless otherwise noted.

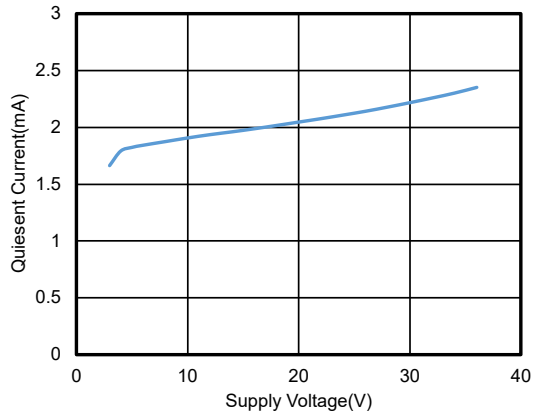


Figure 1. Quiescent Current vs. Supply Voltage

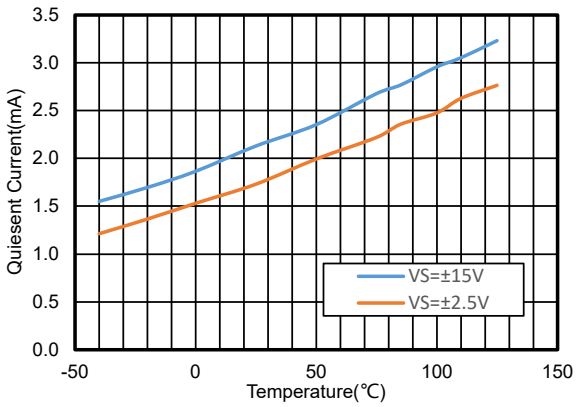


Figure 2. Quiescent Current vs. Temperature

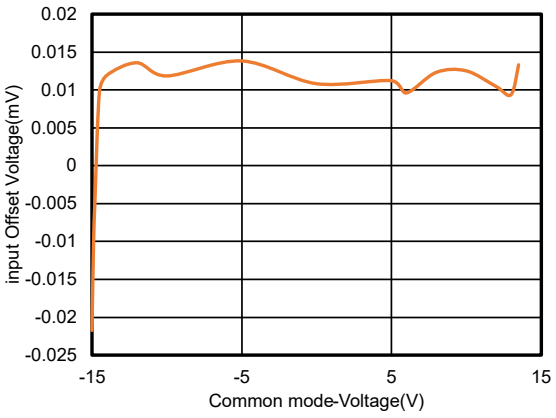


Figure 3. Offset Voltage vs. Common-Mode Voltage

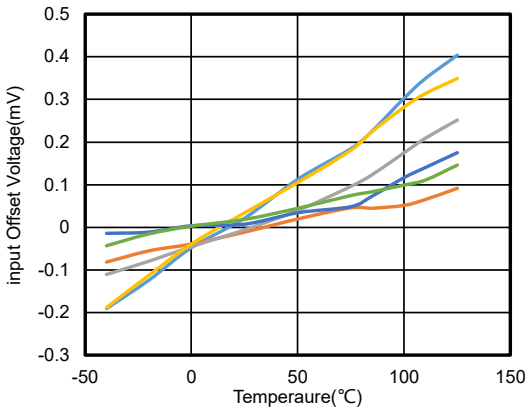


Figure 4. V_{OS} vs. Temperature

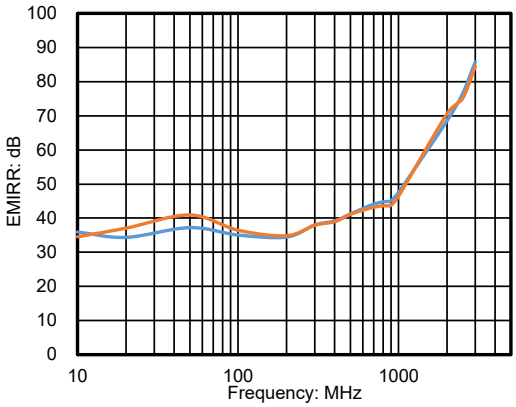


Figure 5. EMIRR vs. Frequency

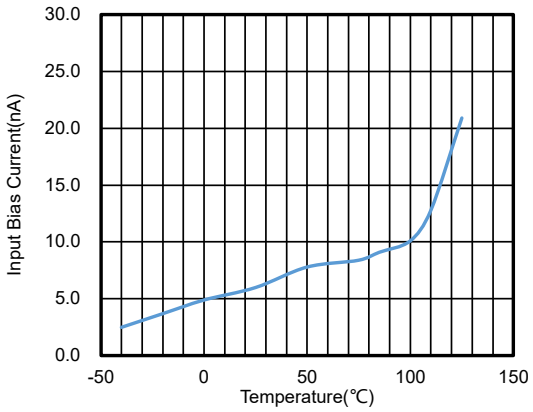


Figure 6. Input Current in Large V_{DM} vs. Temperature

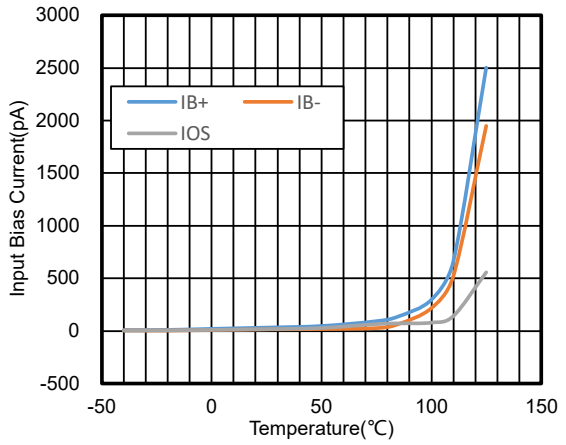


Figure 7. I_B vs. Temperature, −40°C to 125°C

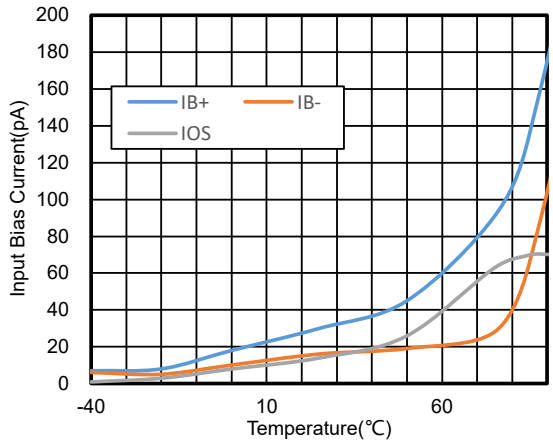


Figure 8. I_B vs. Temperature, −40°C to 90°C

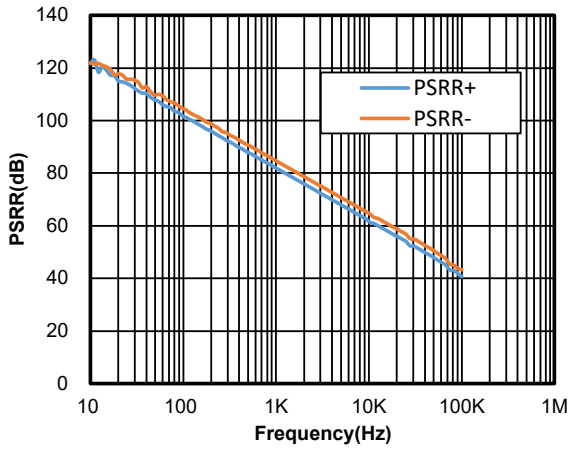


Figure 9. PSRR vs. Frequency

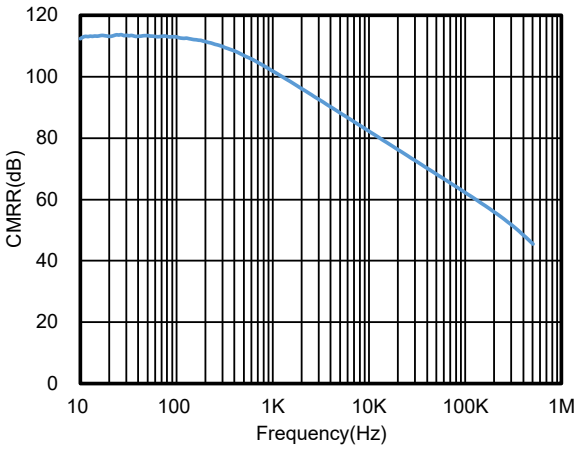


Figure 10. CMRR vs. Frequency

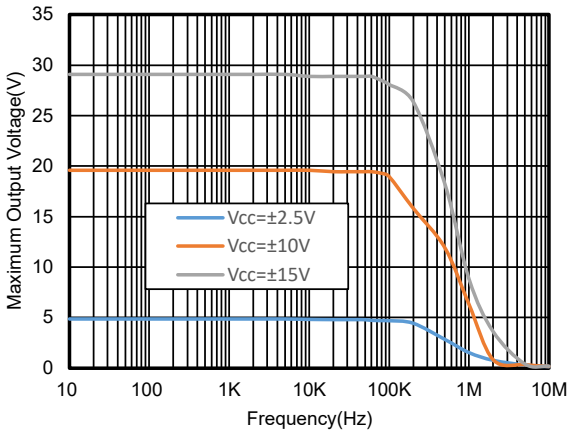


Figure 11. Maximum Output Voltage vs. Frequency

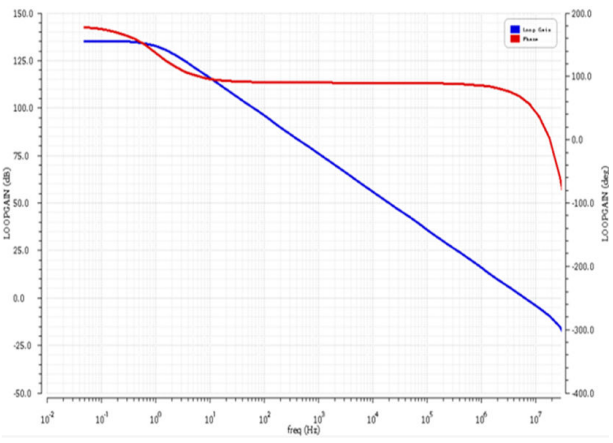


Figure 12. Open-Loop Gain and Phase vs. Frequency, R_{LOAD} = 10 kΩ, C_{LOAD} = 100 pF

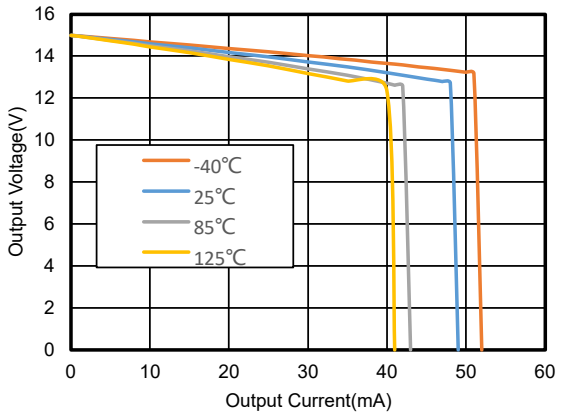


Figure 13. Positive Output Voltage vs. Output Current

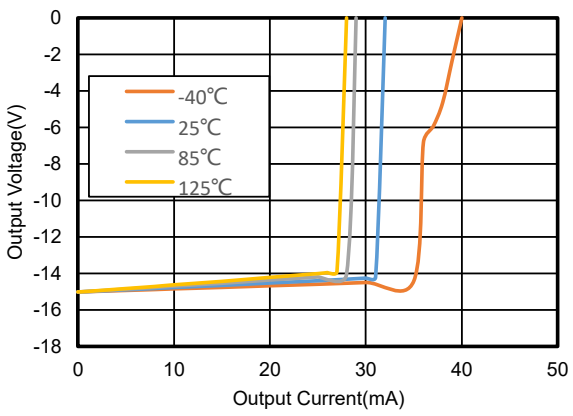
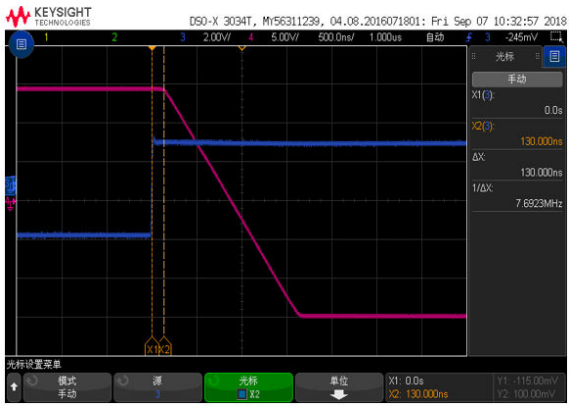


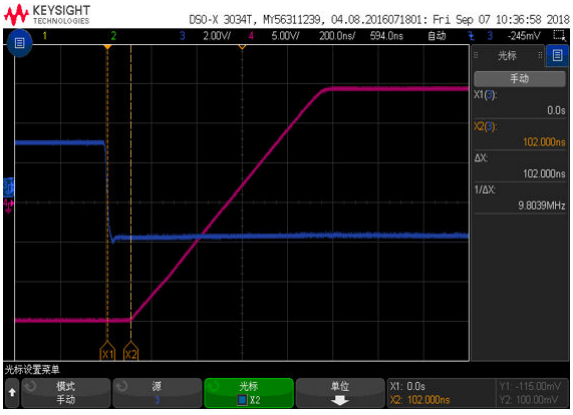
Figure 14. Negative Output Voltage vs. Output Current



Voltage: 5 V/div for Output, Time: 500 ns/div

G = −10, V_{REF} = GND; V_{IN} = 5 V_{PP}, R_{Load} = 2 kΩ, C = 100 pF

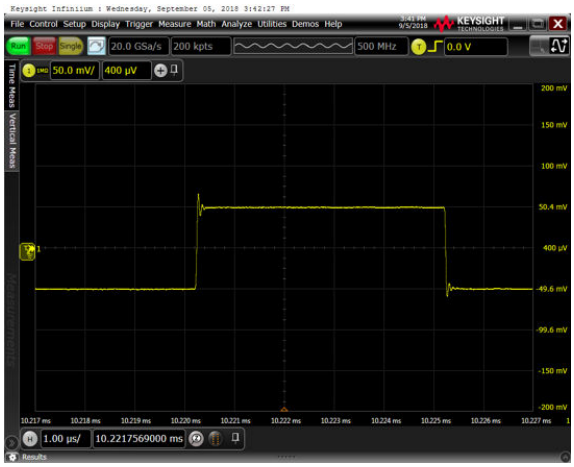
Figure 15. Positive Overload Recovery



Voltage: 5 V/div for Output, Time: 500 ns/div

G = −10, V_{REF} = GND; V_{IN} = 5 V_{PP}, R_{Load} = 2 kΩ, C = 100 pF

Figure 16. Negative Overload Recovery



Voltage: 50 mV/div, Time: 1 μs/div

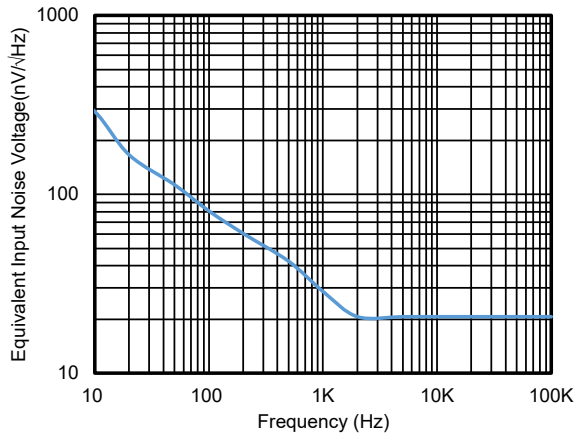
R_L = 2 kΩ, C_L = 100 pF, G = 1

Figure 17. 100-mV Signal Step Response

Voltage: 5 V/div, Time: 1 μs/div

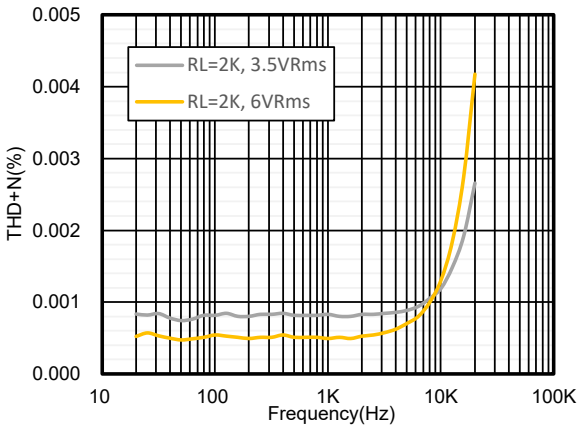
R_L = 2 kΩ, C_L = 100 pF, G = 1

Figure 18. 10-V Signal Step Response



V_S = ±15 V, V_{CM} = 0 V

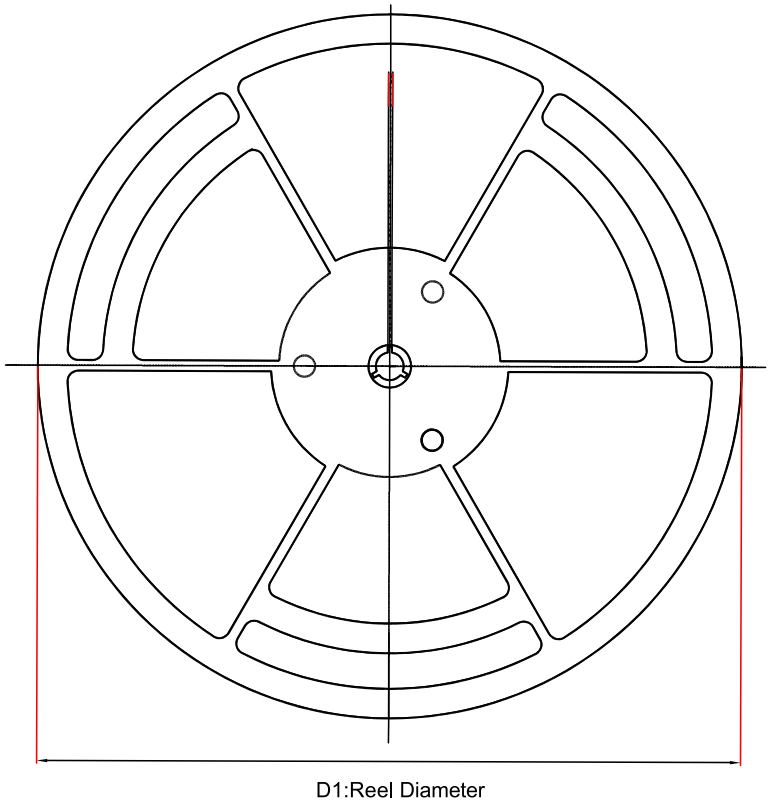
Figure 19. Voltage Noise Spectral Density vs. Frequency

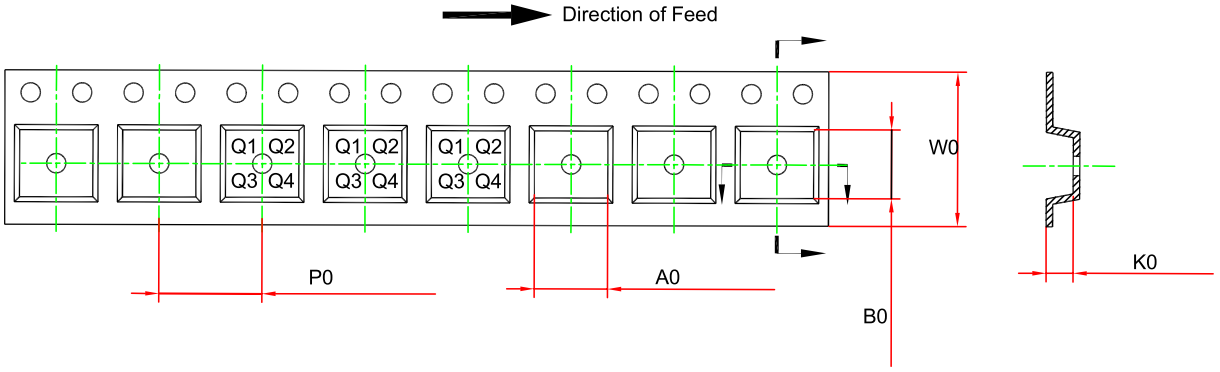


V_S = ± 15 V, V_{CM} = 0 V, G = 1

Figure 20. THD+N vs. Frequency

Tape and Reel Information





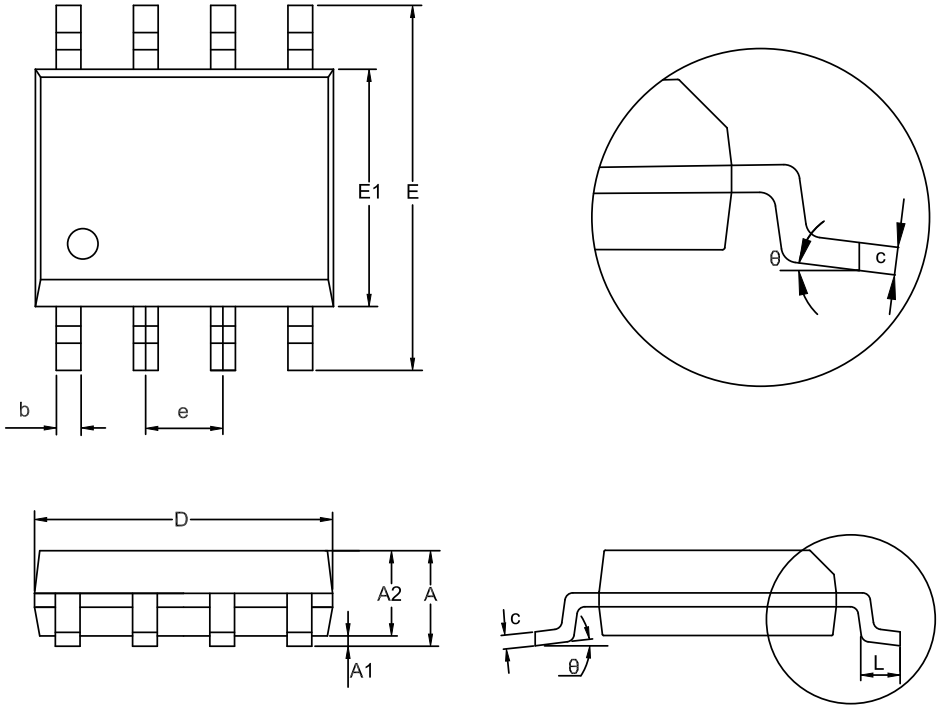
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TP17-SR	SOP8	330	17.6	6.5	5.4	2	8	12	Q1

(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
TP17-SR	−40 to 125°C	SOP8	TP17 XXXX (1)	3	Tape and Reel, 4000	Green

(1) "XXXX" identifies the manufacturing information.

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

IMPORTANT NOTICE AND DISCLAIMER

Performance Information. Performance tests or performance range contained in this document/material are either results of design simulation or actual tests conducted under designated testing environment. Any variation in testing environment or simulation environment, including but not limited to testing method, testing process or testing temperature, may affect actual performance of the product.

Disclaimer. 3PEAK provides technical and reliability data (including data sheets), design resources (including reference designs), application or other design recommendations, networking tools, security information and other resources "As Is". 3PEAK makes no warranty as to the absence of defects, and makes no warranties of any kind, express or implied, including without limitation, implied warranties as to merchantability, fitness for a particular purpose or non-infringement of any third-party's intellectual property rights. Unless otherwise specified in writing, products supplied by 3PEAK are not designed to be used in any life-threatening scenarios, including critical medical applications, automotive safety-critical systems, aviation, aerospace, or any situations where failure could result in bodily harm, loss of life, or significant property damage. 3PEAK disclaims all liability for any such unauthorized use.

This page intentionally left blank