Features

- Supply Voltage: 4.5V to 36V
- Offset Voltage: ±15μV Maximum
- Differential Input Voltage Range to Supply Rail, can Work as Comparator
- Input Rail to $-V_S$, Rail to Rail Output
- Bandwidth: 12MHz
- Slew Rate: 12V/μs
- Over-Temperature Protection
- Low Noise: 6 nV/√Hz at 1kHz
- 2KV HBM, 1KV CDM
- –40°C to 125°C Operation Temperature Range

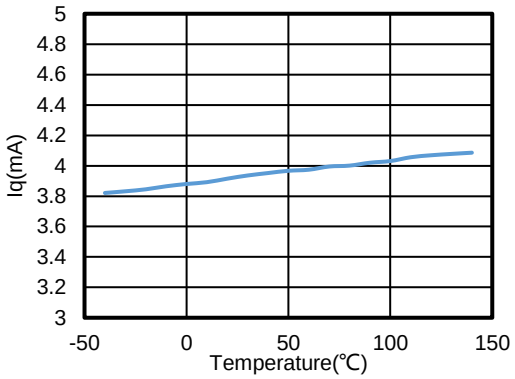
Applications

- Instrumentation
- Active Filters, ASIC Input or Output Amplifier
- Sensor Interface
- Motor Control
- Industrial Control
- Low noise power supply

Description

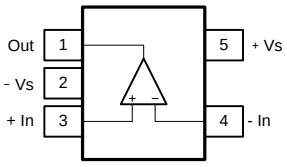
The TPA188X series amplifiers are newest high supply voltage amplifiers with 15μV low offset, low noise and stable high frequency response. They incorporate 3PEAK's proprietary and patented design techniques to achieve very good AC performance with 12MHz bandwidth, 12V/μs slew rate and low distortion while drawing only 2000μA of quiescent current per amplifier. The input common-mode voltage range extends to V–, and the outputs swing rail-to-rail.

The TPA188X has over-temperature protection feature to guarantee the chip safe. The output of TPA188X will enter high impendence when die temperature reach around 170°C and will recover the function when the die temperature down to around 150°C. The product has very small temperature coefficient of power which is helpful for temperature sensitive application.

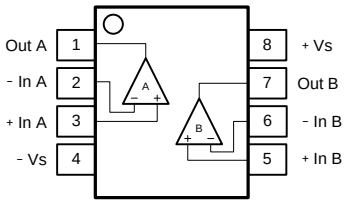


Pin Configuration

TPA1881
5-Pin SOT23
-T Suffixes



TPA1882
8-Pin SOIC/MSOP
-S, -TS, -V Suffixes



TPA1881
8-Pin SOIC
(-S Suffix)

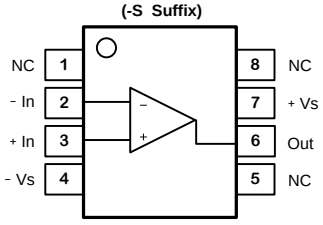


Table of Contents

Revision History

Date	Revision	Notes
2019/1/10	Rev.Pre	Pre-Release Version
2020/5/19	Rev.A	Initial Version
2020/8/3	Rev.A.1	Add Test Figure
2020/11/6	Rev.A.2	Update Test Figure: Iq vs. temperature, Vout vs. Iout
2021/7/7	Rev.A.3	Update maximum rating: Input voltage: $(-V_S)$ – 0.3 to $(+V_S)$ + 0.3 -> $(-V_S)$ – 0.3 to 40 V Differential Input Voltage : $(+V_S)$ - $(-V_S)$ -> $(-V_S)$ - $(+V_S)$ to $(+V_S)$ - $(-V_S)$

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPA1881-SR	-40 to 125°C	8-Pin SOIC	1881	3	Tape and Reel, 4000
TPA1881-TR	-40 to 125°C	5-Pin SOT23	A88	3	Tape and Reel, 3000
TPA1882-SR	-40 to 125°C	8-Pin SOIC	1882	3	Tape and Reel, 4000
TPA1882-VR	-40 to 125°C	8-Pin MSOP	1882	3	Tape and Reel, 3000

Absolute Maximum Ratings Note 1

Parameters	Rating
Supply Voltage, $(+V_S)$– $(-V_S)$	40 V
Input Voltage	$(-V_S)$ – 0.3 to 40 V
Differential Input Voltage	$(-V_S)$ - $(+V_S)$ to $(+V_S)$ - $(-V_S)$
Input Current: +IN, –IN Note 2	±10mA
Output Voltage	$(-V_S)$ – 0.3 to $(+V_S)$ + 0.3
Output Short-Circuit Duration Note 3	Infinite
Maximum Junction Temperature	150°C
Operating Temperature Range	–40 to 125°C
Storage Temperature Range	–65 to 150°C
Lead Temperature (Soldering, 10 sec)	260°C

Note 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.

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

Note 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. 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 and Latch Up Rating

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	1	kV
LU	Latch Up	JESD 78, 25°C	500	mA
		JESD 78, 125°C	200	mA

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
5-Pin SOT23	250	81	°C/W
8-Pin SOIC	158	43	°C/W
8-Pin MSOP	210	45	°C/W

Electrical Characteristics

All test condition is V_S = 30V, T_A = 25°C, R_L = 10kΩ, 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 = 30V			2	2.5	mA
			-40°C to 125°C			2.7	mA
		V_S = 5V			1.9	2.4	mA
			-40°C to 125°C			2.6	mA
PSRR	Power Supply Rejection Ratio	V_S = 4.5V to 36V		135	155		dB
			-40°C to 125°C	130			dB
Input Characteristics							
V_{OS}	Input Offset Voltage	V_S = 30V, V_{CM} = 15V		-15		15	μV
			-40°C to 125°C	-25		25	μV
		V_S = 5V, V_{CM} = 2.5V		-15		15	μV
			-40°C to 125°C	-25		25	μV
V_{OS} TC	Input Offset Voltage Drift		-40°C to 125°C		0.05	0.15	μV/°C
I_B	Input Bias Current				10		pA
			-40°C to 125°C		100		pA
I_{OS}	Input Offset Current				100		pA
I_{IN}	Different Input Current	V_S = 36V, V_{ID} = 36V				100	μA
			-40°C to 125°C			120	μA
C_{IN}	Input Capacitance	Differential Mode			5		pF
		Common Mode			2.5		pF
Av	Open-loop Voltage Gain	R_{LOAD} = 10kΩ, VOUT = 0.5 V to 29.5 V		135	155		dB
			-40°C to 125°C	130			dB
V_{CMR}	Common-mode Input Voltage Range			(V-)		(V+) – 1.5	V
CMRR	Common Mode Rejection Ratio	V_{CM} = 0V to 28.5V		135	155		dB
			-40°C to 125°C	130			dB
Output Characteristics							
	Output Swing from Positive Rail	R_{LOAD} = 100kΩ to V_S/2			12	25	mV
			-40°C to 85°C			35	mV
			-40°C to 125°C			40	mV
		R_{LOAD} = 10kΩ to V_S/2			80	120	mV
			-40°C to 85°C			170	mV
			-40°C to 125°C			200	mV
		R_{LOAD} = 2kΩ to V_S/2			370	500	mV
			-40°C to 85°C			700	mV
			-40°C to 125°C			750	mV

	Output Swing from Negative Rail	R_{LOAD} = 100kΩ to V_S/2			5	25	mV
			-40°C to 85°C			30	mV
			-40°C to 125°C			30	mV
		R_{LOAD} = 10kΩ to V_S/2			30	80	mV
			-40°C to 85°C			95	mV
			-40°C to 125°C			105	mV
		R_{LOAD} = 2kΩ to V_S/2			140	300	mV
			-40°C to 85°C			450	mV
			-40°C to 125°C			500	mV
I_{SC}	Output Short-Circuit Current	Source		70	95		mA
			-40°C to 85°C	55			mA
			-40°C to 125°C	50			mA
		Sink		130	150		mA
			-40°C to 85°C	100			mA
			-40°C to 125°C	85			mA
AC Specifications							
GBW	Gain-Bandwidth Product				12		MHz
SR	Slew Rate	G = 1, 10V step		8	12		V/μs
			-40°C to 125°C	7			V/μs
t_{OR}	Overload Recovery				500		ns
t_S	Settling Time, 0.1%	G = 1, 10V step			5		μs
	Settling Time, 0.01%				7		μs
PM	Phase Margin	R_L=10K, C_L= 50pF			60		°
GM	Gain Margin	R_L=10K, C_L= 50pF			10		dB
Noise Performance							
E_N	Input Voltage Noise	f = 0.1Hz to 10Hz			0.1		$μV_{PP}$
e_N	Input Voltage Noise Density	f = 0.1kHz			6		nV/√Hz
		f = 1kHz			6		nV/√Hz
		f = 10kHz			7		nV/√Hz
i_N	Input Current Noise	f = 10kHz			200		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1kHz, G =1, R_L = 10kΩ, V_{OUT} = $6V_{RMS}$			0.0002		%

Typical Performance Characteristics

V_S = ±15V, V_{CM} = 0V, R_L = 10kΩ, unless otherwise specified.

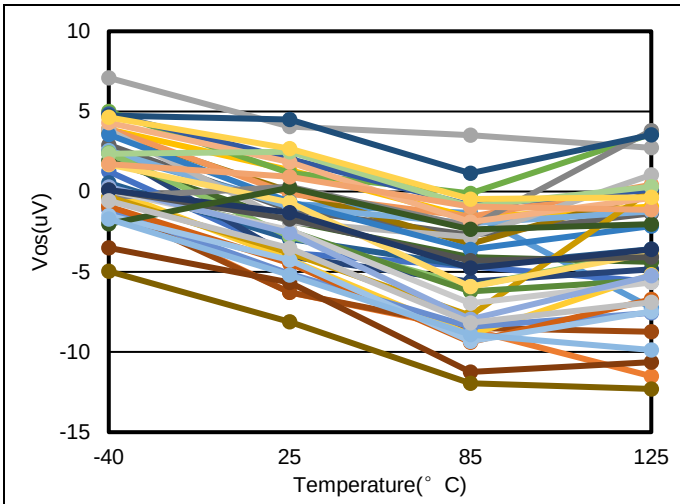


Figure 1. V_{OS} at 30V V_S, 15V V_{CM} vs. Temperature, 40pcs

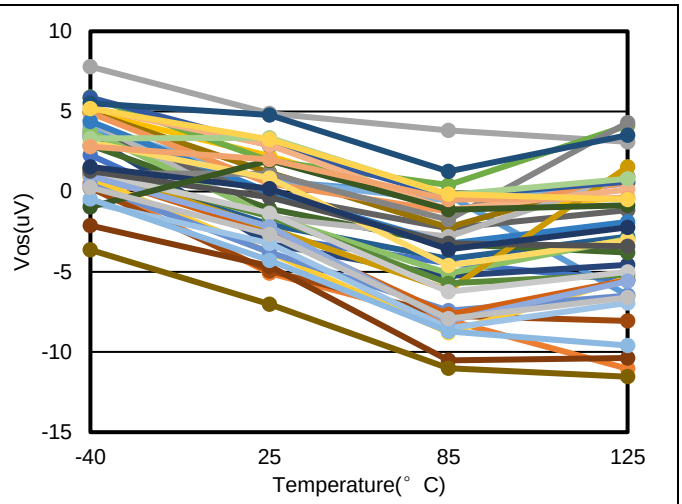


Figure 2. V_{OS} at 5V V_S, 2.5V V_{CM} vs. Temperature, 40pcs

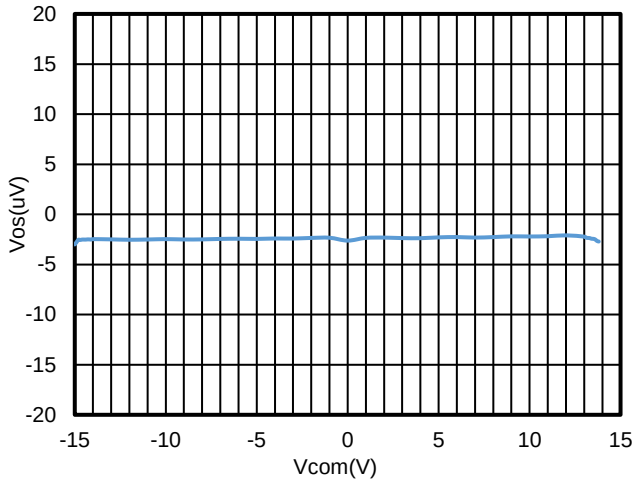


Figure 3. Offset Voltage vs. Common Mode Voltage

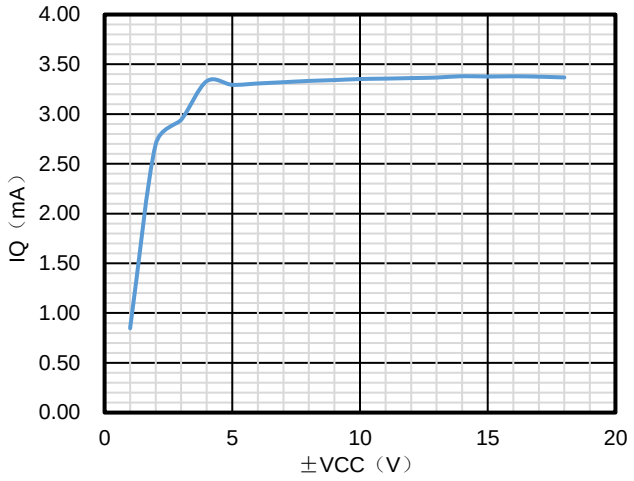


Figure 4. Iq vs. Supply Voltage

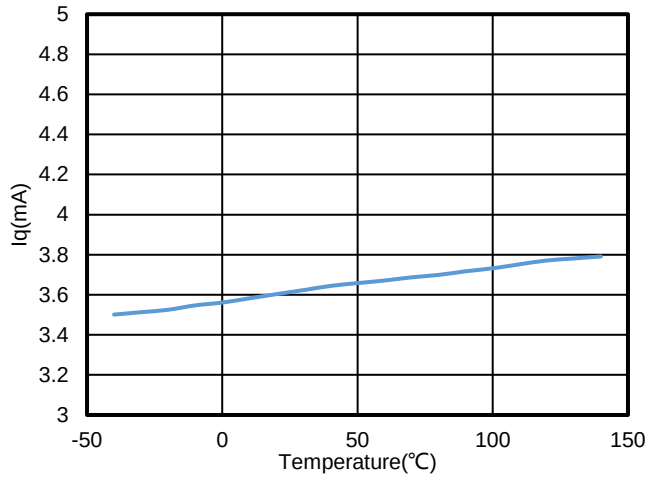


Figure 5. Iq vs. Temperature, +-2.5V Supply, TPA1882

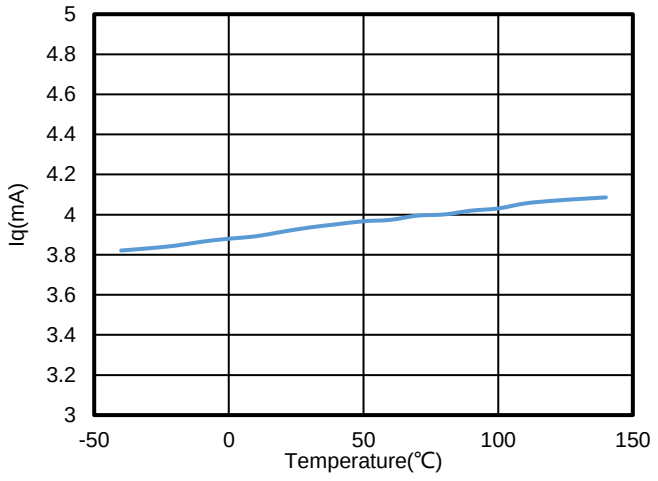


Figure 6. Iq vs. Temperature, +-15V Supply, TPA1882

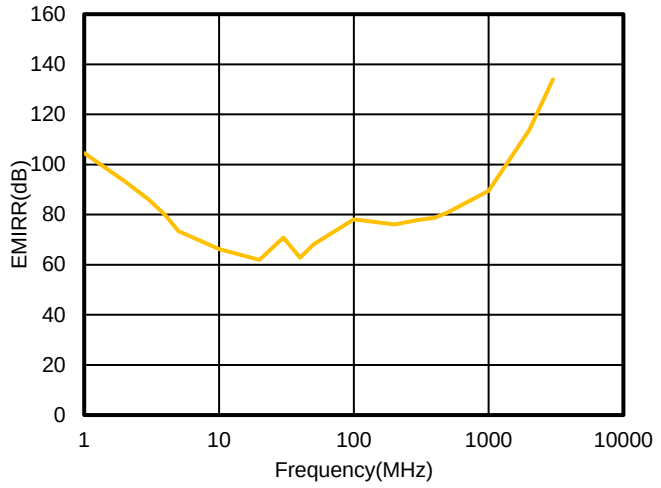


Figure 7. EMIRR vs. Frequency

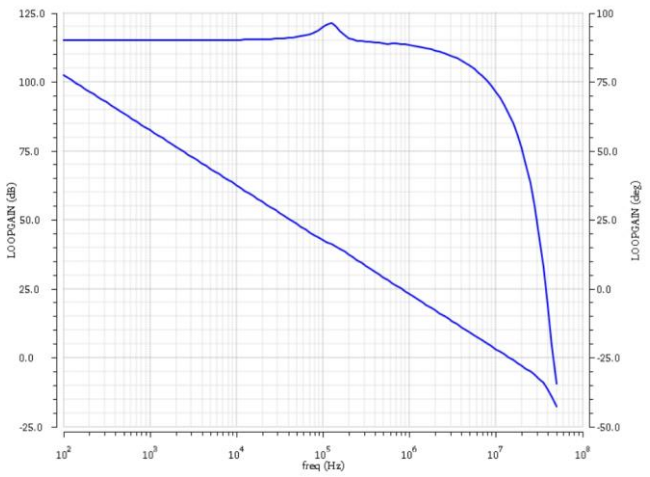


Figure 8. Open Loop Gain and Phase vs. Frequency

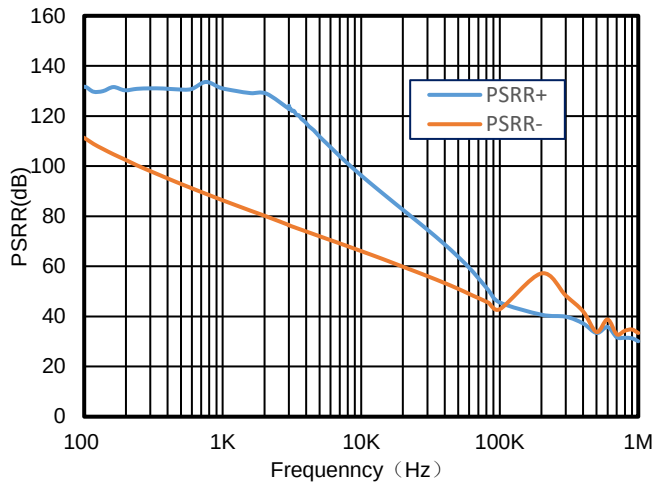


Figure 9. PSRR vs. Frequency

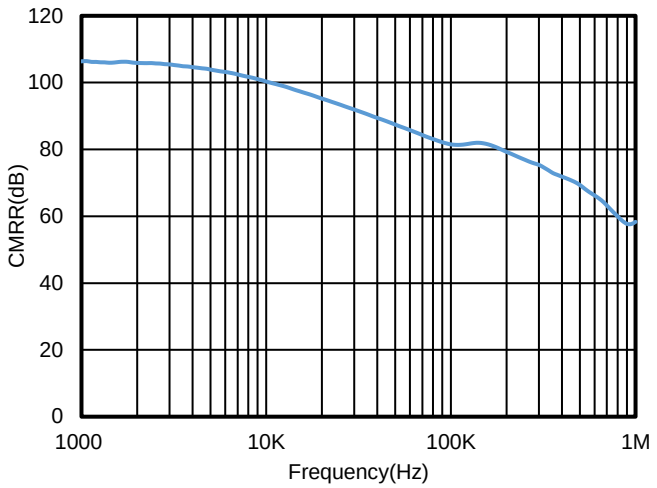
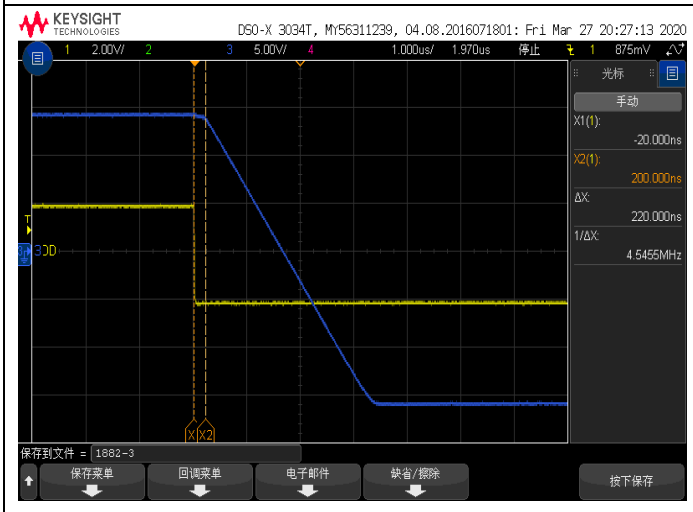


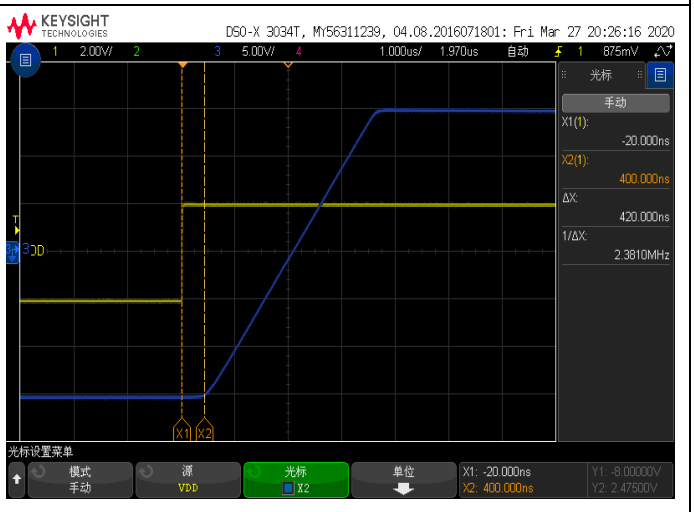
Figure 10. CMRR vs. Frequency



Time: 2us/div, Measure Time: 220ns

R_L=2K, C_L=100pF, G=10

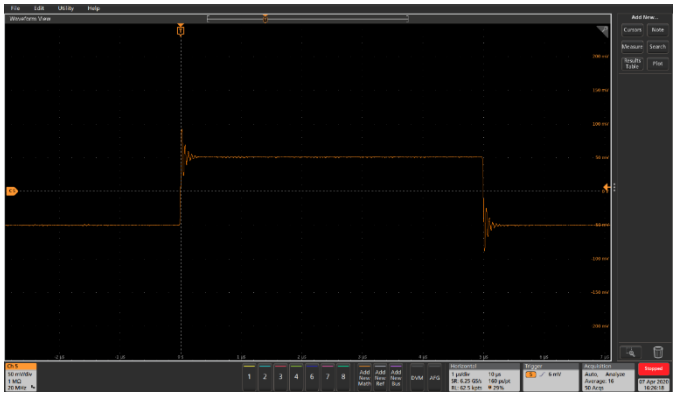
Figure 11. Positive Overload Recovery



Time: 2us/div, Measure Time: 420ns

R_L=2K, C_L=100pF, G=10

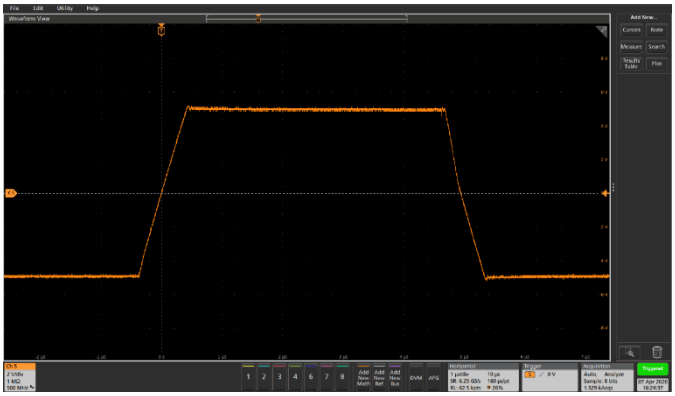
Figure 12. Negative Overload Recovery



Voltage: 50mV/div, Time: 2us/div

R_L=2K, C_L=100pF, G=1

Figure 13. 100mV Signal Step Response



Voltage: 2V/div, Time: 2μs/div

R_L=2K, C_L=100pF, G=1

Figure 14. 10V Signal Step Response

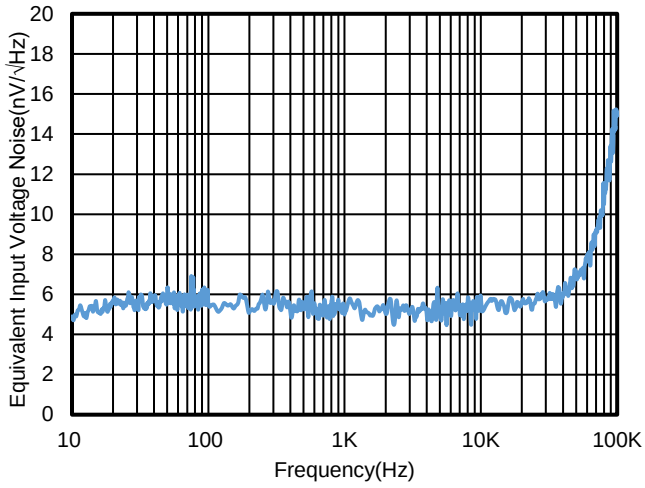


Figure 15. Voltage Noise Spectral Density vs. Frequency

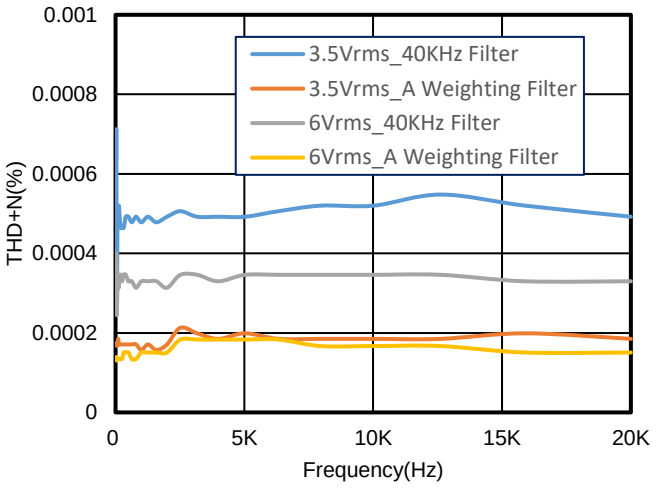


Figure 16. THD+N vs. Frequency

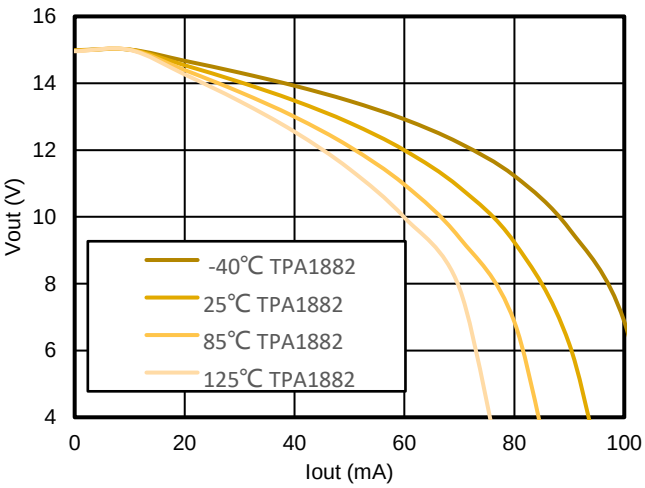


Figure 17. V_{OUT} vs. I_{OUT}, Source

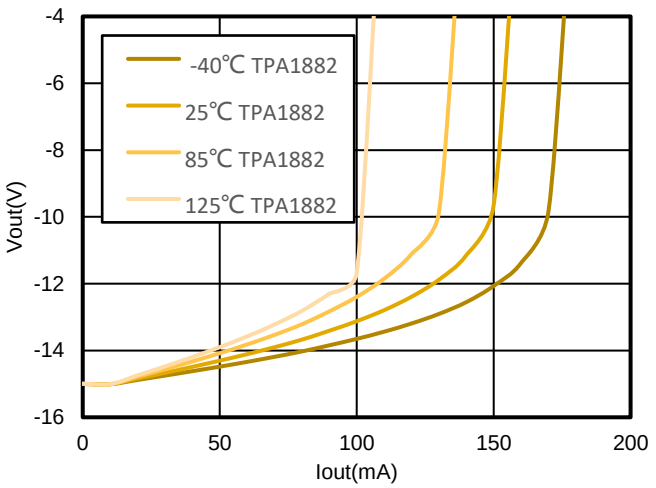
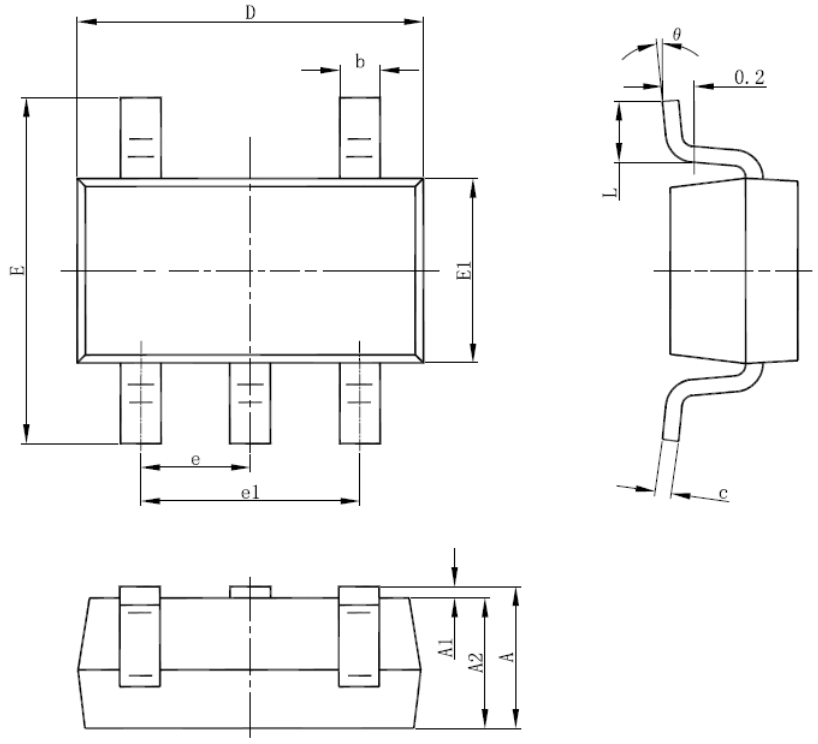


Figure 18. V_{OUT} vs. I_{OUT}, Sink

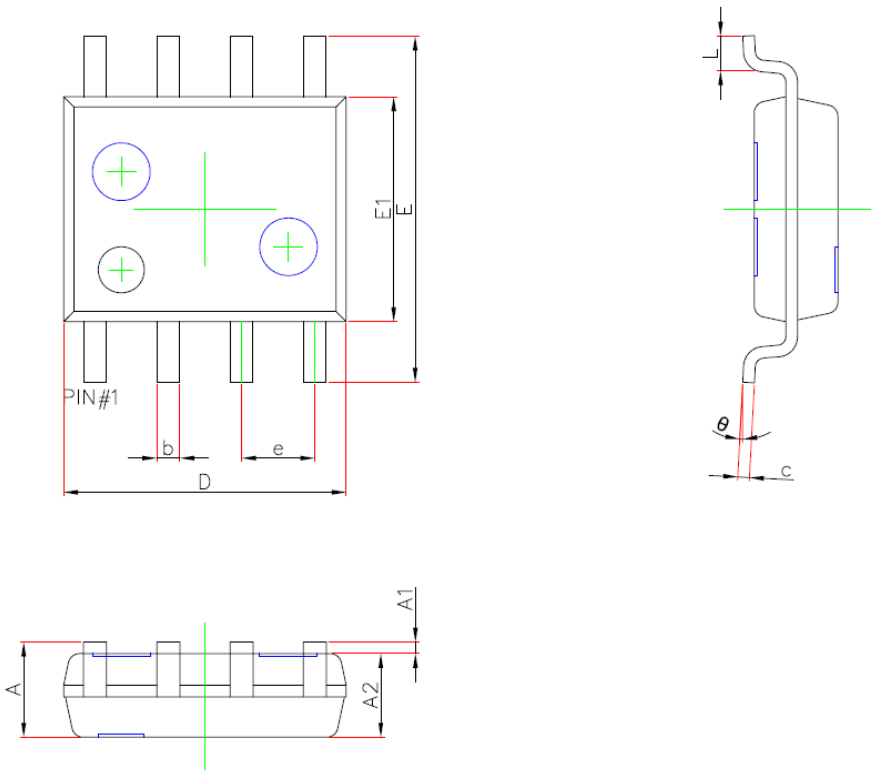
Package Outline Dimensions

SOT23-5



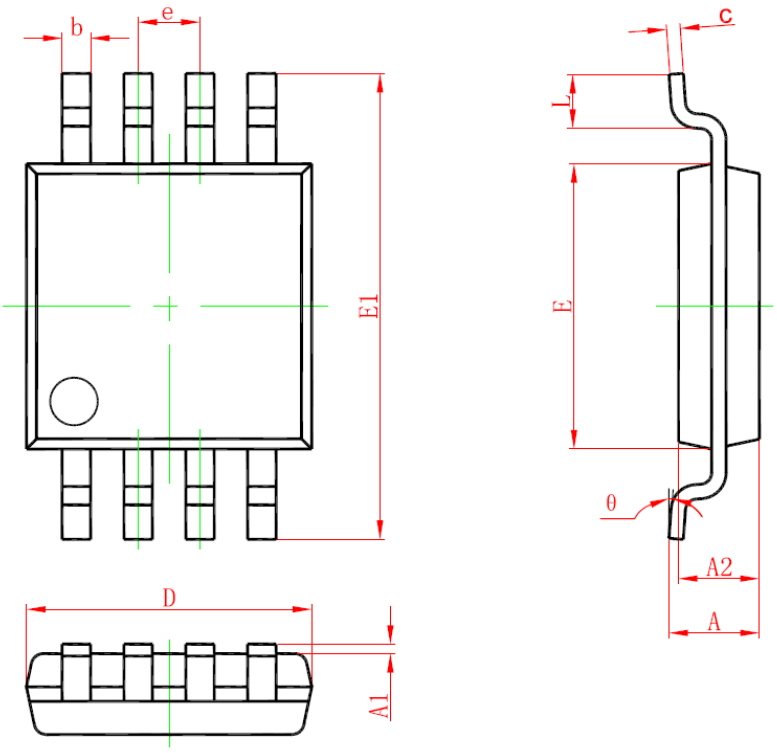
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)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

SOIC-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	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	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	0.800	0.016	0.031
θ	0°	8°	0°	8°

MSOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	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	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°