±250-mV or ±50-mV Input Isolated Amplifier

Features

- CMTI: 100 kV/μs
- Input Voltage Range: ±250 mV or ±50 mV
- Fixed Gain: 8.0, 8.2 or 41
- Very low Gain Error: 0.03% Maximum at 25°C
- System-level Diagnostic Features
- Wide Temperature Range: −40°C to +125°C
- Finished Safety-Related Certifications:
  - CQC Certification per GB 4943.1
  - CB Certifications
- Ongoing Safety-Related Certifications:
  - VDE Certification according to DIN VDE V 0884-17(IEC60747-17)
  - 5000-V_{RMS} Isolation Rating per UL 1577
  - CSA, TUV Certifications

Applications

- Industrial Automation
- Motor Control
- Power Supplies

Description

The devices are precision, isolated amplifiers with an output separated from the input circuitry by capacitive silicon dioxide insulation barrier.

The common-mode transient immunity (CMTI) of the devices has been significantly enhanced through innovative circuit design and optimized structure.

The input of the devices is designed to connect to shunt resistors or other low-voltage level signal sources. The excellent performance of the device supports accurate current control in motor control applications. The common-mode overvoltage and missing high-side supply voltage detection features system-level diagnostics.

The devices are available in WSOP8 and SMP8 packages, and are characterized from −40°C to +125°C.

Quick Selection Guide:

Product	Gain	Input Range	V_{OS}(Max)	Package
TPA8000	8	±250 mV	500 μV	SMP8
TPA8000	8	±250 mV	200 μV	WSOP8
TPA8001	8.2	±250 mV	200 μV	WSOP8
TPA8002	41	±50 mV	100 μV	WSOP8

Typical Application Circuit

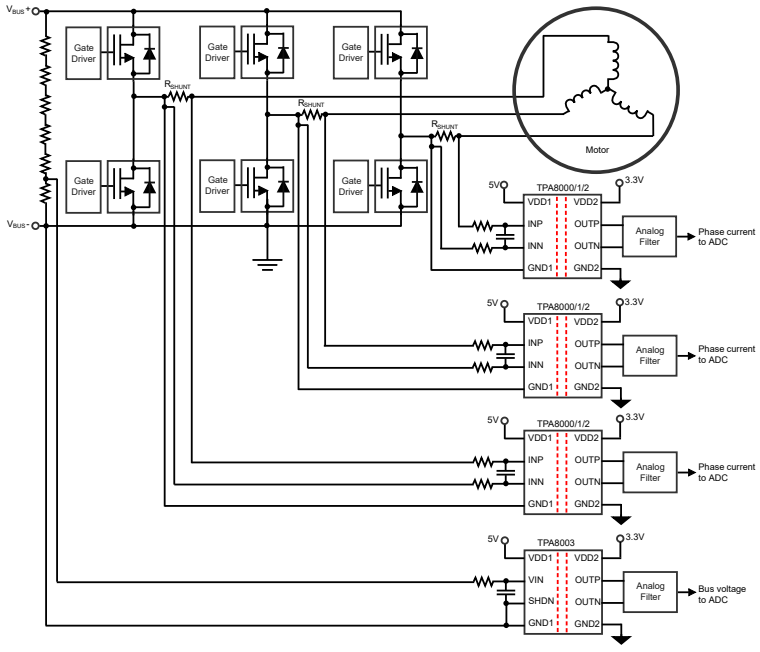


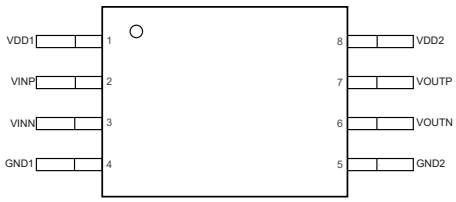
Table of Contents

Revision History

Date	Revision	Notes
2023-09-20	Rev.A.0	Initial Version.

Pin Configuration and Functions

TPA8000, TPA8001, TPA8002
WSOP8 Package
Top View



TPA8000
SMP8 Package
Top View

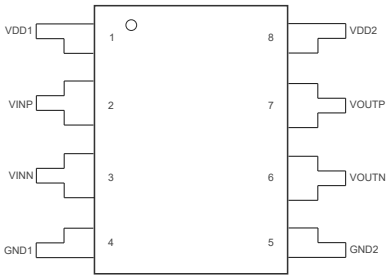


Table 1. Pin Functions

Pin		I/O	Description
No.	Name		
1	VDD1		High-side power supply
2	VINP	Input	Positive analog input
3	VINN	Input	Negative analog input
4	GND1		High-side analog ground
5	GND2		Low-side analog ground
6	VOUTN	Output	Negative analog output
7	VOUTP	Output	Positive analog output
8	VDD2		Low-side power supply

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
VDD	Supply Voltage, VDD1 to GND1 or VDD2 to GND2	−0.3	7	V
V_{INPUT}	Analog Input Voltage at VINP, VINN	GND1 – 6	VDD1 + 0.5	V
	Analog Output Voltage at VOUTP, VOUTN	GND1 – 0.5	VDD2 + 0.5	V
I_{IN}	Input Current to Any Pin except Supply Pins	−10	10	mA
T_J	Operating Virtual Junction Temperature		150	°C
T_{stg}	Storage Temperature	−65	150	°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.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Value	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)	1.5	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.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
VDD1	High-side Supply Voltage (VDD1 to GND1)	3.0	5.0	5.5	V
VDD2	Low-side Supply Voltage (VDD2 to GND2)	3.0	3.3	5.5	V
T_A	Operating Ambient Temperature	−40	25	125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
WSOP8	85	43	°C/W
SMP8	74	65	°C/W

Insulation Specifications

The value of UL and VDE is provided by lab test, the UL and VDE certifications is ongoing.

Parameter		Conditions	Value		Unit
			WSOP8	SMP8	
CLR	External clearance	Shortest terminal-to-terminal distance through air	8.0	6.0	mm
CPG	External creepage	Shortest terminal-to-terminal distance across the package surface	8.0	6.0	mm
DTI	Distance through the insulation	Minimum internal gap (internal clearance)	22	22	μm
DTC	Distance through the Molding compound	Minimum internal distance across the conductors inside the package	0.8	0.6	mm
CTI	Comparative tracking index	DIN EN 60112 (VDE 0303-11); IEC 60112; UL 746A	> 600	> 600	V
	Material group	According to IEC 60664-1	I	I	
	Over-voltage category	For Rated Mains Voltage ≤ 150 V_{RMS}	I-IV	I-IV	
		For Rated Mains Voltage ≤ 300 V_{RMS}	I-IV	I-III	
		For Rated Mains Voltage ≤ 600 V_{RMS}	I-IV	I-II	
		For Rated Mains Voltage ≤ 1000 V_{RMS}	I-III	I	
	Climatic category		40/125/21	40/125/21	
	Pollution degree		2	2	
DIN V VDE V 0884-17 (1)(2)					
V_{IORM}	Maximum repetitive isolation voltage	AC voltage	1700	1414	V_{PK}
V_{IOWM}	Maximum working isolation voltage	AC voltage; TDDB Test	1200	1000	V_{RMS}
		DC voltage	1700	1414	V_{DC}
V_{IOTM}	Maximum transient isolation voltage	V_{TEST} = V_{IOTM}, t = 60 s (qualification); V_{TEST} = 1.2 x V_{IOTM}, t = 1 s (100% production)	7000	6080	V_{PK}
V_{IOSM}	Maximum surge isolation voltage(3)	Test method per IEC 62368-1, 1.2/50 μs waveform, V_{TEST} = 1.3 × V_{IOSM} (qualification)	6500	6500	V_{PK}
q_{pd}	Apparent charge	Method a, After Input/Output safety test subgroup 2/3, V_{ini} = V_{IOTM}, t_{ini} = 60 s; $V_{pd(m)}$ = 1.2 × V_{IORM}, t_m = 10 s	≤ 5	≤ 5	pC
		Method a, After environmental tests subgroup 1, V_{ini} = V_{IOTM}, t_{ini} = 60 s; $V_{pd(m)}$ = 1.6 × V_{IORM}, t_m = 10 s	≤ 5	≤ 5	
		Method b1; At routine test (100% production) and preconditioning (type	≤ 5	≤ 5	

Parameter		Conditions	Value		Unit
			WSOP8	SMP8	
		test), V_{ini} = 1.2 x V_{IOTM}, t_{ini} = 1 s; $V_{pd(m)}$ = 1.875 × V_{IORM}, t_m = 1 s			
C_{IO}	Isolation capacitance	V_{IO} = 0.4 × sin (2πft), f = 1 MHz	~0.5	~0.5	pF
R_{IO}	Isolation resistance	V_{IO} = 500 V, T A= 25°C	> 10^{12}	> 10^{12}	Ω
		V_{IO} = 500 V, 100°C ≤ T A≤ 125°C	> 10^{11}	> 10^{11}	Ω
		V_{IO} = 500 V at T S= 150°C	> 10^{9}	> 10^{9}	Ω
UL 1577					
V_{ISO}	Withstanding isolation voltage	V_{TEST}= V_{ISO} , t = 60 s(qualification); V_{TEST}= 1.2 × V_{ISO}, t = 1 s (100% production)	5000	3750	V_{RMS}

(1) All pins on each side of the barrier are tied together creating a two-terminal device.
(2) This coupler is suitable for safe electrical insulation only within the safety operating ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.
(3) Testing must be carried out in oil.

Safety-Related Certifications

VDE	UL	TUV	CQC	CSA	CB
Certified according to DIN VDE V 0884-17	Certified according to UL 1577 and CSA Component Acceptance Notice 5A	Certified according to EN IEC 62368-1 and EN IEC 61010-1	Certified according to GB 4943.1	Certified CSA C22.2 No. 62368-1 and CAN/CSA-C22.2 No. 60601-1	Certified according to EN IEC 62368-1
			Reinforced insulation (WSOP)		Reinforced insulation (WSOP)
Certificate No.	Report Reference	Registration No.	Certificate No. CQC23001393276	Master contract:	Ref. Certif. No. CN59992

Safety Limiting Values

Parameter	Conditions (1)	Min	Typ	Max	Unit
Safety input, output or supply current	$R_{\theta JA}$ = 85°C/W, VDD1 = VDD2 = 5.5 V, T_J = 150°C, T_A = 25°C, WSOP8 Package			267	mA
	$R_{\theta JA}$ = 74°C/W, VDD1 = VDD2 = 5.5 V, T_J = 150°C, T_A = 25°C, SMP8 Package			307	mA
	$R_{\theta JA}$ = 85°C/W, VDD1 = VDD2 = 3.6 V, T_J = 150°C, T_A = 25°C, WSOP8 Package			408	mA
	$R_{\theta JA}$ = 74°C/W, VDD1 = VDD2 = 3.6 V, T_J = 150°C, T_A = 25°C, SMP8 Package			469	mA
Safety total power	$R_{\theta JA}$ = 85°C/W, T_J = 150°C, T_A = 25°C, WSOP8 Package			1470	mW
	$R_{\theta JA}$ = 74°C/W, T_J = 150°C, T_A = 25°C, SMP8 Package			1689	mW
Maximum safety temperature				150	°C

(1) The assumed junction-to-air thermal resistance in the Thermal Information is that of a device installed on a high-K test board for leaded surface-mount packages.

Electrical Characteristics - TPA8000, TPA8001

Minimum and maximum specifications apply from T_A= –40°C to +125°C, VDD1 = 3.0 V to 5.5 V, VDD2 = 3.0 V to 5.5 V, VINP = –250 mV to +250 mV, and VINN = 0 V; typical specifications are at T_A= 25°C, VDD1 = 5 V, and VDD2 = 3.3 V, unless otherwise noted.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Analog Input							
$V_{Clipping}$	Differential input voltage before clipping output	VINP – VINN			±320		mV
V_{FSR}	Specified linear differential full-scale	VINP – VINN		–250		250	mV
V_{CM}	Specified common-mode input voltage	(VINP + VINN) / 2 to GND1		–0.16		VDD1 – 2.5	V
	Absolute common-mode input voltage (1)	(VINN + VINP) / 2 to GND1		–2		VDD1	V
V_{CMov}	Common-mode overvoltage detection level			VDD1 – 2.4			V
V_{OS}	Input offset voltage	VDD1 = 5 V, VDD2 = 3.3V, VINP = VINN = GND1, T_A= 25°C	WSOP8 Package	–200	±50	200	µV
			SMP8 Package	–500	±100	500	µV
TCV_{OS}	Input offset drift (1)	VDD1 = 5 V, VDD2 = 3.3V, VINP = VINN = GND1, T_A= 25°C		–3	±1	3	µV/°C
CMRR	Common-mode rejection ratio	fIN = 0 Hz, VCM min ≤ VCM ≤ VCM max			–110		dB
		f_{IN}= 10 kHz, V_{CM}min ≤ V_{CM}≤ V_{CM}max			–100		
C_{IND}	Differential input capacitance				1		pF
R_{IN}	Single-ended input resistance	VINN = GND1			19		kΩ
R_{IND}	Differential input resistance				19		kΩ
I_{IB}	Input bias current	VINP = VINN = GND1, I_{IB}= (I_{IBP} + I_{IBN}) / 2		–21	–17		µA
TCI_{IB}	Input bias current drift				2		nA/°C
BW_{IN}	Input bandwidth				1.2		MHz
Analog Output							
	Nominal gain	TPA8001			8.2		
		TPA8000			8		
E_G	Gain error	VDD1 = 5 V, VDD2 = 3.3V, T_A= 25°C		–0.3	±0.05	0.3	%
TCE_G	Gain error drift (1)			–50	±15	50	ppm/°C
	Nonlinearity (1)			–0.02	±0.01	0.02	%
	Nonlinearity drift				1		ppm/°C
THD	Total harmonic distortion	f_{IN}= 10 kHz			–82		dB

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
	Output voltage noise	VINP = VINN = GND1, f_{IN}= 0 Hz, BW = 100 kHz		280		μ VRMS
SNR	Signal-to-noise ratio	f_{IN}= 1 kHz, BW = 10 kHz		80		dB
		f_{IN}= 10 kHz, BW = 100 kHz		62		dB
PSRR	Power-supply rejection ratio	vs VDD1, at dc		–90		dB
		vs VDD1, 100-mV and 10-kHz ripple		–80		dB
		vs VDD2, at dc		–95		dB
		vs VDD2, 100-mV and 10-kHz ripple		–85		dB
CMTI	Common-mode transient immunity	|GND1 – GND2| = 1 kV		100		kV/μs
V_{CMout}	Common-mode output voltage		1.35	1.42	1.49	V
	Output short-circuit current			±15		mA
R_{OUT}	Output resistance	on VOUTP or VOUTN		< 0.2		Ω
BW	Output bandwidth			300		kHz
$V_{CLIPout}$	Clipping differential output voltage	VOUT = (VOUTP – VOUTN); |VIN| = |VINP – VINN| > |VClipping|		±2.5		V
$V_{FAILSAFE}$	Failsafe differential output voltage	V_{CM}≥ V_{CMov}, or VDD1 missing		–2.56	–2.54	V
Power Supply						
$VDD1_{UV}$	undervoltage detection threshold voltage of VDD1	VDD1 falling		2.1	2.4	V
IDD1	High-side supply current	VDD1 = 5.5 V		15	18	mA
		VDD1 = 3.0 V		11	13	mA
IDD2	Low-side supply current	VDD1 = 5.5 V		9	11	mA
		VDD1 = 3.0 V		8	10	mA
Switching Characteristics						
t_r	Rise time (20% – 80%)			1		μs
t_f	Fall time (80% – 20%)			1		μs
	V_{IN} to V_{OUT} signal delay (50% – 10%)			0.8		μs
	V_{IN} to V_{OUT} signal delay (50% – 50%)			1.5		μs
	V_{IN} to V_{OUT} signal delay (50% – 90%)			2.1		μs

(1) Provided by bench test and design simulation.

Electrical Characteristics - TPA8002

Minimum and maximum specifications apply from T_A= –40°C to +125°C, VDD1 = 3.0 V to 5.5 V, VDD2 = 3.0 V to 5.5 V, VINP = –50 mV to +50 mV, and VINN = 0 V; typical specifications are at T_A= 25°C, VDD1 = 5 V, and VDD2 = 3.3 V, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Analog Input						
$V_{Clipping}$	Differential input voltage before clipping output	VINP – VINN		±64		mV
V_{FSR}	Specified linear differential full-scale	VINP – VINN	–50		50	mV
V_{CM}	Specified common-mode input voltage	(VINP + VINN) / 2 to GND1	–0.032		VDD1 – 2.5	V
	Absolute common-mode input voltage (1)	(VINN + VINP) / 2 to GND1	–2		VDD1	V
V_{CMov}	Common-mode overvoltage detection level		VDD1 – 2.4			V
V_{OS}	Input offset voltage	VDD1 = 5 V, VDD2 = 3.3V, VINP = VINN = GND1, T_A= 25°C	–100	±50	100	μV
TCV_{OS}	Input offset drift (1)	VDD1 = 5 V, VDD2 = 3.3V, VINP = VINN = GND1, T_A= 25°C	–0.8	±0.2	0.8	μV/°C
CMRR	Common-mode rejection ratio	fIN = 0 Hz, VCM min ≤ VCM ≤ VCM max		–110		dB
		f_{IN}= 10 kHz, V_{CM}min ≤ V_{CM}≤ V_{CM}max		–100		
C_{IND}	Differential input capacitance			1		pF
R_{IN}	Single-ended input resistance	VINN = GND1		4.75		kΩ
R_{IND}	Differential input resistance			4.9		kΩ
I_{IB}	Input bias current	VINP = VINN = GND1, I_{IB}= (I_{IBP} + I_{IBN}) / 2	–30	–20		μA
TCI_{IB}	Input bias current drift			2		nA/°C
BW_{IN}	Input bandwidth			1.2		MHz
Analog Output						
	Nominal gain	TPA8002		41		
E_G	Gain error	VDD1 = 5 V, at T_A= 25°C	–0.3	±0.05	0.3	%
TCE_G	Gain error drift (1)		–60	±15	60	ppm/°C
	Nonlinearity (1)		–0.02	±0.01	0.02	%
	Nonlinearity drift			1		ppm/°C
THD	Total harmonic distortion	f_{IN}= 10 kHz				dB
	Output voltage noise	VINP = VINN = GND1, f_{IN}= 0 Hz, BW = 100 kHz		300		μVRMS

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
SNR	Signal-to-noise ratio	f_{IN}= 1 kHz, BW = 10 kHz				dB
		f_{IN}= 10 kHz, BW = 100 kHz				dB
PSRR	Power-supply rejection ratio	vs VDD1, at dc		–98		dB
		vs VDD1, 100-mV and 10-kHz ripple				dB
		vs VDD2, at dc		–110		dB
		vs VDD2, 100-mV and 10-kHz ripple				dB
CMTI	Common-mode transient immunity	|GND1 – GND2| = 1 kV		100		kV/μs
V_{CMout}	Common-mode output voltage		1.35	1.42	1.49	V
	Output short-circuit current			±15		mA
R_{OUT}	Output resistance	on VOUTP or VOUTN		< 0.2		Ω
BW	Output bandwidth			300		kHz
$V_{CLIPout}$	Clipping differential output voltage	VOUT = (VOUTP – VOUTN); |VIN| = |VINP – VINN| > | VClipping|		±2.5		V
$V_{FAILSAFE}$	Failsafe differential output voltage	V_{CM}≥ V_{CMov}, or VDD1 missing		–2.56	–2.54	V
Power Supply						
$VDD1_{UV}$	undervoltage detection threshold voltage of VDD1	VDD1 falling		2.1	2.4	V
IDD1	High-side supply current	VDD1 = 5.5 V		14	18	mA
		VDD1 = 3 V		9	13	mA
IDD2	Low-side supply current	VDD2 = 5.5 V		9	11	mA
		VDD2 = 3 V		8	10	mA
Switching Characteristics						
t_r	Rise time (20% – 80%)			1		μs
t_f	Fall time (80% – 20%)			1		μs
	V_{IN} to V_{OUT} signal delay (50% – 10%)			0.8		μs
	V_{IN} to V_{OUT} signal delay (50% – 50%)			1.5		μs
	V_{IN} to V_{OUT} signal delay (50% – 90%)			2.1		μs

(1) Provided by bench test and design simulation.

Typical Performance Characteristics - TPA8000, TPA8001

All test conditions: VDD1 = 5 V, VDD2 = 3.3 V, VINP = –250 mV to 250 mV, VINN = 0 V, unless otherwise noted.

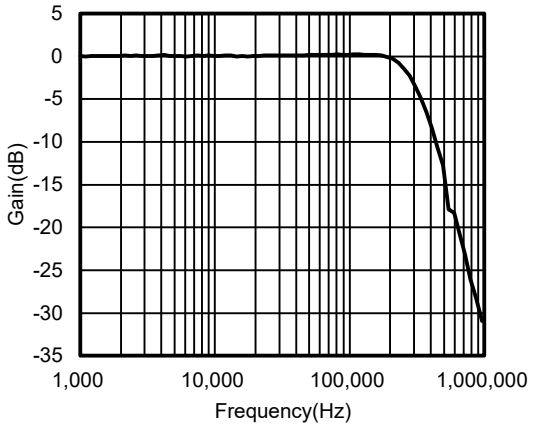


Figure 1. Normalized Gain vs Input Frequency

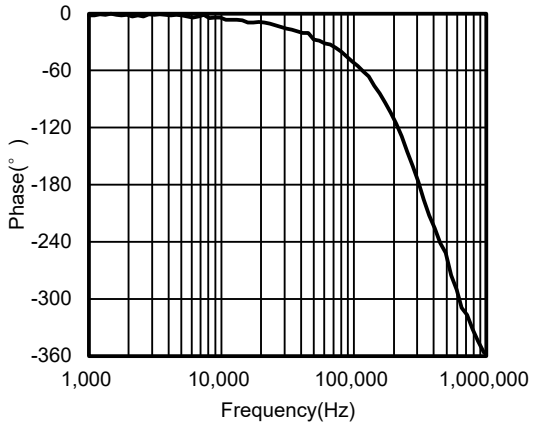


Figure 2. Phase vs Input Frequency

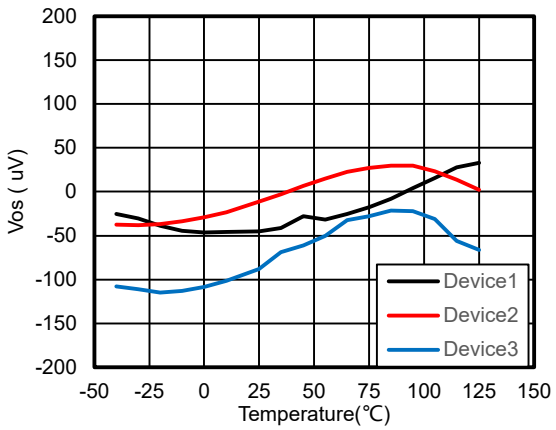


Figure 3. VOS vs Temperature

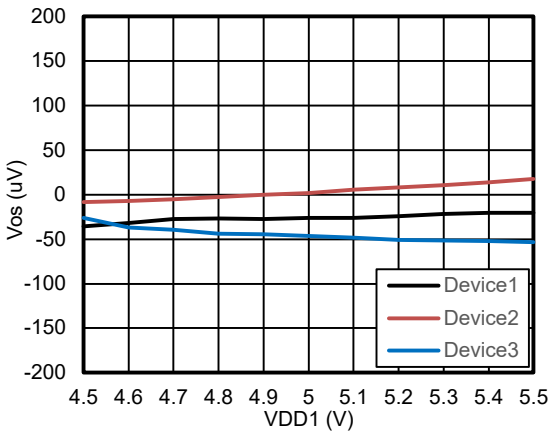


Figure 4. VOS vs VDD1

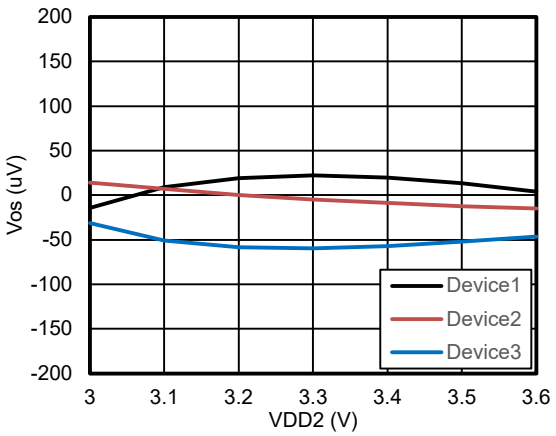


Figure 5. VOS vs VDD2

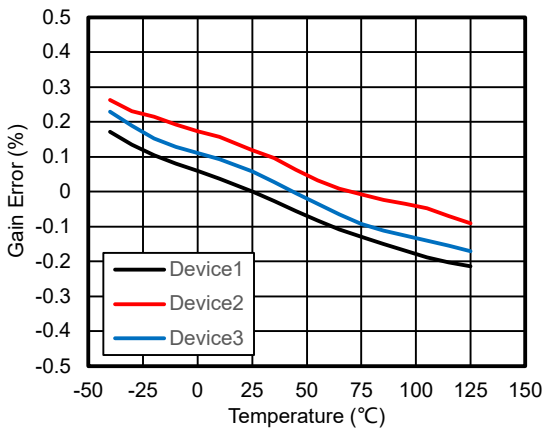


Figure 6. Gain Error vs Temperature

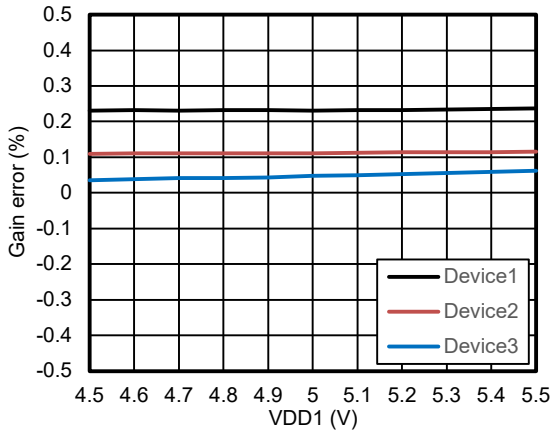


Figure 7. Gain Error vs VDD1

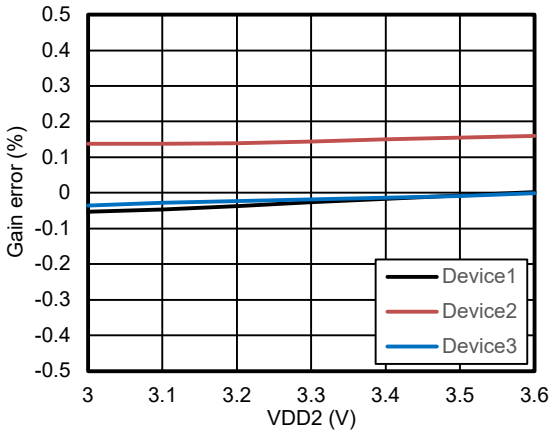


Figure 8. Gain Error vs VDD2

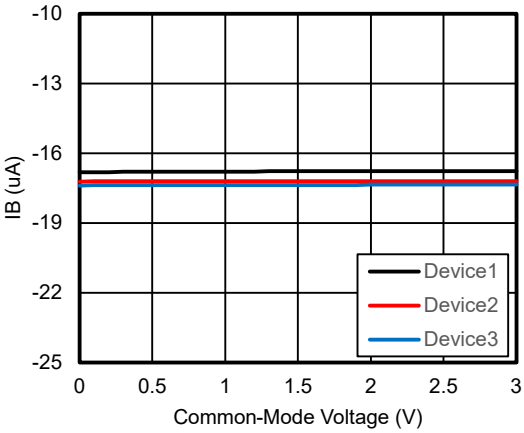


Figure 9. IB vs Common-Mode Voltage

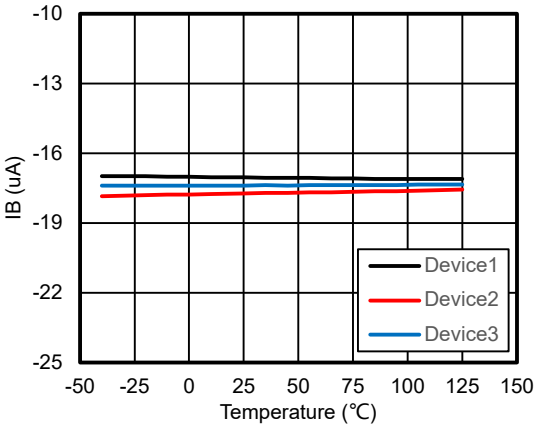


Figure 10. IB vs Temperature

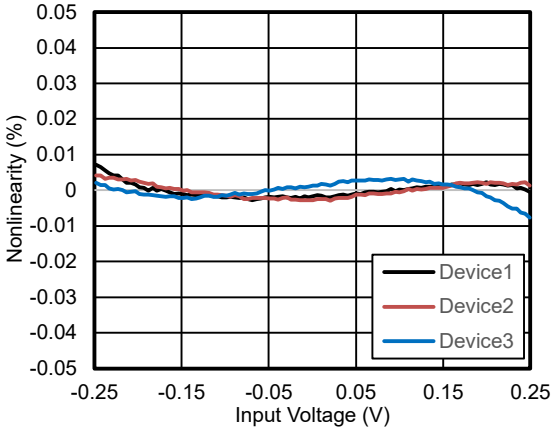


Figure 11. Nonlinearity vs Input Voltage

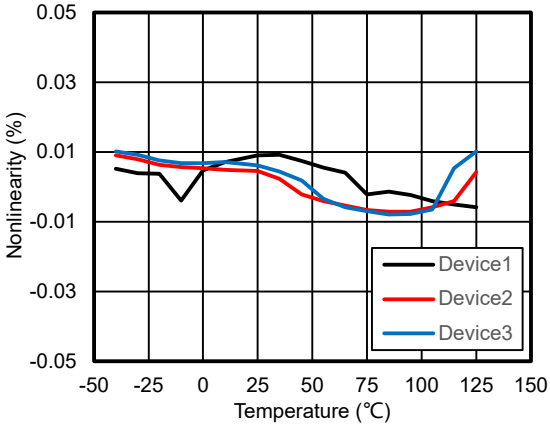


Figure 12. Nonlinearity vs Temperature

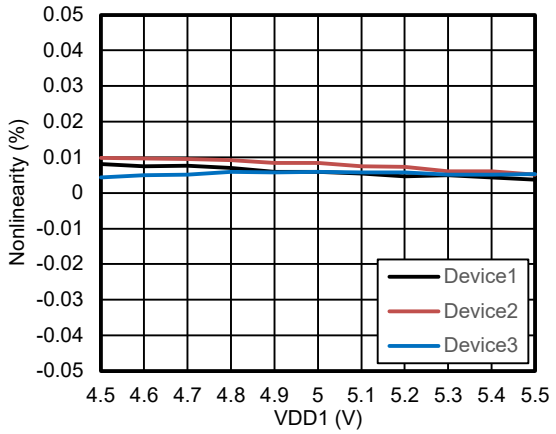


Figure 13. Nonlinearity vs VDD1

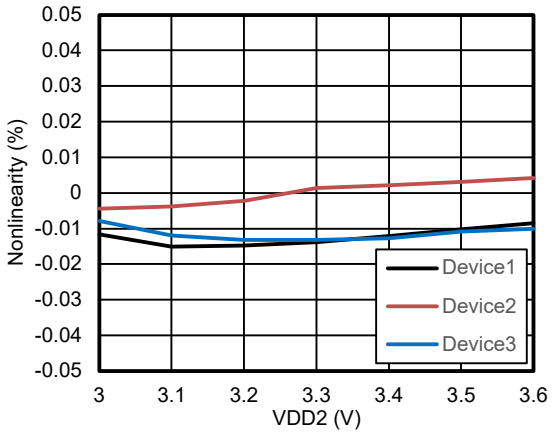


Figure 14. Nonlinearity vs VDD2

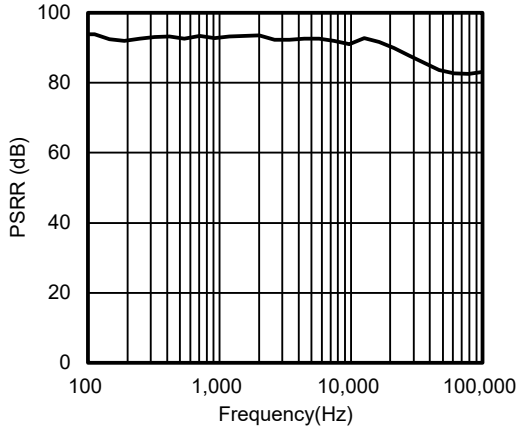


Figure 15. VDD1 PSRR vs Frequency

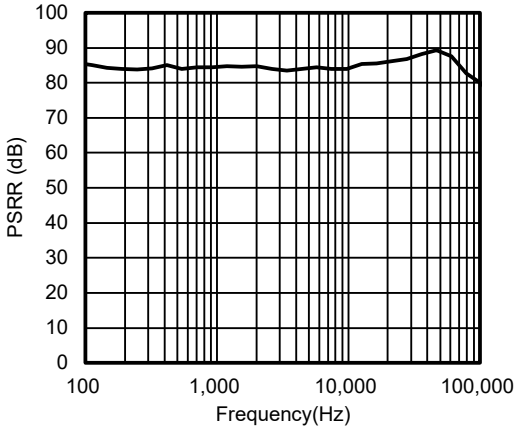


Figure 16. VDD2 PSRR vs Frequency

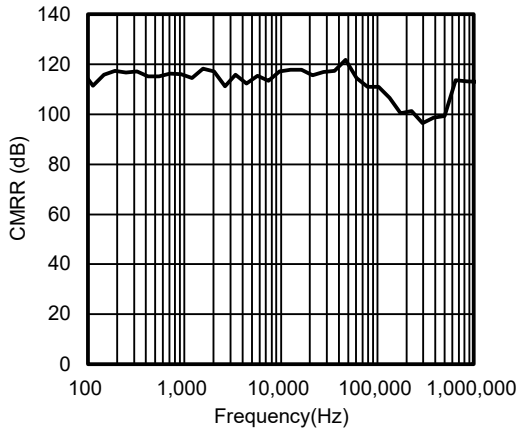


Figure 17. CMRR vs Frequency

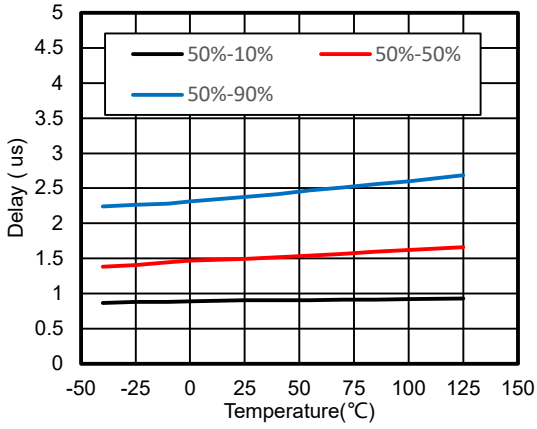


Figure 18. Delay vs Temperature

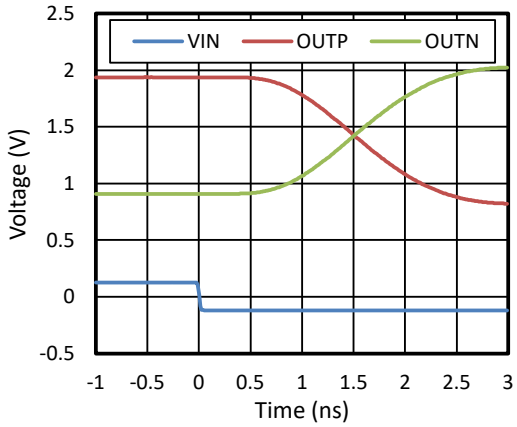


Figure 19. Delay at Negative Edge

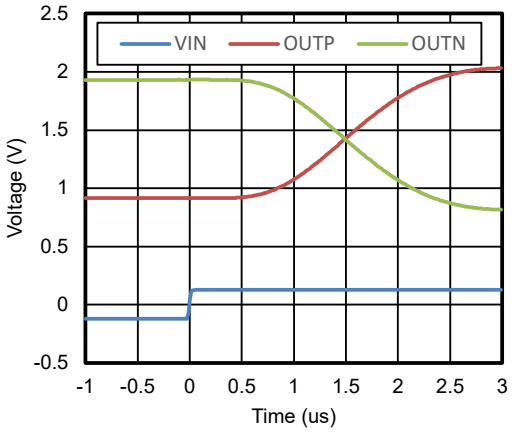


Figure 20. Delay at Postive Edge

Detailed Description

Overview

The device is a fully differential, high-precision, isolated amplifier. The input stage of the device consists of a fully differential amplifier that drives a delta-sigma (ΔΣ) modulator. The modulator utilizes an internal voltage reference source and clock generator to convert the analog input signal into a digital bit stream. A driver (referred to as TX in the functional block diagram) transmits the output of the modulator to the isolation barrier, which isolates the high-side and low-side voltage domains. The received bitstream and clock are synchronized and processed by an analog filter on the low-side and presented as a differential output of the device.

Based on SiO_2-based, double-capacitive isolation barrier, the digital modulation and isolation barrier characteristics provide the device high reliability and common-mode transient immunity.

Functional Block Diagram

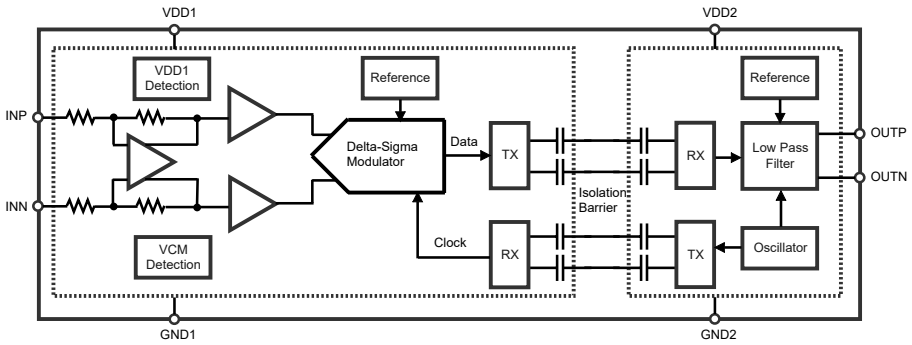


Figure 21. Functional Block Diagram

Feature Description

Fail-Safe Output

The device provides a fail-safe output that simplifies diagnostics on a system level. The fail-safe output is active in two cases:

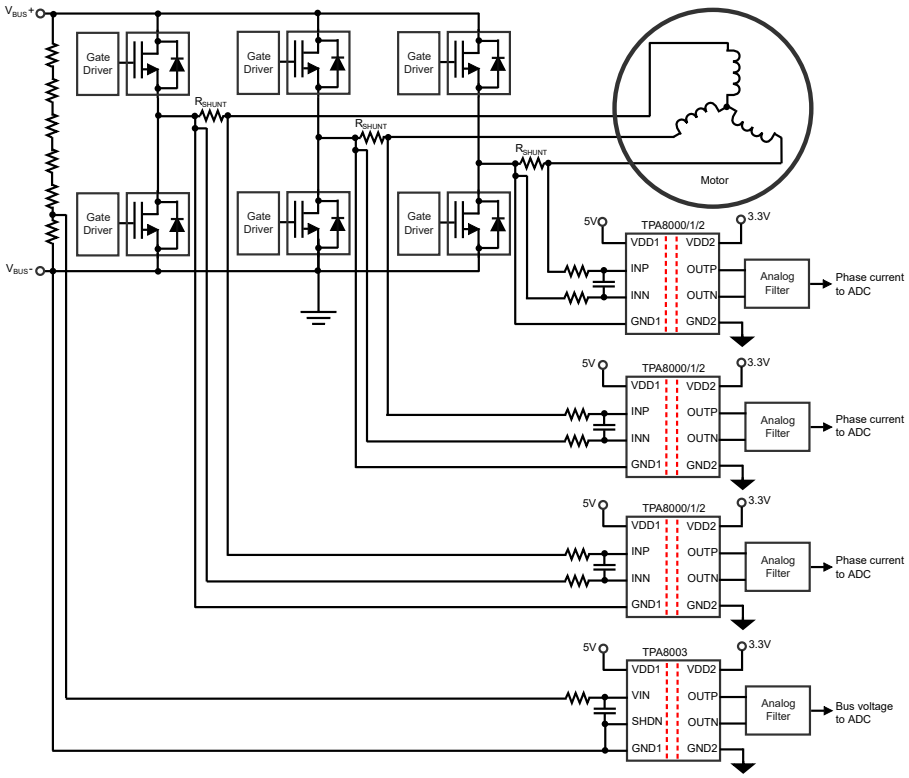
• When the VDD1 is missing, or the voltage at VDD1 is lower than $VDD1_{UV}$(the undervoltage detection threshold voltage of VDD1).

• When the common-mode input voltage, that is V_{CM} = (V_{INP} + V_{INN}) / 2, exceeds the V_{CMov}(the minimum common-mode overvoltage detection level).

A negative differential output voltage exists when the fail-safe output is active. Use the $V_{FAILSAFE}$ voltage specified in the Electrical Characteristics table as a reference value for system diagnostics.

Application and Implementation

Typical Application



Motor Drive Application

Isolated amplifiers are widely used in frequency inverters, which are critical parts of industrial motor drives, photovoltaic inverters, power supplies, and other industrial applications.

The TPA8000/1/2 are optimized for current sensing applications with shunt resistors. The figure in typical application section shows a typical operation of the TPA8000/1/2 for current sensing in a motor drive application. Phase current is measured by the shunt resistors, R_{SHUNT}. The differential input and the high common-mode transient immunity of the TPA8000/1/2 ensure reliable and accurate operation in high-noise environments.

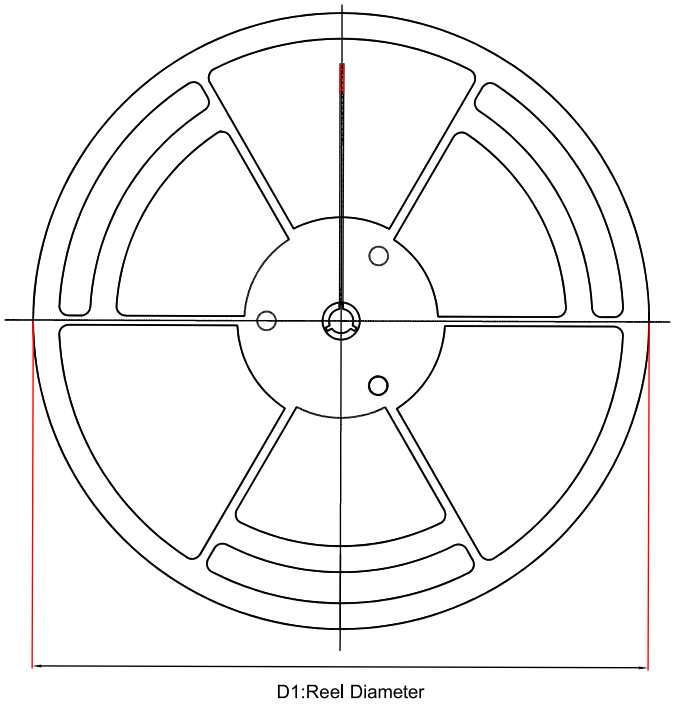
The DC bus voltage is measured by TPA8003 with high-impedance input and wide input voltage range.

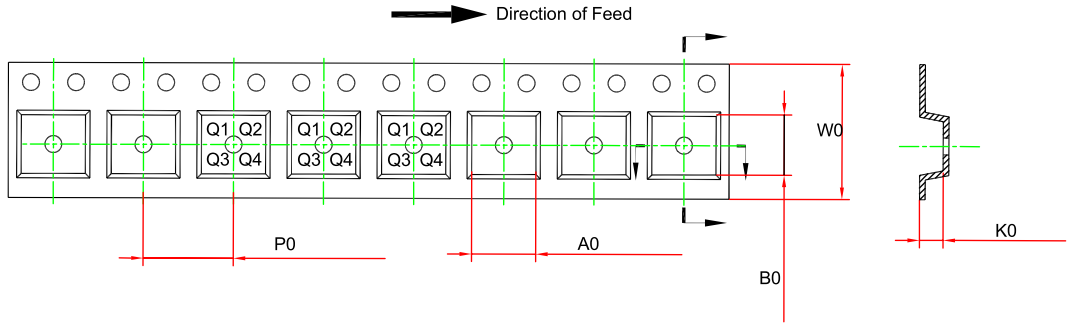
Power Supply Recommendation

In a typical frequency inverter application, the high-side power supply (VDD1) of the device is derived by the floating power supply of the upper gate driver. A Zener diode with shunt resistor can be used to provide the high-side power supply of the device, or a low-cost low-dropout regulator (LDO) may be used to reduce the noise on the power supply. Place a 0.1-µF bypass capacitors as close as possible to the VDD1 pin of the device for best performance, an additional 1-µF to 10-µF capacitor may be used for better filtering.

To decouple the low-side power supply, place a 0.1-µF capacitor placed as close to the VDD2 pin of the device as possible, an additional 1-µF to 10-µF capacitor may be used for better filtering.

Tape and Reel Information



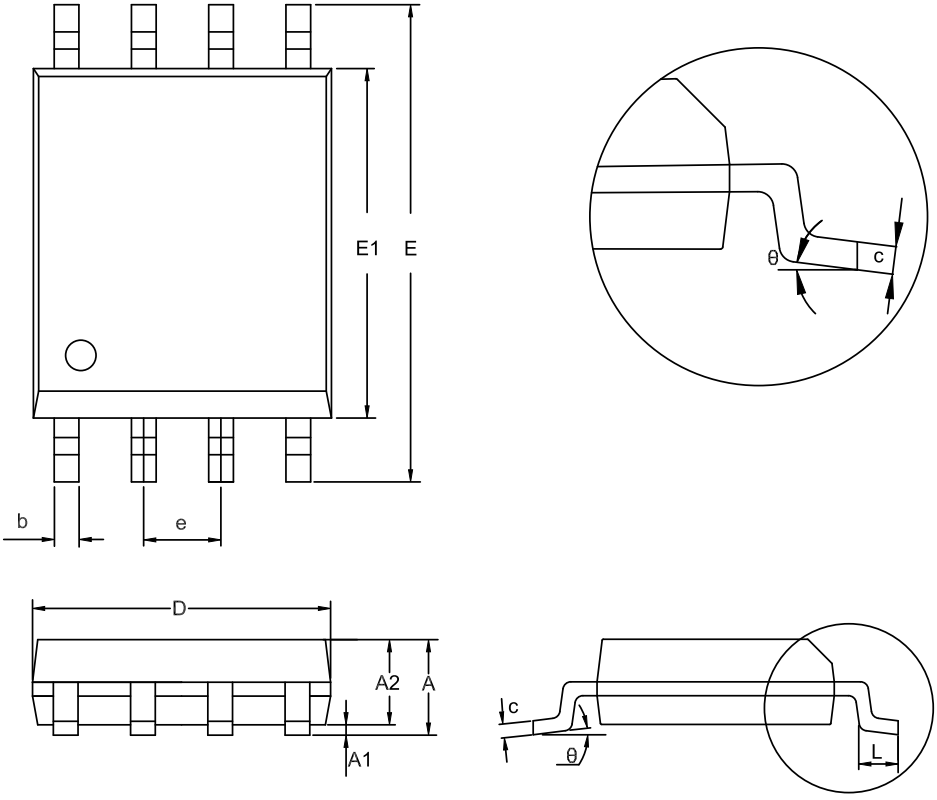


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA8000-SM1R	SMP8	330	29.0	10.90	9.6	4.3	16.0	24.0	Q1
TPA8000-SOAR	WSOP8	330	21.6	11.95	6.2	3.1	16.0	16.0	Q1
TPA8001-SOAR	WSOP8	330	21.6	11.95	6.2	3.1	16.0	16.0	Q1
TPA8002-SOAR	WSOP8	330	21.6	11.95	6.2	3.1	16.0	16.0	Q1

Package Outline Dimensions

WSOP8-B

Package Outline Dimensions SOA(WSOP-8-B)



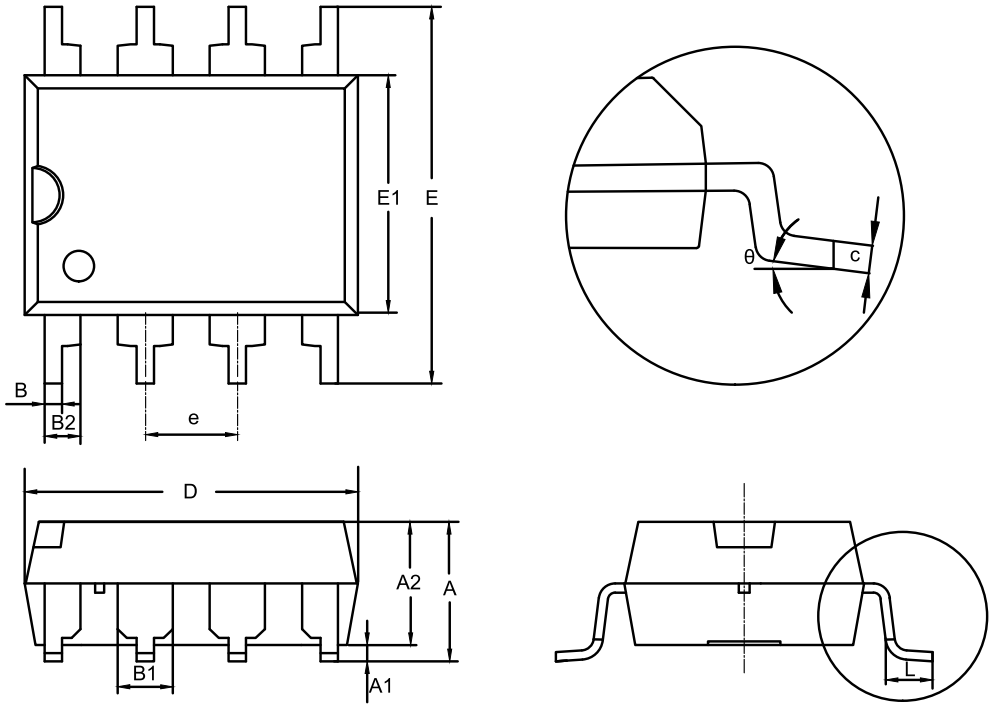
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	2.350	2.650	0.093	0.104
A1	0.100	0.300	0.004	0.012
A2	2.250	2.350	0.089	0.093
b	0.310	0.510	0.012	0.020
c	0.150	0.300	0.006	0.012
D	5.750	5.950	0.226	0.234
E	11.250	11.750	0.443	0.463
E1	7.400	7.600	0.291	0.299
e	1.270 BSC		0.050 BSC	
L	0.500	1.000	0.020	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.

SMP-8

Package Outline Dimensions SM1(SMP-8-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	3.674	4.026	0.145	0.159
A1	0.350	0.550	0.014	0.022
A2	3.324	3.476	0.131	0.137
B1	1.464	1.584	0.058	0.062
B2	0.930	1.050	0.037	0.041
B	0.420	0.540	0.017	0.021
c	0.204	0.304	0.008	0.012
D	9.100	9.300	0.358	0.366
E	10.100	10.700	0.398	0.421
E1	6.370	6.870	0.251	0.270
e	2.540 BSC		0.100 BSC	
L	1.150	1.450	0.045	0.057
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
TPA8000-SM1R	−40 to 125°C	SMP8	A8000	MSL3	Tape and Reel, 800	Green
TPA8000-SOAR	−40 to 125°C	WSOP8	A8000	MSL3	Tape and Reel, 1000	Green
TPA8001-SOAR	−40 to 125°C	WSOP8	A8001	MSL3	Tape and Reel, 1000	Green
TPA8002-SOAR	−40 to 125°C	WSOP8	A8002	MSL3	Tape and Reel, 1000	Green

Green: Defines "Green" to mean RoHS compatible and free of halogen substances.

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