

48V, 10MHz, Low Noise, RRO Operational Amplifiers

1 Features

- Wide Supply: $\pm 2.25\text{ V}$ to $\pm 24\text{ V}$, 4.5 V to 48 V
- Low Offset Voltage: $\pm 0.5\text{ mV}$ Typically
- Low Offset Voltage Drift: $\pm 2\text{ }\mu\text{V}/^\circ\text{C}$
- High Common-Mode Rejection: 112 dB
- Gain Bandwidth: 10 MHz
- Slew Rate: $9\text{ V}/\mu\text{s}$
- Low Noise: $8\text{ nV}/\sqrt{\text{Hz}}$ at 10 kHz
- Low Bias Current: $\pm 10\text{ pA}$
- Rail-to-Rail Output

2 Applications

- Tracking Amplifier in Power Modules
- Merchant Power Supplies
- High-Side and Low-Side Current Sensing
- High Precision Comparator
- Battery-Powered Instruments
- Test and Measurement Equipment
- Multiplexed Data-Acquisition Systems
- Programmable Logic Controllers

3 Description

The GD30HA8281, GD30HA8282 and GD30HA8284 (GD30HA828x) are a family of low power, 48 V wide supply voltage, low noise, rail-to-rail output operational amplifiers capable of operating on supplies ranging from $+4.5\text{ V}$ ($\pm 2.25\text{ V}$) to $+48\text{ V}$ ($\pm 24\text{ V}$). This new generation of high-voltage CMOS operational amplifiers, in conjunction with the GD30AP826x, provide a family of bandwidth, noise, and power options to meet the needs of a wide variety of applications.

The GD30HA828x devices offer outstanding dc precision and ac performance, including low offset ($\pm 0.5\text{ mV}$ typically), low offset drift ($\pm 2\text{ }\mu\text{V}/^\circ\text{C}$ typically), 10 MHz bandwidth, and $8\text{ nV}/\sqrt{\text{Hz}}$ input voltage noise density at 10 kHz.

Unique features such as differential input-voltage range to the negative supply rail, high output current ($\pm 45\text{ mA}$), high capacitive load drive of up to 1nF, and high slew rate ($9\text{V}/\mu\text{s}$) make the GD30HA828x high-performance operational amplifiers for high-voltage industrial applications.

The robust design of the GD30HA828x family provides ease-of-use to the circuit designer: integrated RF/EMI rejection filter, no phase reversal in overdrive conditions, and high electro-static discharge (ESD) protection. The GD30HA828x are optimized for operation at voltages from $+4.5\text{ V}$ ($\pm 2.25\text{ V}$) to $+48\text{V}$ ($\pm 24\text{ V}$) over the extended temperature range of $-40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$.

Device Information¹

PART NUMBER	PACKAGE	BODY SIZE (NOM)
GD30HA8281	SOT23-5L	2.92mm x 1.60mm
	SOIC-8L	4.90mm x 3.92mm
	MSOP-8L	3.00mm x 3.00mm
GD30HA8282	SOIC-8L	4.90mm x 3.92mm
	MSOP-8L	3.00mm x 3.00mm
GD30HA8284	SOIC-14L	8.73mm x 3.95mm
	TSSOP-14L	4.96mm x 4.40mm

1. For all available packages, see the [Package Information](#) at the end of data sheet.

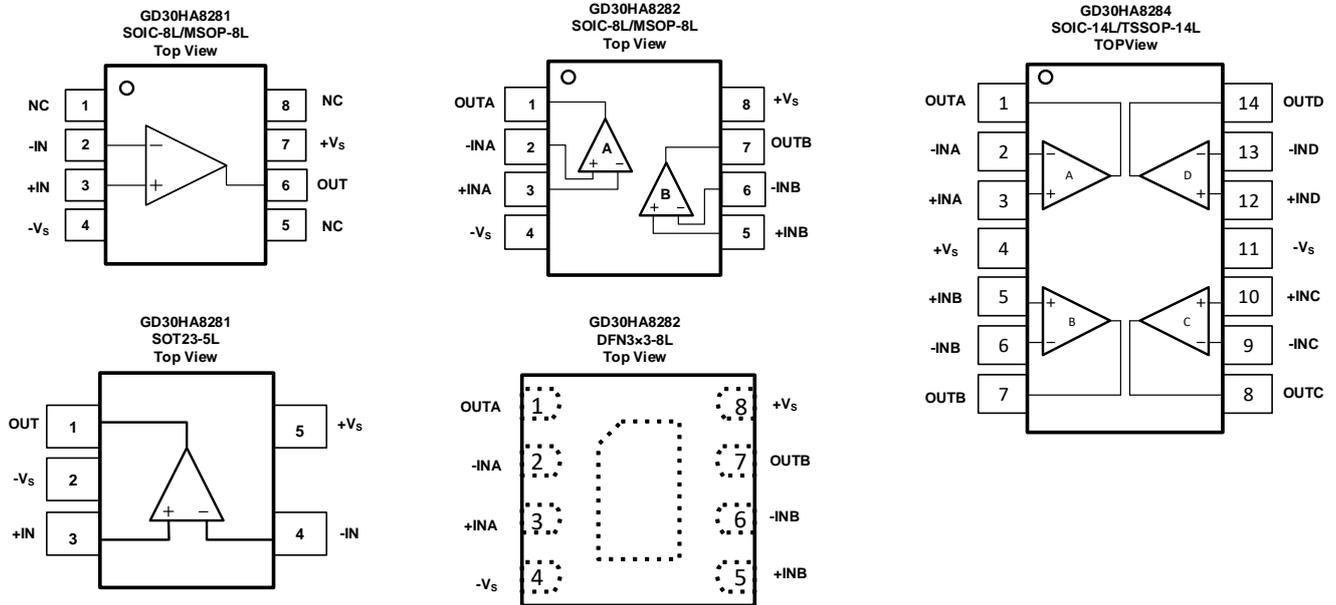


Table of Contents

1	Features	1
2	Applications	1
3	Description	1
	Table of Contents	2
4	Device Overview	3
4.1	Pinout and Pin Assignment	3
4.2	Pin Description	3
5	Parameter Information	4
5.1	Absolute Maximum Ratings	4
5.2	Recommended Operation Conditions	4
5.3	Electrical Sensitivity	4
5.4	Thermal Characteristics	4
5.5	Electrical Characteristics	5
5.6	Typical Characteristics	7
6	Package Information	8
6.1	Outline Dimensions	8
6.2	Recommended Land Pattern	18
7	Ordering Information	23
8	Revision History	24

4 Device Overview

4.1 Pinout and Pin Assignment



4.2 Pin Description

NAME	PIN TYPE ¹	FUNCTION
-IN	I	Inverting input of the amplifier. The voltage range is from V_{S-} to $V_{S+} - 1.5$ V.
+IN	I	Non-inverting input of the amplifier. This pin has the same voltage range as -IN.
+Vs	P	Positive power supply. The voltage is from 4.5 V to 48 V. Split supplies are possible as long as the voltage between V_{S+} and V_{S-} is from 4.5 V to 48 V.
-Vs	P	Negative power supply. It is normally tied to ground. It can also be tied to a voltage other than ground as long as the voltage between V_{S+} and V_{S-} is from 4.5 V to 48 V.
OUT	O	Amplifier output.
NC		No connection.

1. I = Input, O = Output, P = Power.

5 Parameter Information

5.1 Absolute Maximum Ratings

Exceeding the operating temperature range (unless otherwise noted)¹

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{S+} to V_{S-}	Supply Voltage		60.0	V
V_I	Signal Input Voltage	$-V_S - 0.3$	$+V_S + 0.3$	V
I_I	Signal Input Current	-10	10	mA
	Output Short-Circuit	Continuous		s
T_J	Junction Temperature, T_J		150	°C
T_{stg}	Storage Temperature Range, T_{stg}	-65	+150	°C
	Lead Temperature Range (Soldering 10 sec)		260	°C

- The maximum ratings are the limits to which the device can be subjected without permanently damaging the device. Note that the device is not guaranteed to operate properly at the maximum ratings. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

5.2 Recommended Operation Conditions

SYMBOL ^{1,2}	PARAMETER	MIN	TYP	MAX	UNIT
V_{CM}	Common-mode voltage range	$-V_S$		$+V_S - 1.5$	V
T_A	Operating temperature range	-40		125	°C

- The device is not guaranteed to function outside of its operating conditions.

5.3 Electrical Sensitivity

SYMBOL	CONDITIONS	VALUE	UNIT
$V_{ESD(HBM)}$	Human body model (HBM), per MIL-STD-883J / Method 3015.9 ¹	±2000	V
$V_{ESD(CDM)}$	Charge-device model (CDM), per ESDA/JEDEC JS-002-2014 ²	±2000	V

- JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible if necessary precautions are taken.
- JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 250-V CDM is possible if necessary precautions are taken.

5.4 Thermal Characteristics

SYMBOL ¹	CONDITIONS	PACKAGE	VALUE	UNIT
Θ_{JA}	Junction to ambient thermal resistance	SOT23-5L	190	°C/W
		MSOP-8L	201	
		SOIC-8L	125	
		TSSOP-14L	112	
		SOIC-14L	115	

- Thermal characteristics are based on simulation, and meet JEDEC document JESD51-7.

5.5 Electrical Characteristics

$V_S = 4.5\text{ V to }48\text{ V}$, $T_A = +25\text{ }^\circ\text{C}$, $V_{CM} = V_{OUT} = V_S / 2$, and $R_L = 10\text{ k}\Omega$ connected to $V_S / 2$, unless otherwise noted. Boldface limits apply over the specified temperature range, $T_A = -40\text{ }^\circ\text{C to }+125\text{ }^\circ\text{C}$.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	Input offset voltage			± 0.5	± 1.8	mV
dV_{OS}/dT	Offset voltage drift ¹	$T_A = -40\text{ to }+125\text{ }^\circ\text{C}$		± 2		$\mu\text{V}/^\circ\text{C}$
PSRR	Power supply rejection ratio	$V_S = 4.5\text{ to }48\text{ V}$, $V_{CM} = 0.1\text{ V}$		5		$\mu\text{V/V}$
		$T_A = -40\text{ to }+125\text{ }^\circ\text{C}$		10		
INPUT BIAS CURRENT						
I_B	Input bias current ¹			10		pA
		$T_A = -40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$		150		
		$T_A = -40\text{ }^\circ\text{C to }+125\text{ }^\circ\text{C}$		600		
I_{OS}	Input offset current ¹			5		pA
NOISE						
V_n	Input voltage noise	$f = 0.1\text{ to }10\text{ Hz}$		4		μV_{P-P}
e_n	Input voltage noise density	$f = 10\text{ KHz}$		8		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 1\text{ KHz}$		10		
I_n	Input current noise density	$f = 1\text{ KHz}$		5		$\text{fA}/\sqrt{\text{Hz}}$
INPUT VOLTAGE						
V_{CM}	Common-mode voltage range		$-V_S$		$+V_S - 1.5$	V
CMRR	Common-mode rejection ratio	$V_S = 40\text{ V}$, $V_{CM} = 0\text{ to }38\text{ V}$		112		dB
		$V_{CM} = 0.1\text{ to }38\text{ V}$, $T_A = -40\text{ to }+125\text{ }^\circ\text{C}$		100		
		$V_S = 5.0\text{ V}$, $V_{CM} = 0\text{ to }3.5\text{ V}$		93		
		$V_{CM} = 0.1\text{ to }3.0\text{ V}$, $T_A = -40\text{ to }+125\text{ }^\circ\text{C}$		82		
INPUT IMPEDANCE						
C_{IN}	Input capacitance	Differential		2.0		pF
		Common mode		3.5		
OPEN-LOOP GAIN						
A_{VOL}	Open-loop voltage gain	$V_S = 40\text{ V}$, $V_O = 0.1\text{ to }39.9\text{ V}$		126		dB
		$T_A = -40\text{ to }+125\text{ }^\circ\text{C}$		118		
		$V_S = 5\text{ V}$, $V_O = 0.1\text{ to }4.9\text{ V}$		116		
		$T_A = -40\text{ to }+125\text{ }^\circ\text{C}$		108		
FREQUENCY RESPONSE						
GBW	Gain band width product			10		MHz
SR	Slew rate	$V_S = 40\text{ V}$, $G = +1$, 10 V step		9		$\text{V}/\mu\text{s}$

**Electrical Characteristics (continued)**

$V_S = 4.5\text{ V to }48\text{ V}$, $T_A = +25\text{ }^\circ\text{C}$, $V_{CM} = V_{OUT} = V_S / 2$, and $R_L = 10\text{ k}\Omega$ connected to $V_S / 2$, unless otherwise noted.

Boldface limits apply over the specified temperature range, $T_A = -40\text{ }^\circ\text{C to }+125\text{ }^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
THD+N	Total harmonic distortion + noise	$G = +1$, $f = 1\text{ KHz}$, $V_O = 3V_{RMS}$		0.0002		%
t_s	Settling time	To 0.1%, $V_S = 40\text{V}$, $G = +1, 5\text{V step}$		1.6		μs
		To 0.01%, $V_S = 40\text{V}$, $G = +1$, 5V step		3.5		
t_{OR}	Overload recovery time	$V_{IN} * \text{Gain} > V_S$		0.6		μs
OUTPUT						
V_{OH}	High output voltage swing	$V_S = \pm 20\text{V}$, $R_L = 10\text{k}\Omega$		$+V_S - 95$		mV
		$V_S = \pm 20\text{V}$, $R_L = 2\text{k}\Omega$		$+V_S - 255$		
V_{OL}	Low output voltage swing	$V_S = \pm 20\text{V}$, $R_L = 10\text{k}\Omega$		$-V_S + 60$		mV
		$V_S = \pm 20\text{V}$, $R_L = 2\text{k}\Omega$		$-V_S + 240$		
I_{SC}	Short-circuit current			± 45		mA
POWER SUPPLY						
V_S	Operating supply voltage	$T_A = -40\text{ }^\circ\text{C to }+125\text{ }^\circ\text{C}$	4.5		48	V
I_q	Quiescent current (per amplifier)	$V_S = 5\text{V}$		2.05		mA
		$V_S = 40\text{V}$		2.75		

1. Guaranteed by design and engineering sample characterization.

5.6 Typical Characteristics

At $T_A = +25^\circ\text{C}$, $V_{CM} = V_S/2$, and $R_L = 10\text{k}\Omega$ connected to $V_S/2$, unless otherwise noted.

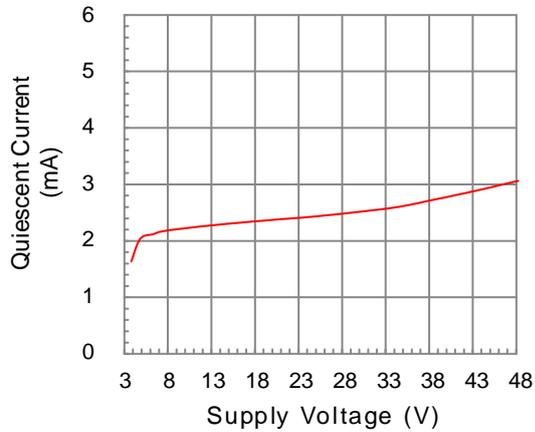


Figure 1. Quiescent Current vs. Supply Voltage

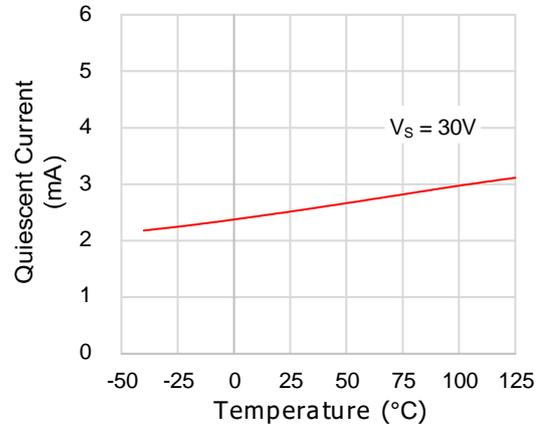


Figure 2. Quiescent Current vs. Temperature

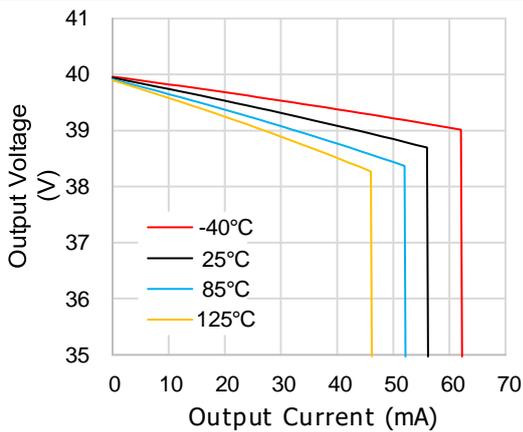


Figure 3. Output Voltage Swing vs. Output Current (Sourcing, $V_S = 40\text{V}$)

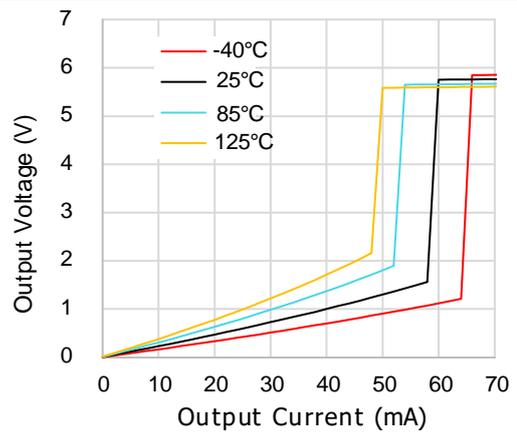


Figure 4. Output Voltage Swing vs. Output Current (Sinking, $V_S = 40\text{V}$)

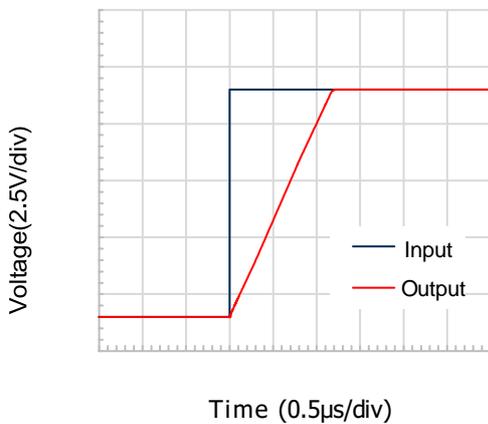


Figure 5. Large-Signal Step Response (Failing)

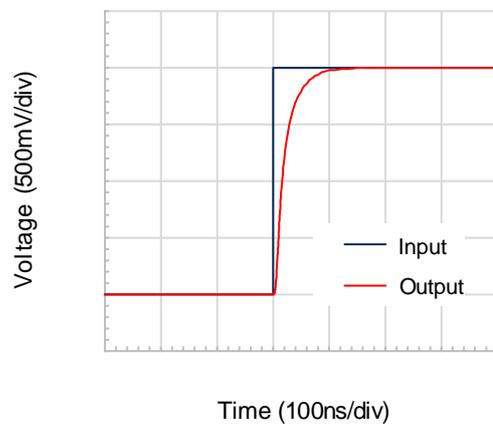
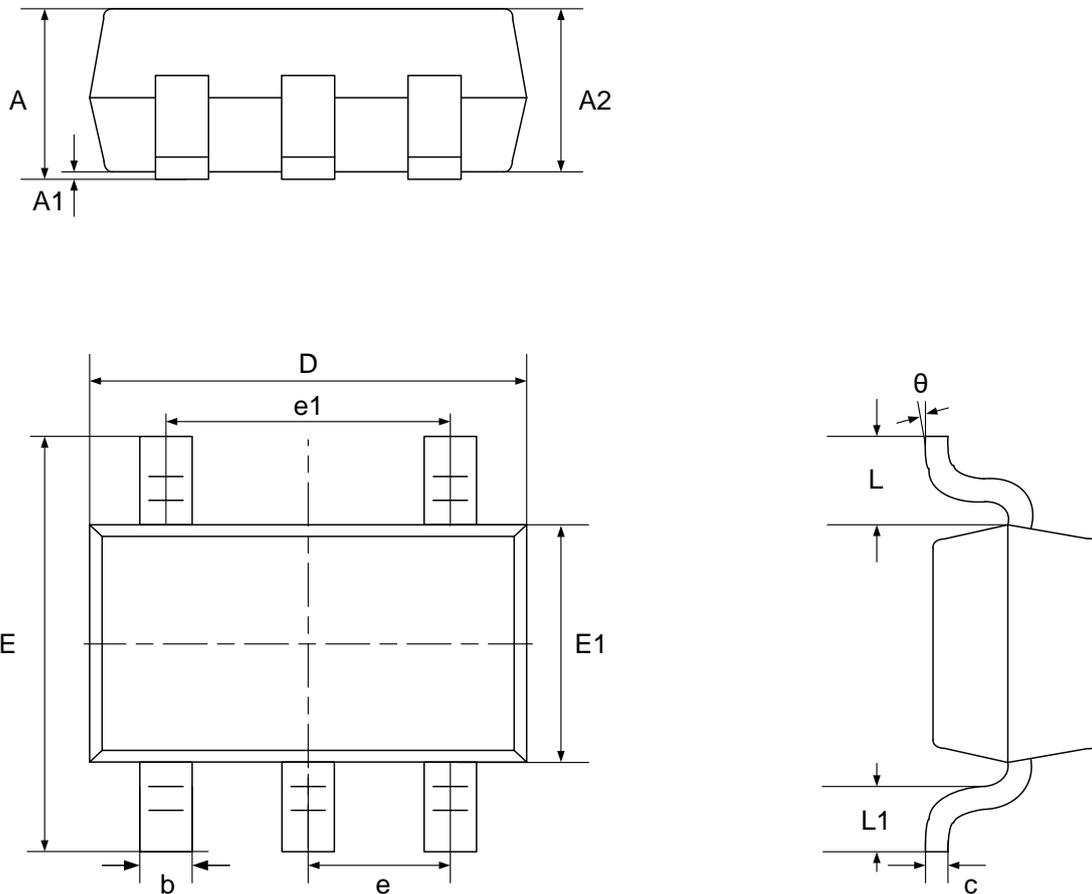


Figure 6. Small-Signal Step Response

6 Package Information

6.1 Outline Dimensions

SOT23-5L Package Outline



NOTES:

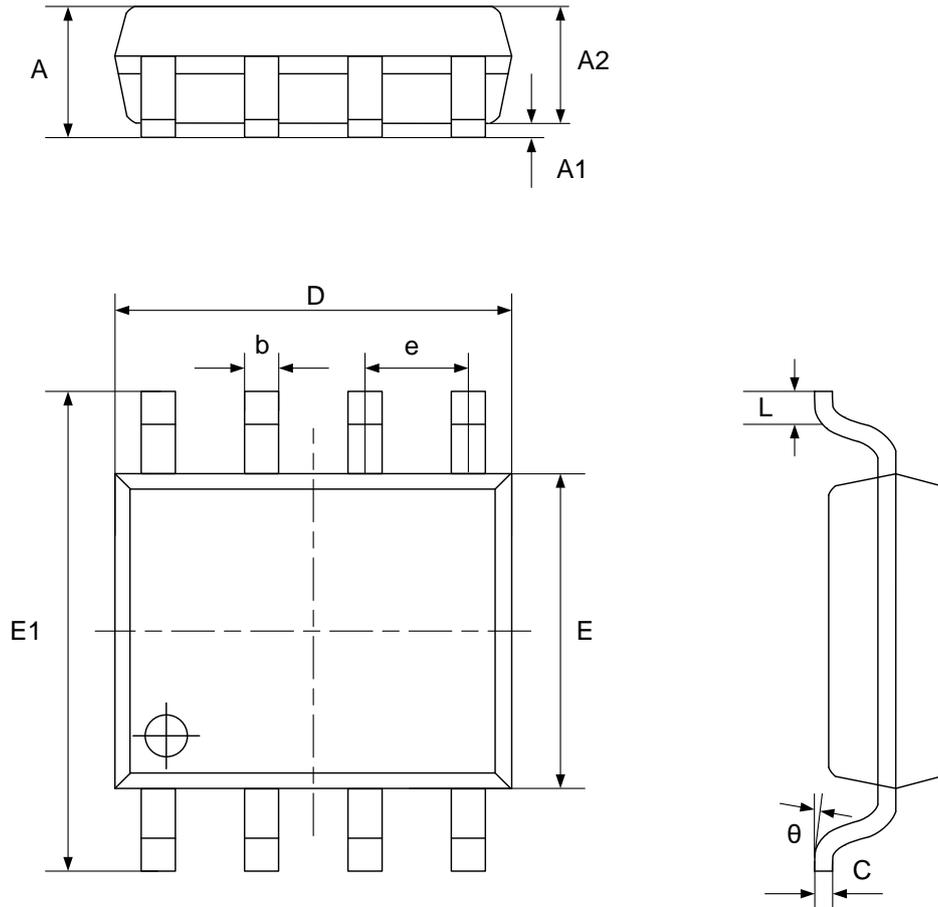
1. All dimensions are in millimeters.
2. Package dimensions does not include mold flash, protrusions, or gate burrs.
3. Refer to the [Table 1 SOT23-5L dimensions\(mm\)](#).



Table 1. SOT23-5L dimensions(mm)

SYMBOL	MIN	TYP	MAX
A			1.35
A1	0.00		0.15
A2	1.00		1.20
b	0.35		0.45
c	0.14		0.20
D	2.82		3.02
E	2.60		3.00
E1	1.526		1.726
e	0.95 BSC		
e1	1.90 BSC		
L	0.60 REF		
L1	0.30		0.60
θ	0°		8°

SOIC-8L Package Outline



NOTES: (continued)

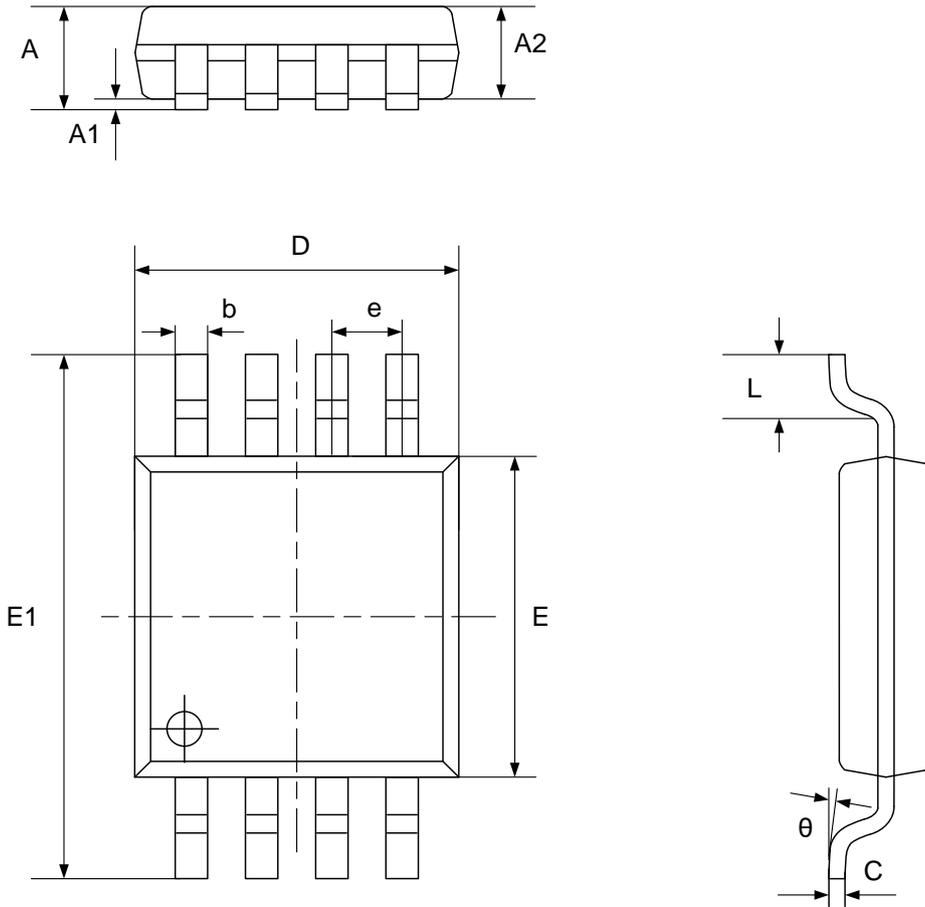
1. Refer to the [Table 2 SOIC-8L dimensions\(mm\)](#).



Table 2. SOIC-8L dimensions(mm)

SYMBOL	MIN	TYP	MAX
A	1.370		1.670
A1	0.070		0.170
A2	1.300		1.500
b	0.306		0.506
C		0.203	
D	4.700		5.100
E	3.820		4.020
E1	5.800		6.200
e		1.270	
L	0.450		0.750
θ	0°		8°

MSOP-8L Package Outline



NOTES: (continued)

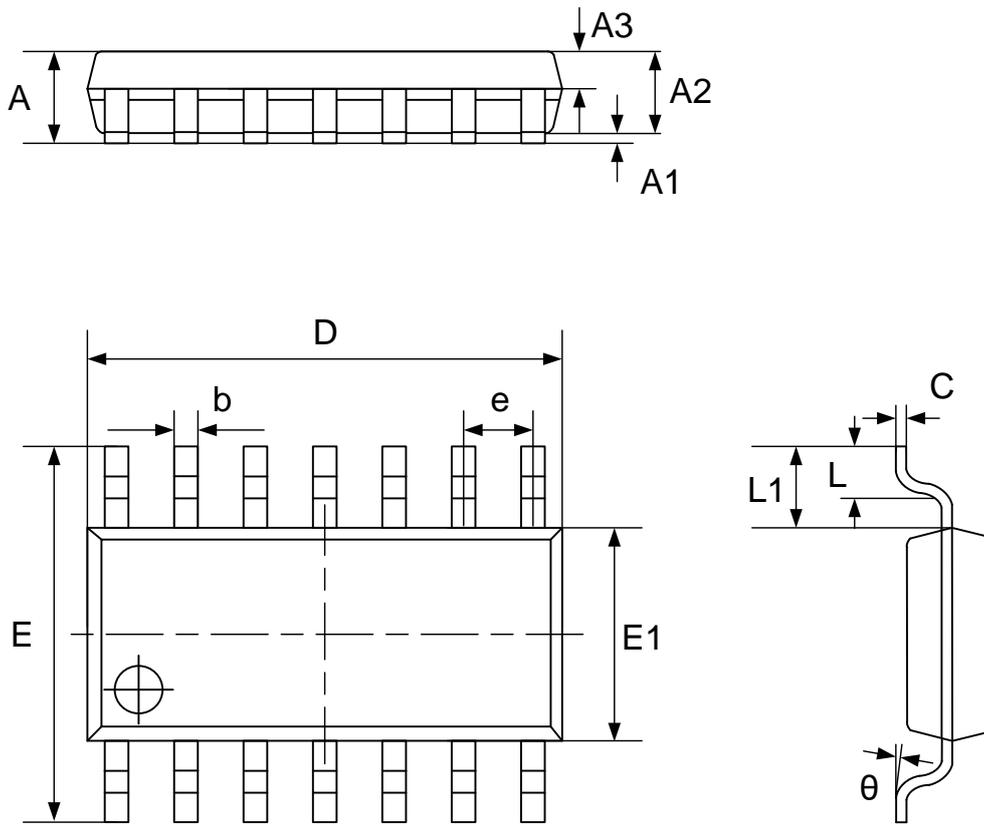
1. Refer to the [Table 3 MSOP-8L dimensions\(mm\)](#).



Table 3. MSOP-8L dimensions(mm)

SYMBOL	MIN	TYP	MAX
A	0.800		1.100
A1	0.050		0.150
A2	0.750		0.950
b	0.290		0.380
C	0.150		0.200
D	2.900		3.100
E	2.900		3.100
E1	4.700		5.100
e		0.650	
L	0.400		0.700
θ	0°		8°

SOIC-14L Package Outline



NOTES: (continued)

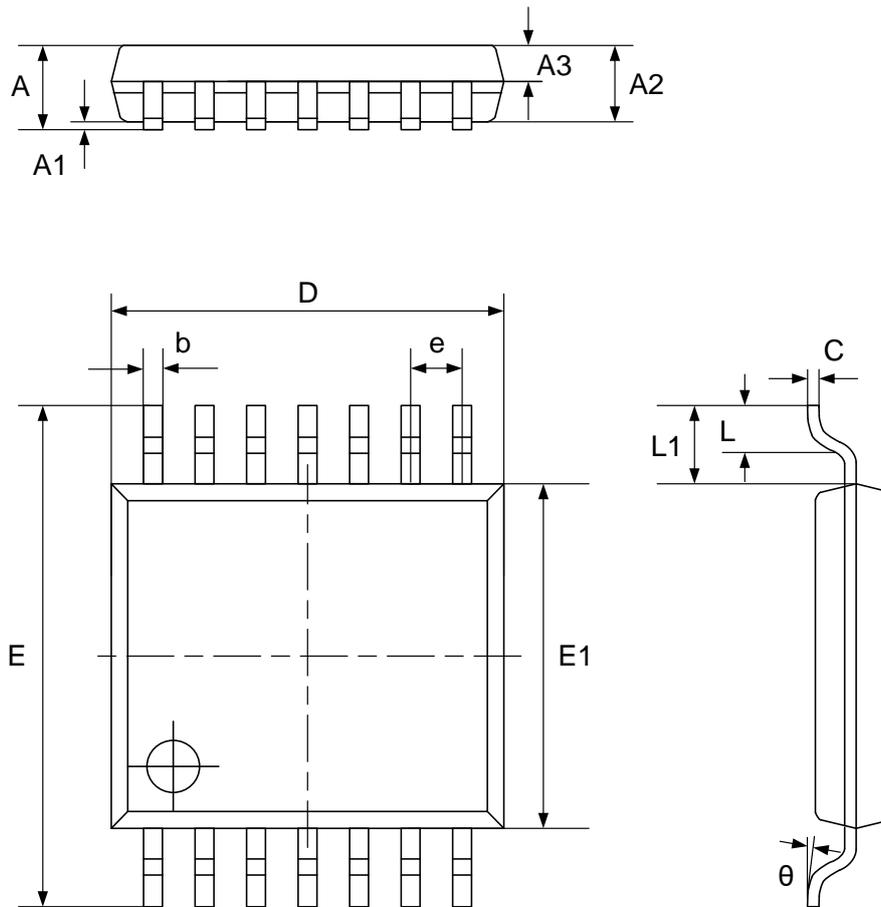
1. Refer to the [Table 4 SOIC-14L dimensions\(mm\)](#).



Table 4. SOIC-14L dimensions(mm)

SYMBOL	MIN	TYP	MAX
A	1.450		1.850
A1	0.100		0.300
A2	1.350		1.550
A3	0.550		0.750
b		0.406	
C		0.203	
D	8.630		8.830
E	5.840		6.240
E1	3.850		4.050
e		1.270	
L1	1.040 REF		
L	0.350		0.750
θ	2°		8°

TSSOP-14L Package Outline



NOTES: (continued)

1. Refer to the [Table 5 TSSOP-14L dimensions\(mm\)](#).



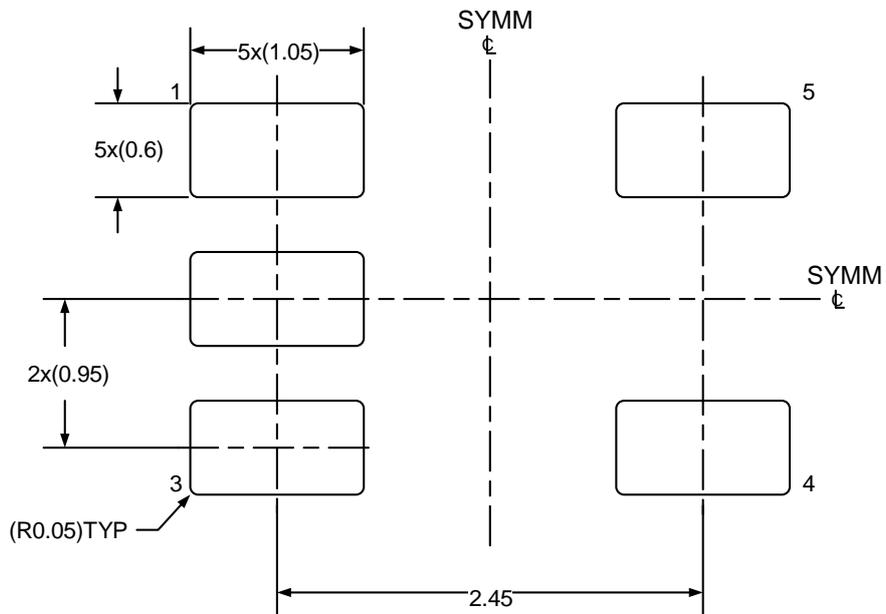
Table 5. TSSOP-14L dimensions(mm)

SYMBOL	MIN	TYP	MAX
A			1.200
A1	0.050		0.150
A2	0.900		1.050
A3	0.390		0.490
b	0.200		0.290
C	0.130		0.180
D	4.860		5.060
E	6.200		6.600
E1	4.300		4.500
e		0.650	
L1	1.000 REF		
L	0.450		0.750
θ	0°		8°



6.2 Recommended Land Pattern

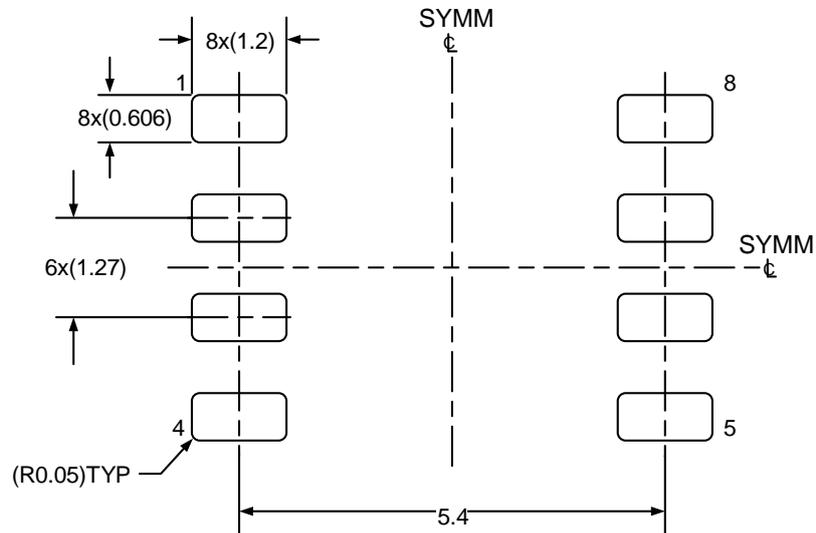
SOT23-5L Land Pattern Example



NOTES: (continued)

1. Refer to the IPC-7351 can also help you complete the designs.
2. Exposed metal shown.
3. Drawing is 20X scale.

SOIC-8L Land Pattern Example

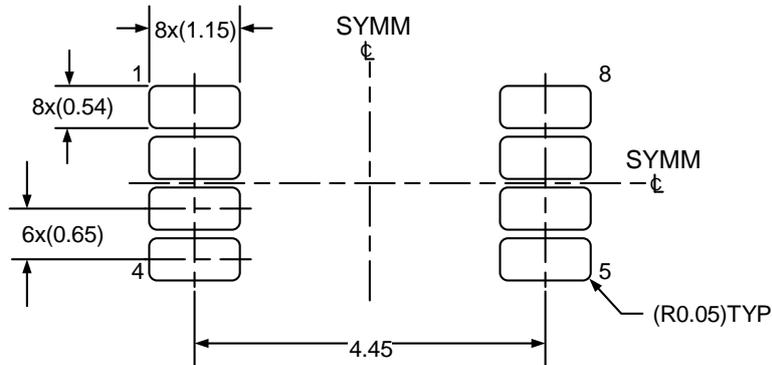


NOTES: (continued)

1. Refer to the IPC-7351 can also help you complete the designs.
2. Exposed metal shown.
3. Drawing is 10X scale.



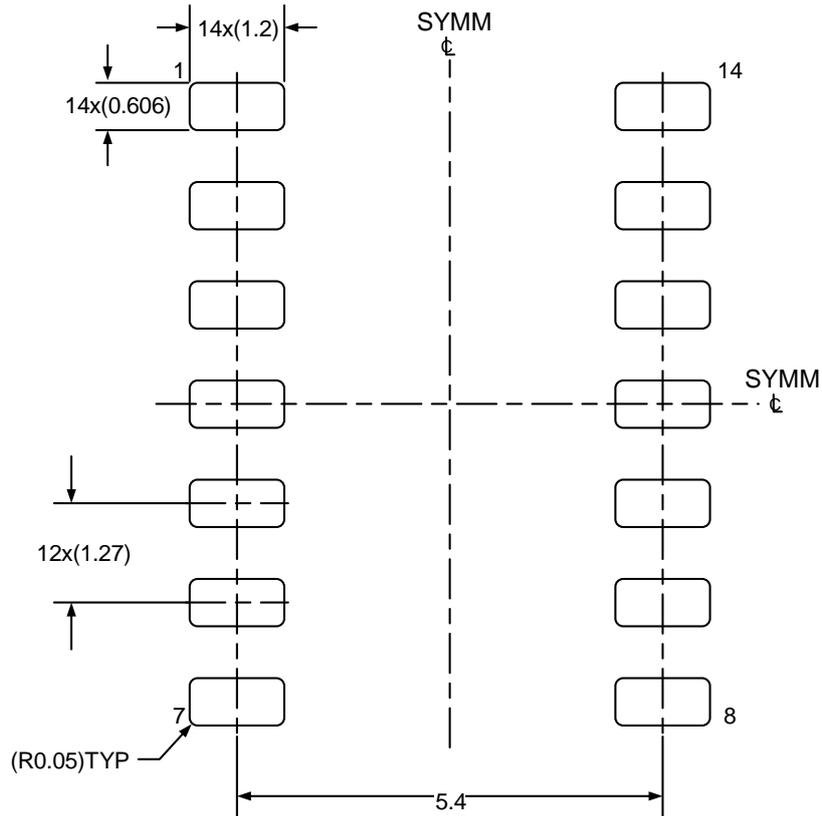
MSOP-8L Land Pattern Example



NOTES: (continued)

- 1. Refer to the IPC-7351 can also help you complete the designs.
- 2. Exposed metal shown.
- 3. Drawing is 10X scale.

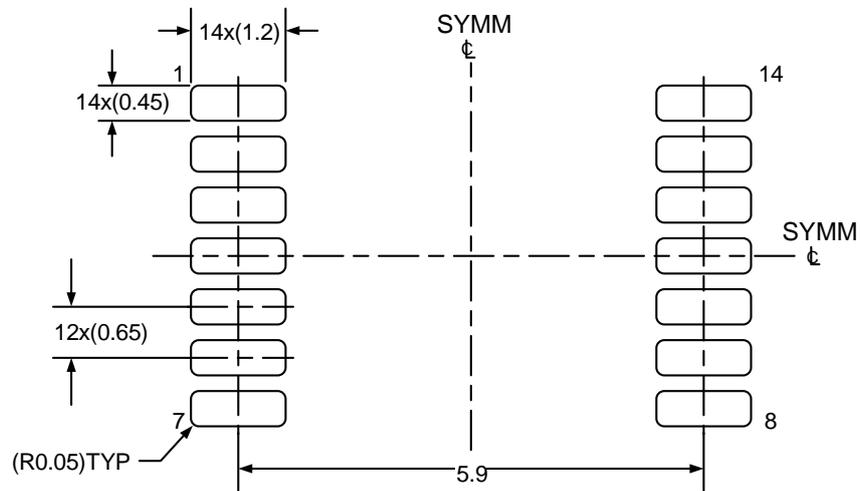
SOIC-14L Land Pattern Example



NOTES: (continued)

1. Refer to the IPC-7351 can also help you complete the designs.
2. Exposed metal shown.
3. Drawing is 10X scale.

TSSOP-14L Land Pattern Example



NOTES: (continued)

1. Refer to the IPC-7351 can also help you complete the designs.
2. Exposed metal shown.
3. Drawing is 10X scale.



7 Ordering Information

Ordering Code	Package Type	ECO Plan	Packing Type	MOQ	OP Temp(°C)
GD30HA8281NSTR-I	SOT23-5L	Green	Tape & Reel	3000	-40°C to +125°C
GD30HA8281WGTR-I	SOIC-8L	Green	Tape & Reel	4000	-40°C to +125°C
GD30HA8281WMTR-I	MSOP-8L	Green	Tape & Reel	3000	-40°C to +125°C
GD30HA8282WGTR-I	SOIC-8L	Green	Tape & Reel	4000	-40°C to +125°C
GD30HA8282WMTR-I	MSOP-8L	Green	Tape & Reel	3000	-40°C to +125°C
GD30HA8284ZLTR-I	SOIC-14L	Green	Tape & Reel	2500	-40°C to +125°C
GD30HA8284ZPTR-I	TSSOP-14L	Green	Tape & Reel	3000	-40°C to +125°C



8 Revision History

REVISION NUMBER	DESCRIPTION	DATE
1.0	Initial release and device details	2024

Important Notice

This document is the property of GigaDevice Semiconductor Inc. and its subsidiaries (the "Company"). This document, including any product of the Company described in this document (the "Product"), is owned by the Company according to the laws of the People's Republic of China and other applicable laws. The Company reserves all rights under such laws and no Intellectual Property Rights are transferred (either wholly or partially) or licensed by the Company (either expressly or impliedly) herein. The names and brands of third party referred thereto (if any) are the property of their respective owner and referred to for identification purposes only.

The Company makes no representations or warranties of any kind, express or implied, with regard to the merchantability and the fitness for a particular purpose of the Product, nor does the Company assume any liability arising out of the application or use of any Product described in this document. Any information provided in this document is provided only for reference purposes. It is the sole responsibility of the user of this document to determine whether the Product is suitable and fit for its applications and products planned, and properly design, program, and test the functionality and safety of its applications and products planned using the Product. Unless otherwise expressly specified in the datasheet of the Product, the Product is designed, developed, and/or manufactured for ordinary business, industrial, personal, and/or household applications only, and the Product is not designed or intended for use in (i) safety critical applications such as weapons systems, nuclear facilities, atomic energy controller, combustion controller, aeronautic or aerospace applications, traffic signal instruments, pollution control or hazardous substance management; (ii) life-support systems, other medical equipment or systems (including life support equipment and surgical implants); (iii) automotive applications or environments, including but not limited to applications for active and passive safety of automobiles (regardless of front market or aftermarket), for example, EPS, braking, ADAS (camera/fusion), EMS, TCU, BMS, BSG, TPMS, Airbag, Suspension, DMS, ICMS, Domain, ESC, DCDC, e-clutch, advanced-lighting, etc.. Automobile herein means a vehicle propelled by a self-contained motor, engine or the like, such as, without limitation, cars, trucks, motorcycles, electric cars, and other transportation devices; and/or (iv) other uses where the failure of the device or the Product can reasonably be expected to result in personal injury, death, or severe property or environmental damage (collectively "Unintended Uses"). Customers shall take any and all actions to ensure the Product meets the applicable laws and regulations. The Company is not liable for, in whole or in part, and customers shall hereby release the Company as well as its suppliers and/or distributors from, any claim, damage, or other liability arising from or related to all Unintended Uses of the Product. Customers shall indemnify and hold the Company, and its officers, employees, subsidiaries, affiliates as well as its suppliers and/or distributors harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of the Product.

Information in this document is provided solely in connection with the Product. The Company reserves the right to make changes, corrections, modifications or improvements to this document and the Product described herein at any time without notice. The Company shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2024 GigaDevice – All rights reserved