36V, Industry-Standard Operational Amplifiers

1 Features

- Wide Supply: ±1.5V to ±18V, 3.0V to 36V
- Extended Temperature Range: -40°C ~ +125°C
- Offset Voltage: ±2 mV (typical)
- Offset Voltage Temperature Drift: 7μV/°C
- Input Common-Mode Voltage Range Includes Ground
- Large Voltage Gain: 100 dB (typical)
- Gain Bandwidth: 0.7 MHz
- Slew Rate: 0.3 V/μs
- Quiescent Current: 250 μA/ch (typical)
- Large Output Voltage Swing: 0V to V_{CC}-1.5 V

2 Applications

- Merchant network and server power supply units
- Multi-function printers
- Power supplies and mobile chargers
- Motor control: AC induction, BDC, BLDC and stepper motor. etc
- Indoor and outdoor air conditioners
- Washers, dryers, and refrigerators
- AC inverters, string inverters, central inverters
- Electronic point-of-sale systems

3 Description

The GD30HA2904/GD30HA2902 series amplifiers are the industry-standard operational amplifiers which include different channels of high-voltage(36V) op-amps. These devices provide outstanding value for cost-sensitive applications, with features including low offset, common-mode input range to ground.

These series standard op-amps could simplify circuit design with enhanced features, such as unity- gain stability and lower quiescent current of 250μA per amplifier(typical).

The GD30HA2904(dual) is offered in SOIC-8L and MSOP-8L packages, the quad of GD30HA2902 is offered in both SOIC-14L and TSSOP-14L packages.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
GD30HA2904	SOIC-8L	4.90mm x 3.92mm
	MSOP-8L	3.00mm x 3.00mm
GD30HA2902	SOIC-14L	8.73mm x 3.95mm
	TSSOP-14L	4.96mm x 4.40mm

1. For all available packages, see the *Package Information* and *Ordering Information* at the end of data sheet.

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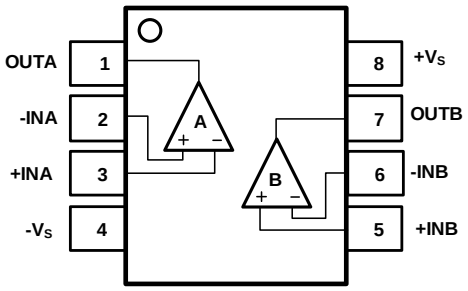
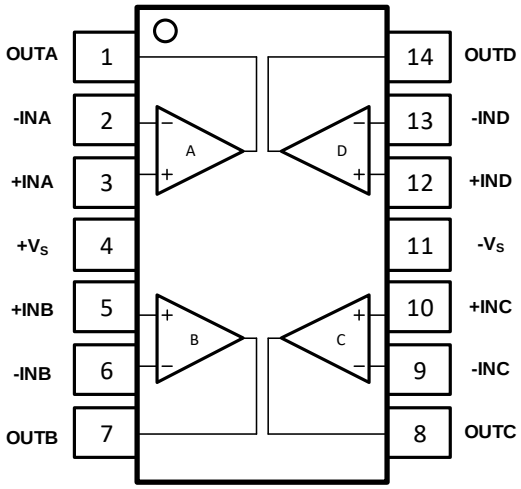
4 Device Overview

4.1 Pinout and Pin Assignment

GD30HA2904
SOIC-8L/MSOP-8L
Top View



GD30HA2902
SOIC-14L/TSSOP-14L
Top View



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+} – 2.0V.
+IN	I	Non-inverting input of the amplifier. This pin has the same voltage range as –IN.
$+V_S$	P	Positive power supply. The voltage is from 3.0V to 36V. Split supplies are possible as long as the voltage between V_{S+} and V_{S-} is from 3.0V to 36V.
$-V_S$	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 3.0V to 36V.
OUT	O	Amplifier output.

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		40.0	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

1. 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	$-V_S$		$+V_S-2.0$	V
T_A	Operating temperature range	−40		125	°C

1. 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), ANSI/ESDA/JEDEC JS-001-2017[1]	±500	V
$V_{ESD(CDM)}$	Charge-device model (CDM), ANSI/ESDA/JEDEC JS-002-2022[2]	±1000	V

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.

5.4 Thermal Characteristics

SYMBOL[1]	CONDITIONS	PACKAGE	VALUE	UNIT
Θ_{JA}	Junction to ambient thermal resistance	MSOP-8L	171	°C/W
		SOIC-8L	124.7	
		TSSOP-14L	135.8	
		SOIC-14L	106.9	

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

5.5 Electrical Characteristics

V_S = 5.0 V to 36V, T_A = +25 °C, V_{CM} = V_{OUT} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted. Boldface limits apply over the specified temperature range, T_A = −40 °C to +125 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	Input offset voltage	V_S = 5.0V to 30V, V_{CM} = 0, V_{OUT} = 1.4V		±2	±7	mV
		V_S = 5.0V to 30V, V_{CM} = 0, V_{OUT} = 1.4V, T_A = −40 to +125 °C			±10	
dV_{OS}/d_T	Offset voltage drift[1]	T_A = −40 to +125°C		±7		μV/°C
	Channel separaton	f = 1KHz ~ 20KHz		120		dB
PSRR	Power supply rejection ratio	V_S = 3.0 to 30 V, V_{CM} = 0.1V T_A = −40 to +125°C	60	100		dB
INPUT BIAS CURRENT						
I_B	Input bias current[1]	V_{CM} = 0		−20	-200	nA
		V_{CM} = 0, T_A = −40 to +125°C			-500	
I_{OS}	Input offset current[1]	V_{CM} = 0	5	50		nA
		V_{CM} = 0, T_A = −40 to +125°C		150		
NOISE						
e_n	Input voltage noise density	f = 1 KHz		40		nV/√Hz
INPUT VOLTAGE						
V_{CM}	Common-mode voltage range	V_S = 5.0V to 30V, T_A = −40 to +125 °C	$-V_S$		$+V_S$ – 2.0	V
CMRR	Common-mode rejection ratio	V_S = 5.0V to 30V, V_{CM} = 0V	60	80		dB
OPEN-LOOP GAIN						
A_{VOL}	Open-loop voltage gain	V_S = 15V, V_{OUT} = 1.0V to 11V, R_L > 2 kΩ		85	100	dB
		V_S = 15V, V_{OUT} = 1.0V to 11V R_L > 2kΩ, T_A = −40 to +125 °C	82			
FREQUENCY RESPONSE						
GBW	Gain band width product			0.7		MHz
SR	Slew rate	V_S = 5 V, G = +1		0.3		V/μs

Electrical Characteristics (continued)

V_S = 5.0 V to 36V, T_A = +25 °C, V_{CM} = V_{OUT} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted. Boldface limits apply over the specified temperature range, T_A = −40 °C to +125 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
OUTPUT						
V_{OH}	High output voltage swing	V_S = 30V, R_L = 2kΩ, T_A = −40 to +125°C			$+V_S$ − 4	V
		V_S = 30V, R_L = 10kΩ, T_A = −40 to +125°C			$+V_S$ − 3	
V_{OL}	Low output voltage swing	V_S = 5V, R_L = 10kΩ, T_A = −40 to +125 °C			$-V_S$ + 20	mV
I_{SOURCE}	Out Source Current	V_S = 15V, V_{OUT} = 0V, V_{ID} = 1V	20	40		mA
		V_S = 15V, V_{OUT} = 0V, V_{ID} = 1V T_A = −40 to +125 °C	10			
I_{SINK}	Out Sink Current	V_S = 15V, V_{OUT} = 0V, V_{ID} = 1V T_A = −40 to +125 °C	5			mA
I_{SC}	Short-circuit current	V_S = 15V		±40	±60	mA
POWER SUPPLY						
V_S	Operating supply voltage	T_A = −40°C to +125°C	3.0		36	V
I_Q	Quiescent current (per amplifier)	V_S = 5V		250	620	μA
		V_S = 30V		375	1050	

1. Guaranteed by design and engineering sample characterization.

5.6 Typical Characteristics

V_S = 5.0 V to 36V, T_A = +25 °C, V_{CM} = V_{OUT} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted.

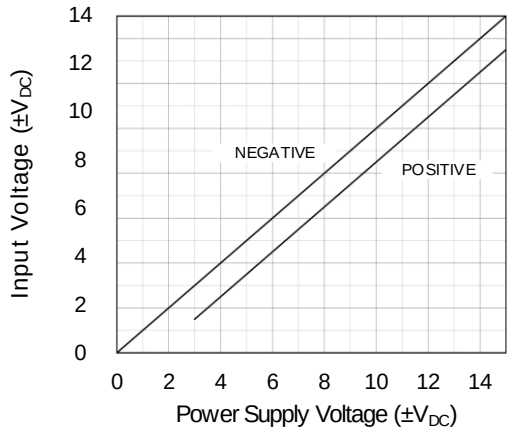


Figure 1. Input Voltage Range vs. Supply Voltage

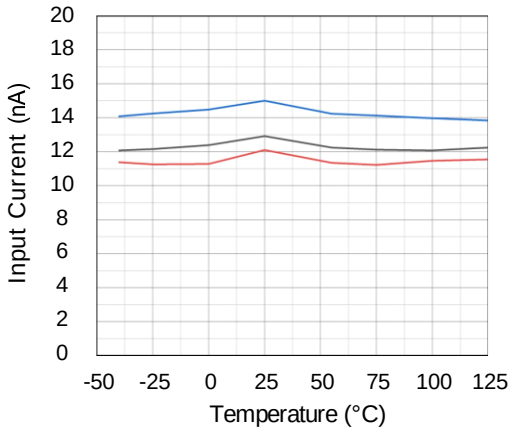


Figure 2. Input Bias Current vs. Temperature

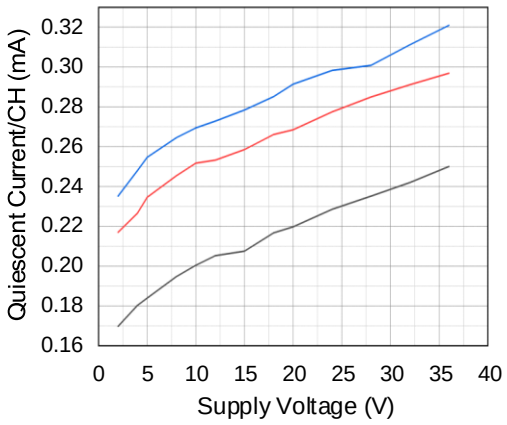


Figure 3. Quiescent Current vs. Supply Voltage

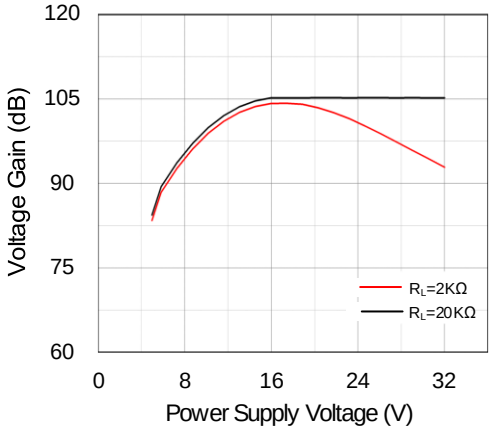


Figure 4. Open-loop Gain vs. Supply Voltage

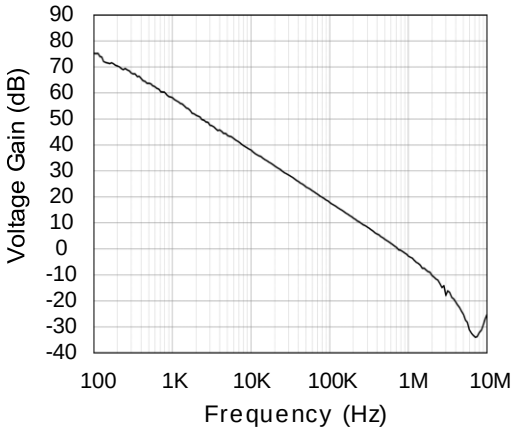


Figure 5. Open-loop Gain vs. Frequency

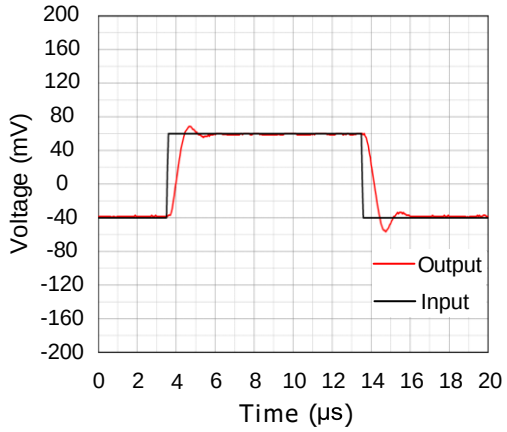


Figure 6. Small Signal Step Response

Typical Characteristics (continued)

V_S = 5.0 V to 36V, T_A = +25 °C, V_{CM} = V_{OUT} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted.

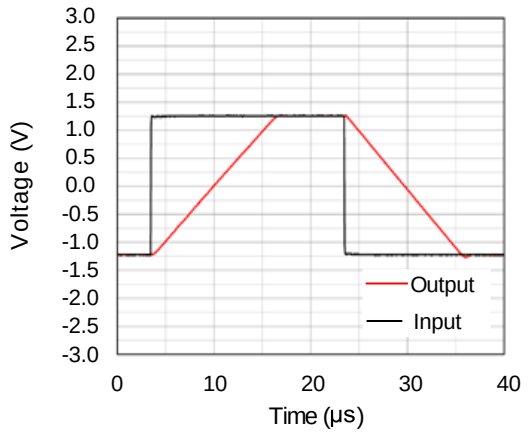


Figure 7. Large Signal Step Response

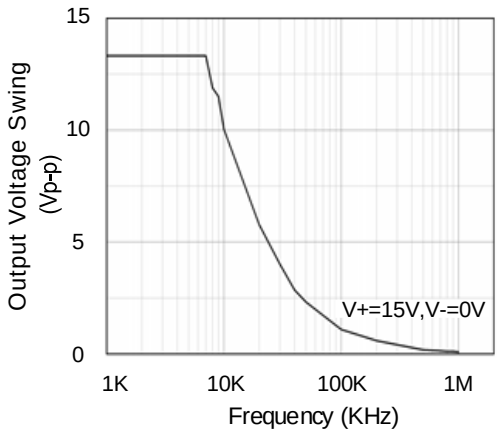


Figure 8. Output Swing vs. Frequency

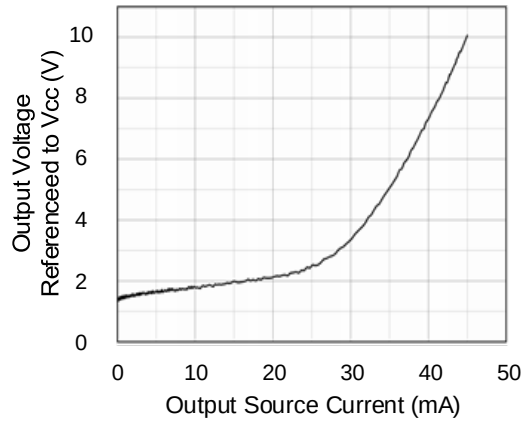


Figure 9. Output Swing to V_{CC} vs. Output Sourcing Current

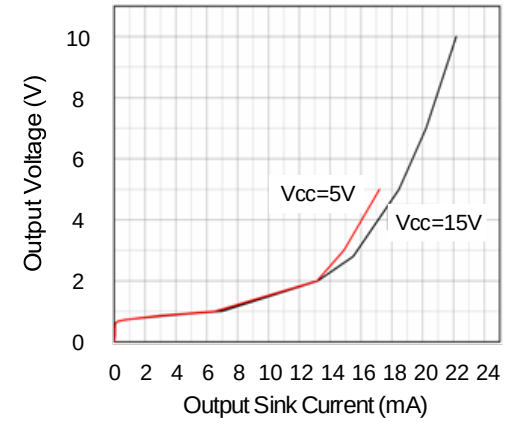


Figure 10. Output Swing vs. Output Sinking Current

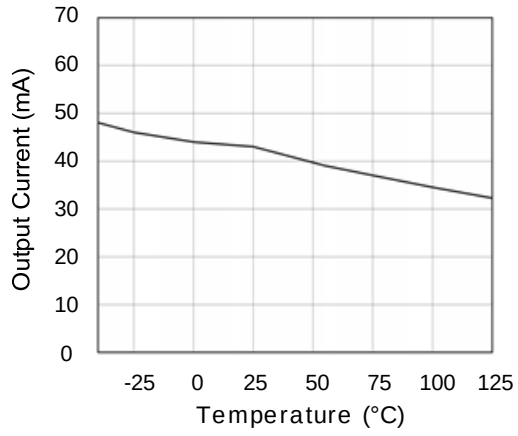
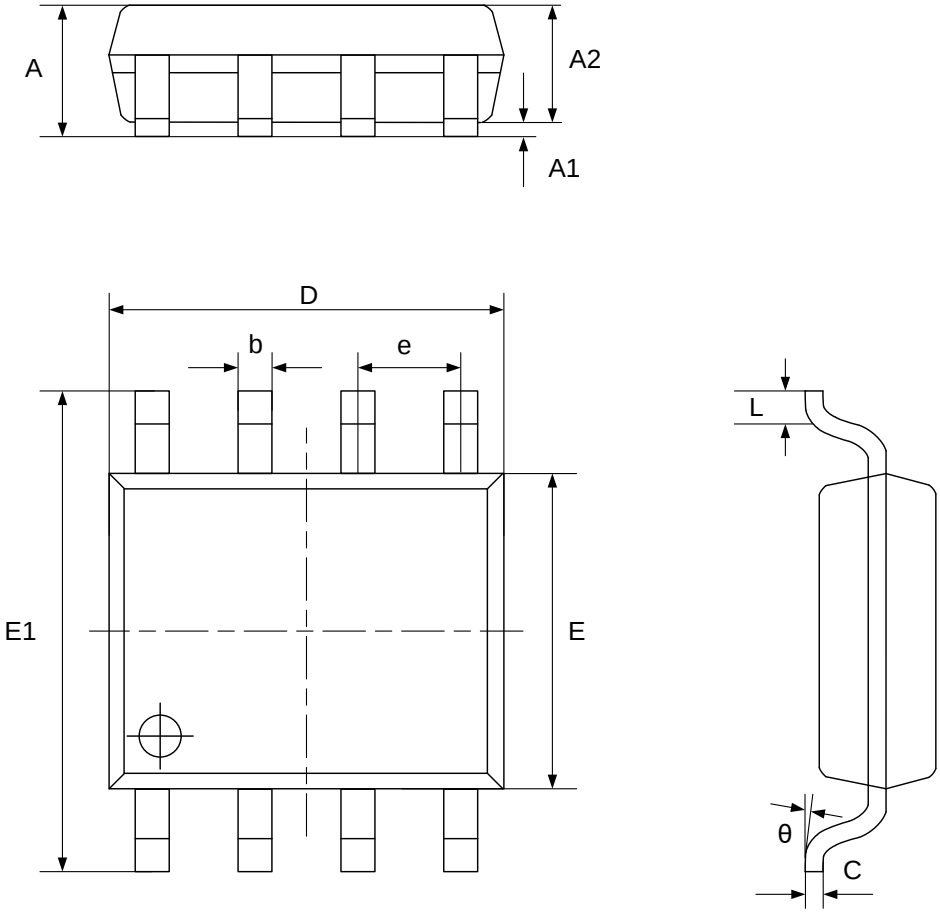


Figure 11. Output Sourcing Current vs.Temperature

6 Package Information

6.1 Outline Dimensions

SOIC-8L Package Outline



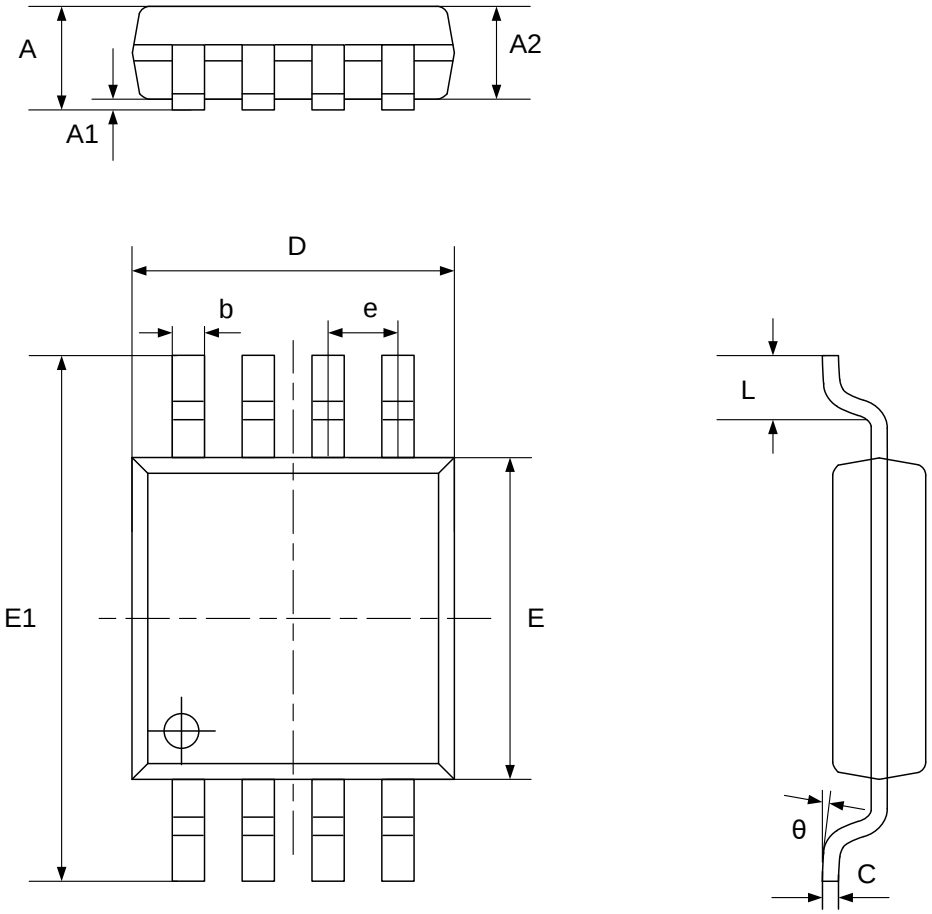
NOTES: (continued)

1. All dimensions are in millimeters.
2. Package dimensions does not include mold flash, protrusions, or gate burrs.
3. Refer to the Table 1 *SOIC-8L dimensions(mm)*.

Table 1. 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



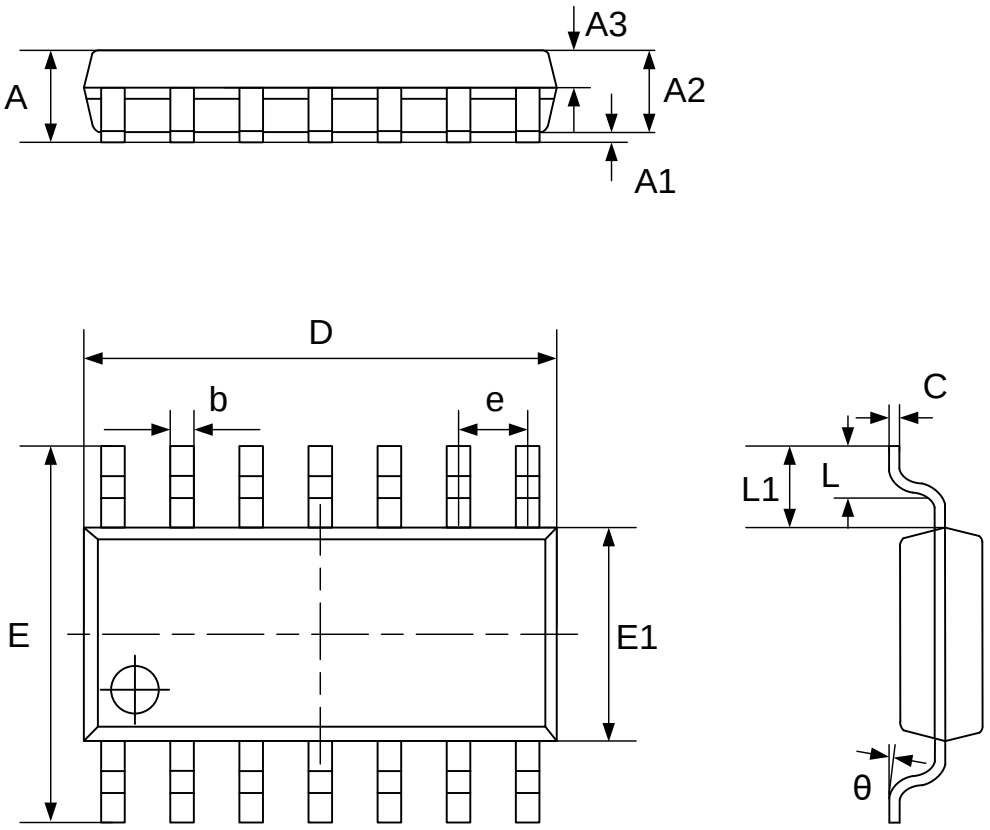
NOTES: (continued)

1. Refer to the Table 2 *MSOP-8L dimensions(mm)*.

Table 2. 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



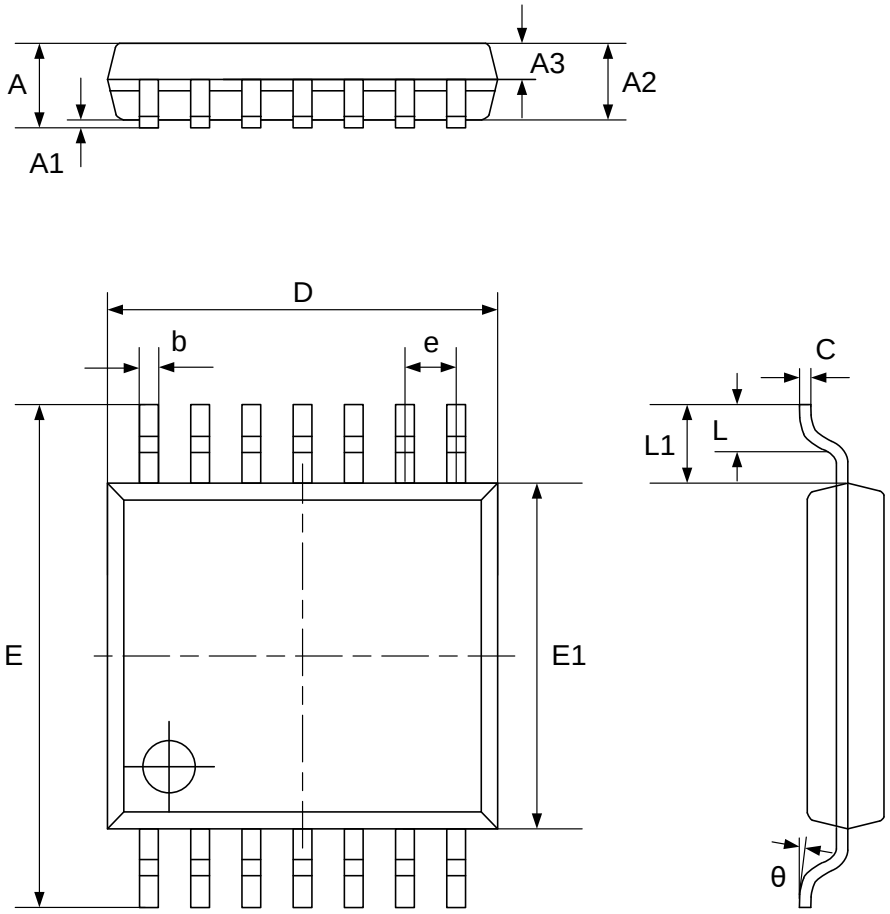
NOTES: (continued)

1. Refer to the Table 3 *SOIC-14L dimensions(mm)*.

Table 3. 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)

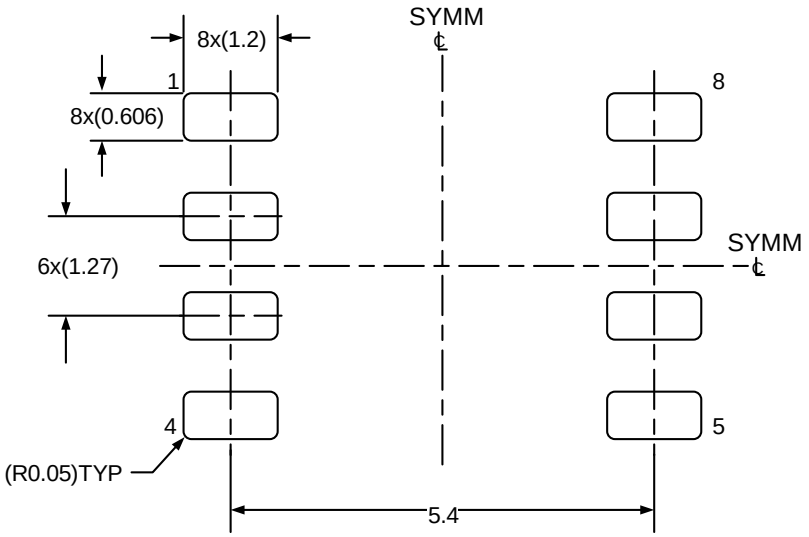
1. Refer to the Table 4 *TSSOP-14L dimensions(mm).*

Table 4. 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

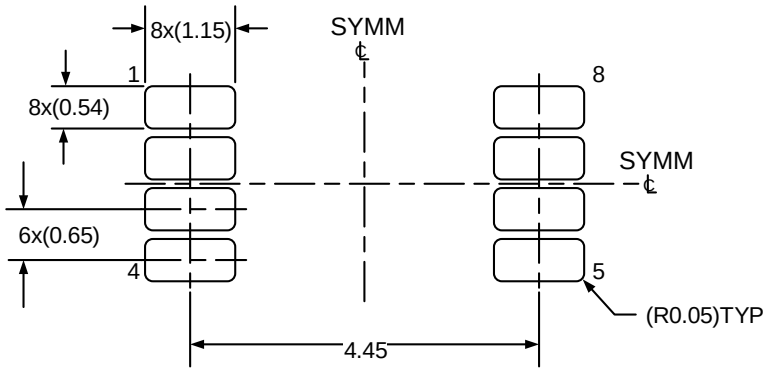
SOIC-8L Land Pattern Example



NOTES: (continued)

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

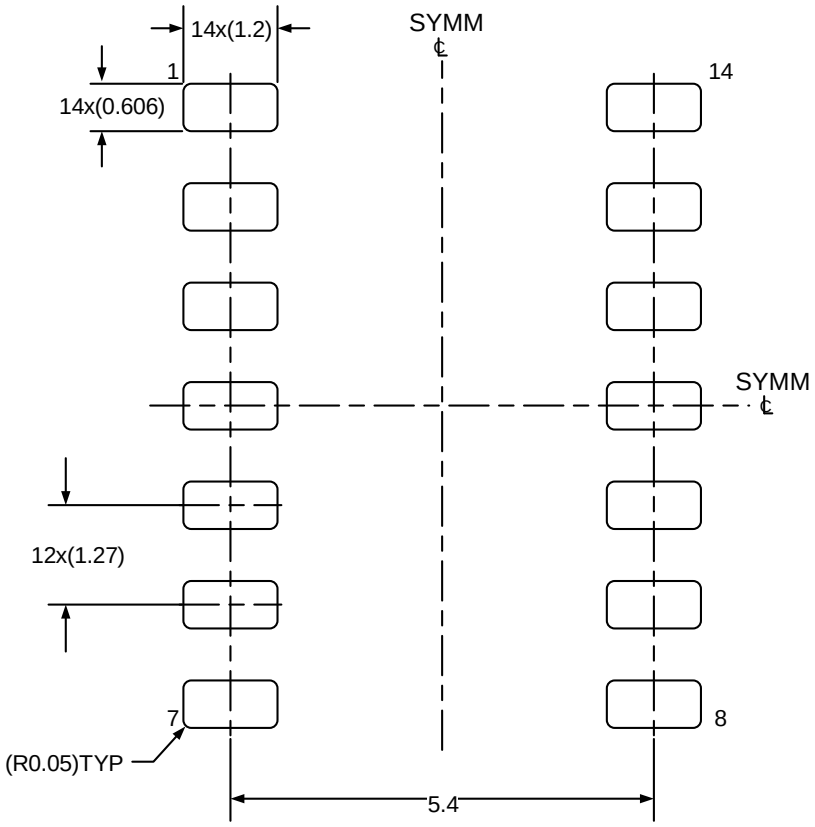
MSOP-8L Land Pattern Example



NOTES: (continued)

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

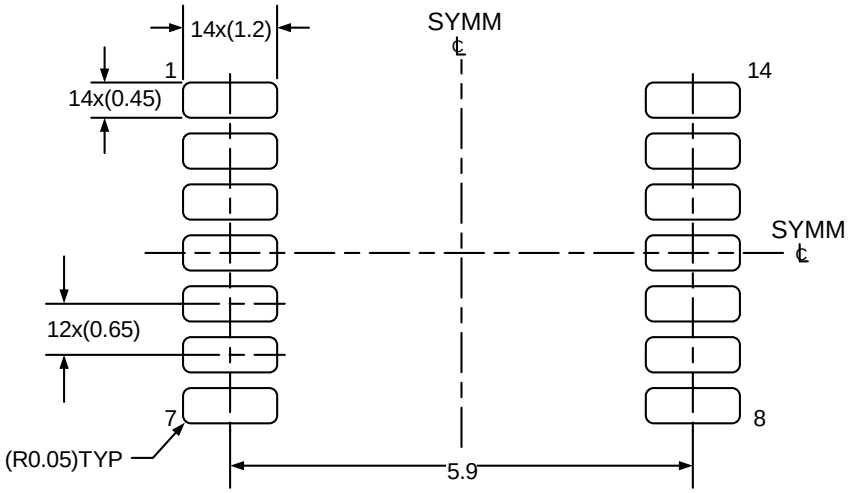
SOIC-14L Land Pattern Example



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)
GD30HA2904WMTR-IL2	MSOP-8L	Green	Tape & Reel	3000	−40°C to +125°C
GD30HA2904WGTR-IL2	SOIC-8L	Green	Tape & Reel	4000	−40°C to +125°C
GD30HA2902ZLTR-IL4	SOIC-14L	Green	Tape & Reel	2500	−40°C to +125°C
GD30HA2902ZPTR-IL4	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

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