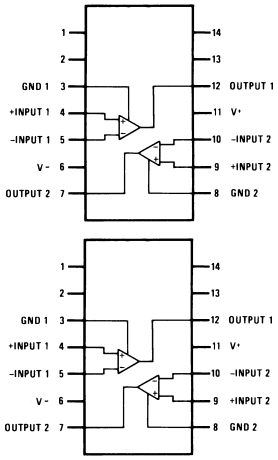
LMx19 High Speed Dual Comparator

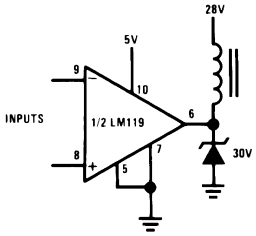
1 Features

- Two Independent Comparators
- Operates from a Single 5-V Supply
- Typically 80-ns Response Time at ±15 V
- Minimum Fan-out of 2 Each Side
- Maximum Input Current of 1 μA Over Temperature
- Inputs and Outputs can be Isolated from System Ground
- High Common-Mode Slew Rate

Connection Diagram



Typical Application - Relay Driver



2 Description

The LM119 series are precision high-speed dual comparators fabricated on a single monolithic chip. They are designed to operate over a wide range of supply voltages down to a single 5-V logic supply and ground. They have higher gain and lower input currents than devices such as the LM710. The uncommitted collector of the output stage makes the LM119 compatible with RTL, DTL, and TTL, as well as capable of driving lamps and relays at currents of up to 25 mA.

The LM319A offers improved precision over the standard LM319, with tighter tolerances on offset voltage, offset current, and voltage gain.

Although designed primarily for applications requiring operation from digital logic supplies, the LM119 series are fully specified for power supplies up to ±15 V. The series features faster response than the LM111, at the expense of higher power dissipation. However, the high-speed, wide operating voltage range and low package count make the LM119 more versatile than older devices such as the LM711.

The LM119 is specified from −55°C to +125°C, the LM219 is specified from −25°C to +85°C, and the LM319A and LM319 are specified from 0°C to +70°C.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM119, LM219, LM319	TO-100 (10)	8.96 mm × 8.96 mm
	CDIP (14)	6.67 mm × 19.56 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Table of Contents

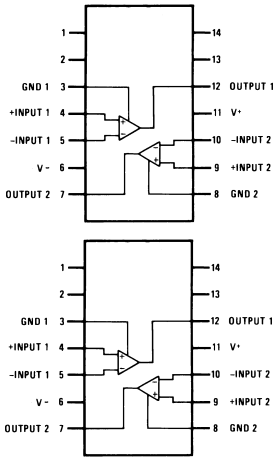
3 Revision History

Changes from Revision A (May 2004) to Revision B **Page**

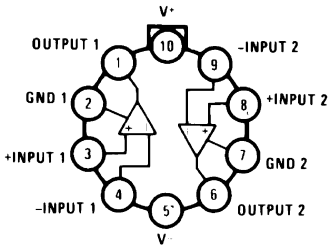
- Changed datasheet to new TI format from National. ... 1
- Added *Pin Functions* and *Thermal Information* tables, the *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1

4 Pin Configuration and Functions

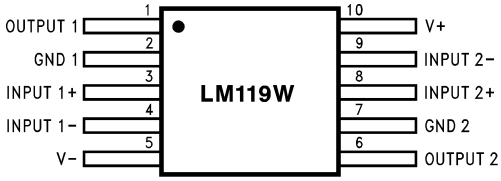
D, J, or NFF Package
14-Pins CDIP and PDIP
Top View



LME Package
10-Pins TO-100 (Metal Can Package)
Top View



NAD Package
10-Pins CFP
Top View



Pin Functions

PIN				I/O	DESCRIPTION
NAME	NO. (D, J, NFF 14)	NO. (LME 10)	NO. (NAD 10)		
OUTPUT 1	1	12	1	O	Comparator 1 output
GND 1	2	3	2	G	Comparator 1 ground connection
INPUT 1+	3	4	3	I	Comparator 1 input
INPUT 1-	4	5	4	I	Comparator 1 input
V-	5	6	5	P	Negative supply voltage
OUTPUT 2	6	7	6	O	Comparator 2 output
GND 2	7	8	7	G	Comparator 2 ground connection
INPUT 2+	8	9	8	I	Comparator 2 input
INPUT 2-	9	10	9	I	Comparator 2 input
V+	10	11	10	P	Positive supply voltage
NC	1,2,13,14				No connect. Do not connect to ground.

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)(2)(3)

		MIN	MAX	UNIT
Total supply voltage			36	V
Output to negative supply voltage			36	V
Ground to negative supply voltage			25	V
Ground to positive supply voltage			18	V
Differential input voltage		–5	+5	V
Input voltage(4)		–15	+15	V
Power dissipation(5)			500	mW
Output short circuit duration			10	sec
Lead temperature (soldering, 10 sec.)			260	°C
Soldering information(6)	Dual-In-Line Package Soldering (10 seconds)		260	°C
	Small Outline Package Vapor Phase (60 seconds)		215	
	Small Outline Package Infrared (15 seconds)		220	
Operating temperature	LM119	–55	125	°C
	LM219	–25	85	
	LM319A, LM319	0	70	
Storage temperature, T_{stg}		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(3) Refer to RETS119X for LM119H/883 and LM119J/883 specifications.
(4) For supply voltages less than ±15 V the absolute maximum input voltage is equal to the supply voltage.
(5) The maximum junction temperature of the LM119 is 150°C, while that of the LM219 is 110°C. For operating at elevated temperatures, devices in the H10 package must be derated based on a thermal resistance of 160°C/W, junction to ambient, or 19°C/W, junction to case. The thermal resistance of the J14 and N14 packages is 100°C/W, junction to ambient.
(6) See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±800	V

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

5.3 Thermal Information

THERMAL METRIC(1)		LM119, LM219, LM319			UNIT
		TO-100 (LME)	PDIP (NFF)	CDIP (J)	
		10 PINS	14 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	160	100	100	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	19	NA	NA	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

5.4 Electrical Characteristics LM119, LM219

These specifications apply for V_S = ±15 V, and the Ground pin at ground, and −55°C ≤ TA ≤ +125°C, unless otherwise stated. With the LM219, all temperature specifications are limited to −25°C ≤ TA ≤ +85°C. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5-V supply up to ±15-V supplies. Do not operate the device with more than 16 V from ground to V_S.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Offset Voltage (1)	T_A = 25°C, RS ≤ 5k		0.7	4	mV
Input Offset Current (1)	T_A = 25°C		30	75	nA
Input Bias Current	T_A = 25°C		150	500	nA
Voltage Gain	T_A = 25°C (2)	10	40		V/mV
Response Time (3)	T_A = 25°C, V_S = ±15 V		80		ns
Saturation Voltage	V_{IN} ≤ −5 mV, I_{OUT} = 25 mA T_A = 25°C		0.75	1.5	V
Output Leakage Current	V_{IN} ≥ 5 mV, V_{OUT} = 35 V T_A = 25°C		0.2	2	µA
Input Offset Voltage (1)	R_S ≤ 5k			7	mV
Input Offset Current (1)				100	nA
Input Bias Current				1000	nA
Input Voltage Range	V_S = ±15 V	–12	±13	+12	V
	V^+ = 5 V, V^- = 0	1		3	
Saturation Voltage	V^+ ≥ 4.5 V, V^- = 0 V_{IN} ≤ −6 mV, I_{SINK} ≤ 3.2 mA T_A ≥ 0°C		0.23	0.4	V
	T_A ≤ 0°C			0.6	
Output Leakage Current	V_{IN} ≥ 5 mV, V_{OUT} = 35 V, V^- = V_{GND} = 0 V		1	10	µA
Differential Input Voltage				±5	V
Positive Supply Current	T_A = 25°C, V^+ = 5 V, V^- = 0		4.3		mA
Positive Supply Current	T_A = 25°C, V_S = ±15 V		8	11.5	mA
Negative Supply Current	T_A = 25°C, V_S = ±15 V		3	4.5	mA

(1) The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1-mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
(2) Output is pulled up to 15 V through a 1.4-kW resistor.
(3) The response time specified is for a 100-mV input step with 5-mV overdrive.

5.5 Electrical Characteristics LM319, LM319A

These specifications apply for V_S = ±15 V, and 0°C ≤ T_A ≤ 70°C, unless otherwise stated. The offset voltage, offset current, and bias current specifications apply for any supply voltage from a single 5-V supply up to ±15-V supplies. Do not operate the device with more than 16 V from ground to V_S.

PARAMETER	TEST CONDITIONS	LM319A			LM319			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage (1)	T_A = 25°C, RS ≤ 5k		0.5	1		2	8	mV
Input Offset Current (1)	T_A = 25°C		20	40		80	200	nA
Input Bias Current	T_A = 25°C		150	500		250	1000	nA
Voltage Gain	T_A = 25°C (2)	20	40		8	40		V/mV
Response Time (3)	T_A = 25°C, V_S = ±15 V		80			80		ns
Saturation Voltage	V_{IN} ≤ −10 mV, I_{OUT} = 25 mA T_A = 25°C		0.75	1.5		0.75	1.5	V
Output Leakage Current	V_{IN} ≥ 10 mV, V_{OUT} = 35 V V^- = V_{GND} = 0 V, T_A = 25°C		0.2	10		0.2	10	µA
Input Offset Voltage (1)	R_S ≤ 5k			10			10	mV
Input Offset Current (1)				300			300	nA
Input Bias Current				1000			1200	nA
Input Voltage Range	V_S = ±15 V		±13			±13		V
	V^+ = 5 V, V^- = 0	1		3	1		3	
Saturation Voltage	V^+ ≥ 4.5 V, V^- = 0 V_{IN} ≤ −10 mV, I_{SINK} ≤ 3.2 mA		0.3	0.4		0.3	0.4	V
Differential Input Voltage				±5			±5	V
Positive Supply Current	T_A = 25°C, V^+ = 5 V, V^- = 0		4.3			4.3		mA
Positive Supply Current	T_A = 25°C, V_S = ±15 V		8	12.5		8	12.5	mA
Negative Supply Current	T_A = 25°C, V_S = ±15 V		3	5		3	5	mA

(1) The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1-mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
(2) Output is pulled up to 15 V through a 1.4-kW resistor.
(3) The response time specified is for a 100-mV input step with 5-mV overdrive.

5.6 Typical Characteristics

5.6.1 Typical Characteristics – LM119, LM119A, LM219

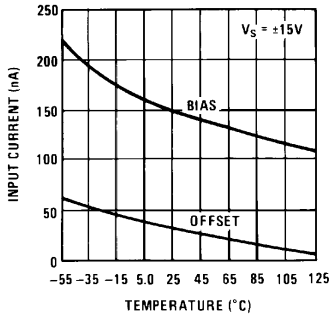


Figure 1. Input Currents

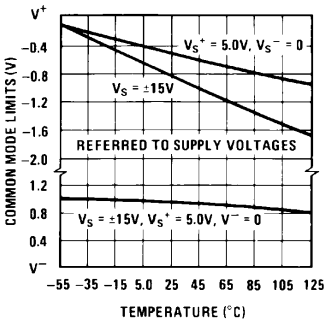


Figure 2. Common-Mode Limits

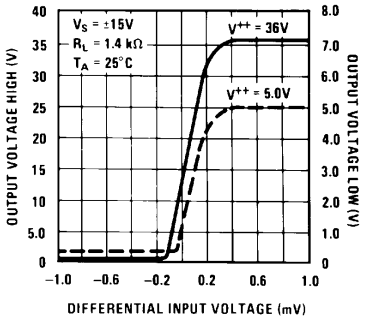


Figure 3. Transfer Function

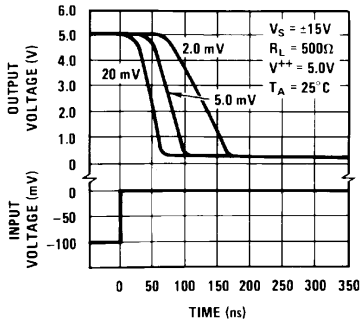


Figure 4. Response Time for Various Input Overdrives

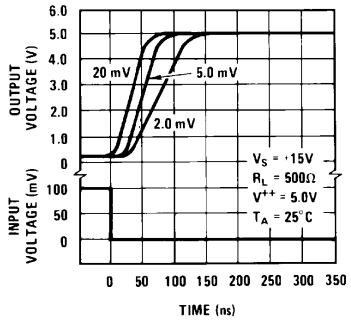


Figure 5. Response Time for Various Input Overdrives

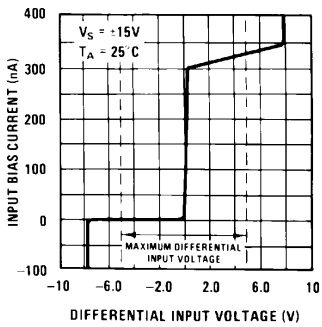


Figure 6. Input Characteristics

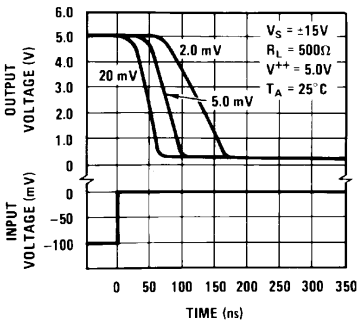


Figure 7. Response Time for Various Input Overdrives

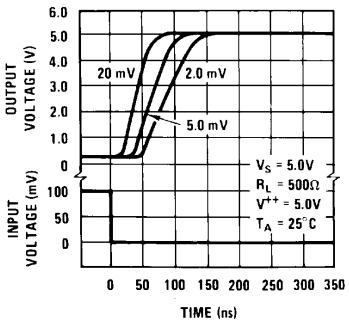


Figure 8. Response Time for Various Input Overdrives

Typical Characteristics – LM119, LM119A, LM219 (continued)

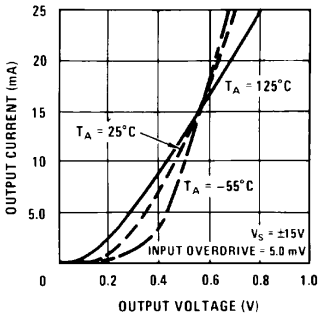


Figure 9. Output Saturation Voltage

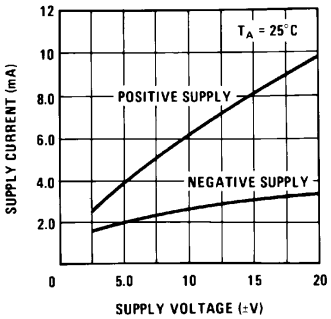


Figure 10. Supply Current

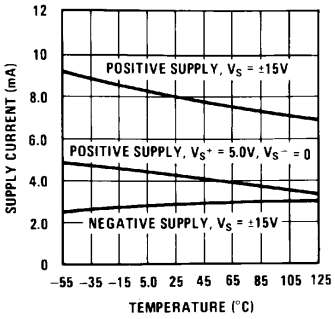


Figure 11. Supply Current

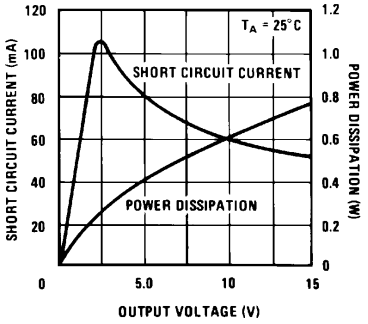


Figure 12. Output Limiting Characteristics

5.6.2 Typical Characteristics – LM319, LM319A

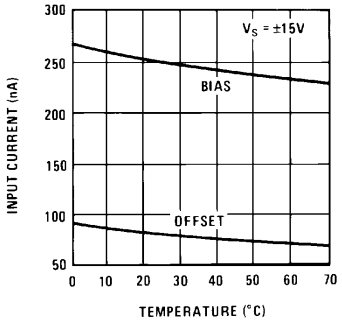


Figure 13. Input Currents

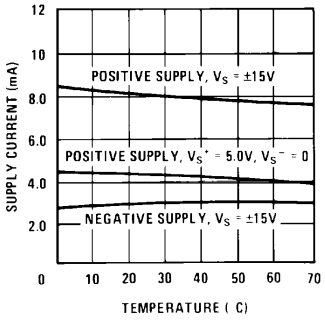


Figure 14. Supply Currents

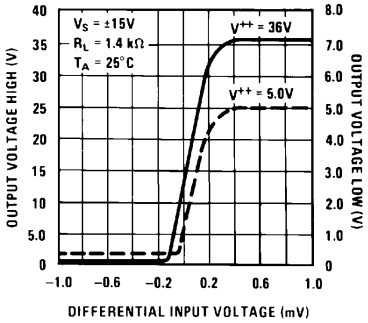


Figure 15. Transfer Function

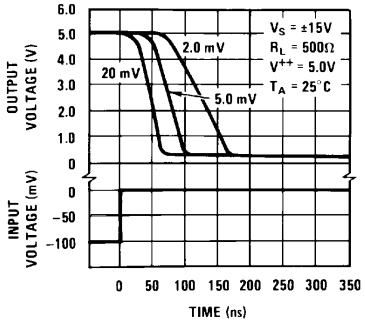


Figure 16. Response Time for Various Input Overdrives

Typical Characteristics – LM319, LM319A (continued)

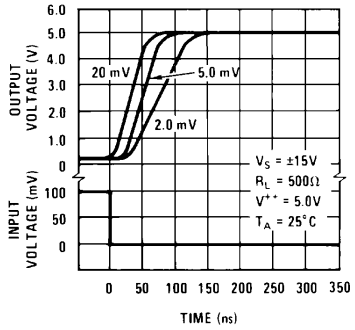


Figure 17. Response Time for Various Input Overdrives

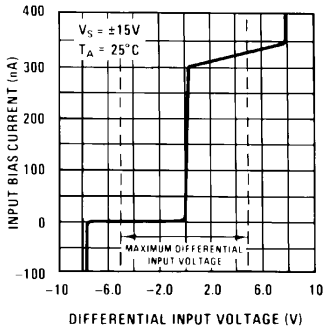


Figure 18. Input Characteristics

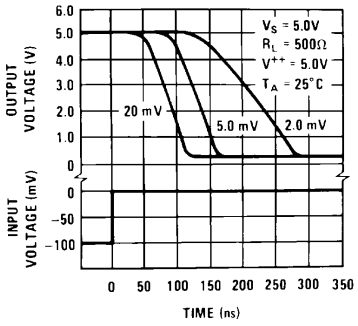


Figure 19. Response Time for Various Input Overdrives

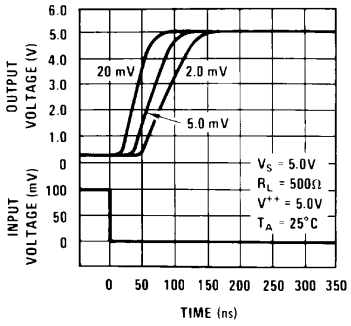


Figure 20. Response Time for Various Input Overdrives

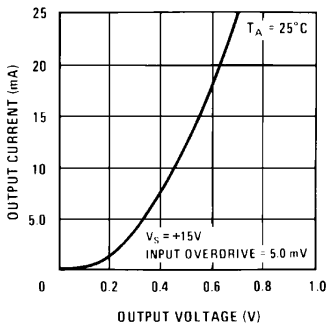


Figure 21. Output Saturation Voltage

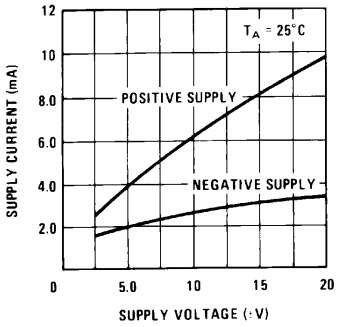


Figure 22. Supply Current

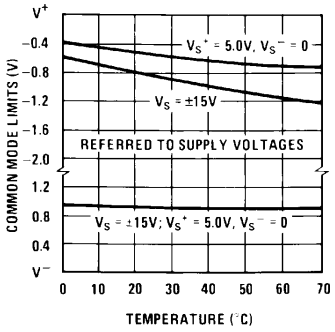


Figure 23. Common-Mode Limits

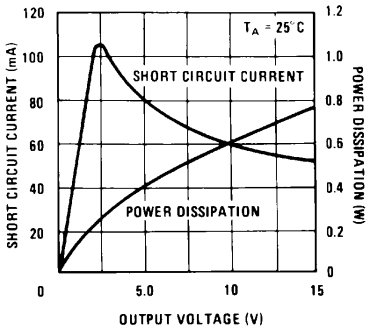
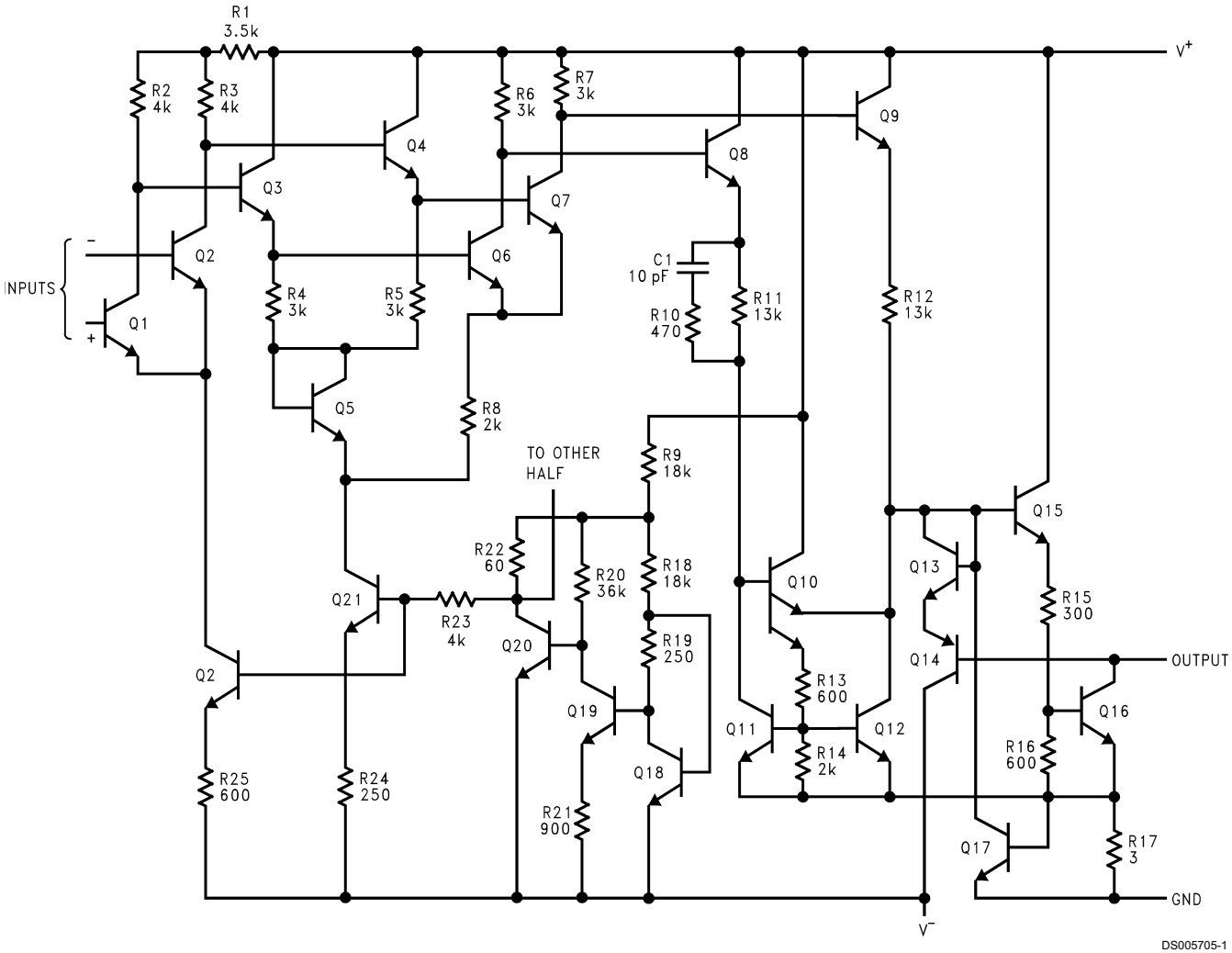


Figure 24. Output Limiting Characteristics

6 Detailed Description

6.1 Functional Block Diagram



∗Do not operate the LM119 with more than 16V between GND and V+

7 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

7.1 Typical Applications

7.1.1 Relay Driver

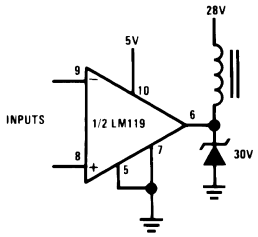


Figure 25. Relay Driver

7.1.2 Window Detector

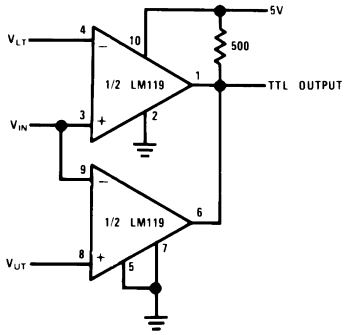


Figure 26. Window Detector

8 Device and Documentation Support

8.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
LM119	Click here	Click here	Click here	Click here	Click here
LM219	Click here	Click here	Click here	Click here	Click here
LM319	Click here	Click here	Click here	Click here	Click here

8.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

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8.4 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

8.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

9 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM119H	ACTIVE	TO-100	LME	10	500	TBD	Call TI	Call TI	-55 to 125	(LM119H ~ LM119H)	Samples
LM119H/NOPB	ACTIVE	TO-100	LME	10	500	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	-55 to 125	(LM119H ~ LM119H)	Samples
LM119J	ACTIVE	CDIP	J	14	25	TBD	Call TI	Call TI	-55 to 125	LM119J	Samples
LM319AM	NRND	SOIC	D	14	55	TBD	Call TI	Call TI	0 to 70	LM319AM	
LM319AM/NOPB	ACTIVE	SOIC	D	14	55	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	LM319AM	Samples
LM319AMX/NOPB	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	LM319AM	Samples
LM319M	NRND	SOIC	D	14	55	TBD	Call TI	Call TI	0 to 70	LM319M	
LM319M/NOPB	ACTIVE	SOIC	D	14	55	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	LM319M	Samples
LM319MX/NOPB	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	LM319M	Samples
LM319N/NOPB	ACTIVE	PDIP	NFF	14	25	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	0 to 70	LM319N	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

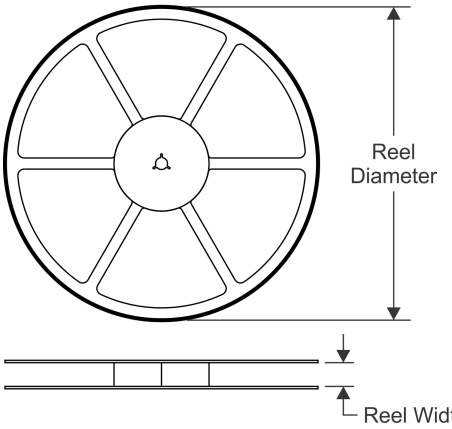
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

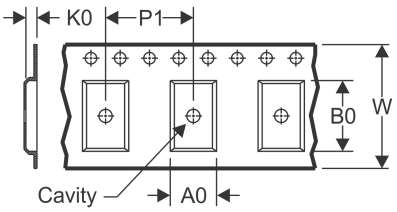
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

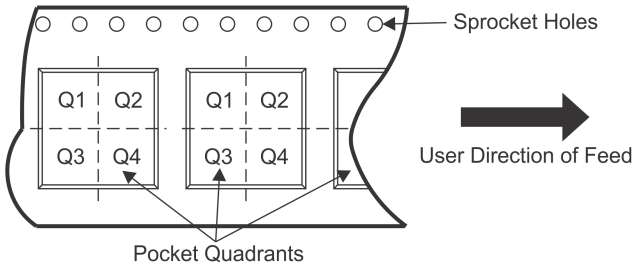


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

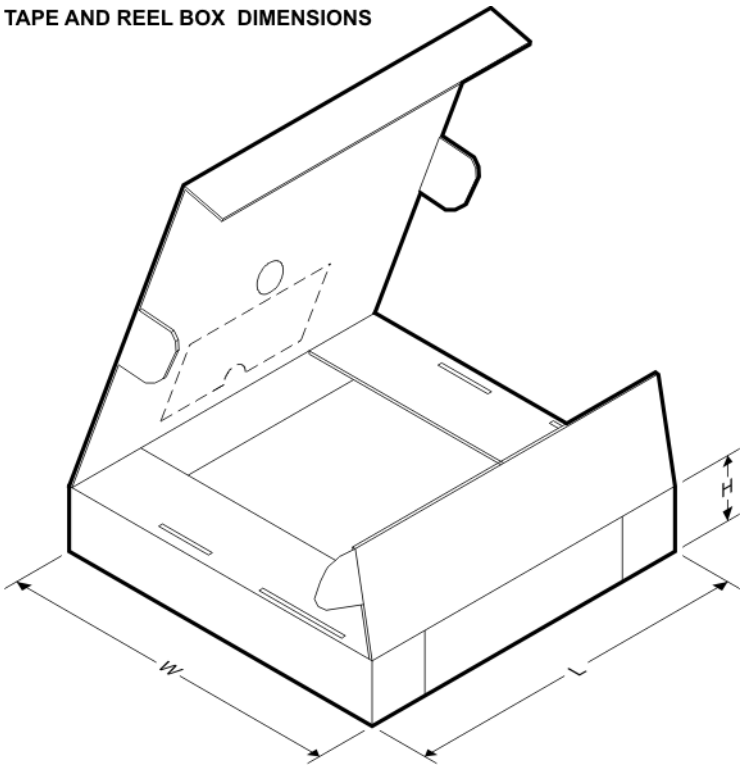
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM319AMX/NOPB	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1
LM319MX/NOPB	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS

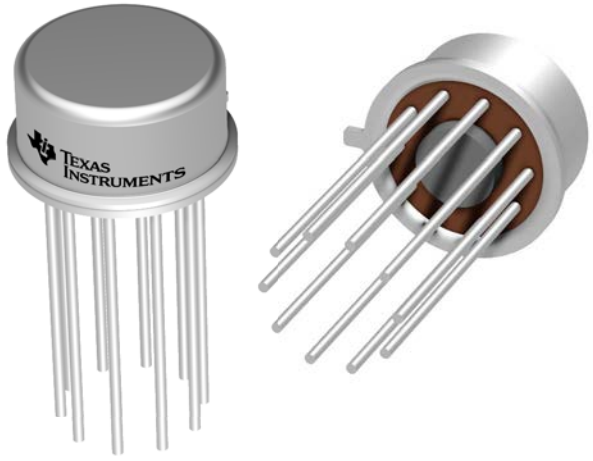


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM319AMX/NOPB	SOIC	D	14	2500	367.0	367.0	35.0
LM319MX/NOPB	SOIC	D	14	2500	367.0	367.0	35.0

LME 10 TO-CAN - 5.72 mm max height

METAL CYLINDRICAL PACKAGE



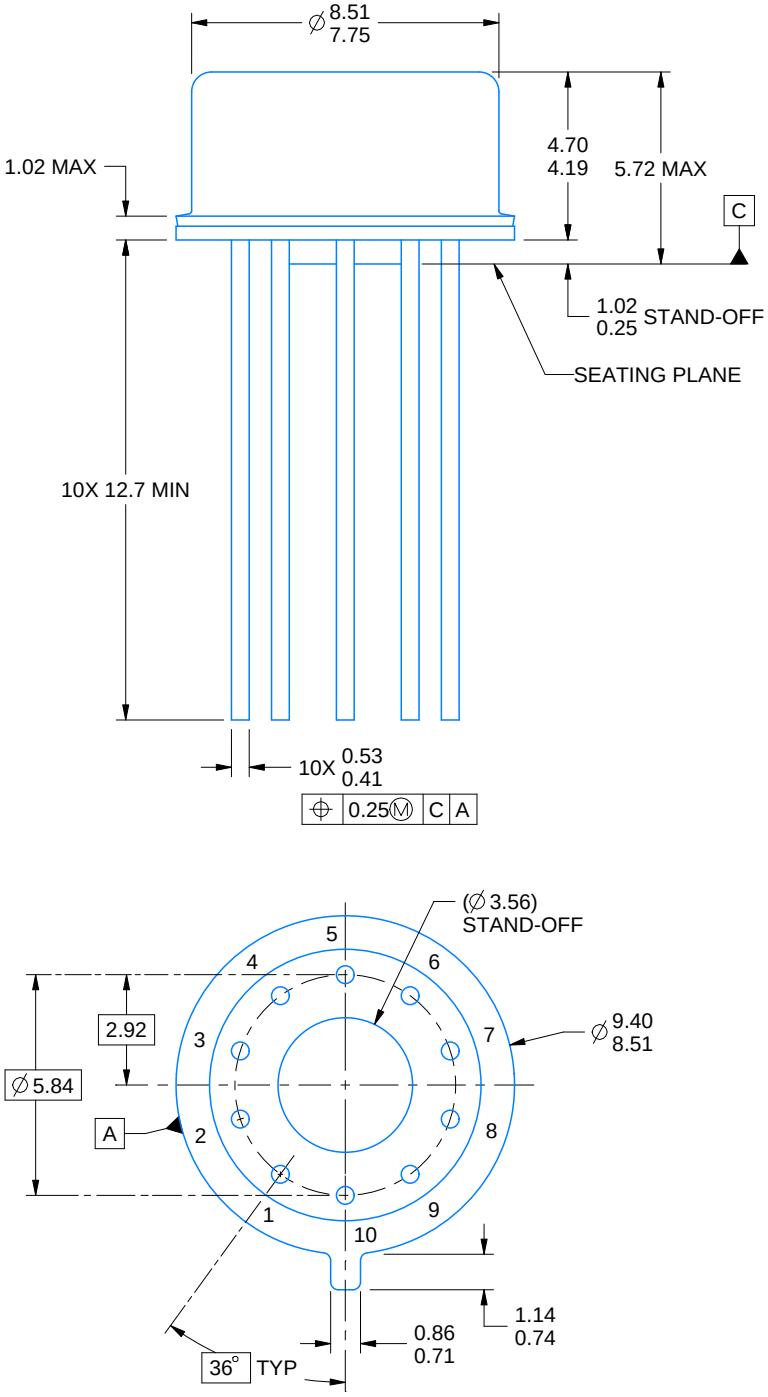
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

PACKAGE OUTLINE

LME0010A

TO-CAN - 5.72 mm max height

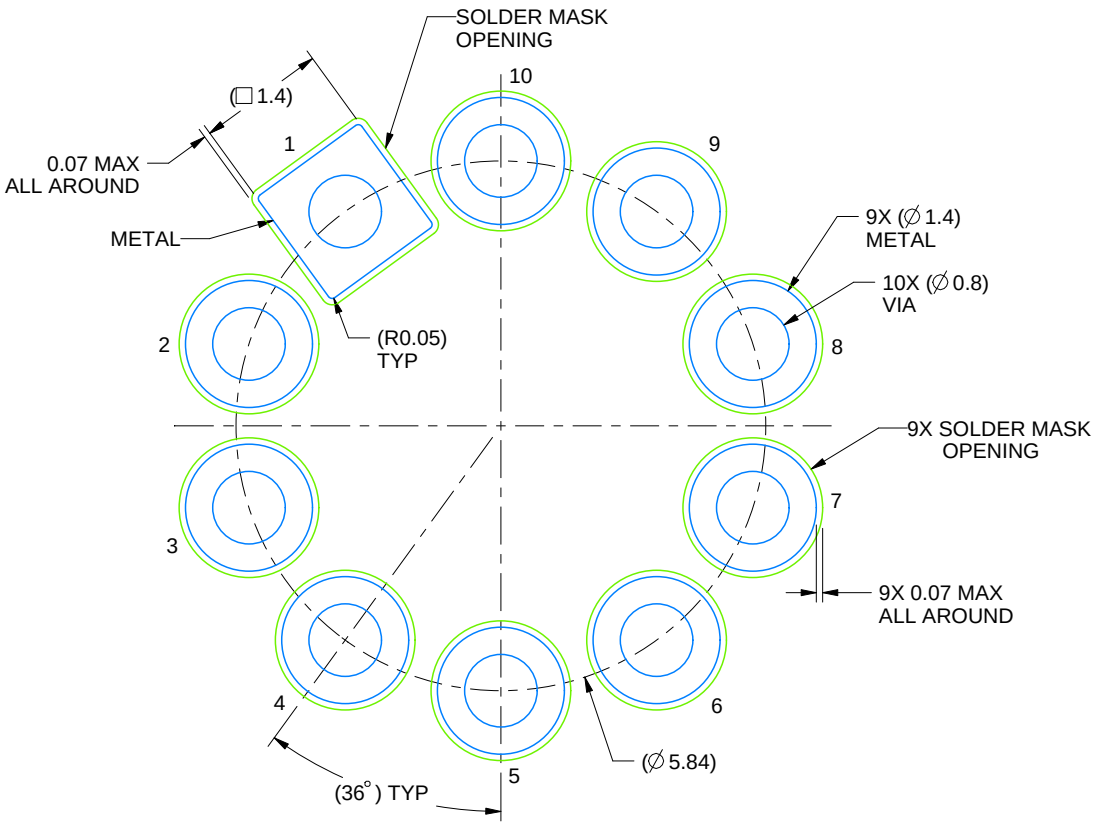
METAL CYLINDRICAL PACKAGE



4220604/A 05/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration MO-006/TO-100.



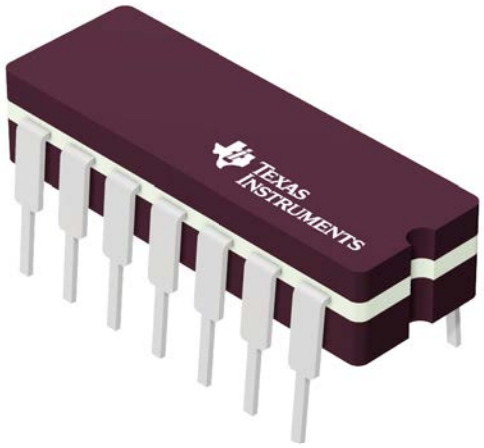
LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 12X

4220604/A 05/2017

GENERIC PACKAGE VIEW

J 14 CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

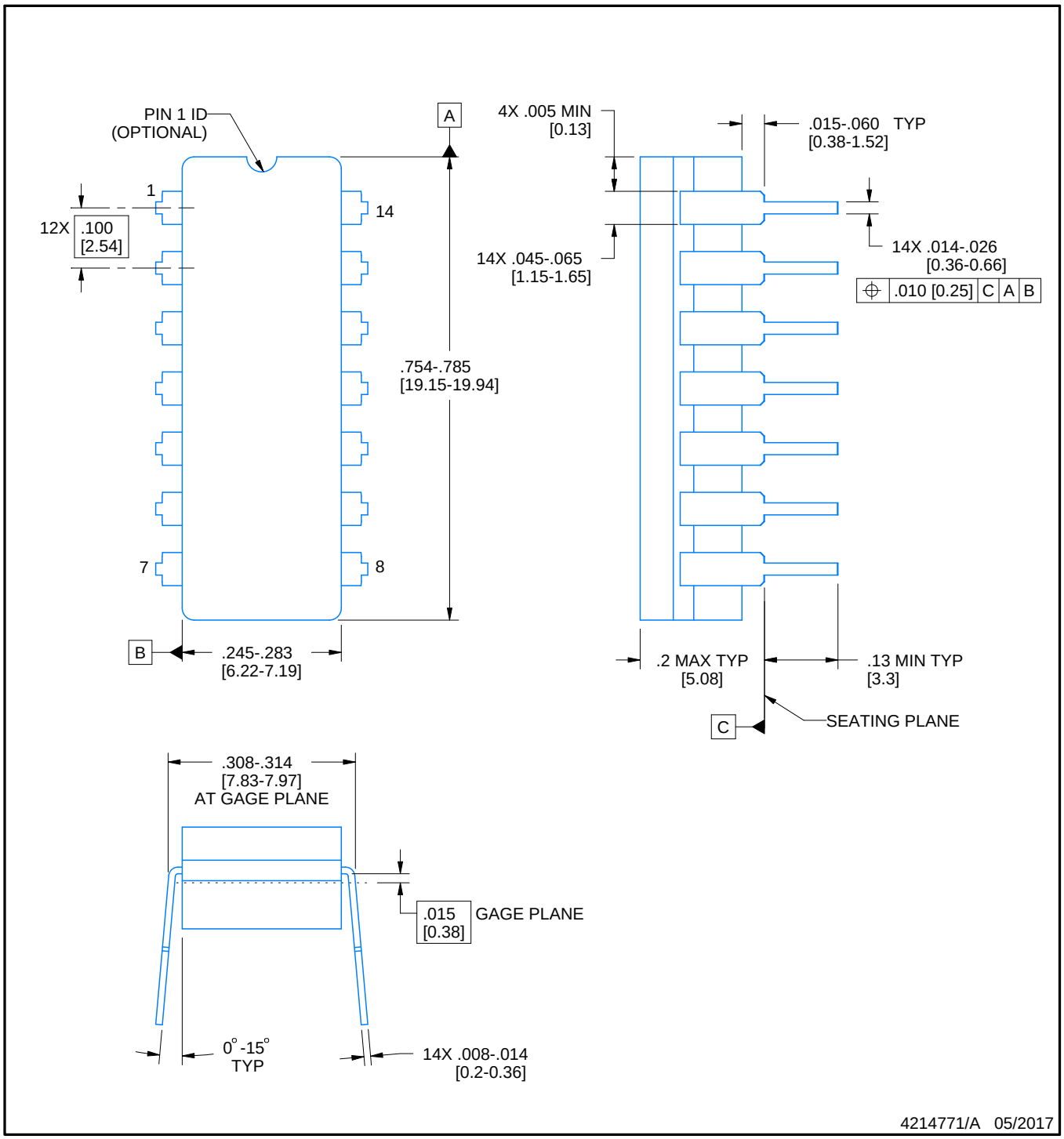
4040083-5/G

PACKAGE OUTLINE

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



NOTES:

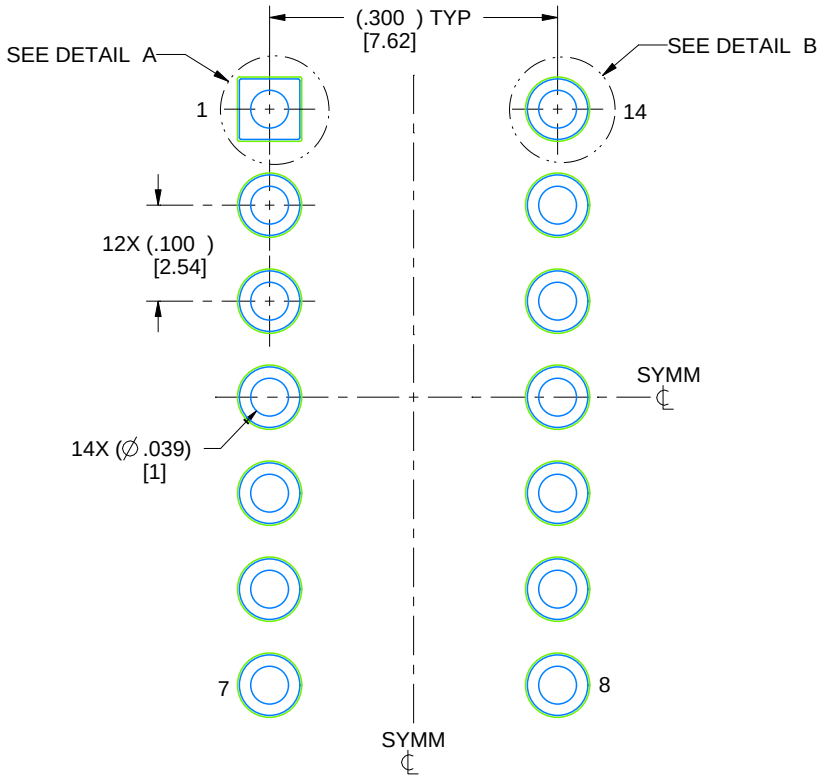
1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermitically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.

EXAMPLE BOARD LAYOUT

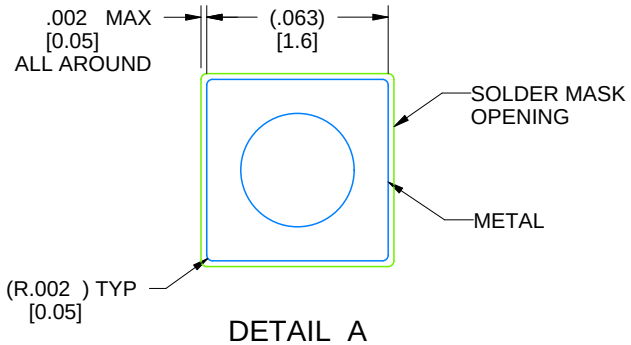
J0014A

CDIP - 5.08 mm max height

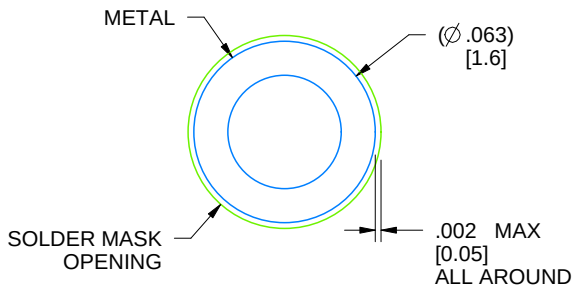
CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 5X



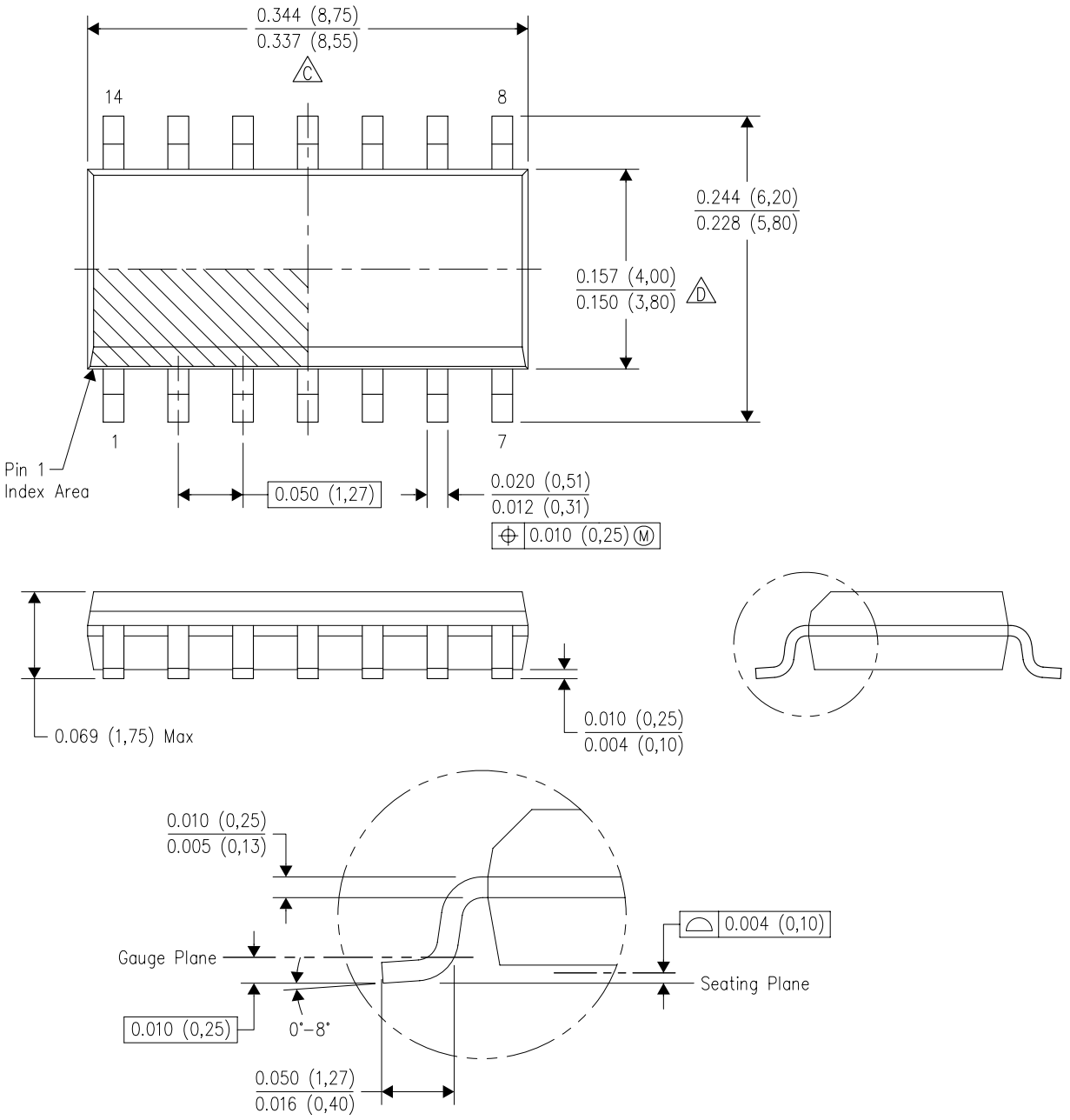
DETAIL A
SCALE: 15X



DETAIL B
13X, SCALE: 15X

4214771/A 05/2017

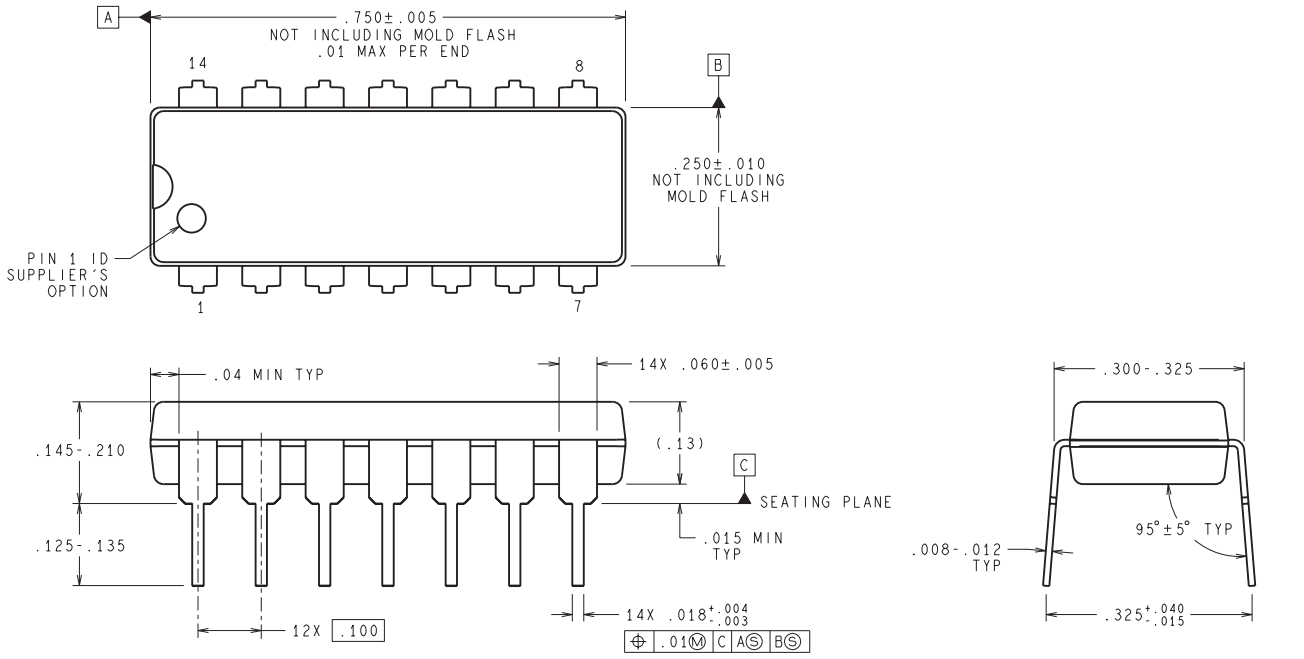
D (R–PDSO–G14) PLASTIC SMALL OUTLINE



4040047–5/M 06/11

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AB.

NFF0014A



DIMENSIONS ARE IN INCHES
DIMENSIONS IN ( ) FOR REFERENCE ONLY

N14A (Rev G)

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