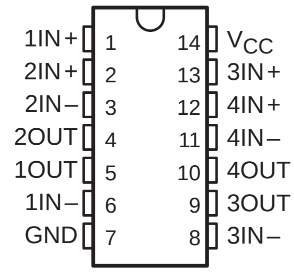
- **Wide Range of Supply Voltages, Single or Dual Supplies**
- **Wide Bandwidth**
- **Large Output Voltage Swing**
- **Output Short-Circuit Protection**
- **Internal Frequency Compensation**
- **Low Input Bias Current**
- **Designed to Be Interchangeable With National Semiconductor LM2900 and LM3900, Respectively**

N PACKAGE
(TOP VIEW)

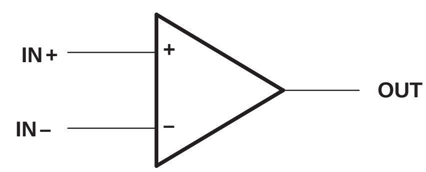


description

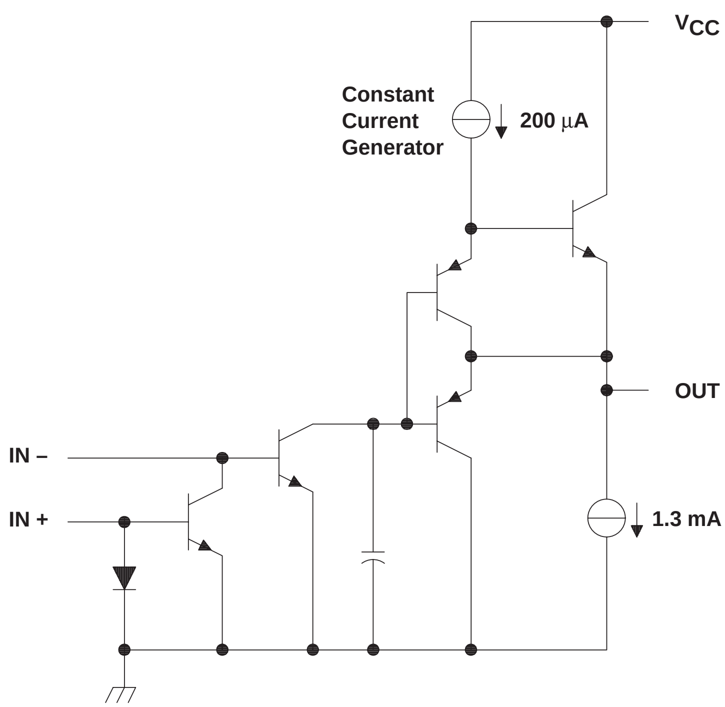
These devices consist of four independent, high-gain frequency-compensated Norton operational amplifiers that were designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies is also possible. The low supply current drain is essentially independent of the magnitude of the supply voltage. These devices provide wide bandwidth and large output voltage swing.

The LM2900 is characterized for operation from –40°C to 85°C, and the LM3900 is characterized for operation from 0°C to 70°C.

symbol (each amplifier)



schematic (each amplifier)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

	LM2900	LM3900	UNIT
Supply voltage, V_{CC} (see Note 1)	36	36	V
Input current	20	20	mA
Duration of output short circuit (one amplifier) to ground at (or below) 25°C free-air temperature (see Note 2)	unlimited	unlimited	
Continuous total dissipation	See Dissipation Rating Table		
Operating free-air temperature range	–40 to 85	0 to 70	°C
Storage temperature range	–65 to 150	–65 to 150	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260	260	°C

NOTES: 1. All voltage values, except differential voltages, are with respect to the network ground terminal.
2. Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
N	1150 mW	9.2 mW/°C	736 mW	598 mW

recommended operating conditions

	LM2900		LM3900		UNIT
	MIN	MAX	MIN	MAX	
Supply voltage, V_{CC} (single supply)	4.5	32	4.5	32	V
Supply voltage, V_{CC+} (dual supply)	2.2	16	2.2	16	V
Supply voltage, V_{CC-} (dual supply)	–2.2	–16	–2.2	–16	V
Input current (see Note 3)		–1		–1	mA
Operating free-air temperature, T_A	–40	85	0	70	°C

NOTE 3: Clamp transistors are included that prevent the input voltages from swinging below ground more than approximately –0.3 V. The negative input currents that may result from large signal overdrive with capacitive input coupling must be limited externally to values of approximately –1 mA. Negative input currents in excess of –4 mA causes the output voltage to drop to a low voltage. These values apply for any one of the input terminals. If more than one of the input terminals are simultaneously driven negative, maximum currents are reduced. Common-mode current biasing can be used to prevent negative input voltages.

electrical characteristics, V_{CC} = 15 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		LM2900			LM3900			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
I_{IB}	Input bias current (inverting input)	I_{I+} = 0	T_A = 25°C		30	200		30	200	nA
			T_A = Full range		300			300		
	Mirror gain	I_{I+} = 20 µA to 200 µA, T_A = Full range, See Note 4		0.9		1.1	0.9		1.1	µA/µA
	Change in mirror gain				2%	5%		2%	5%	
	Mirror current	V_{I+} = V_{I-}, T_A = Full range, See Note 4			10	500		10	500	µA
A_{VD}	Large-signal differential voltage amplification	V_O = 10 V, R_L = 10 kΩ, f = 100 Hz		1.2	2.8		1.2	2.8		V/mV
r_i	Input resistance (inverting input)				1			1		MΩ
r_o	Output resistance				8			8		kΩ
B_1	Unity-gain bandwidth (inverting input)				2.5			2.5		MHz
k_{SVR}	Supply voltage rejection ratio (ΔV_{CC} /ΔV_{IO})				70			70		dB
V_{OH}	High-level output voltage	I_{I+} = 0, I_{I-} = 0	R_L = 2 kΩ	13.5			13.5			V
			V_{CC} = 30 V, No load		29.5			29.5		
V_{OL}	Low-level output voltage	I_{I+} = 0, I_{I-} = 10 µA, R_L = 2 kΩ			0.09	0.2		0.09	0.2	V
I_{OS}	Short-circuit output current (output internally high)	I_{I+} = 0, I_{I-} = 0, V_O = 0		–6	–18		–6	–10		mA
	Pulldown current			0.5	1.3		0.5	1.3		mA
I_{OL}	Low-level output current‡	I_{I-} = 5 µA	V_{OL} = 1 V		5			5		mA
I_{CC}	Supply current (four amplifiers)	No load			6.2	10		6.2	10	mA

† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified. Full range for T_A is –40°C to 85°C for LM2900 and 0°C to 70°C for LM3900.

‡ The output current-sink capability can be increased for large-signal conditions by overdriving the inverting input.

NOTE 4: These parameters are measured with the output balanced midway between V_{CC} and GND.

operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	Low-to-high output	V_O = 10 V, C_L = 100 pF, R_L = 2 kΩ		0.5		V/µs
		High-to-low output			20		

TYPICAL CHARACTERISTICS†

INPUT BIAS CURRENT (INVERTING INPUT)
vs
FREE-AIR TEMPERATURE

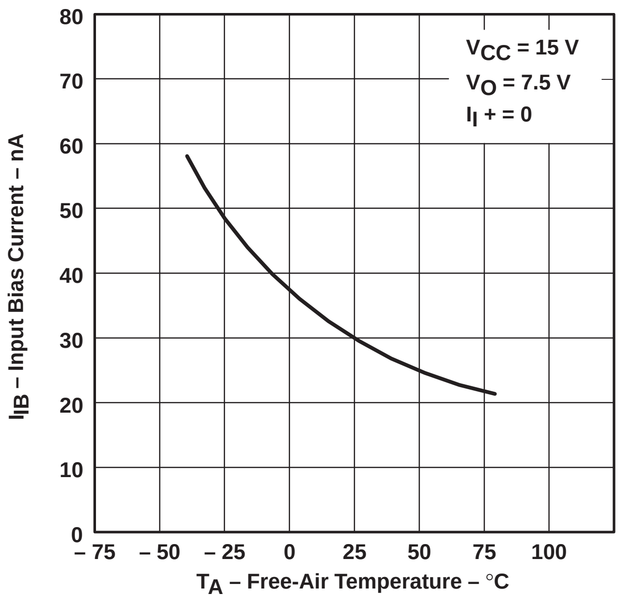


Figure 1

MIRROR GAIN
vs
FREE-AIR TEMPERATURE

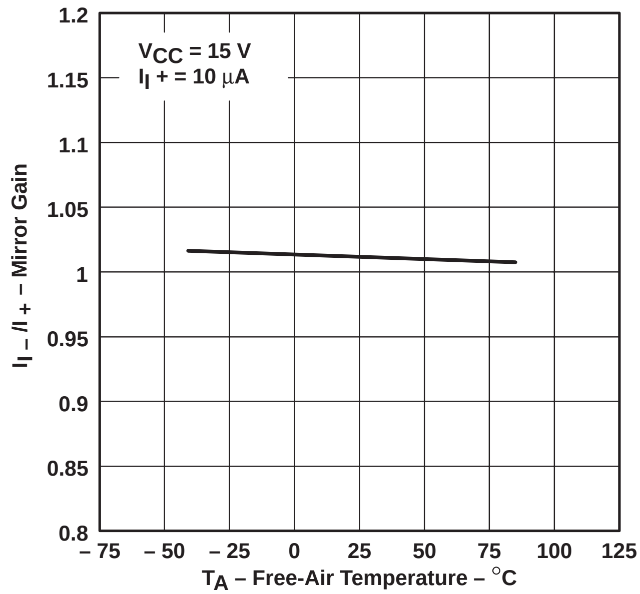


Figure 2

LARGE SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREQUENCY

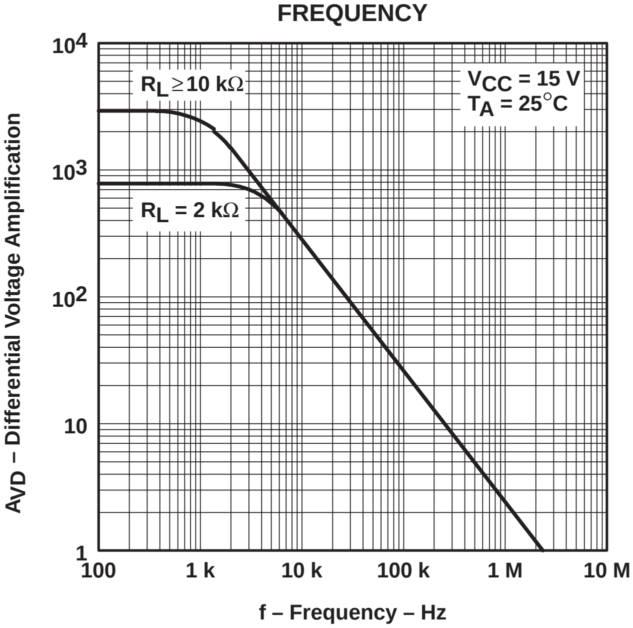


Figure 3

LARGE SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
SUPPLY VOLTAGE

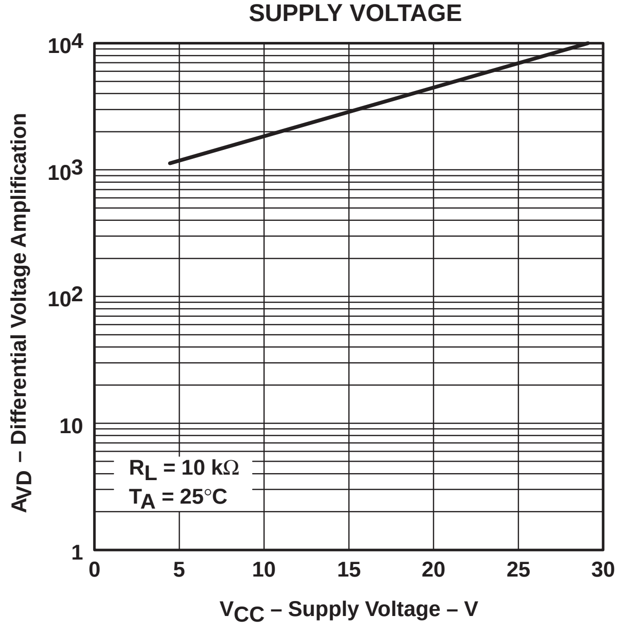


Figure 4

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

LARGE SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREE-AIR TEMPERATURE

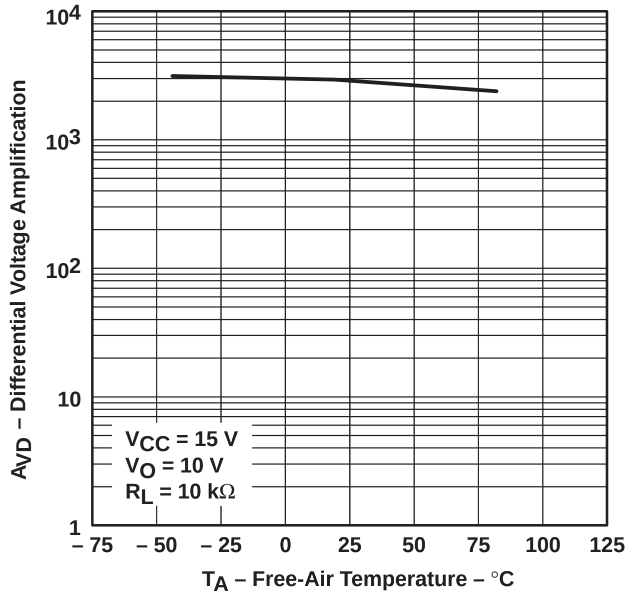


Figure 5

SUPPLY VOLTAGE REJECTION RATIO
vs
FREQUENCY

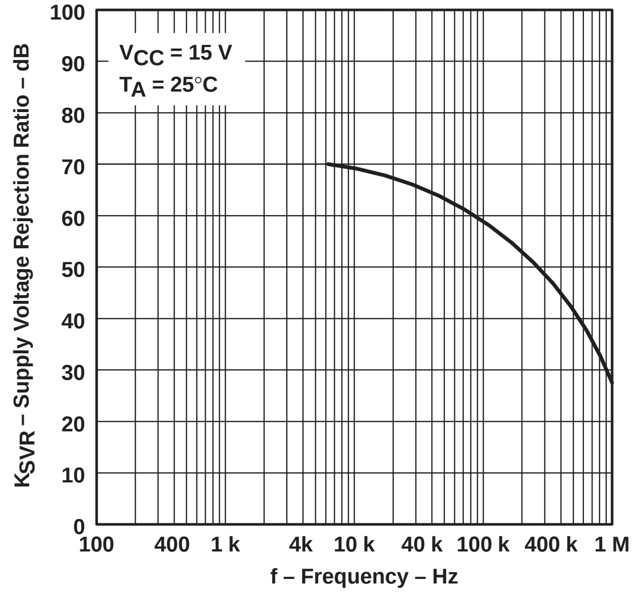


Figure 6

PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

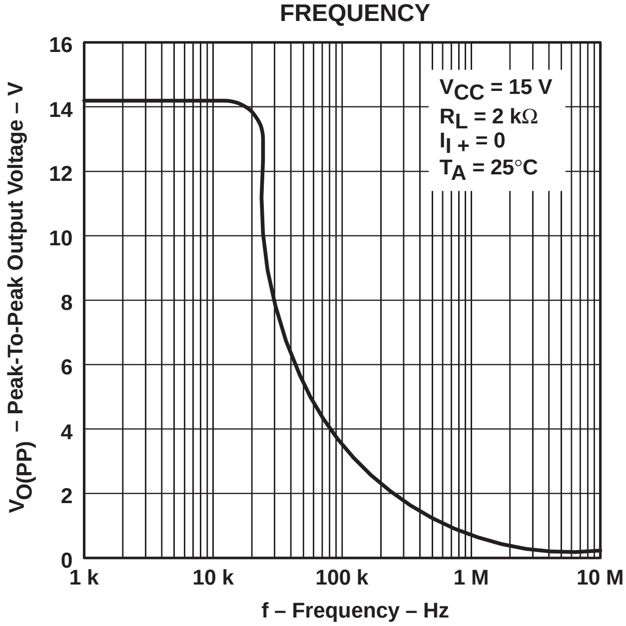


Figure 7

SHORT-CIRCUIT OUTPUT CURRENT
(OUTPUT INTERNALLY HIGH)
vs
SUPPLY VOLTAGE

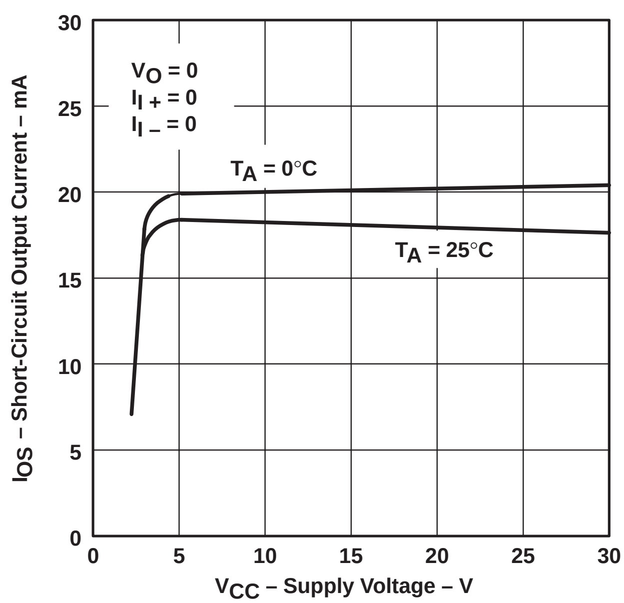


Figure 8

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

LOW-LEVEL OUTPUT CURRENT vs SUPPLY VOLTAGE

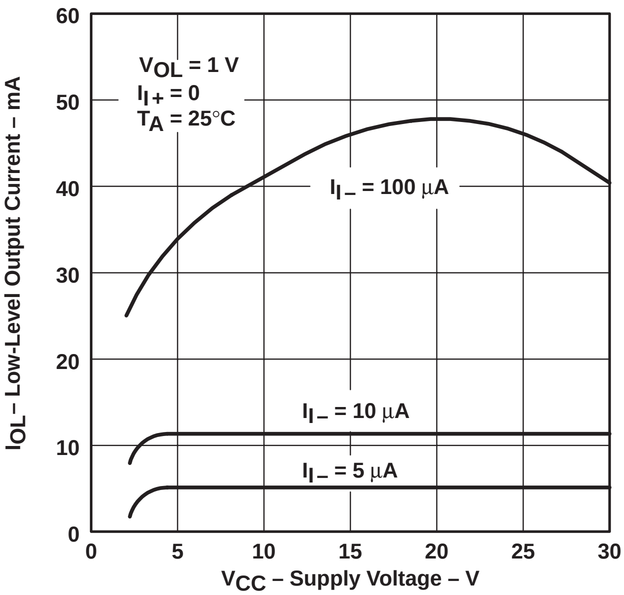


Figure 9

PULLDOWN CURRENT vs SUPPLY VOLTAGE

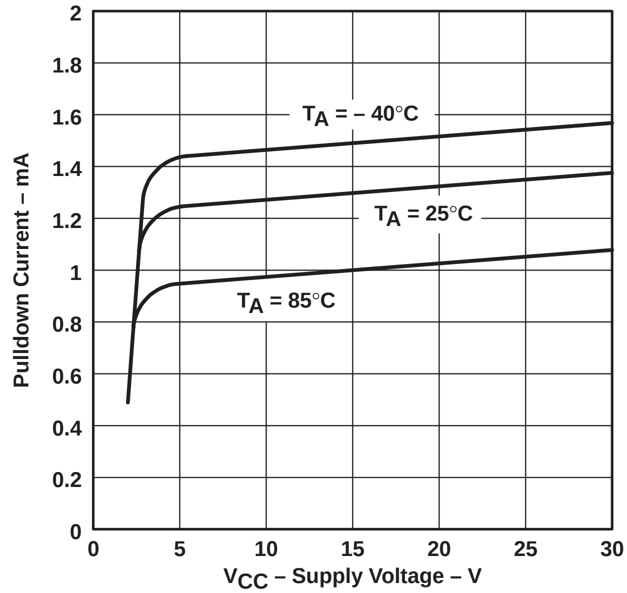


Figure 10

PULLDOWN CURRENT vs FREE-AIR TEMPERATURE

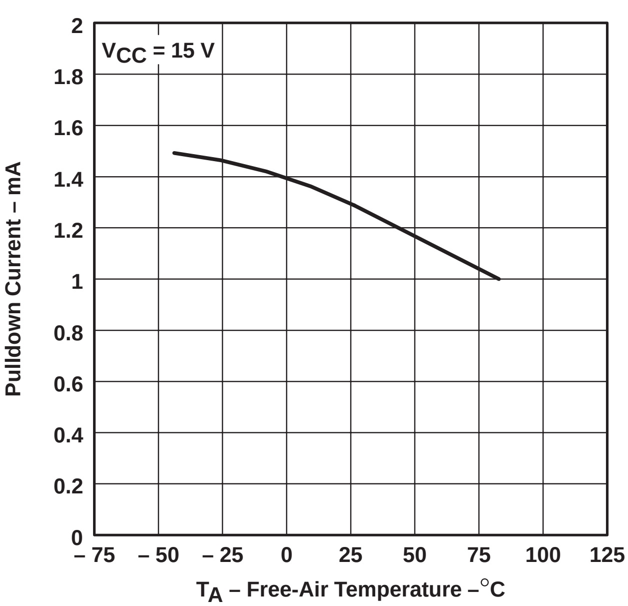


Figure 11

TOTAL SUPPLY CURRENT vs SUPPLY VOLTAGE

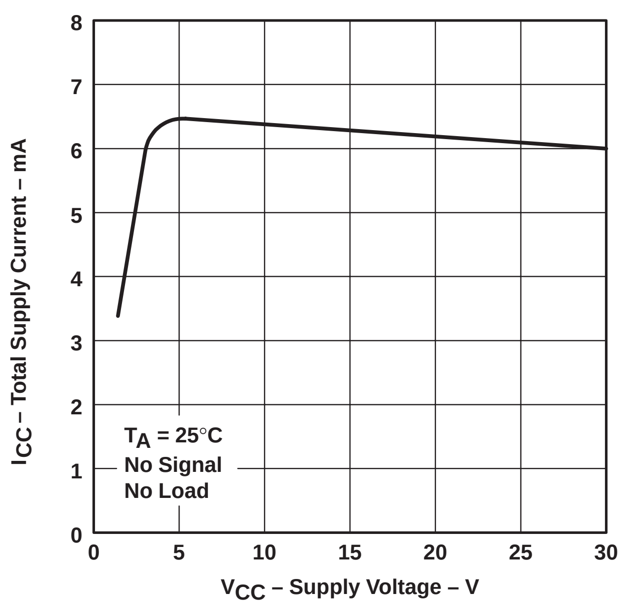


Figure 12

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

APPLICATION INFORMATION

Norton (or current-differencing) amplifiers can be used in most standard general-purpose operational amplifier applications. Performance as a dc amplifier in a single-power-supply mode is not as precise as a standard integrated-circuit operational amplifier operating from dual supplies. Operation of the amplifier can best be understood by noting that input currents are differenced at the inverting input terminal and this current then flows through the external feedback resistor to produce the output voltage. Common-mode current biasing is generally useful to allow operating with signal levels near (or even below) ground.

Internal transistors clamp negative input voltages at approximately –0.3 V but the magnitude of current flow has to be limited by the external input network. For operation at high temperature, this limit should be approximately –100 μA.

Noise immunity of a Norton amplifier is less than that of standard bipolar amplifiers. Circuit layout is more critical since coupling from the output to the noninverting input can cause oscillations. Care must also be exercised when driving either input from a low-impedance source. A limiting resistor should be placed in series with the input lead to limit the peak input current. Current up to 20 mA will not damage the device, but the current mirror on the noninverting input will saturate and cause a loss of mirror gain at higher current levels, especially at high operating temperatures.

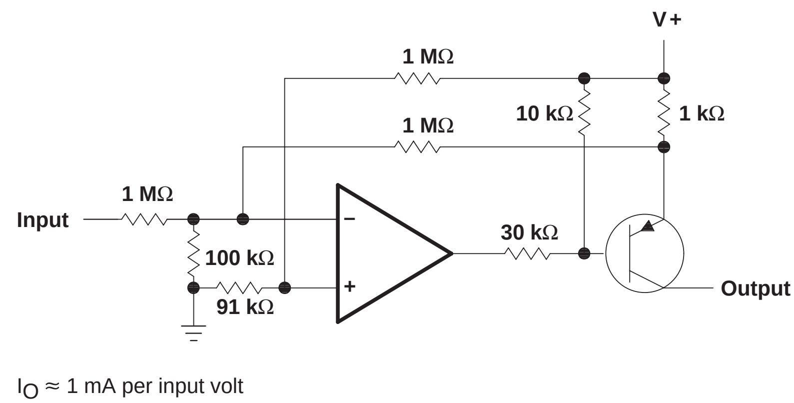


Figure 13. Voltage-Controlled Current Source

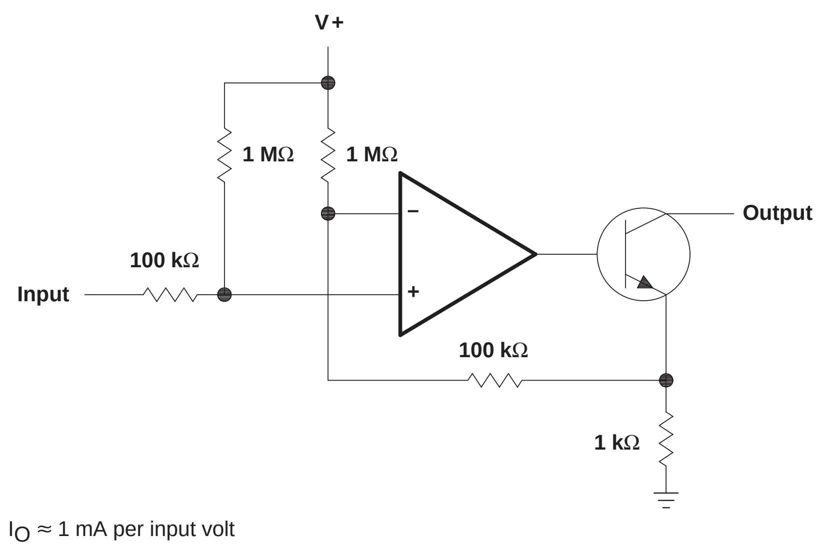


Figure 14. Voltage-Controlled Current Sink

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Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
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		Wireless	www.ti.com/wireless

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PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
LM2900D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM2900N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM2900N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM2900N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM2900NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM2900NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM2900NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM3900D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
LM3900DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LM3900N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM3900N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM3900N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM3900NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM3900NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
LM3900NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

(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.

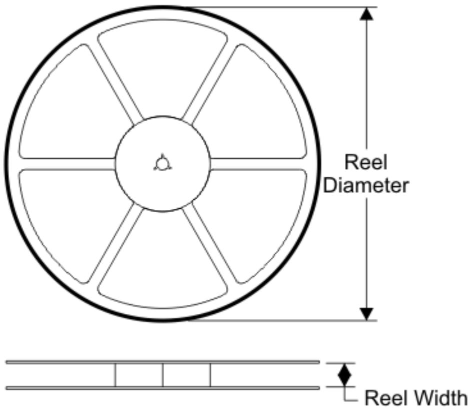
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

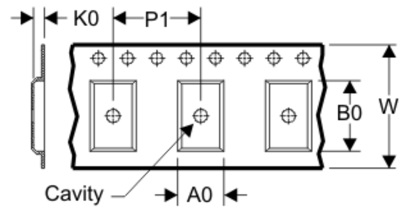
PACKAGE MATERIALS INFORMATION

TAPE AND REEL BOX INFORMATION

REEL DIMENSIONS

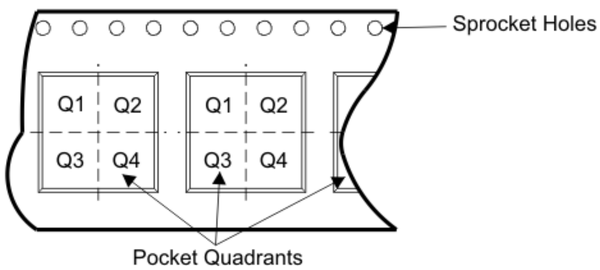


TAPE DIMENSIONS



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

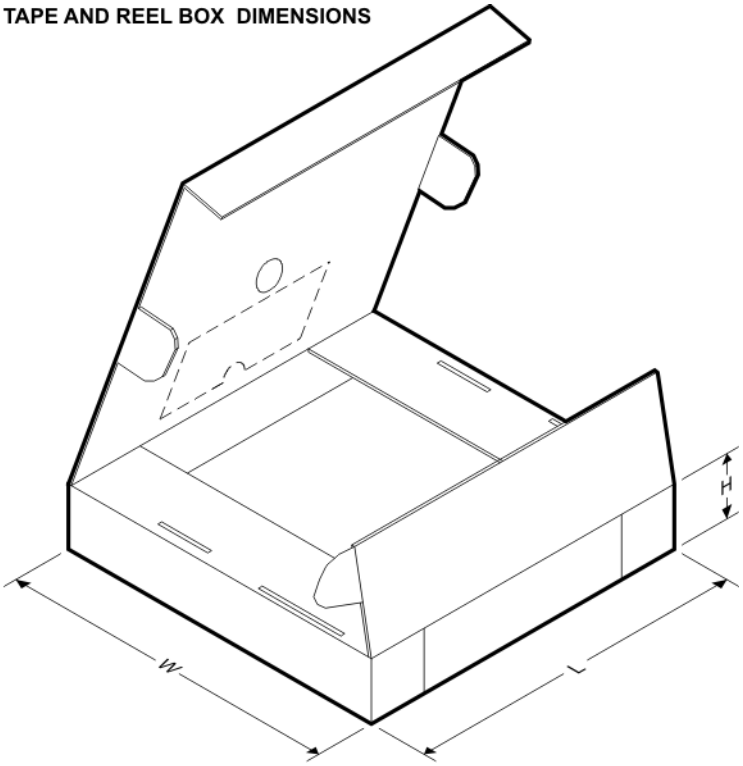
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM2900DR	D	14	SITE 41	330	16	6.5	9.0	2.1	8	16	Q1
LM3900DR	D	14	SITE 41	330	16	6.5	9.0	2.1	8	16	Q1

PACKAGE MATERIALS INFORMATION

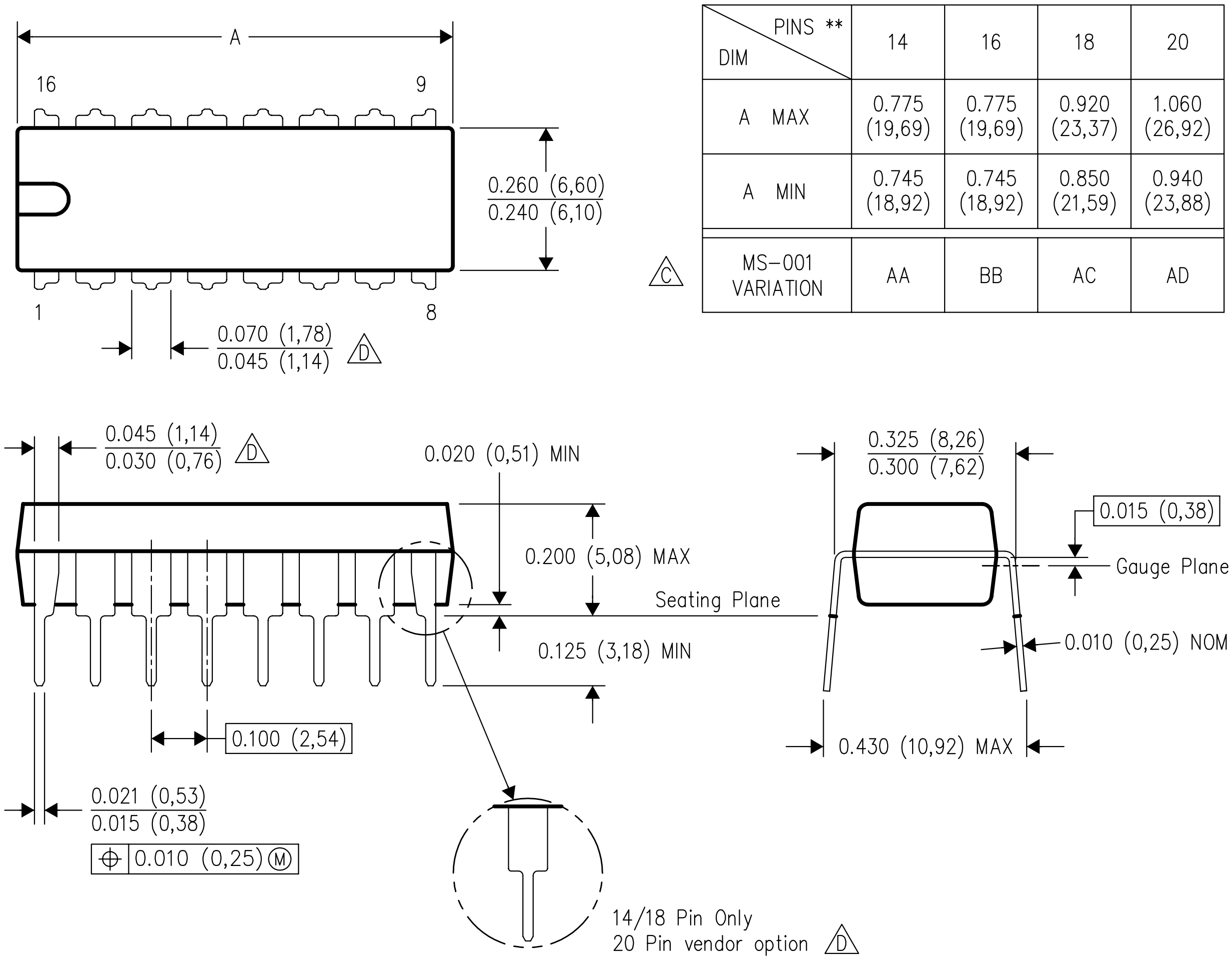
TAPE AND REEL BOX DIMENSIONS



Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
LM2900DR	D	14	SITE 41	346.0	346.0	33.0
LM3900DR	D	14	SITE 41	346.0	346.0	33.0

N (R-PDIP-T**) PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

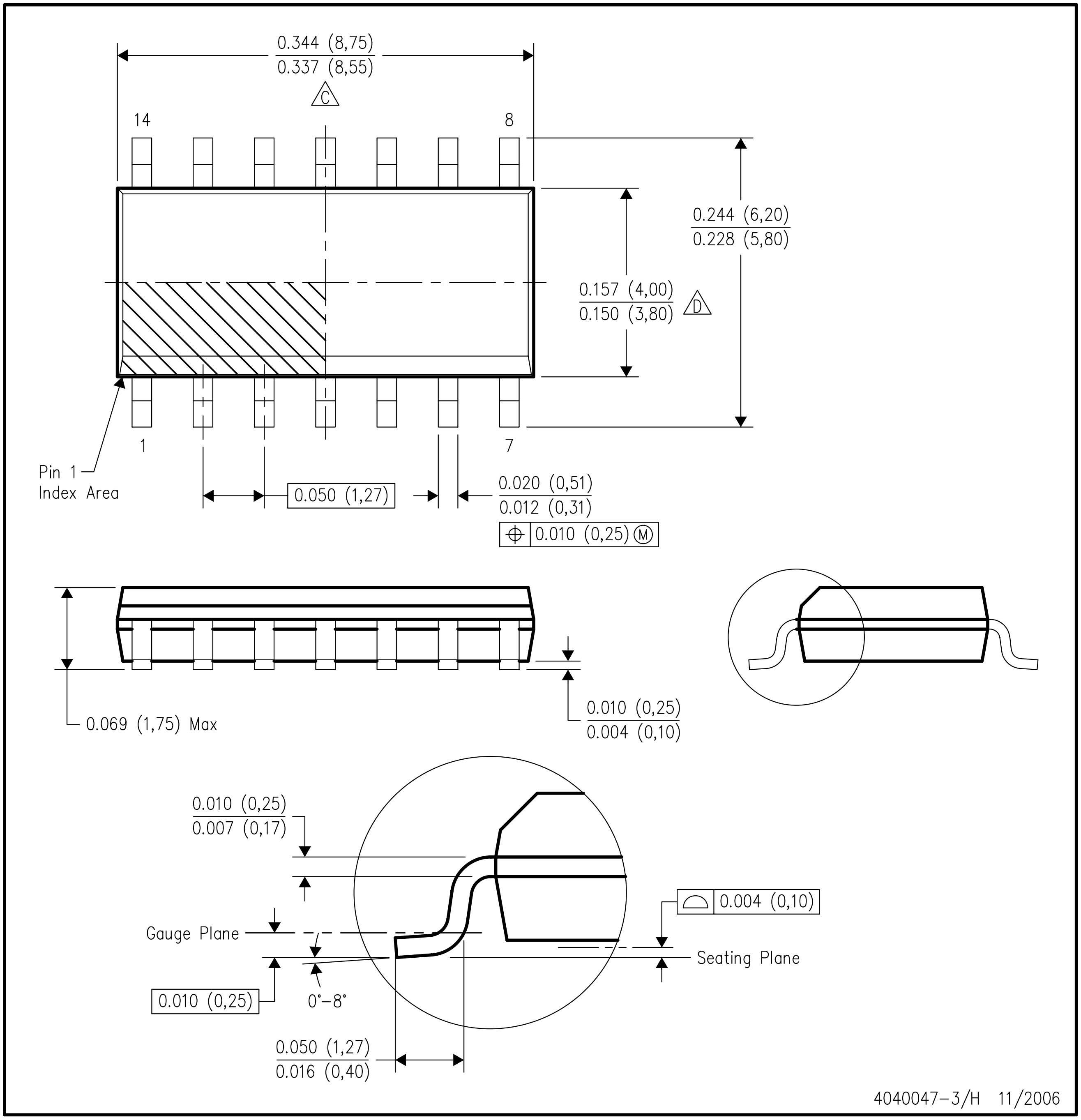


PINS ** / DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD

4040049/E 12/2002

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R–PDSO–G14) PLASTIC SMALL–OUTLINE PACKAGE



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 .006 (0,15) per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS-012 variation AB.