TEXAS INSTRUMENTS
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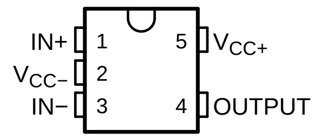
LMV931 SINGLE, LMV932 DUAL, LMV934 QUAD 1.8-V OPERATIONAL AMPLIFIERS WITH RAIL-TO-RAIL INPUT AND OUTPUT

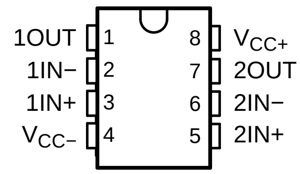
FEATURES

- **1.8-V, 2.7-V, and 5-V Specifications**
- **Rail-to-Rail Output Swing**
  - **600-Ω Load . . . 80 mV From Rail**
  - **2-kΩ Load . . . 30 mV From Rail**
- **V_{ICR} . . . 200 mV Beyond Rails**
- **Gain Bandwidth . . . 1.4 MHz**
- **Supply Current . . . 100 μA/Amplifier**
- **Max V_{IO} . . . 4 mV**
- **Space-Saving Packages**
  - **LMV931: SOT-23 and SC-70**
  - **LMV932: MSOP and SOIC**
  - **LMV934: SOIC and TSSOP**

LMV931 . . . DBV (SOT-23-5) OR DCK (SC-70) PACKAGE
(TOP VIEW)



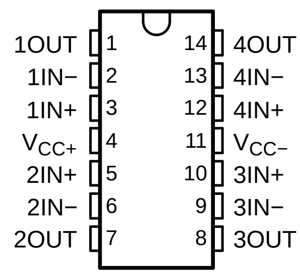
LMV932 . . . D (SOIC) OR
DGK (VSSOP/MSOP) PACKAGE
(TOP VIEW)



APPLICATIONS

- **Industrial (Utility/Energy Metering)**
- **Automotive**
- **Communications (Optical Telecom, Data/Voice Cable Modems)**
- **Consumer Electronics (PDAs, PCs, CDR/W, Portable Audio)**
- **Supply-Current Monitoring**
- **Battery Monitoring**

LMV934 . . . D (SOIC) OR PW (TSSOP) PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

ORDERING INFORMATION

T_A	PACKAGE(1)			ORDERABLE PART NUMBER	TOP-SIDE MARKING(2)
–40°C to 125°C	Single	SOT-23 – DBV	Reel of 3000	LMV931IDBVR	RBB_
			Reel of 250	LMV931IDBVT	PREVIEW
		SC-70 – DCK	Reel of 3000	LMV931IDCKR	RB_
			Reel of 250	LMV931IDCKT	PREVIEW
	Dual	MSOP/VSSOP – DGK	Reel of 2500	LMV932IDGKR	RD_
			Reel of 250	LMV932IDGKT	PREVIEW
		SOIC – D	Tube of 75	LMV932ID	MV932I
			Reel of 2500	LMV932IDR	
	Quad	SOIC – D	Tube of 50	LMV934ID	LMV934I
			Reel of 2500	LMV934IDR	
		TSSOP – PW	Tube of 90	LMV934IPW	MV934I
			Reel of 2000	LMV934IPWR	

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(2) DBV/DCK/DGK: The actual top-side marking has one additional character that designates the assembly/test site.

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

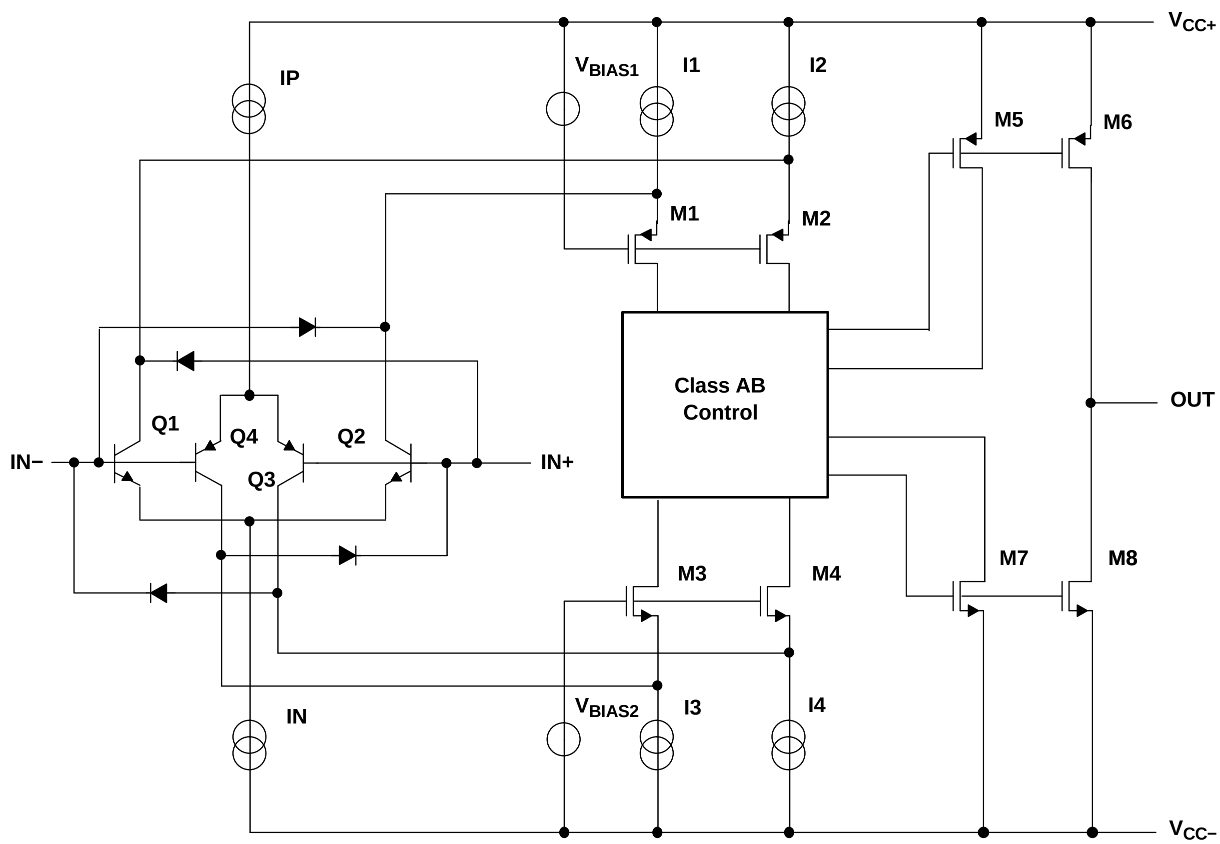
The LMV93x devices are low-voltage low-power operational amplifiers that are well suited for today's low-voltage and/or portable applications. Specified for operation of 1.8 V to 5 V, they can be used in portable applications that are powered from a single-cell Li-ion or two-cell batteries. They have rail-to-rail input and output capability for maximum signal swings in low-voltage applications. The LMV93x input common-mode voltage extends 200 mV beyond the rails for increased flexibility. The output can swing rail-to-rail unloaded and typically can reach 80 mV from the rails, while driving a 600-Ω load (at 1.8-V operation).

During 1.8-V operation, the devices typically consume a quiescent current of 103 µA per channel, and yet they are able to achieve excellent electrical specifications, such as 101-dB open-loop DC gain and 1.4-MHz gain bandwidth. Furthermore, the amplifiers offer good output drive characteristics, with the ability to drive a 600-Ω load and 1000-pF capacitance with minimal ringing.

The LMV93x devices are offered in the latest packaging technology to meet the most demanding space-constraint applications. The LMV931 is offered in standard SOT-23 and SC-70 packages. The LMV932 is available in the traditional MSOP and SOIC packages. The LMV934 is available in the traditional SOIC and TSSOP packages.

The LMV93x devices are characterized for operation from –40°C to 125°C, making the part universally suited for commercial, industrial, and automotive applications.

SIMPLIFIED SCHEMATIC



Absolute Maximum Ratings(1)

over free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
$V_{CC+} – V_{CC–}$	Supply voltage(2)			5.5	V
V_{ID}	Differential input voltage(3)		Supply voltage		
V_I	Input voltage range, either input		$V_{CC–}$ – 0.2	V_{CC+} + 0.2	V
	Duration of output short circuit (one amplifier) to $V_{CC\pm}$(4)(5)		Unlimited		
θ_{JA}	Package thermal impedance(5)(6)	D package (8 pin)		97	°C/W
		D package (14 pin)		86	
		DBV package		206	
		DCK package		252	
		DGK package		172	
		PW package		113	
T_J	Operating virtual junction temperature			150	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
(3) Differential voltages are at IN+ with respect to IN–.
(4) Applies to both single-supply and split-supply operation. Continuous short-circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of 45 mA over long term may adversely affect reliability.
(5) Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
(6) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

		MIN	MAX	UNIT
V_{CC}	Supply voltage ($V_{CC+} – V_{CC–}$)	1.8	5	V
T_A	Operating free-air temperature	–40	125	°C

ESD Protection

	TYP	UNIT
Human-Body Model	2000	V
Machine Model	200	V

Electrical Characteristics

V_{CC+} = 1.8 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	LMV931 (single)		25°C		1	4	mV
				Full range			6	
		LMV932 (dual), LMV934 (quad)		25°C		1	5.5	
				Full range			7.5	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C		5.5		μV/°C
I_{IB}	Input bias current	V_{IC} = V_{CC+} – 0.8 V		25°C		15	35	nA
				25°C			65	
				Full range			75	
I_{IO}	Input offset current			25°C		13	25	nA
				Full range			40	
I_{CC}	Supply current (per channel)			25°C		103	185	μA
				Full range			205	
CMRR	Common-mode rejection ratio	0 ≤ V_{IC} ≤ 0.6 V, 1.4 V ≤ V_{IC} ≤ 1.8 V		25°C	60	78		dB
				–40°C to 85°C	55			
		0.2 ≤ V_{IC} ≤ 0.6 V, 1.4 V ≤ V_{IC} ≤ 1.6 V		–40°C to 125°C	55			
		–0.2 ≤ V_{IC} ≤ 0 V, 1.8 V ≤ V_{IC} ≤ 2 V		25°C	50	72		
k_{SVR}	Supply-voltage rejection ratio	1.8 V ≤ V_{CC+} ≤ 5 V, V_{IC} = 0.5 V		25°C	75	100		dB
				Full range	70			
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		25°C	V_{CC-} – 0.2	–0.2 to 2.1	V_{CC+} + 0.2	V
				–40°C to 85°C	V_{CC-}		V_{CC+}	
				–40°C to 125°C	V_{CC-} + 0.2		V_{CC+} – 0.2	
A_V	Large-signal voltage gain — LMV931	V_O = 0.2 V to 1.6 V, V_{IC} = 0.5 V	R_L = 600 Ω to 0.9 V	25°C	77	101		dB
				Full range	73			
			R_L = 2 kΩ to 0.9 V	25°C	80	105		
				Full range	75			
	Large-signal voltage gain — LMV932, LMV934		R_L = 600 Ω to 0.9 V	25°C	75	90		
				Full range	72			
			R_L = 2 kΩ to 0.9 V	25°C	78	100		
				Full range	75			
V_O	Output swing	R_L = 600 Ω to 0.9 V, V_{ID} = ±100 mV	High level	25°C	1.65	1.72		V
				Full range	1.63			
			Low level	25°C		0.077	0.105	
				Full range			0.120	
		R_L = 2 kΩ to 0.9 V, V_{ID} = ±100 mV	High level	25°C	1.75	1.77		
				Full range	1.74			
			Low level	25°C		0.024	0.035	
				Full range			0.040	
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	25°C	4	8		mA
				Full range	3.3			
		V_O = 1.8 V, V_{ID} = –100 mV	Sinking	25°C	7	9		
				Full range	5			

Electrical Characteristics (continued)

V_{CC+} = 1.8 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
GBW	Gain bandwidth product		25°C		1.4		MHz
SR	Slew rate[1]		25°C		0.35		V/µS
Φ_m	Phase margin		25°C		67		°
	Gain margin		25°C		7		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 0.5 V	25°C		60		nV/√Hz
I_n	Equivalent input noise current	f = 1 kHz	25°C		0.06		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 600 Ω, V_{ID} = 1 V_{p-p}	25°C		0.023		%
	Amplifier-to-amplifier isolation[2]		25°C		123		dB

(1) Number specified is the slower of the positive and negative slew rates.
(2) Input referred, V_{CC+} = 5 V and R_L = 100 kΩ connected to 2.5 V. Each amplifier is excited, in turn, with a 1-kHz signal to produce V_O = 3 V_{p-p}.

Electrical Characteristics

V_{CC+} = 2.7 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	LMV931 (single)		25°C		1	4	mV
				Full range			6	
		LMV932 (dual), LMV934 (quad)		25°C		1	5.5	
				Full range			7.5	
$\alpha_{V_{IO}}$	Average temperature coefficient of input offset voltage			25°C		5.5		µV/°C
I_{IB}	Input bias current	V_{IC} = V_{CC+} – 0.8 V		25°C		15	35	nA
				25°C			65	
				Full range			75	
I_{IO}	Input offset current			25°C		8	25	nA
				Full range			40	
I_{CC}	Supply current (per channel)			25°C		105	190	µA
				Full range			210	
CMRR	Common-mode rejection ratio	0 ≤ V_{IC} ≤ 1.5 V, 2.3 V ≤ V_{IC} ≤ 2.7 V		25°C	60	81		dB
				–40°C to 85°C	55			
		0.2 ≤ V_{IC} ≤ 1.5 V, 2.3 V ≤ V_{IC} ≤ 2.5 V		–40°C to 125°C	55			
		–0.2 ≤ V_{IC} ≤ 0 V, 2.7 V ≤ V_{IC} ≤ 2.9 V		25°C	50	74		
k_{SVR}	Supply-voltage rejection ratio	1.8 V ≤ V_{CC+} ≤ 5 V, V_{IC} = 0.5 V		25°C	75	100		dB
				Full range	70			
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		25°C	V_{CC-} – 0.2	–0.2 to 3	V_{CC+} + 0.2	V
				–40°C to 85°C	V_{CC-}		V_{CC+}	
				–40°C to 125°C	V_{CC-} + 0.2		V_{CC+} – 0.2	
A_V	Large-signal voltage gain	LMV931, V_O = 0.2 V to 2.5 V	R_L = 600 Ω to 1.35 V	25°C	87	104		dB
				Full range	86			
			R_L = 2 kΩ to 1.35 V	25°C	92	110		
				Full range	91			
		LMV932, LMV934, V_O = 0.2 V to 2.5 V	R_L = 600 Ω to 1.35 V	25°C	78	90		
				Full range	75			
			R_L = 2 kΩ to 1.35 V	25°C	81	100		
				Full range	78			
V_O	Output swing	R_L = 600 Ω to 1.35 V, V_{ID} = ±100 mV	High level	25°C	2.55	2.62		V
				Full range	2.53			
			Low level	25°C		0.083	0.11	
				Full range			0.13	
		R_L = 2 kΩ to 1.35 V, V_{ID} = ±100 mV	High level	25°C	2.65	2.675		
				Full range	2.64			
			Low level	25°C		0.025	0.04	
				Full range			0.045	
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	25°C	20	30		mA
				Full range	15			
		V_O = 2.7 V, V_{ID} = –100 mV	Sinking	25°C	18	25		
				Full range	12			
GBW	Gain bandwidth product			25°C		1.4		MHz

Electrical Characteristics (continued)

V_{CC+} = 2.7 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
SR	Slew rate[1]		25°C		0.4		V/μS
Φ_m	Phase margin		25°C		70		°
	Gain margin		25°C		7.5		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 0.5 V	25°C		57		$nV/\sqrt{Hz}$
I_n	Equivalent input noise current	f = 1 kHz	25°C		0.082		$pA/\sqrt{Hz}$
THD	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 600 Ω, V_{ID} = 1 V_{p-p}	25°C		0.022		%
	Amplifier-to-amplifier isolation[2]		25°C		123		dB

(1) Number specified is the slower of the positive and negative slew rates.
(2) Input referred, V_{CC+} = 5 V and R_L = 100 kΩ connected to 2.5 V. Each amplifier is excited, in turn, with a 1-kHz signal to produce V_O = 3 V_{p-p}.

Electrical Characteristics

V_{CC+} = 5 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	LMV931 (single)		25°C		1	4	mV
V_{IO}	Input offset voltage	LMV931 (single)		Full range			6	mV
V_{IO}	Input offset voltage	LMV932 (dual), LMV934 (quad)		25°C		1	5.5	mV
V_{IO}	Input offset voltage	LMV932 (dual), LMV934 (quad)		Full range			7.5	mV
$\alpha_{V_{IO}}$	Average temperature coefficient of input offset voltage			25°C		5.5		μV/°C
I_{IB}	Input bias current	V_{IC} = V_{CC+} – 0.8 V		25°C		15	35	nA
I_{IB}	Input bias current			25°C			65	nA
I_{IB}	Input bias current			Full range			75	nA
I_{IO}	Input offset current			25°C		9	25	nA
I_{IO}	Input offset current			Full range			40	nA
I_{CC}	Supply current (per channel)			25°C		116	210	μA
I_{CC}	Supply current (per channel)			Full range			230	μA
CMRR	Common-mode rejection ratio	0 ≤ V_{IC} ≤ 3.8 V, 4.6 V ≤ V_{IC} ≤ 5 V		25°C	60	86		dB
CMRR	Common-mode rejection ratio	0 ≤ V_{IC} ≤ 3.8 V, 4.6 V ≤ V_{IC} ≤ 5 V		–40°C to 85°C	55			dB
CMRR	Common-mode rejection ratio	0.3 ≤ V_{IC} ≤ 3.8 V, 4.6 V ≤ V_{IC} ≤ 4.7 V		–40°C to 125°C	55			dB
CMRR	Common-mode rejection ratio	–0.2 ≤ V_{IC} ≤ 0 V, 5 V ≤ V_{IC} ≤ 5.2 V		25°C	50	78		dB
k_{SVR}	Supply-voltage rejection ratio	1.8 V ≤ V_{CC+} ≤ 5 V, V_{IC} = 0.5 V		25°C	75	100		dB
k_{SVR}	Supply-voltage rejection ratio	1.8 V ≤ V_{CC+} ≤ 5 V, V_{IC} = 0.5 V		Full range	70			dB
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		25°C	V_{CC-} – 0.2	–0.2 to 5.3	V_{CC+} + 0.2	V
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		–40°C to 85°C	V_{CC-}		V_{CC+}	V
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		–40°C to 125°C	V_{CC-} + 0.3		V_{CC+} – 0.3	V
A_V	Large-signal voltage gain, LMV931	V_O = 0.2 V to 4.8 V	R_L = 600 Ω to 2.5 V	25°C	88	102		dB
A_V	Large-signal voltage gain, LMV931	V_O = 0.2 V to 4.8 V	R_L = 600 Ω to 2.5 V	Full range	87			dB
A_V	Large-signal voltage gain, LMV931	V_O = 0.2 V to 4.8 V	R_L = 2 kΩ to 2.5 V	25°C	94	113		dB
A_V	Large-signal voltage gain, LMV931	V_O = 0.2 V to 4.8 V	R_L = 2 kΩ to 2.5 V	Full range	93			dB
A_V	Large-signal voltage gain, LMV932, LMV934	V_O = 0.2 V to 4.8 V	R_L = 600 Ω to 2.5 V	25°C	81	90		dB
A_V	Large-signal voltage gain, LMV932, LMV934	V_O = 0.2 V to 4.8 V	R_L = 600 Ω to 2.5 V	Full range	78			dB
A_V	Large-signal voltage gain, LMV932, LMV934	V_O = 0.2 V to 4.8 V	R_L = 2 kΩ to 2.5 V	25°C	85	100		dB
A_V	Large-signal voltage gain, LMV932, LMV934	V_O = 0.2 V to 4.8 V	R_L = 2 kΩ to 2.5 V	Full range	82			dB
V_O	Output swing	R_L = 600 Ω to 2.5 V, V_{ID} = ±100 mV	High level	25°C	4.855	4.89		V
V_O	Output swing	R_L = 600 Ω to 2.5 V, V_{ID} = ±100 mV	High level	Full range	4.835			V
V_O	Output swing	R_L = 600 Ω to 2.5 V, V_{ID} = ±100 mV	Low level	25°C		0.12	0.16	V
V_O	Output swing	R_L = 600 Ω to 2.5 V, V_{ID} = ±100 mV	Low level	Full range			0.18	V
V_O	Output swing	R_L = 2 kΩ to 2.5 V, V_{ID} = ±100 mV	High level	25°C	4.945	4.967		V
V_O	Output swing	R_L = 2 kΩ to 2.5 V, V_{ID} = ±100 mV	High level	Full range	4.935			V
V_O	Output swing	R_L = 2 kΩ to 2.5 V, V_{ID} = ±100 mV	Low level	25°C		0.037	0.065	V
V_O	Output swing	R_L = 2 kΩ to 2.5 V, V_{ID} = ±100 mV	Low level	Full range			0.075	V
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	25°C	80	100		mA
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	Full range	68			mA
I_{OS}	Output short-circuit current	V_O = 5 V, V_{ID} = –100 mV	Sinking	25°C	58	65		mA
I_{OS}	Output short-circuit current	V_O = 5 V, V_{ID} = –100 mV	Sinking	Full range	45			mA

Electrical Characteristics (continued)

V_{CC+} = 5 V, V_{CC-} = 0 V, $V_{IC} = V_{CC+}/2$, $V_O = V_{CC+}/2$, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
GBW	Gain bandwidth product		25°C		1.5		MHz
SR	Slew rate(1)		25°C		0.42		V/µS
Φ_m	Phase margin		25°C		71		°
	Gain margin		25°C		8		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 0.5 V	25°C		50		$nV/\sqrt{Hz}$
I_n	Equivalent input noise current	f = 1 kHz	25°C		0.07		$pA/\sqrt{Hz}$
THD	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 600 Ω, V_{ID} = 1 V_{p-p}	25°C		0.022		%
	Amplifier-to-amplifier isolation(2)		25°C		123		dB

(1) Number specified is the slower of the positive and negative slew rates.
(2) Input referred, V_{CC+} = 5 V and R_L = 100 kΩ connected to 2.5 V. Each amplifier is excited, in turn, with a 1-kHz signal to produce V_O = 3 V_{p-p}.

TYPICAL CHARACTERISTICS

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

SUPPLY CURRENT vs SUPPLY VOLTAGE

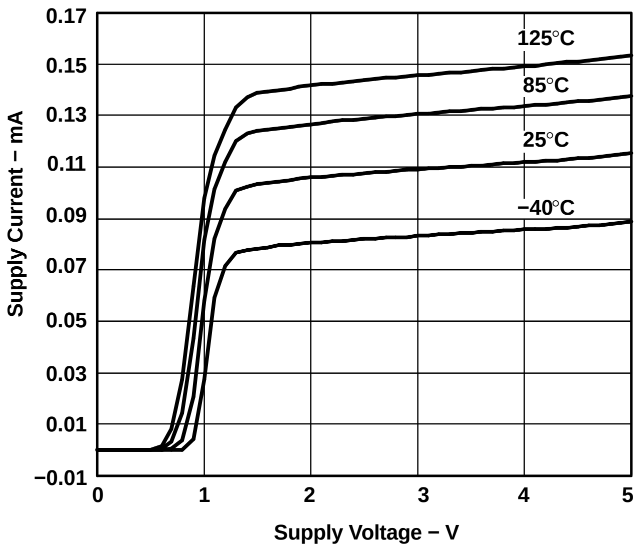


Figure 1.

SLEW RATE vs SUPPLY VOLTAGE

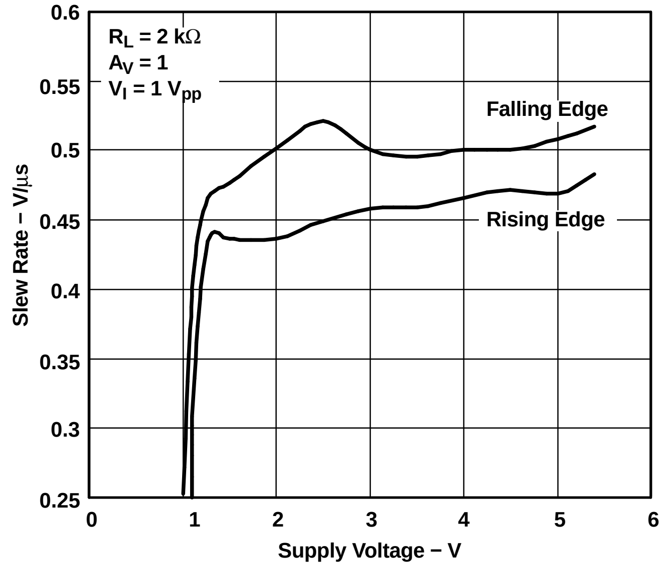


Figure 2.

SOURCE CURRENT vs OUTPUT VOLTAGE

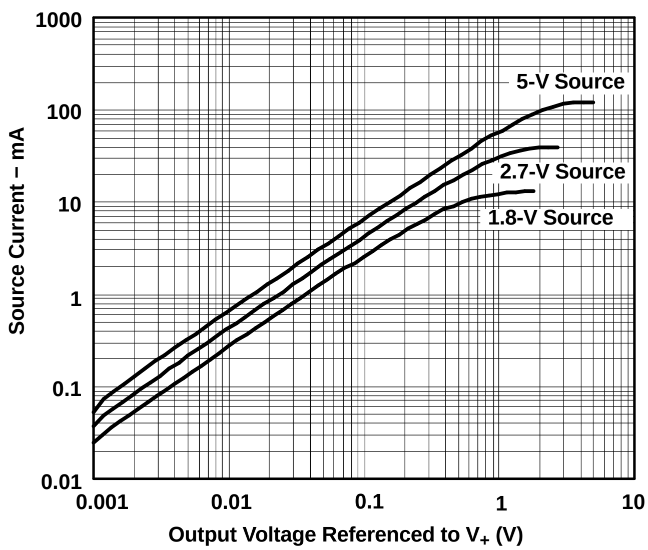


Figure 3.

SINK CURRENT vs OUTPUT VOLTAGE

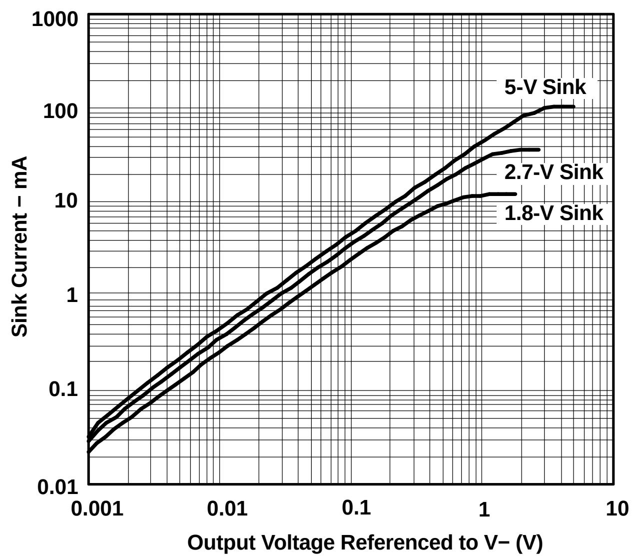


Figure 4.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

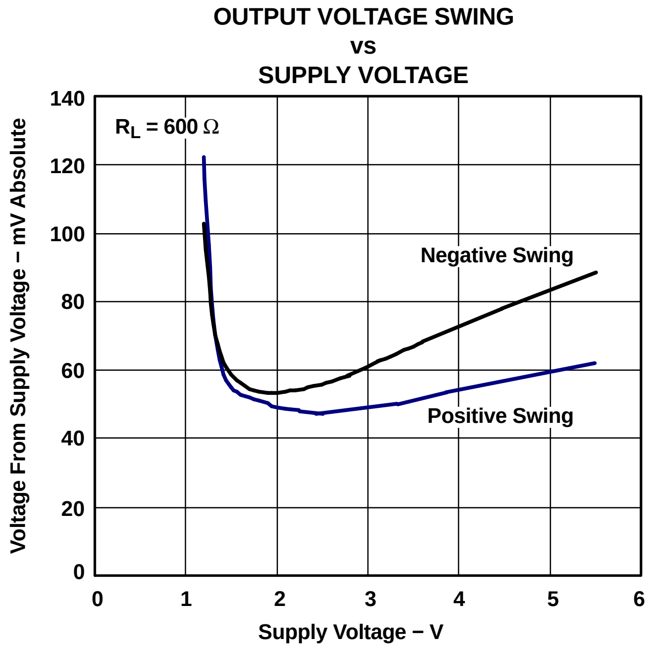


Figure 5.

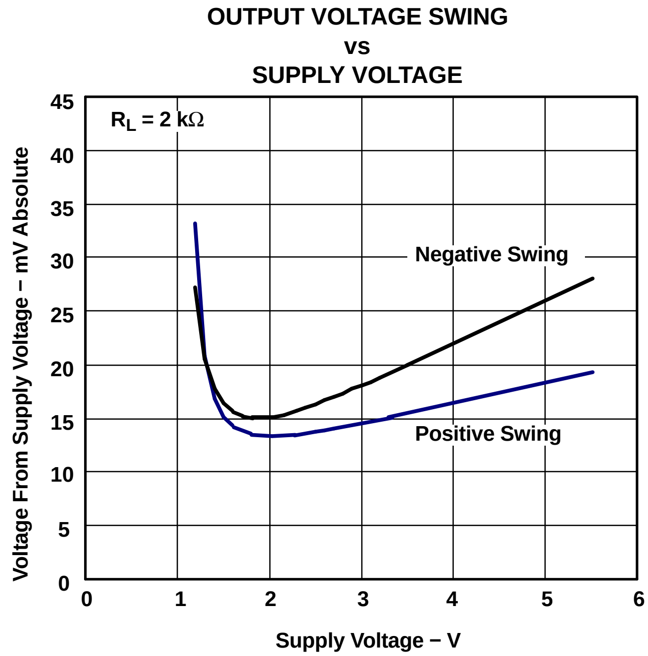


Figure 6.

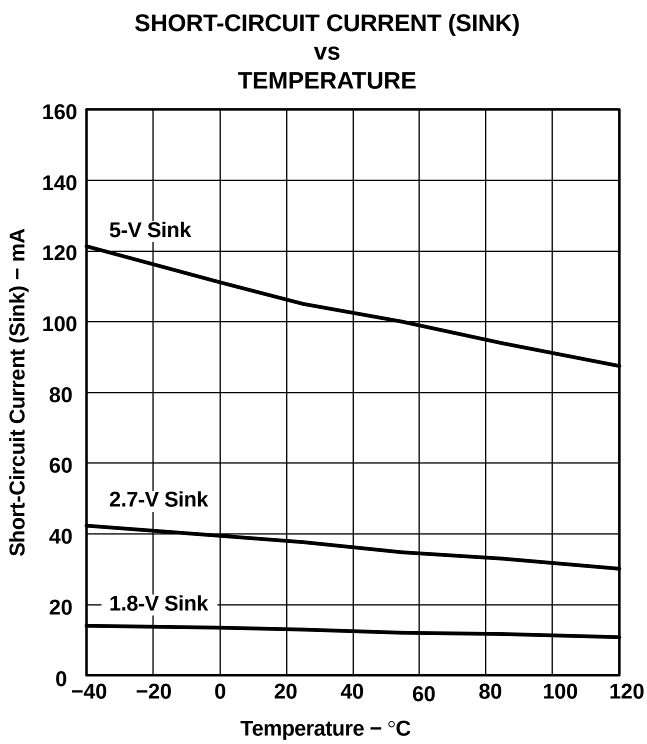


Figure 7.

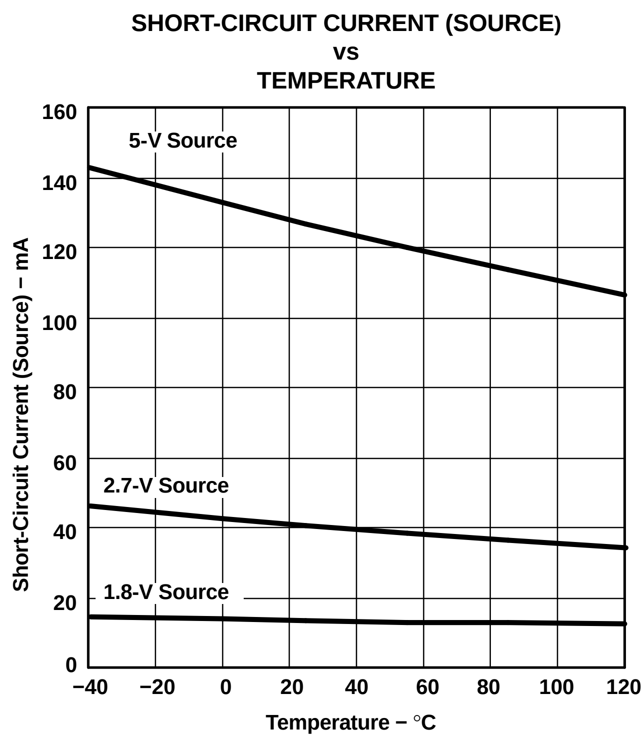


Figure 8.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

1.8-V FREQUENCY RESPONSE vs C_L

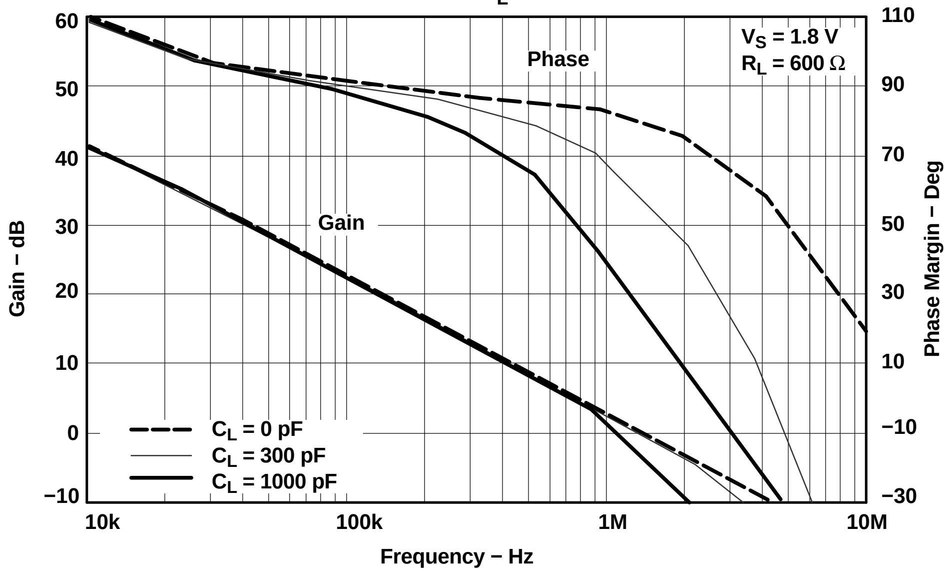


Figure 9.

5-V FREQUENCY RESPONSE vs C_L

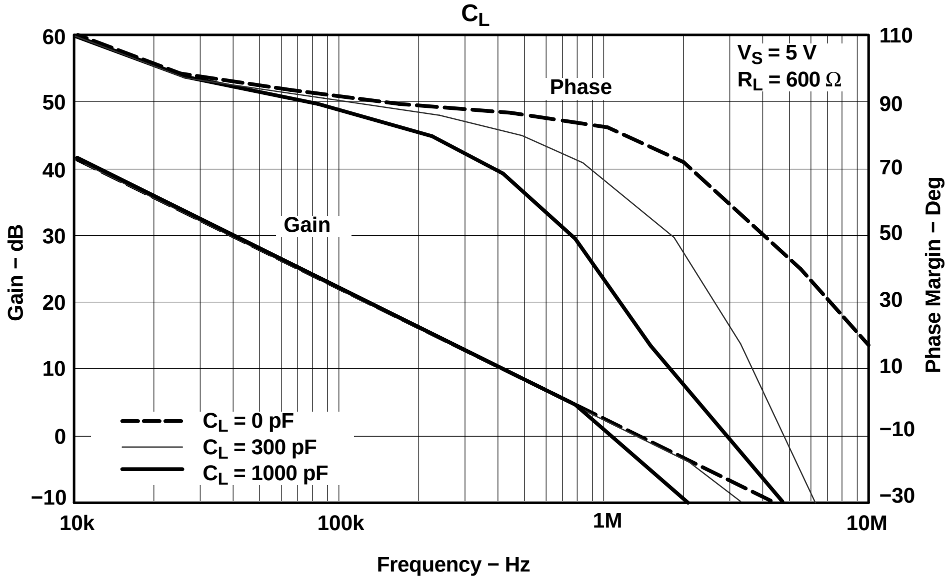


Figure 10.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

1.8-V FREQUENCY RESPONSE vs TEMPERATURE

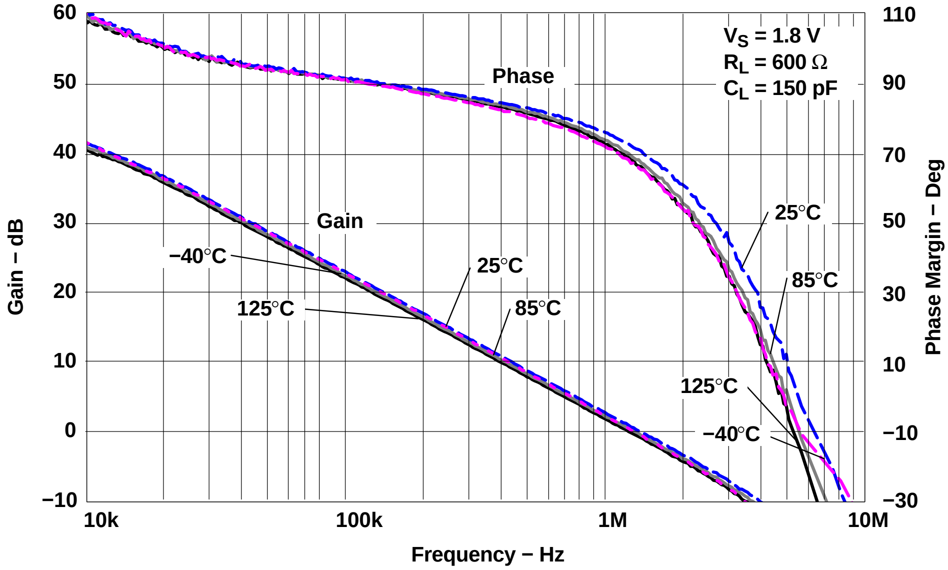


Figure 11.

5-V FREQUENCY RESPONSE vs TEMPERATURE

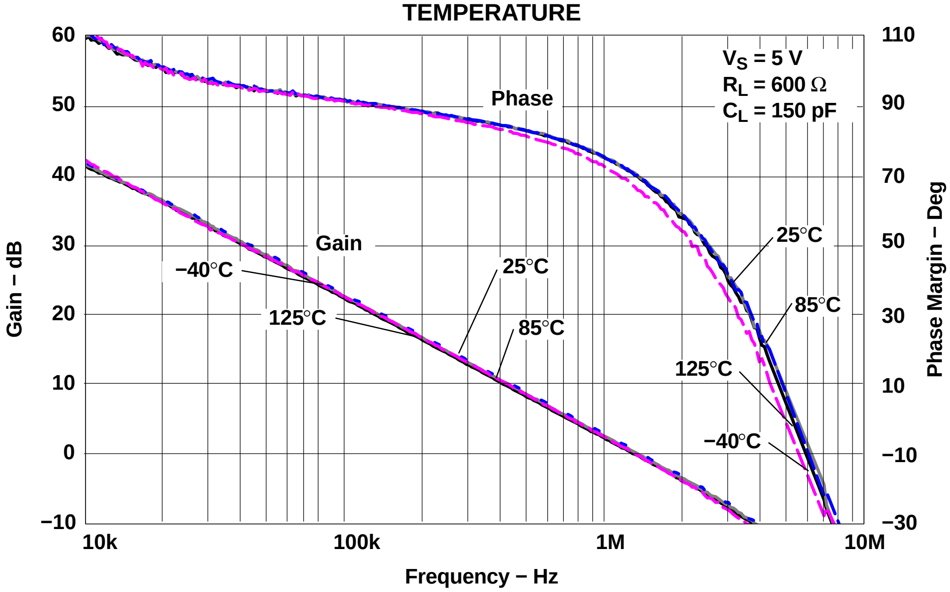


Figure 12.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

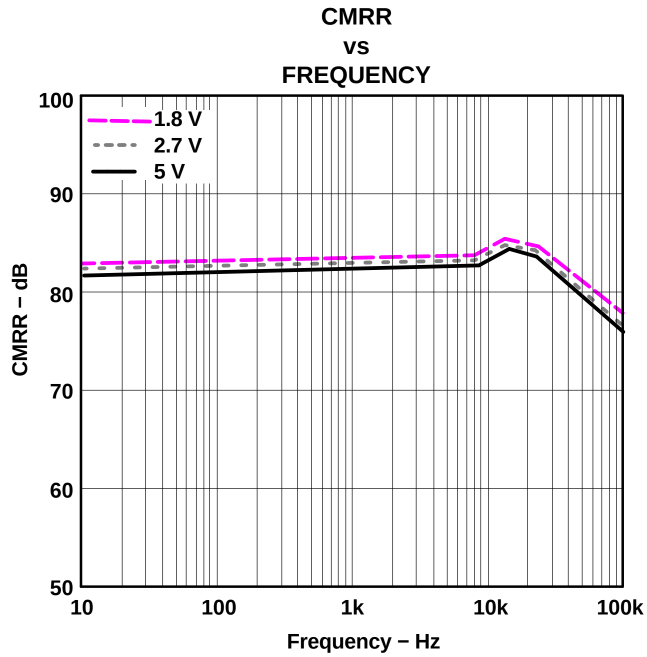


Figure 13.

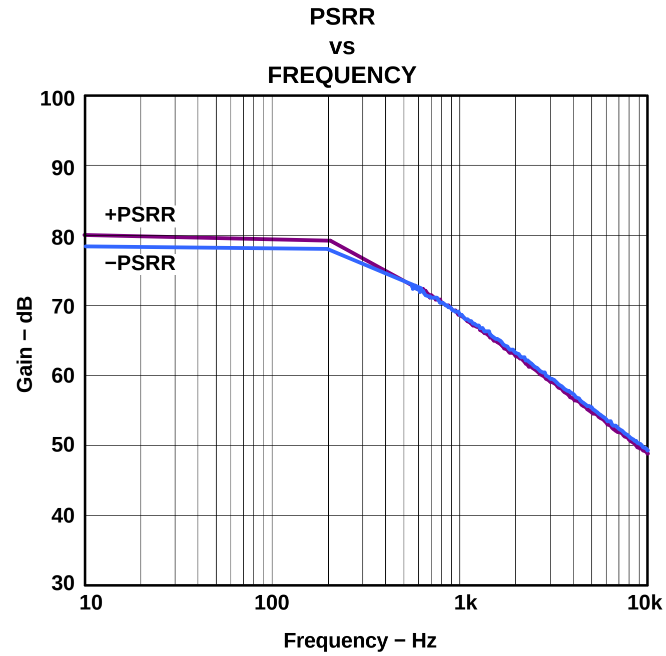


Figure 14.

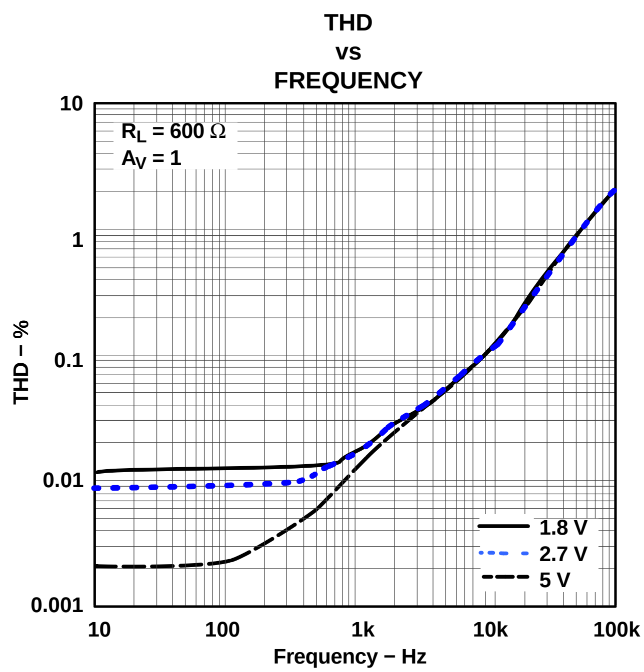


Figure 15.

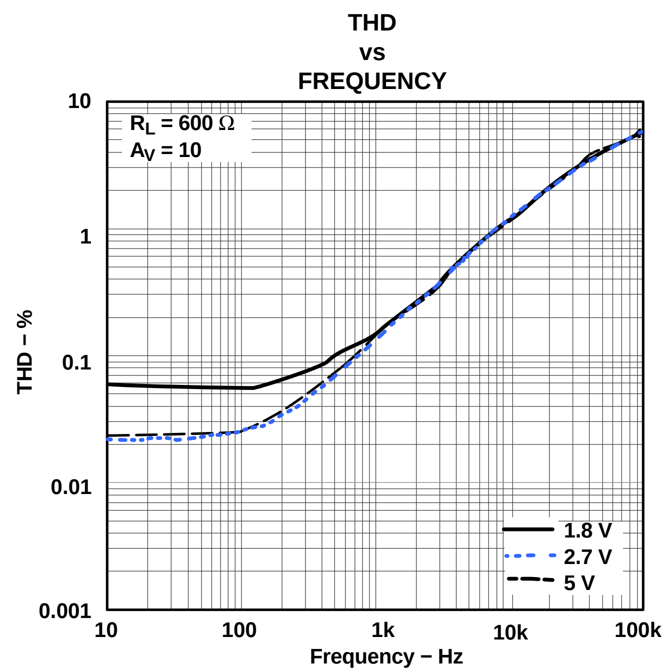


Figure 16.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

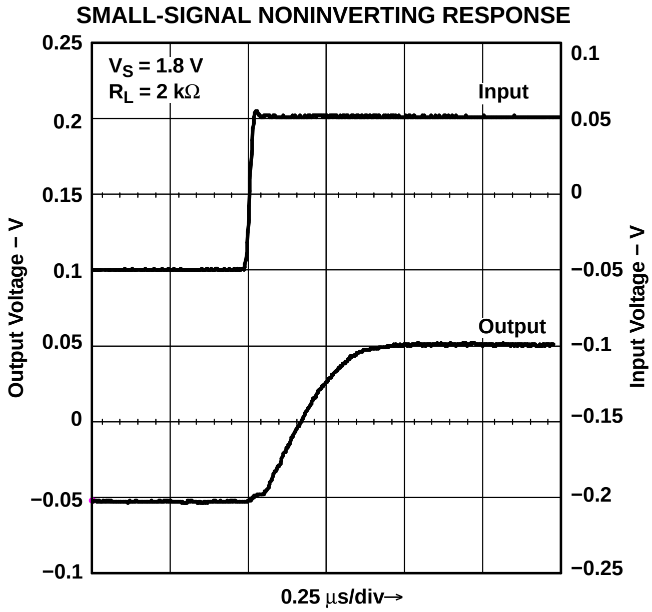


Figure 17.

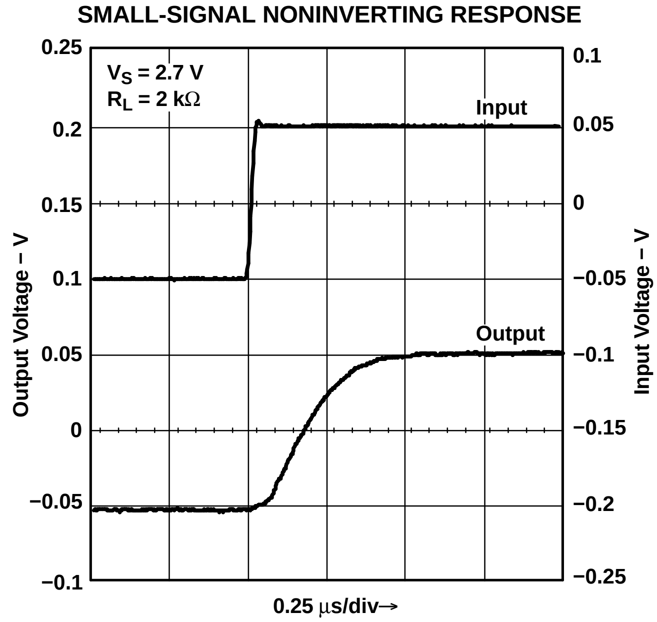


Figure 18.

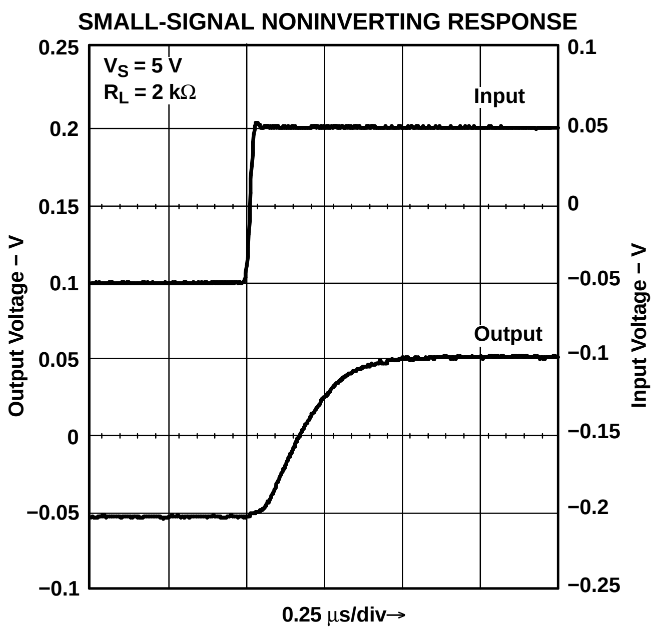


Figure 19.

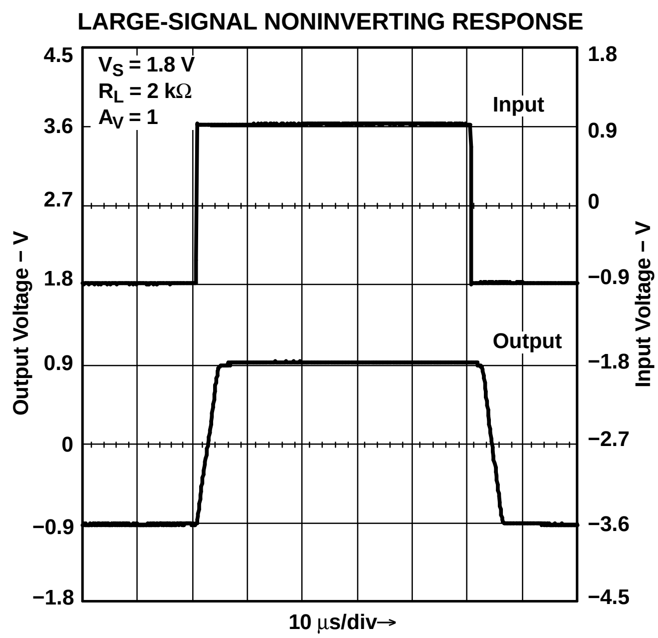


Figure 20.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

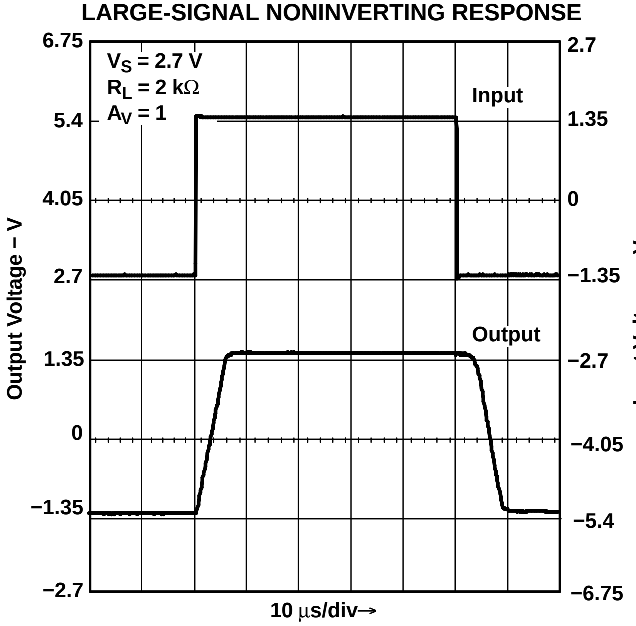


Figure 21.

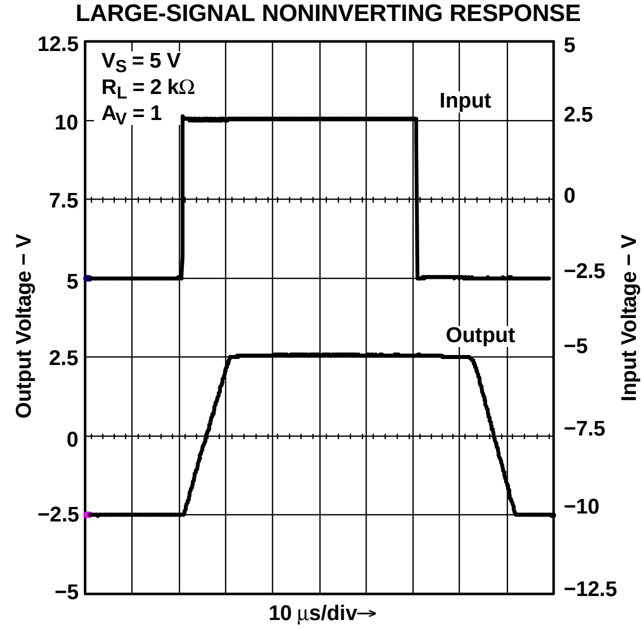


Figure 22.

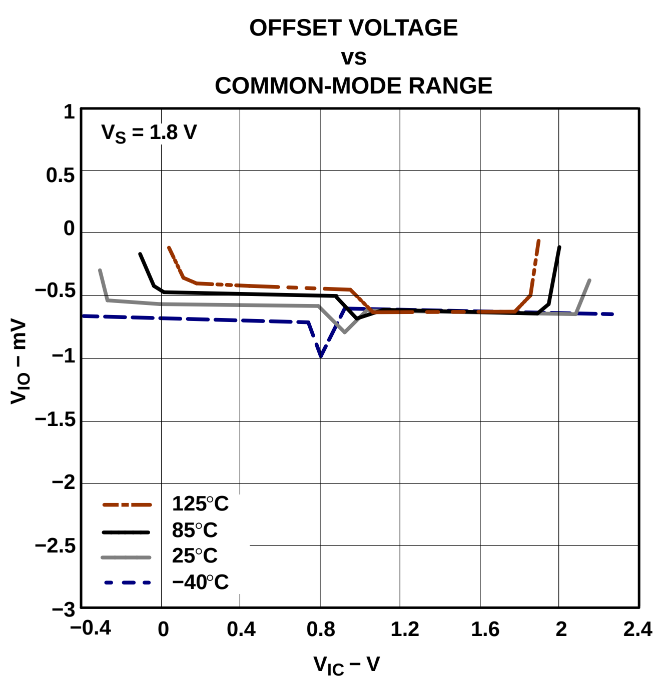


Figure 23.

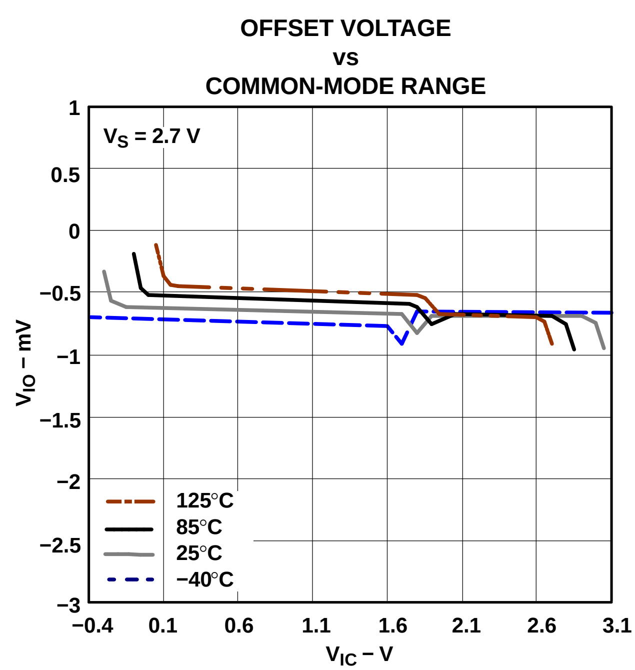


Figure 24.

TYPICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, Single Supply, T_A = 25°C (unless otherwise specified)

OFFSET VOLTAGE
vs
COMMON-MODE RANGE

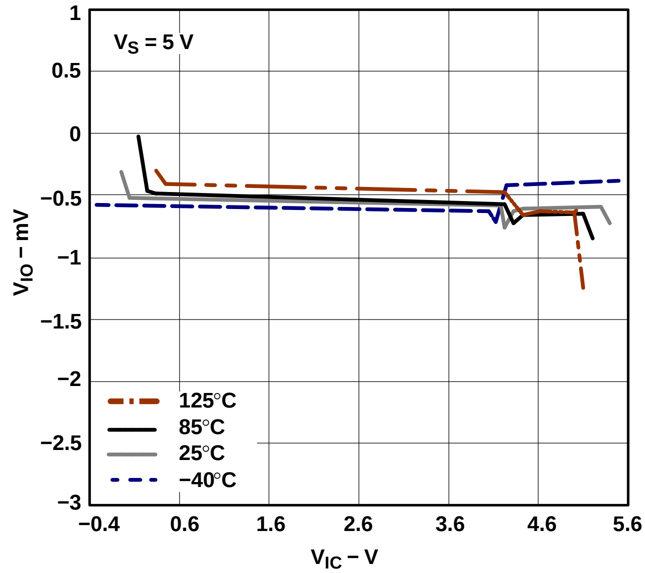


Figure 25.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
LMV931IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV931IDBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV931IDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV931IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV931IDCKRE4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV931IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV932IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IPWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IPWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV934IPWRE4	ACTIVE	TSSOP	PW	14	2000	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)
LMV934IPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(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.

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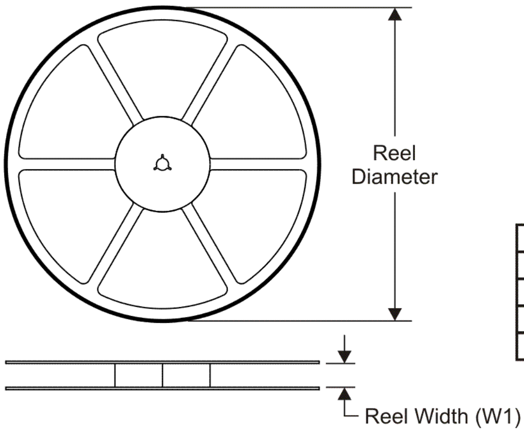
OTHER QUALIFIED VERSIONS OF LMV931 :
- Automotive: LMV931-Q1

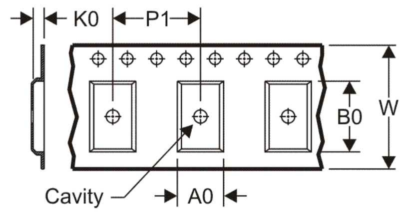
NOTE: Qualified Version Definitions:
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

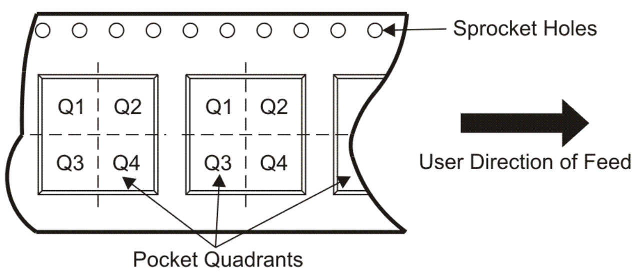


TAPE DIMENSIONS



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

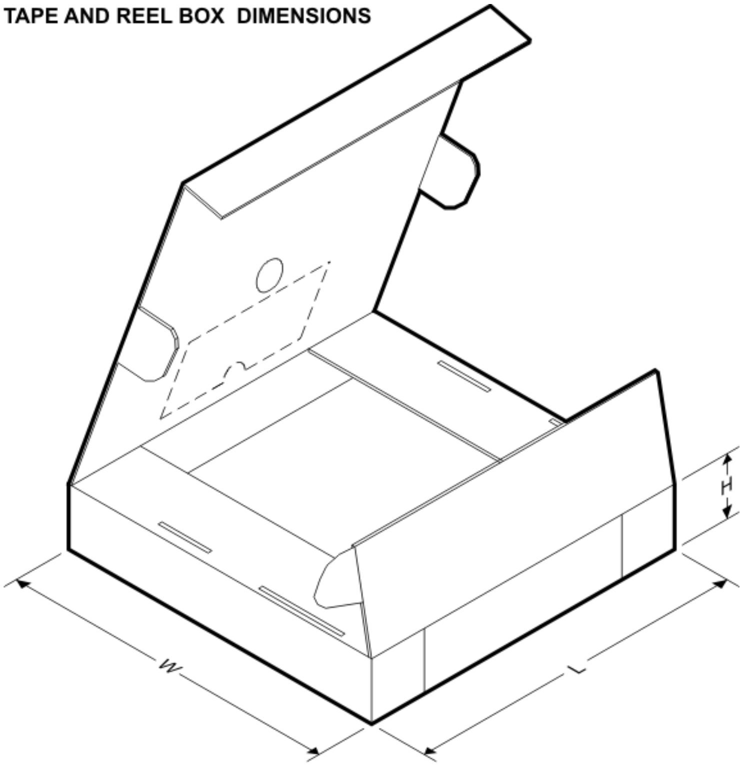
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LMV931IDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
LMV931IDBVR	SOT-23	DBV	5	3000	180.0	9.2	3.23	3.17	1.37	4.0	8.0	Q3
LMV931IDCKR	SC70	DCK	5	3000	180.0	9.2	2.24	2.34	1.22	4.0	8.0	Q3
LMV931IDCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
LMV932IDGKR	MSOP	DGK	8	2500	330.0	13.0	5.3	3.4	1.4	8.0	12.0	Q1
LMV932IDGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.3	1.3	8.0	12.0	Q1
LMV932IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
LMV934IDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LMV934IPWR	TSSOP	PW	14	2000	330.0	12.4	7.0	5.6	1.6	8.0	12.0	Q1

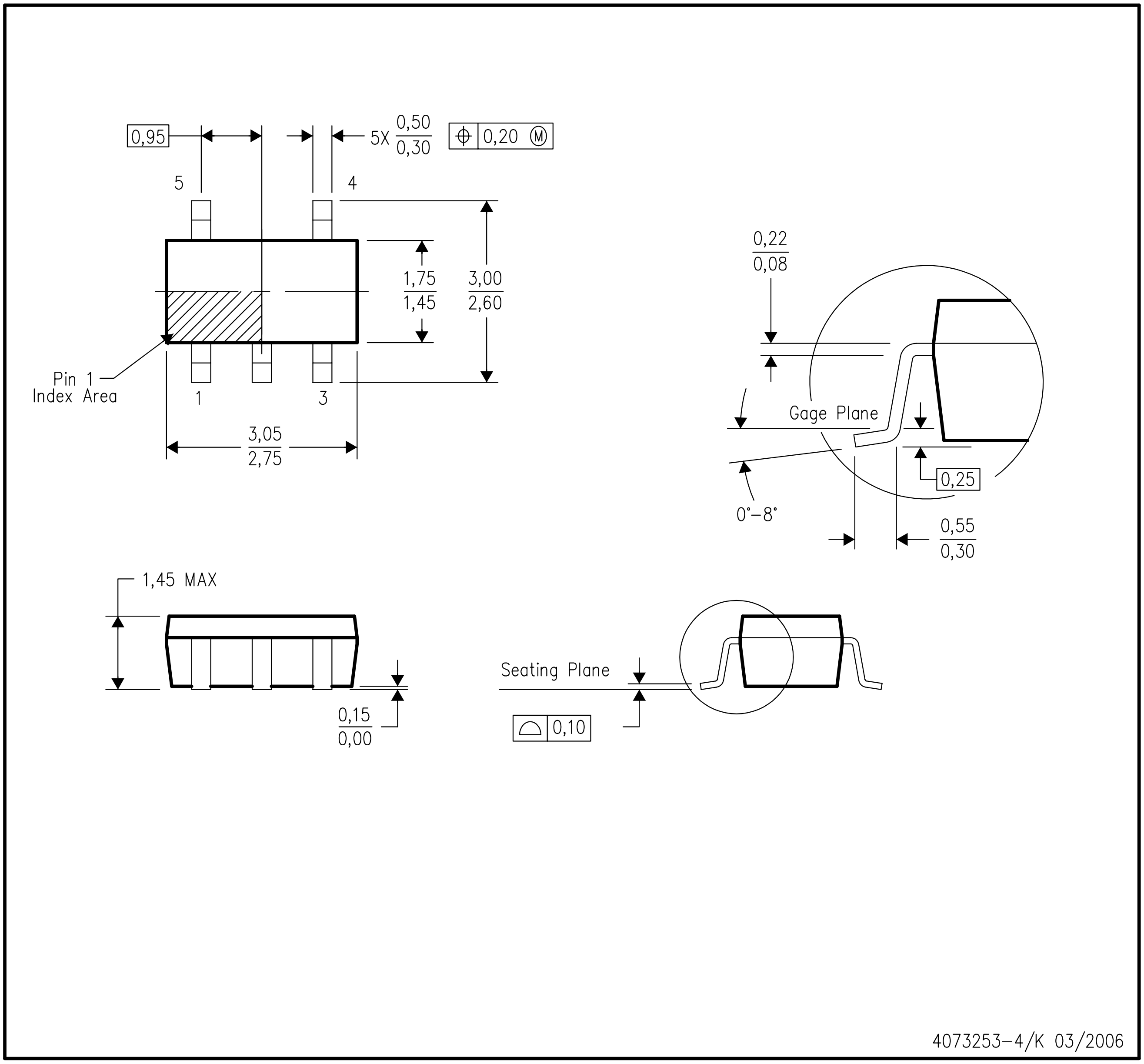
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

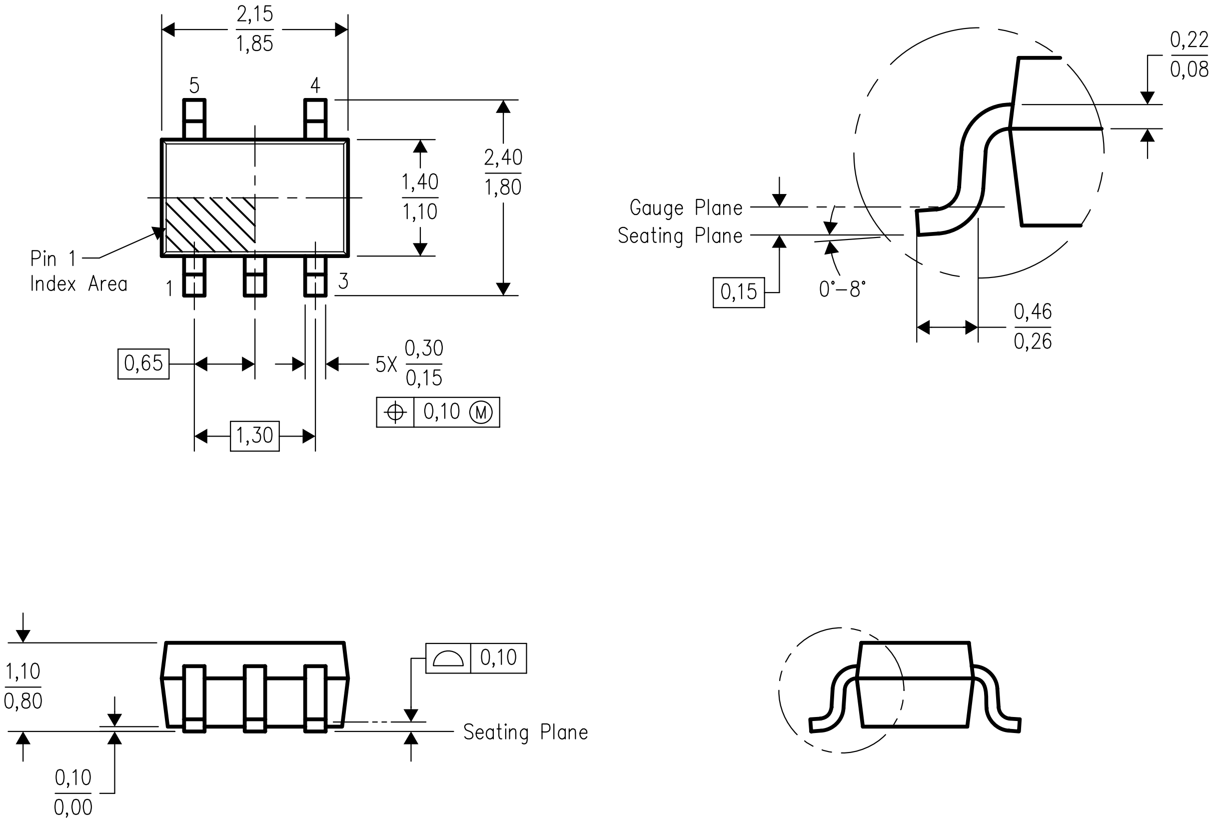
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMV931IDBVR	SOT-23	DBV	5	3000	565.0	140.0	75.0
LMV931IDBVR	SOT-23	DBV	5	3000	205.0	200.0	33.0
LMV931IDCKR	SC70	DCK	5	3000	205.0	200.0	33.0
LMV931IDCKR	SC70	DCK	5	3000	565.0	140.0	75.0
LMV932IDGKR	MSOP	DGK	8	2500	358.0	335.0	35.0
LMV932IDGKR	MSOP	DGK	8	2500	370.0	355.0	55.0
LMV932IDR	SOIC	D	8	2500	340.5	338.1	20.6
LMV934IDR	SOIC	D	14	2500	346.0	346.0	33.0
LMV934IPWR	TSSOP	PW	14	2000	346.0	346.0	29.0

DBV (R-PDSO-G5) PLASTIC SMALL-OUTLINE PACKAGE



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Falls within JEDEC MO-178 Variation AA.

DCK (R-PDSO-G5) PLASTIC SMALL-OUTLINE PACKAGE

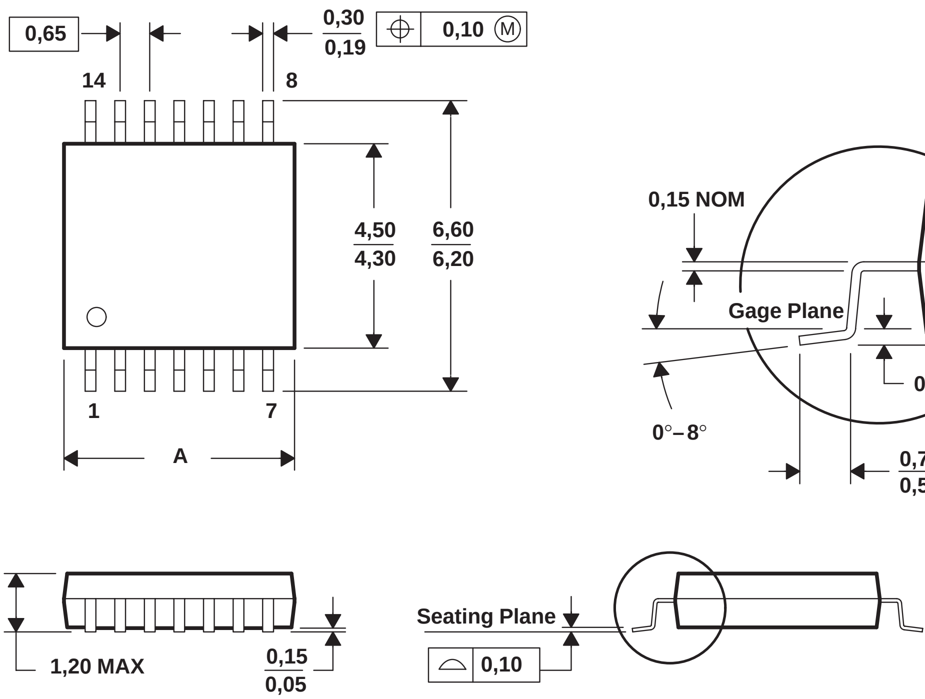


4093553-3/G 01/2007

NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Falls within JEDEC MO-203 variation AA.

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN

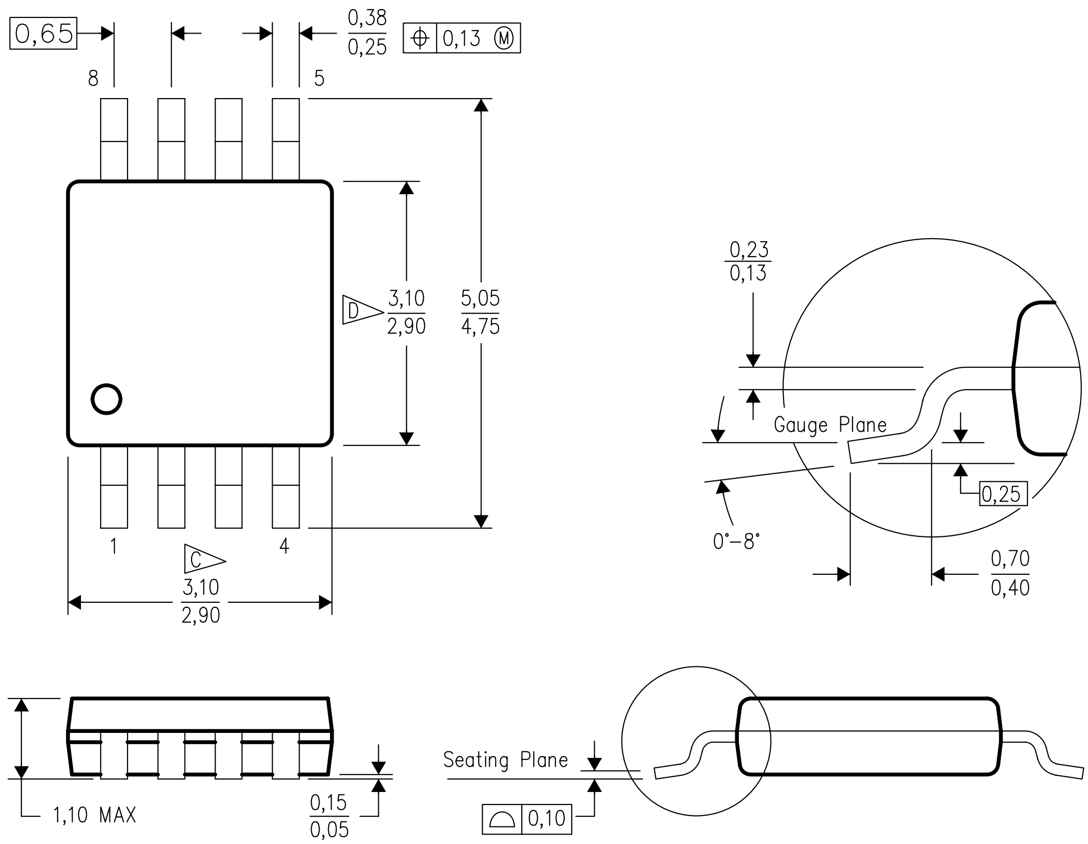


PINS ** / DIM	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

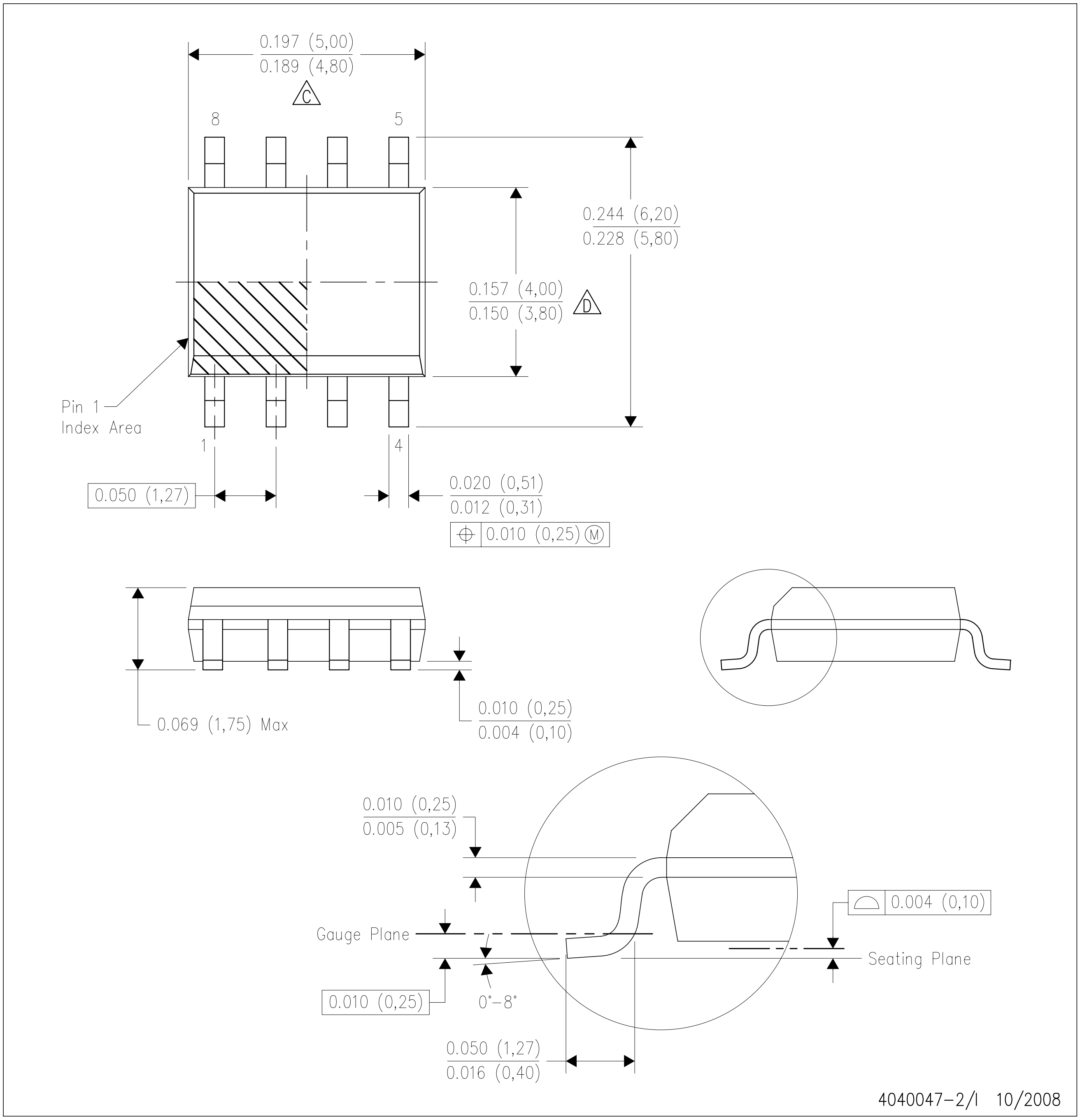
DGK (S-PDSO-G8) PLASTIC SMALL-OUTLINE PACKAGE



4073329/E 05/06

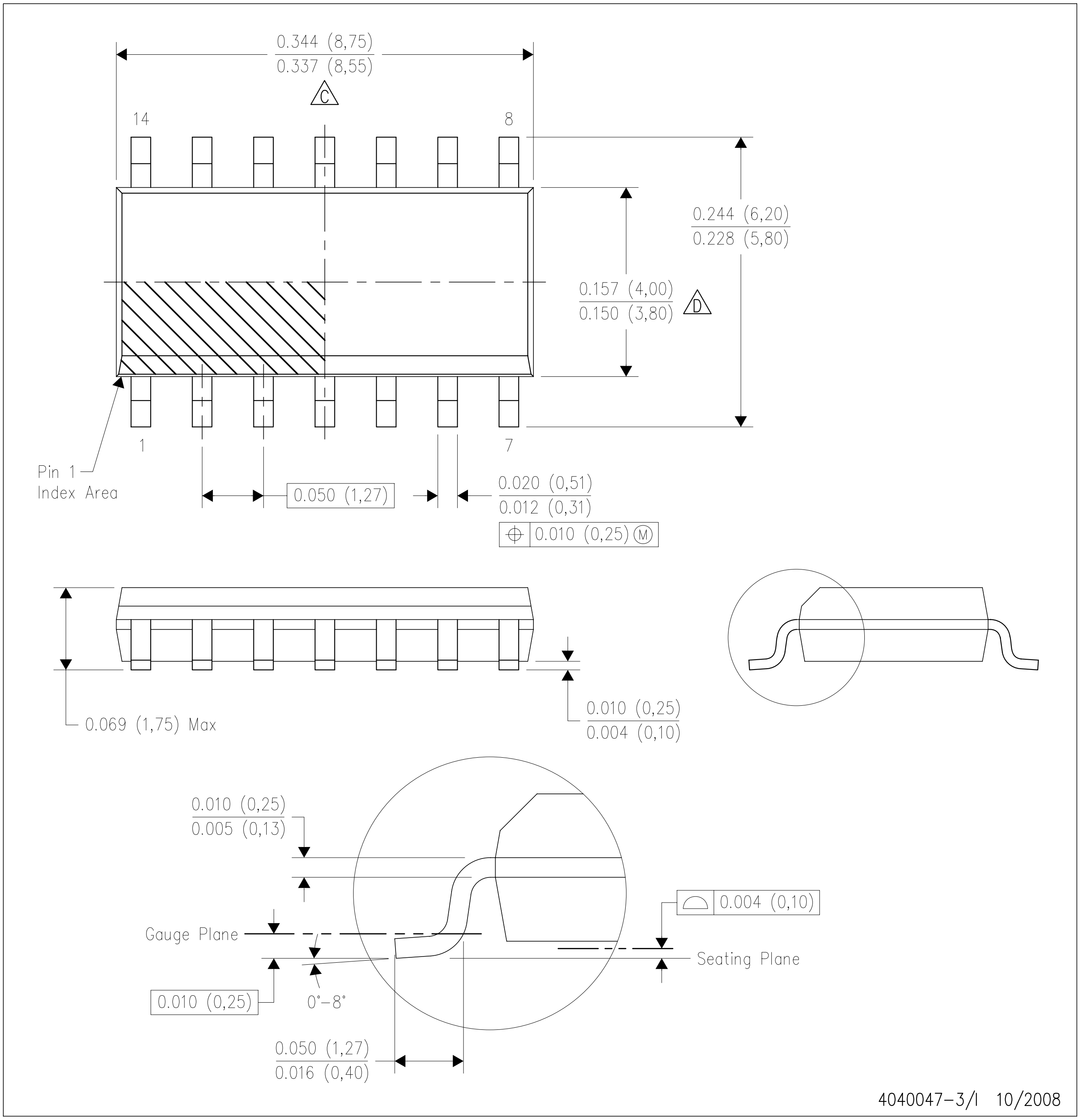
NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
- E. Falls within JEDEC MO–187 variation AA, except interlead flash.

D (R-PDSO-G8) 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 AA.

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.

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