

FEATURES

- 2.7-V and 5-V Performance
- Rail-to-Rail Output Swing
- Input Bias Current...1 pA Typ
- Input Offset Voltage...0.25 mV Typ
- Low Supply Current...100 μ A Typ
- Low Shutdown Current...45 pA Typ
- Gain Bandwidth of 1 MHz Typ
- Slew Rate...1 V/ μ s Typ
- Turn-On Time From Shutdown...5 μ s Typ
- Input Referred Voltage Noise (at 10 kHz)...
20 nV/ $\sqrt{\text{Hz}}$
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)

APPLICATIONS

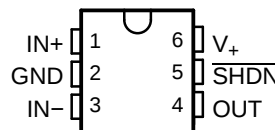
- Cordless/Cellular Phones
- Consumer Electronics (Laptops, PDAs)
- Audio Pre-Amps for Voice
- Portable/Battery-Powered Electronic Equipment
- Supply-Current Monitoring
- Battery Monitoring
- Buffers
- Filters
- Drivers

DESCRIPTION/ORDERING INFORMATION

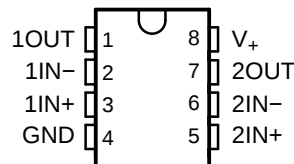
The LMV341, LMV342, LMV344 devices are single, dual, and quad CMOS operational amplifiers, respectively, with low voltage, low power, and rail-to-rail output swing capabilities. The PMOS input stage offers an ultra-low input bias current of 1 pA (typ) and an offset voltage of 0.25 mV (typ). The single supply amplifier is designed specifically for low-voltage (2.7 V to 5 V) operation, with a wide common-mode input voltage range that typically extends from -0.2 V to 0.8 V from the positive supply rail. The LMV341 (single) also offers a shutdown (SHDN) pin that can be used to disable the device. In shutdown mode, the supply current is reduced to 33 nA (typ). Additional features of the family are a 20-nV/ $\sqrt{\text{Hz}}$ voltage noise at 10 kHz, 1-MHz unity-gain bandwidth, 1-V/ μ s slew rate, and 100- μ A current consumption per channel.

Offered in both the SOT-23 and smaller SC-70 packages, the LMV341 is suitable for the most space-constraint applications. The LMV342 dual device is offered in the standard SOIC and MSOP packages. An extended industrial temperature range from -40°C to 125°C makes these devices suitable in a wide variety of commercial and industrial environments.

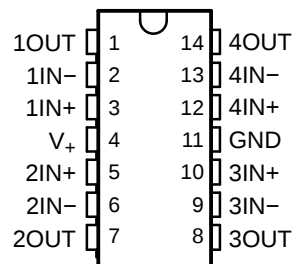
LMV341 . . . DBV (SOT-23) OR DCK (SC-70) PACKAGE
(TOP VIEW)



LMV342 . . . D (SOIC) OR DGK (MSOP) PACKAGE
(TOP VIEW)



LMV344 . . . D (SOIC) OR PW (TSSOP) PACKAGE
(TOP VIEW)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

LMV341, LMV342, LMV344

RAIL-TO-RAIL OUTPUT CMOS OPERATIONAL AMPLIFIERS WITH SHUTDOWN

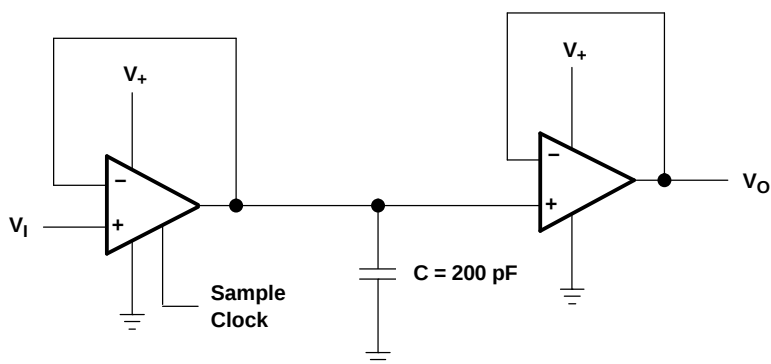
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ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾			ORDERABLE PART NUMBER	TOP-SIDE MARKING ⁽²⁾
–40°C to 125°C	Single	SOT-23 – DBV	Reel of 3000	LMV341IDBVR	RC9_
			Reel of 250	LMV341IDBVT	PREVIEW
		SC-70 – DCK	Reel of 3000	LMV341IDCKR	R4_
			Reel of 250	LMV341IDCKVT	PREVIEW
	Dual	SOIC – D	Tube of 75	LMV342ID	MV342I
			Reel of 2500	LMV342IDR	
		MSOP/VSSOP – DGK	Reel of 250	LMV342IDGK	RP_
			Reel of 2500	LMV342IDGKR	
	Quad	SOIC – D	Tube of 50	LMV344ID	LMV344I
			Reel of 2500	LMV344IDR	
		TSSOP – PW	Tube of 90	LMV344IPW	MV344I
			Reel of 2000	LMV344IPWR	

- (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.

APPLICATION CIRCUIT: SAMPLE-AND-HOLD CIRCUIT



Absolute Maximum Ratings⁽¹⁾

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

			MIN	MAX	UNIT
V ₊	Supply voltage ⁽²⁾			5.5	V
V _{ID}	Differential input voltage ⁽³⁾			±5.5	V
V _I	Input voltage range (either input)		0	5.5	V
θ _{JA}	Package thermal impedance ⁽⁴⁾⁽⁵⁾	D package	8 pin	97	°C/W
			14 pin	86	
		DBV package		165	
		DCK package		259	
		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₊ 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) 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)/θ_{JA}. Operating at the absolute maximum T_J of 150°C can affect reliability.
- (5) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

			MIN	MAX	UNIT
V ₊	Supply voltage (single-supply operation)		2.5	5.5	V
T _A	Operating free-air temperature		–40	125	°C

ESD Protection

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

LMV341, LMV342, LMV344

RAIL-TO-RAIL OUTPUT CMOS OPERATIONAL AMPLIFIERS WITH SHUTDOWN

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Electrical Characteristics

$V_+ = 2.7\text{ V}$, $GND = 0\text{ V}$, $V_{IC} = V_O = V_+/2$, $R_L > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{IO}	Input offset voltage			25°C		0.25	4	mV
				Full range			4.5	
α _{VIO}	Average temperature coefficient of input offset voltage			Full range		1.7		μV/°C
I _{IB}	Input bias current			25°C		1	120	pA
				−40°C to 85°C			250	
				−40°C to 125°C			3	nA
I _{IO}	Input offset current			25°C		6.6		fA
CMRR	Common-mode rejection ratio	0 ≤ V _{ICR} ≤ 1.7 V		25°C	56	80		dB
		0 ≤ V _{ICR} ≤ 1.6 V		Full range	50			
k _{SVR}	Supply-voltage rejection ratio	2.7 V ≤ V ₊ ≤ 5 V		25°C	65	82		dB
				Full range	60			
V _{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		25°C	0	−0.2 to 1.9	1.7	V
A _V	Large-signal voltage gain ⁽²⁾	R _L = 10 kΩ to 1.35 V		25°C	78	113		dB
				Full range	70			
		R _L = 2 kΩ to 1.35 V		25°C	72	103		
				Full range	64			
V _O	Output swing (delta from supply rails)	R _L = 2 kΩ to 1.35 V	Low level	25°C		24	60	mV
				Full range			95	
			High level	25°C		26	60	
				Full range			95	
		R _L = 10 kΩ to 1.35 V	Low level	25°C		5	30	
				Full range			40	
			High level	25°C		5.3	30	
				Full range			40	
I _{CC}	Supply current (per channel)			25°C		100	170	μA
				Full range			230	
I _{OS}	Output short-circuit current	Sourcing	LMV341, LMV342	25°C		20	32	mA
			LMV344			18	24	
		Sinking					15	
SR	Slew rate	R _L = 10 kΩ ⁽³⁾		25°C		1		V/μs
GBM	Unity-gain bandwidth	R _L = 10 kΩ, C _L = 200 pF		25°C		1		MHz
Φ _m	Phase margin	R _L = 100 kΩ		25°C		72		deg
G _m	Gain margin	R _L = 100 kΩ		25°C		20		dB
V _n	Equivalent input noise voltage	f = 1 kHz		25°C		40		nV/√Hz
I _n	Equivalent input noise current	f = 1 kHz		25°C		0.001		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, A _V = 1, R _L = 600 Ω, V _I = 1 V _{PP}		25°C		0.017		%

(1) Typical values represent the most likely parametric norm.

(2) $GND + 0.2\text{ V} \leq V_O \leq V_+ - 0.2\text{ V}$

(3) Connected as voltage follower with 2- V_{PP} step input. Number specified is the slower of the positive and negative slew rates.

Shutdown Characteristics

$V_+ = 2.7\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{\text{IC}} = V_{\text{O}} = V_+/2$, $R_L > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$I_{\text{CC}}(\text{SHDN})$	Supply current in shutdown mode	$V_{\text{SD}} = 0\text{ V}$	25°C		0.045	1000	nA
			Full range			1.5	μA
$t_{(\text{on})}$	Amplifier turn-on time		25°C		5		μs
V_{SD}	Shutdown pin voltage range	ON mode	25°C	1.7 to 2.7	2.4 to 2.7		V
		Shutdown mode		0 to 1	0 to 0.8		

LMV341, LMV342, LMV344

RAIL-TO-RAIL OUTPUT CMOS OPERATIONAL AMPLIFIERS WITH SHUTDOWN

SLOS447G – SEPTEMBER 2004 – REVISED FEBRUARY 2006

Electrical Characteristics

$V_+ = 5\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{\text{IC}} = V_{\text{O}} = V_+/2$, $R_L > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{IO}	Input offset voltage			25°C		0.25	4	mV
				Full range			4.5	
α _{VIO}	Average temperature coefficient of input offset voltage			Full range		1.9		μV/°C
I _{IB}	Input bias current			25°C		1	200	pA
				–40°C to 85°C			375	
				–40°C to 125°C			5	nA
I _{IO}	Input offset current			25°C		6.6		fA
CMRR	Common-mode rejection ratio	0 ≤ V _{ICR} ≤ 4 V		25°C	56	86		dB
		0 ≤ V _{ICR} ≤ 3.9 V		Full range	50			
k _{SVR}	Supply-voltage rejection ratio	2.7 V ≤ V ₊ ≤ 5 V		25°C	65	82		dB
				Full range	60			
V _{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		25°C	0	–0.2 to 4.2	4	V
A _V	Large-signal voltage gain ⁽²⁾	R _L = 10 kΩ to 2.5 V		25°C	78	116		dB
				Full range	70			
		R _L = 2 kΩ to 2.5 V		25°C	72	107		
				Full range	64			
V _O	Output swing (delta from supply rails)	R _L = 2 kΩ to 2.5 V	Low level	25°C		32	60	mV
				Full range			95	
			High level	25°C		34	60	
				Full range			95	
		R _L = 10 kΩ to 2.5 V	Low level	25°C		7	30	
				Full range			40	
			High level	25°C		7	30	
				Full range			40	
I _{CC}	Supply current (per channel)			25°C		107	200	μA
				Full range			260	
I _{OS}	Output short-circuit current	Sourcing	LMV341, LMV342	25°C	85	113		mA
					LMV344	TBD	TBD	
		Sinking				50	75	
SR	Slew rate	R _L = 10 kΩ ⁽³⁾		25°C		1		V/μs
GBM	Unity-gain bandwidth	R _L = 10 kΩ, C _L = 200 pF		25°C		1		MHz
Φ _m	Phase margin	R _L = 100 kΩ		25°C		70		deg
G _m	Gain margin	R _L = 100 kΩ		25°C		20		dB
V _n	Equivalent input noise voltage	f = 1 kHz		25°C		39		nV/√Hz
I _n	Equivalent input noise current	f = 1 kHz		25°C		0.001		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, A _V = 1, R _L = 600 Ω, V _I = 1 V _{PP}		25°C		0.012		%

(1) Typical values represent the most likely parametric norm.

(2) $\text{GND} + 0.2\text{ V} \leq V_{\text{O}} \leq V_+ - 0.2\text{ V}$

(3) Connected as voltage follower with 2- V_{PP} step input. Number specified is the slower of the positive and negative slew rates.

Shutdown Characteristics

$V_+ = 5\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{IC} = V_O = V_+/2$, $R_L > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$I_{CC}(\text{SHDN})$	Supply current in shutdown mode	$V_{SD} = 0\text{ V}$	25°C		0.033	1	μA
			Full range			1.5	
$t_{(\text{on})}$	Amplifier turn-on time		25°C		5		μs
V_{SD}	Shutdown pin voltage range	ON mode	25°C		3.1 to 5	4.5 to 5	V
		Shutdown mode			0 to 1	0 to 0.8	

TYPICAL CHARACTERISTICS

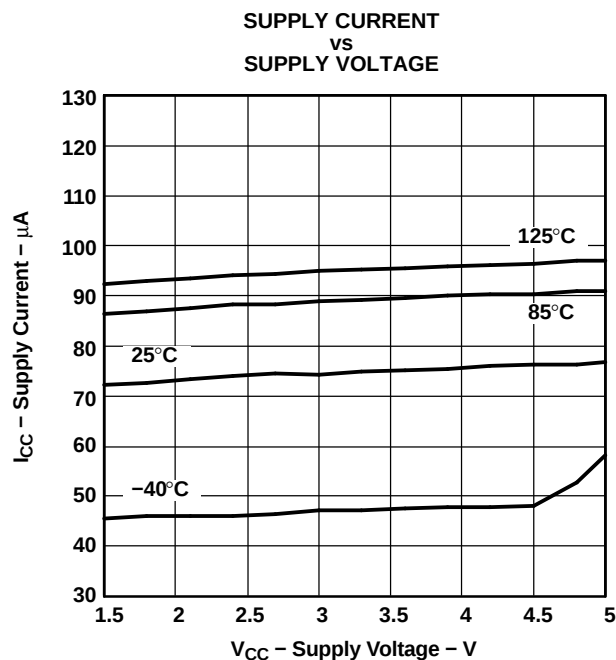


Figure 1.

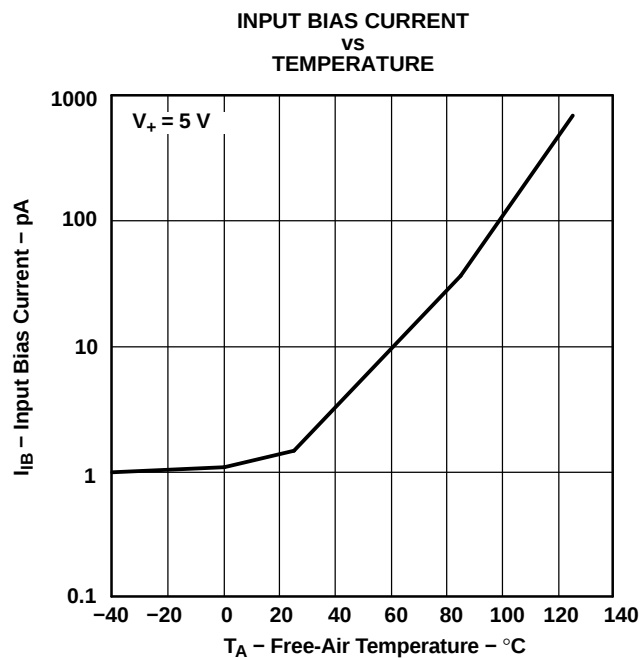


Figure 2.

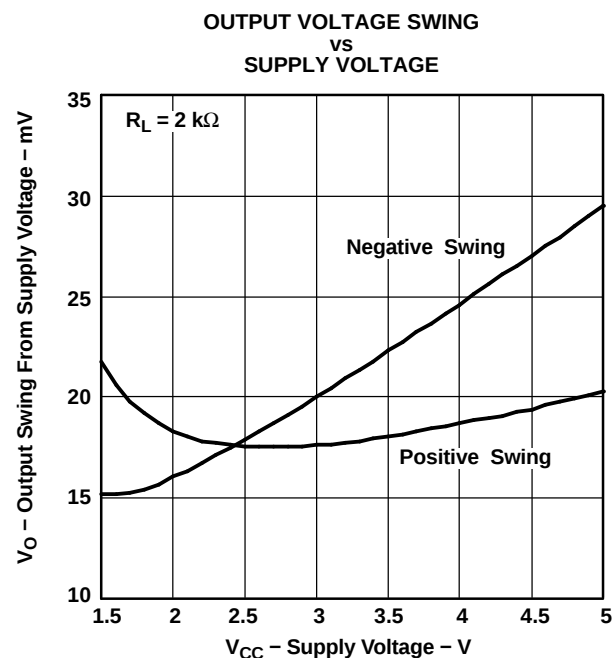


Figure 3.

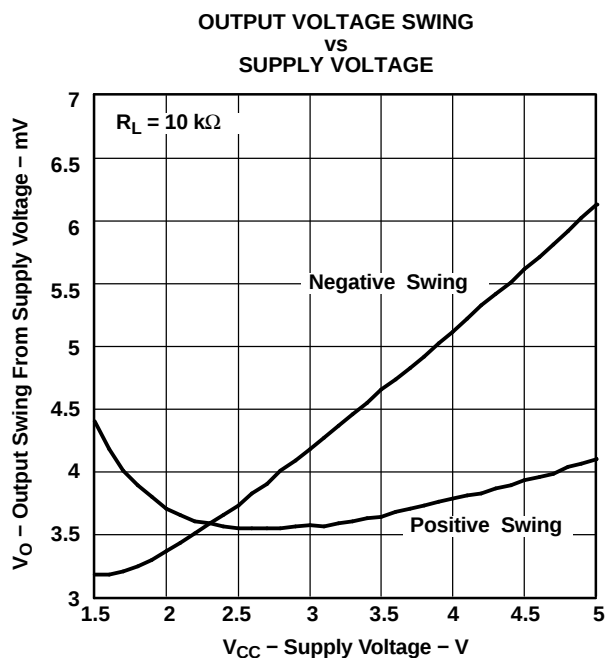


Figure 4.

TYPICAL CHARACTERISTICS (continued)

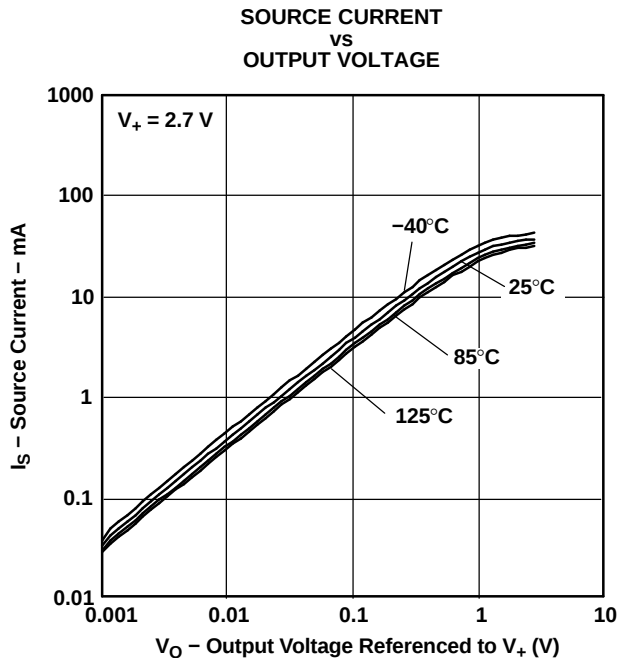


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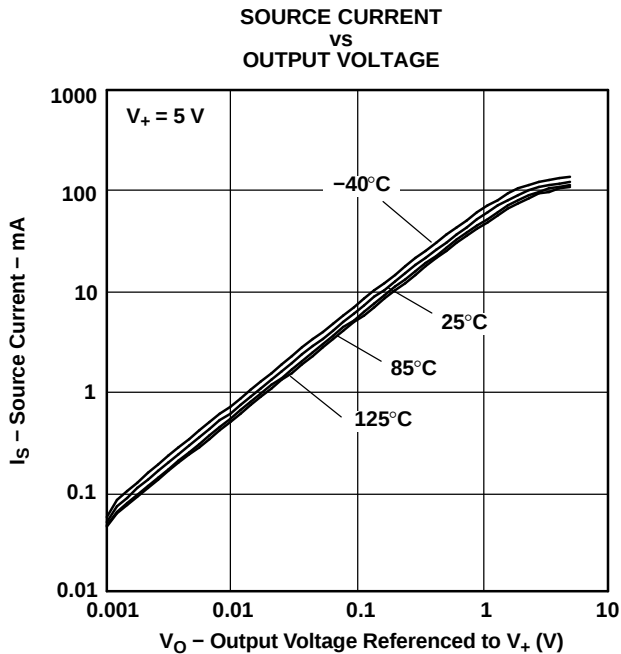


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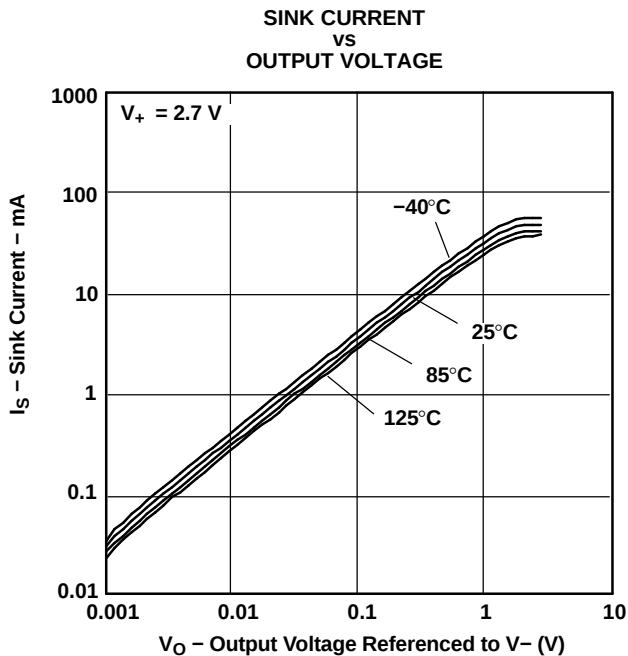


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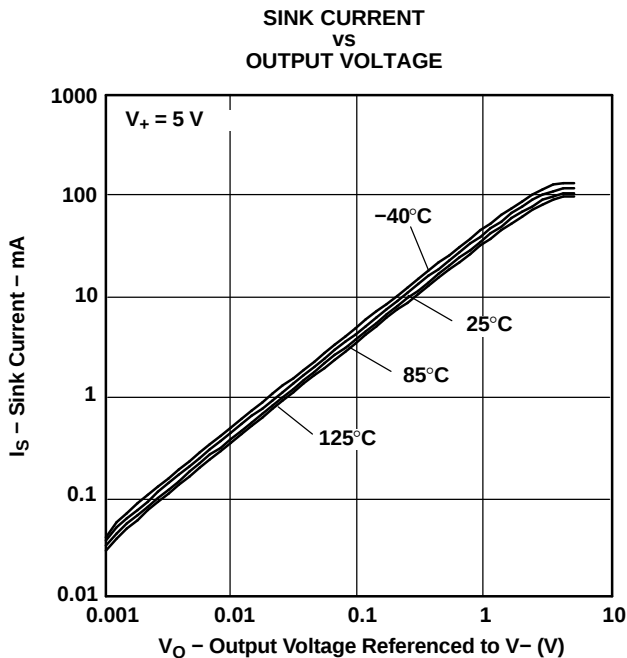


Figure 8.

TYPICAL CHARACTERISTICS (continued)

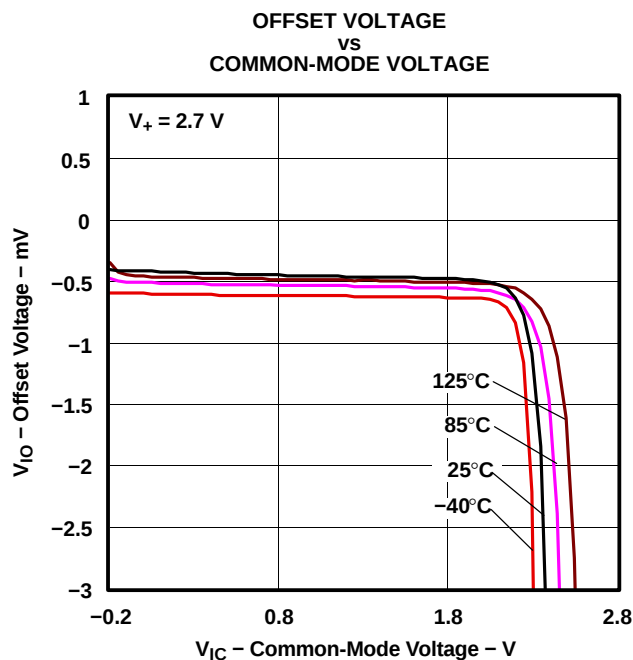


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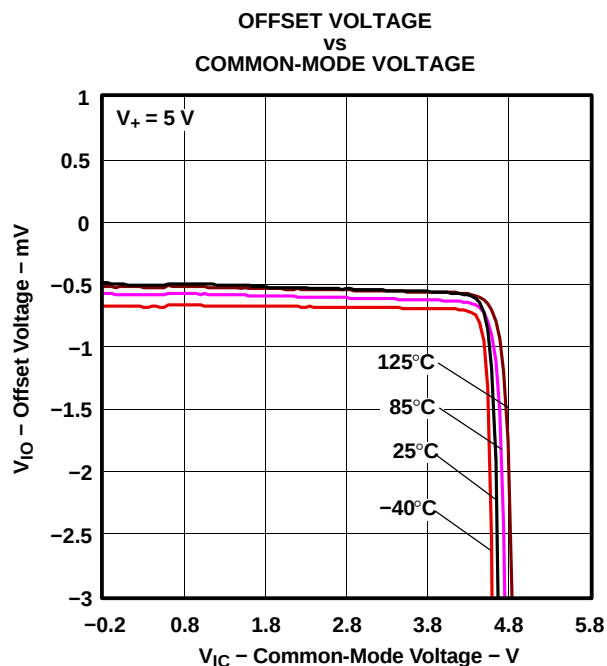


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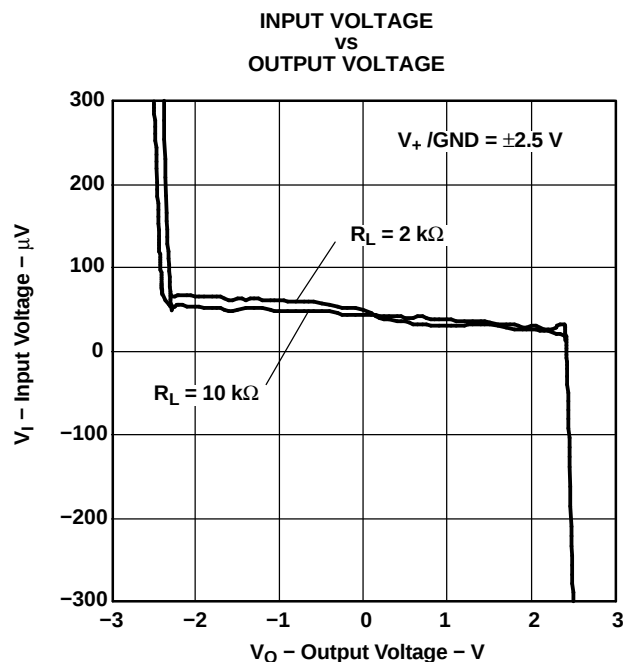


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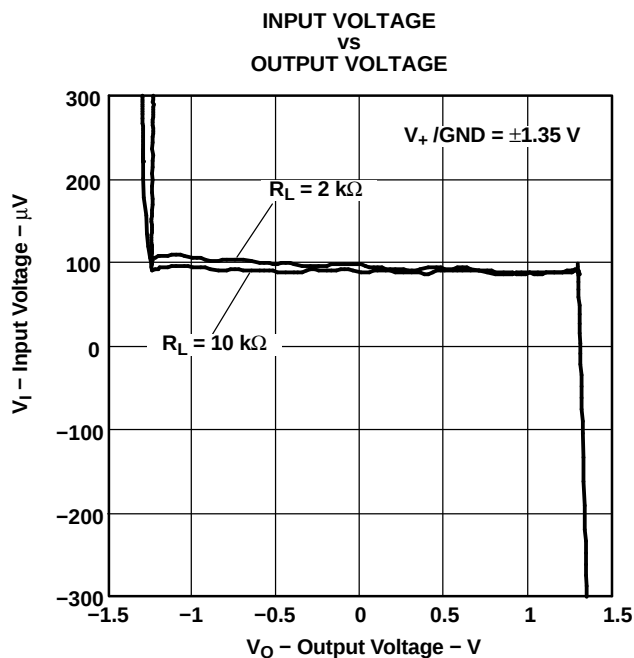


Figure 12.

TYPICAL CHARACTERISTICS (continued)

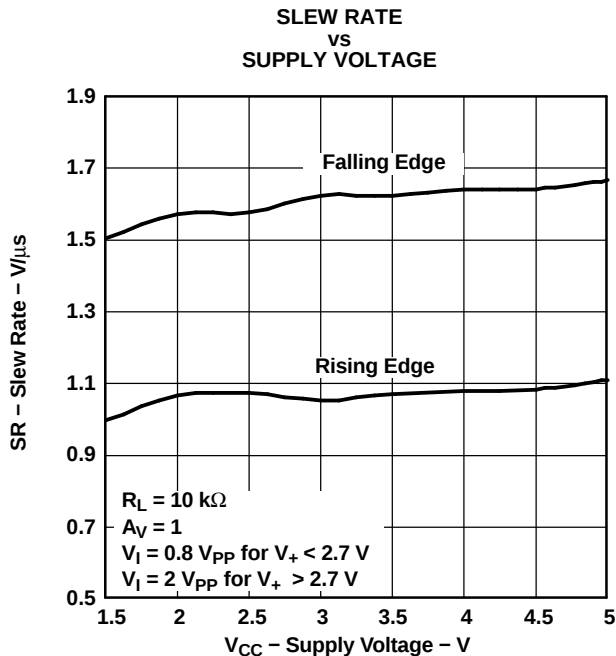


Figure 13.

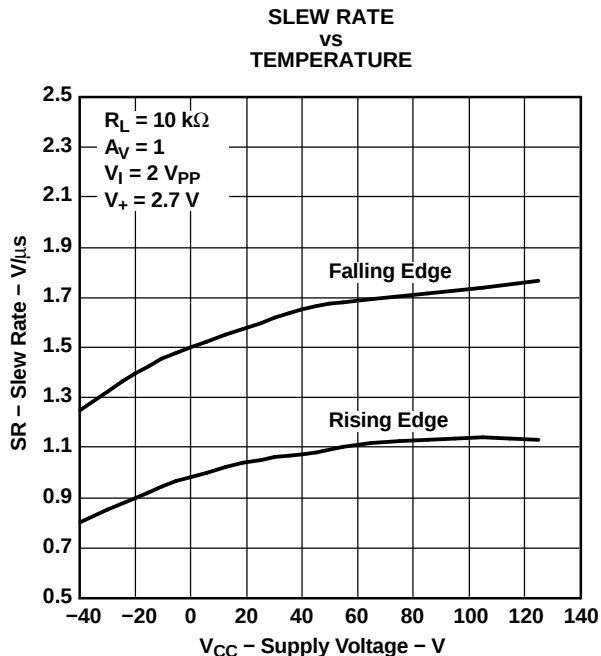


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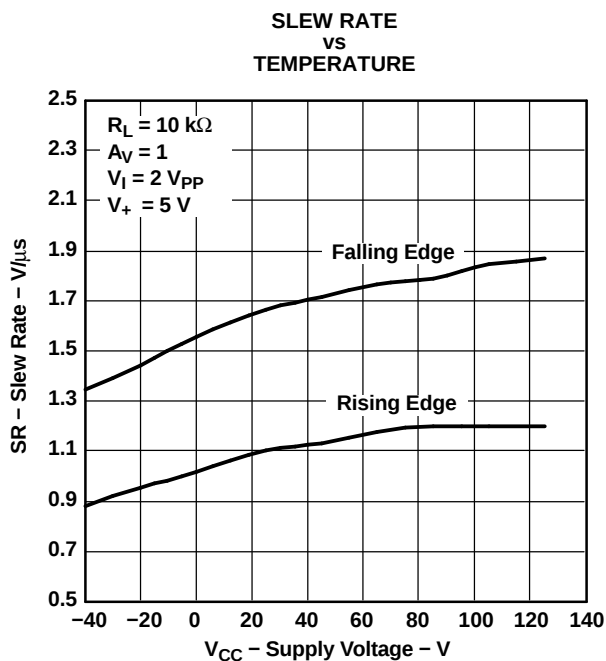


Figure 15.

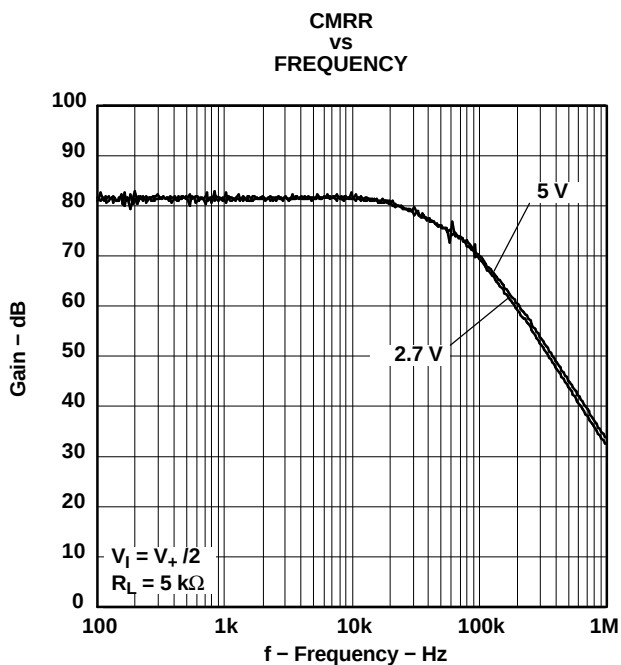


Figure 16.

TYPICAL CHARACTERISTICS (continued)

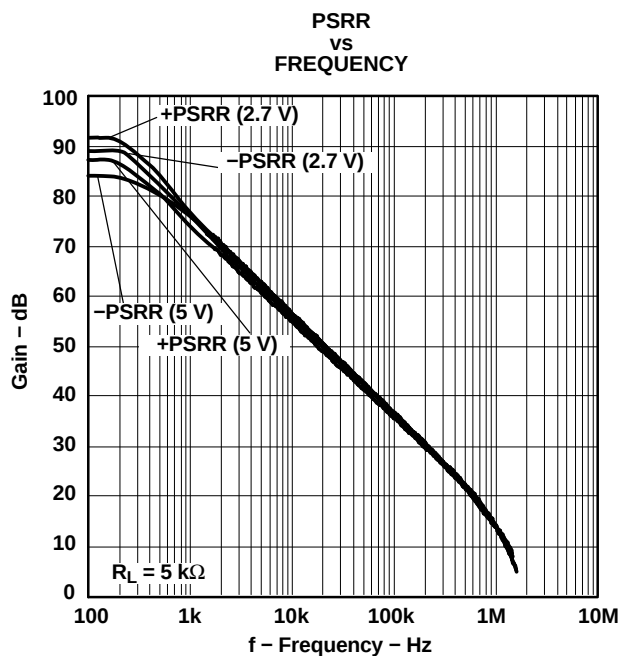


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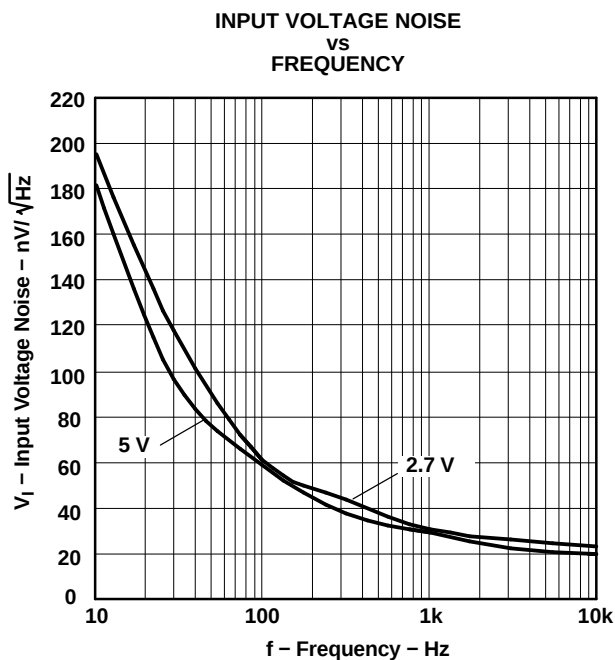


Figure 18.

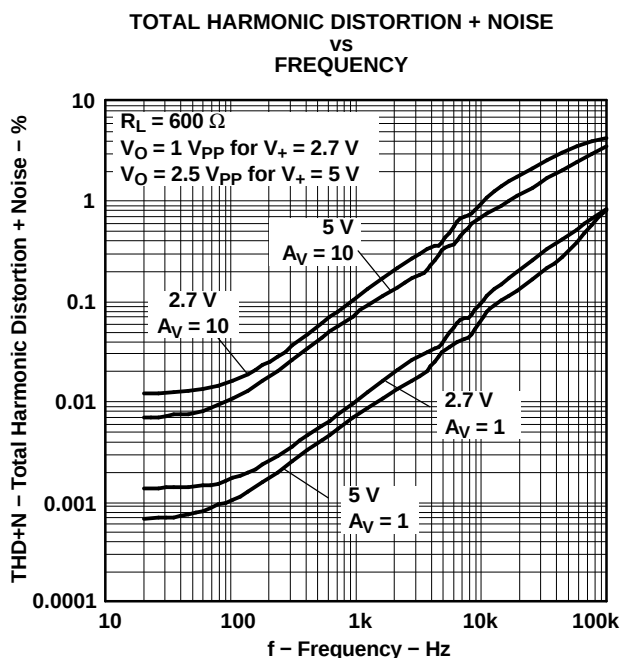


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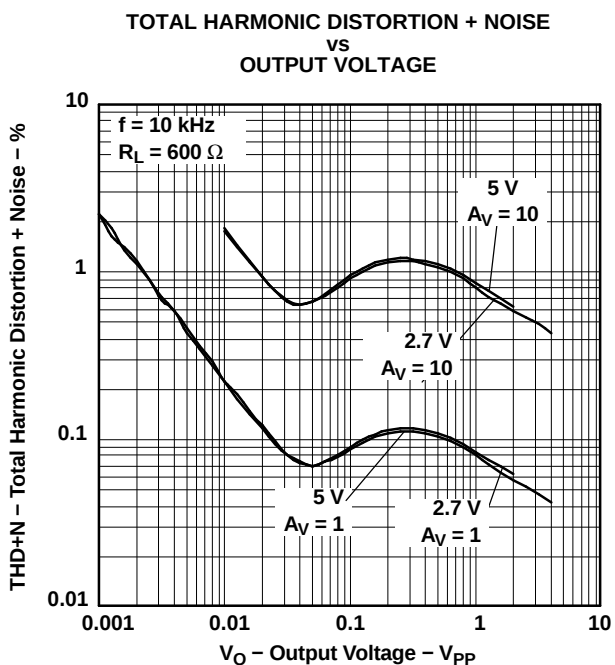
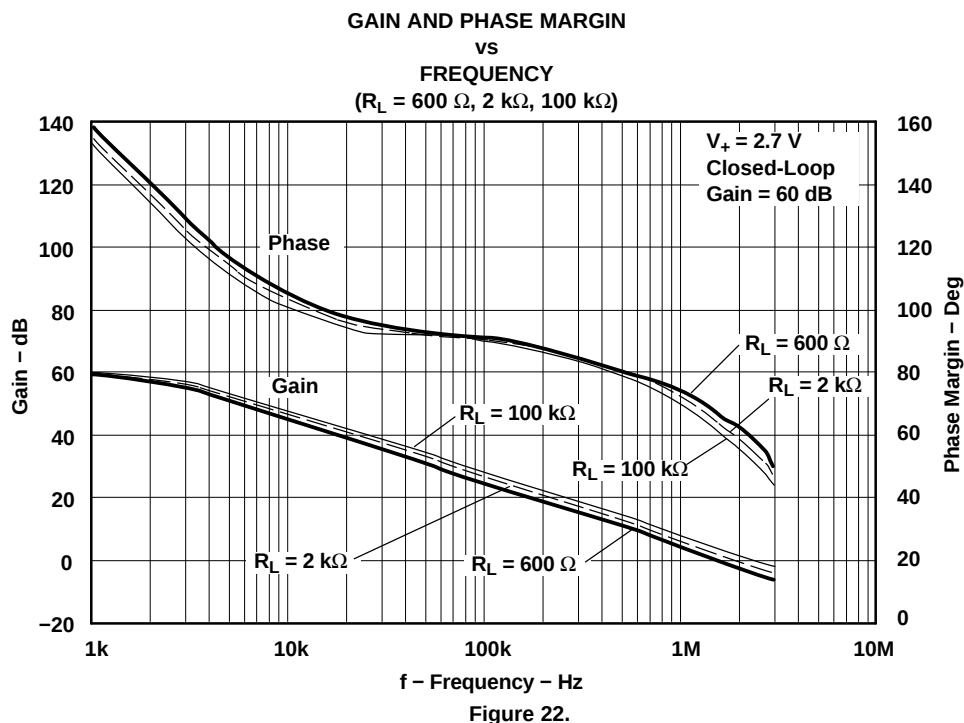
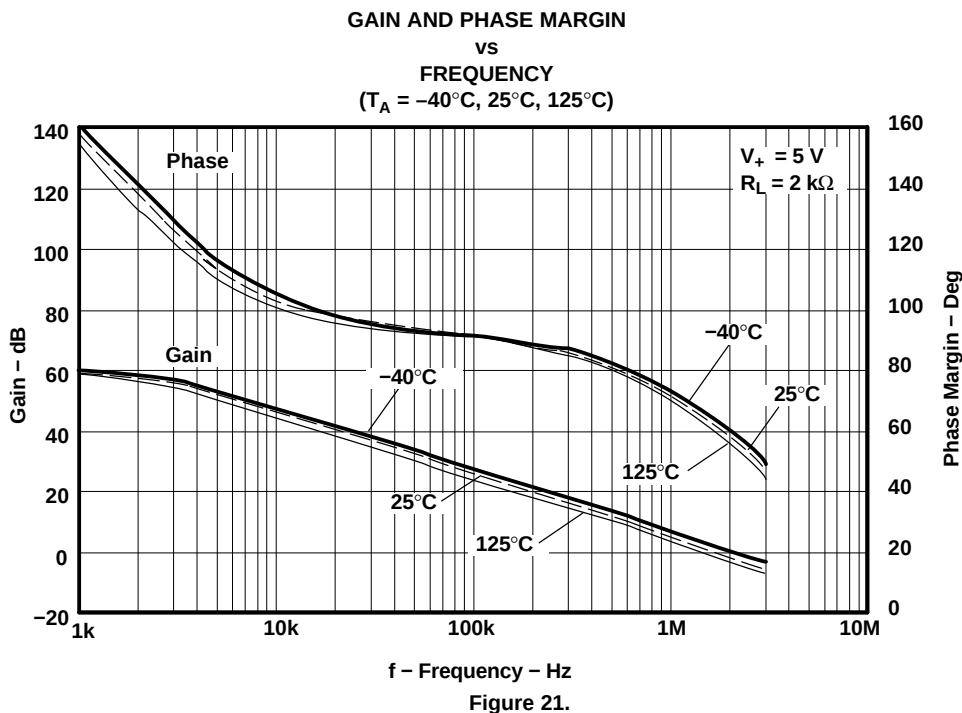


Figure 20.

TYPICAL CHARACTERISTICS (continued)



TYPICAL CHARACTERISTICS (continued)

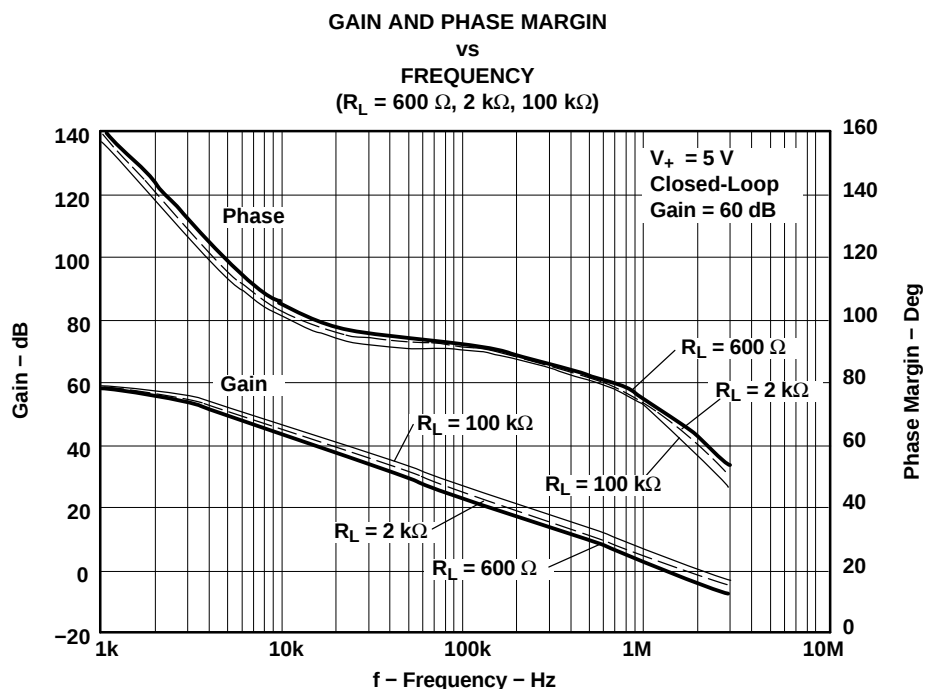


Figure 23.

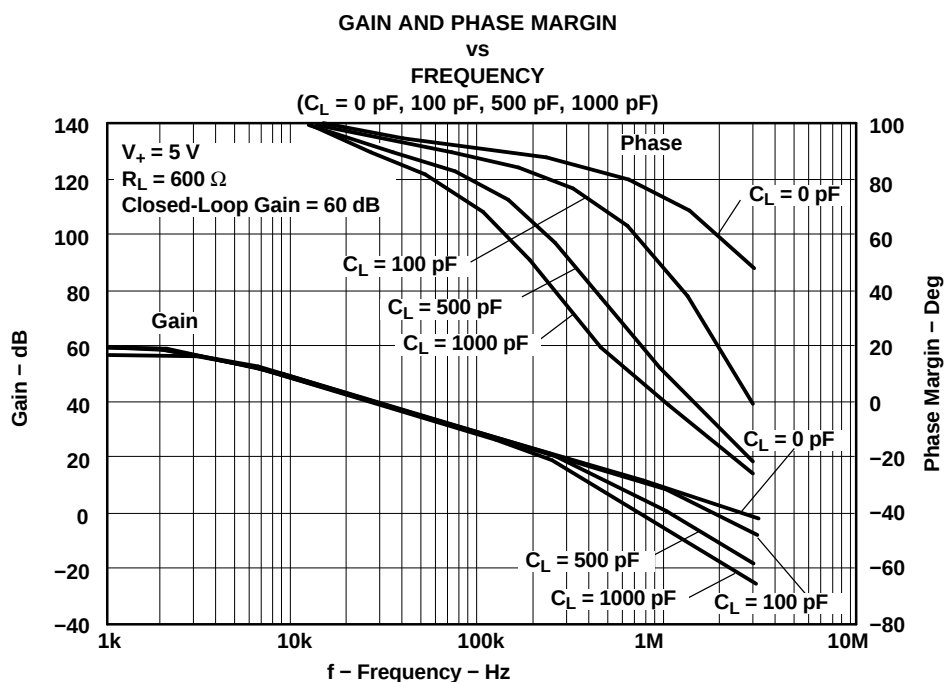


Figure 24.

TYPICAL CHARACTERISTICS (continued)

SMALL-SIGNAL NONINVERTING RESPONSE

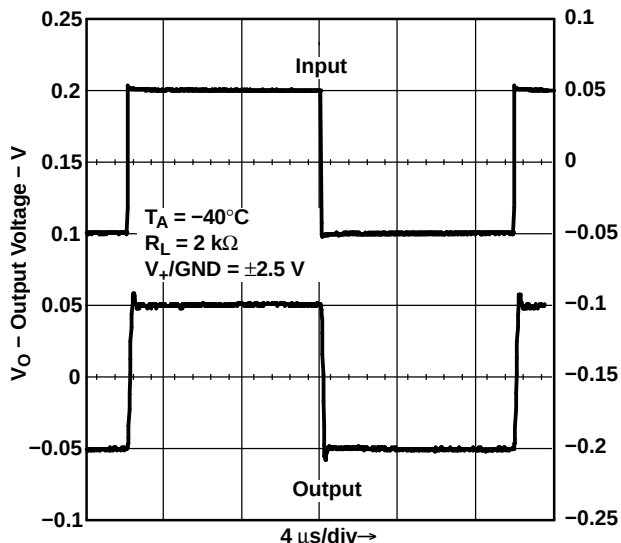


Figure 25.

LARGE-SIGNAL NONINVERTING RESPONSE

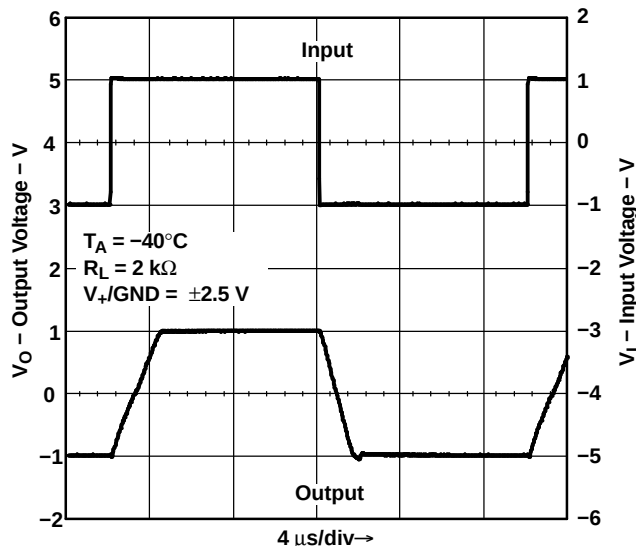


Figure 26.

SMALL-SIGNAL NONINVERTING RESPONSE

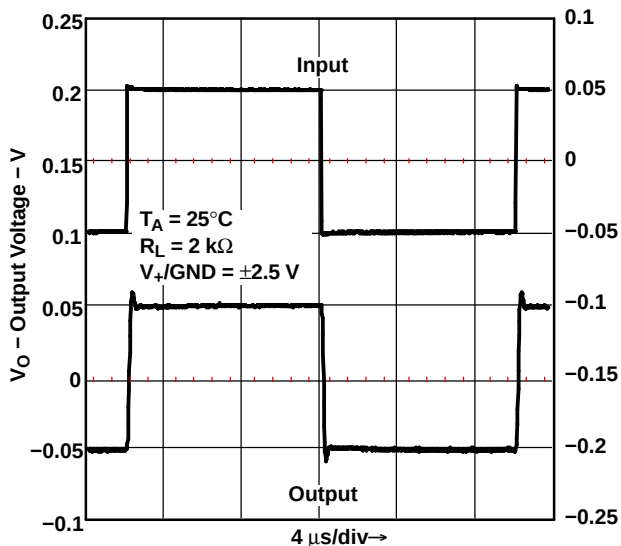


Figure 27.

LARGE-SIGNAL NONINVERTING RESPONSE

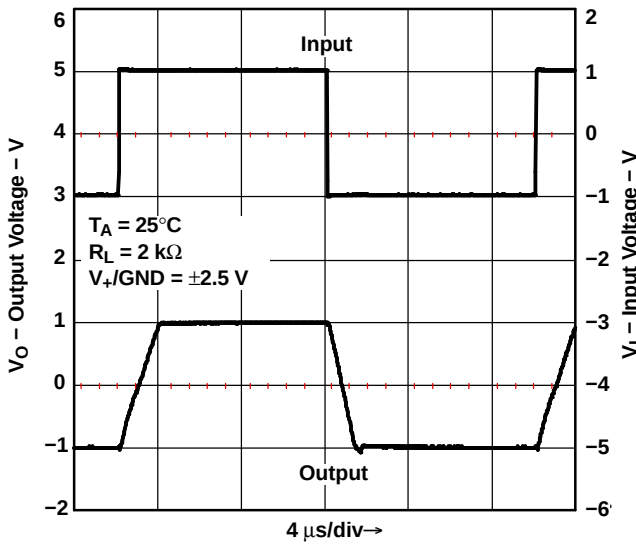


Figure 28.

TYPICAL CHARACTERISTICS (continued)

SMALL-SIGNAL NONINVERTING RESPONSE

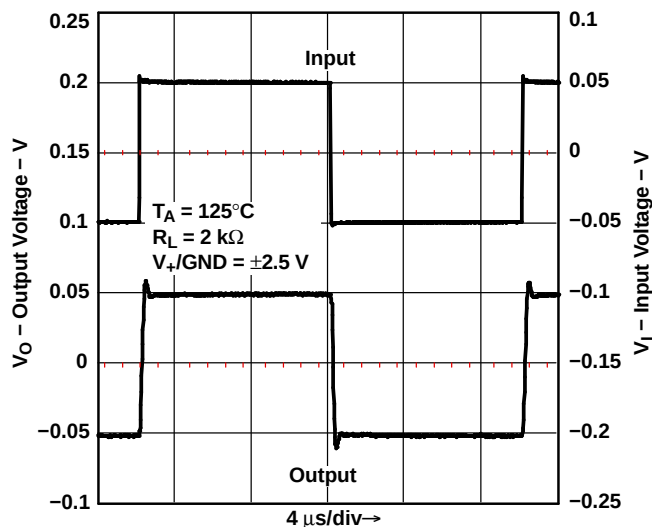


Figure 29.

LARGE-SIGNAL NONINVERTING RESPONSE

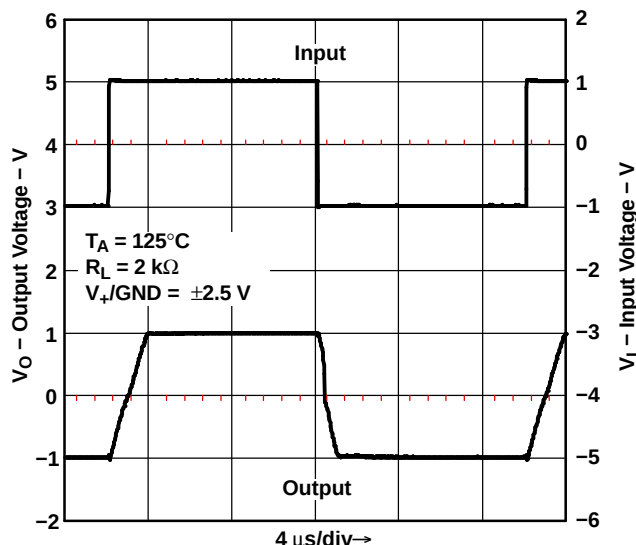


Figure 30.

SMALL-SIGNAL INVERTING RESPONSE

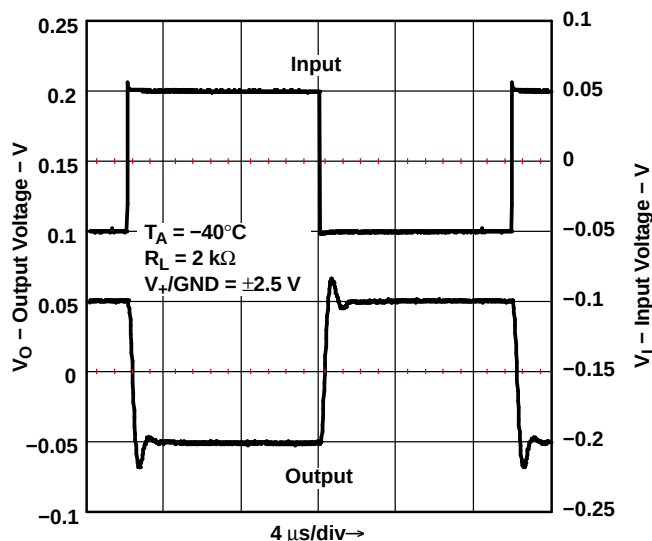


Figure 31.

LARGE-SIGNAL INVERTING RESPONSE

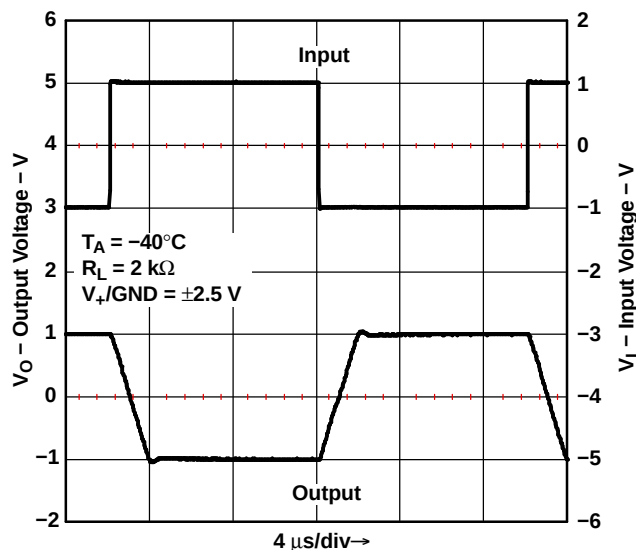


Figure 32.

TYPICAL CHARACTERISTICS (continued)

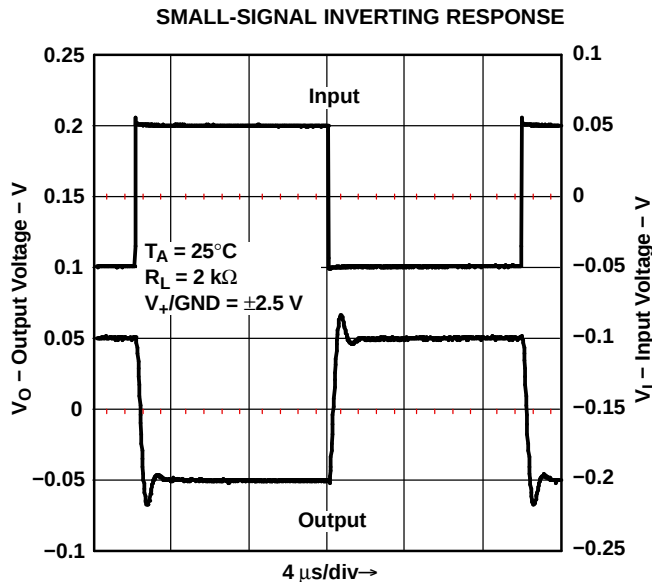


Figure 33.

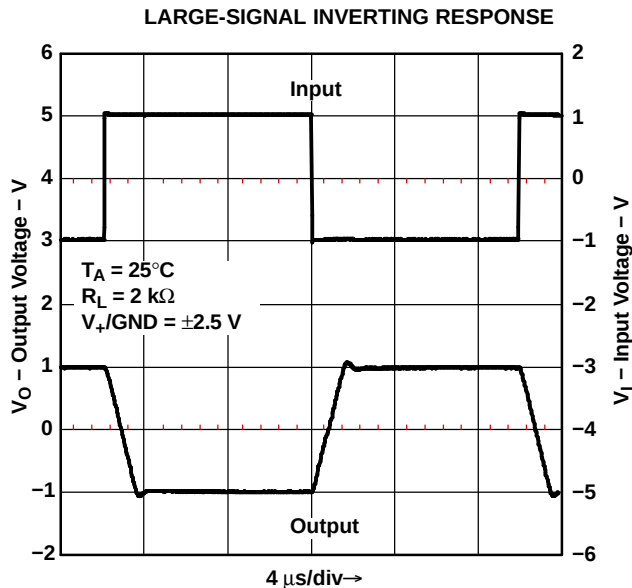


Figure 34.

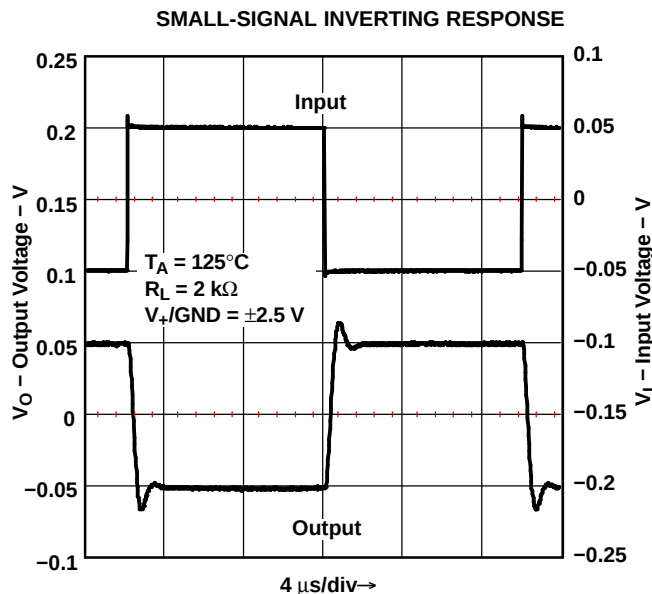


Figure 35.

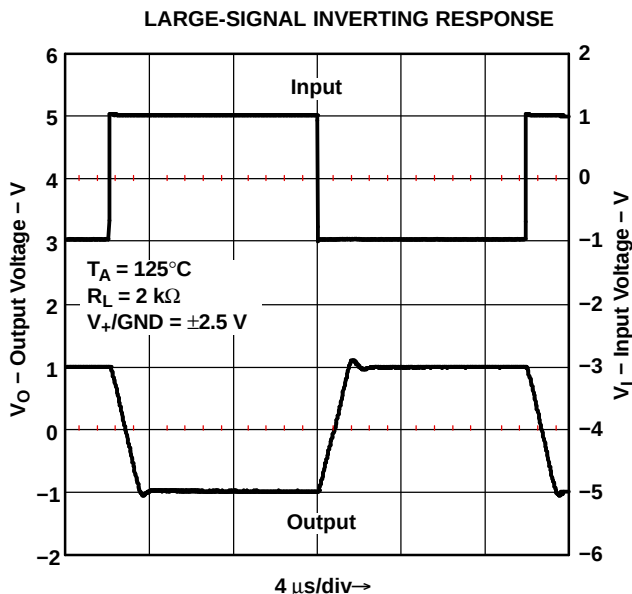


Figure 36.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LMV341IDBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV341IDBVRE4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV341IDCKR	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV341IDCKRE4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV341IDCKRG4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV342ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV342IDDUR	PREVIEW	VSSOP	DDU	8	3000	TBD	Call TI	Call TI
LMV342IDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV342IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV342IDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV342IDGKT	PREVIEW	MSOP	DGK	8	250	TBD	Call TI	Call TI
LMV342IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV342IDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IPWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV344IPWRE4	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)

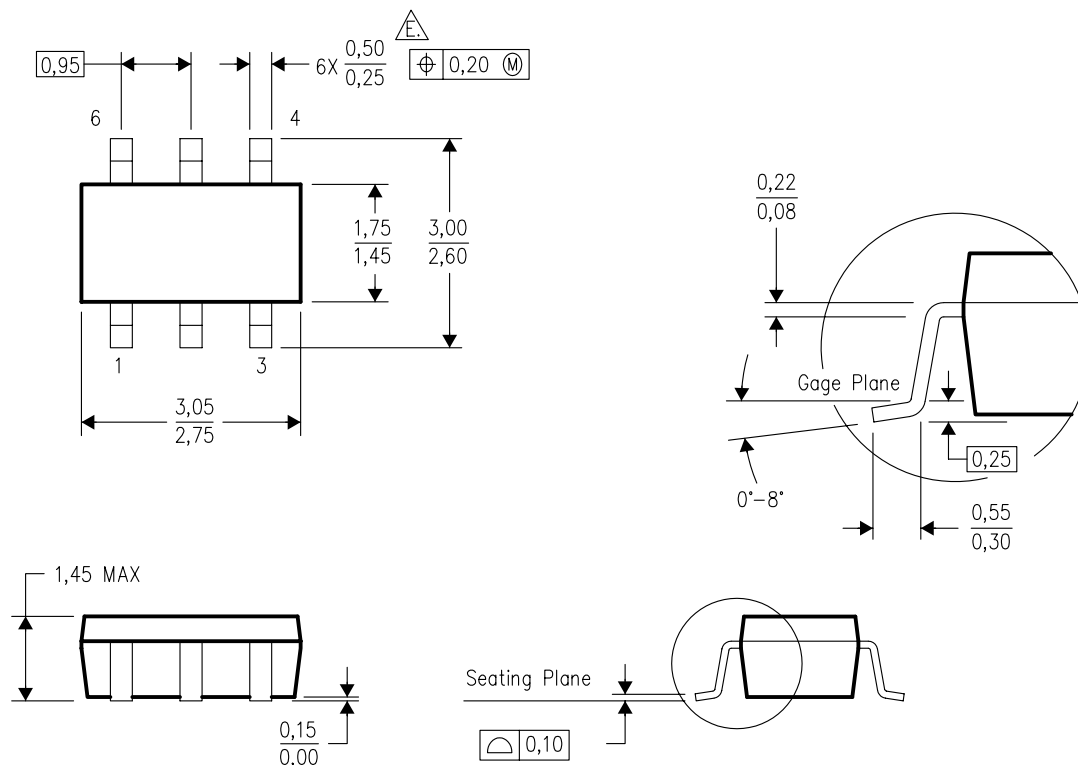
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE

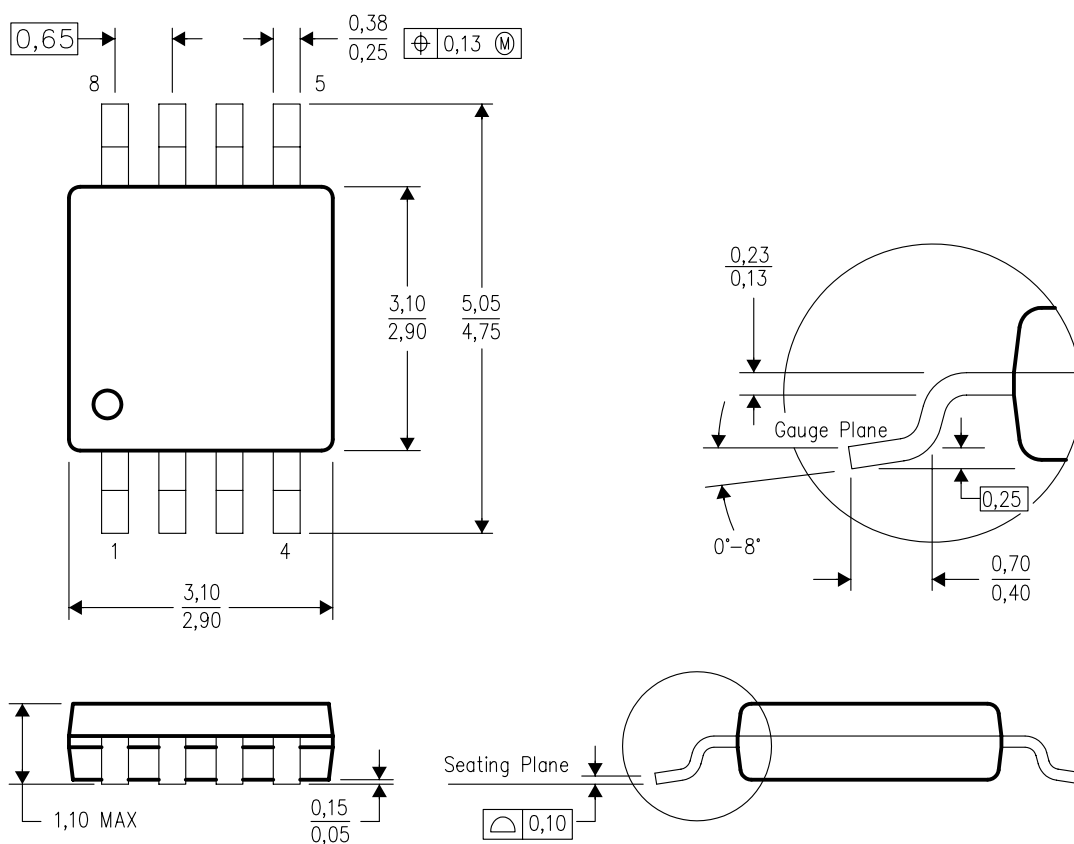


4073253-5/J 10/2005

- 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. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
-  Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



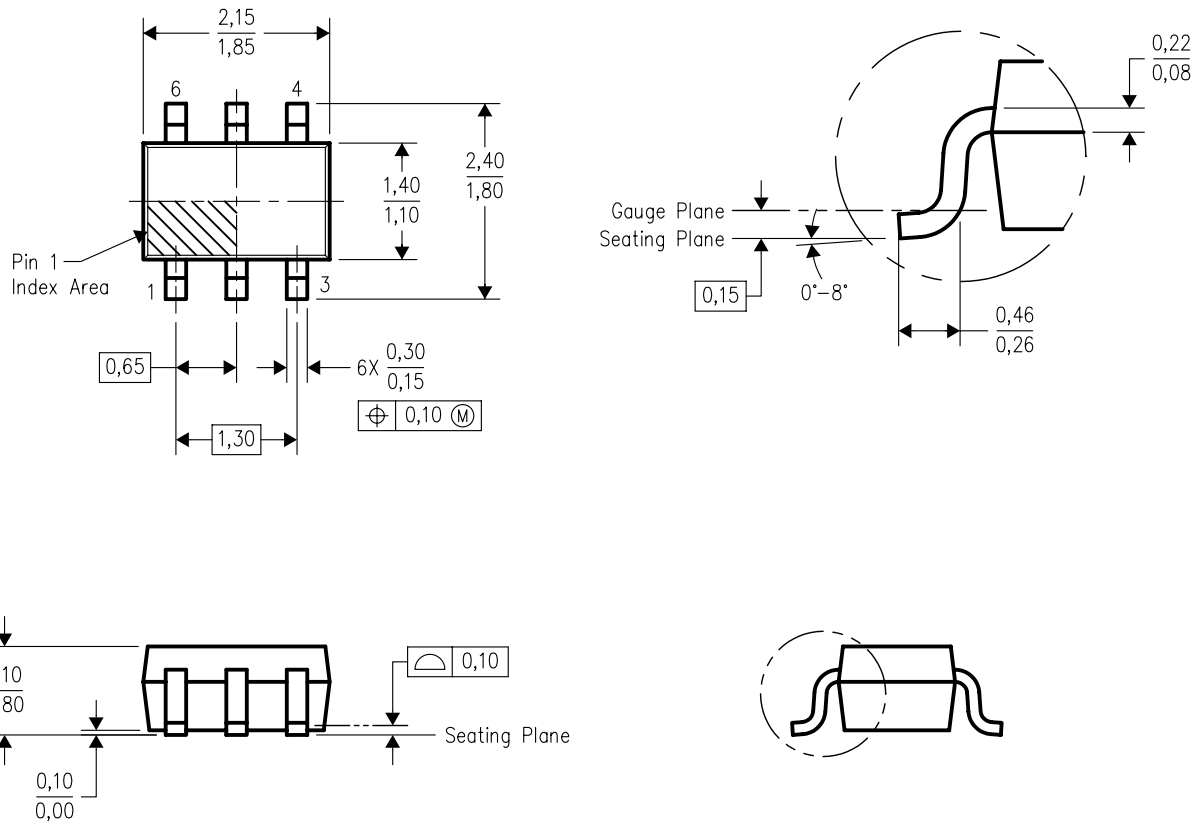
4073329/D 12/03

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.
- D. Falls within JEDEC MO-187 variation AA.

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE

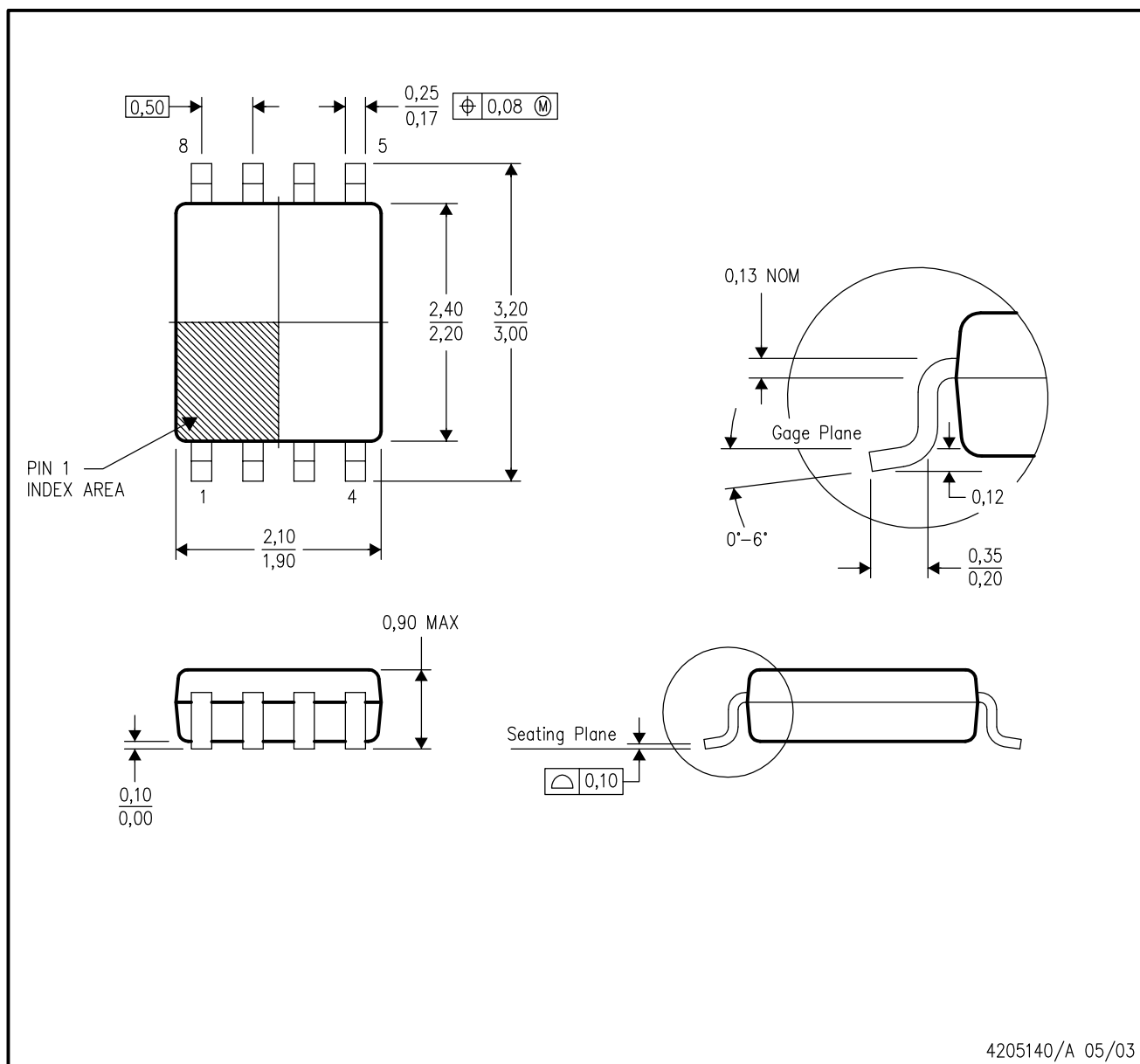


4093553-3/E 10/2005

- 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 AB.

DDU (R-PDSO-G8)

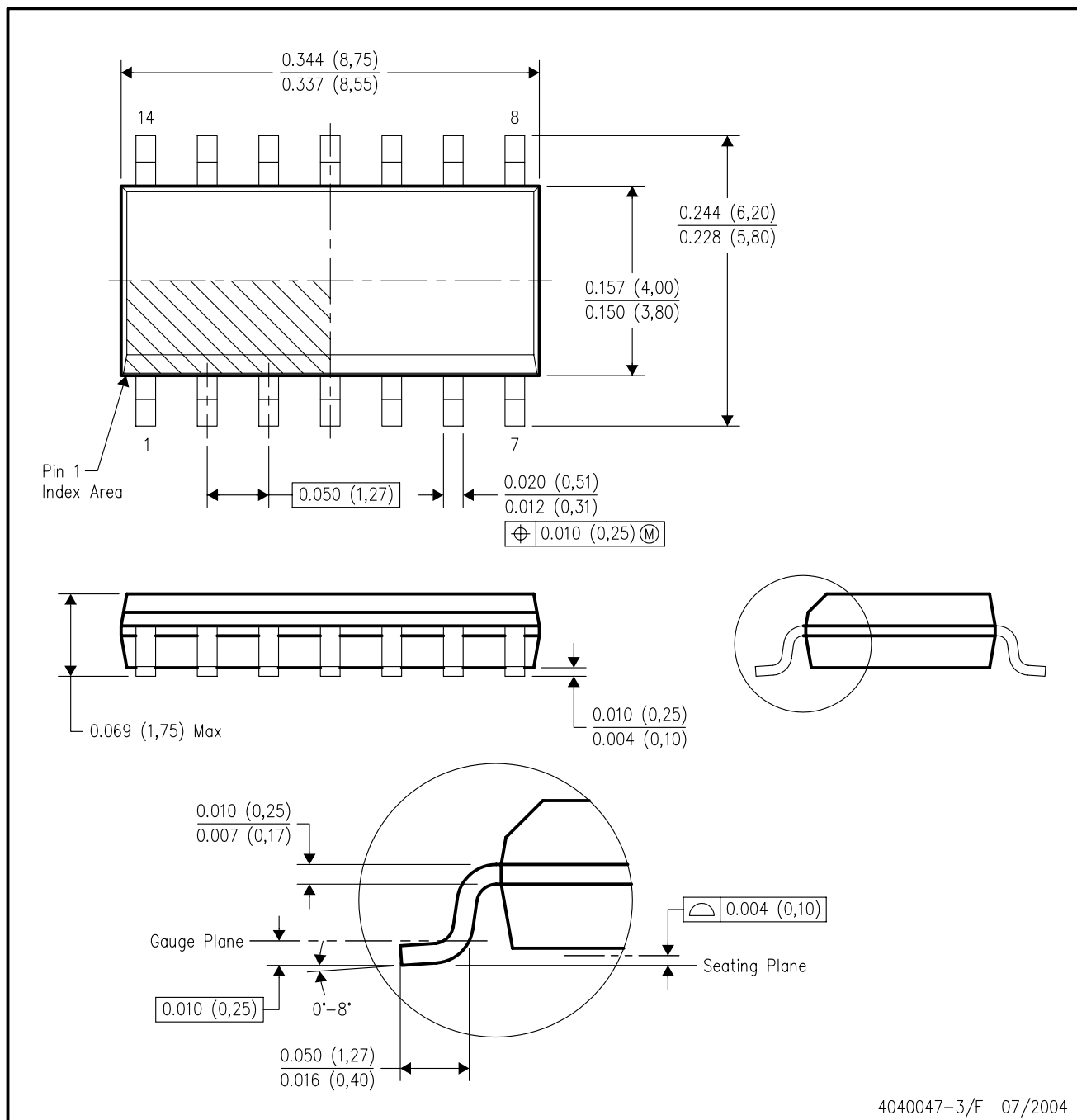
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion.
 - Falls within JEDEC MO-187 variation CA.

D (R-PDSO-G14)

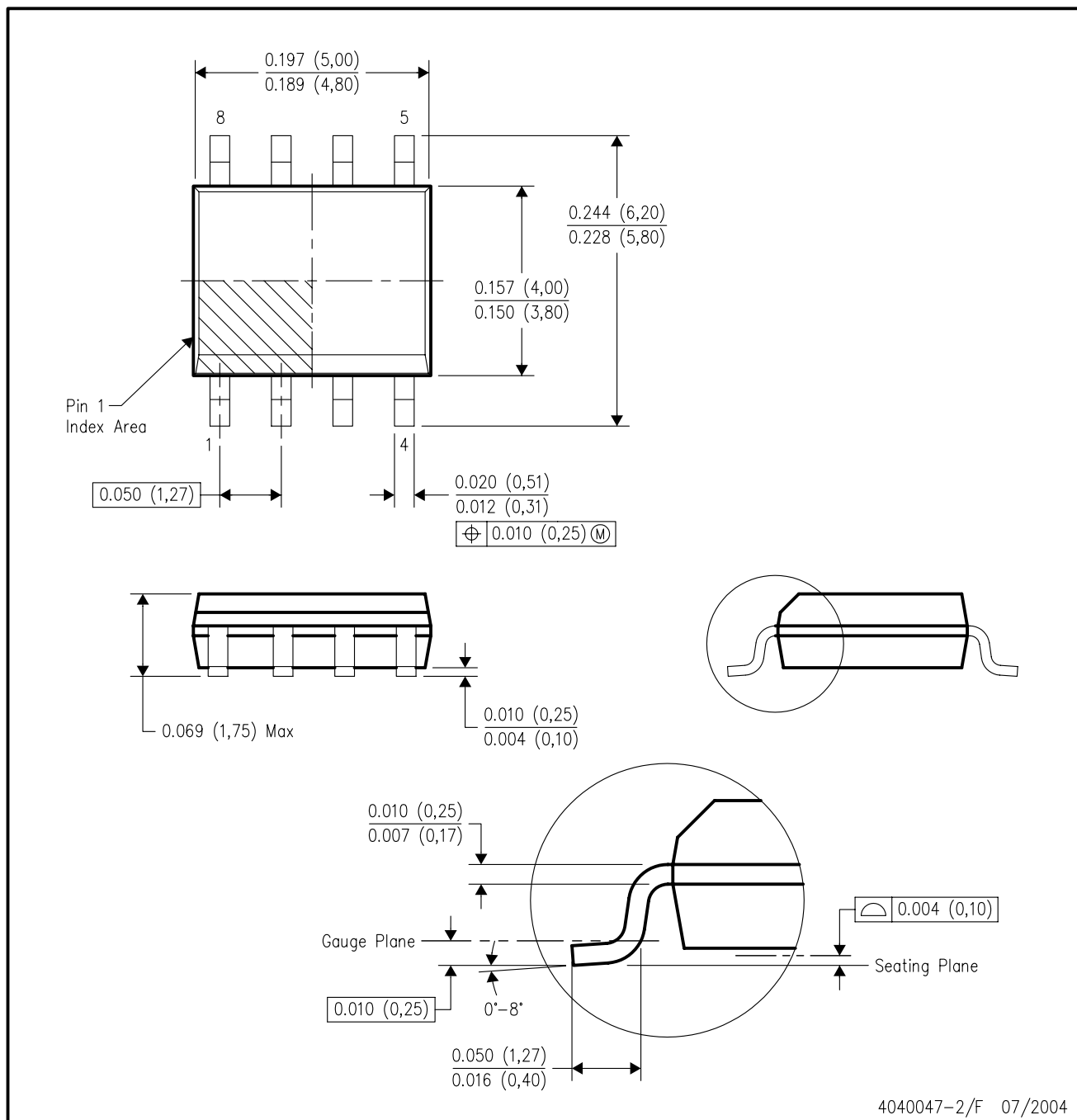
PLASTIC SMALL-OUTLINE PACKAGE



4040047-3/F 07/2004

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

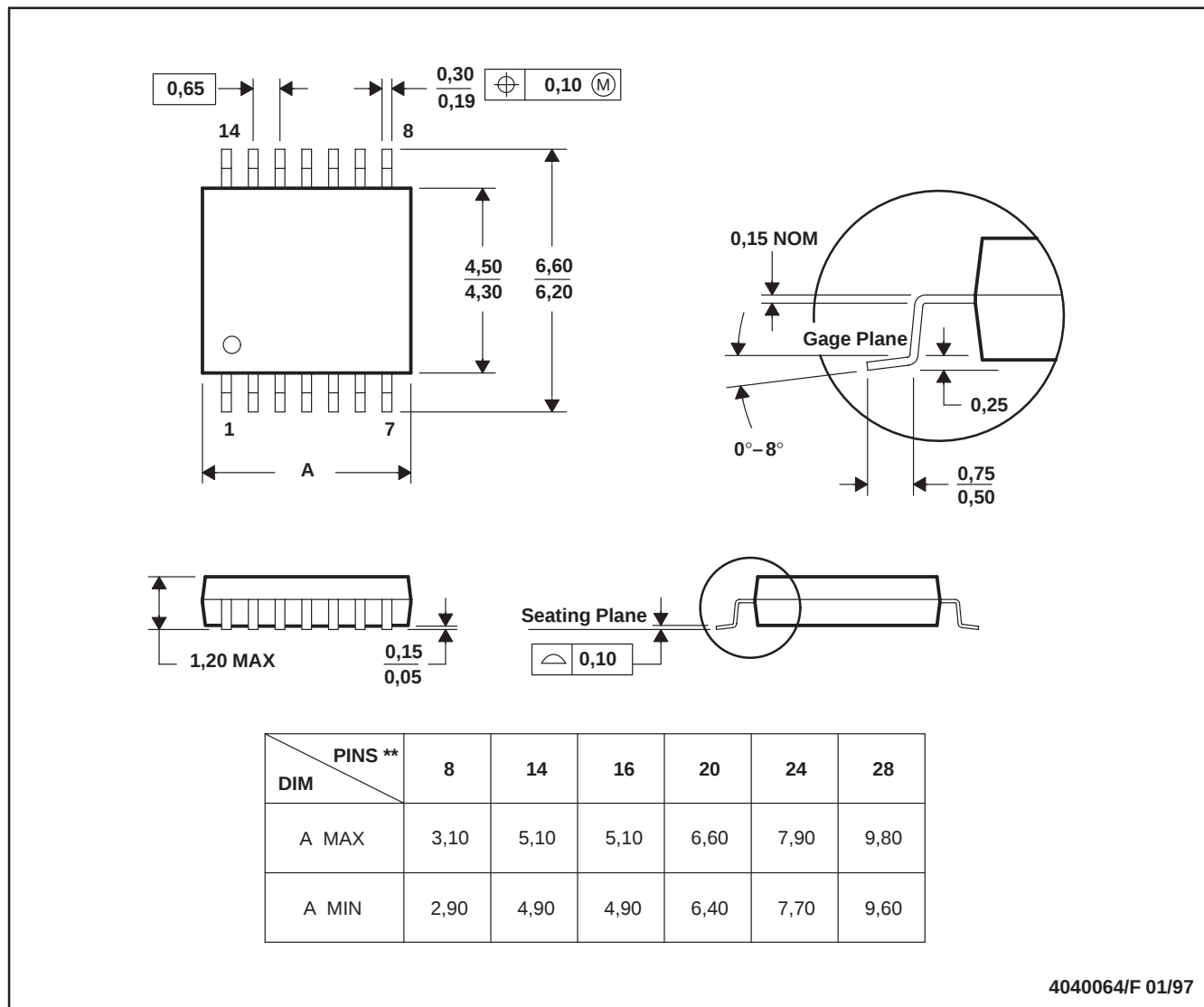


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-012 variation AA.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- 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

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