

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS263K – AUGUST 1999 – REVISED JUNE 2003

- **2.7-V and 5-V Performance**
- **Low-Power Shutdown Mode (LMV324S)**
- **No Crossover Distortion**
- **Low Supply Current:**
  - LMV321 . . . 130  $\mu$ A Typ
  - LMV358 . . . 210  $\mu$ A Typ
  - LMV324 . . . 410  $\mu$ A Typ
  - LMV324S . . . 410  $\mu$ A Typ
- **Rail-to-Rail Output Swing**
- **ESD Protection Exceeds JESD 22**
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

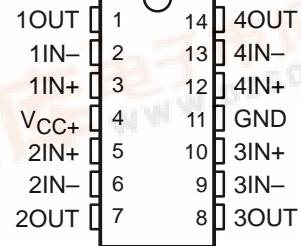
## description/ordering information

The LMV321, LMV358, and LMV324/LMV324S are single, dual, and quad low-voltage (2.7 V to 5.5 V), operational amplifiers with rail-to-rail output swing. The LMV324S is a variation of the standard LMV324 that includes a power-saving shutdown feature that reduces supply current to a maximum of 5  $\mu$ A per channel when the amplifiers are not needed.

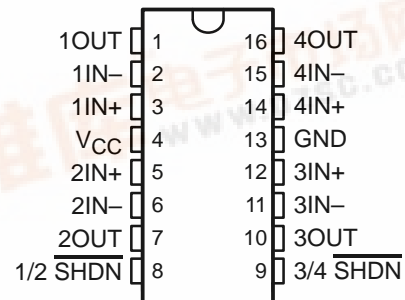
The LMV321, LMV358, LMV324, and LMV324S are the most cost-effective solutions for applications where low-voltage operation, space saving, and low price are needed. These amplifiers were designed specifically for low-voltage (2.7 V to 5 V) operation, with performance specifications meeting or exceeding the venerable LM358 and LM324 devices that operate from 5 V to 30 V. Additional features of the LMV3xx devices are a common-mode input voltage range that includes ground, 1-MHz unity-gain bandwidth, and 1-V/ $\mu$ s slew rate.

The LMV321 is available in the ultra-small DCK (SC-70) package, which is approximately one-half the size of the DBV (SOT-23) package. This package saves space on printed circuit boards and enables the design of small portable electronic devices. It also allows the designer to place the device closer to the signal source to reduce noise pickup and increase signal integrity.

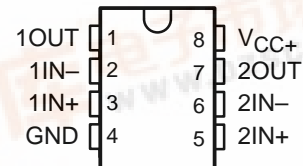
LMV324 . . . D OR PW PACKAGE  
(TOP VIEW)



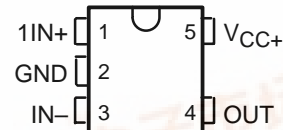
LMV324S . . . D OR PW PACKAGE  
(TOP VIEW)



LMV358 . . . D, DGK, OR PW PACKAGE  
(TOP VIEW)



LMV321 . . . DBV OR DCK PACKAGE  
(TOP VIEW)



# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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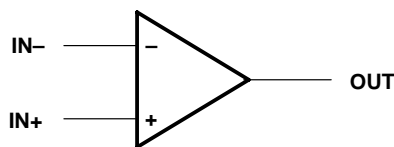
## ORDERING INFORMATION

T <sub>A</sub>		PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	Single	SC-70 (DCK)	Reel of 3000	LMV321IDCKR	R3_
			Reel of 250	LMV321IDCKT	
		SOT23-5 (DBV)	Reel of 3000	LMV321IDBVR	RC1_
			Reel of 250	LMV321IDBVT	
	Dual	MSOP/VSSOP (DGK)	Reel of 2500	LMV358IDGKR	R5R
			Tube of 75	LMV358ID	
		SOIC (D)	Reel of 2500	LMV358IDR	MV358I
			Tube of 150	LMV358IPW	
		TSSOP (PW)	Reel of 2000	LMV358IPWR	MV358I
			Reel of 2000	LMV358IPWR	
	Quad	SOIC (D)	Tube of 50	LMV324ID	LMV324I
			Reel of 2500	LMV324IDR	
			Tube of 40	LMV324SID	LMV324SI
			Reel of 2500	LMV324SIDR	
TSSOP (PW)		Reel of 2000	LMV324IPWR	MV324I	
		Reel of 2000	LMV324SIPWR	MV324SI	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.

### symbol (each amplifier)



# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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

Supply voltage, $V_{CC}$ (see Note 1)	5.5 V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm 5.5$ V
Input voltage, $V_I$ (either input)	0 to 5.5 V
Duration of output short circuit (one amplifier) to ground at (or below) $T_A = 25^\circ\text{C}$ , $V_{CC} \leq 5.5$ V (see Note 3)	Unlimited
Package thermal impedance, $\theta_{JA}$ (see Notes 4 and 5):	
D (8-pin) package	97°C/W
D (14-pin) package	86°C/W
D (16-pin) package	73°C/W
DBV package	206°C/W
DCK package	252°C/W
DGK package	172°C/W
PW (8-pin) package	149°C/W
PW (14-pin) package	113°C/W
PW (16-pin) package	108°C/W
Operating virtual junction temperature, $T_J$	150°C
Storage temperature range, $T_{stg}$	–65 to 150°C

† 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.

- NOTES:
1. All voltage values (except differential voltages and  $V_{CC}$  specified for the measurement of  $I_{OS}$ ) are with respect to the network GND.
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. Short circuits from outputs to  $V_{CC}$  can cause excessive heating and eventual destruction.
  4. Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Selecting the maximum of 150°C can affect reliability.
  5. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 6)

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage (single-supply operation)	2.7	5.5	V
$V_{IH}$	Amplifier turn-on voltage level (LMV324S)‡	$V_{CC} = 2.7$ V	1.7	V
		$V_{CC} = 5$ V	3.5	
$V_{IL}$	Amplifier turn-off voltage level (LMV324S)	$V_{CC} = 2.7$ V	0.7	V
		$V_{CC} = 5$ V	1.5	
$T_A$	Operating free-air temperature	–40	85	°C

‡  $V_{IH}$  should not be allowed to exceed  $V_{CC}$ .

NOTE 6: All unused control inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## electrical characteristics at $T_A = 25^\circ\text{C}$ and $V_{CC+} = 2.7\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage			1.7	7	mV
$\alpha_{V_{IO}}$	Average temperature coefficient of input offset voltage			5		$\mu\text{V}/^\circ\text{C}$
$I_{IB}$	Input bias current			11	250	nA
$I_{IO}$	Input offset current			5	50	nA
CMRR	Common-mode rejection ratio	$V_{CM} = 0$ to 1.7 V	50	63		dB
$k_{SVR}$	Supply-voltage rejection ratio	$V_{CC} = 2.7\text{ V}$ to 5 V, $V_O = 1\text{ V}$	50	60		dB
$V_{ICR}$	Common-mode input voltage range	CMRR $\geq 50$ dB	0 to 1.7	-0.2 to 1.9		V
Output swing		$R_L = 10\text{ k}\Omega$ to 1.35 V	High level	$V_{CC}-100$	$V_{CC}-10$	mV
			Low level		60	
$I_{CC}$	Supply current	LMV321I		80	170	$\mu\text{A}$
		LMV358I (both amplifiers)		140	340	
		LMV324I/LMV324SI (all four amplifiers)		260	680	
$B_1$	Unity-gain bandwidth	$C_L = 200\text{ pF}$		1		MHz
$\Phi_m$	Phase margin			60		deg
$G_m$	Gain margin			10		dB
$V_n$	Equivalent input noise voltage	$f = 1\text{ kHz}$		46		$\text{nV}/\sqrt{\text{Hz}}$
$I_n$	Equivalent input noise current	$f = 1\text{ kHz}$		0.17		$\text{pA}/\sqrt{\text{Hz}}$

## shutdown characteristics (LMV324S) at $T_A = 25^\circ\text{C}$ and $V_{CC+} = 2.7\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{CC(\text{SHDN})}$	Supply current in shutdown mode (per channel)	$\overline{\text{SHDN}} \leq 0.6\text{ V}$			5	$\mu\text{A}$
$t_{(\text{on})}$	Amplifier turn-on time	$A_V = 1$ , $R_L = \text{Open}$ (measured at 50% point)		2		$\mu\text{s}$
$t_{(\text{off})}$	Amplifier turn-off time	$A_V = 1$ , $R_L = \text{Open}$ (measured at 50% point)		40		ns

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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**electrical characteristics at specified free-air temperature range,  $V_{CC+} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT	
$V_{IO}$	Input offset voltage		25°C		1.7	7	mV	
			-40°C to 85°C			9		
$\alpha_{V_{IO}}$	Average temperature coefficient of input offset voltage		25°C		5		$\mu\text{V}/^\circ\text{C}$	
$I_{IB}$	Input bias current		25°C		15	250	nA	
			-40°C to 85°C			500		
$I_{IO}$	Input offset current		25°C		5	50	nA	
			-40°C to 85°C			150		
CMRR	Common-mode rejection ratio	$V_{CM} = 0$ to 4 V	25°C	50	65		dB	
$k_{SVR}$	Supply-voltage rejection ratio	$V_{CC} = 2.7\text{ V}$ to 5 V, $V_O = 1\text{ V}$ , $V_{CM} = 1\text{ V}$	25°C	50	60		dB	
$V_{ICR}$	Common-mode input voltage range	$CMMR \geq 50\text{ dB}$	25°C	0 to 4	-0.2 to 4.2		V	
Output swing		$R_L = 2\text{ k}\Omega$ to 2.5 V	High level	25°C	$V_{CC}-300$	$V_{CC}-40$	mV	
				-40°C to 85°C	$V_{CC}-400$			
			Low level	25°C		120		300
				-40°C to 85°C				400
		$R_L = 10\text{ k}\Omega$ to 2.5 V	High level	25°C	$V_{CC}-100$	$V_{CC}-10$		
				-40°C to 85°C	$V_{CC}-200$			
Low level	25°C		65	180				
	-40°C to 85°C			280				
$A_{VD}$	Large-signal differential voltage gain	$R_L = 2\text{ k}\Omega$	25°C	15	100		V/mV	
			-40°C to 85°C		10			
$I_{OS}$	Output short-circuit current	Sourcing, $V_O = 0\text{ V}$	25°C	5	60		mA	
		Sinking, $V_O = 5\text{ V}$		10	160			
$I_{CC}$	Supply current	LMV321I	25°C		130	250	$\mu\text{A}$	
			-40°C to 85°C			350		
		LMV358I (both amplifiers)	25°C		210	440		
			-40°C to 85°C			615		
LMV324I/LMV324SI (all four amplifiers)	25°C		410	830				
	-40°C to 85°C			1160				
$B_1$	Unity-gain bandwidth	$C_L = 200\text{ pF}$	25°C		1		MHz	
$\phi_m$	Phase margin		25°C		60		deg	
$G_m$	Gain margin		25°C		10		dB	
$V_n$	Equivalent input noise voltage	$f = 1\text{ kHz}$	25°C		39		$\text{nV}/\sqrt{\text{Hz}}$	
$I_n$	Equivalent input noise current	$f = 1\text{ kHz}$	25°C		0.21		$\text{pA}/\sqrt{\text{Hz}}$	
SR	Slew rate		25°C		1		V/ $\mu\text{s}$	

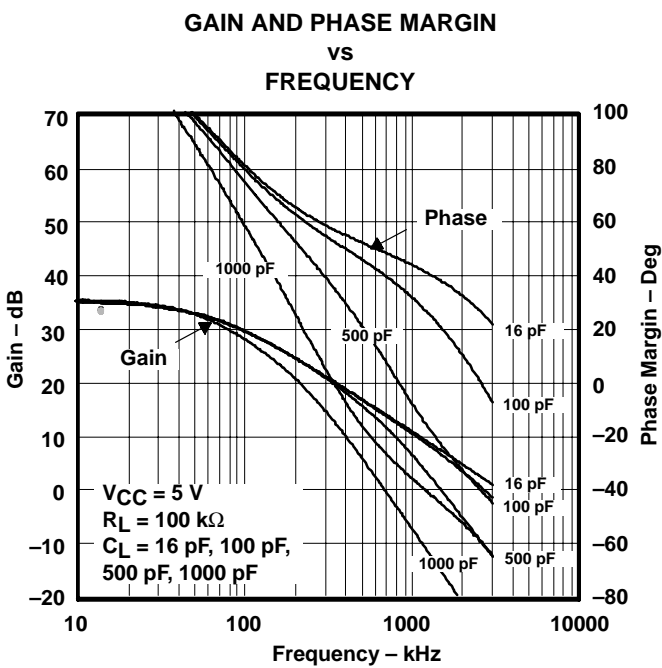
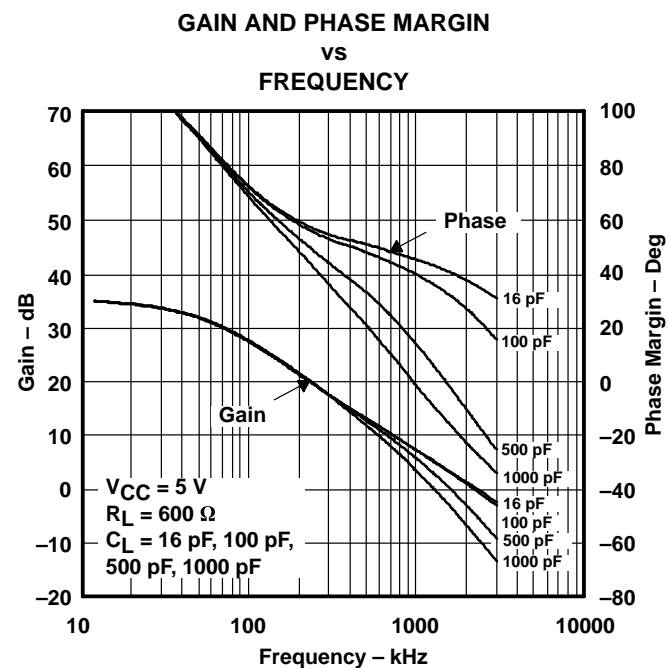
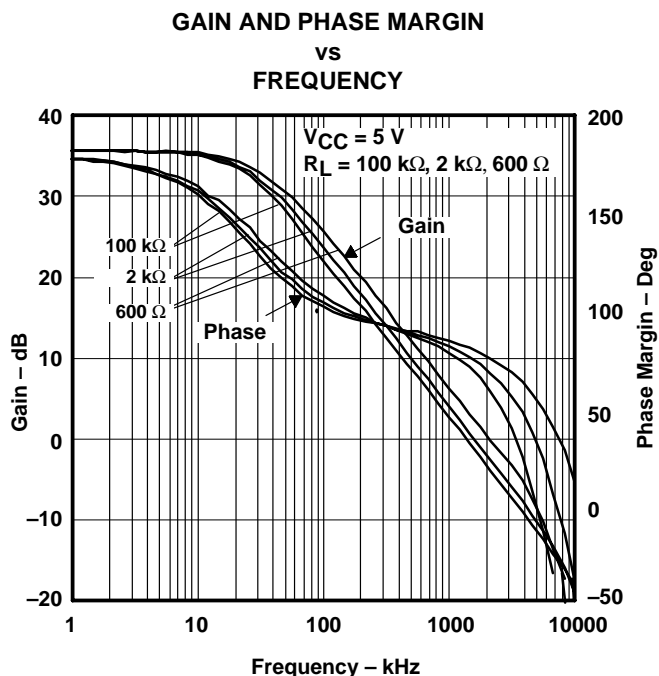
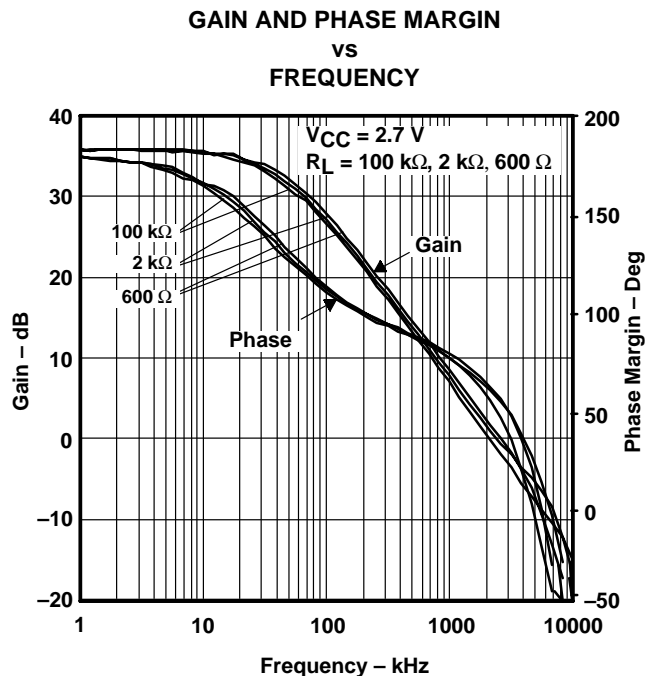
**shutdown characteristics (LMV324S) at  $T_A = 25^\circ\text{C}$  and  $V_{CC+} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$I_{CC}(\text{SHDN})$	Supply current in shutdown mode (per channel)	$\overline{\text{SHDN}} \leq 0.6\text{ V}$	-40°C to 85°C			5	$\mu\text{A}$
$t_{(on)}$	Amplifier turn-on time	$A_V = 1$ , $R_L = \text{Open}$ (measured at 50% point)			2		$\mu\text{s}$
$t_{(off)}$	Amplifier turn-off time	$A_V = 1$ , $R_L = \text{Open}$ (measured at 50% point)			40		ns

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS



# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

**GAIN AND PHASE MARGIN  
vs  
FREQUENCY**

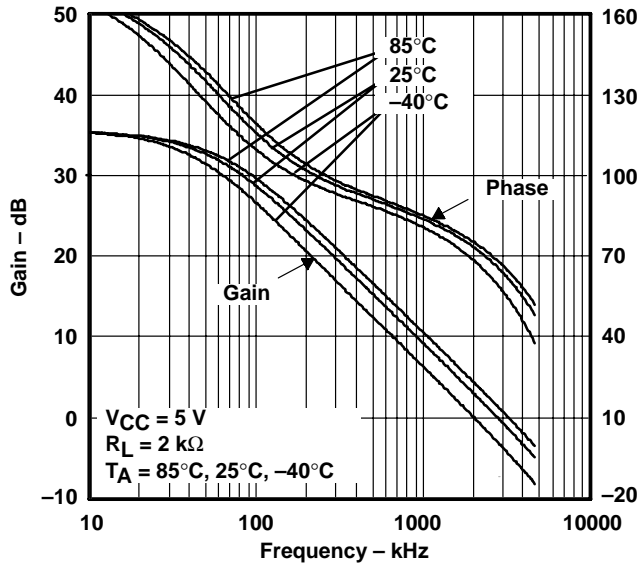


Figure 5

**STABILITY  
vs  
CAPACITIVE LOAD**

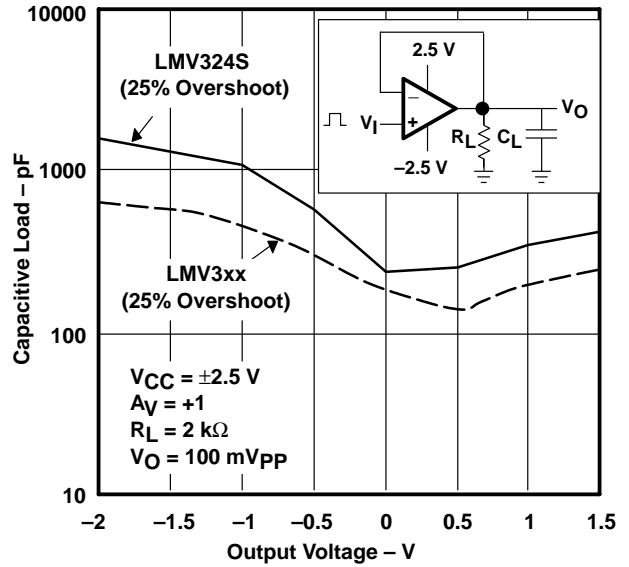


Figure 6

**STABILITY  
vs  
CAPACITIVE LOAD**

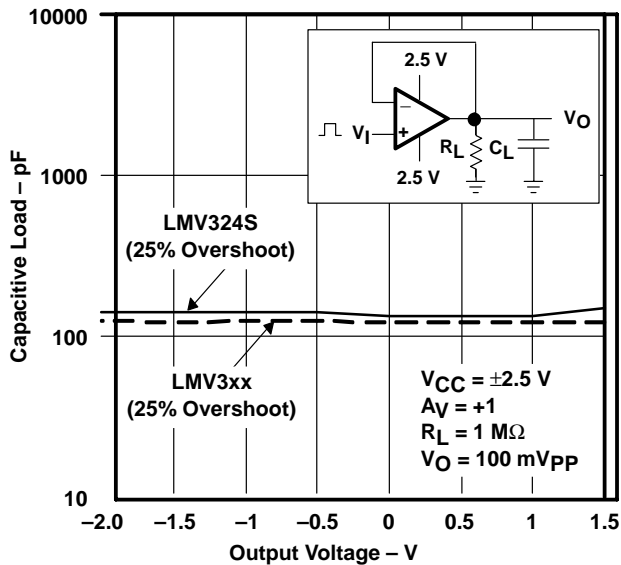


Figure 7

**STABILITY  
vs  
CAPACITIVE LOAD**

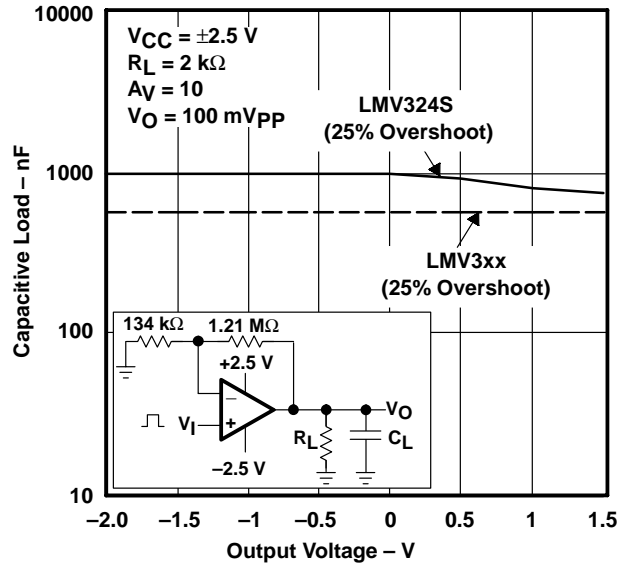


Figure 8

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

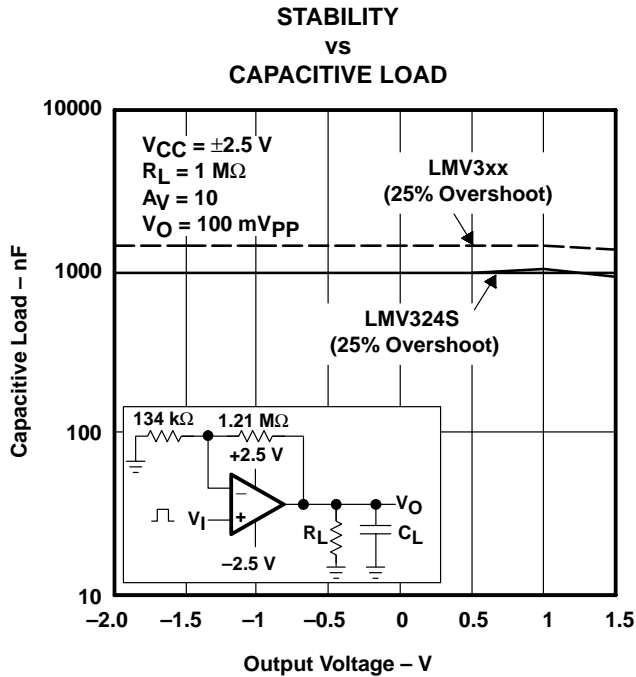


Figure 9

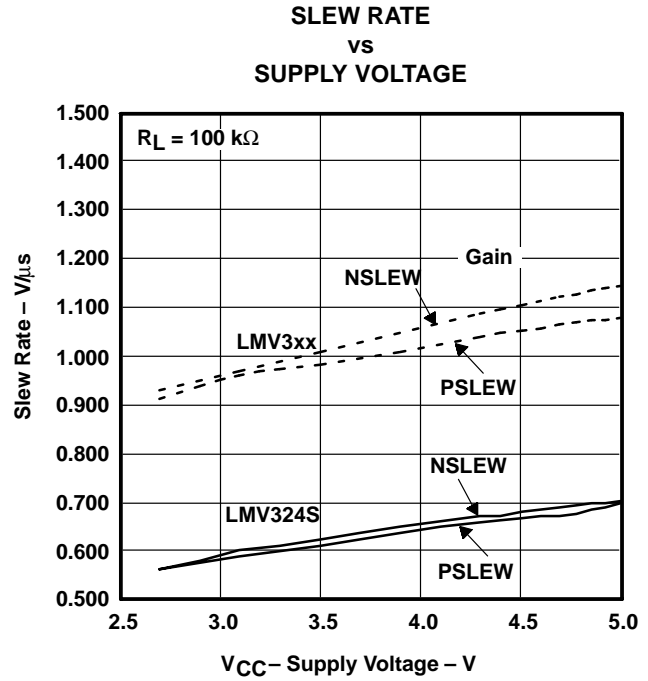


Figure 10

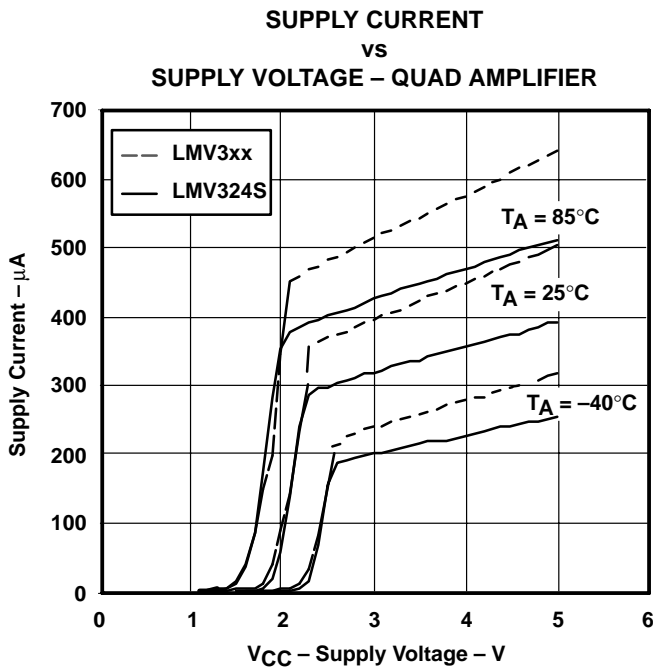


Figure 11

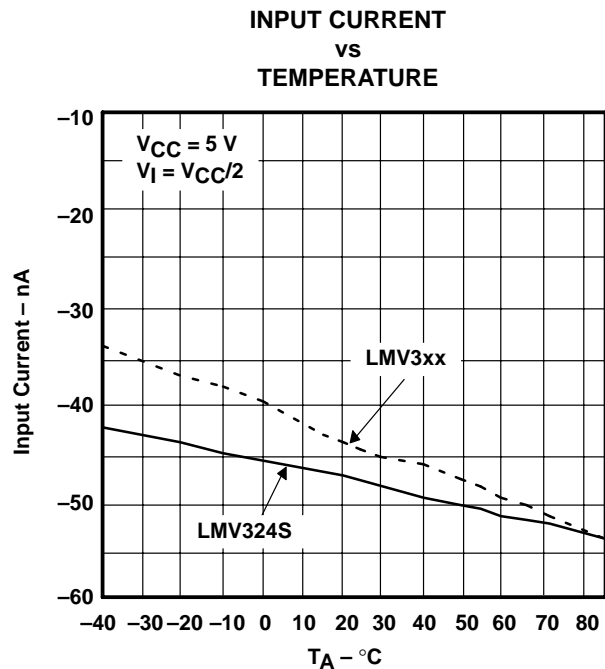
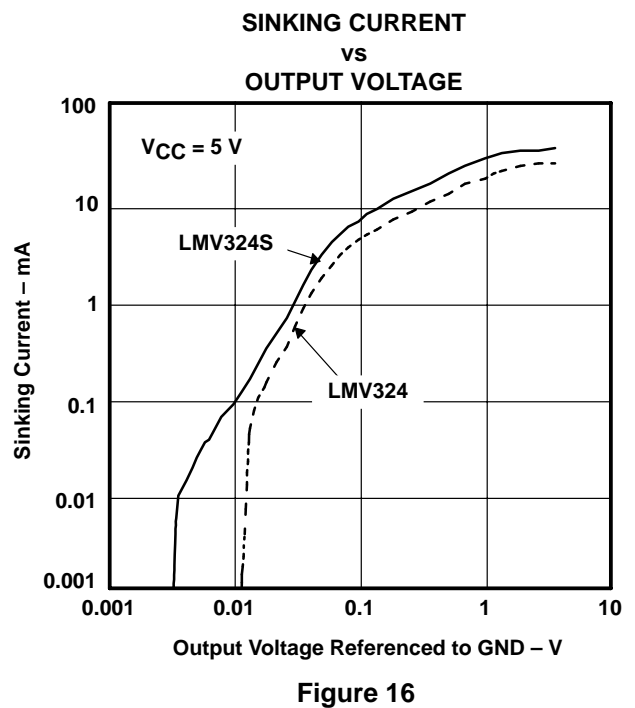
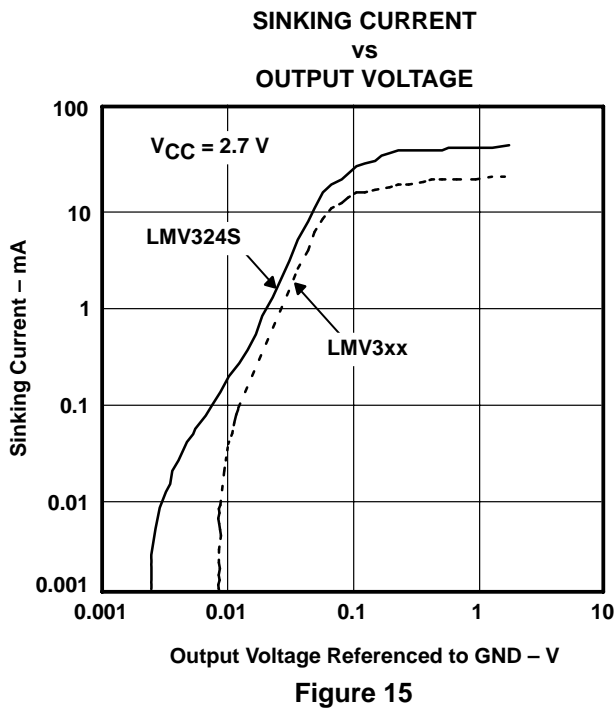
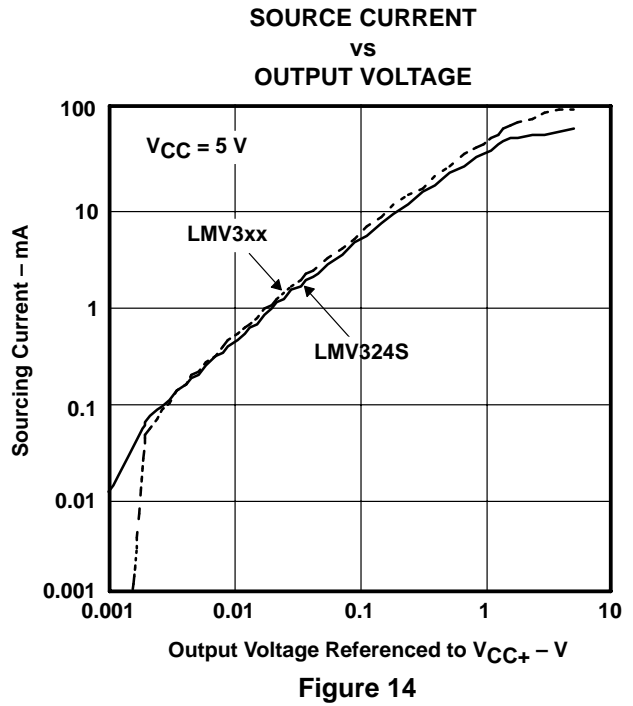
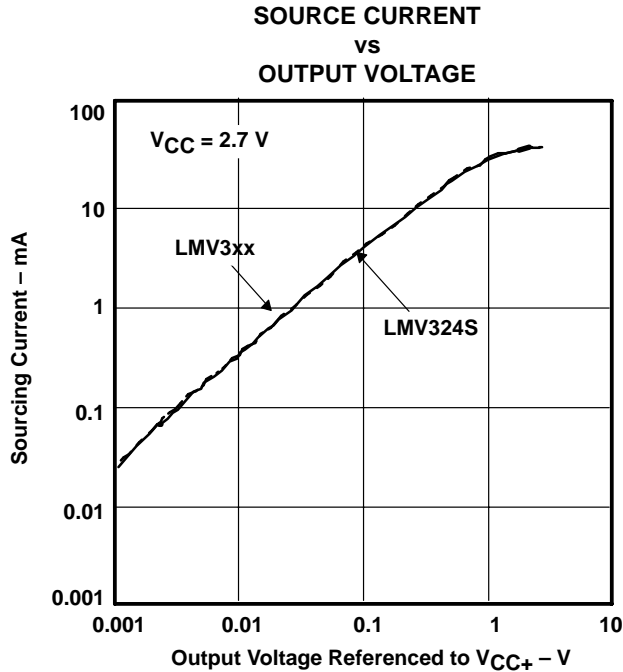


Figure 12

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS



# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

SHORT-CIRCUIT CURRENT  
vs  
TEMPERATURE

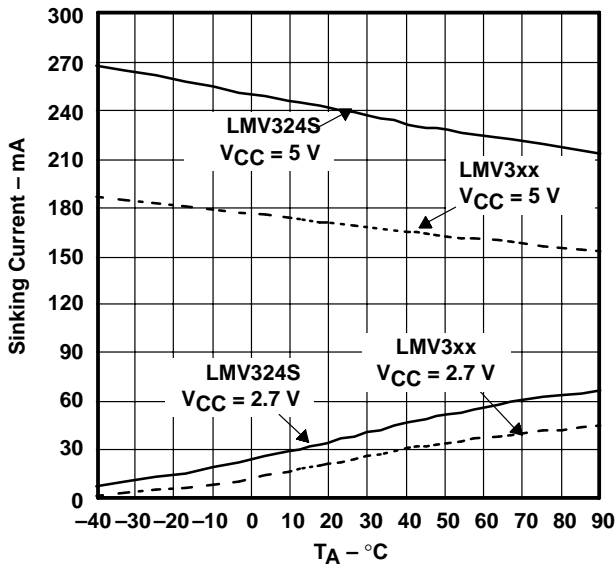


Figure 17

SHORT-CIRCUIT CURRENT  
vs  
TEMPERATURE

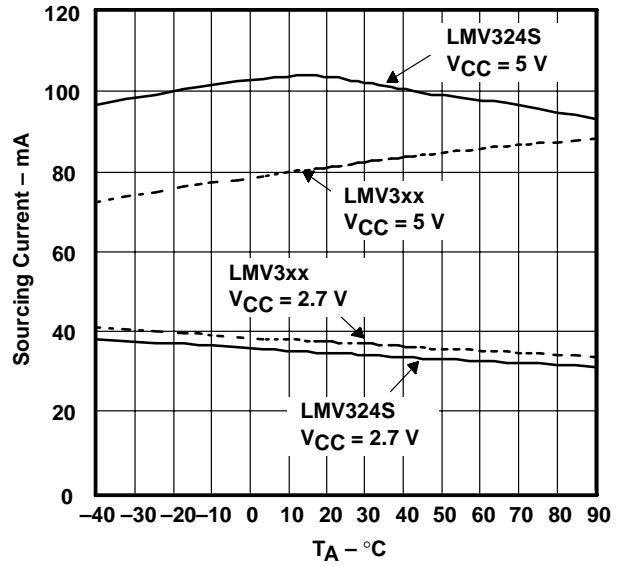


Figure 18

-k<sub>SVR</sub>  
vs  
FREQUENCY

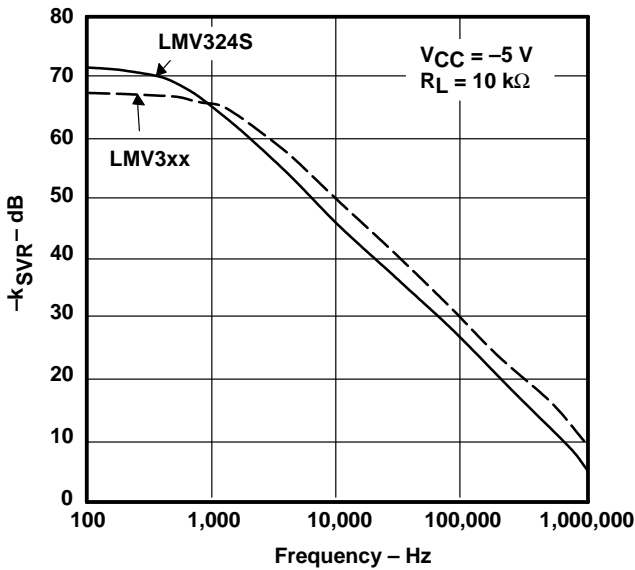


Figure 19

+k<sub>SVR</sub>  
vs  
FREQUENCY

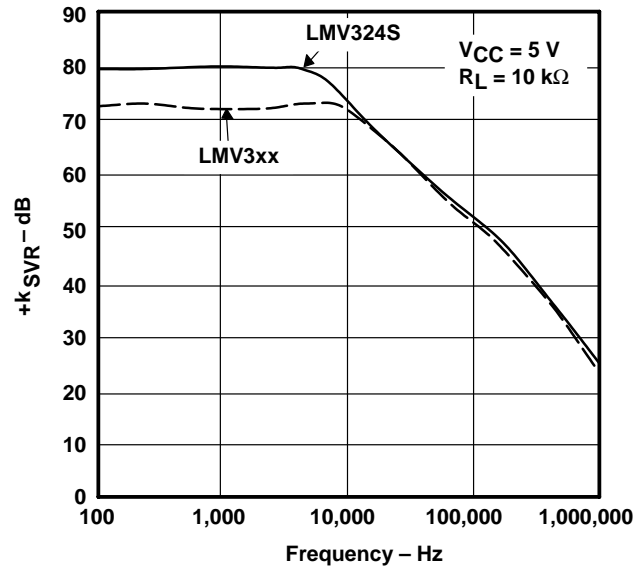
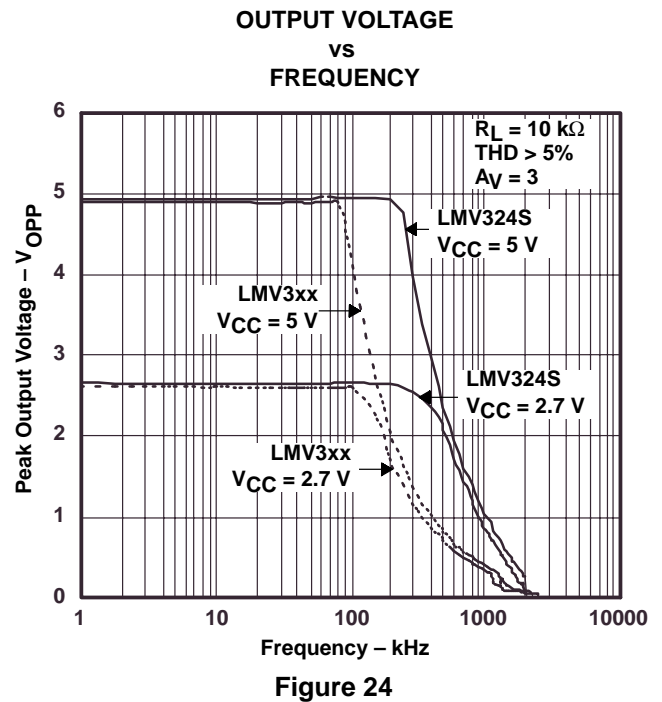
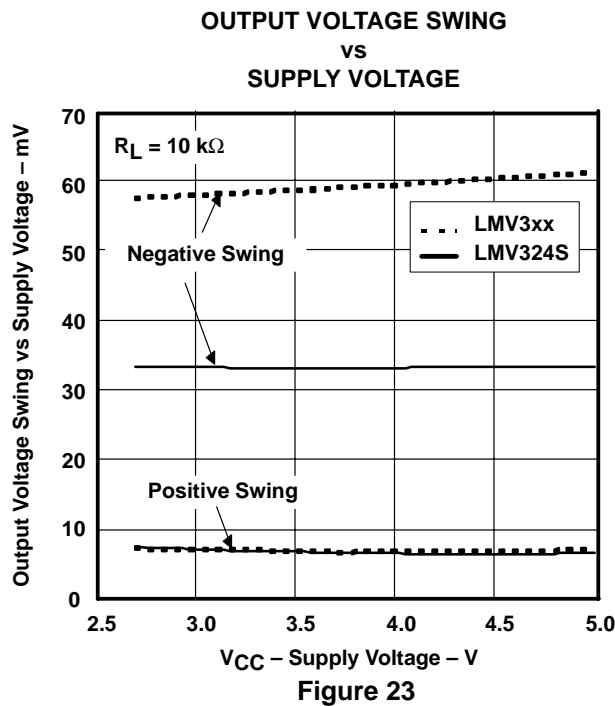
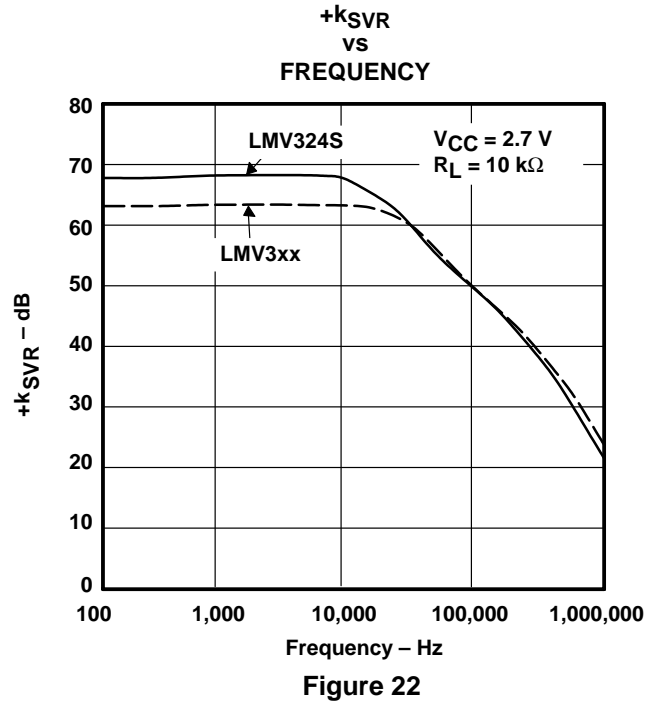
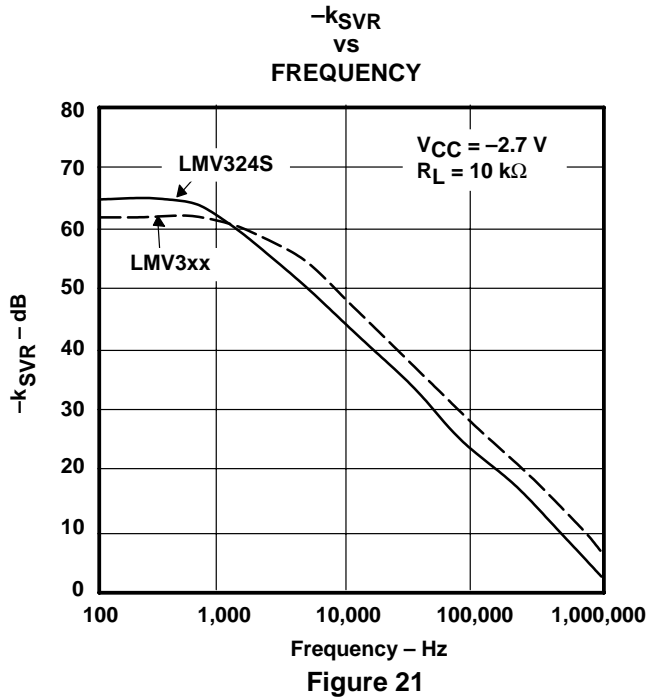


Figure 20

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS



# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

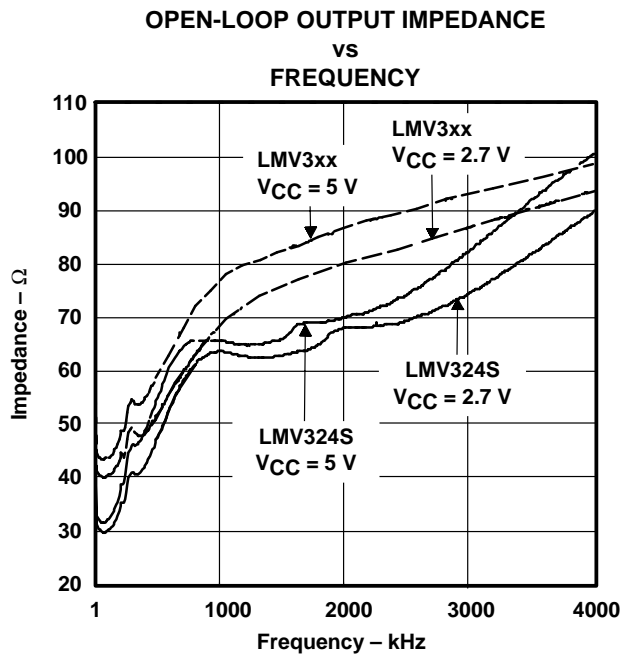


Figure 25

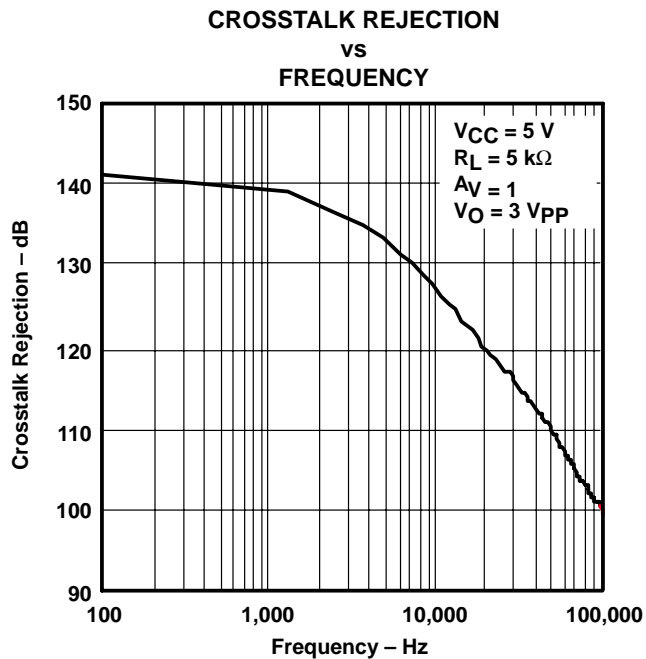


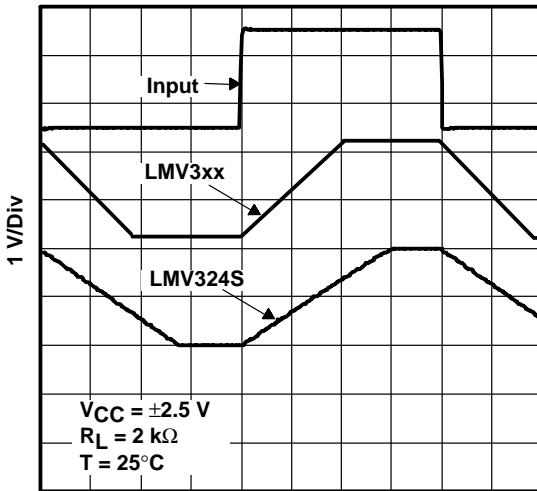
Figure 26

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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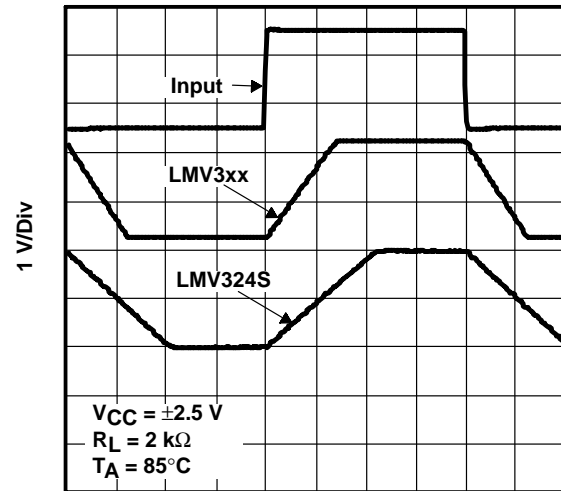
## TYPICAL CHARACTERISTICS

### NONINVERTING LARGE-SIGNAL PULSE RESPONSE



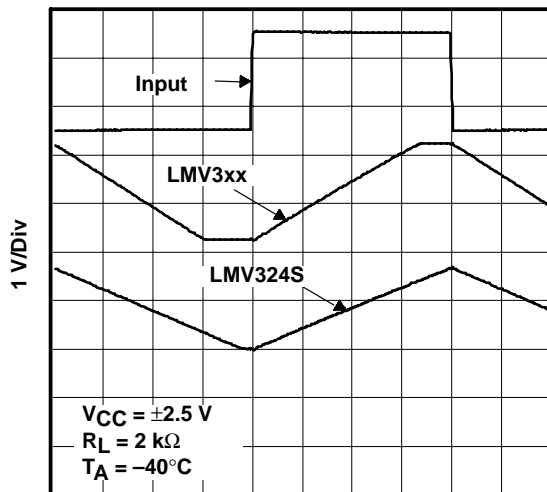
1  $\mu\text{s}/\text{Div}$   
Figure 27

### NONINVERTING LARGE-SIGNAL PULSE RESPONSE



1  $\mu\text{s}/\text{Div}$   
Figure 28

### NONINVERTING LARGE-SIGNAL PULSE RESPONSE



1  $\mu\text{s}/\text{Div}$   
Figure 29

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS263K – AUGUST 1999 – REVISED JUNE 2003

## TYPICAL CHARACTERISTICS

### NONINVERTING SMALL-SIGNAL PULSE RESPONSE

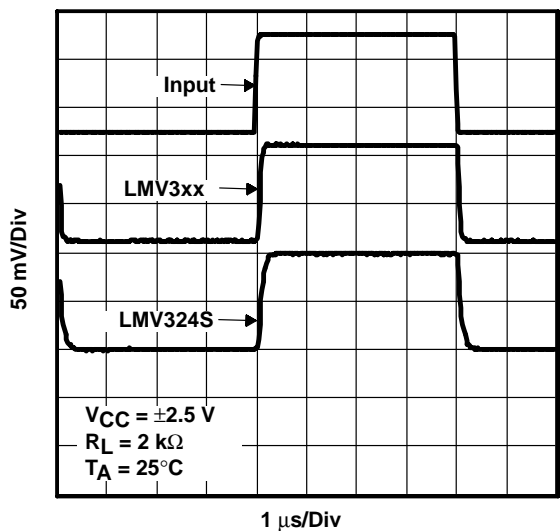


Figure 30

### NONINVERTING SMALL-SIGNAL PULSE RESPONSE

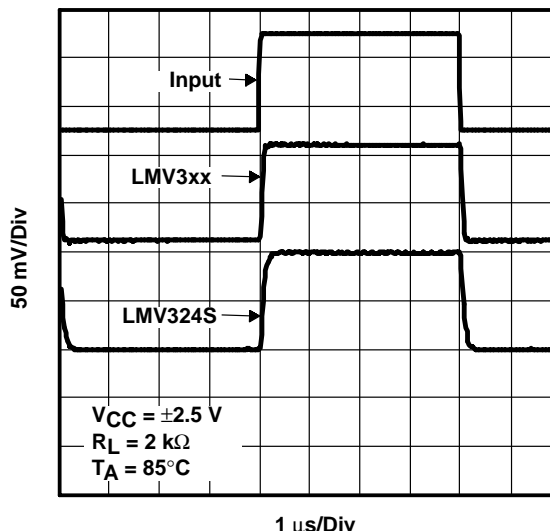


Figure 31

### NONINVERTING SMALL-SIGNAL PULSE RESPONSE

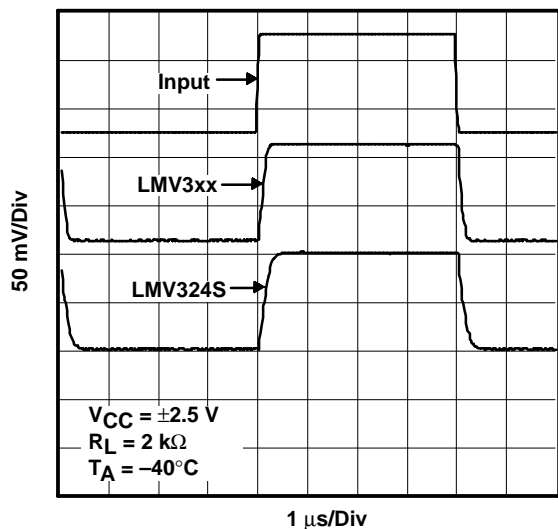


Figure 32

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS263K – AUGUST 1999 – REVISED JUNE 2003

## TYPICAL CHARACTERISTICS

### INVERTING LARGE-SIGNAL PULSE RESPONSE

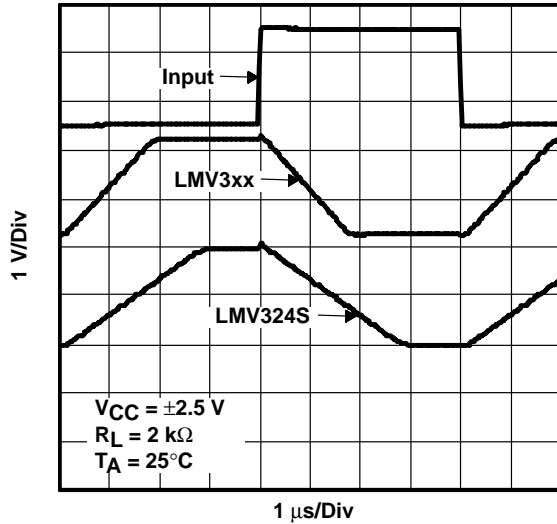


Figure 33

### INVERTING LARGE-SIGNAL PULSE RESPONSE

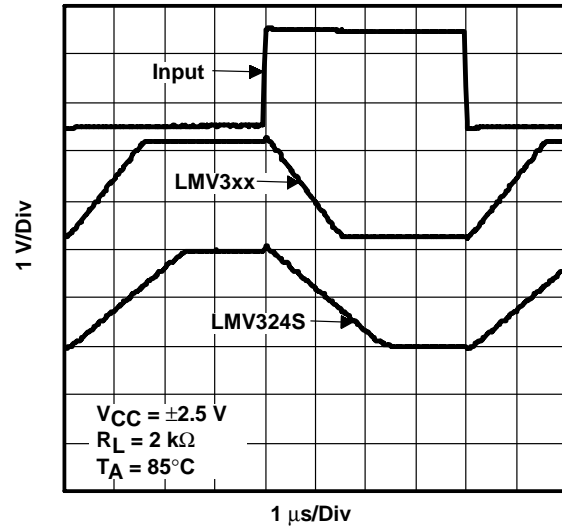


Figure 34

### INVERTING LARGE-SIGNAL PULSE RESPONSE

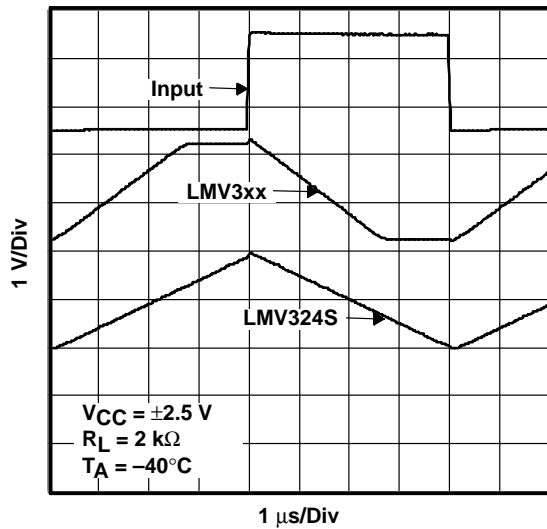


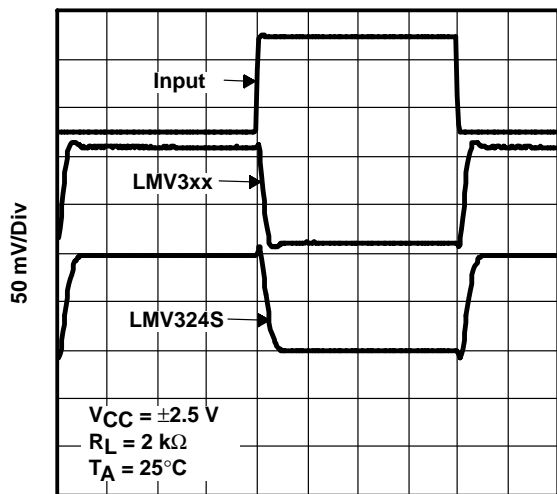
Figure 35

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS263K – AUGUST 1999 – REVISED JUNE 2003

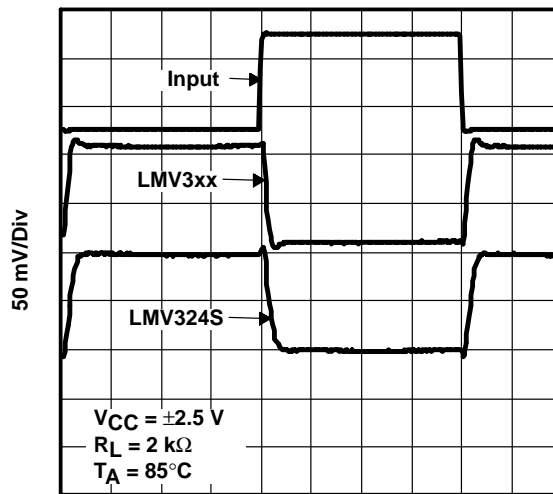
## TYPICAL CHARACTERISTICS

### INVERTING SMALL-SIGNAL PULSE RESPONSE



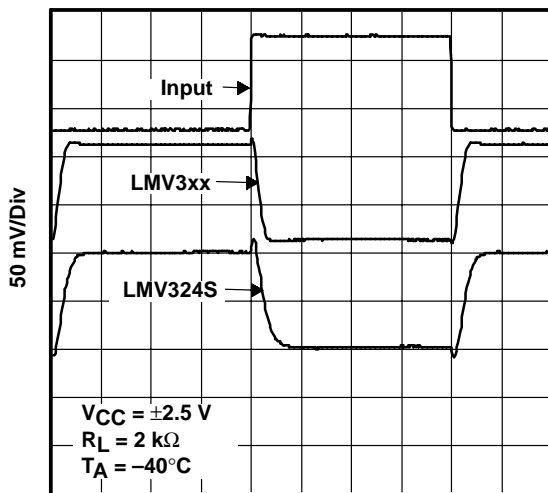
1  $\mu\text{s}/\text{Div}$   
Figure 36

### INVERTING SMALL-SIGNAL PULSE RESPONSE



1  $\mu\text{s}/\text{Div}$   
Figure 37

### INVERTING SMALL-SIGNAL PULSE RESPONSE



1  $\mu\text{s}/\text{Div}$   
Figure 38

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS263K – AUGUST 1999 – REVISED JUNE 2003

## TYPICAL CHARACTERISTICS

INPUT CURRENT NOISE  
vs  
FREQUENCY

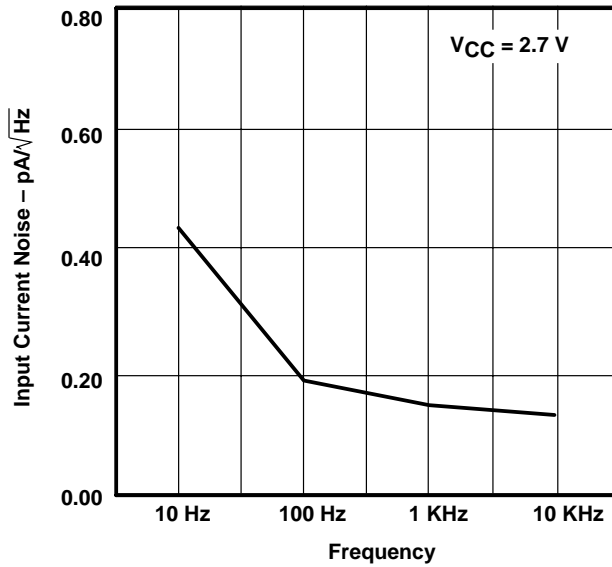


Figure 39

INPUT CURRENT NOISE  
vs  
FREQUENCY

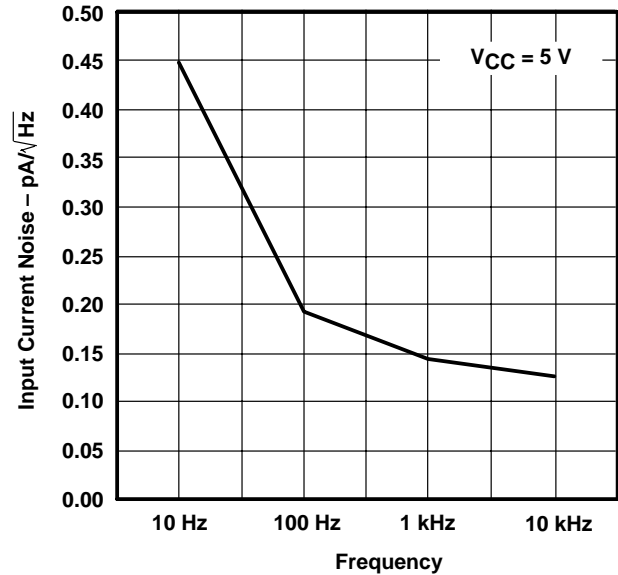


Figure 40

INPUT VOLTAGE NOISE  
vs  
FREQUENCY

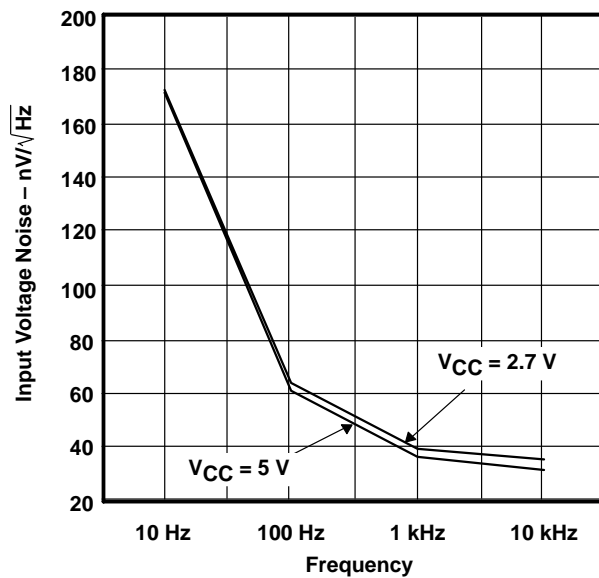


Figure 41

# LMV321 SINGLE, LMV358 DUAL, LMV324 QUAD, LMV324S QUAD WITH SHUTDOWN LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS263K – AUGUST 1999 – REVISED JUNE 2003

## TYPICAL CHARACTERISTICS

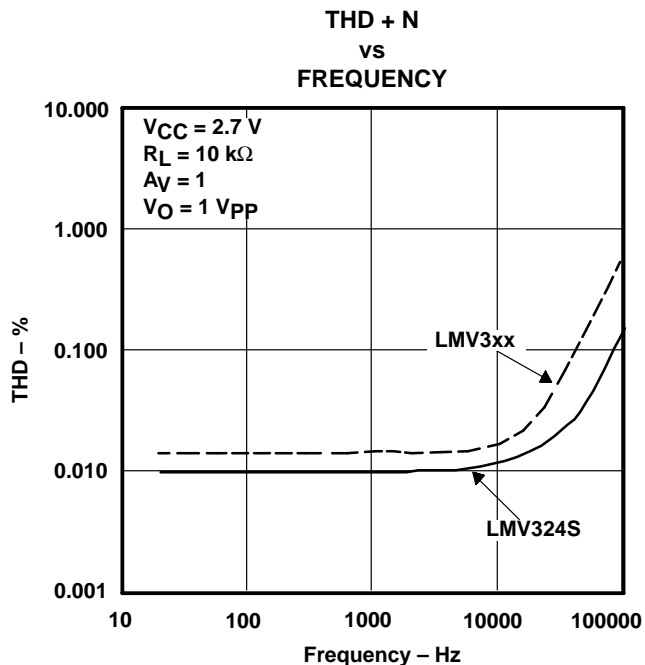


Figure 42

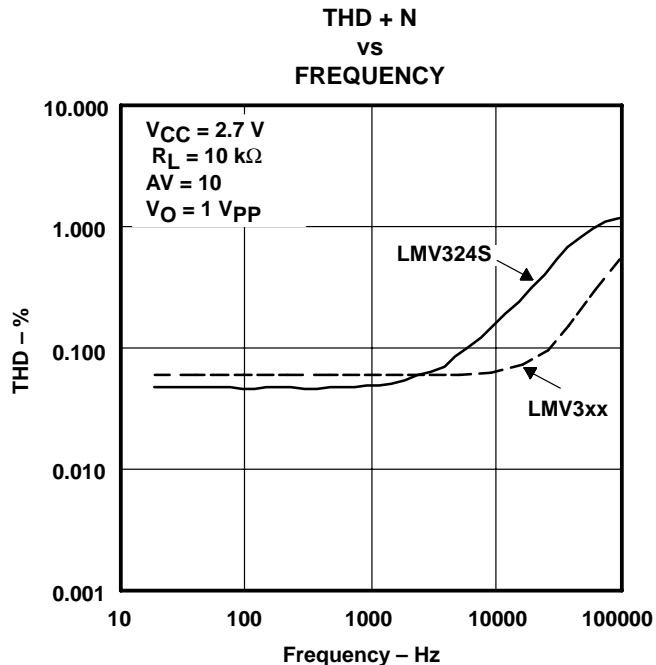


Figure 43

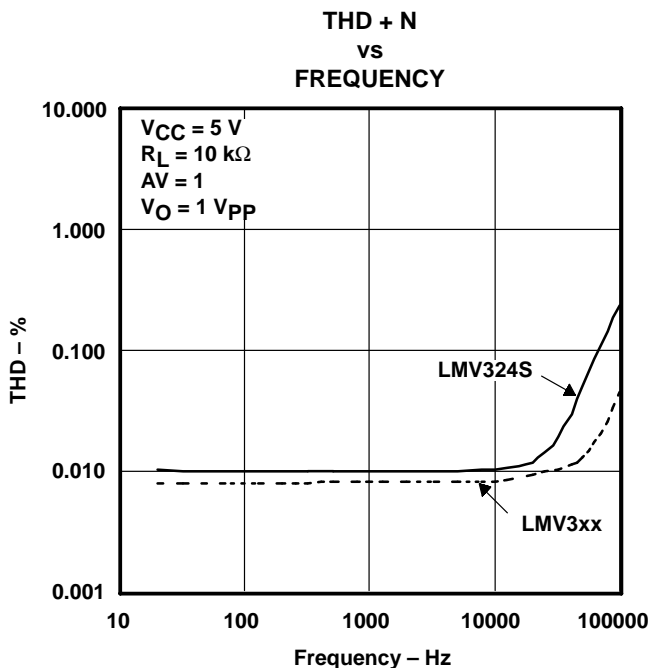


Figure 44

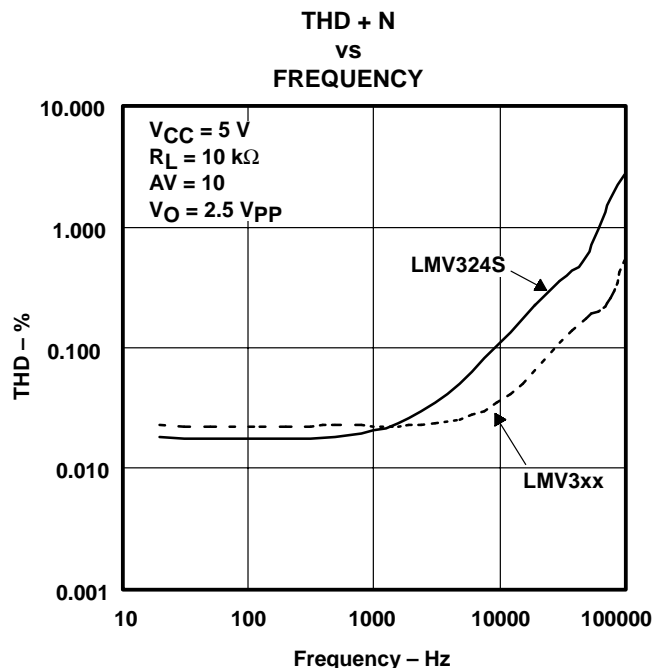


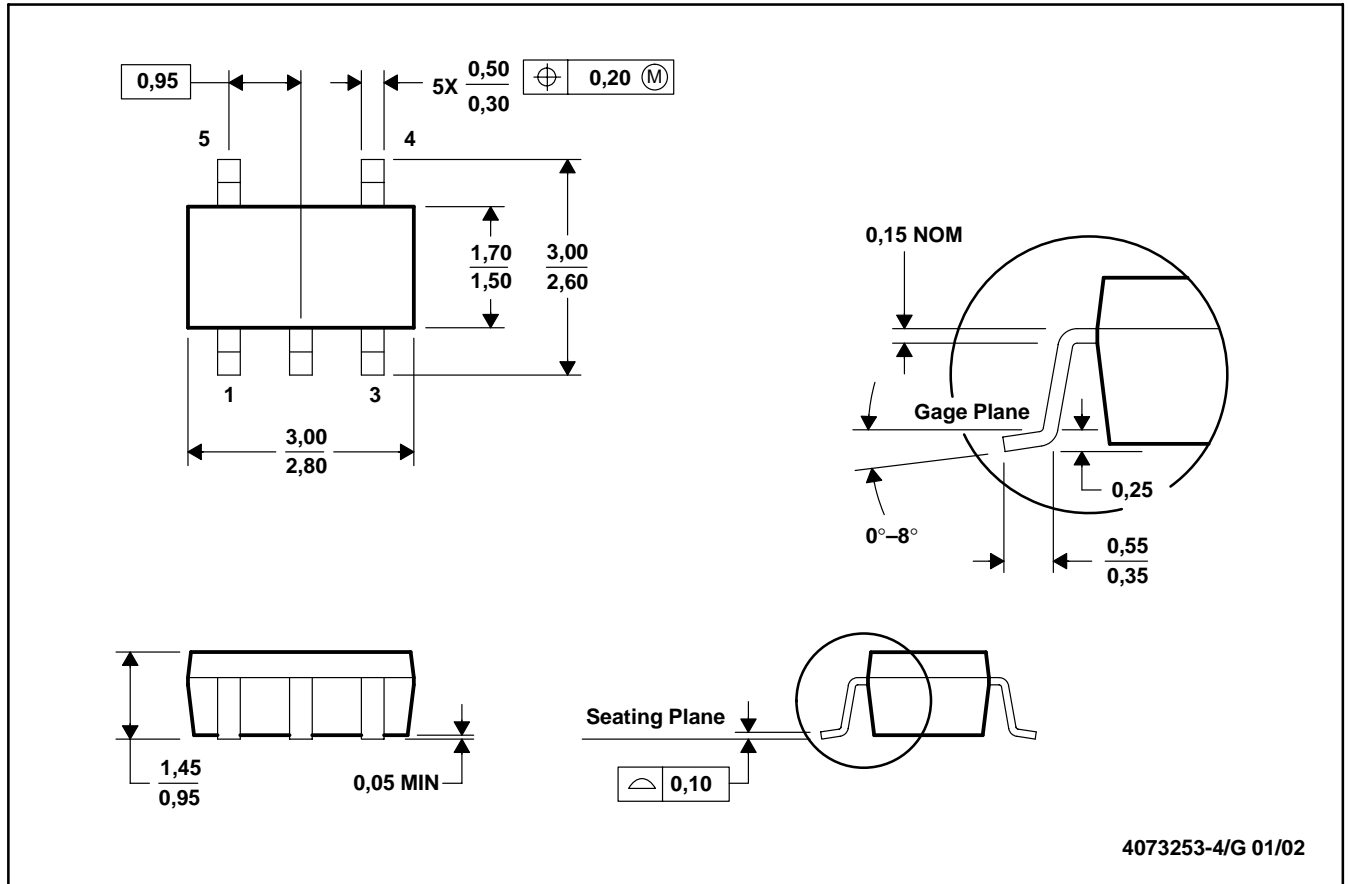
Figure 45

# MECHANICAL DATA

MPDS018E – FEBRUARY 1996 – REVISED FEBRUARY 2002

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE



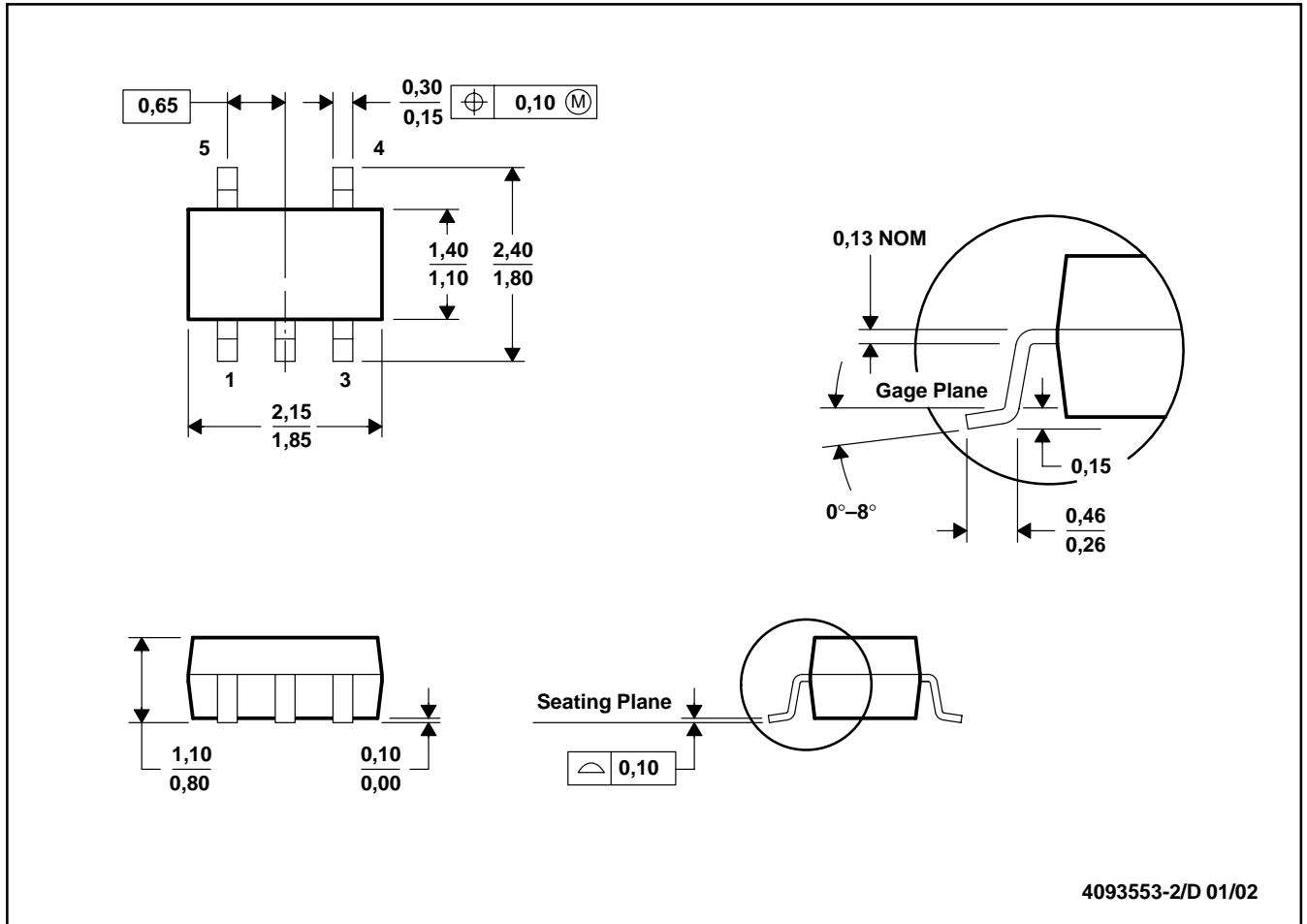
- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion.  
D. Falls within JEDEC MO-178

# MECHANICAL DATA

MPDS025C – FEBRUARY 1997 – REVISED FEBRUARY 2002

DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



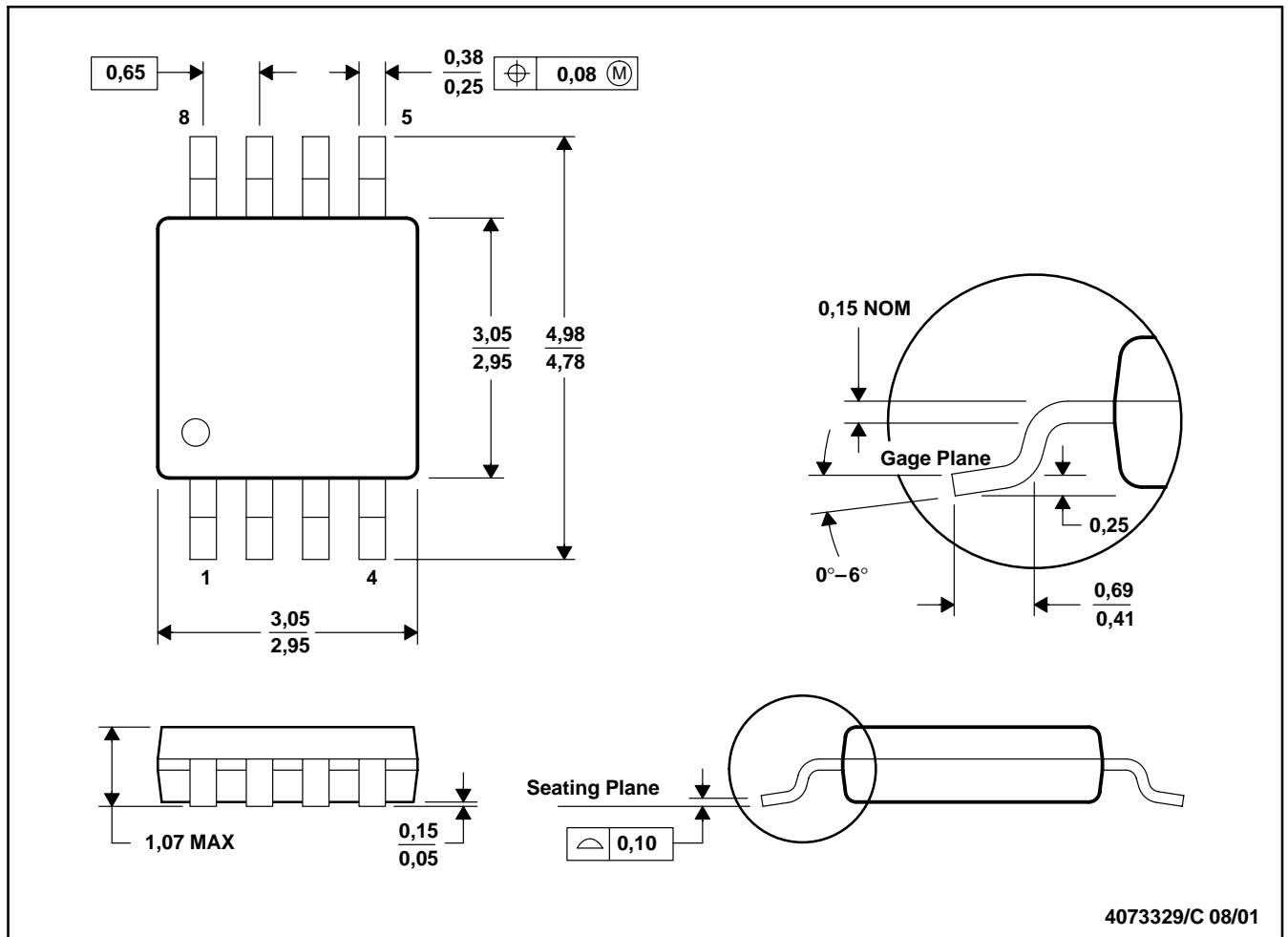
- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion.  
 D. Falls within JEDEC MO-203

# MECHANICAL DATA

MPDS028B – JUNE 1997 – REVISED SEPTEMBER 2001

DGK (R-PDSO-G8)

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.  
 D. Falls within JEDEC MO-187

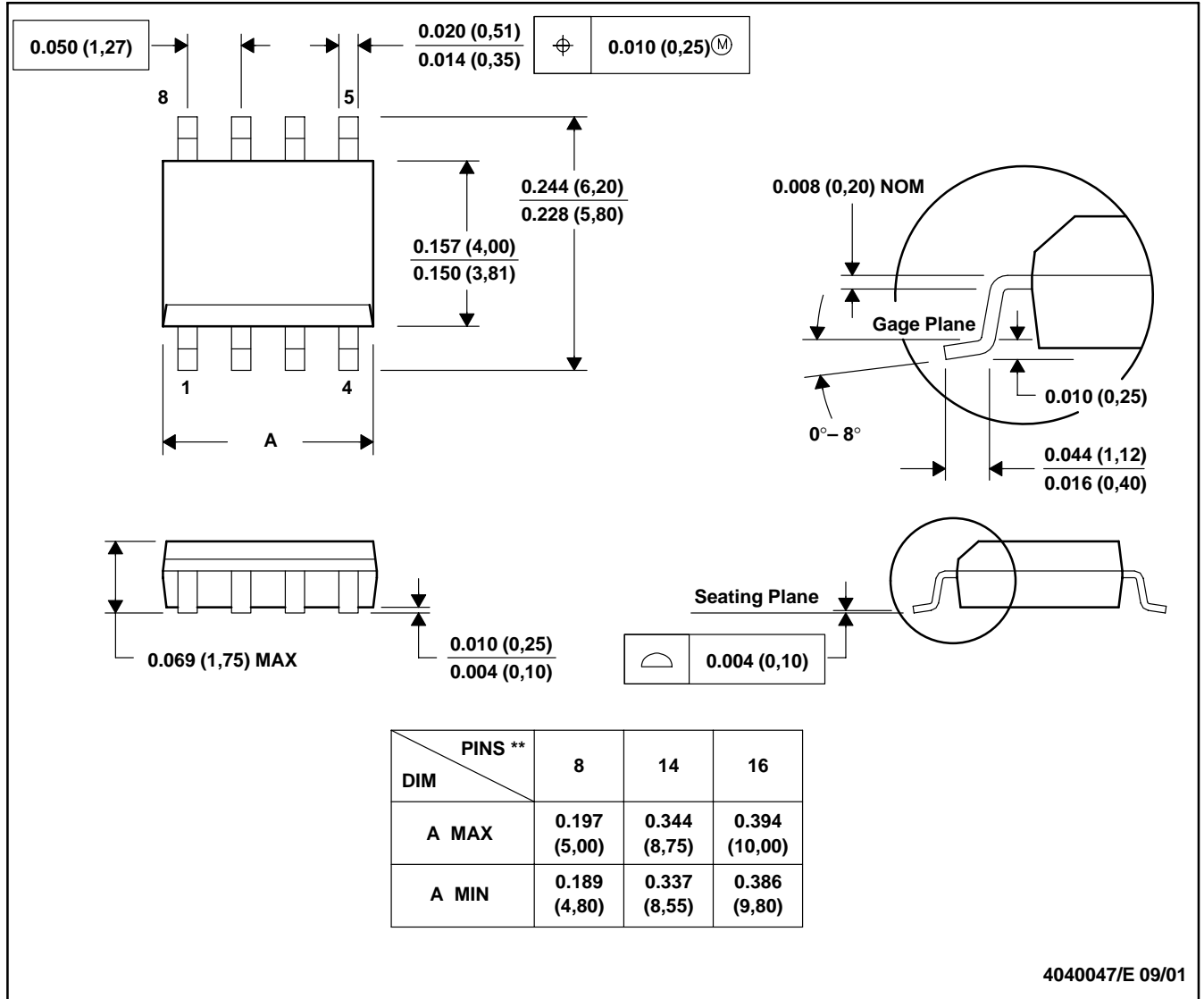
# MECHANICAL DATA

MSOI002B – JANUARY 1995 – REVISED SEPTEMBER 2001

## D (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



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

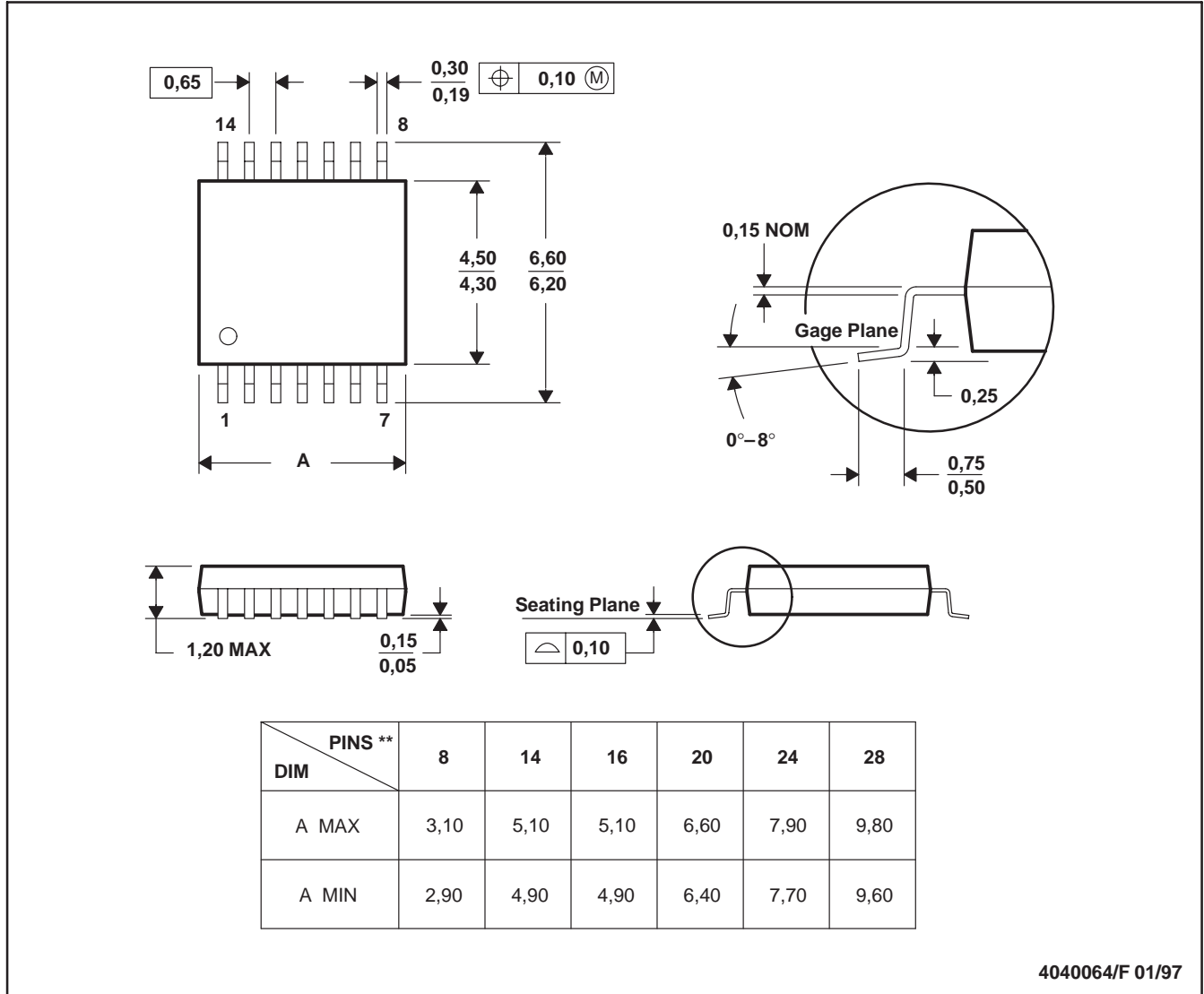
# MECHANICAL DATA

MTSS001C – JANUARY 1995 – REVISED FEBRUARY 1999

**PW (R-PDSO-G\*\*)**

**PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



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

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Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
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Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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