

LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

SLOS434F – FEBRUARY 2004 – REVISED OCTOBER 2004

- 2.5-V, 2.7-V, and 5-V Performance
- –40°C to 125°C Operation
- No Crossover Distortion
- Low Supply Current at $V_{CC+} = 5\text{ V}$:
 LMV821 . . . 0.3 mA Typ
 LMV822 . . . 0.5 mA Typ
 LMV824 . . . 1 mA Typ
- Rail-to-Rail Output Swing
- Gain Bandwidth of 5.5 MHz Typ at 5 V
- Slew Rate of 1.9 V/ μs Typ at 5 V

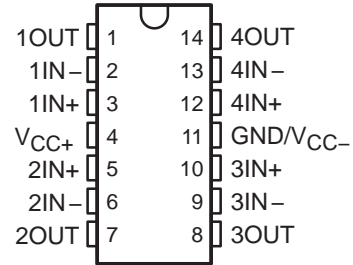
description/ordering information

The LMV821, LMV822, and LMV824 single, dual, and quad devices are low-voltage (2.5 V to 5.5 V), low-power commodity operational amplifiers. Electrical characteristics are very similar to the LMV3xx operational amplifiers (low supply current, rail-to-rail outputs, input common-mode range, which includes ground). However, the LMV8XX devices offer a higher bandwidth (5.5 MHz typical) and faster slew rate (1.9 V/ μs typical).

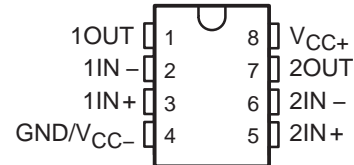
The LMV8xx devices are cost-effective solutions for applications requiring low-voltage/low-power operation and space-saving considerations. The LMV821 is available in the ultra-small DCK package, which is approximately half the size of SOT23-5. The DCK package saves space on printed circuit boards and enables the design of small portable electronic devices (cordless and cellular phones, laptops, PDAs, PC/MIA). It also allows the designer to place the device closer to the signal source to reduce noise pickup and increase signal integrity.

The LMV8xx devices are characterized for operation from –40°C to 85°C. The LMV8xxI devices are characterized for operation from –40°C to 125°C.

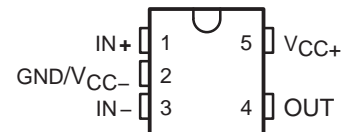
LMV824 . . . D, DGV, OR PW PACKAGE
(TOP VIEW)



LMV822 . . . D OR DGK PACKAGE
(TOP VIEW)



LMV821 . . . DBV OR DCK PACKAGE
(TOP VIEW)



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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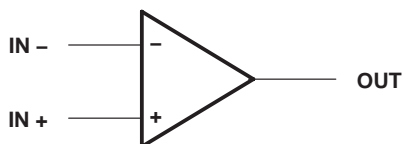
ORDERING INFORMATION

T _A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡	
-40°C to 85°C	Single	SC-70 (DCKR)	Reel of 3000	LMV821DCKR	RY_
		SC-70 (DCKT)	Reel of 250	LMV821DCKT	
		SOT-23 (DBVR)	Reel of 3000	LMV821DBVR	RB8_
		SOT-23 (DBVT)	Reel of 250	LMV821DBVT	
	Dual	SOIC (D)	Tube of 75	LMV822D	MV822
			Reel of 2500	LMV822DR	
		MSOP/VSSOP (DGK)	Tube of 100	LMV822DGK	RAB
			Reel of 2500	LMV822DGKR	
	Quad	SOIC (D)	Tube of 50	LMV824D	LMV824
			Reel of 2500	LMV824DR	
		TSSOP (PW)	Tube of 90	LMV824PW	MV824
			Reel of 2000	LMV824PWR	
TVSOP (DGV)		Reel of 2000	LMV824DGVR	MV824	
-40°C to 125°C		Single	SC-70 (DCKR)	Reel of 3000	LMV821IDCKR
	SC-70 (DCKT)		Reel of 250	LMV821IDCKT	
	SOT-23 (DBVR)		Reel of 3000	LMV821IDBVR	RB1_
	SOT-23 (DBVT)		Reel of 250	LMV821IDBVT	
	Dual	SOIC (D)	Tube of 75	LMV822ID	MV822I
			Reel of 2500	LMV822IDR	
		MSOP/VSSOP (DGK)	Tube of 100	LMV822IDGK	R8_
			Reel of 2500	LMV822IDGKR	
	Quad	SOIC (D)	Tube of 50	LMV824ID	LMV824I
			Reel of 2500	LMV824IDR	
		TSSOP (PW)	Tube of 90	LMV824IPW	MV824I
			Reel of 2000	LMV824IPWR	
TVSOP (DGV)		Reel of 2000	LMV824IDGVR	MV824I	

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

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

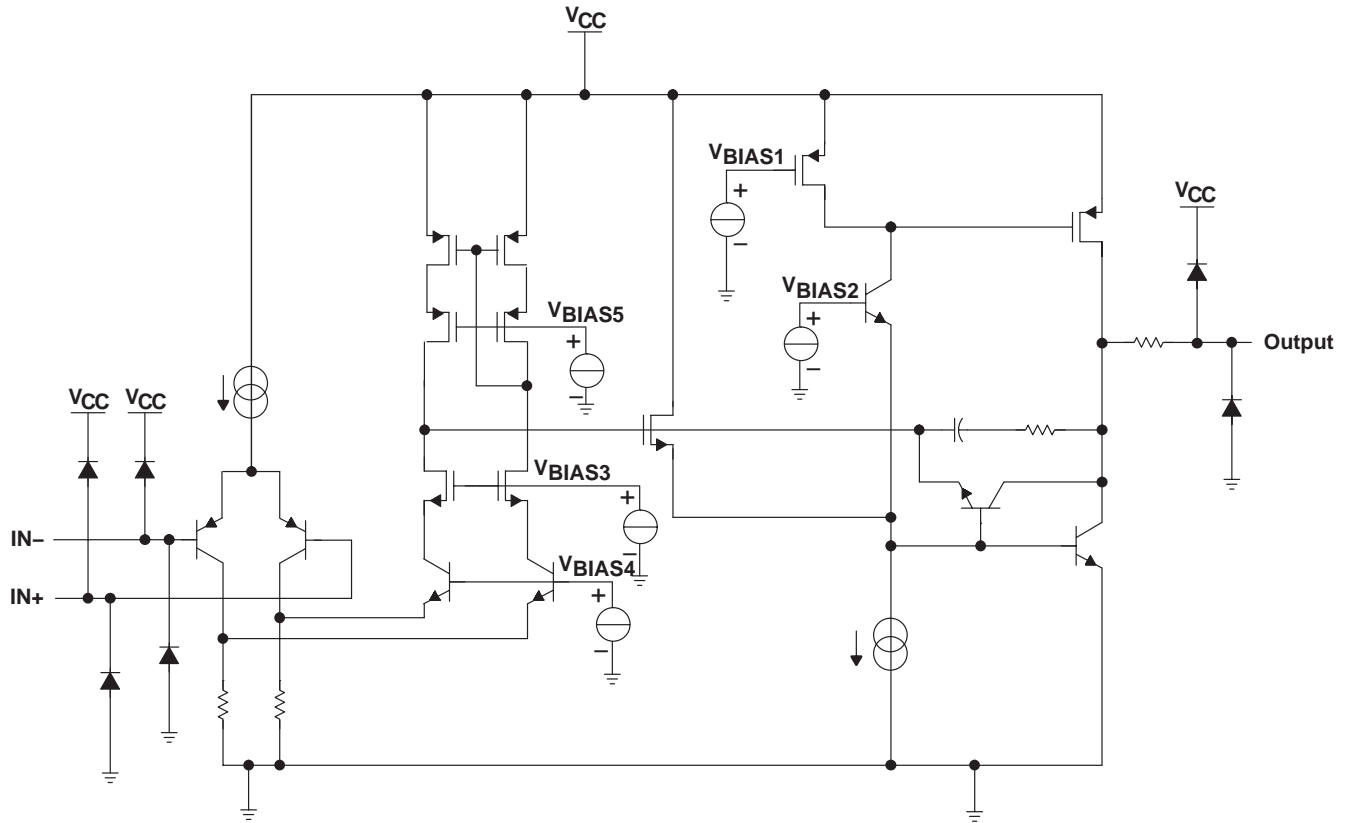
symbol (each amplifier)



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LMV824 simplified schematic



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)	$\pm V_{CC}$
Input voltage range, V_I (either input)	V_{CC-} to V_{CC+}
Duration of output short circuit (one amplifier) to ground at (or below), $T_A = 25^\circ\text{C}$, $V_{CC} \leq 5.5\text{ V}$ (see Note 3)	Unlimited
Package thermal impedance, θ_{JA} (see Notes 4 and 5):	
D (8-pin) package	97°C/W
D (14-pin) package	86°C/W
DBV package	206°C/W
DCK package	252°C/W
DGK package	172°C/W
DGV package	127°C/W
PW package	113°C/W
Operating virtual junction temperature, T_J	150°C
Storage temperature range, T_{Stg}	-65°C 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 $T_J(\text{max})$, θ_{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.



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recommended operating conditions

		MIN	MAX	UNIT	
V _{CC}	Supply voltage (single-supply operation)	2.5	5	V	
T _A	Operating free-air temperature	LMV8xxl	-40	125	°C
		LMV8xx	-40	85	°C

**2.5-V electrical characteristics, T_A = -40°C to 85°C,
V_{CC+} = 2.5 V, V_{CC-} = 0 V, V_{IC} = 1 V, V_O = 1.25 V, and R_L > 1 MΩ (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	T _A	LMV8xx			UNIT
			MIN	TYP	MAX	
V _{IO} Input offset voltage		25°C	1		3.5	mV
		-40°C to 85°C			4	
V _O Output swing	V _{CC+} = 2.5 V, R _L = 600 Ω to 1.25 V	High level	25°C	2.30	2.37	V
			-40°C to 85°C	2.20		
		Low level	25°C	0.13		
		-40°C to 85°C			0.30	
	V _{CC+} = 2.5 V, R _L = 2 kΩ to 1.25 V	High level	25°C	2.40	2.46	
			-40°C to 85°C	2.30		
Low level		25°C	0.08		0.12	
		-40°C to 85°C			0.20	

**2.5-V electrical characteristics, T_A = -40°C to 125°C,
V_{CC+} = 2.5 V, V_{CC-} = 0 V, V_{IC} = 1 V, V_O = 1.25 V, and R_L > 1 MΩ (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	T _A	LMV8xxl			UNIT
			MIN	TYP	MAX	
V _{IO} Input offset voltage		25°C	1		3.5	mV
		-40°C to 125°C			5.5	
V _O Output swing	V _{CC+} = 2.5 V, R _L = 600 Ω to 1.25 V	High level	25°C	2.28	2.37	V
			-40°C to 125°C	2.18		
		Low level	25°C	0.13		
		-40°C to 125°C			0.32	
	V _{CC+} = 2.5 V, R _L = 2 kΩ to 1.25 V	High level	25°C	2.38	2.46	
			-40°C to 125°C	2.28		
Low level		25°C	0.08		0.14	
		-40°C to 125°C			0.22	



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**2.7-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 85°C ,
 $V_{CC+} = 2.7\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 1\text{ V}$, $V_O = 1.35\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	T_A	LMV8xx			UNIT
			MIN	TYP	MAX	
V_{IO} Input offset voltage		25°C	1	3.5	mV	
		-40°C to 85°C	4			
α_{VIO} Average temperature coefficient of input offset voltage		25°C	1		$\mu\text{V}/^\circ\text{C}$	
I_{IB} Input bias current		25°C	30	90	nA	
		-40°C to 85°C	140			
I_{IO} Input offset current		25°C	0.5	30	nA	
		-40°C to 85°C	50			
CMRR Common-mode rejection ratio	$V_{IC} = 0$ to 1.7 V	25°C	70	85	dB	
		-40°C to 85°C	68			
+kSVR Positive supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$ to 4 V, $V_{CC-} = -1\text{ V}$, $V_O = 0$, $V_{IC} = 0$	25°C	75	85	dB	
		-40°C to 85°C	70			
-kSVR Negative supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$, $V_{CC-} = -1\text{ V}$ to -3.3 V, $V_O = 0$, $V_{IC} = 0$	25°C	73	85	dB	
		-40°C to 85°C	70			
V_{ICR} Common-mode input voltage range	CMRR ≥ 50 dB	25°C	-0.2 to 1.9	-0.3 to 2	V	
A_V Large-signal voltage amplification	$R_L = 600\ \Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 2.2 V	Sourcing	25°C	90	100	dB
			-40°C to 85°C	85		
	$R_L = 600\ \Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 0.5 V	Sinking	25°C	85	90	
			-40°C to 85°C	80		
$R_L = 2\text{ k}\Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 2.2 V	Sourcing	25°C	95	100		
		-40°C to 85°C	90			
$R_L = 2\text{ k}\Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 0.5 V	Sinking	25°C	90	95		
		-40°C to 85°C	85			
V_O Output swing	$V_{CC+} = 2.7\text{ V}$, $R_L = 600\ \Omega$ to 1.35 V	High level	25°C	2.50	2.58	V
			-40°C to 85°C	2.40		
	Low level	25°C	0.13	0.20		
		-40°C to 85°C	0.30			
	$V_{CC+} = 2.7\text{ V}$, $R_L = 2\text{ k}\Omega$ to 1.35 V	High level	25°C	2.60	2.66	
			-40°C to 85°C	2.50		
Low level	25°C	0.08	0.120			
	-40°C to 85°C	0.200				
I_O Output current	$V_O = 0\text{ V}$	Sourcing	25°C	12	16	mA
	$V_O = 2.7\text{ V}$	Sinking	25°C	12	26	



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2.7-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 85°C ,
 $V_{CC+} = 2.7\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 1\text{ V}$, $V_O = 1.35\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted)
 (continued)

PARAMETER	TEST CONDITIONS	T_A	LMV8xx			UNIT
			MIN	TYP	MAX	
I_{CC} Supply current	LMV821	25°C	0.22	0.3	mA	
		-40°C to 85°C	0.5			
	LMV822 (both amplifiers)	25°C	0.45	0.6		
		-40°C to 85°C	0.8			
	LMV824 (all four amplifiers)	25°C	0.72	1.0		
		-40°C to 85°C	1.2			
SR Slew rate†		25°C	1.7		V/ μs	
GBW Gain-bandwidth product	See Note 6	25°C	5		MHz	
ϕ_m Phase margin	See Note 6	25°C	60		deg	
Gain margin	See Note 6	25°C	8.6		dB	
Amplifier-to-amplifier isolation	$V_{CC+} = 5\text{ V}$, $R_L = 100\text{ k}\Omega$ to $2.5\text{ V}\ddagger$	25°C	135		dB	
V_n Equivalent input noise voltage	$f = 1\text{ kHz}$, $V_{IC} = 1\text{ V}$	25°C	45		nV/ $\sqrt{\text{Hz}}$	
I_n Equivalent input noise current	$f = 1\text{ kHz}$	25°C	0.18		pA/ $\sqrt{\text{Hz}}$	
THD Total harmonic distortion	$f = 1\text{ kHz}$, $A_V = -2$, $R_L = 10\text{ k}\Omega$, $V_O = 4.1\text{ V}_{p-p}$	25°C	0.01		%	

† Connected as voltage follower with 1-V step input. Value specified is the slower of the positive and negative slew rates.

‡ Each amplifier excited in turn with 1 kHz to produce $V_O = 3\text{ V}_{p-p}$

NOTE 6: 40-dB closed-loop dc gain, $C_L = 22\text{ pF}$

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2.7-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 125°C , $V_{CC+} = 2.7\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 1\text{ V}$, $V_O = 1.35\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_A	LMV8xxI			UNIT
			MIN	TYP	MAX	
V_{IO} Input offset voltage		25°C	1	3.5	mV	
		-40°C to 125°C		5.5		
α_{VIO} Average temperature coefficient of input offset voltage		25°C	1		$\mu\text{V}/^\circ\text{C}$	
I_{IB} Input bias current		25°C	30	90	nA	
		-40°C to 125°C		140		
I_{IO} Input offset current		25°C	0.5	30	nA	
		-40°C to 125°C		50		
CMRR Common-mode rejection ratio	$V_{IC} = 0$ to 1.7 V	25°C	70	85	dB	
		-40°C to 125°C	68			
+kSVR Positive supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$ to 4 V, $V_{CC-} = -1\text{ V}$, $V_O = 0$, $V_{IC} = 0$	25°C	75	85	dB	
		-40°C to 125°C	70			
-kSVR Negative supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$, $V_{CC-} = -1\text{ V}$ to -3.3 V, $V_O = 0$, $V_{IC} = 0$	25°C	73	85	dB	
		-40°C to 125°C	70			
V_{ICR} Common-mode input voltage range	CMRR ≥ 50 dB	25°C	-0.2 to 1.9	-0.3 to 2	V	
A_V Large-signal voltage amplification	$R_L = 600\ \Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 2.2 V	Sourcing	25°C	90	100	dB
			-40°C to 125°C	85		
	$R_L = 600\ \Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 0.5 V	Sinking	25°C	85	90	
			-40°C to 125°C	80		
	$R_L = 2\text{ k}\Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 2.2 V	Sourcing	25°C	95	100	
			-40°C to 125°C	90		
	$R_L = 2\text{ k}\Omega$ to 1.35 V, $V_O = 1.35\text{ V}$ to 0.5 V	Sinking	25°C	90	95	
			-40°C to 125°C	85		
V_O Output swing	$V_{CC+} = 2.7\text{ V}$, $R_L = 600\ \Omega$ to 1.35 V	High level	25°C	2.50	2.58	V
			-40°C to 125°C	2.40		
		Low level	25°C	0.13	0.20	
			-40°C to 125°C		0.30	
	$V_{CC+} = 2.7\text{ V}$, $R_L = 2\text{ k}\Omega$ to 1.35 V	High level	25°C	2.60	2.66	
			-40°C to 125°C	2.50		
		Low level	25°C	0.08	0.120	
			-40°C to 125°C		0.200	
I_O Output current	$V_O = 0\text{ V}$	Sourcing	25°C	12	16	mA
	$V_O = 2.7\text{ V}$			Sinking	12	



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2.7-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 125°C ,
 $V_{CC+} = 2.7\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 1\text{ V}$, $V_O = 1.35\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted)
 (continued)

PARAMETER	TEST CONDITIONS	T_A	LMV8xxI			UNIT
			MIN	TYP	MAX	
I_{CC} Supply current	LMV821	25°C	0.22	0.3	mA	
		-40°C to 125°C		0.5		
	LMV822 (both amplifiers)	25°C	0.45	0.6		
		-40°C to 125°C		0.8		
	LMV824 (all four amplifiers)	25°C	0.72	1.0		
		-40°C to 125°C		1.2		
SR Slew rate†		25°C	1.7		V/ μs	
GBW Gain-bandwidth product	See Note 6	25°C	5		MHz	
ϕ_m Phase margin	See Note 6	25°C	60		deg	
Gain margin	See Note 6	25°C	8.6		dB	
Amplifier-to-amplifier isolation	$V_{CC+} = 5\text{ V}$, $R_L = 100\text{ k}\Omega$ to $2.5\text{ V}\ddagger$	25°C	135		dB	
V_n Equivalent input noise voltage	$f = 1\text{ kHz}$, $V_{IC} = 1\text{ V}$	25°C	45		nV/ $\sqrt{\text{Hz}}$	
I_n Equivalent input noise current	$f = 1\text{ kHz}$	25°C	0.18		pA/ $\sqrt{\text{Hz}}$	
THD Total harmonic distortion	$f = 1\text{ kHz}$, $A_V = -2$, $R_L = 10\text{ k}\Omega$, $V_O = 4.1\text{ V}_{p-p}$	25°C	0.01		%	

† Connected as voltage follower with 1-V step input. Value specified is the slower of the positive and negative slew rates.

‡ Each amplifier excited in turn with 1 kHz to produce $V_O = 3\text{ V}_{p-p}$

NOTE 6: 40-dB closed-loop dc gain, $C_L = 22\text{ pF}$

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**5-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 85°C ,
 $V_{CC+} = 5\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 2\text{ V}$, $V_O = 2.5\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	T_A	LMV8xx			UNIT	
			MIN	TYP	MAX		
V_{IO} Input offset voltage		25°C		1	3.5	mV	
		-40°C to 85°C			4		
α_{VIO} Average temperature coefficient of input offset voltage		25°C		1		$\mu\text{V}/^\circ\text{C}$	
I_{IB} Input bias current		25°C		40	100	nA	
		-40°C to 85°C			150		
I_{IO} Input offset current		25°C		0.5	30	nA	
		-40°C to 85°C			50		
CMRR Common-mode rejection ratio	$V_{IC} = 0$ to 4 V	25°C		72	90	dB	
		-40°C to 85°C			70		
+kSVR Positive supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$ to 4 V, $V_{CC-} = -1\text{ V}$, $V_O = 0$, $V_{IC} = 0$	25°C		75	85	dB	
		-40°C to 85°C			70		
-kSVR Negative supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$, $V_{CC-} = -1\text{ V}$ to -3.3 V, $V_O = 0$, $V_{IC} = 0$	25°C		73	85	dB	
		-40°C to 85°C			70		
V_{ICR} Common-mode input voltage range	CMRR ≥ 50 dB	25°C		-0.2 to 4.2	-0.3 to 4.3	V	
A_V Large-signal voltage amplification	$R_L = 600\ \Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 4.5 V	Sourcing	25°C		95	105	dB
			-40°C to 85°C			90	
	$R_L = 600\ \Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 0.5 V	Sinking	25°C		95	105	
			-40°C to 85°C			90	
$R_L = 2\text{ k}\Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 4.5 V	Sourcing	25°C		95	105		
		-40°C to 85°C			90		
$R_L = 2\text{ k}\Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 0.5 V	Sinking	25°C		95	105		
		-40°C to 85°C			90		
V_O Output swing	$V_{CC+} = 5\text{ V}$, $R_L = 600\ \Omega$ to 2.5 V	High level	25°C		4.75	4.84	V
			-40°C to 85°C			4.70	
	Low level	25°C		0.17	0.250		
		-40°C to 85°C			0.30		
	$V_{CC+} = 5\text{ V}$, $R_L = 2\text{ k}\Omega$ to 2.5 V	High level	25°C		4.85	4.90	
			-40°C to 85°C			4.80	
Low level	25°C		0.10	0.15			
	-40°C to 85°C			0.20			
I_O Output current	$V_O = 0\text{ V}$	Sourcing	25°C		20	45	mA
			-40°C to 85°C			15	
	$V_O = 5\text{ V}$	Sinking	25°C		20	40	
			-40°C to 85°C			15	



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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5-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 85°C ,
 $V_{CC+} = 5\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 2\text{ V}$, $V_O = 2.5\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted) (continued)

PARAMETER	TEST CONDITIONS	T_A	LMV8xx			UNIT
			MIN	TYP	MAX	
I_{CC} Supply current	LMV821	25°C	0.30	0.4	mA	
		-40°C to 85°C		0.6		
	LMV822 (both amplifiers)	25°C	0.5	0.7		
		-40°C to 85°C		0.9		
	LMV824 (all four amplifiers)	25°C	1.0	1.3		
		-40°C to 85°C		1.5		
SR Slew rate†		25°C	1.4	1.9	V/ μs	
GBW Gain-bandwidth product	See Note 6	25°C	5.5		MHz	
ϕ_m Phase margin	See Note 6	25°C	64.2		deg	
Gain margin	See Note 6	25°C	8.7		dB	
Amplifier-to-amplifier isolation	$V_{CC+} = 5\text{ V}$, $R_L = 100\text{ k}\Omega$ to $2.5\text{ V}\ddagger$	25°C	135		dB	
V_n Equivalent input noise voltage	$f = 1\text{ kHz}$, $V_{IC} = 1\text{ V}$	25°C	42		nV/ $\sqrt{\text{Hz}}$	
I_n Equivalent input noise current	$f = 1\text{ kHz}$	25°C	0.20		pA/ $\sqrt{\text{Hz}}$	
THD Total harmonic distortion	$f = 1\text{ kHz}$, $A_V = -2$, $R_L = 10\text{ k}\Omega$, $V_O = 4.1\text{ V}_{p-p}$	25°C	0.01		%	

† Connected as voltage follower with 3-V step input. Value specified is the slower of the positive and negative slew rates.

‡ Each amplifier excited in turn with 1 kHz to produce $V_O = 3\text{ V}_{p-p}$

NOTE 6: 40-dB closed-loop dc gain, $C_L = 22\text{ pF}$



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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**5-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 125°C ,
 $V_{CC+} = 5\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 2\text{ V}$, $V_O = 2.5\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	T_A	LMV8xxI			UNIT
			MIN	TYP	MAX	
V_{IO} Input offset voltage		25°C	1	3.5	mV	
		-40°C to 125°C	5.5			
α_{VIO} Average temperature coefficient of input offset voltage		25°C	1		$\mu\text{V}/^\circ\text{C}$	
I_{IB} Input bias current		25°C	40	100	nA	
		-40°C to 125°C	150			
I_{IO} Input offset current		25°C	0.5	30	nA	
		-40°C to 125°C	50			
CMRR Common-mode rejection ratio	$V_{IC} = 0$ to 4 V	25°C	72	90	dB	
		-40°C to 125°C	70			
+kSVR Positive supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$ to 4 V, $V_{CC-} = -1\text{ V}$, $V_O = 0$, $V_{IC} = 0$	25°C	75	85	dB	
-kSVR Negative supply-voltage rejection ratio	$V_{CC+} = 1.7\text{ V}$, $V_{CC-} = -1\text{ V}$ to -3.3 V, $V_O = 0$, $V_{IC} = 0$	25°C	73	85		
		-40°C to 125°C	70			
V_{ICR} Common-mode input voltage range	CMRR ≥ 50 dB	25°C	-0.2 to 4.2	-0.3 to 4.3	V	
A_V Large-signal voltage amplification	$R_L = 600\ \Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 4.5 V	Sourcing	25°C	95	105	dB
			-40°C to 125°C	90		
	Sinking	25°C	95	105		
		-40°C to 125°C	90			
$R_L = 2\text{ k}\Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 4.5 V	Sourcing	25°C	95	105		
		-40°C to 125°C	90			
$R_L = 2\text{ k}\Omega$ to 2.5 V, $V_O = 2.5\text{ V}$ to 0.5 V	Sinking	25°C	95	105		
		-40°C to 125°C	90			
V_O Output swing	$V_{CC+} = 5\text{ V}$, $R_L = 600\ \Omega$ to 2.5 V	High level	25°C	4.75	4.84	V
			-40°C to 125°C	4.60		
	Low level	25°C	0.17	0.250		
		-40°C to 125°C	0.30			
	$V_{CC+} = 5\text{ V}$, $R_L = 2\text{ k}\Omega$ to 2.5 V	High level	25°C	4.85	4.90	
			-40°C to 125°C	4.80		
Low level	25°C	0.10	0.15			
	-40°C to 125°C	0.20				
I_O Output current	$V_O = 0\text{ V}$	Sourcing	25°C	20	45	mA
			-40°C to 125°C	15		
	$V_O = 5\text{ V}$	Sinking	25°C	20	40	
			-40°C to 125°C	15		



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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5-V electrical characteristics, $T_A = -40^\circ\text{C}$ to 125°C ,
 $V_{CC+} = 5\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{IC} = 2\text{ V}$, $V_O = 2.5\text{ V}$, and $R_L > 1\text{ M}\Omega$ (unless otherwise noted) (continued)

PARAMETER	TEST CONDITIONS	T_A	LMV8xxI			UNIT
			MIN	TYP	MAX	
I_{CC} Supply current	LMV821	25°C	0.3	0.4	mA	
		-40°C to 125°C		0.6		
	LMV822 (both amplifiers)	25°C	0.5	0.7		
		-40°C to 125°C		0.9		
	LMV824 (all four amplifiers)	25°C	1	1.3		
		-40°C to 125°C		1.5		
SR Slew rate	$V_{CC+} = 5\text{ V}^\dagger$	25°C	1.4	1.9	V/ μs	
GBW Gain-bandwidth product	See Note 6	25°C	5.5		MHz	
ϕ_m Phase margin	See Note 6	25°C	64.2		deg	
Gain margin	See Note 6	25°C	8.7		dB	
Amp-to-amp isolation	$V_{CC+} = 5\text{ V}$, $R_L = 100\text{ k}\Omega$ to 2.5 V^\ddagger	25°C	135		dB	
V_n Equivalent input noise voltage	$f = 1\text{ kHz}$, $V_{IC} = 1\text{ V}$	25°C	42		nV/ $\sqrt{\text{Hz}}$	
I_n Equivalent input noise current	$f = 1\text{ kHz}$	25°C	0.20		pA/ $\sqrt{\text{Hz}}$	
THD Total harmonic distortion	$f = 1\text{ kHz}$, $A_V = -2$, $R_L = 10\text{ k}\Omega$, $V_O = 4.1\text{ V}_{p-p}$	25°C	0.01		%	

† Connected as voltage follower with 3-V step input. Value specified is the slower of the positive and negative slew rates.

‡ Each amplifier excited in turn with 1 kHz to produce $V_O = 3\text{ V}_{p-p}$

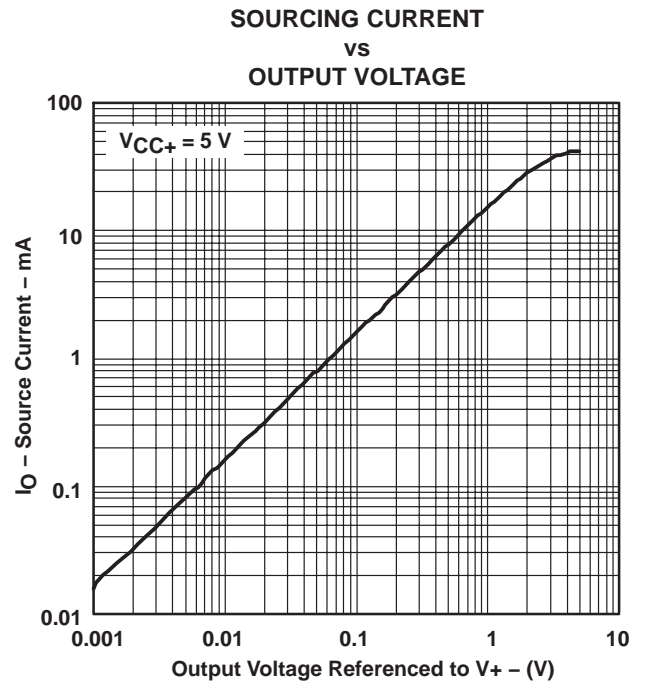
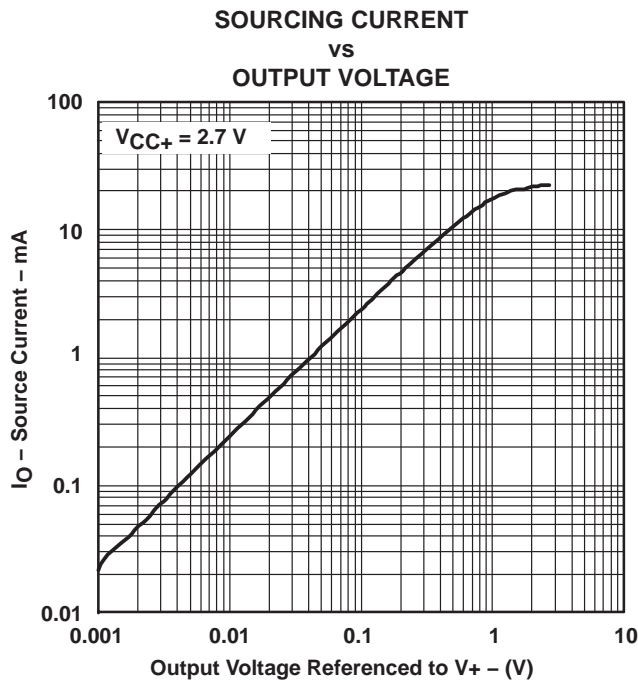
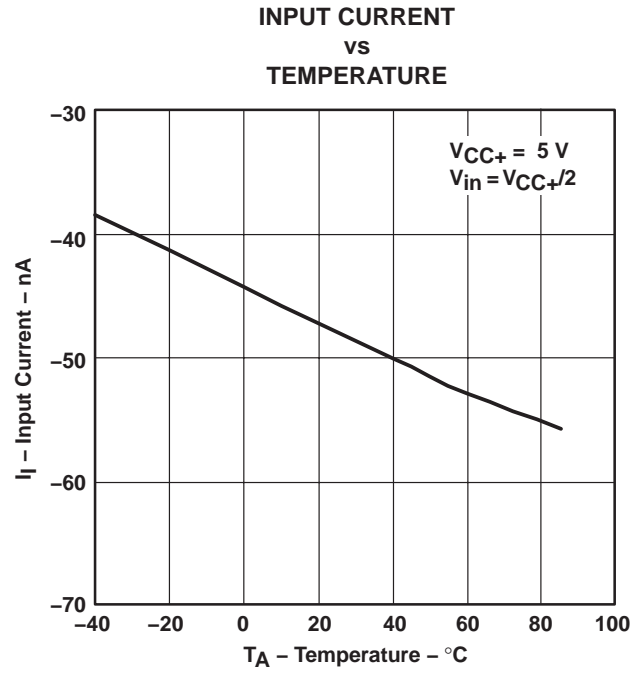
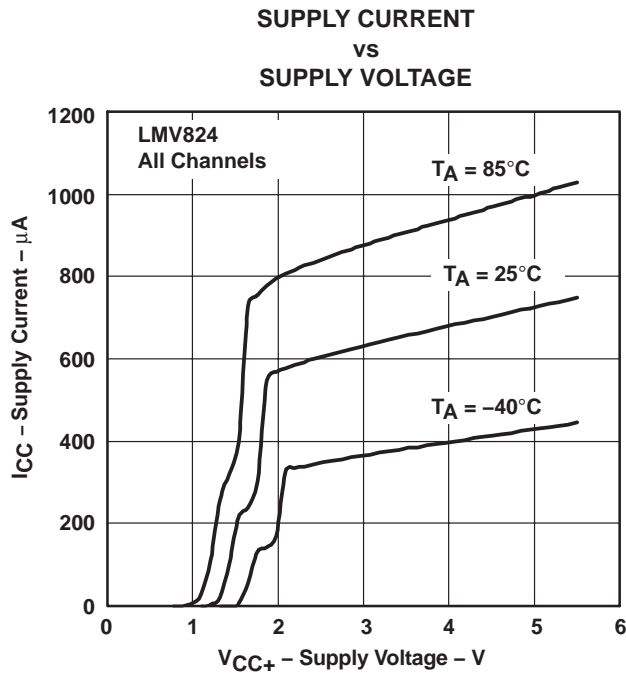
NOTE 6: 40-dB closed-loop dc gain, $C_L = 22\text{ pF}$



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $V_{CC+} = 5\text{-V}$ Single Supply, Unless Otherwise Noted)



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TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $V_{CC+} = 5\text{-V}$ Single Supply, Unless Otherwise Noted)

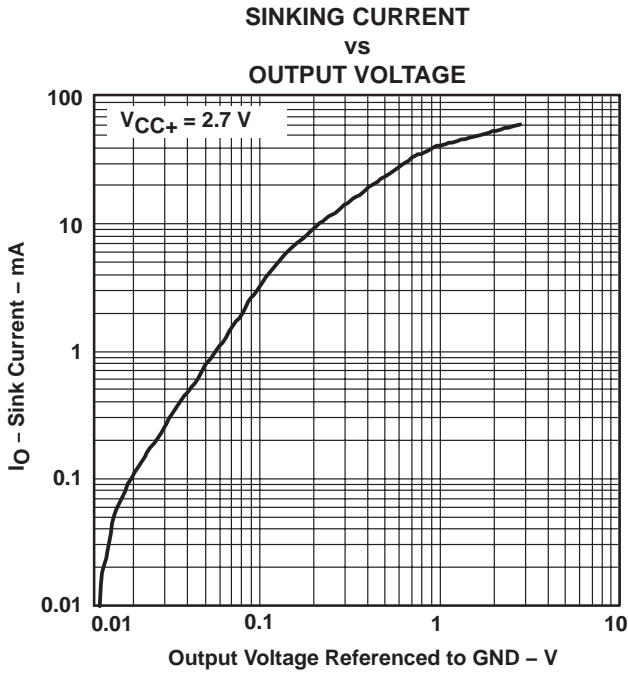


Figure 5

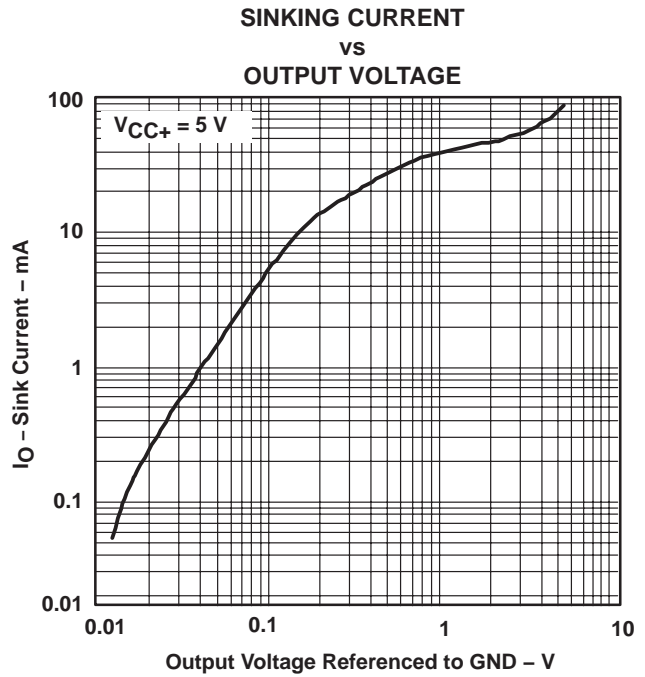


Figure 6

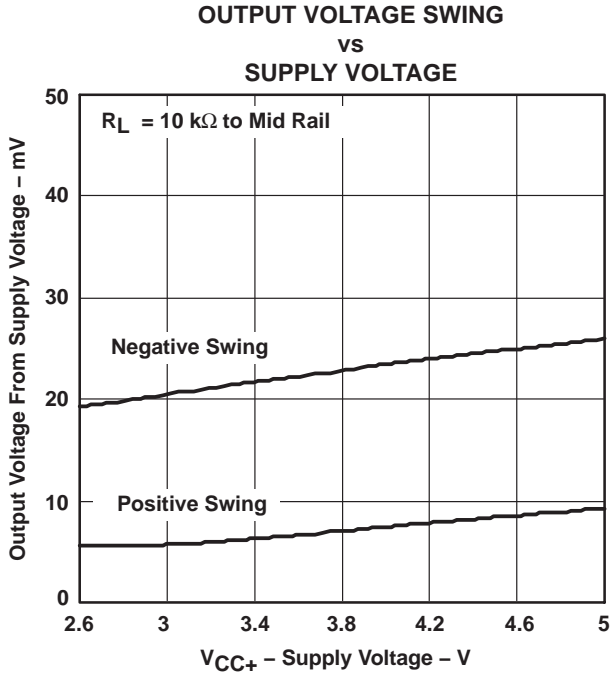


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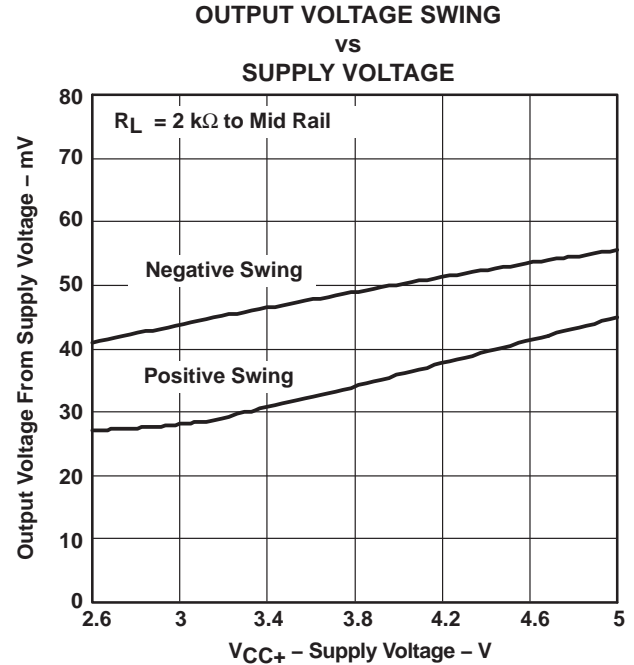


Figure 8



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $V_{CC+} = 5\text{-V}$ Single Supply, Unless Otherwise Noted)

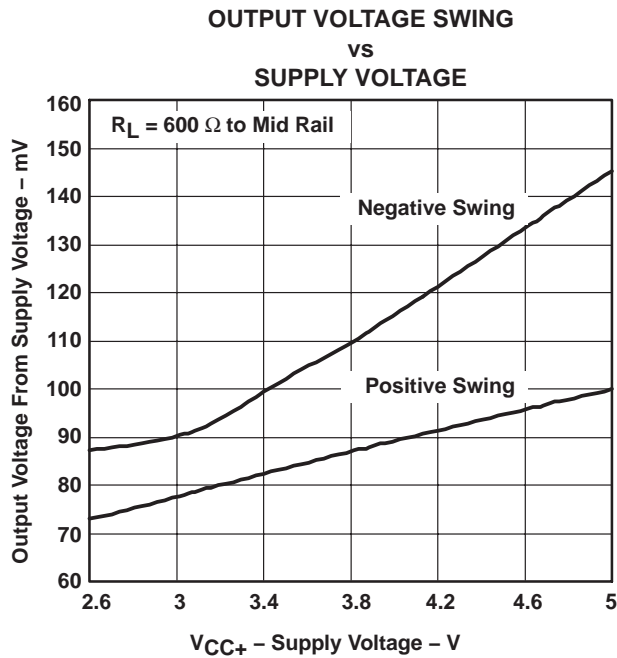


Figure 9

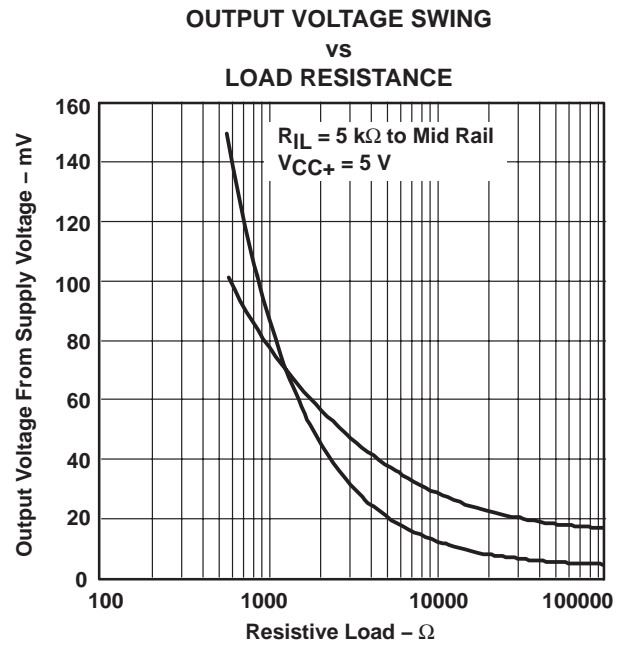


Figure 10

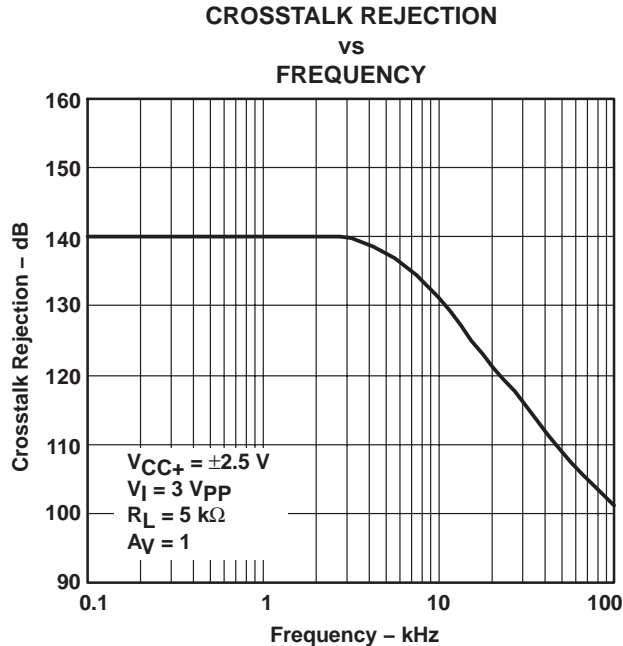


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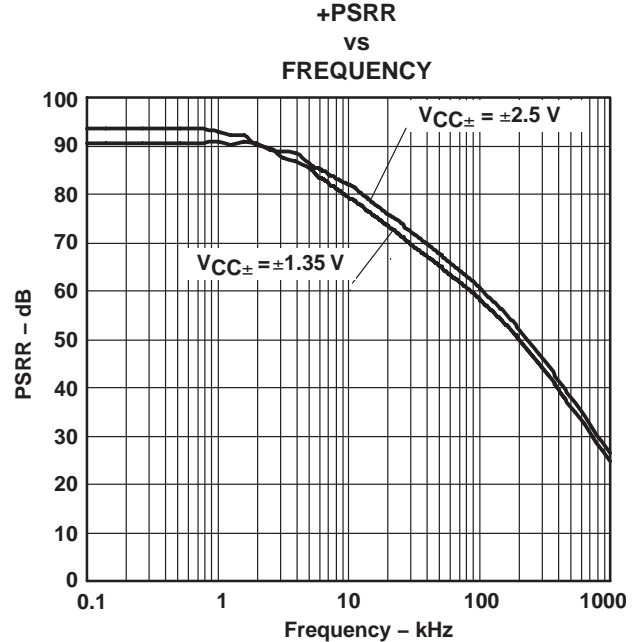
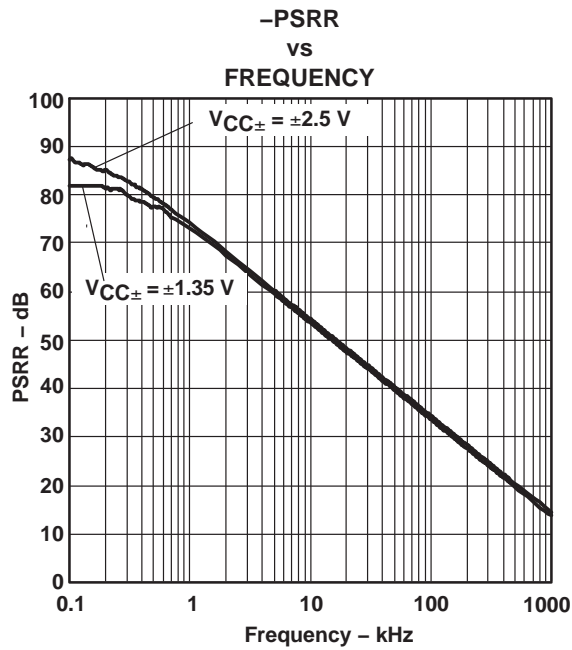


Figure 12

LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS
($T_A = 25^\circ\text{C}$, $V_{CC+} = 5\text{-V}$ Single Supply, Unless Otherwise Noted)



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS

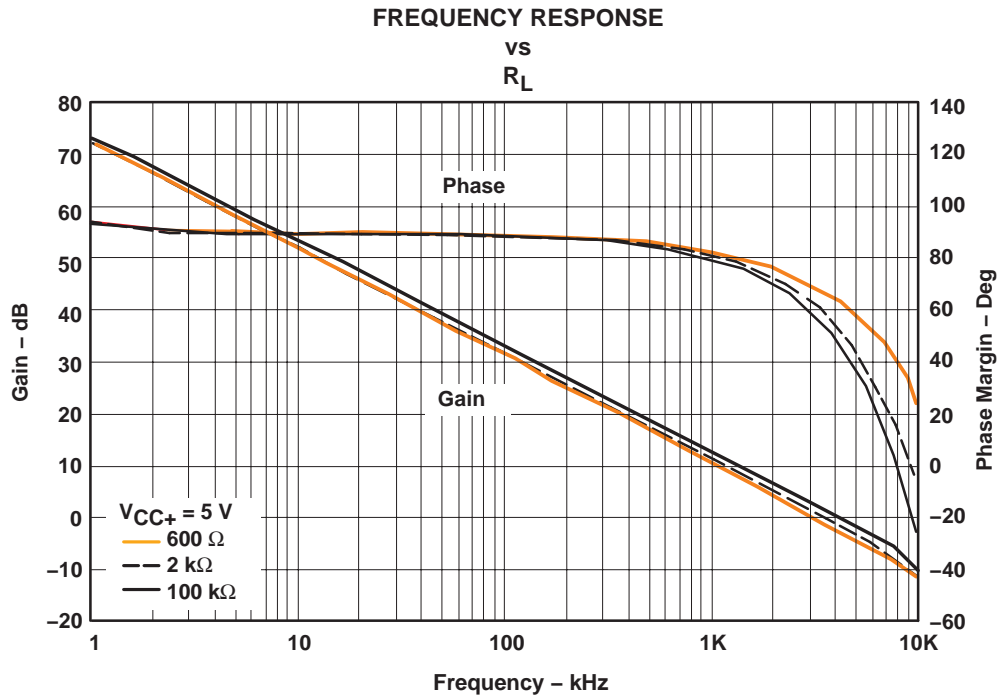


Figure 14

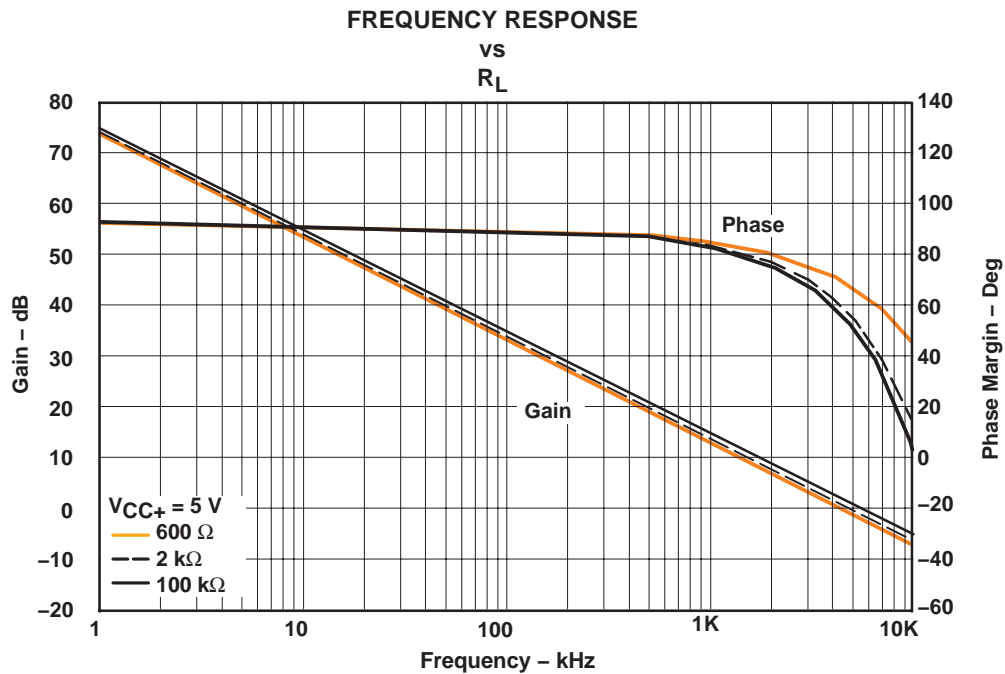
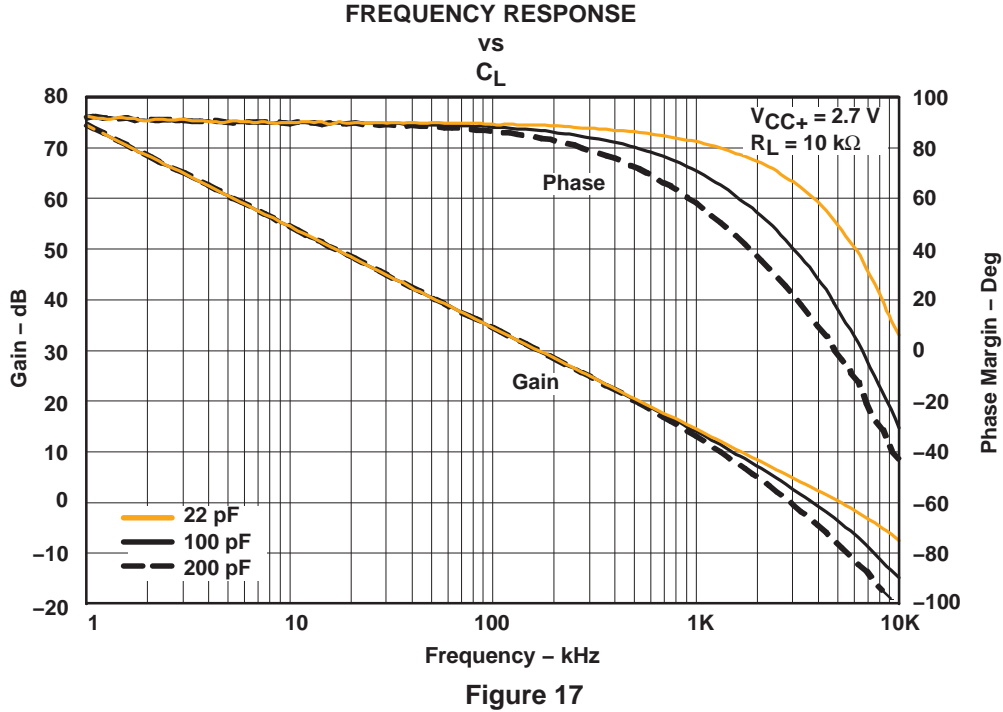
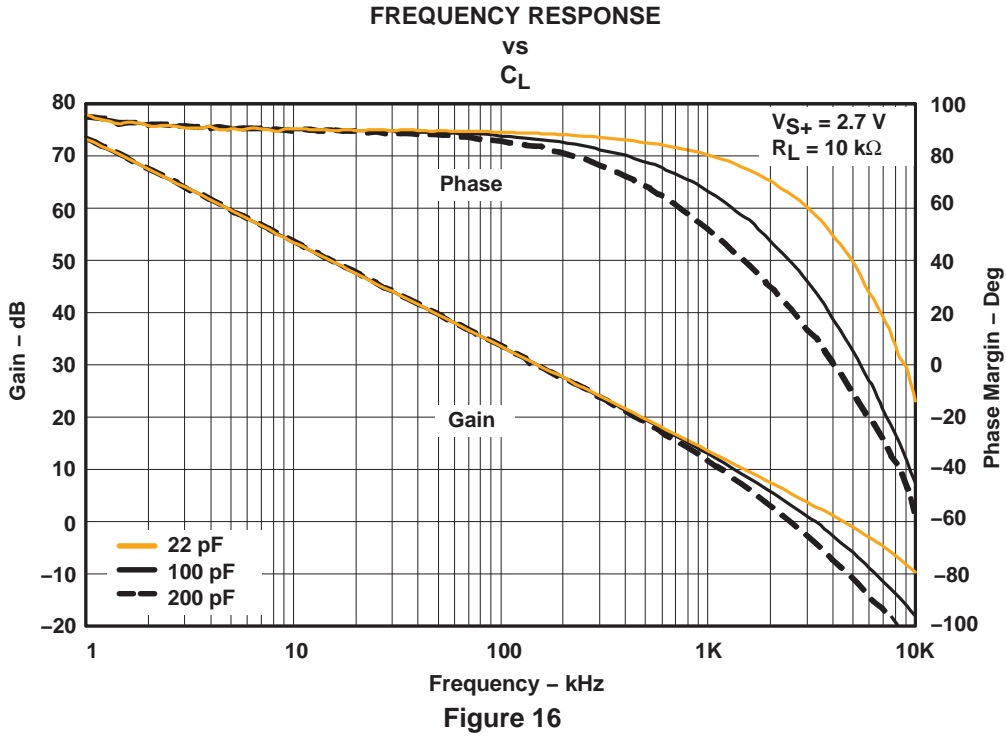


Figure 15

LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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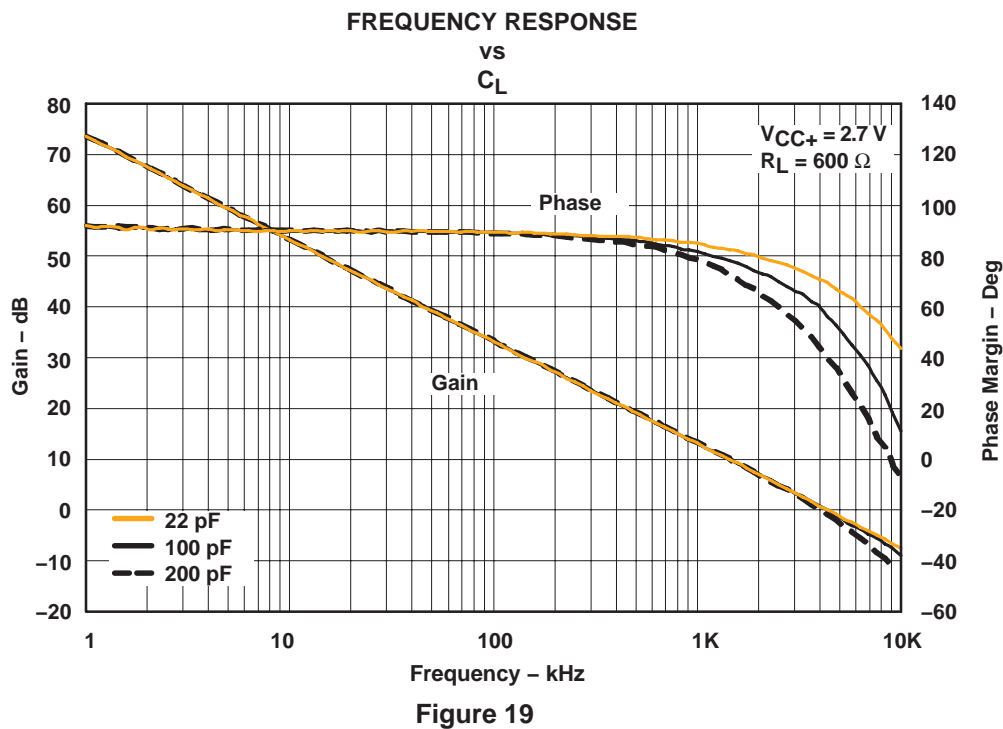
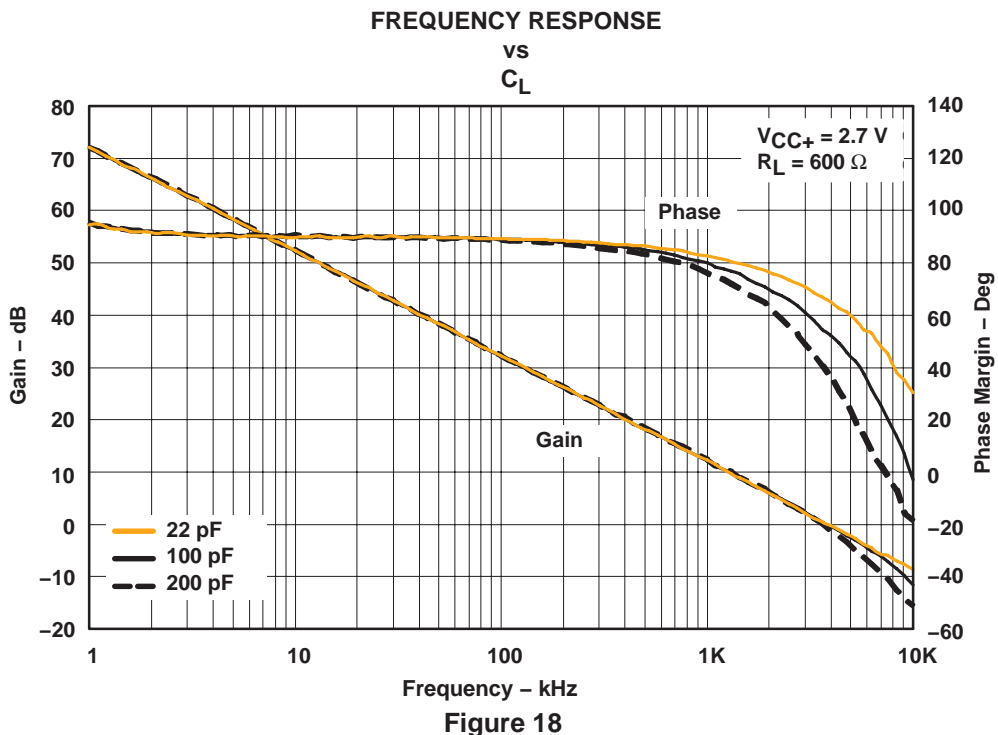
TYPICAL CHARACTERISTICS



LMV821 SINGLE, LMV822 DUAL, LMV824 QUAD LOW-VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LMV821DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV821DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV822D	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV822DGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
LMV822DR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV822ID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV822IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
LMV822IDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV824D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV824DGVR	ACTIVE	TVSOP	DGV	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
LMV824DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV824ID	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV824IDGVR	ACTIVE	TVSOP	DGV	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
LMV824IDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LMV824IPW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
LMV824IPWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
LMV824PW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
LMV824PWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

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

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DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

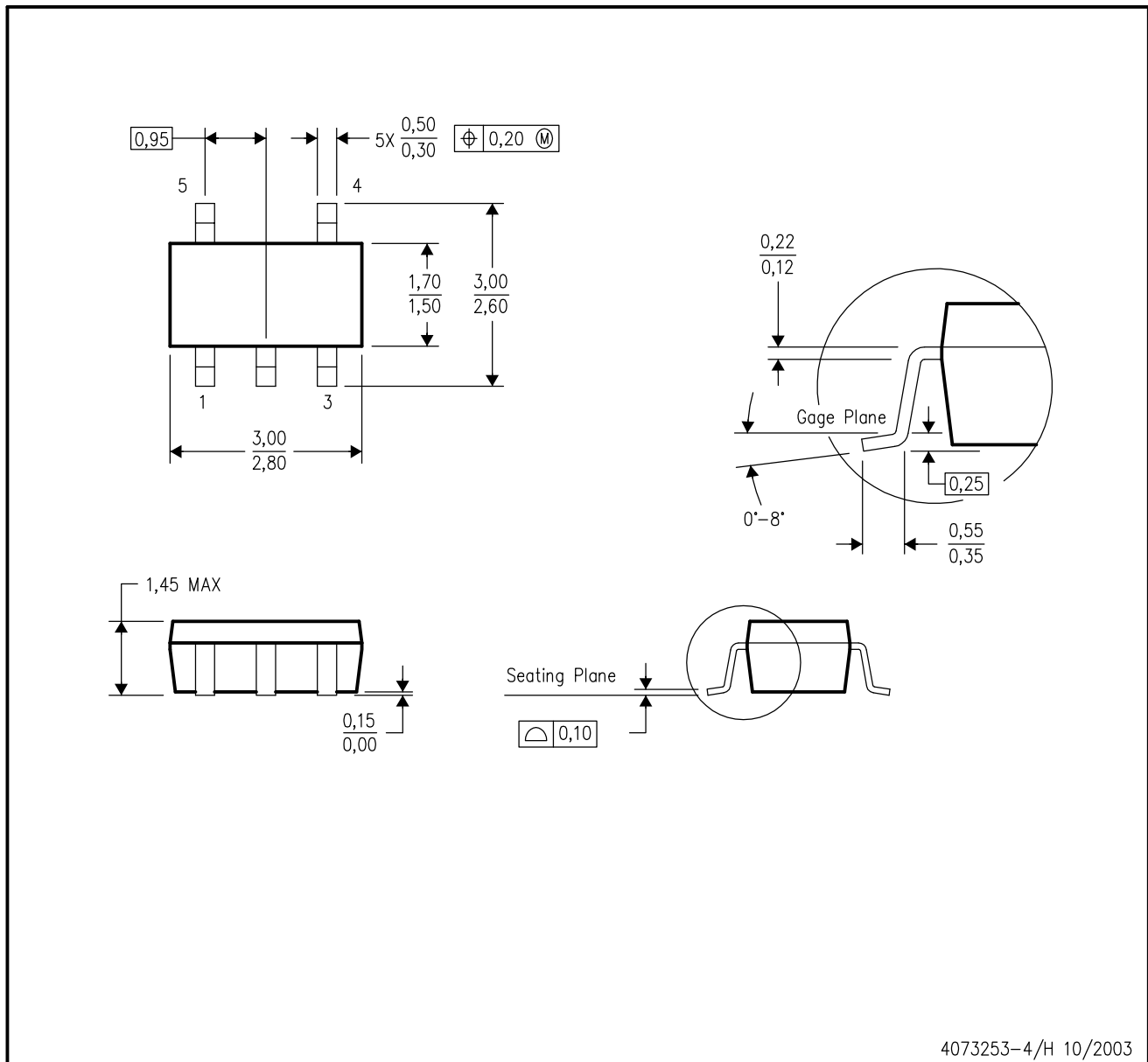
24 PINS SHOWN



- 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 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



4073253-4/H 10/2003

- 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 Variation AA.

DCK (R-PDSO-G5)

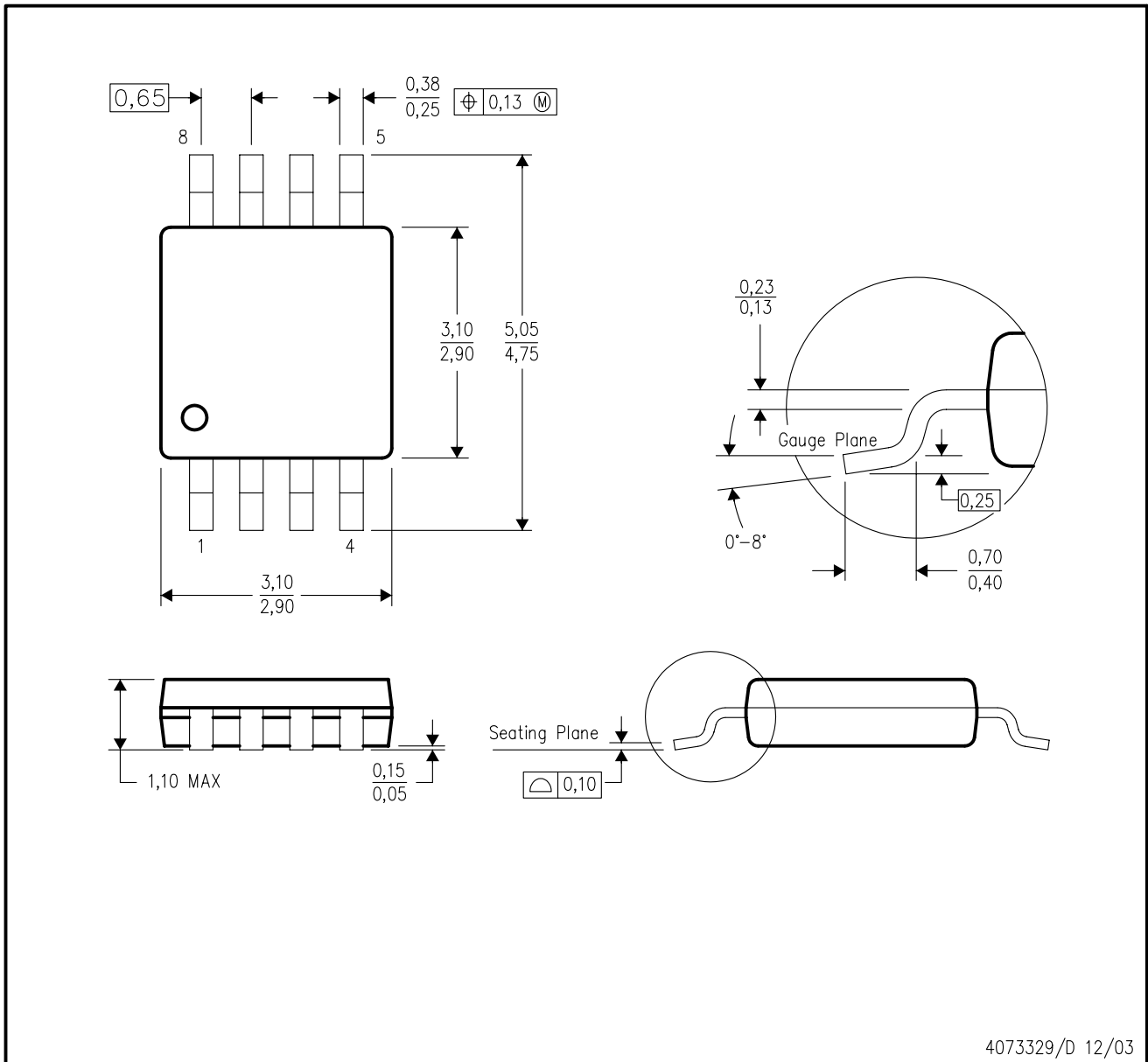
PLASTIC SMALL-OUTLINE PACKAGE



- 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

DGK (S-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 variation AA.

D (R-PDSO-G14)

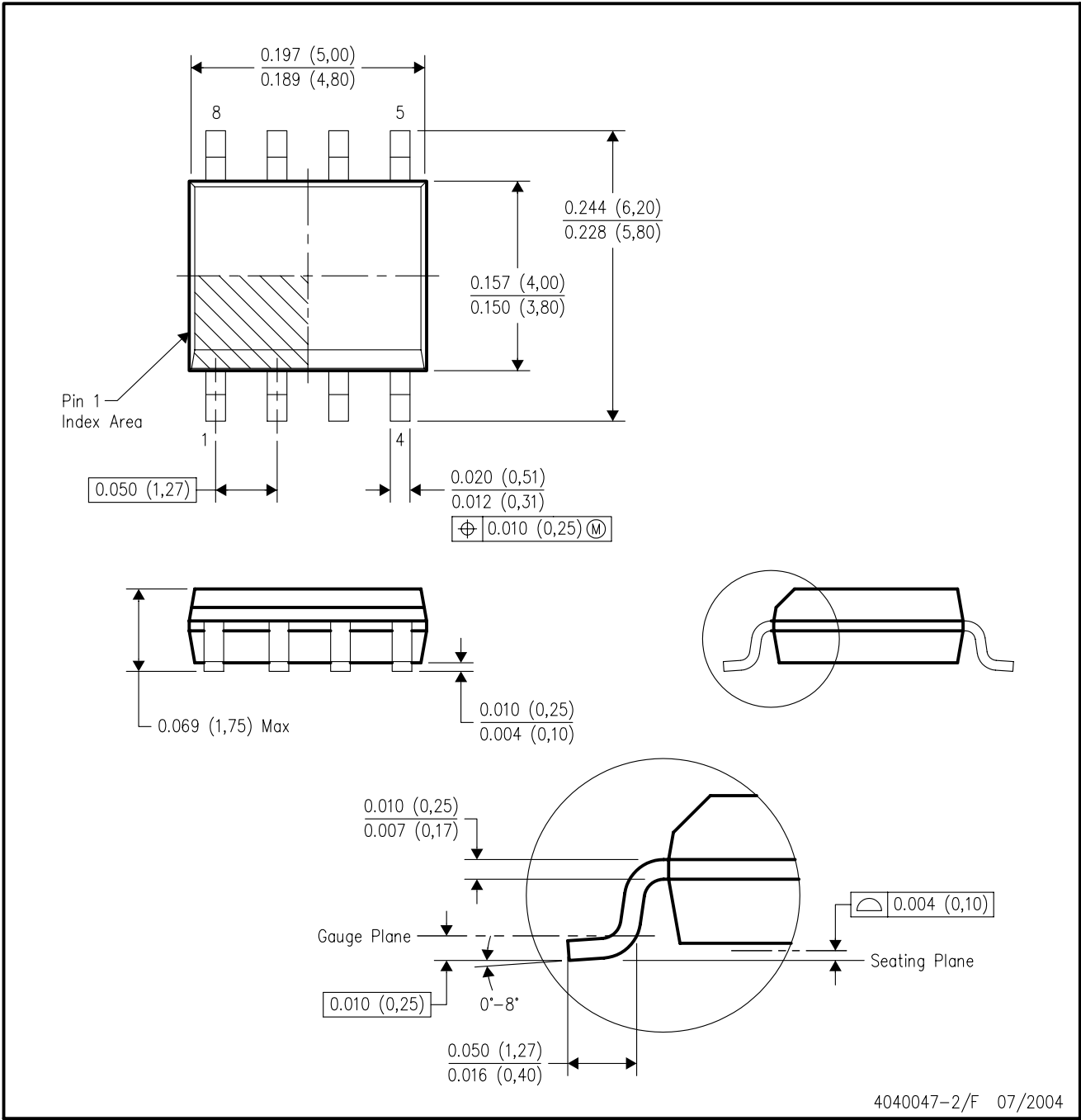
PLASTIC SMALL-OUTLINE PACKAGE



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

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 dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-012 variation AA.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



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

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