LMV821-Q1 is Obsolete

LOW-VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

Check for Samples: LMV821-Q1, LMV822-Q1, LMV824-Q1

FEATURES

- **Qualified for Automotive Applications**
- **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 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**

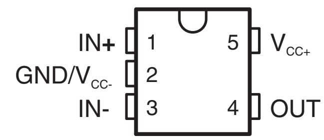
DESCRIPTION/ORDERING INFORMATION

The LMV821 single, LMV822 dual, and LMV824 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 that includes ground). However, the LMV82x devices offer a higher bandwidth (5.5 MHz typical) and faster slew rate (1.9 V/µs typical).

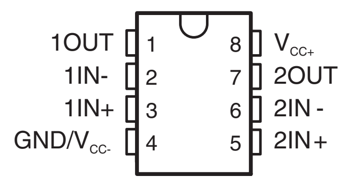
The LMV82x devices are cost-effective solutions for applications requiring low-voltage/low-power operation and space-saving considerations. The LMV821 saves space on printed circuit boards and enables the design of small portable electronic devices (cordless and cellular phones, laptops, PDAs, PCMIA). It also allows the designer to place the device closer to the signal source to reduce noise pickup and increase signal integrity.

The LMV82x devices are characterized for operation from –40°C to 125°C.

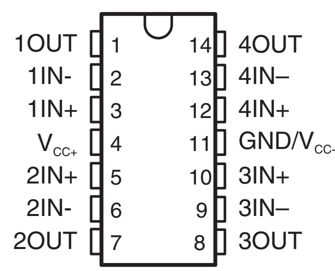
LMV821...DBV PACKAGE
(TOP VIEW)



LMV822...DGK PACKAGE
(TOP VIEW)



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

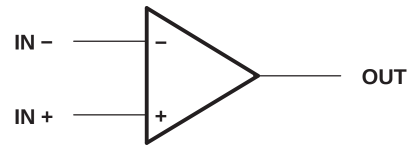


ORDERING INFORMATION(1)

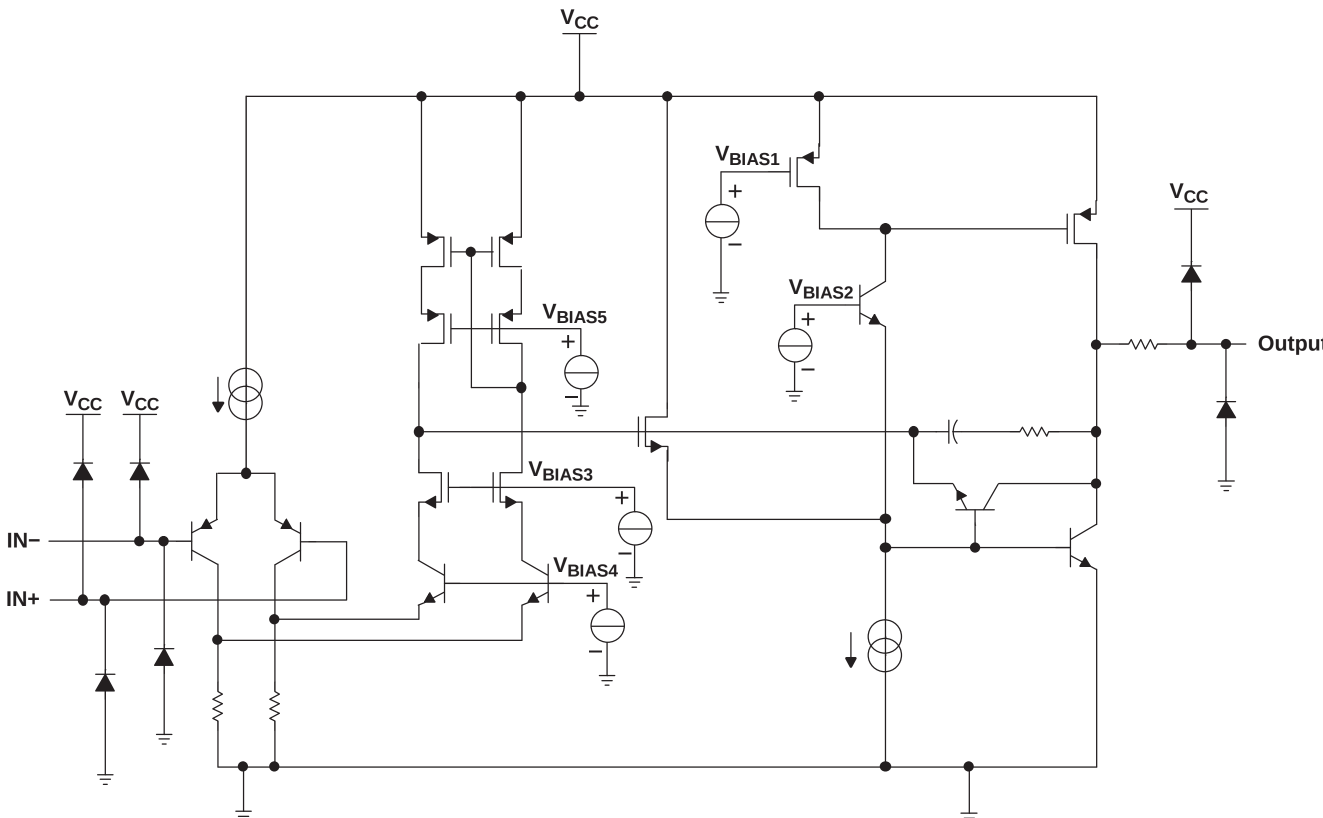
T_A	PACKAGE(2)			ORDERABLE PART NUMBER	TOP-SIDE MARKING(3)
–40°C to 125°C	Single	SOT-23 – DBV	Reel of 3000	LMV821QDBVRQ1	RB1_
	Dual	MSOP/VSSOP – DGK	Reel of 2500	LMV822QDGKRQ1	R8B
	Quad	SOIC – D	Reel of 2500	LMV824QDRQ1	LMV824Q
		TSSOP – PW	Reel of 2000	LMV824QPWRQ1	MV824Q

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(3) DBV: The actual top-side marking has one additional character that designates the wafer fab/assembly site.

SYMBOL (EACH AMPLIFIER)



SIMPLIFIED SCHEMATIC



ABSOLUTE MAXIMUM RATINGS(1)

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

V_{CC}	Supply voltage(2)		5.5 V
V_{ID}	Differential input voltage(3)		$\pm V_{CC}$
V_I	Input voltage range (either input)		V_{CC-} to V_{CC+}
	Duration of output short circuit (one amplifier) to ground(4)	At or below T_A = 25°C, $V_{CC} \le$ 5.5 V	Unlimited
θ_{JA}	Package thermal impedance(5) (6)	D package	97°C/W
		DBV package	206°C/W
		DGK package	172°C/W
		PW package	113°C/W
T_J	Operating virtual-junction temperature		150°C
T_{stg}	Storage temperature range		–65°C to 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) Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.
(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 (single-supply operation)	2.5	5	V
T_A	Operating free-air temperature	–40	125	°C

2.5-V ELECTRICAL CHARACTERISTICS

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	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage			25°C		1	6	mV
				–40°C to 125°C			6	
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	0.22	
				–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	

2.7-V ELECTRICAL CHARACTERISTICS

V_{CC+} = 2.7 V, V_{CC-} = 0 V, V_{IC} = 1 V, V_O = 1.35 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage			25°C		1	6	mV
				–40°C to 125°C			6	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C		1		µV/°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			
$+k_{SVR}$	Positive supply-voltage rejection ratio	V_{CC+} = 1.7 V to 4 V, V_{CC-} = –1 V, V_O = 0, V_{IC} = 0		25°C	75	85		dB
				–40°C to 125°C	70			
$-k_{SVR}$	Negative supply-voltage rejection ratio	V_{CC+} = 1.7 V, V_{CC-} = –1 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 Ω to 1.35 V, V_O = 1.35 V to 2.2 V	Sourcing	25°C	90	100		dB
				–40°C to 125°C	85			
		R_L = 600 Ω to 1.35 V, V_O = 1.35 V to 0.5 V	Sinking	25°C	85	90		
				–40°C to 125°C	80			
		R_L = 2 kΩ to 1.35 V, V_O = 1.35 V to 2.2 V	Sourcing	25°C	95	100		
				–40°C to 125°C	90			
		R_L = 2 kΩ to 1.35 V, V_O = 1.35 V to 0.5 V	Sinking	25°C	90	95		
				–40°C to 125°C	85			
V_O	Output swing	V_{CC+} = 2.7 V, R_L = 600 Ω to 1.35 V	High level	25°C	2.5	2.58		V
				–40°C to 125°C	2.4			
			Low level	25°C		0.13	0.2	
				–40°C to 125°C			0.3	
		V_{CC+} = 2.7 V, R_L = 2 kΩ to 1.35 V	High level	25°C	2.6	2.66		
				–40°C to 125°C	2.5			
			Low level	25°C		0.08	0.12	
				–40°C to 125°C			0.2	
I_O	Output current	V_O = 0 V	Sourcing	25°C	12	16		mA
		V_O = 2.7 V	Sinking	25°C	12	26		
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	
				–40°C to 125°C			1.2	

2.7-V ELECTRICAL CHARACTERISTICS (continued)

V_{CC+} = 2.7 V, V_{CC-} = 0 V, V_{IC} = 1 V, V_O = 1.35 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
SR	Slew rate[1]		25°C		1.7		V/µs
GBW	Gain bandwidth product	[2]	25°C		5		MHz
Φ_m	Phase margin	[2]	25°C		60		deg
	Gain margin	[2]	25°C		8.6		dB
	Amplifier-to-amplifier isolation	V_{CC+} = 5 V, R_L = 100 kΩ to 2.5 V[3]	25°C		135		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 1 V	25°C		45		nV/√Hz
I_n	Equivalent input noise current	f = 1 kHz	25°C		0.18		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, A_V = –2, R_L = 10 kΩ, V_O = 4.1 V_{p-p}	25°C		0.01		%

(1) Connected as voltage follower with 1-V step input. Value specified is the slower of the positive and negative slew rates.
(2) 40-dB closed-loop dc gain, C_L = 22 pF
(3) Each amplifier excited in turn with 1 kHz to produce V_O = 3 V_{p-p}

5-V ELECTRICAL CHARACTERISTICS

V_{CC+} = 5 V, V_{CC-} = 0 V, V_{IC} = 2 V, V_O = 2.5 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage			25°C		1	6	mV
				–40°C to 125°C			6	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C		1		μV/°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			
$+k_{SVR}$	Positive supply-voltage rejection ratio	V_{CC+} = 1.7 V to 4 V, V_{CC-} = –1 V, V_O = 0, V_{IC} = 0		25°C	75	85		dB
				–40°C to 125°C	70			
$-k_{SVR}$	Negative supply-voltage rejection ratio	V_{CC+} = 1.7 V, V_{CC-} = –1 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 4.2	–0.3 to 4.3		V
A_V	Large-signal voltage amplification	R_L = 600 Ω to 2.5 V, V_O = 2.5 V to 4.5 V	Sourcing	25°C	95	105		dB
				–40°C to 125°C	90			
		R_L = 600 Ω to 2.5 V, V_O = 2.5 V to 0.5 V	Sinking	25°C	95	105		
				–40°C to 125°C	90			
		R_L = 2 kΩ to 2.5 V, V_O = 2.5 V to 4.5 V	Sourcing	25°C	95	105		
				–40°C to 125°C	90			
		R_L = 2 kΩ to 2.5 V, V_O = 2.5 V to 0.5 V	Sinking	25°C	95	105		
				–40°C to 125°C	90			
V_O	Output swing	V_{CC+} = 5 V, R_L = 600 Ω to 2.5 V	High level	25°C	4.75	4.84		V
				–40°C to 125°C	4.6			
			Low level	25°C		0.17	0.25	
				–40°C to 125°C			0.3	
		V_{CC+} = 5 V, R_L = 2 kΩ to 2.5 V	High level	25°C	4.85	4.9		
				–40°C to 125°C	4.8			
			Low level	25°C		0.1	0.15	
				–40°C to 125°C			0.2	
I_O	Output current	V_O = 0 V	Sourcing	25°C	20	45		mA
				–40°C to 125°C	15			
		V_O = 5 V	Sinking	25°C	20	40		
				–40°C to 125°C	15			
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	

5-V ELECTRICAL CHARACTERISTICS (continued)

V_{CC+} = 5 V, V_{CC-} = 0 V, V_{IC} = 2 V, V_O = 2.5 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
SR	Slew rate	V_{CC+} = 5 V(1)	25°C	1.4	1.9		V/µs
GBW	Gain bandwidth product	(2)	25°C		5.5		MHz
Φ_m	Phase margin	(2)	25°C		64.2		deg
	Gain margin	(2)	25°C		8.7		dB
	Amplifier-to-amplifier isolation	V_{CC+} = 5 V, R_L = 100 kΩ to 2.5 V(3)	25°C		135		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 1 V	25°C		42		nV/√Hz
I_n	Equivalent input noise current	f = 1 kHz	25°C		0.2		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, A_V = –2, R_L = 10 kΩ, V_O = 4.1 V_{p-p}	25°C		0.01		%

(1) Connected as voltage follower with 3-V step input. Value specified is the slower of the positive and negative slew rates.
(2) 40-dB closed-loop dc gain, C_L = 22 pF
(3) Each amplifier excited in turn with 1 kHz to produce V_O = 3 V_{p-p}

TYPICAL CHARACTERISTICS

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

SUPPLY CURRENT vs SUPPLY VOLTAGE

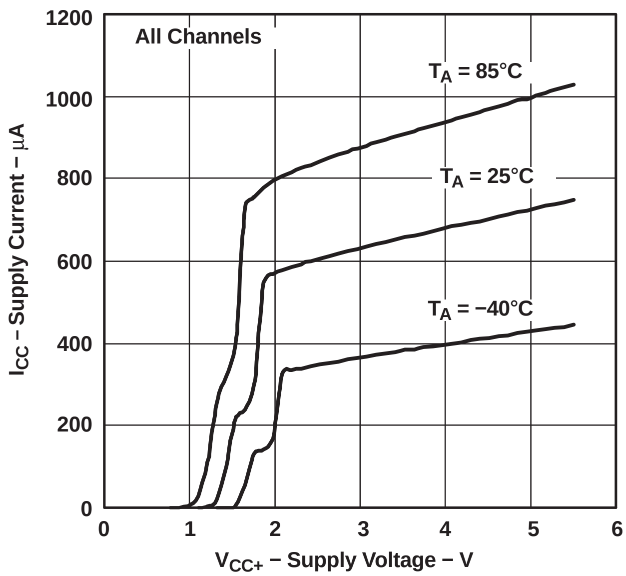


Figure 1.

INPUT CURRENT vs TEMPERATURE

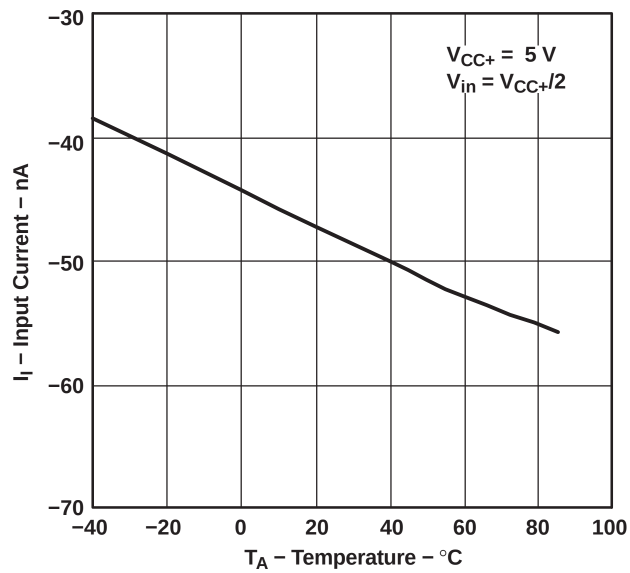


Figure 2.

SOURCING CURRENT vs OUTPUT VOLTAGE

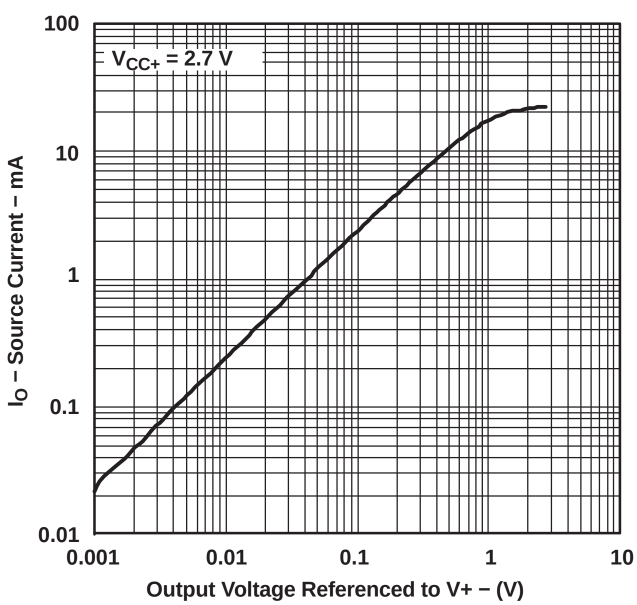


Figure 3.

SOURCING CURRENT vs OUTPUT VOLTAGE

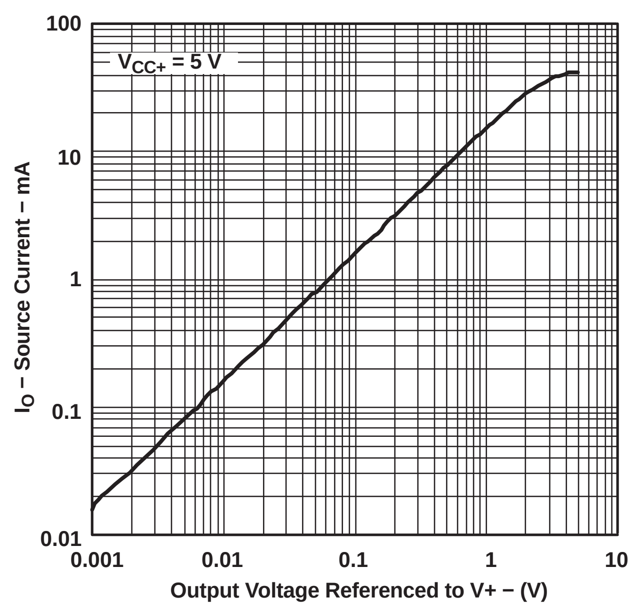


Figure 4.

TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

SINKING CURRENT vs OUTPUT VOLTAGE

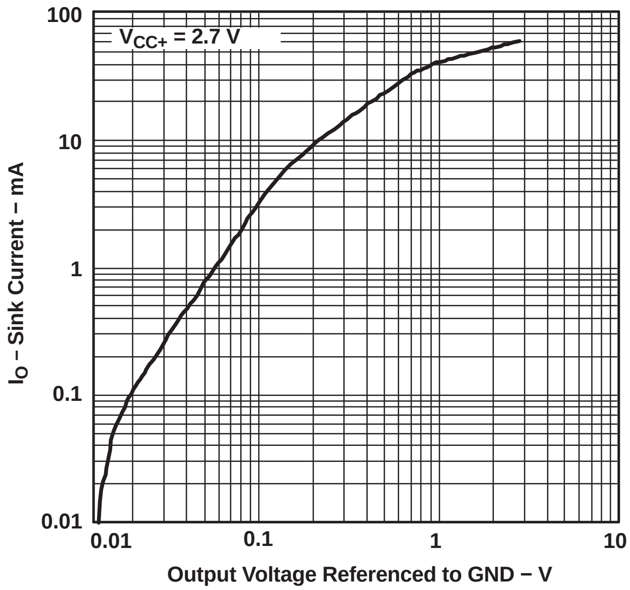


Figure 5.

SINKING CURRENT vs OUTPUT VOLTAGE

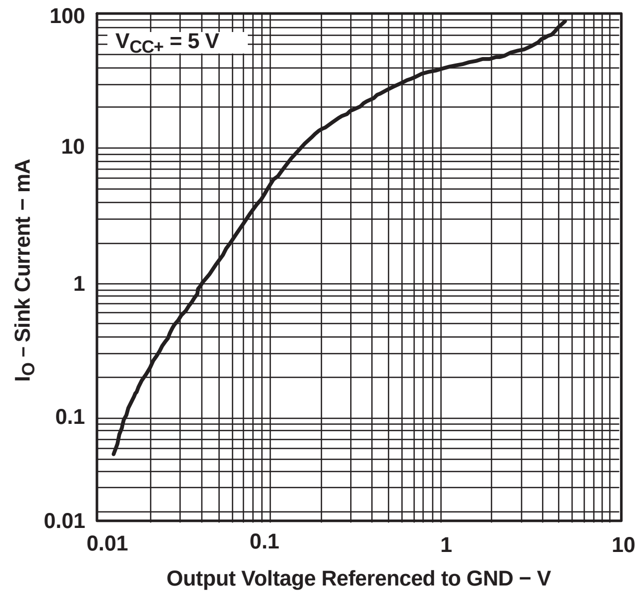


Figure 6.

OUTPUT VOLTAGE SWING vs SUPPLY VOLTAGE

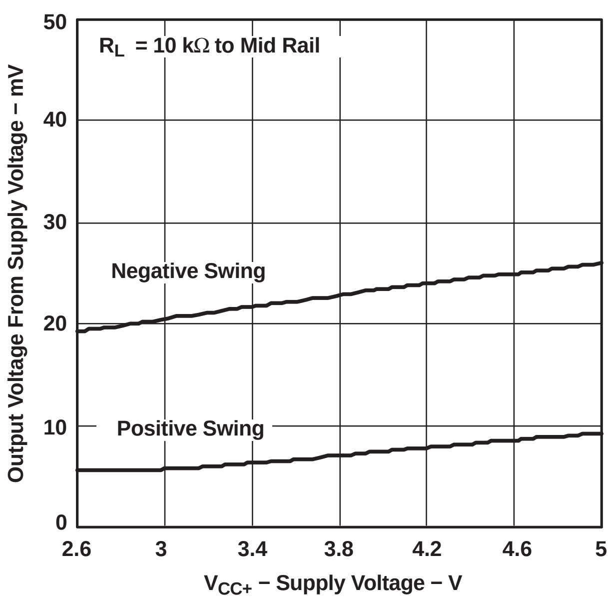


Figure 7.

OUTPUT VOLTAGE SWING vs SUPPLY VOLTAGE

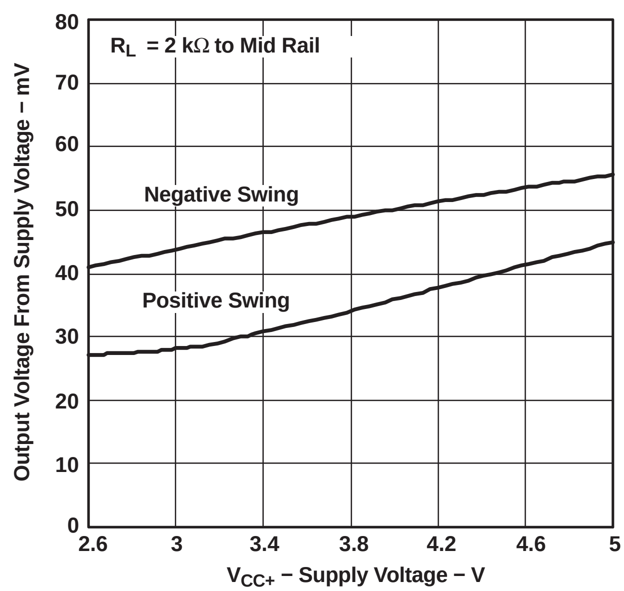


Figure 8.

TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

OUTPUT VOLTAGE SWING vs SUPPLY VOLTAGE

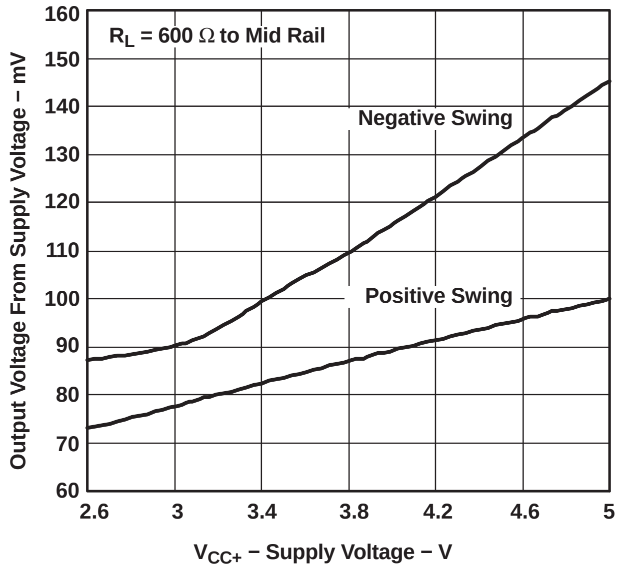


Figure 9.

OUTPUT VOLTAGE SWING vs LOAD RESISTANCE

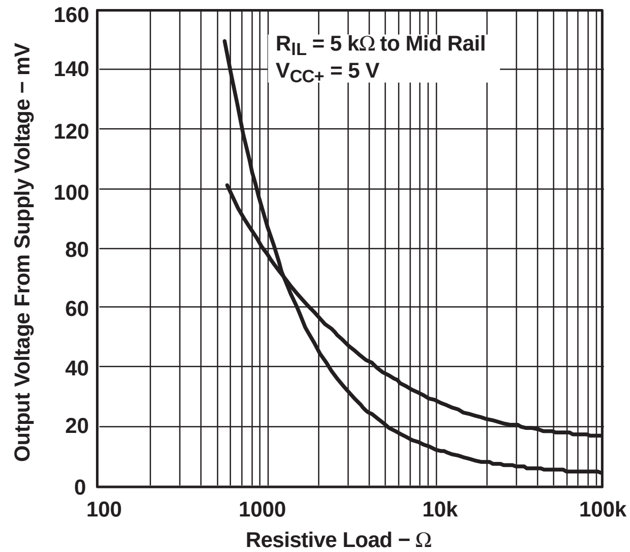


Figure 10.

CROSSTALK REJECTION vs FREQUENCY

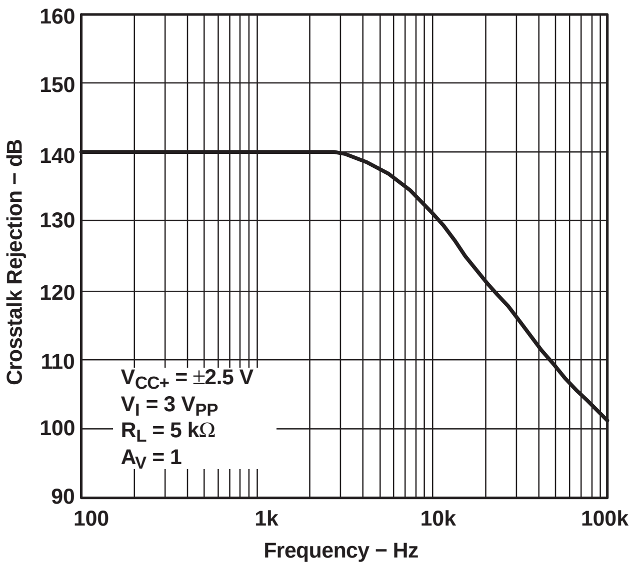


Figure 11.

+PSRR vs FREQUENCY

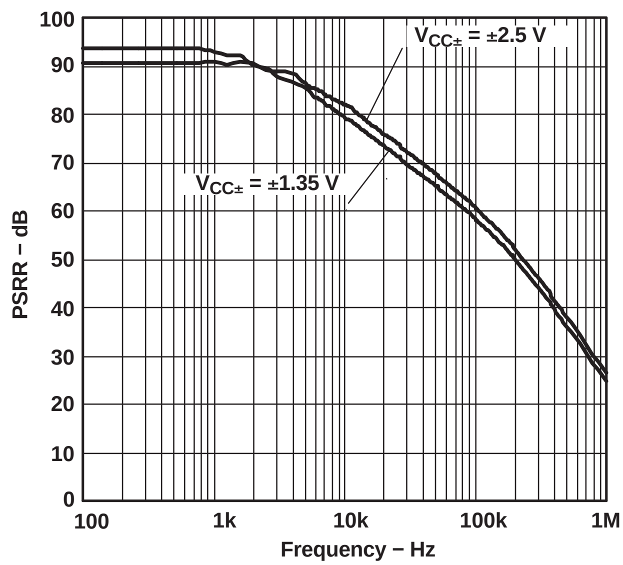


Figure 12.

TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

–PSRR vs FREQUENCY

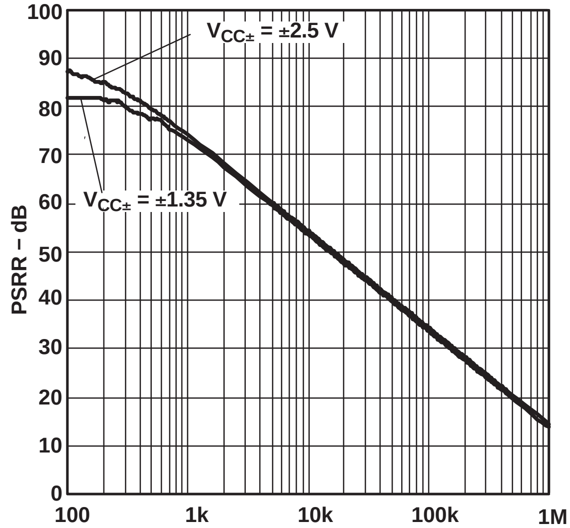


Figure 13.

GAIN AND PHASE MARGIN vs FREQUENCY (V_{CC+} = 2.7 V, R_L = 600 Ω, 2 kΩ, 100 kΩ)

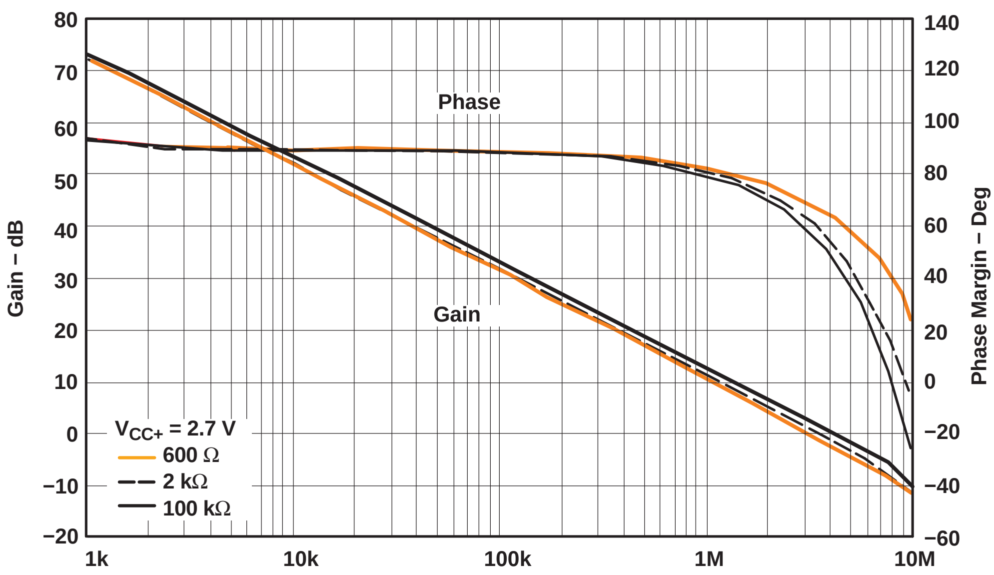


Figure 14.

TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

GAIN AND PHASE MARGIN vs FREQUENCY (V_{CC+} = 5 V, R_L = 600 Ω, 2 kΩ, 100 kΩ)

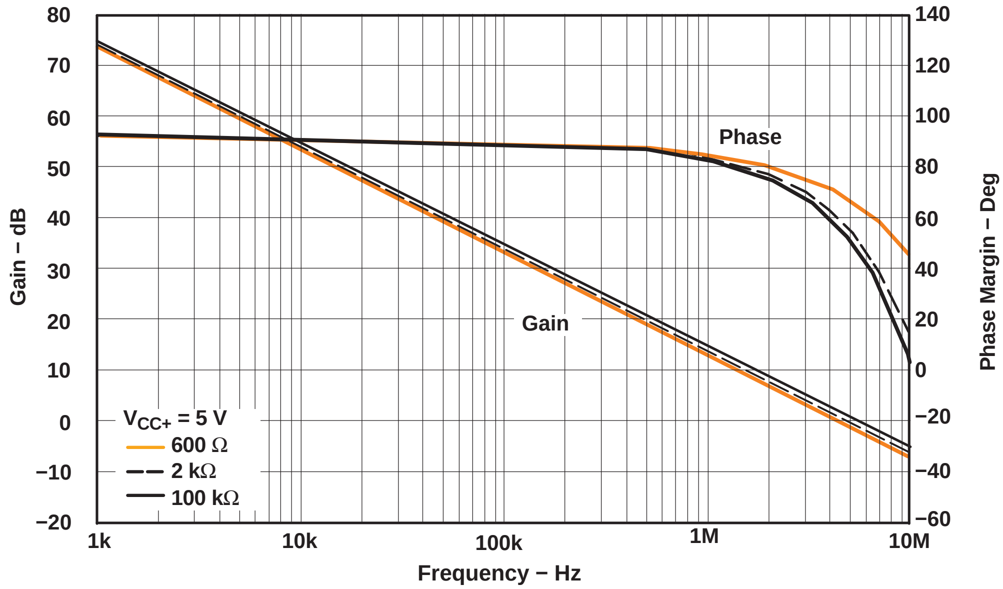


Figure 15.

GAIN AND PHASE MARGIN vs FREQUENCY (V_{CC+} = 2.7 V, R_L = 10 kΩ, C_L = 22 pF, 100 pF, 200 pF)

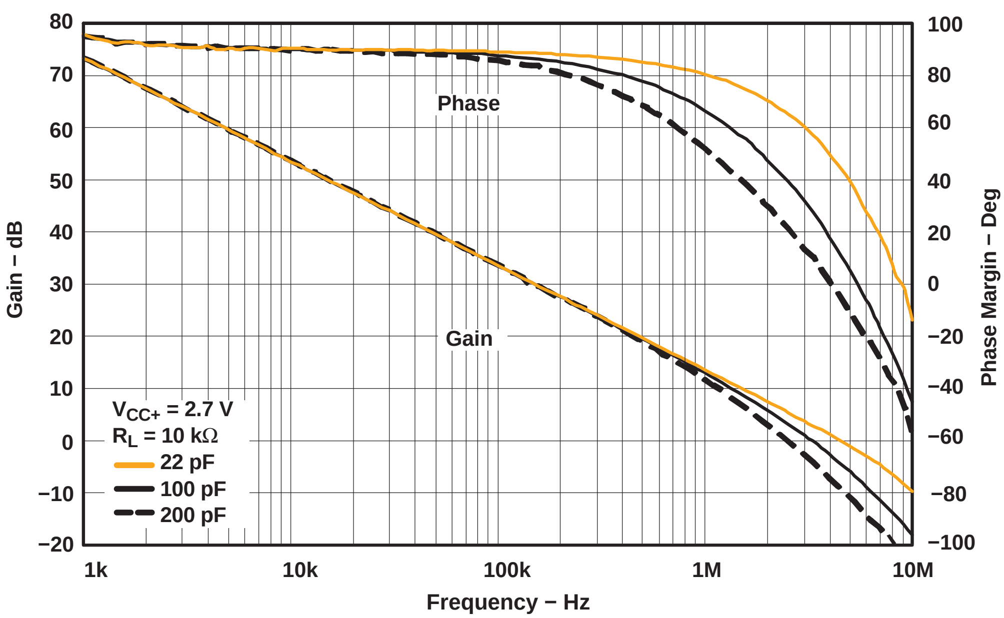


Figure 16.

TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

GAIN AND PHASE MARGIN vs FREQUENCY (V_{CC+} = 5 V, R_L = 10 kΩ, C_L = 22 pF, 100 pF, 200 pF)

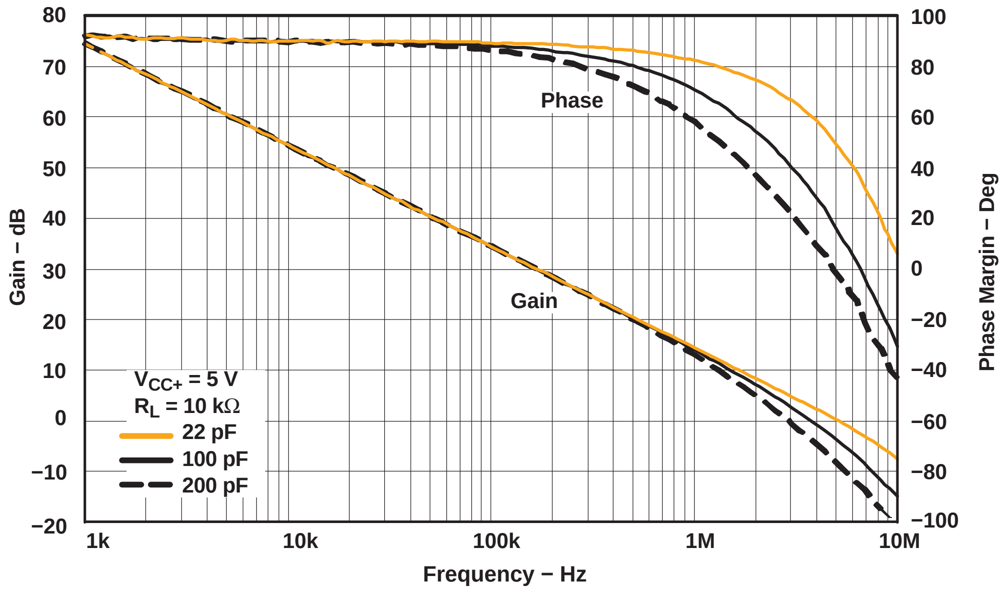


Figure 17.

GAIN AND PHASE MARGIN vs FREQUENCY (V_{CC+} = 2.7 V, R_L = 600 Ω, C_L = 22 pF, 100 pF, 200 pF)

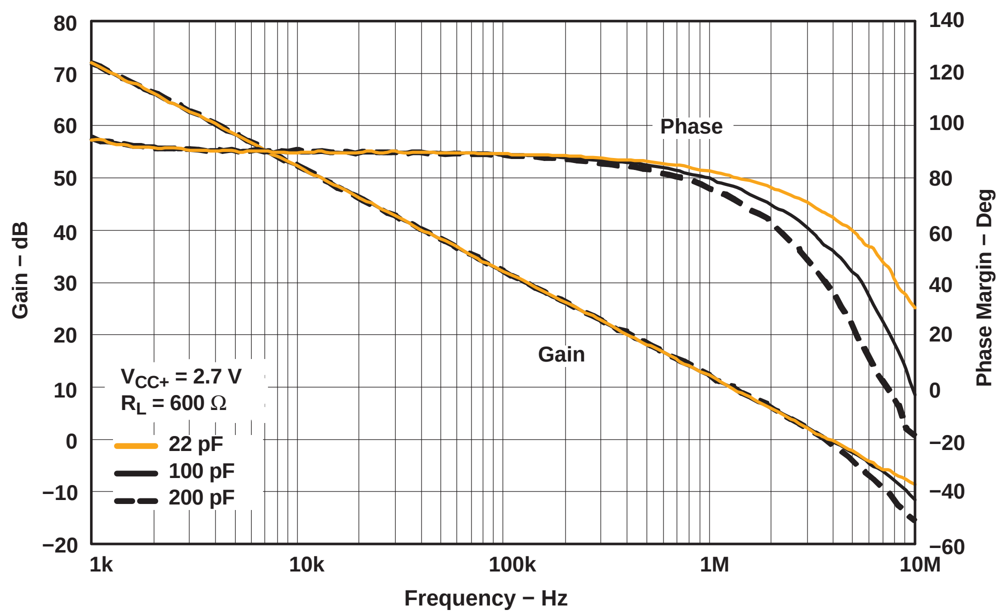


Figure 18.

TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_{CC+} = 5-V single supply (unless otherwise noted)

GAIN AND PHASE MARGIN
vs
FREQUENCY
(V_{CC+} = 5 V, R_L = 600 Ω, C_L = 22 pF, 100 pF, 200 pF)

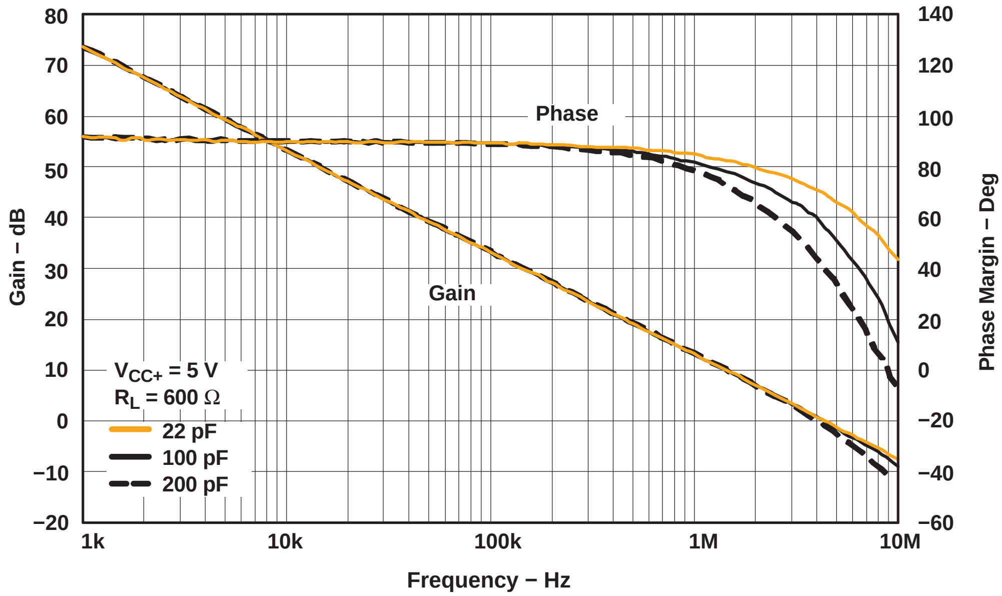


Figure 19.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LMV821QDBVRQ1	OBSOLETE	SOT-23	DBV	5		TBD	Call TI	Call TI	

(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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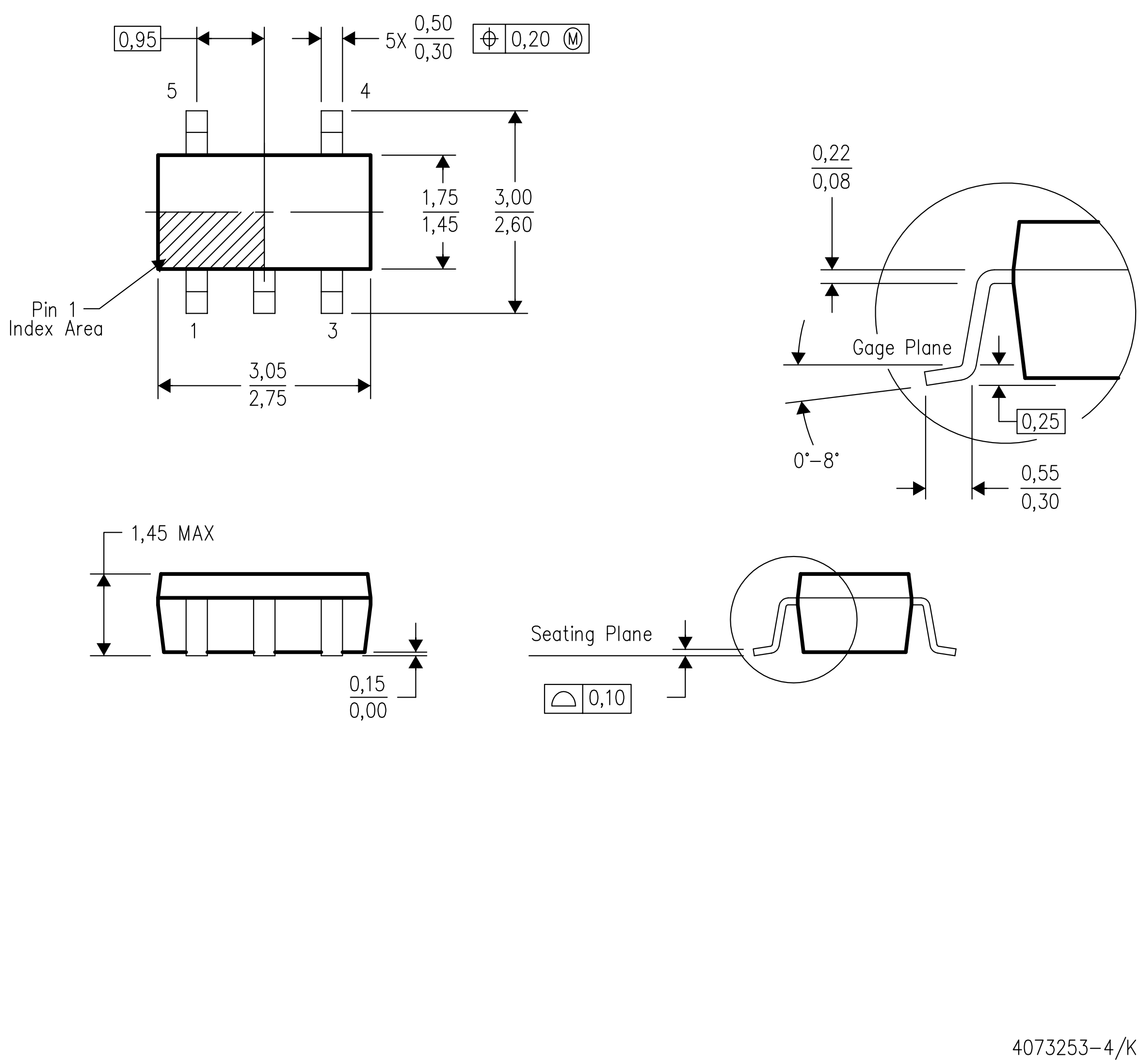
OTHER QUALIFIED VERSIONS OF LMV821-Q1 :

- Catalog: LMV821

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

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.

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