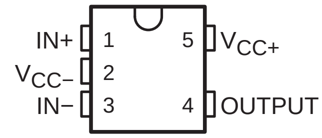
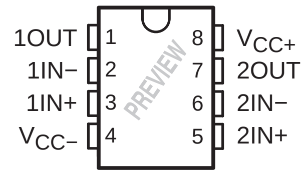
- **Qualified for Automotive Applications**
- **1.8-V, 2.7-V, and 5-V Specifications**
- **Rail-to-Rail Output Swing**
  - **600-Ω Load . . . 80 mV From Rail**
  - **2-kΩ Load . . . 30 mV From Rail**
- **V_{ICR} . . . 200 mV Beyond Rails**
- **Gain Bandwidth . . . 1.4 MHz**
- **Supply Current . . . 100 μA/Amplifier**
- **Max V_{IO} . . . 4 mV**
- **Space-Saving Packages**
  - **LMV931: SOT-23 and SC-70**
  - **LMV932: MSOP and SOIC**
  - **LMV934: SOIC and TSSOP**
- **Applications**
  - **Industrial (Utility/Energy Metering)**
  - **Automotive**
  - **Communications (Optical Telecom, Data/Voice Cable Modems)**
  - **Consumer Electronics (PDAs, PCs, CDR/W, Portable Audio)**
  - **Supply-Current Monitoring**
  - **Battery Monitoring**

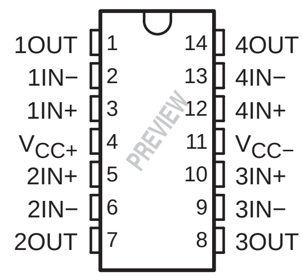
LMV931 . . . DBV (SOT23-5) OR DCK (SC-70) PACKAGE
(TOP VIEW)



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



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



description/ordering information

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

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

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.

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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description/ordering information (continued)

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

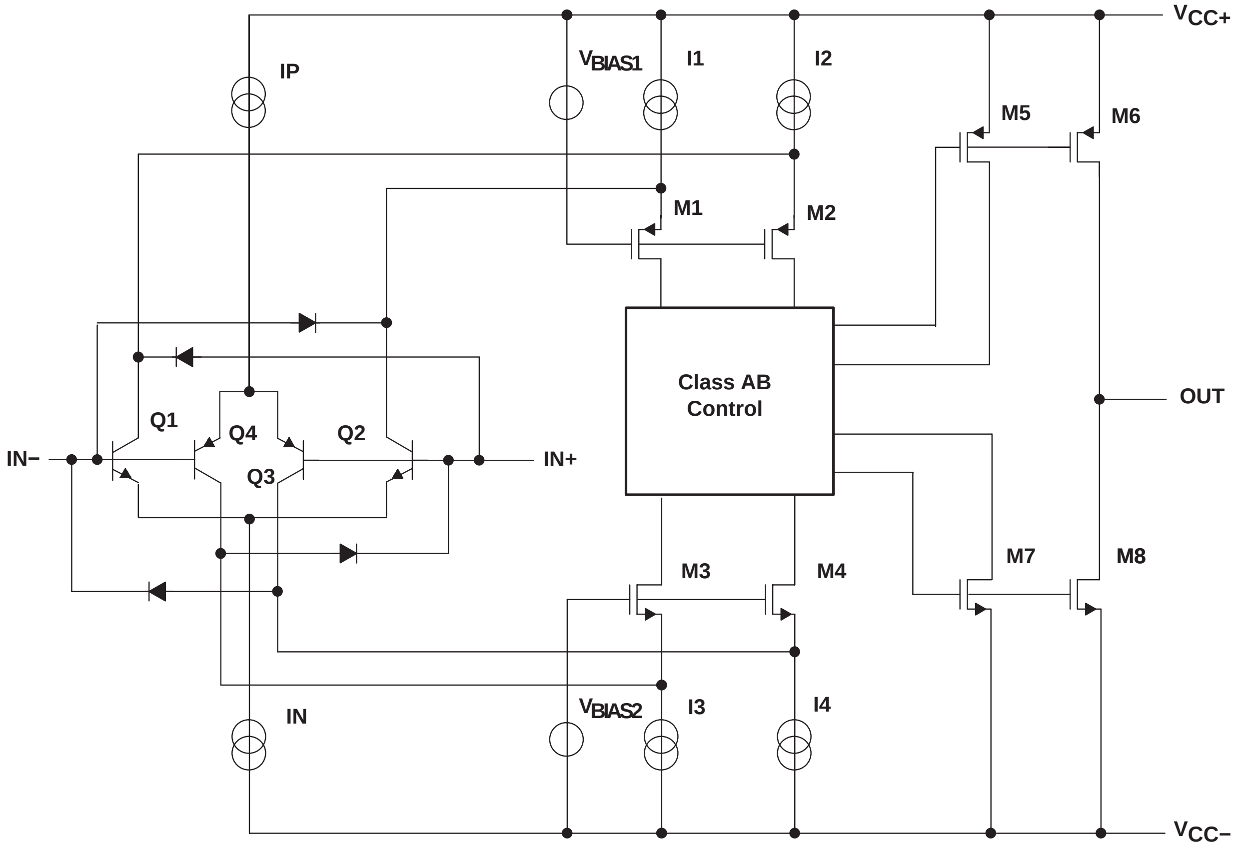
The LMV93x devices are characterized for operation from −40°C to 125°C, making the part universally suited for commercial, industrial, and automotive applications.

ORDERING INFORMATION†

T_A	PACKAGE‡			ORDERABLE PART NUMBER	TOP-SIDE MARKING§
−40°C to 125°C	Single	SOT-23 (DBV)	Reel of 3000	LMV931QDBVRQ1	RBB_
			Reel of 250	LMV931QDBVTQ1	PREVIEW
		SC-70 (DCK)	Reel of 3000	LMV931QDCKRQ1	RB_
			Reel of 250	LMV931QDCKTQ1	PREVIEW
	Dual	MSOP/VSSOP (DGK)	Reel of 2500	LMV932QDGKRQ1	PREVIEW
			Reel of 250	LMV932QDGKTQ1	
		SOIC (D)	Tube of 75	LMV932QDQ1	PREVIEW
			Reel of 2500	LMV932QDRQ1	
	Quad	SOIC (D)	Tube of 50	LMV934QDQ1	PREVIEW
			Reel of 2500	LMV934QDRQ1	
		TSSOP (PW)	Tube of 90	LMV934QPWQ1	PREVIEW
			Reel of 2000	LMV934QPWRQ1	

† 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 http://www.ti.com.
‡ Package drawings, thermal data, and symbolization are available at http://www.ti.com/packaging.
§ DBV/DCK/DGK: The actual top-side marking has one additional character that designates the assembly/test site.

simplified schematic



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

Supply voltage, $V_{CC+} - V_{CC-}$ (see Note 1) . . . . 5.5 V
Differential input voltage, V_{ID} (see Note 2) . . . . Supply voltage
Input voltage range, V_I (either input) . . . . V_{CC-} − 0.2 V to V_{CC+} + 0.2 V
Duration of output short circuit (one amplifier) to $V_{CC}\pm$ (see Notes 3 and 4) . . . . Unlimited
Package thermal impedance, θ_{JA} (see Notes 4 and 5): D package (8 pin) . . . . 97°C/W
D package (14 pin) . . . . 86°C/W
DBV package . . . . 206°C/W
DCK package . . . . 252°C/W
DGK package . . . . 172°C/W
PW package . . . . 113°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. Applies to both single-supply and split-supply operation. Continuous short-circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of 45 mA over long term may adversely affect reliability.
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 $P_D = (T_J(max) - T_A)/\theta_{JA}$. 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_{CC}	Supply voltage ($V_{CC+} - V_{CC-}$)	1.8	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

electrical characteristics at T_A = 25°C, V_{CC+} = 1.8 V, V_{CC-} = 0 V, $V_{IC} = V_{CC+}/2$, $V_O = V_{CC+}/2$, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER			TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		LMV931 (single)	25°C		1	4	mV
				Full range			6	
			LMV932 (dual), LMV934 (quad)	25°C		1	5.5	
				Full range			7.5	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C		5.5		μV/°C
I_{IB}	Input bias current		$V_{IC} = V_{CC+} - 0.8$ V	25°C		15	35	nA
				25°C			65	
				Full range			75	
I_{IO}	Input offset current			25°C		13	25	nA
				Full range			40	
I_{CC}	Supply current (per channel)			25°C		103	185	μA
				Full range			205	
CMRR	Common-mode rejection ratio		$0 \le V_{IC} \le 0.6$ V, $1.4\ V \le V_{IC} \le 1.8$ V	25°C	60	78		dB
				−40°C to 85°C	55			
			$0.2\ V \le V_{IC} \le 0.6$ V, $1.4\ V \le V_{IC} \le 1.6$ V	−40°C to 125°C	55			
			$-0.2\ V \le V_{IC} \le 0$ V, $1.8\ V \le V_{IC} \le 2$ V	25°C	50	72		
k_{SVR}	Supply-voltage rejection ratio		$1.8\ V \le V_{CC+} \le 5$ V, V_{IC} = 0.5 V	25°C	75	100		dB
				Full range	70			
V_{ICR}	Common-mode input voltage range		CMRR ≥ 50 dB	25°C	$V_{CC-} - 0.2$	−0.2 to 2.1	$V_{CC+} + 0.2$	V
				−40°C to 85°C	V_{CC-}		V_{CC+}	
				−40°C to 125°C	$V_{CC-} + 0.2$		$V_{CC+} - 0.2$	
A_V	Large-signal voltage gain	LMV931	R_L = 600 Ω to 0.9 V, V_O = 0.2 V to 1.6 V, V_{IC} = 0.5 V	25°C	77	101		dB
				Full range	73			
			R_L = 2 kΩ to 0.9 V, V_O = 0.2 V to 1.6 V, V_{IC} = 0.5 V	25°C	80	105		
				Full range	75			
		LMV932, LMV934	R_L = 600 Ω to 0.9 V, V_O = 0.2 V to 1.6 V, V_{IC} = 0.5 V	25°C	75	90		
				Full range	72			
			R_L = 2 kΩ to 0.9 V, V_O = 0.2 V to 1.6 V, V_{IC} = 0.5 V	25°C	78	100		
				Full range	75			

electrical characteristics at T_A = 25°C, V_{CC+} = 1.8 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)(continued)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_O	Output swing	R_L = 600 Ω to 0.9 V, V_{ID} = ±100 mV	High level	25°C	1.65	1.72		V
				Full range	1.63			
			Low level	25°C		0.077	0.105	
				Full range			0.120	
		R_L = 2 kΩ to 0.9 V, V_{ID} = ±100 mV	High level	25°C	1.75	1.77		
				Full range	1.74			
			Low level	25°C		0.024	0.035	
				Full range			0.04	
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	25°C	4	8		mA
				Full range	3.3			
		V_O = 1.8 V, V_{ID} = −100 mV	Sinking	25°C	7	9		
				Full range	5			
GBW	Gain bandwidth product			25°C		1.4		MHz
SR	Slew rate	See Note 6		25°C		0.35		V/μS
Φ_m	Phase margin			25°C		67		°
	Gain margin			25°C		7		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 0.5 V		25°C		60		nV/$\sqrt{Hz}$
I_n	Equivalent input noise current	f = 1 kHz		25°C		0.06		pA/$\sqrt{Hz}$
THD	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 600 Ω, V_{ID} = 1 V_{p-p}		25°C		0.023		%
	Amp-to-amp isolation	See Note 7		25°C		123		dB

NOTES: 6. Number specified is the slower of the positive and negative slew rates.
7. Input referred, V_{CC+} = 5 V and R_L = 100 kΩ connected to 2.5 V. Each amp is excited, in turn, with a 1-kHz signal to produce V_O = 3 V_{p-p}.

electrical characteristics at T_A = 25°C, V_{CC+} = 2.7 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER			TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		LMV931 (single)	25°C		1	4	mV
				Full range			6	
			LMV932 (dual), LMV934 (quad)	25°C		1	5.5	
				Full range			7.5	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C		5.5		μV/°C
I_{IB}	Input bias current		$V_{IC} = V_{CC+} - 0.8$ V	25°C		15	35	nA
				25°C			65	
				Full range			75	
I_{IO}	Input offset current			25°C		8	25	nA
				Full range			40	
I_{CC}	Supply current (per channel)			25°C		105	190	μA
				Full range			210	
CMRR	Common-mode rejection ratio		$0 \le V_{IC} \le 1.5$ V, $2.3\text{ V} \le V_{IC} \le 2.7$ V	25°C	60	81		dB
				−40°C to 85°C	55			
			$0.2 \le V_{IC} \le 1.5$ V, $2.3\text{ V} \le V_{IC} \le 2.5$ V	−40°C to 125°C	55			
			$-0.2\text{ V} \le V_{IC} \le 0$ V, $2.7\text{ V} \le V_{IC} \le 2.9$ V	25°C	50	74		
k_{SVR}	Supply-voltage rejection ratio		$1.8\text{ V} \le V_{CC+} \le 5$ V, V_{IC} = 0.5 V	25°C	75	100		dB
				Full range	70			
V_{ICR}	Common-mode input voltage range		CMRR ≥ 50 dB	25°C	$V_{CC-} - 0.2$	−0.2 to 3.0	$V_{CC+} + 0.2$	V
				−40°C to 85°C	V_{CC-}		V_{CC+}	
				−40°C to 125°C	$V_{CC-} + 0.2$		$V_{CC+} - 0.2$	
A_V	Large-signal voltage gain	LMV931	R_L = 600 Ω to 1.35 V, V_O = 0.2 V to 2.5 V	25°C	87	104		dB
				Full range	86			
			R_L = 2 kΩ to 1.35 V, V_O = 0.2 V to 2.5 V	25°C	92	110		
				Full range	91			
		LMV932, LMV934	R_L = 600 Ω to 1.35 V, V_O = 0.2 V to 2.5 V	25°C	78	90		
				Full range	75			
			R_L = 2 kΩ to 1.35 V, V_O = 0.2 V to 2.5 V	25°C	81	100		
				Full range	78			

electrical characteristics at T_A = 25°C, V_{CC+} = 2.7 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_O	Output swing	R_L = 600 Ω to 1.35 V, V_{ID} = ±100 mV	High level	25°C	2.55	2.62		V
				Full range	2.53			
			Low level	25°C		0.083	0.11	
				Full range			0.13	
		R_L = 2 kΩ to 1.35 V, V_{ID} = ±100 mV	High level	25°C	2.65	2.675		
				Full range	2.64			
			Low level	25°C		0.025	0.04	
				Full range			0.045	
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	25°C	20	30		mA
				Full range	15			
		V_O = 2.7 V, V_{ID} = −100 mV	Sinking	25°C	18	25		
				Full range	12			
GBW	Gain bandwidth product			25°C		1.4		MHz
SR	Slew rate	See Note 6		25°C		0.4		V/μS
Φ_m	Phase margin			25°C		70		°
	Gain margin			25°C		7.5		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 0.5 V		25°C		57		nV/$\sqrt{Hz}$
I_n	Equivalent input noise current	f = 1 kHz		25°C		0.082		pA/$\sqrt{Hz}$
THD	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 600 Ω, V_{ID} = 1 V_{p-p}		25°C		0.022		%
	Amp-to-amp isolation	See Note 7		25°C		123		dB

NOTES: 6. Number specified is the slower of the positive and negative slew rates.
7. Input referred, V_{CC+} = 5 V and R_L = 100 kΩ connected to 2.5 V. Each amp is excited, in turn, with a 1-kHz signal to produce V_O = 3 V_{p-p}.

electrical characteristics at T_A = 25°C, V_{CC+} = 5 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER			TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		LMV931 (single)	25°C		1	4	mV
				Full range			6	
			LMV932 (dual), LMV934 (quad)	25°C		1	5.5	
				Full range			7.5	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C		5.5		μV/°C
I_{IB}	Input bias current		V_{IC} = V_{CC+} − 0.8 V	25°C		15	35	nA
				25°C			65	
				Full range			75	
I_{IO}	Input offset current			25°C		9	25	nA
				Full range			40	
I_{CC}	Supply current (per channel)			25°C		116	210	μA
				Full range			230	
CMRR	Common-mode rejection ratio		0 ≤ V_{IC} ≤ 3.8 V, 4.6 V ≤ V_{IC} ≤ 5 V	25°C	60	86		dB
				−40°C to 85°C	55			
			0.3 ≤ V_{IC} ≤ 3.8 V, 4.6 V ≤ V_{IC} ≤ 4.7 V	−40°C to 125°C	55			
			−0.2 V ≤ V_{IC} ≤ 0 V, 5 V ≤ V_{IC} ≤ 5.2 V	25°C	50	78		
k_{SVR}	Supply-voltage rejection ratio		1.8 V ≤ V_{CC+} ≤ 5 V, V_{IC} = 0.5 V	25°C	75	100		dB
				Full range	70			
V_{ICR}	Common-mode input voltage range		CMRR ≥ 50 dB	25°C	V_{CC-} − 0.2	−0.2 to 5.3	V_{CC+} + 0.2	V
				−40°C to 85°C	V_{CC-}		V_{CC+}	
				−40°C to 125°C	V_{CC-} + 0.3		V_{CC+} − 0.3	
A_V	Large-signal voltage gain	LMV931	R_L = 600 Ω to 2.5 V, V_O = 0.2 V to 4.8 V	25°C	88	102		dB
				Full range	87			
			R_L = 2 kΩ to 2.5 V, V_O = 0.2 V to 4.8 V	25°C	94	113		
				Full range	93			
		LMV932, LMV934	R_L = 600 Ω to 2.5 V, V_O = 0.2 V to 4.8 V	25°C	81	90		
				Full range	78			
			R_L = 2 kΩ to 2.5 V, V_O = 0.2 V to 4.8 V	25°C	85	100		
				Full range	82			

electrical characteristics at T_A= 25°C, V_{CC+} = 5 V, V_{CC-} = 0 V, V_{IC} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_O	Output swing	R_L = 600 Ω to 2.5 V, V_{ID} = ±100 mV	High level	25°C	4.855	4.89		V
				Full range	4.835			
			Low level	25°C		0.12	0.16	
				Full range			0.18	
		R_L = 2 kΩ to 2.5 V, V_{ID} = ±100 mV	High level	25°C	4.945	4.967		
				Full range	4.935			
			Low level	25°C		0.037	0.065	
				Full range			0.075	
I_{OS}	Output short-circuit current	V_O = 0 V, V_{ID} = 100 mV	Sourcing	25°C	80	100		mA
				Full range	68			
		V_O = 5 V, V_{ID} = −100 mV	Sinking	25°C	58	65		
				Full range	45			
GBW	Gain bandwidth product			25°C		1.5		MHz
SR	Slew rate	See Note 6		25°C		0.42		V/μS
Φ_m	Phase margin			25°C		71		°
	Gain margin			25°C		8		dB
V_n	Equivalent input noise voltage	f = 1 kHz, V_{IC} = 1 V		25°C		50		$nV/\sqrt{Hz}$
I_n	Equivalent input noise current	f = 1 kHz		25°C		0.07		$pA/\sqrt{Hz}$
THD	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 600 Ω, V_{ID} = 1 V_{p-p}		25°C		0.022		%
	Amp-to-amp isolation	See Note 7		25°C		123		dB

NOTES: 6. Number specified is the slower of the positive and negative slew rates.

7. Input referred, V_{CC+} = 5 V and R_L = 100 kΩ connected to 2.5 V. Each amp is excited, in turn, with a 1-kHz signal to produce V_O = 3 V_{p-p}.

TYPICAL PERFORMANCE CHARACTERISTICS
Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

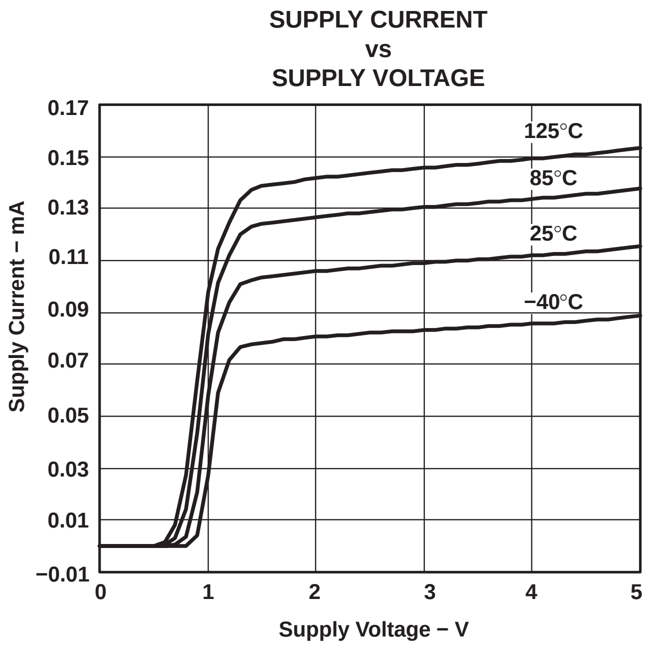


Figure 1

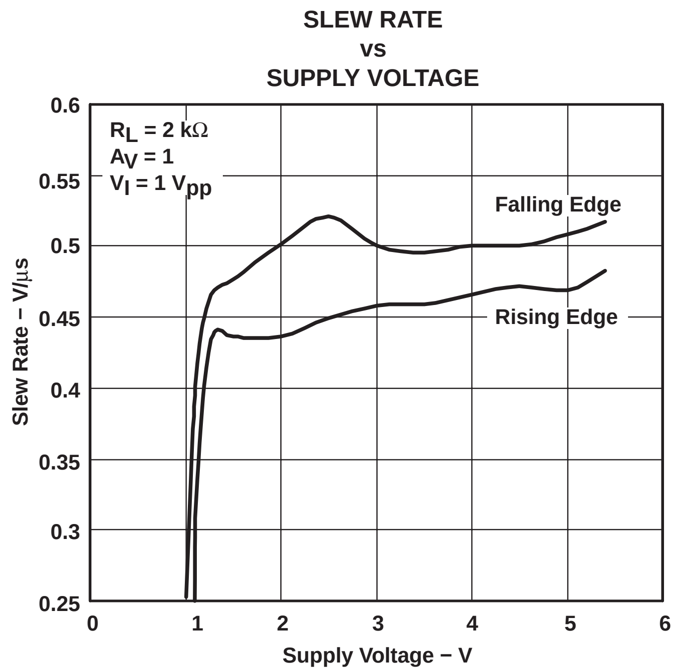


Figure 2

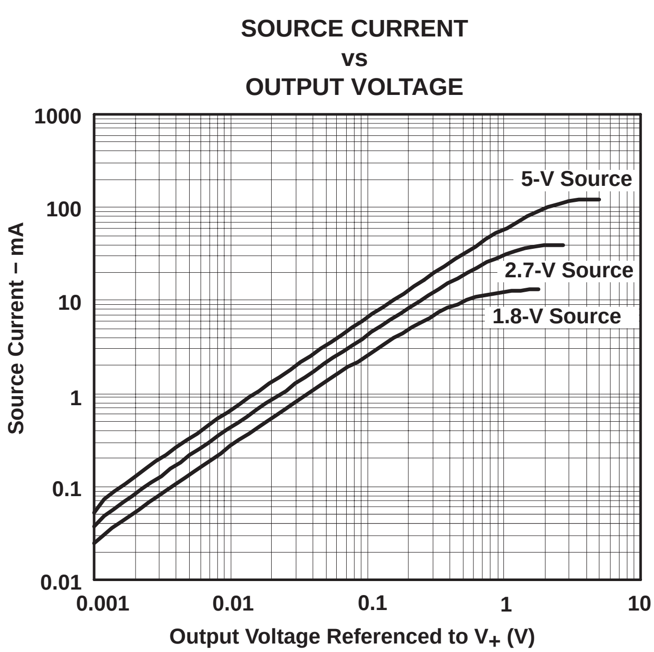


Figure 3

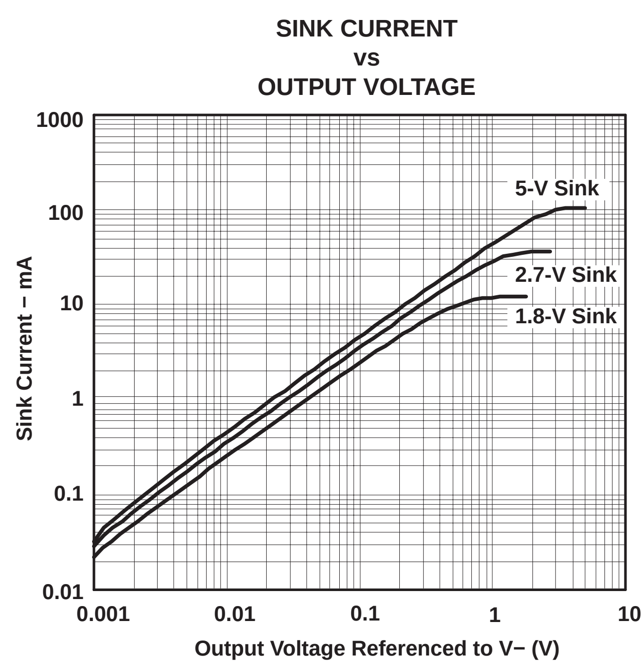


Figure 4

TYPICAL PERFORMANCE CHARACTERISTICS
Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

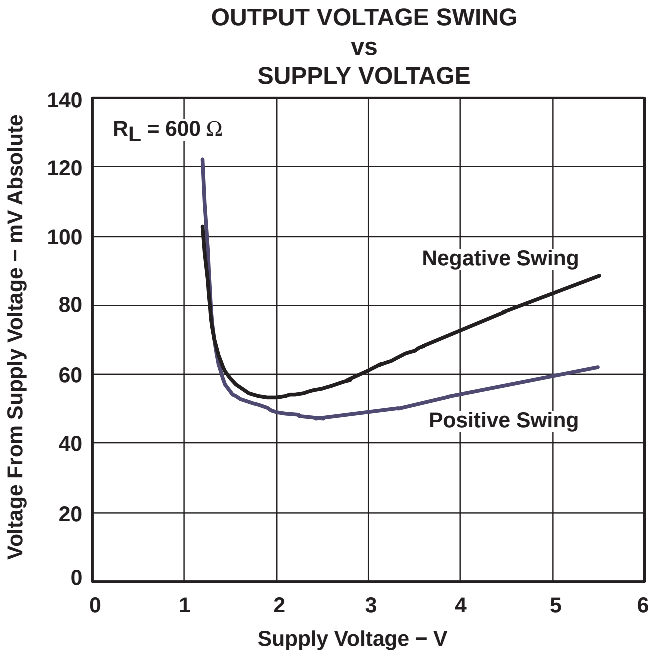


Figure 5

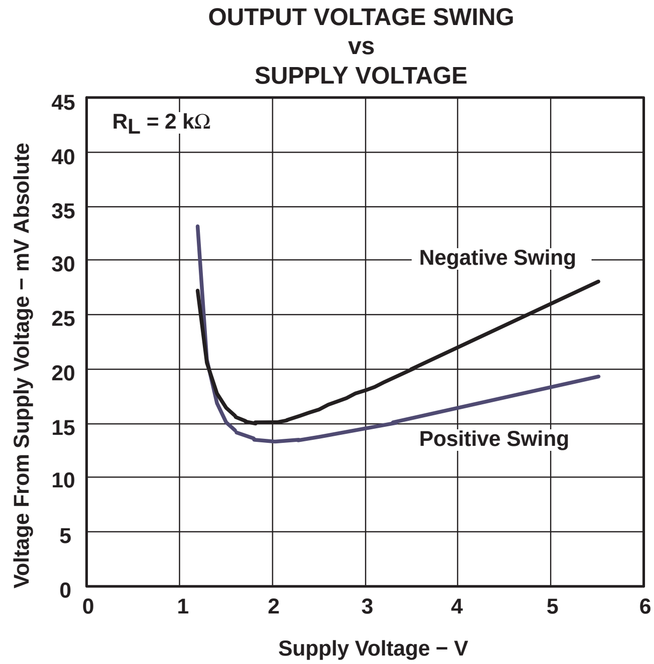


Figure 6

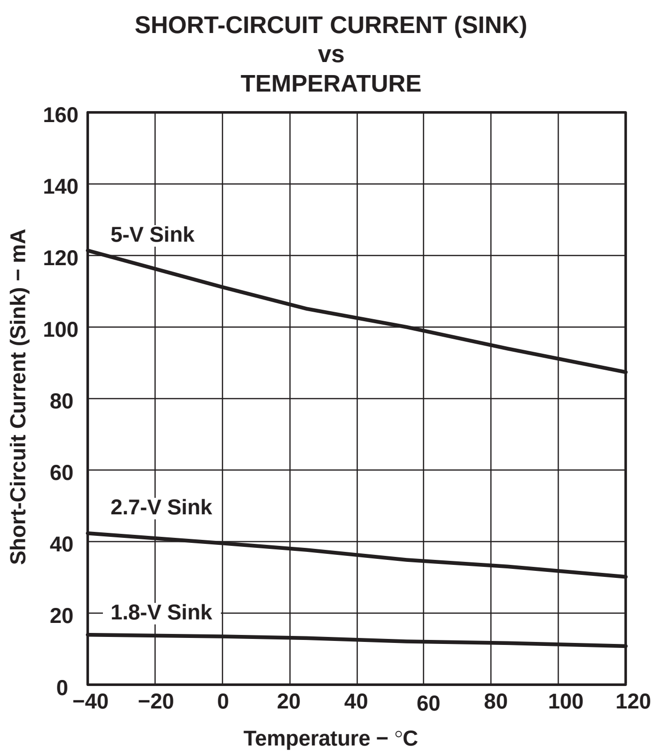


Figure 7

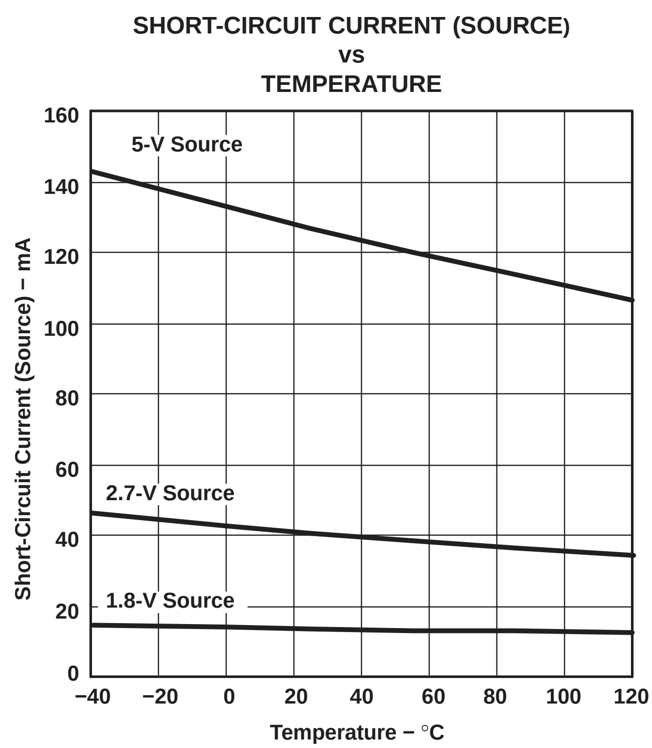


Figure 8

TYPICAL PERFORMANCE CHARACTERISTICS
Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

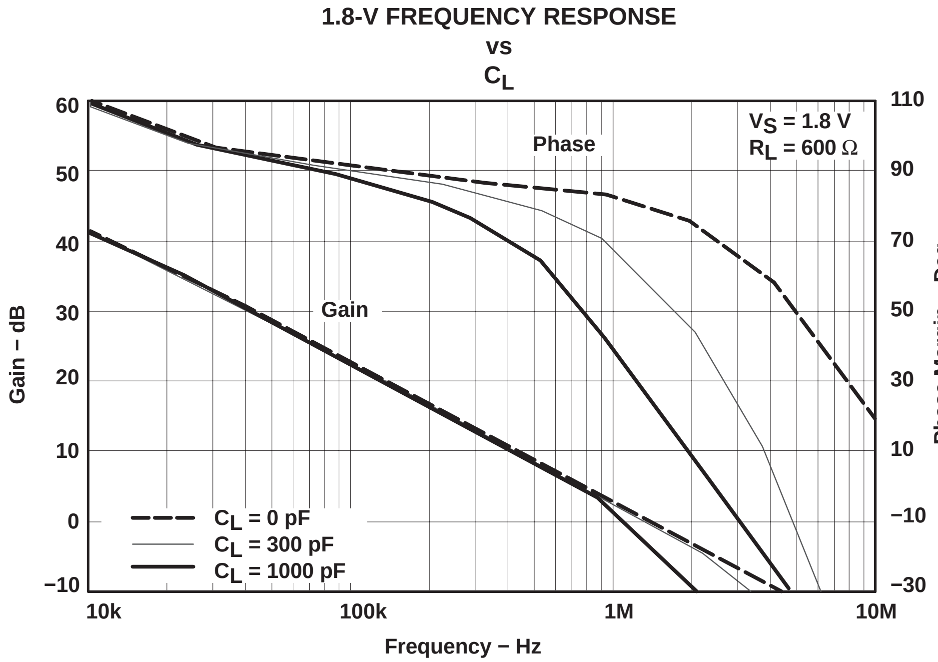


Figure 9

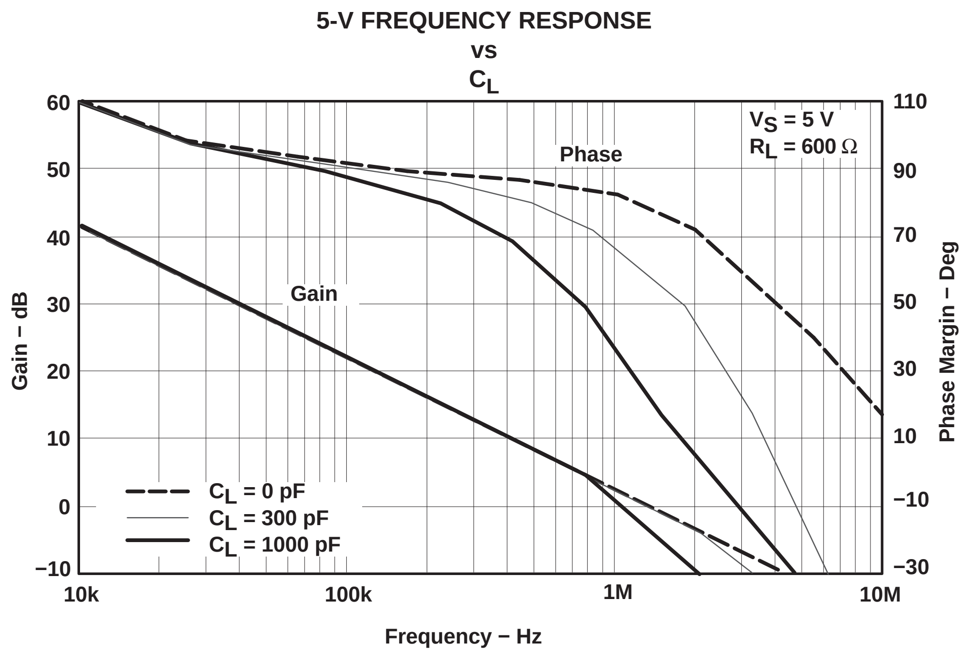
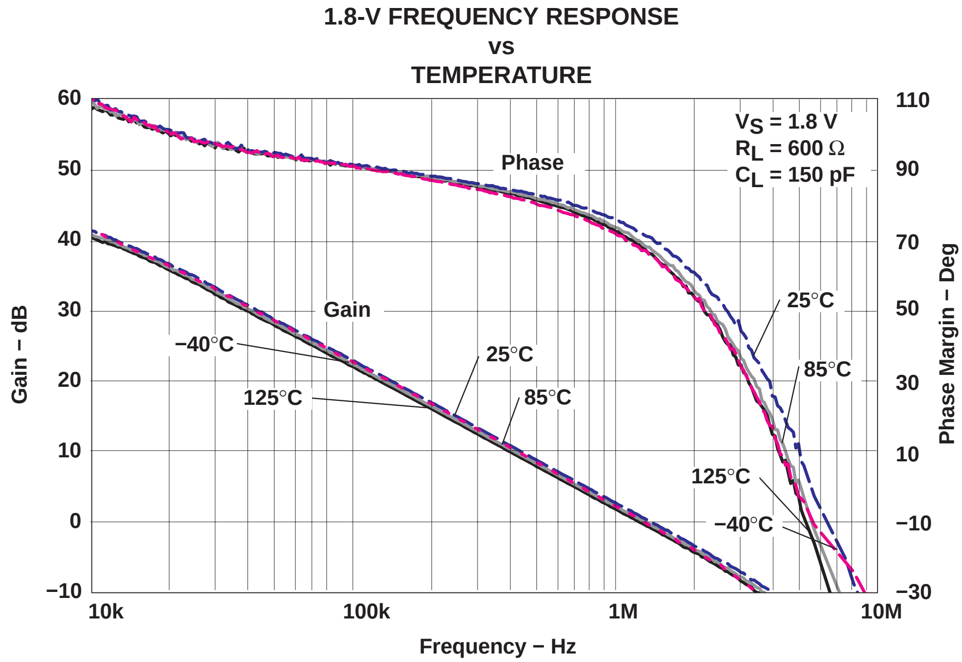


Figure 10

TYPICAL PERFORMANCE CHARACTERISTICS
Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C



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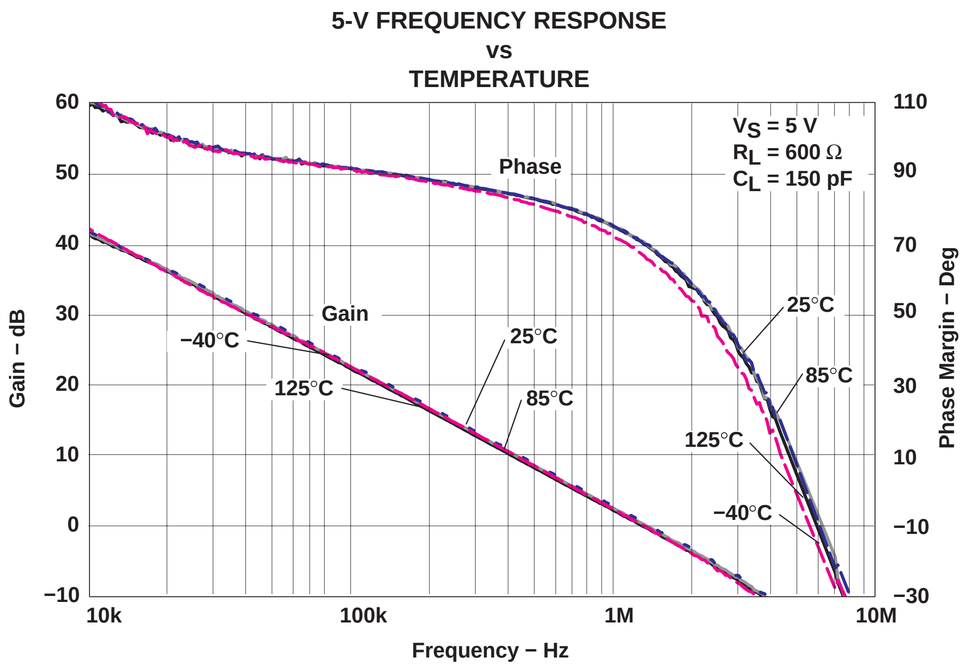

Figure 12

TYPICAL PERFORMANCE CHARACTERISTICS
Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

CMRR vs FREQUENCY

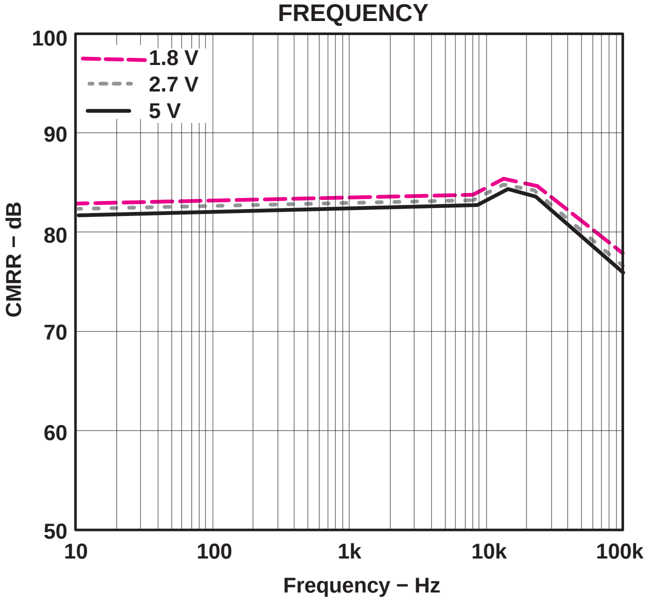

Figure 13

PSRR vs FREQUENCY

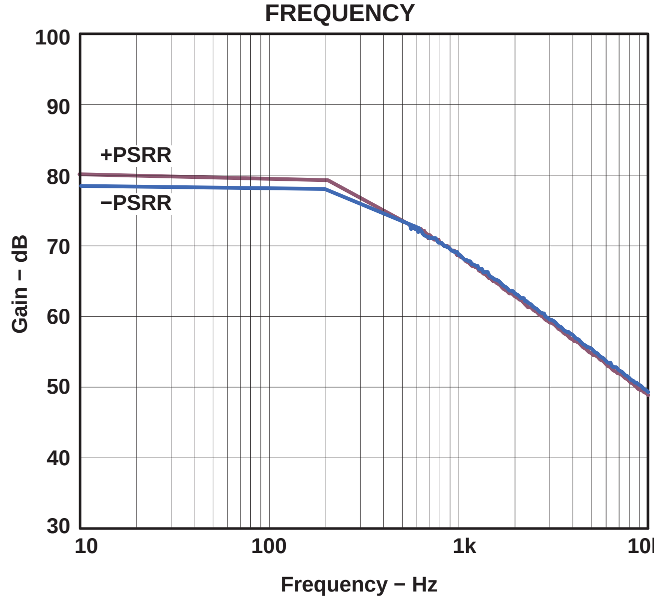

Figure 14

THD vs FREQUENCY

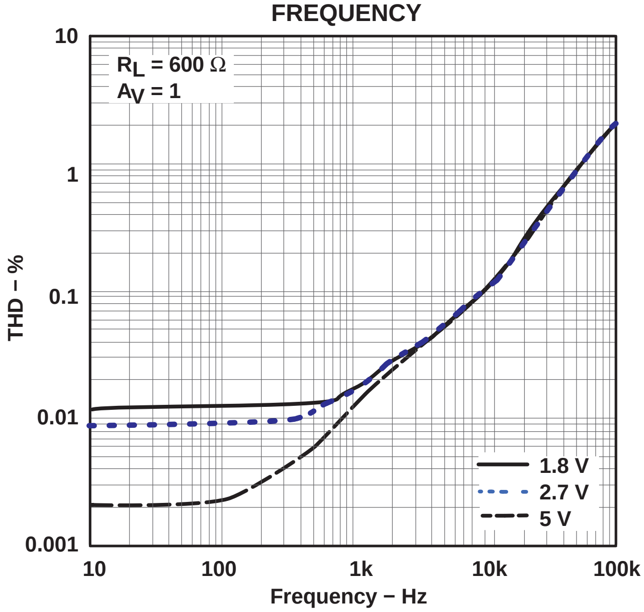

Figure 15

THD vs FREQUENCY

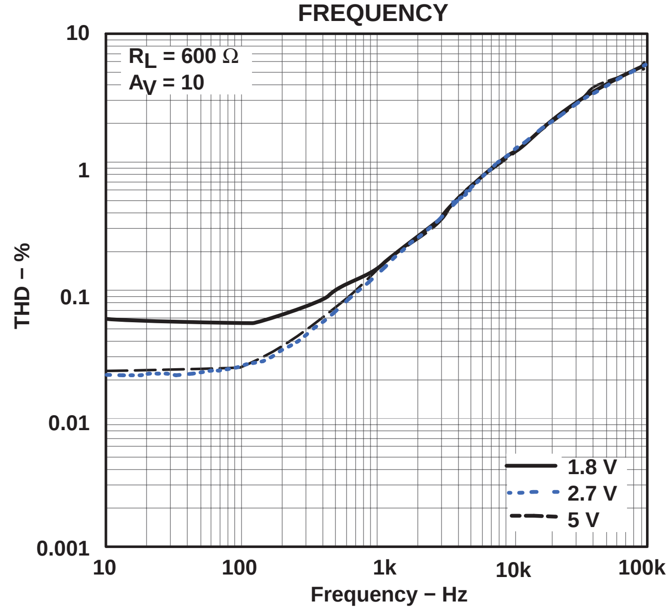

Figure 16

TYPICAL PERFORMANCE CHARACTERISTICS

Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

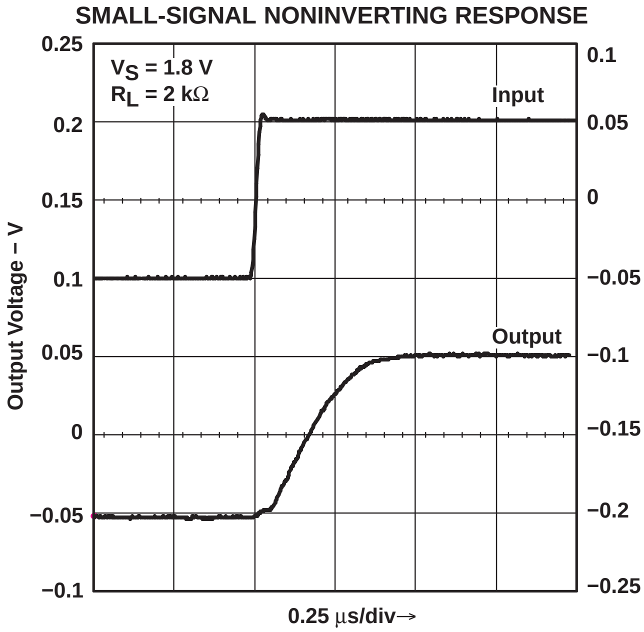

Figure 17

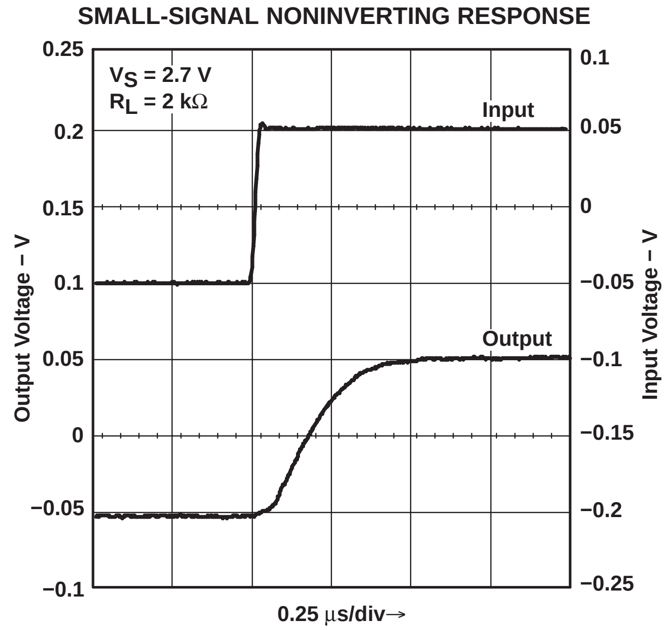

Figure 18

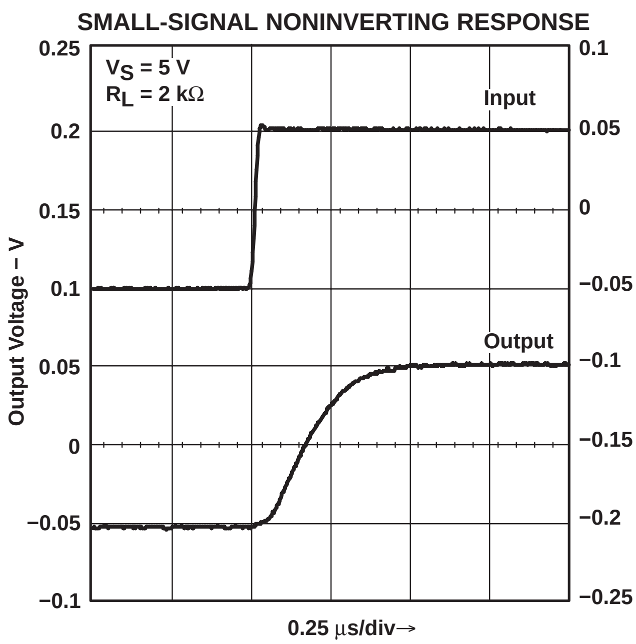

Figure 19

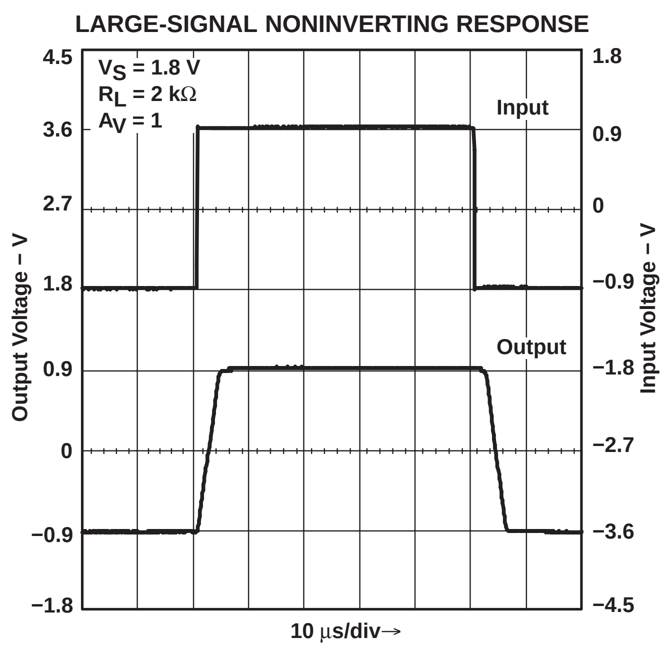

Figure 20

TYPICAL PERFORMANCE CHARACTERISTICS
Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

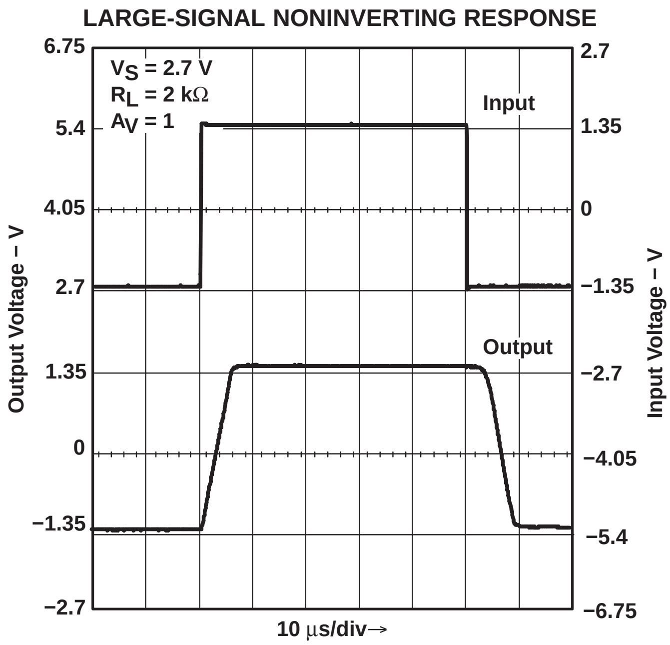

Figure 21

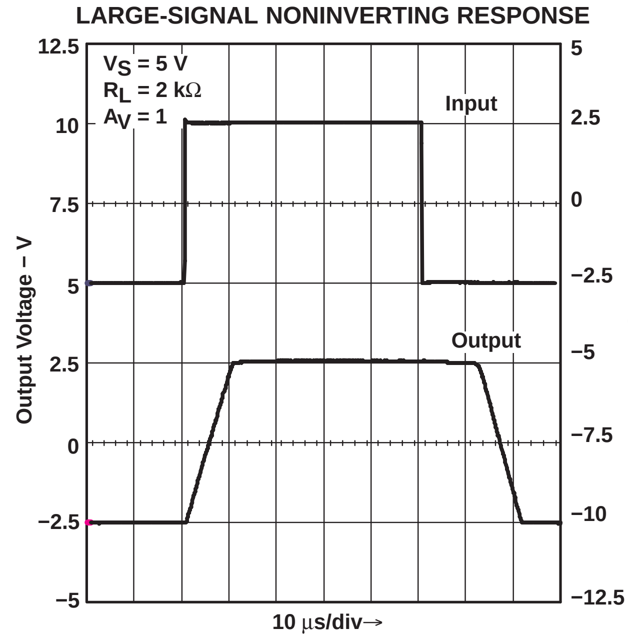

Figure 22

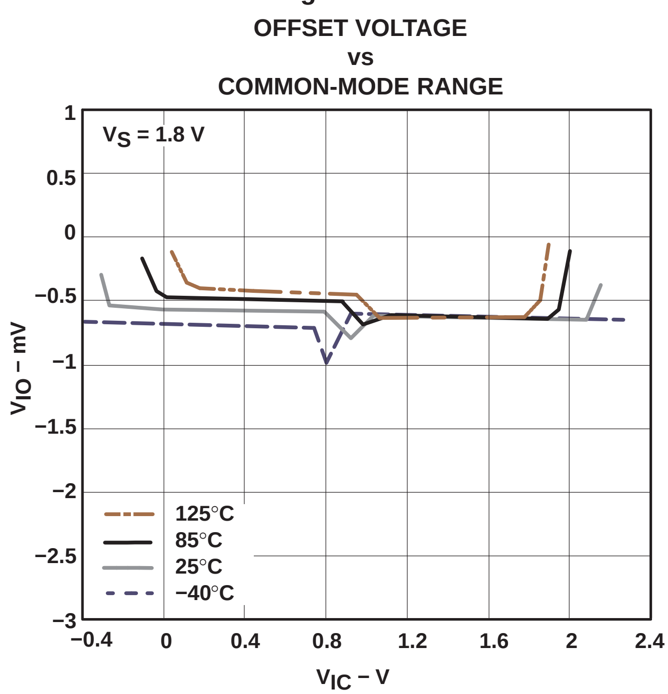

Figure 23

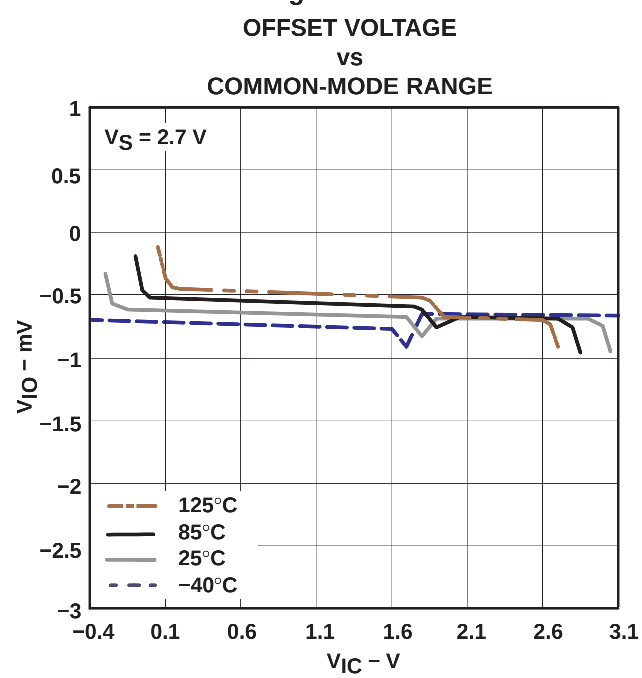

Figure 24

TYPICAL PERFORMANCE CHARACTERISTICS

Unless Otherwise Specified, V_{CC+} = 5 V, Single Supply, T_A = 25°C

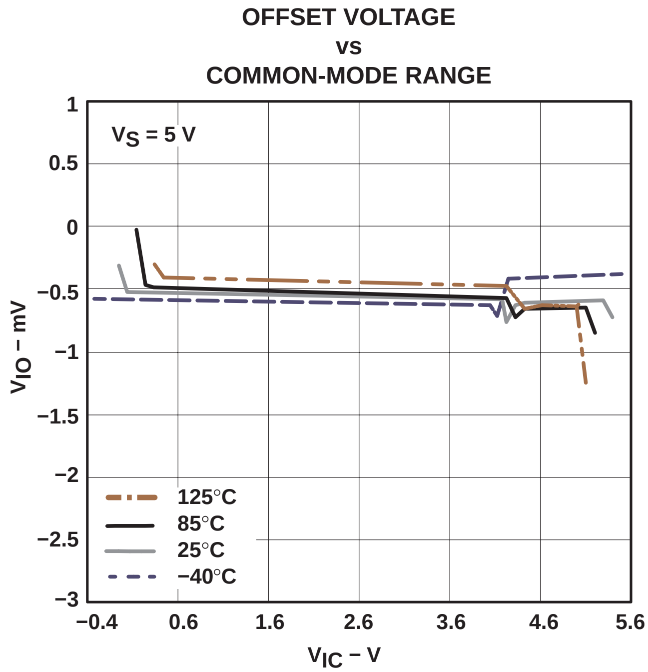

Figure 25

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
LMV931QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV931QDCKRQ1	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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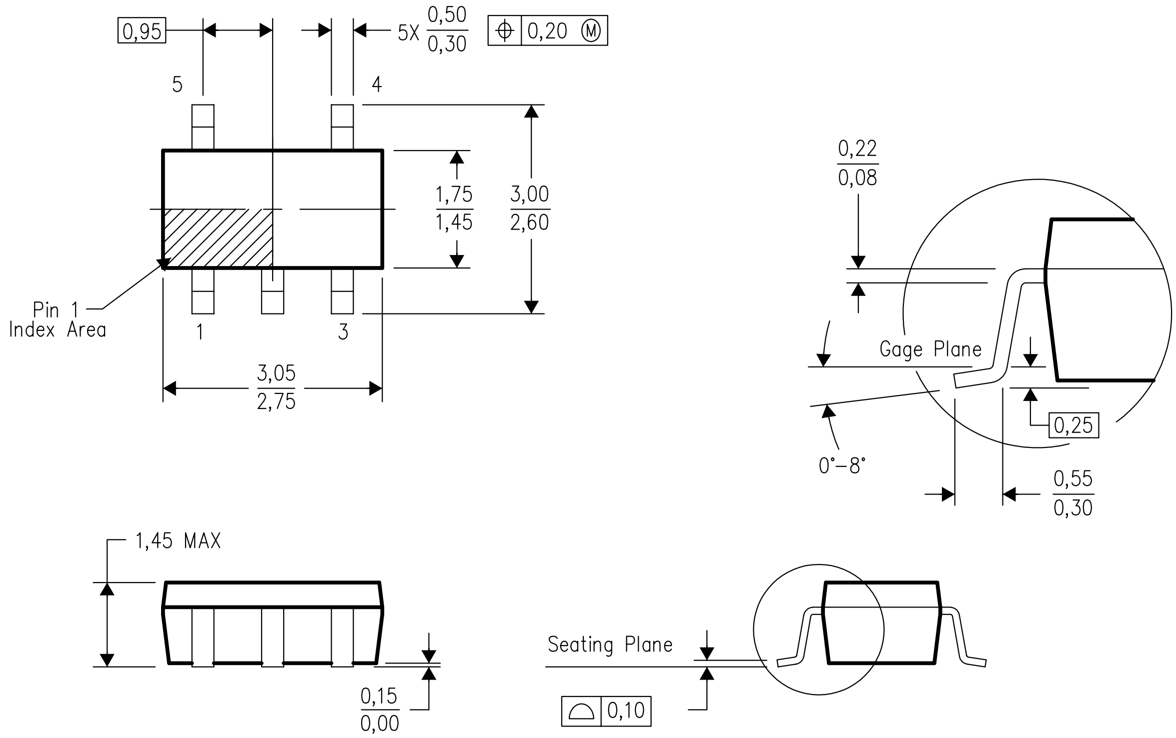
OTHER QUALIFIED VERSIONS OF LMV931-Q1 :
- Catalog: LMV931

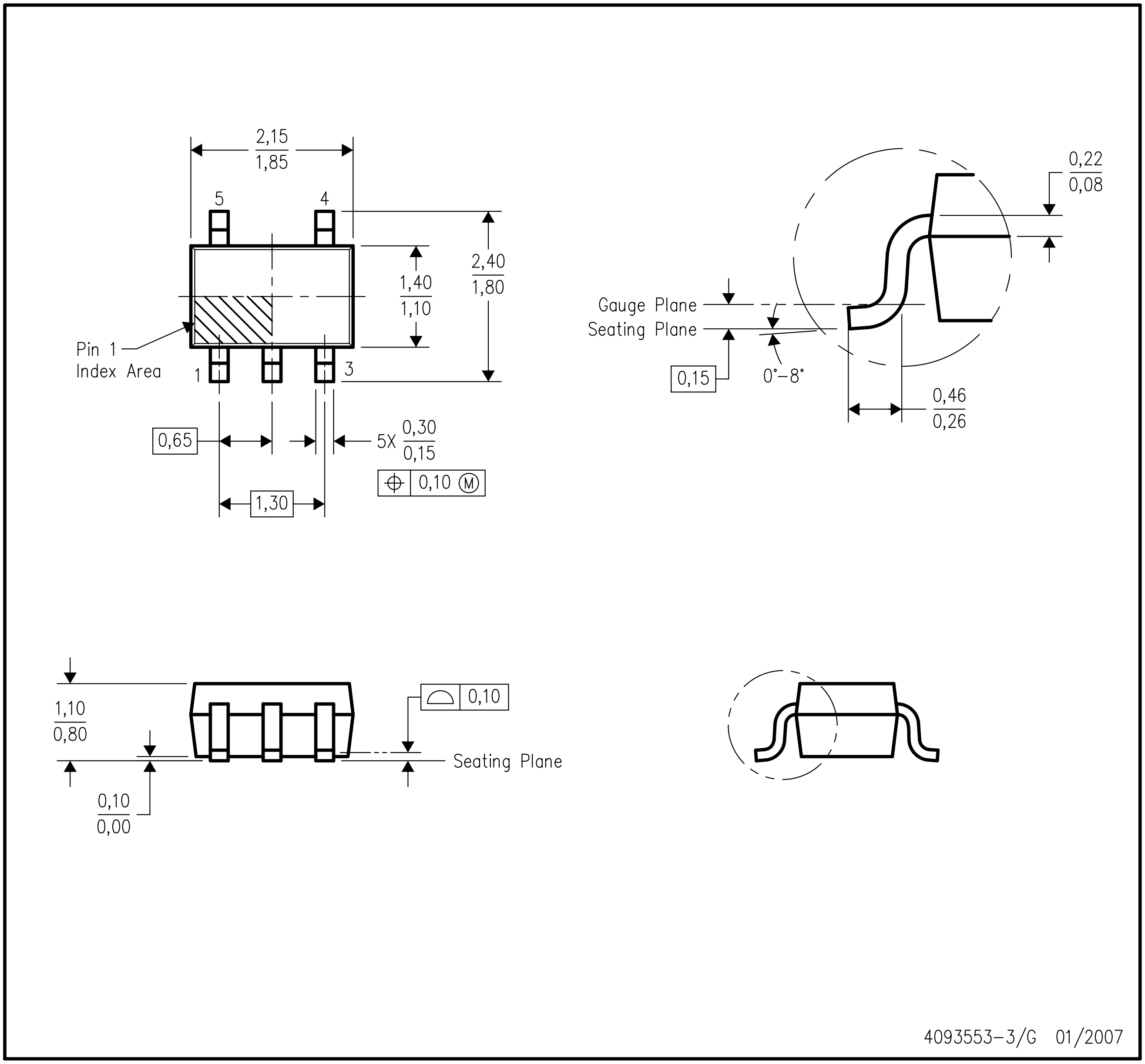
NOTE: Qualified Version Definitions:
- Catalog - TI's standard catalog product

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.

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. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO-203 variation AA.

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