10-MHz LOW-NOISE LOW-VOLTAGE LOW-POWER OPERATIONAL AMPLIFIERS

Check for Samples: LMV721, LMV722

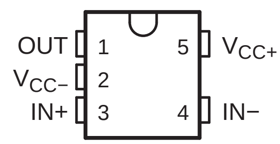
FEATURES

- Power-Supply Voltage Range: 2.2 V to 5 V
- Low Supply Current: 930 μA/Amplifier at 2.2 V
- High Unity-Gain Bandwidth: 10 MHz
- Rail-to-Rail Output Swing
  - 600-Ω Load: 120 mV From Either Rail at 2.2 V
  - 2-kΩ Load: 50 mV From Either Rail at 2.2 V
- Input Common-Mode Voltage Range Includes Ground
- Input Voltage Noise: 9 nV/√Hz at f = 1 kHz

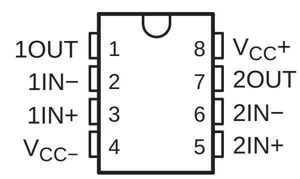
APPLICATIONS

- Cellular and Cordless Phones
- Active Filter and Buffers
- Laptops and PDAs
- Battery Powered Electronics

LMV721...DBV or DCK PACKAGE (TOP VIEW)



LMV722...D, DGK, OR DRG PACKAGE (TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The LMV721 (single) and LMV722 (dual) are low-noise low-voltage low-power operational amplifiers that can be designed into a wide range of applications. The LMV721 and LMV722 have a unity-gain bandwidth of 10 MHz, a slew rate of 5 V/μs, and a quiescent current of 930 μA/amplifier at 2.2 V.

The LMV721 and LMV722 are designed to provide optimal performance in low-voltage and low-noise systems. They provide rail-to-rail output swing into heavy loads. The input common-mode voltage range includes ground, and the maximum input offset voltage are 3.5 mV (over recommended temperature range) for the devices. Their capacitive load capability is also good at low supply voltages. The operating range is from 2.2 V to 5.5 V.

ORDERING INFORMATION(1)

T_A	PACKAGE(2)			ORDERABLE PART NUMBER	TOP-SIDE MARKING(3)
–40°C to 85°C	Single	SC-70 – DCK	Reel of 3000	LMV721IDCKR	RK_
			Reel of 250	LMV721IDCKT	
		SOT-23 – DBV	Reel of 3000	LMV721IDBVR	RBF_
	Dual	SOIC – D	Reel of 2500	LMV722IDR	MV722I
			Tube of 75	LMV722ID	
		VSSOP – DGK	Reel of 2500	LMV722IDGKR	R6_
		QFN – DRG	Reel of 2500	LMV722IDRGR	ZYY

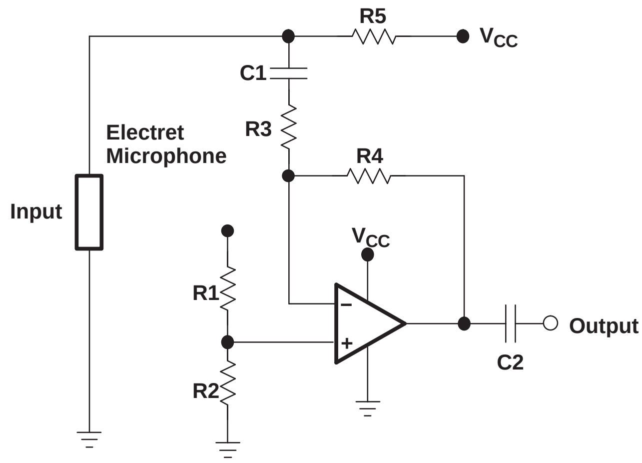
(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(3) DBV/DCK/DGK: The actual top-side marking has one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

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 the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2005–2009, Texas Instruments Incorporated

Typical Application



Absolute Maximum Ratings[1]

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

			MIN	MAX	UNIT
$V_{CC+} – V_{CC–}$	Supply voltage[2]			5.5	V
V_{ID}	Differential input voltage[3]			±Supply voltage	V
$θ_{JA}$	Package thermal impedance[4]	D package[5]		97	°C/W
		DBV package[5]		206	
		DCK package[5]		252	
		DGK package[5]		172	
		DRG package[6]		50.7	
T_J	Operating virtual-junction temperature			150	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values (except differential voltages and V_{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) Maximum power dissipation is a function of T_J(max), $θ_{JA}$, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/θ_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
(5) The package thermal impedance is calculated in accordance with JESD 51-7.
(6) The package thermal impedance is calculated in accordance with JESD 51-5.

Recommended Operating Conditions

		MIN	MAX	UNIT
$V_{CC+} – V_{CC–}$	Supply voltage	2.2	5	V
T_J	Operating virtual-junction temperature	–40	85	°C

ESD Protection

	TYP	UNIT
Human-Body Model	2000	V
Machine Model	100	V

Copyright © 2005–2009, Texas Instruments Incorporated

Electrical Characteristics

V_{CC+} = 2.2 V, V_{CC-} = GND, V_{ICR} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_J	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		25°C		0.02	3	mV
			–40°C to 85°C			3.5	
TCV_{IO}	Input offset voltage average drift		25°C		0.6		μV/°C
I_{IB}	Input bias current		25°C		260		nA
I_{IO}	Input offset current		25°C		25		nA
CMMR	Common-mode rejection ratio	V_{ICR} = 0 V to 1.3 V	25°C	70	88		dB
			–40°C to 85°C	64			
PSRR	Power-supply rejection ratio	V_{CC+} = 2.2 V to 5 V, V_O = 0, V_{ICR} = 0	25°C	80	90		dB
			–40°C to 85°C	70			
V_{ICR}	Input common-mode voltage	CMRR ≥ 50 dB	25°C		–0.3		V
					1.3		
A_{VD}	Large-signal voltage gain	R_L = 600 Ω, V_O = 0.75 V to 2 V	25°C	75	81		dB
			–40°C to 85°C	70			
		R_L = 2 kΩ, V_O = 0.5 V to 2.1 V	25°C	75	84		
			–40°C to 85°C	70			
V_O	Output swing	R_L = 600 Ω to V_{CC+}/2	25°C	2.090	2.125		V
			–40°C to 85°C	2.065			
			25°C		0.071	0.120	
			–40°C to 85°C			0.145	
		R_L = 2 kΩ to V_{CC+}/2	25°C	2.150	2.177		
			–40°C to 85°C	2.125			
			25°C		0.056	0.080	
			–40°C to 85°C			0.105	
I_O	Output current	Sourcing, V_O = 0 V, $V_{IN(diff)}$ = ±0.5 V	25°C	10	14.9		mA
			–40°C to 85°C	5			
		Sinking, V_O = 2.2 V, $V_{IN(diff)}$ = ±0.5 V	25°C	10	17.6		
			–40°C to 85°C	5			
I_{CC}	Supply current	LMV721	25°C		0.93	1.3	mA
			–40°C to 85°C			1.5	
		LMV722	25°C		1.81	2.4	
			–40°C to 85°C			2.6	
SR	Slew rate (1)		25°C		4.9		V/μs
GBW	Gain bandwidth product		25°C		10		MHz
Φ_m	Phase margin		25°C		67.4		°
G_m	Gain margin		25°C		–9.8		dB
V_n	Input-referred voltage noise	f = 1 kHz	25°C		9		nV/√Hz
I_n	Input-referred current noise	f = 1 kHz	25°C		0.3		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, AV = 1, R_L = 600 Ω, V_O = 500 mV_{pp}	25°C		0.004		%

(1) Connected as voltage follower with 1-V step input. Number specified is the slower of the positive and negative slew rate.

Copyright © 2005–2009, Texas Instruments Incorporated

Electrical Characteristics

V_{CC+} = 5 V, V_{CC-} = GND, V_{ICR} = V_{CC+}/2, V_O = V_{CC+}/2, and R_L > 1 MΩ (unless otherwise noted)

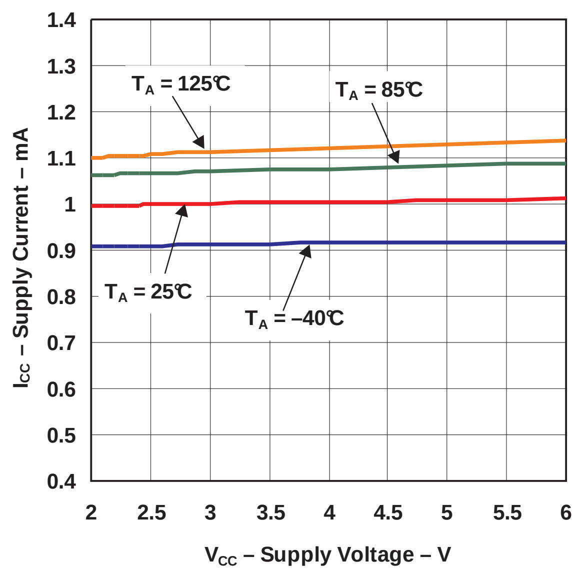
PARAMETER		TEST CONDITIONS	T_J	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		25°C		–0.08	3	mV
			–40°C to 85°C			3.5	
TCV_{IO}	Input offset voltage average drift		25°C		0.6		μV/°C
I_{IB}	Input bias current		25°C		260		nA
I_{IO}	Input offset current		25°C		25		nA
CMMR	Common-mode rejection ratio	V_{ICR} = 0 V to 4.1 V	25°C	80	89		dB
			–40°C to 85°C	75			
PSRR	Power-supply rejection ratio	V_{CC+} = 2.2 V to 5 V, V_O = 0, V_{ICR} = 0	25°C	70	90		dB
			–40°C to 85°C	64			
V_{ICR}	Input common-mode voltage	CMRR ≥ 50 dB	25°C		–0.3		V
					4.1		
A_{VD}	Large-signal voltage gain	R_L = 600 Ω, V_O = 0.75 V to 4.8 V	25°C	80	87		dB
			–40°C to 85°C	70			
		R_L = 2 kΩ, V_O = 0.7 V to 4.9V	25°C	80	94		
			–40°C to 85°C	70			
V_O	Output swing	R_L = 600 Ω to V_{CC+}/2	25°C	4.84	4.882		V
			–40°C to 85°C	4.815			
			25°C		0.134	0.19	
			–40°C to 85°C			0.215	
		R_L = 2 kΩ to V_{CC+}/2	25°C	4.93	4.952		
			–40°C to 85°C	4.905			
			25°C		0.076	0.11	
			–40°C to 85°C			0.135	
I_O	Output current	Sourcing, V_O = 0 V, $V_{IN(diff)}$ = ±0.5 V	25°C	20	52.6		mA
			–40°C to 85°C	12			
		Sinking, V_O = 2.2 V, $V_{IN(diff)}$ = ±0.5 V	25°C	15	23.7		
			–40°C to 85°C	8.5			
I_{CC}	Supply current	LMV721	25°C		1.03	1.4	mA
			–40°C to 85°C			1.7	
		LMV722	25°C		2.01	2.4	
			–40°C to 85°C			2.8	
SR	Slew rate (1)		25°C		5.25		V/μs
GBW	Gain bandwidth product		25°C		10		MHz
Φ_m	Phase margin		25°C		72		°
G_m	Gain margin		25°C		–11		dB
V_n	Input-referred voltage noise	f = 1 kHz	25°C		8.5		nV/√Hz
I_n	Input-referred current noise	f = 1 kHz	25°C		0.2		pA/√Hz
THD	Total harmonic distortion	f = 1 kHz, AV = 1, R_L = 600 Ω, V_O = 500 mV_{pp}	25°C		0.001		%

(1) Connected as voltage follower with 1-V step input. Number specified is the slower of the positive and negative slew rate.

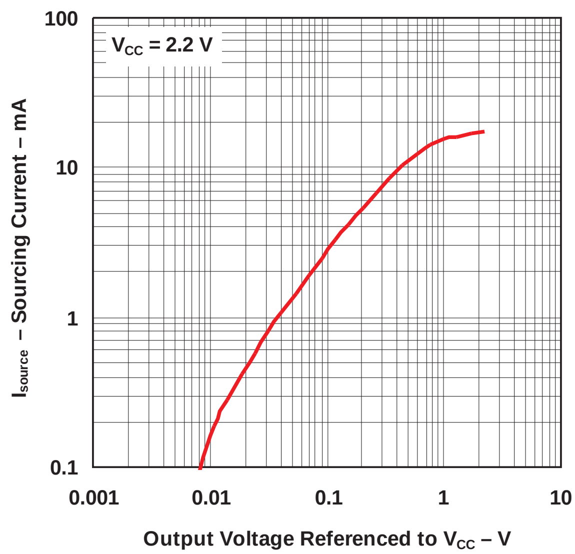
 Copyright © 2005–2009, Texas Instruments Incorporated

TYPICAL CHARACTERISTICS

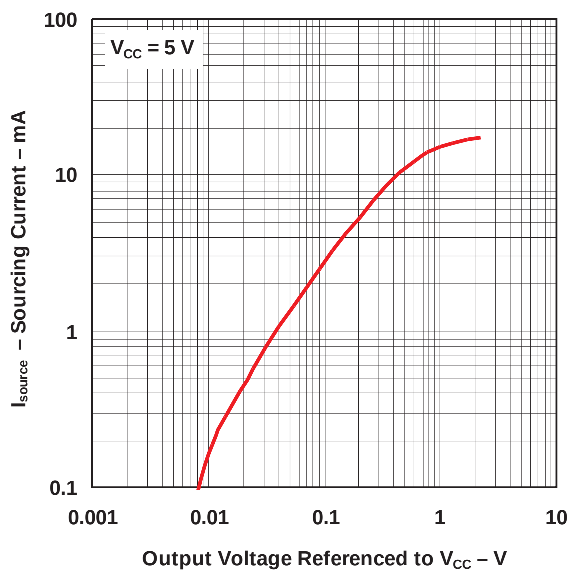
SUPPLY CURRENT vs SUPPLY VOLTAGE



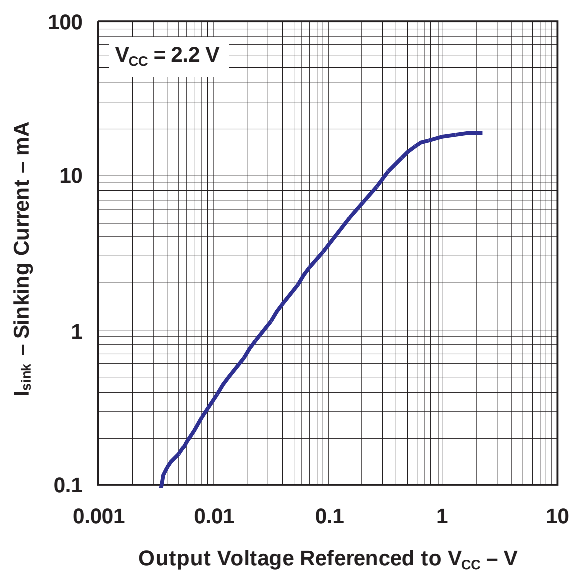
SOURCING CURRENT vs OUTPUT VOLTAGE



SOURCING CURRENT vs OUTPUT VOLTAGE

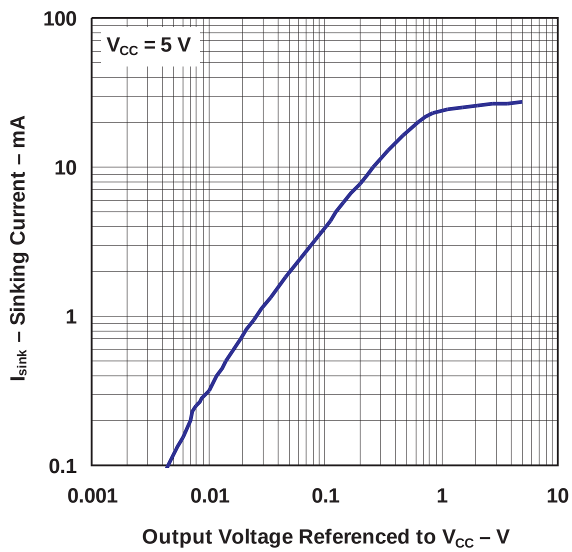


SINKING CURRENT vs OUTPUT VOLTAGE

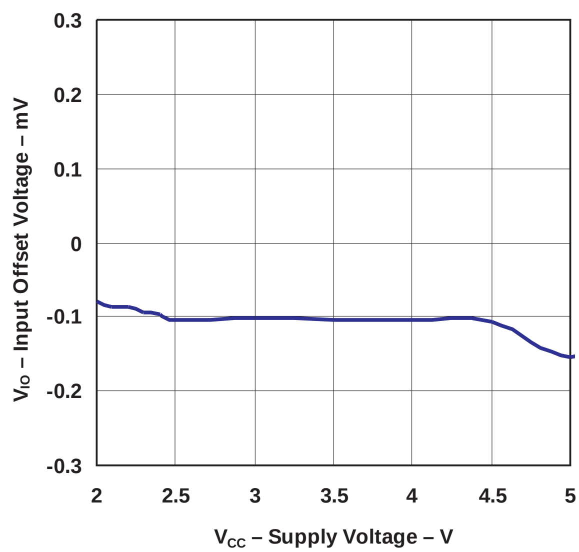


TYPICAL CHARACTERISTICS (continued)

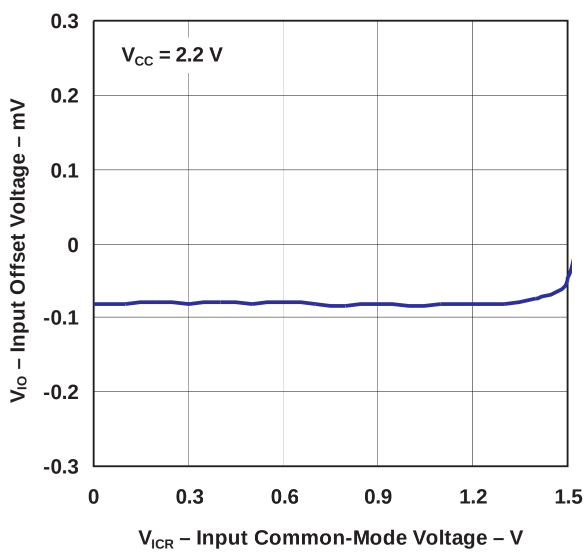
SINKING CURRENT
vs
OUTPUT VOLTAGE



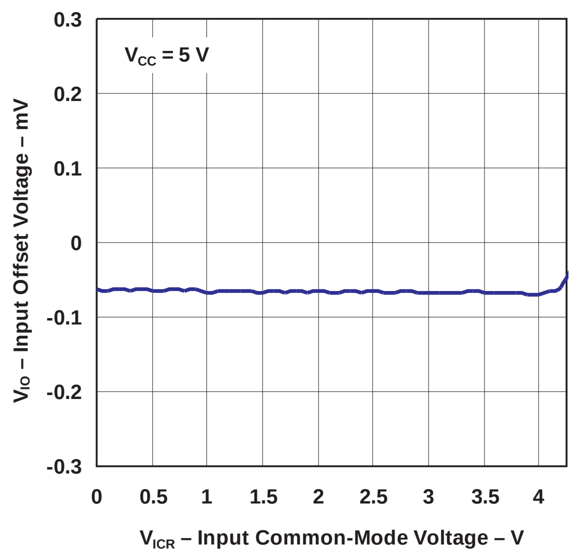
OUTPUT VOLTAGE SWING
vs
SUPPLY VOLTAGE



INPUT OFFSET VOLTAGE
vs
INPUT COMMON-MODE VOLTAGE



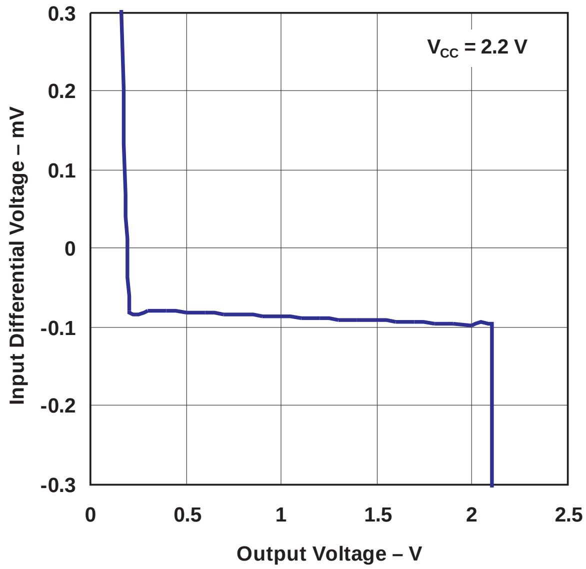
INPUT OFFSET VOLTAGE
vs
INPUT COMMON-MODE VOLTAGE



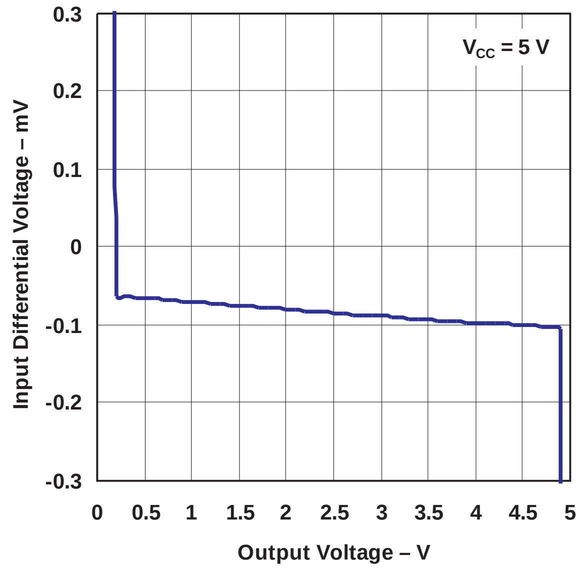
 Copyright © 2005–2009, Texas Instruments Incorporated

TYPICAL CHARACTERISTICS (continued)

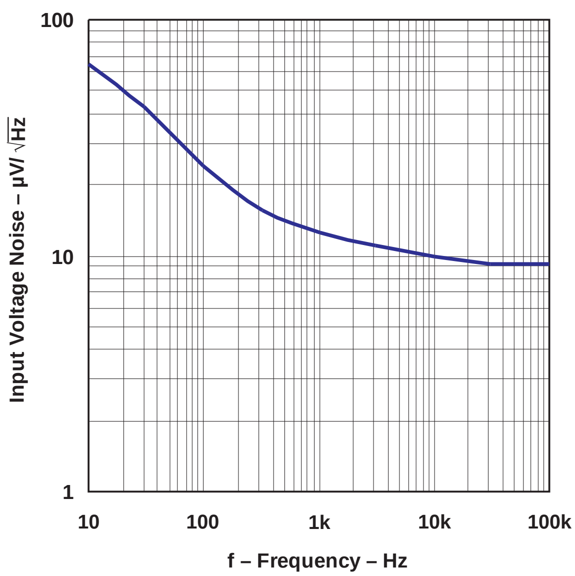
INPUT VOLTAGE
vs
OUTPUT VOLTAGE



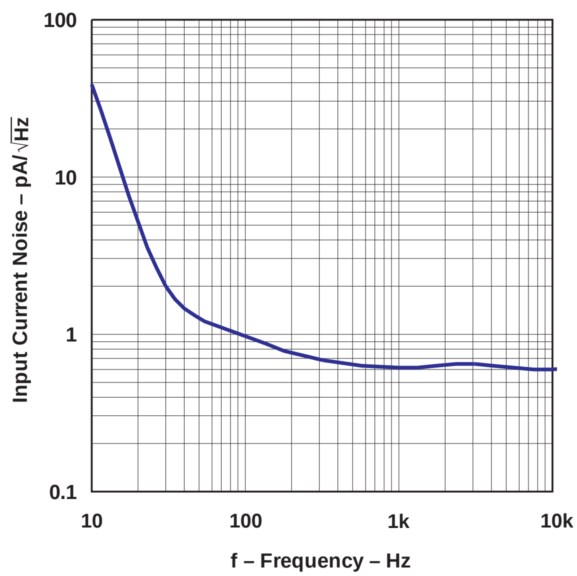
INPUT VOLTAGE
vs
OUTPUT VOLTAGE



INPUT VOLTAGE NOISE
vs
FREQUENCY

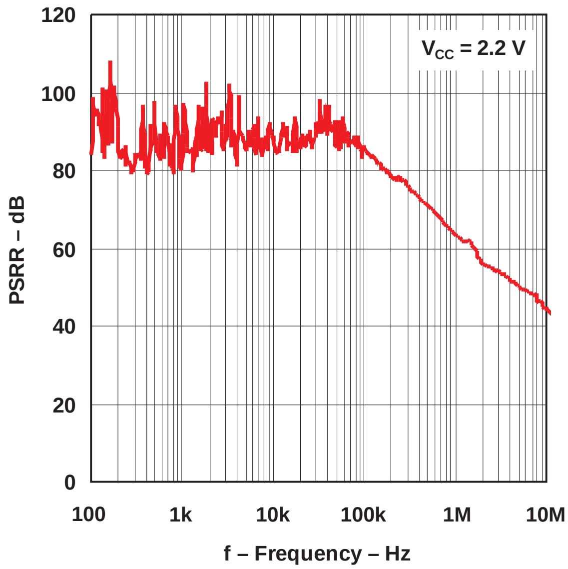


INPUT CURRENT NOISE
vs
FREQUENCY

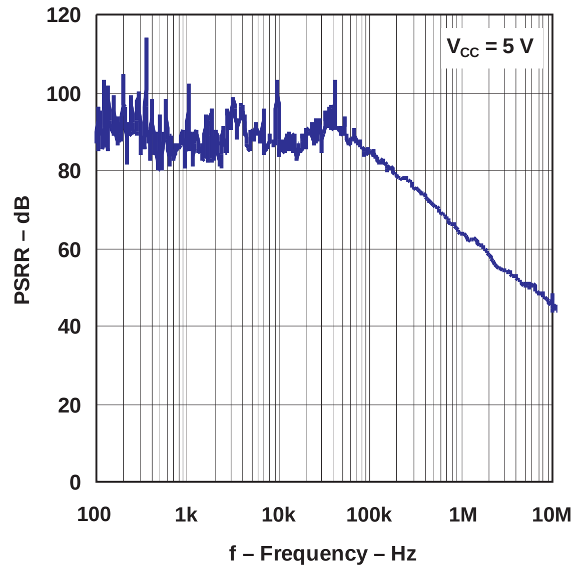


TYPICAL CHARACTERISTICS (continued)

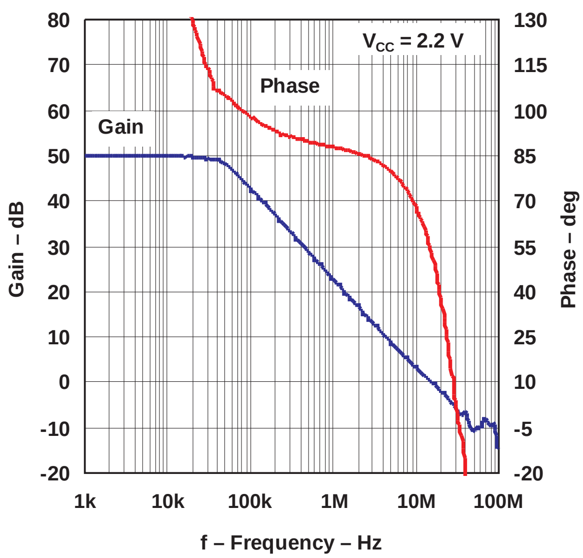
PSRR vs FREQUENCY



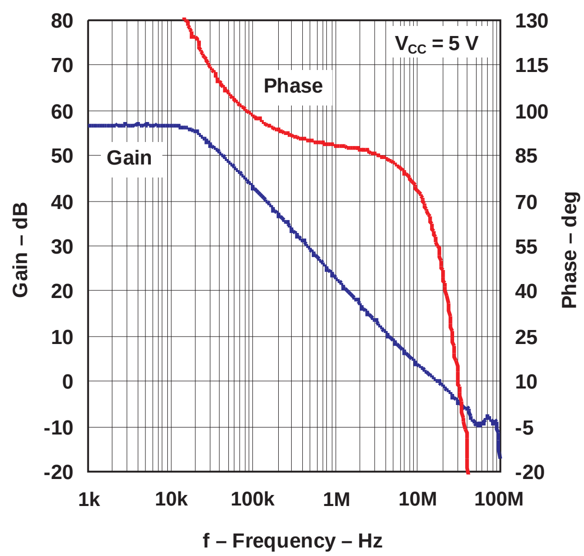
PSRR vs FREQUENCY



GAIN AND PHASE vs FREQUENCY



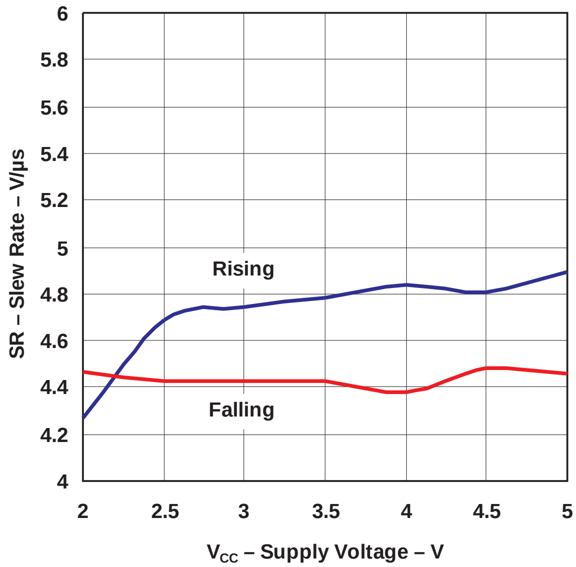
GAIN AND PHASE vs FREQUENCY



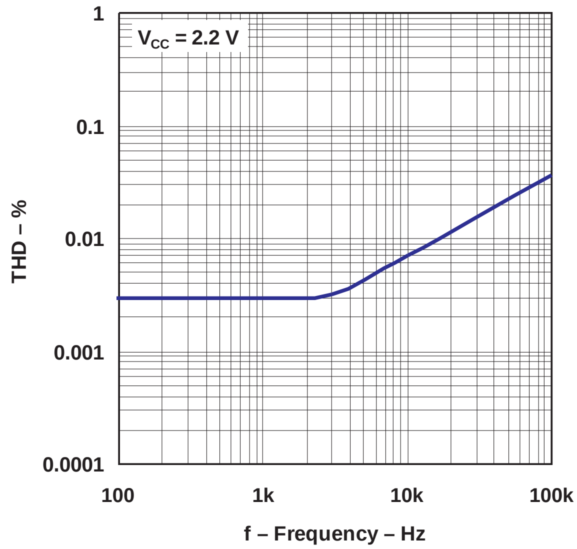
 Copyright © 2005–2009, Texas Instruments Incorporated

TYPICAL CHARACTERISTICS (continued)

SLEW RATE vs SUPPLY VOLTAGE

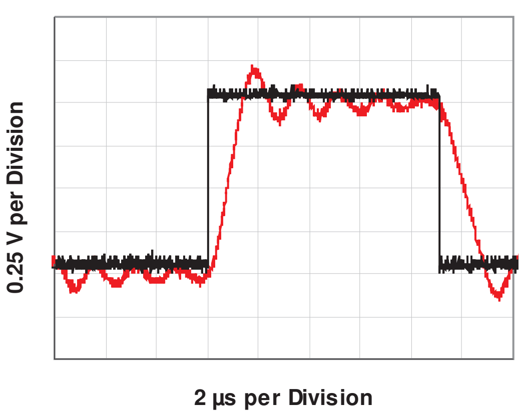


THD vs FREQUENCY



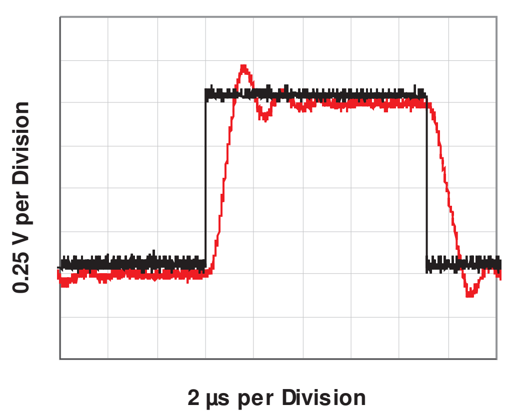
PULSE RESPONSE

V_{cc} = 5 V, R_L = 2 kΩ, C_L = 21.2 nF, R_o = 0 Ω



PULSE RESPONSE

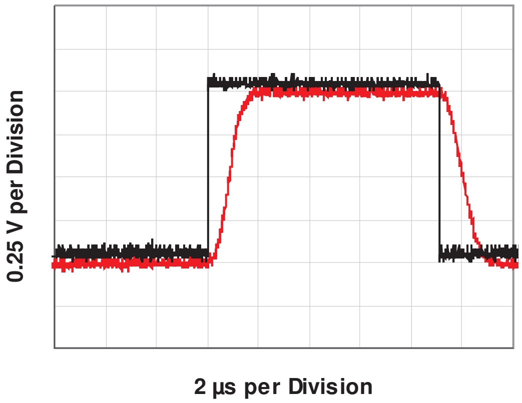
V_{cc} = 5 V, R_L = 2 kΩ, C_L = 21.2 nF, R_o = 2.1 Ω



TYPICAL CHARACTERISTICS (continued)

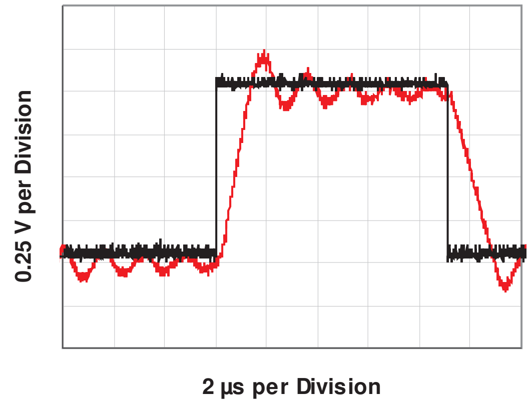
PULSE RESPONSE

V_{CC} = 5 V, R_L = 2 kΩ, C_L = 21.2 nF, R_o = 9.5 Ω



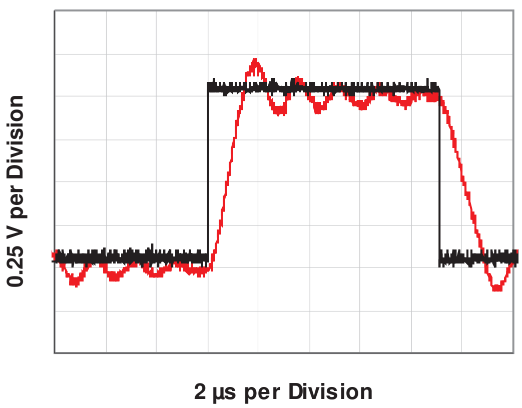
PULSE RESPONSE

V_{CC} = 5 V, R_L = 10 kΩ, C_L = 21.2 nF, R_o = 0 Ω



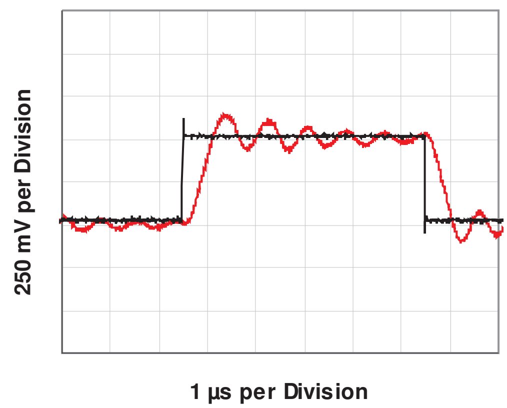
PULSE RESPONSE

V_{CC} = 5 V, R_L = 600 Ω, C_L = 21.2 nF, R_o = 0 Ω



PULSE RESPONSE

V_{CC} = 2.2 V, R_L = 2 Ω, C_L = 2.12 nF, R_o = 0 Ω

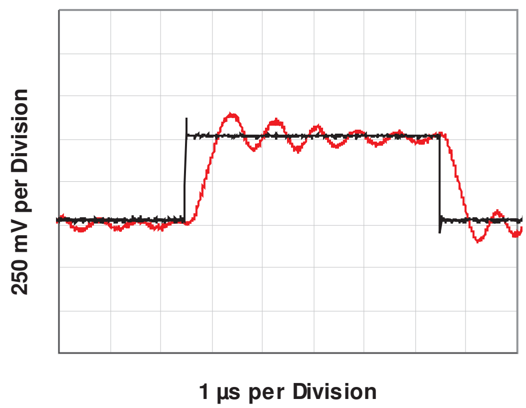


Copyright © 2005–2009, Texas Instruments Incorporated

TYPICAL CHARACTERISTICS (continued)

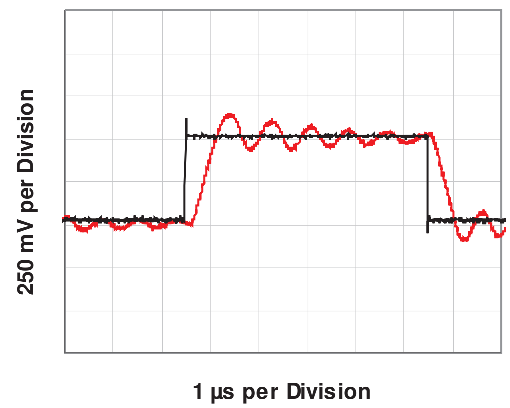
PULSE RESPONSE

V_{CC} = 2.2 V, R_L = 2 kΩ, C_L = 2.12 nF, R_o = 0 Ω



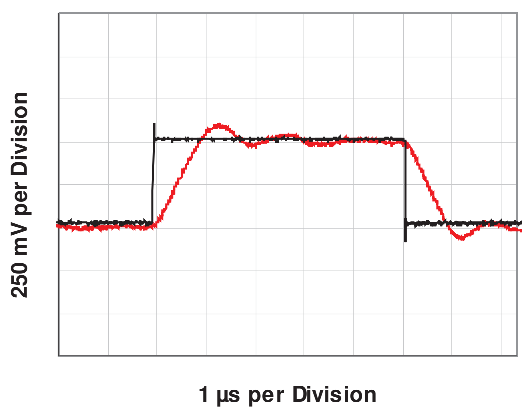
PULSE RESPONSE

V_{CC} = 2.2 V, R_L = 10 kΩ, C_L = 2.12 nF, R_o = 0 Ω



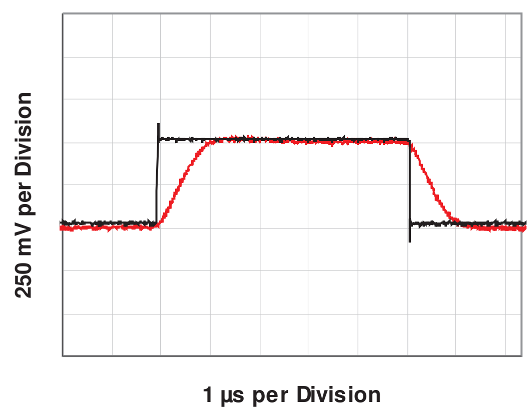
PULSE RESPONSE

V_{CC} = 2.2 V, R_L = 10 kΩ, C_L = 2.12 nF, R_o = 2.2 Ω



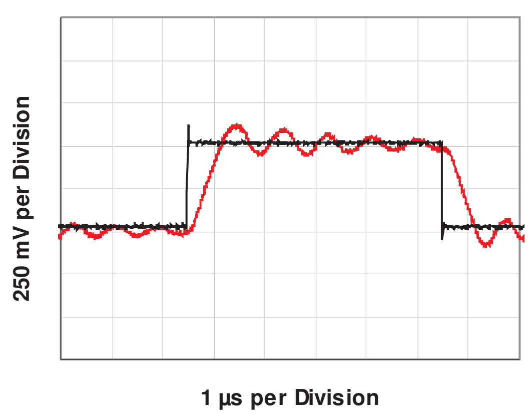
PULSE RESPONSE

V_{CC} = 2.2 V, R_L = 10 kΩ, C_L = 2.12 nF, R_o = 11.5 Ω



PULSE RESPONSE

V_{CC} = 2.2 V, R_L = 600 Ω, C_L = 1.89 nF, R_o = 0 Ω



Copyright © 2005–2009, Texas Instruments Incorporated

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
LMV721IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV721IDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV721IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV721IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV721IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV721IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV722ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV722IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV722IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV722IDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV722IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV722IDRG4	ACTIVE	SOIC	D	8	2500	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)

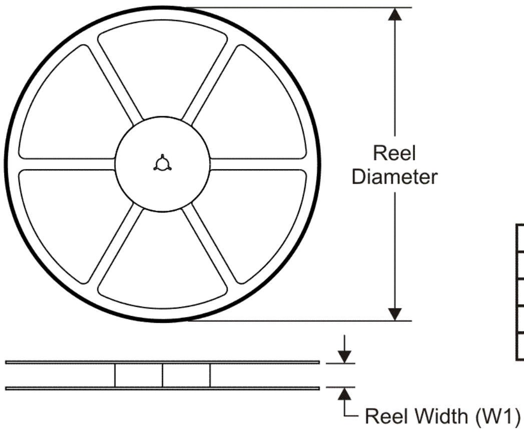
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

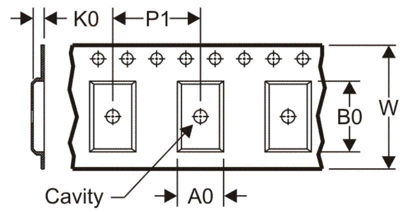
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

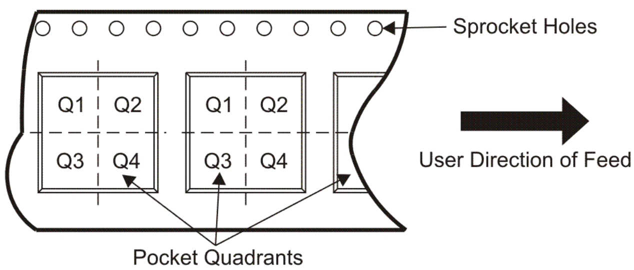


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

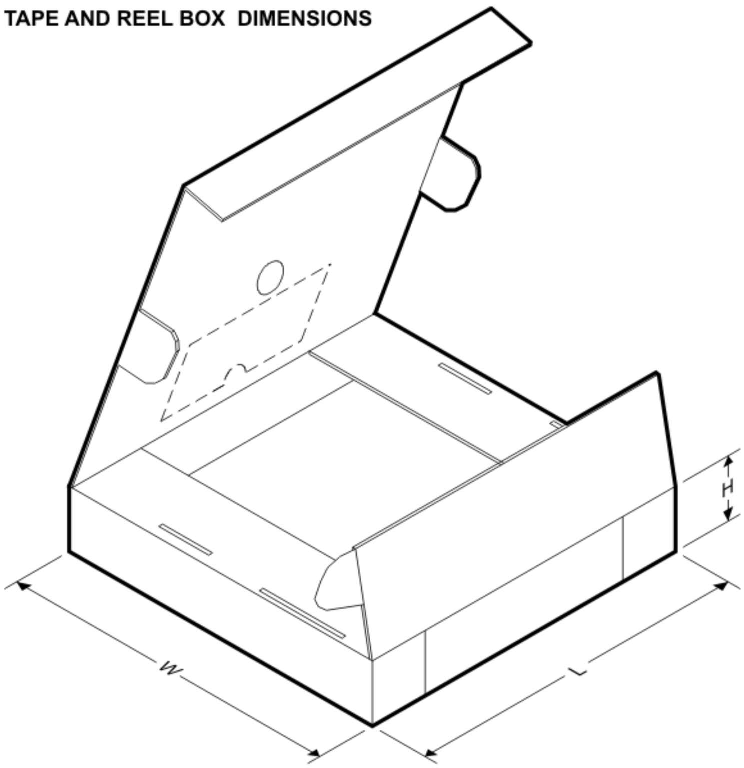
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMV721IDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
LMV721IDCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
LMV721IDCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
LMV722IDGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.3	1.3	8.0	12.0	Q1
LMV722IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

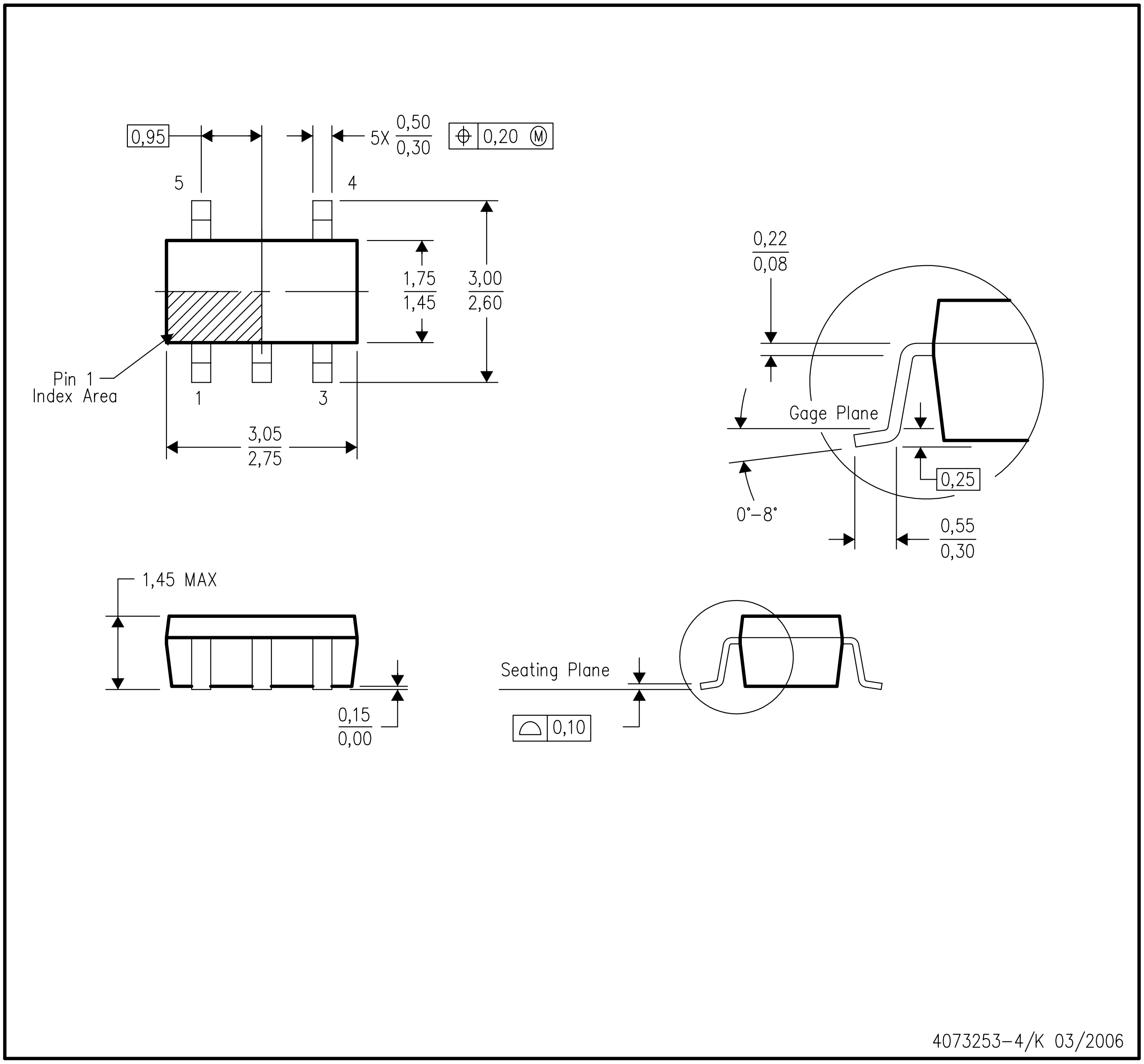
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

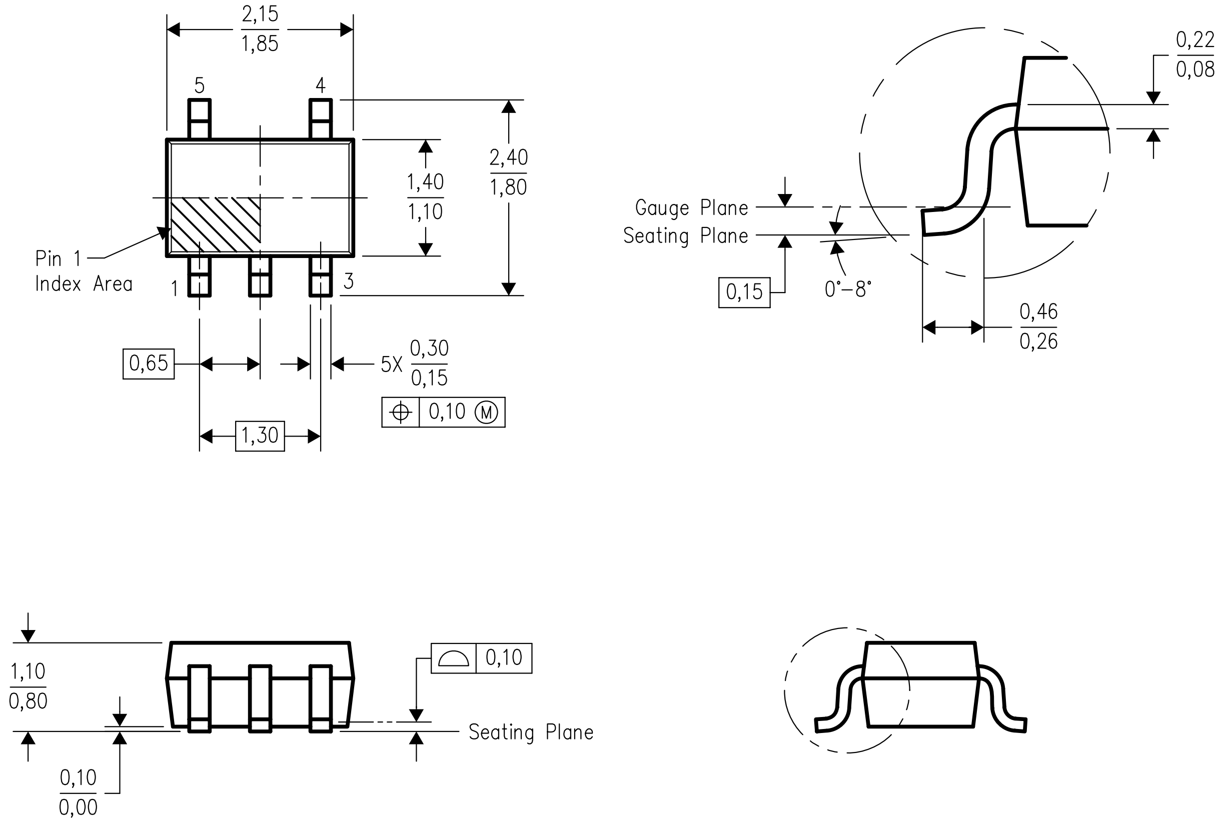
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMV721IDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
LMV721IDCKR	SC70	DCK	5	3000	180.0	180.0	18.0
LMV721IDCKT	SC70	DCK	5	250	180.0	180.0	18.0
LMV722IDGKR	MSOP	DGK	8	2500	370.0	355.0	55.0
LMV722IDR	SOIC	D	8	2500	340.5	338.1	20.6

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.

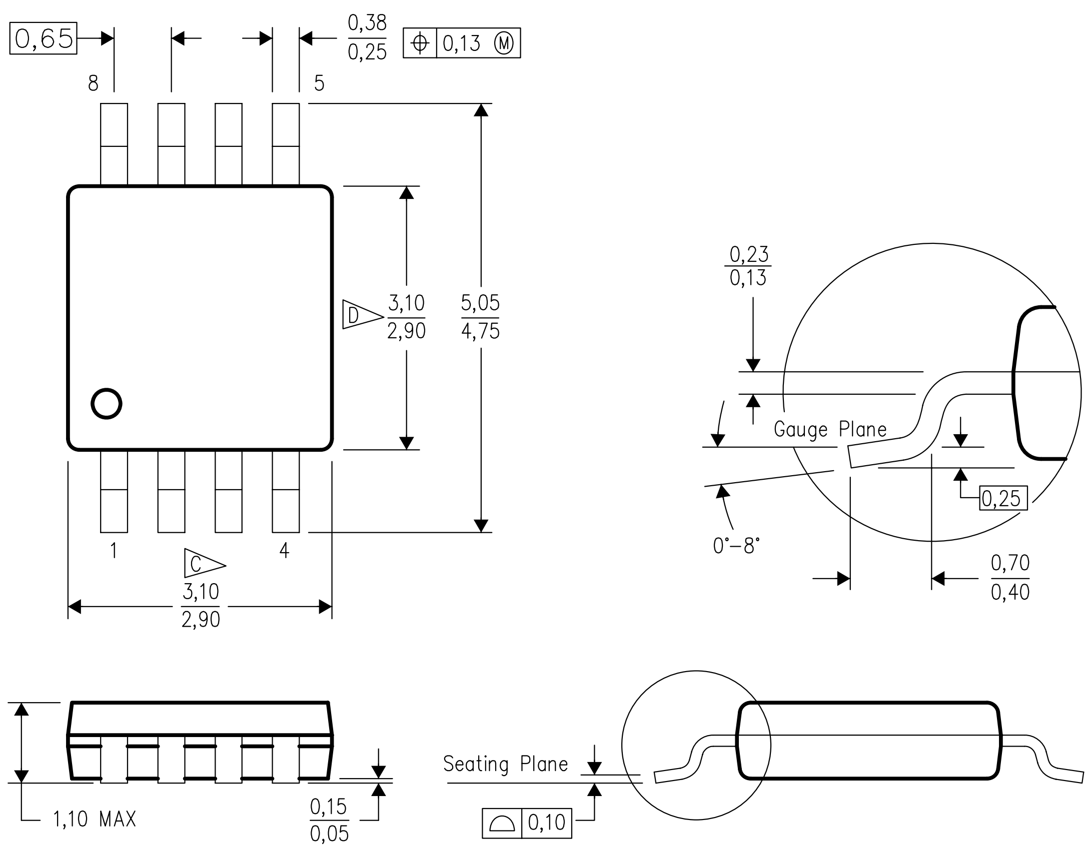
DCK (R-PDSO-G5) PLASTIC SMALL-OUTLINE PACKAGE



4093553-3/G 01/2007

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.

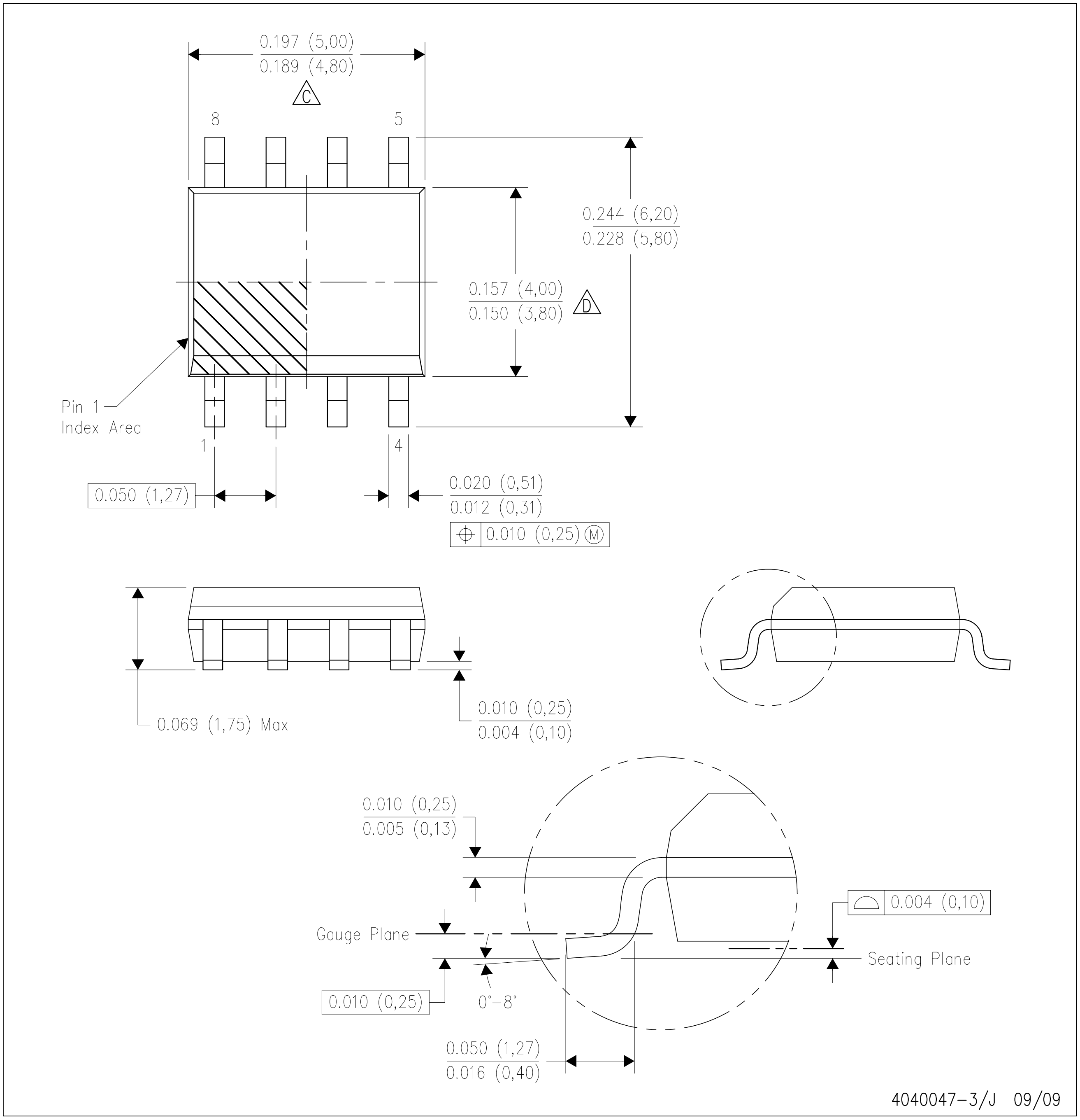
DGK (S-PDSO-G8) PLASTIC SMALL-OUTLINE PACKAGE



4073329/E 05/06

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
E. Falls within JEDEC MO-187 variation AA, except interlead flash.

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 length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS–012 variation AA.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated