LMH6642Q/LMH6643Q 低功耗 130MHz 75mA 轨到轨输出放大器

1 特性

- （V_S = ±5V，T_A = 25°C，R_L = 2kΩ，A_V = +1。 如无特殊说明则采用典型值）。
- −3dB BW (A_V = +1) 130MHz
- 电源电压范围在 2.7V 至 10V 之间
- 转换率，(A_V = −1) 130V/µs(1)
- 电源电流（无负载）2.7 mA/amp
- 输出短路电流 +115mA/−145mA
- 线性输出电流 ±75mA
- 输入共模电压下限为 V^- 以下 0.5V，上限为 V^+ 以上 1V
- 输出电压距电源轨摆幅 40mV
- 输入电压噪声 (100kHz) 17nV/√Hz
- 输入电流噪声 (100kHz) 0.9pA/√Hz
- THD（5MHz，R_L = 2kΩ，V_O = $2V_{PP}$，A_V = +2) −62dBc
- 稳定时间 68ns
- 在 3V、5V 和 ±5V 电压下体现完整特性
- 过驱恢复时间 100ns
- 输出短路保护(2)
- 超出 CMVR 时不发生输出反相
- LMH6643QMM 和 LMH6642QMF 符合 AEC-Q100 3 级要求并且按汽车应用级流程制造

(1) 转换率是上升转换率和下降转换率的平均值

(2) 在室温及温度低于室温时，V_S < 6V 的输出短路持续时间无限。V_S > 6V 时，允许的短路持续时间为 1.5ms。

2 应用

- 有源滤波器
- CD/DVD ROM
- ADC 缓冲放大器
- 便携式视频设备
- 电流感测缓冲器
- 汽车

3 说明

LMH664X 系列是真正的单电源电压反馈放大器，可提供高速 (130MHz) 低失真 (−62dBc) 特性和超高输出电流（约 75mA），与性能类似的现有器件相比，该产品的成本和功耗更低。

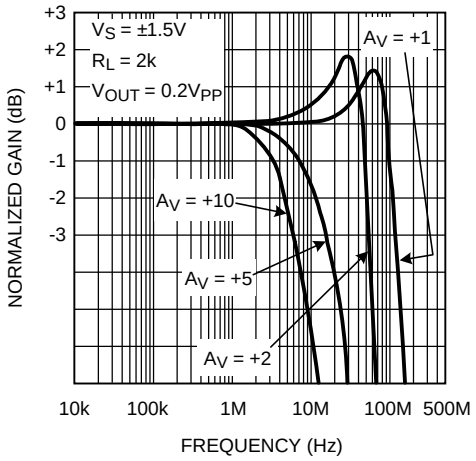
输入共模电压范围扩展至下限 V^- 以下 0.5V，上限 V^+ 以上 1V。 各电源轨输出电压范围扩展至 40mV 以内，允许较宽的动态范围，尤其适用于低压应用。 输出级能够输出约 75mA 的电流以驱动较大负载。 高速输出转换率 (130V/µs) 可确保较大的峰峰值输出摆幅即使在更高的速度条件下也能保持不变，从而在 3V 电源下输出优异的 40MHz 满功率带宽。 器件的上述特性及低成本优势是多种工业和商业应用的理想特性。

器件信息(1)

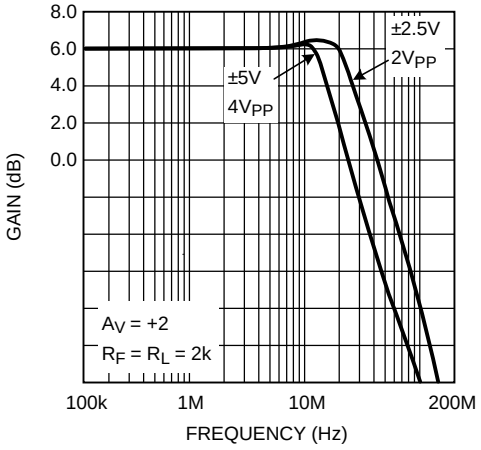
部件号	封装	封装尺寸（标称值）
LMH6642-Q1	SOT-23 (5)	2.90mm x 1.60mm
LMH6643-Q1	VSSOP (8)	3.00mm × 3.00mm

(1) 如需了解所有可用封装，请见数据表末尾的可订购产品附录。

闭环增益与 不同增益下的频率



大信号频率响应



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4 修订历史记录

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision B (March 2013) to Revision C **Page**

- 已更改 数据表结构和组织结构。 添加、更新或重新命名了以下部分：器件信息表，引脚配置和功能，应用和实施，器件和文档支持，机械、封装和订购信息 ... 1
- Changed "Junction Temperature Range" to "Operating Temperature Range" in Recommended Operating Conditions ... 4
- Deleted T_J = 25°C in Electrical Characteristics tables ... 5
- Deleted T_J = 25°C in Typical Performance Characteristics section. ... 11

Changes from Revision A (March 2013) to Revision B **Page**

- Changed layout of National Data Sheet to TI format ... 24

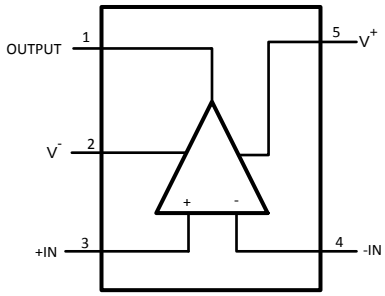
5 Description (continued)

Careful attention has been paid to ensure device stability under all operating voltages and modes. The result is a very well behaved frequency response characteristic (0.1dB gain flatness up the 12MHz under 150Ω load and A_V = +2) with minimal peaking (typically 2dB maximum) for any gain setting and under both heavy and light loads. This along with fast settling time (68ns) and low distortion allows the device to operate well in ADC buffer, and high frequency filter applications as well as other applications.

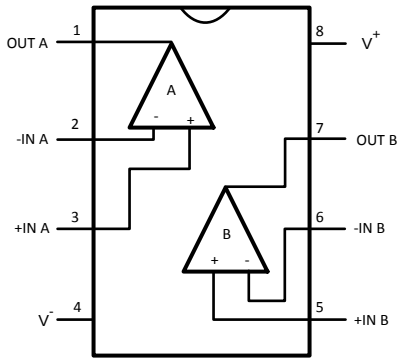
This device family offers professional quality video performance with low DG (0.01%) and DP (0.01°) characteristics. Differential Gain and Differential Phase characteristics are also well maintained under heavy loads (150Ω) and throughout the output voltage range. The LMH664X family is offered in single (LMH6642) and dual (LMH6643).

6 Pin Configuration and Functions

5-Pin SOT-23 Package
Package DBV0005A
Top View



8-Pin VSSOP Package
Package DGK0008A
Top View



Pin Functions

PIN			I/O	DESCRIPTION
NAME	NUMBER			
	LMH6642Q	LMH6643Q		
-IN	4		I	Inverting Input
+IN	3		I	Non-inverting Input
-IN A		2	I	ChA Inverting Input
+IN A		3	I	ChA Non-inverting Input
-IN B		6	I	ChB Inverting Input
+IN B		5	I	ChB Non-inverting Input
OUT A		1	O	ChA Output
OUT B		7	O	ChB Output
OUTPUT	1		O	Output
V^-	2	4	I	Negative Supply
V^+	5	8	I	Positive Supply

7 Specifications

7.1 Absolute Maximum Ratings (1)(2)(1)

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

	MIN	MAX	UNIT
V_{IN} Differential		±2.5	V
Output Short Circuit Duration		See (3) and (4)	
Supply Voltage (V^+ - V^-)		13.5	V
Voltage at Input/Output pins		V^+ +0.8 V^- −0.8	V
Input Current		±10	mA
Junction Temperature (5)		+150	°C
Soldering Information			
Infrared or Convection Reflow (20 sec)		235	°C
Wave Soldering Lead Temp.(10 sec)		260	°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(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.
(4) Output short circuit duration is infinite for V_S < 6 V at room temperature and below. For V_S > 6 V, allowable short circuit duration is 1.5ms.
(5) The maximum power dissipation is a function of $T_{J(MAX)}$,$R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly onto a PC board.

7.2 Handling Ratings

			MIN	MAX	UNIT
T_{stg}	Storage temperature range		−65	+150	°C
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 (1)		2000	V
		Machine Model (MM) (2)		200	
		Charged Device Model (CDM), per AEC Q100-011		1000	

(1) AEC Q100-002 indicates HBM stressing is done in accordance with the ANSI/ESDA/JEDEC JS-001 specification,1.5kΩ in series with 100pF.
(2) Machine Model, 0Ω in series with 200pF.

7.3 Recommended Operating Conditions (1)

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

	MIN	MAX	UNIT
Supply Voltage (V^+ – V^-)	2.7	10	V
Operating Temperature Range (2)	−40	+85	°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
(2) The maximum power dissipation is a function of $T_{J(MAX)}$,$R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly onto a PC board.

7.4 Thermal Information

THERMAL METRIC (1)		DBV05A	DGK08A	UNIT
		5 PINS	8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance (2)	265°C/W	235°C/W	°C/W

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.
(2) The maximum power dissipation is a function of $T_{J(MAX)}$,$R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly onto a PC board.

7.5 3V Electrical Characteristics

Unless otherwise specified, all limits ensured for V^+ = 3V, V^- = 0V, V_{CM} = V_O = $V^+/2$, V_{ID} (input differential voltage) as noted (where applicable) and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
BW	−3dB BW	A_V = +1, V_{OUT} = 200mV$_{PP}$	80	115		MHz
		A_V = +2, −1, V_{OUT} = 200mV$_{PP}$		46		
$BW_{0.1dB}$	0.1dB Gain Flatness	A_V = +2, R_L = 150Ω to V+/2, R_L = 402Ω, V_{OUT} = 200mV$_{PP}$		19		MHz
PBW	Full Power Bandwidth	A_V = +1, −1dB, V_{OUT} = 1V$_{PP}$		40		MHz
e_n	Input-Referred Voltage Noise	f = 100kHz		17		nV/√Hz
		f = 1kHz		48		
i_n	Input-Referred Current Noise	f = 100kHz		0.90		pA/√Hz
		f = 1kHz		3.3		
THD	Total Harmonic Distortion	f = 5MHz, V_O = 2V$_{PP}$, A_V = −1, R_L = 100Ω to $V^+/2$		−48		dBc
DG	Differential Gain	V_{CM} = 1V, NTSC, A_V = +2 R_L =150Ω to $V^+/2$		0.17%		
		R_L =1kΩ to $V^+/2$		0.03%		
DP	Differential Phase	V_{CM} = 1V, NTSC, A_V = +2 R_L =150Ω to $V^+/2$		0.05		deg
		R_L =1kΩ to $V^+/2$		0.03		
CT Rej.	Cross-Talk Rejection	f = 5MHz, Receiver: R_f = R_g = 510Ω, A_V = +2		47		dB
T_S	Settling Time	V_O = 2V$_{PP}$, ±0.1%, 8pF Load, V_S = 5V		68		ns
SR	Slew Rate(3)	A_V = −1, V_I = 2V$_{PP}$	90	120		V/µs
V_{OS}	Input Offset Voltage	For LMH6642		±1	±5 **±7**	mV
		For LMH6643		±1	±3.4 **±7**	
TC V_{OS}	Input Offset Average Drift	(4)		±5		µV/°C
I_B	Input Bias Current	(5)		−1.50	−2.60 **−3.25**	µA
I_{OS}	Input Offset Current			20	800 **1000**	nA
R_{IN}	Common Mode Input Resistance			3		MΩ
C_{IN}	Common Mode Input Capacitance			2		pF
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 50dB		−0.5	−0.2 **−0.1**	V
			1.8 **1.6**	2.0		
CMRR	Common Mode Rejection Ratio	V_{CM} Stepped from 0V to 1.5V	72	95		dB
A_{VOL}	Large Signal Voltage Gain	V_O = 0.5V to 2.5V R_L = 2kΩ to $V^+/2$	80 **75**	96		dB
		V_O = 0.5V to 2.5V R_L = 150Ω to $V^+/2$	74 **70**	82		
V_O	Output Swing High	R_L = 2kΩ to $V^+/2$, V_{ID} = 200mV	2.90	2.98		V
		R_L = 150Ω to $V^+/2$, V_{ID} = 200mV	2.80	2.93		
	Output Swing Low	R_L = 2kΩ to $V^+/2$, V_{ID} = −200mV		25	75	mV
		R_L = 150Ω to $V^+/2$, V_{ID} = −200mV		75	150	

(1) All limits are ensured by testing or statistical analysis.
(2) Typical values represent the most likely parametric norm.
(3) Slew rate is the average of the rising and falling slew rates.
(4) Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes by the total temperature change.
(5) Positive current corresponds to current flowing into the device.

3V Electrical Characteristics (continued)

Unless otherwise specified, all limits ensured for V^+ = 3V, V^- = 0V, $V_{CM} = V_O = V^+/2$, V_{ID} (input differential voltage) as noted (where applicable) and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$ V_{ID} = 200mV (6)	50 **35**	95		mA
		Sinking to $V^+/2$ V_{ID} = −200mV (6)	55 **40**	110		
I_{OUT}	Output Current	V_{OUT} = 0.5V from either supply		±65		mA
+PSRR	Positive Power Supply Rejection Ratio	V^+ = 3.0V to 3.5V, V_{CM} = 1.5V	75	85		dB
I_S	Supply Current (per channel)	No Load		2.70	4.00 **4.50**	mA

(6) Short circuit test is a momentary test. Output short circuit duration is infinite for V_S < 6V at room temperature and below. For V_S > 6V, allowable short circuit duration is 1.5ms.

7.6 5V Electrical Characteristics

Unless otherwise specified, all limits ensured for V^+ = 5V, V^- = 0V, V_{CM} = V_O = $V^+/2$, V_{ID} (input differential voltage) as noted (where applicable) and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
BW	−3dB BW	A_V = +1, V_{OUT} = 200mV$_{PP}$	90	120		MHz
		A_V = +2, −1, V_{OUT} = 200mV$_{PP}$		46		
$BW_{0.1dB}$	0.1dB Gain Flatness	A_V = +2, R_L = 150Ω to V+/2, R_f = 402Ω, V_{OUT} = 200mV$_{PP}$		15		MHz
PBW	Full Power Bandwidth	A_V = +1, −1dB, V_{OUT} = 2V$_{PP}$		22		MHz
e_n	Input-Referred Voltage Noise	f = 100kHz		17		nV/√Hz
		f = 1kHz		48		
i_n	Input-Referred Current Noise	f = 100kHz		0.90		pA/√Hz
		f = 1kHz		3.3		
THD	Total Harmonic Distortion	f = 5MHz, V_O = 2V$_{PP}$, A_V = +2		−60		dBc
DG	Differential Gain	NTSC, A_V = +2, R_L =150Ω to $V^+/2$		0.16%		
		R_L = 1kΩ to $V^+/2$		0.05%		
DP	Differential Phase	NTSC, A_V = +2, R_L = 150Ω to $V^+/2$		0.05		deg
		R_L = 1kΩ to $V^+/2$		0.01		
CT Rej.	Cross-Talk Rejection	f = 5MHz, Receiver: R_f = R_g = 510Ω, A_V = +2		47		dB
T_S	Settling Time	V_O = 2V$_{PP}$, ±0.1%, 8pF Load		68		ns
SR	Slew Rate (3)	A_V = −1, V_I = 2V$_{PP}$	95	125		V/µs
V_{OS}	Input Offset Voltage	For LMH6642		±1	±5 **±7**	mV
		For LMH6643		±1	±3.4 **±7**	
TC V_{OS}	Input Offset Average Drift	(4)		±5		µV/°C
I_B	Input Bias Current	(5)		−1.70	−2.60 **−3.25**	µA
I_{OS}	Input Offset Current			20	800 **1000**	nA
R_{IN}	Common Mode Input Resistance			3		MΩ
C_{IN}	Common Mode Input Capacitance			2		pF
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 50dB		−0.5	−0.2 **−0.1**	V
			3.8 **3.6**	4.0		
CMRR	Common Mode Rejection Ratio	V_{CM} Stepped from 0V to 3.5V	72	95		dB
A_{VOL}	Large Signal Voltage Gain	V_O = 0.5V to 4.50V, R_L = 2kΩ to $V^+/2$	86 **82**	98		dB
		V_O = 0.5V to 4.25V, R_L = 150Ω to $V^+/2$	76 **72**	82		
V_O	Output Swing High	R_L = 2kΩ to $V^+/2$, V_{ID} = 200mV	4.90	4.98		V
		R_L = 150Ω to $V^+/2$, V_{ID} = 200mV	4.65	4.90		
	Output Swing Low	R_L = 2kΩ to $V^+/2$, V_{ID} = −200mV		25	100	mV
		R_L = 150Ω to $V^+/2$, V_{ID} = −200mV		100	150	

(1) All limits are ensured by testing or statistical analysis.
(2) Typical values represent the most likely parametric norm.
(3) Slew rate is the average of the rising and falling slew rates.
(4) Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes by the total temperature change.
(5) Positive current corresponds to current flowing into the device.

5V Electrical Characteristics (continued)

Unless otherwise specified, all limits ensured for V^+ = 5V, V^- = 0V, $V_{CM} = V_O = V^+/2$, V_{ID} (input differential voltage) as noted (where applicable) and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$ V_{ID} = 200mV (6)	55 **40**	115		mA
		Sinking to $V^+/2$ V_{ID} = −200mV (6)	70 **55**	140		
I_{OUT}	Output Current	V_O = 0.5V from either supply		±70		mA
+PSRR	Positive Power Supply Rejection Ratio	V^+ = 4.0V to 6V	79	90		dB
I_S	Supply Current (per channel)	No Load		2.70	4.25 **5.00**	mA

(6) Short circuit test is a momentary test. Output short circuit duration is infinite for V_S < 6V at room temperature and below. For V_S > 6V, allowable short circuit duration is 1.5ms.

7.7 ±5V Electrical Characteristics

Unless otherwise specified, all limits ensured for V^+ = 5V, V^- = −5V, V_{CM} = V_O = 0V, V_{ID} (input differential voltage) as noted (where applicable) and R_L = 2kΩ to ground. **Boldface** limits apply at the temperature extremes.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
BW	−3dB BW	A_V = +1, V_{OUT} = 200mV$_{PP}$	95	130		MHz
		A_V = +2, −1, V_{OUT} = 200mV$_{PP}$		46		
$BW_{0.1dB}$	0.1dB Gain Flatness	A_V = +2, R_L = 150Ω to V+/2, R_f = 806Ω, V_{OUT} = 200mV$_{PP}$		12		MHz
PBW	Full Power Bandwidth	A_V = +1, −1dB, V_{OUT} = 2V$_{PP}$		24		MHz
e_n	Input-Referred Voltage Noise	f = 100kHz		17		nV/√Hz
		f = 1kHz		48		
i_n	Input-Referred Current Noise	f = 100kHz		0.90		pA/√Hz
		f = 1kHz		3.3		
THD	Total Harmonic Distortion	f = 5MHz, V_O = 2V$_{PP}$, A_V = +2		−62		dBc
DG	Differential Gain	NTSC, A_V = +2, R_L = 150Ω to V^+/2		0.15%		
		R_L = 1kΩ to V^+/2		0.01%		
DP	Differential Phase	NTSC, A_V = +2, R_L = 150Ω to V^+/2		0.04		deg
		R_L = 1kΩ to V^+/2		0.01		
CT Rej.	Cross-Talk Rejection	f = 5MHz, Receiver: R_f = R_g = 510Ω, A_V = +2		47		dB
T_S	Settling Time	V_O = 2V$_{PP}$, ±0.1%, 8pF Load, V_S = 5V		68		ns
SR	Slew Rate (3)	A_V = −1, V_I = 2V$_{PP}$	100	135		V/µs
V_{OS}	Input Offset Voltage	For LMH6642		±1	±5 **±7**	mV
		For LMH6643		±1	±3.4 **±7**	
TC V_{OS}	Input Offset Average Drift	(4)		±5		µV/°C
I_B	Input Bias Current	(5)		−1.60	−2.60 **−3.25**	µA
I_{OS}	Input Offset Current			20	800 **1000**	nA
R_{IN}	Common Mode Input Resistance			3		MΩ
C_{IN}	Common Mode Input Capacitance			2		pF
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 50dB		−5.5	−5.2 **−5.1**	V
			3.8 **3.6**	4.0		
CMRR	Common Mode Rejection Ratio	V_{CM} Stepped from −5V to 3.5V	74	95		dB
A_{VOL}	Large Signal Voltage Gain	V_O = −4.5V to 4.5V, R_L = 2kΩ	88 **84**	96		dB
		V_O = −4.0V to 4.0V, R_L = 150Ω	78 **74**	82		
V_O	Output Swing High	R_L = 2kΩ, V_{ID} = 200mV	4.90	4.96		V
		R_L = 150Ω, V_{ID} = 200mV	4.65	4.80		
	Output Swing Low	R_L = 2kΩ, V_{ID} = −200mV		−4.96	−4.90	V
		R_L = 150Ω, V_{ID} = −200mV		−4.80	−4.65	

(1) All limits are ensured by testing or statistical analysis.
(2) Typical values represent the most likely parametric norm.
(3) Slew rate is the average of the rising and falling slew rates.
(4) Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes by the total temperature change.
(5) Positive current corresponds to current flowing into the device.

±5V Electrical Characteristics (continued)

Unless otherwise specified, all limits ensured for V^+ = 5V, V^- = −5V, V_{CM} = V_O = 0V, V_{ID} (input differential voltage) as noted (where applicable) and R_L = 2kΩ to ground. **Boldface** limits apply at the temperature extremes.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
I_{SC}	Output Short Circuit Current	Sourcing to Ground V_{ID} = 200mV (6)	60 **35**	115		mA
		Sinking to Ground V_{ID} = −200mV (6)	85 **65**	145		
I_{OUT}	Output Current	V_O = 0.5V from either supply	±75			mA
PSRR	Power Supply Rejection Ratio	(V^+, V^-) = (4.5V, −4.5V) to (5.5V, −5.5V)	78	90		dB
I_S	Supply Current (per channel)	No Load		2.70	4.50 **5.50**	mA

(6) Short circuit test is a momentary test. Output short circuit duration is infinite for V_S < 6V at room temperature and below. For V_S > 6V, allowable short circuit duration is 1.5ms.

7.8 Typical Performance Characteristics

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

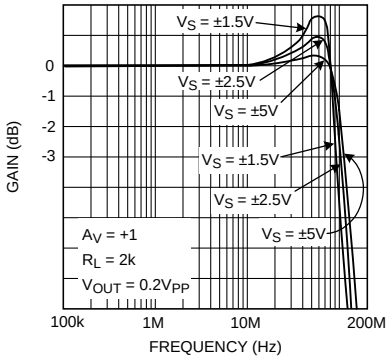


Figure 1. Closed Loop Frequency Response for Various Supplies

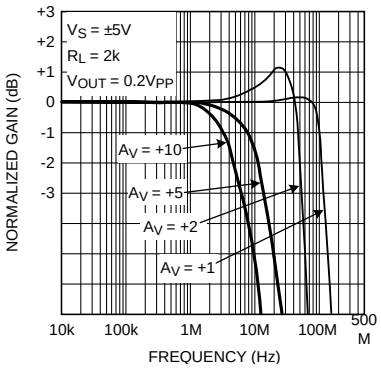


Figure 2. Closed Loop Gain vs. Frequency for Various Gain

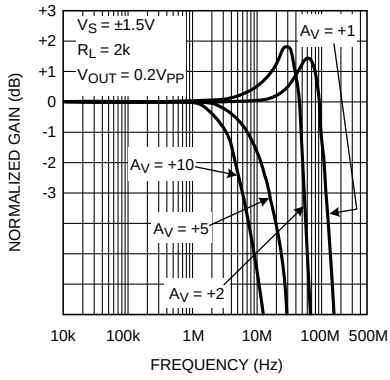


Figure 3. Closed Loop Gain vs. Frequency for Various Gain

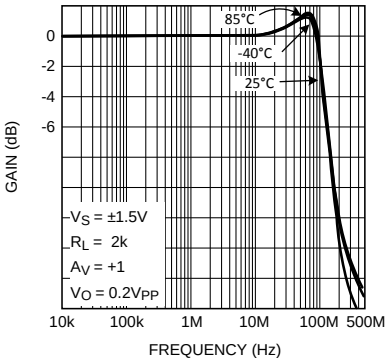


Figure 4. Closed Loop Frequency Response for Various Temperature

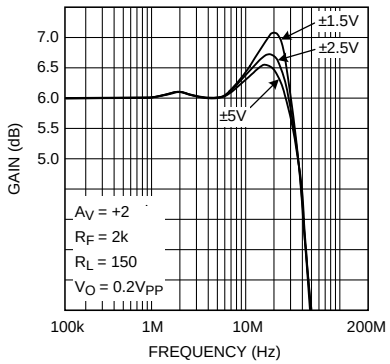


Figure 5. Closed Loop Gain vs. Frequency for Various Supplies

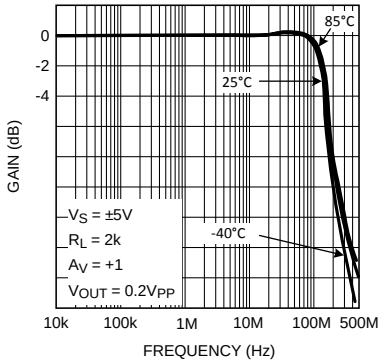


Figure 6. Closed Loop Frequency Response for Various Temperature

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

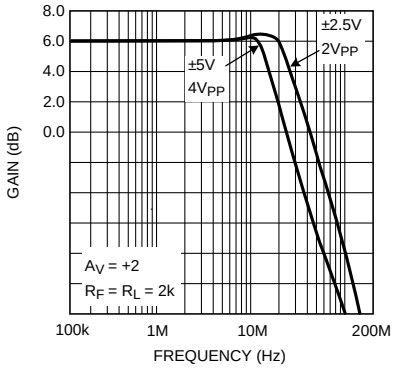


Figure 7. Large Signal Frequency Response

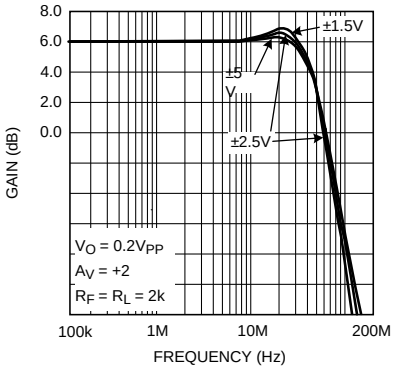


Figure 8. Closed Loop Small Signal Frequency Response for Various Supplies

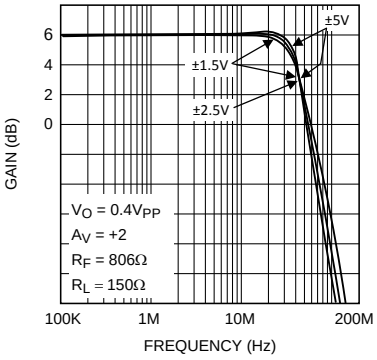


Figure 9. Closed Loop Frequency Response for Various Supplies

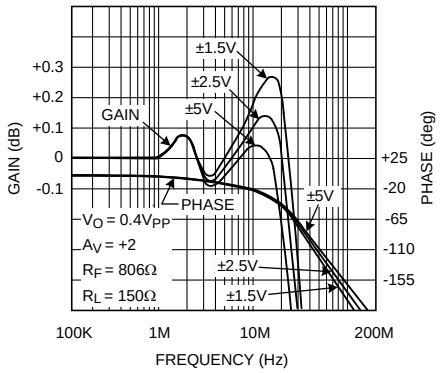


Figure 10. ±0.1dB Gain Flatness for Various Supplies

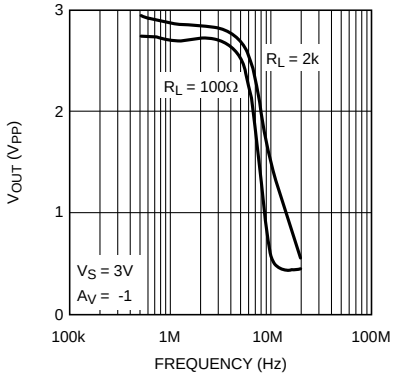


Figure 11. V_{OUT} (V_{PP}) for THD < 0.5%

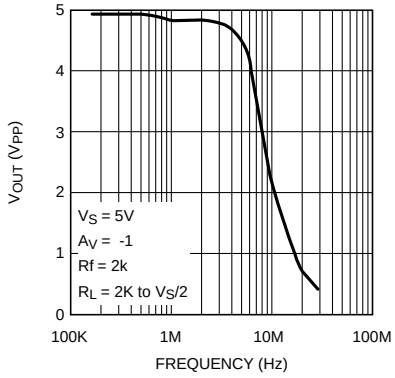


Figure 12. V_{OUT} (V_{PP}) for THD < 0.5%

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

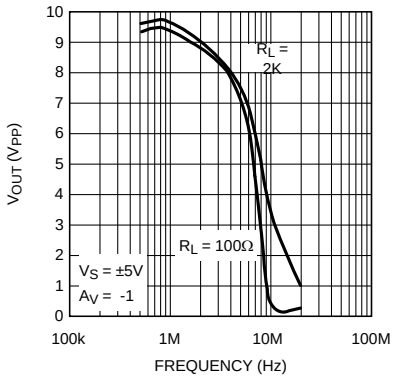


Figure 13. V_{OUT} (V_{PP}) for THD < 0.5%

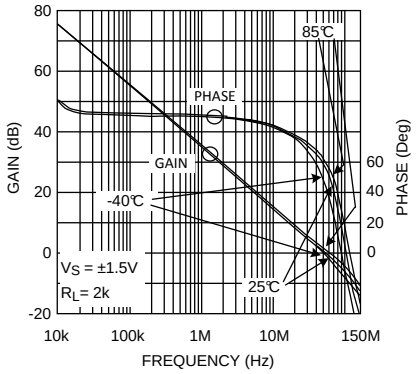


Figure 14. Open Loop Gain/Phase for Various Temperature

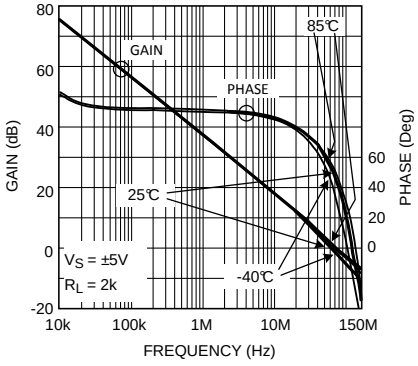


Figure 15. Open Loop Gain/Phase for Various Temperature

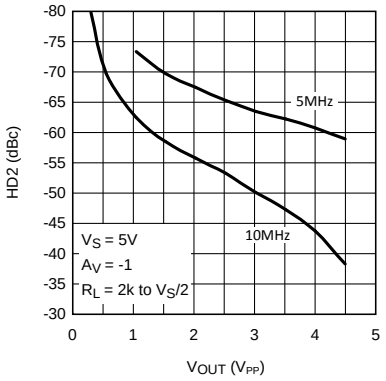


Figure 16. HD2 (dBc) vs. Output Swing

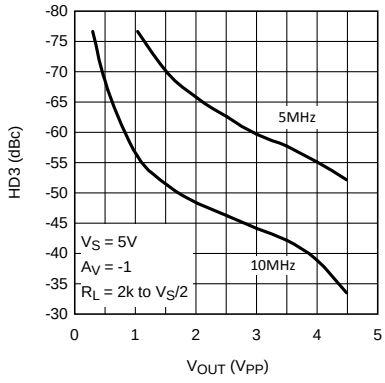


Figure 17. HD3 (dBc) vs. Output Swing

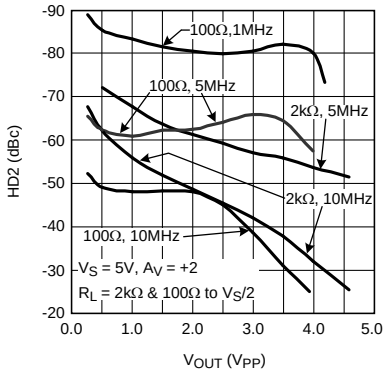


Figure 18. HD2 vs. Output Swing

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

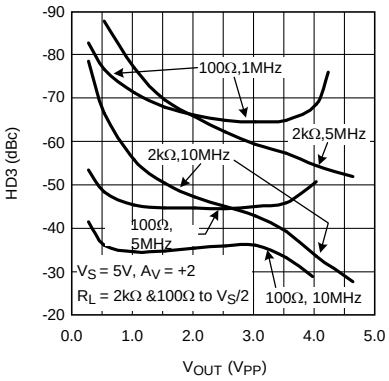


Figure 19. HD3 vs. Output Swing

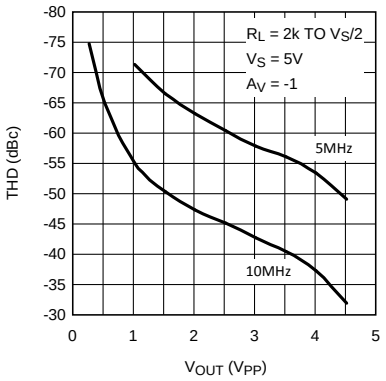


Figure 20. THD (dBc) vs. Output Swing

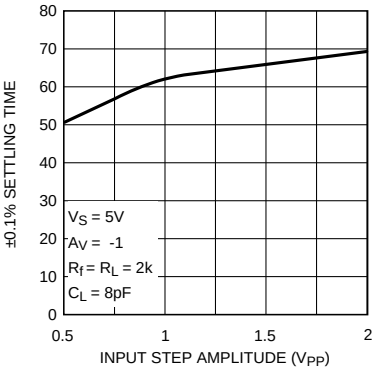


Figure 21. Settling Time vs. Input Step Amplitude (Output Slew and Settle Time)

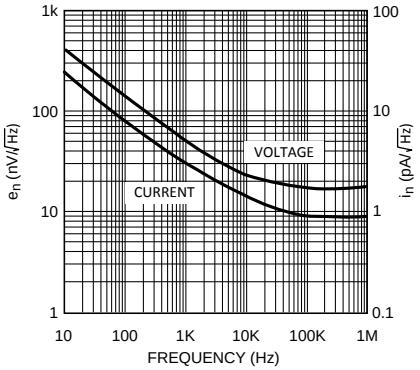


Figure 22. Input Noise vs. Frequency

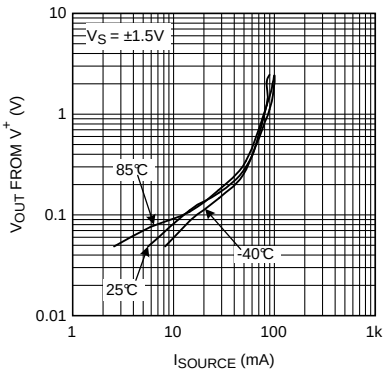


Figure 23. V_{OUT} from V^+ vs. I_{SOURCE}

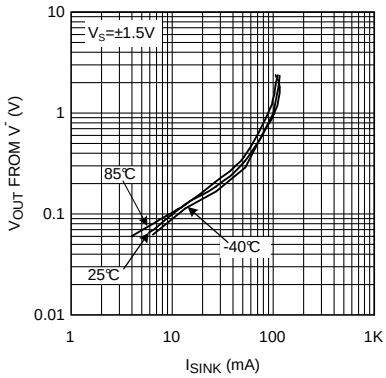


Figure 24. V_{OUT} from V^- vs. I_{SINK}

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

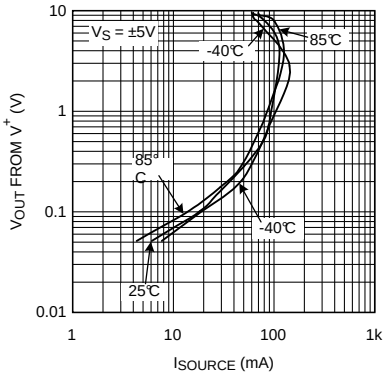


Figure 25. V_{OUT} from V^+ vs. I_{SOURCE}

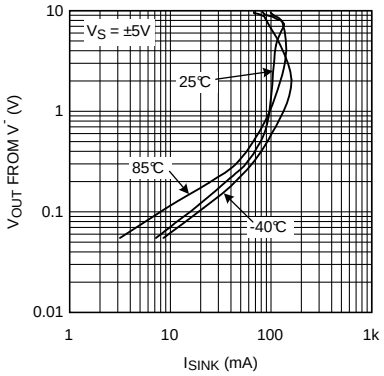


Figure 26. V_{OUT} from V^- vs. I_{SINK}

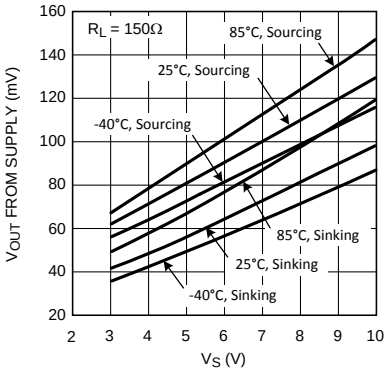


Figure 27. Swing vs. V_S

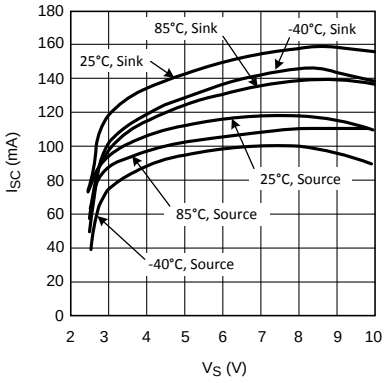


Figure 28. Short Circuit Current (to V_S/2) vs. V_S

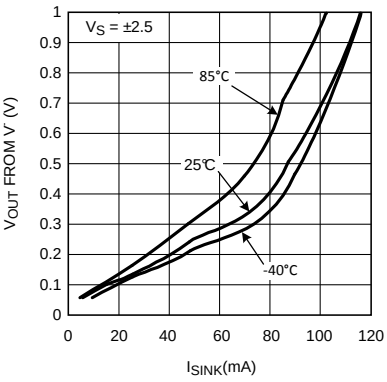


Figure 29. Output Sinking Saturation Voltage vs. I_{OUT}

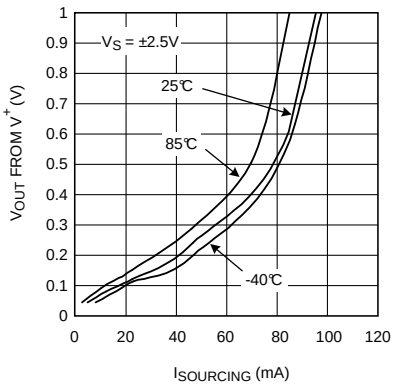


Figure 30. Output Sourcing Saturation Voltage vs. I_{OUT}

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

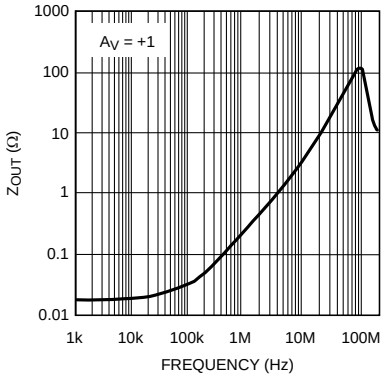


Figure 31. Closed Loop Output Impedance vs. Frequency, A_V = +1

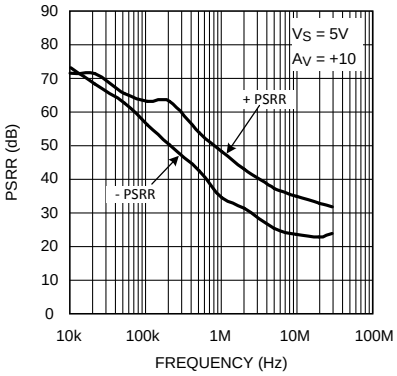


Figure 32. PSRR vs. Frequency

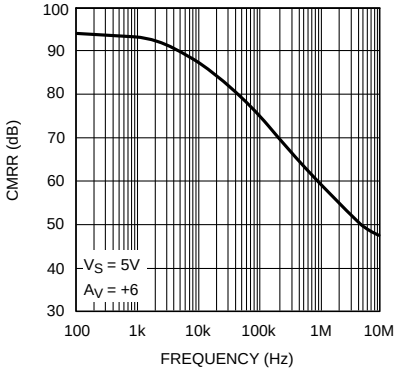


Figure 33. CMRR vs. Frequency

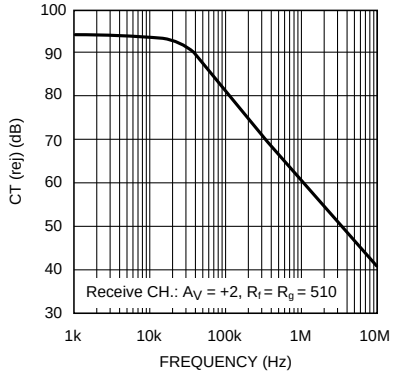


Figure 34. Crosstalk Rejection vs. Frequency (Output to Output)

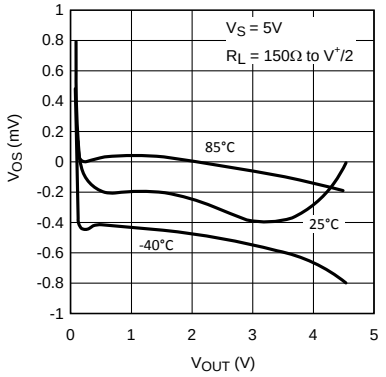


Figure 35. V_{OS} vs. V_{OUT} (Typical Unit)

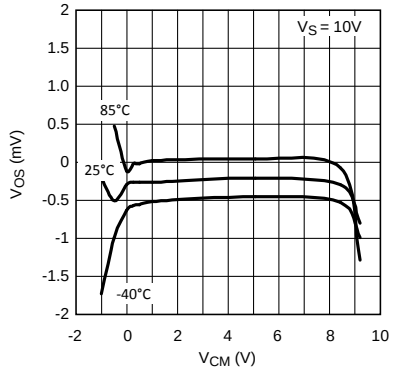


Figure 36. V_{OS} vs. V_{CM} (Typical Unit)

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

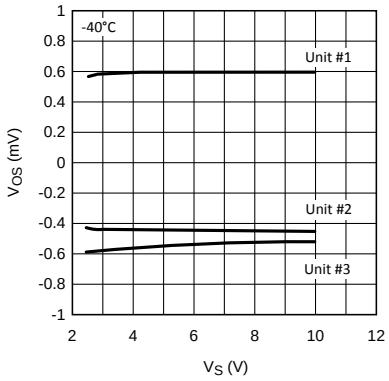


Figure 37. V_{OS} vs. V_S (for 3 Representative Units)

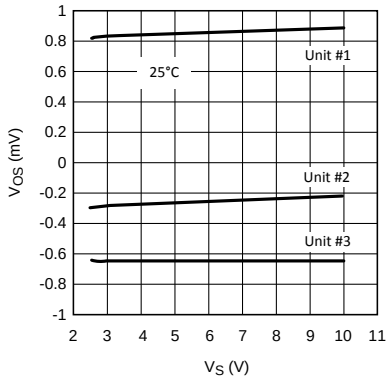


Figure 38. V_{OS} vs. V_S (for 3 Representative Units)

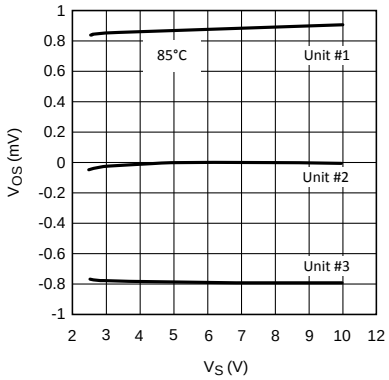


Figure 39. V_{OS} vs. V_S (for 3 Representative Units)

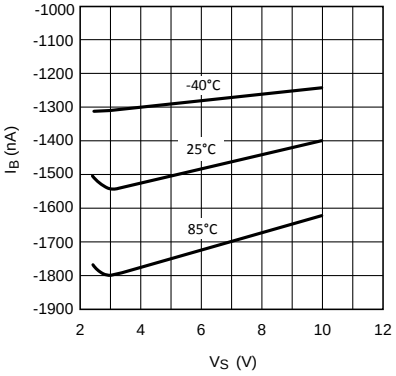


Figure 40. I_B vs. V_S

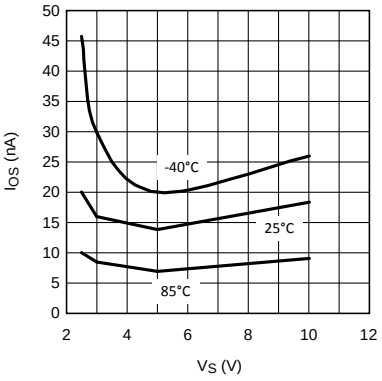


Figure 41. I_{OS} vs. V_S

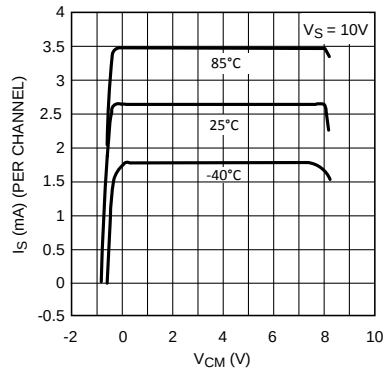


Figure 42. I_S vs. V_{CM}

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

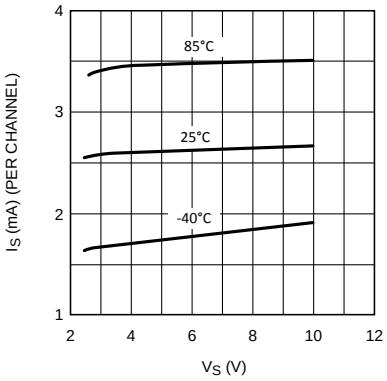


Figure 43. I_S vs. V_S

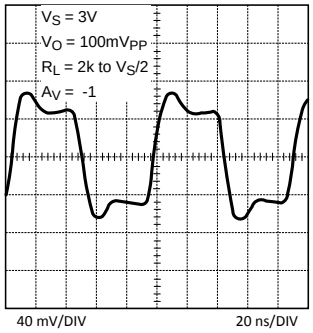


Figure 44. Small Signal Step Response

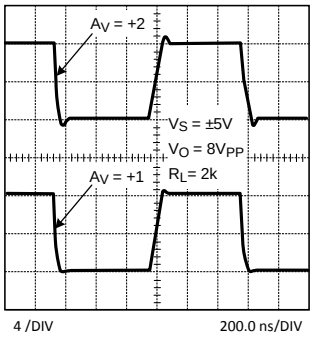


Figure 45. Large Signal Step Response

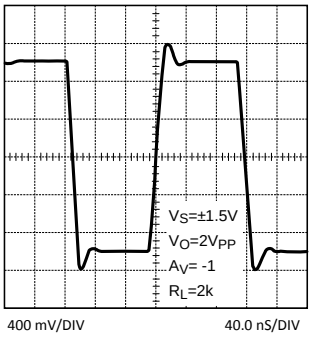


Figure 46. Large Signal Step Response

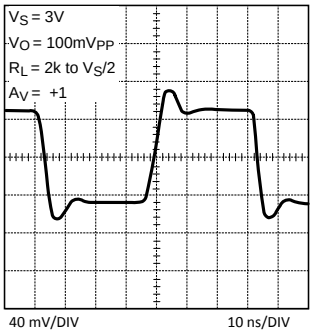


Figure 47. Small Signal Step Response

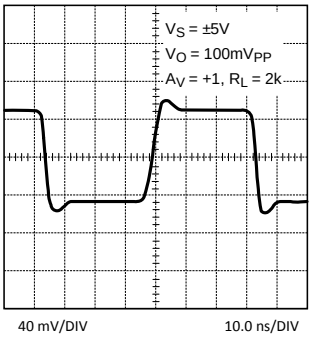


Figure 48. Small Signal Step Response

Typical Performance Characteristics (continued)

V^+ = +5, V^- = −5V, R_F = R_L = 2kΩ. Unless otherwise specified.

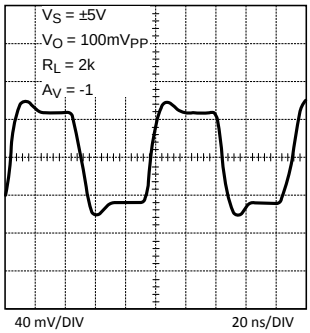


Figure 49. Small Signal Step Response

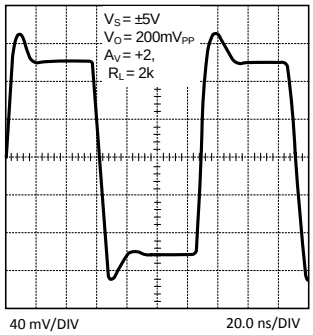


Figure 50. Small Signal Step Response

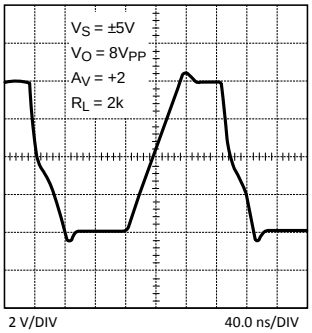


Figure 51. Large Signal Step Response

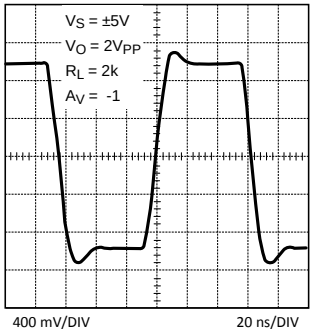


Figure 52. Large Signal Step Response

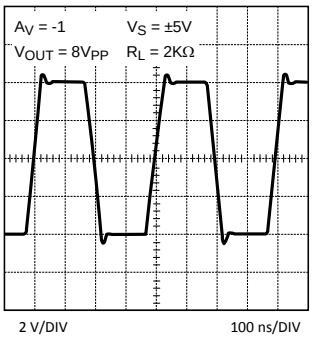


Figure 53. Large Signal Step Response

8 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Circuit Description

The LMH664X family is based on Texas Instruments' proprietary VIP10 dielectrically isolated bipolar process.

This device family architecture features the following:

- Complimentary bipolar devices with exceptionally high f_t (~8 GHz) even under low supply voltage (2.7 V) and low bias current.
- A class A-B "turn-around" stage with improved noise, offset, and reduced power dissipation compared to similar speed devices (patent pending).
- Common Emitter push-push output stage capable of 75mA output current (at 0.5V from the supply rails) while consuming only 2.7 mA of total supply current per channel. This architecture allows output to reach within milli-volts of either supply rail.
- Consistent performance over the entire operating supply voltage range with little variation for the most important specifications (for example, BW, SR, I_{OUT}, and so forth).
- Significant power saving (~40%) compared to competitive devices on the market with similar performance.

8.1.1 Application Hints

This Op Amp family is a drop-in replacement for the AD805X family of high speed Op Amps in most applications. In addition, the LMH664X will typically save about 40% on power dissipation, due to lower supply current, when compared to competition. All AD805X family's ensured parameters are included in the list of LMH664X ensured specifications in order to ensure equal or better level of performance. However, as in most high performance parts, due to subtleties of applications, it is strongly recommended that the performance of the part to be evaluated is tested under actual operating conditions to ensure full compliance to all specifications.

With 3V supplies and a common mode input voltage range that extends 0.5V below V^-, the LMH664X find applications in low voltage/low power applications. Even with 3V supplies, the −3dB BW (@ A_V = +1) is typically 115MHz with a tested limit of 80MHz. Production testing ensures that process variations with not compromise speed. High frequency response is exceptionally stable confining the typical −3dB BW over the industrial temperature range to ±2.5%.

As can be seen from the *Typical Performance Characteristics*, the LMH664X output current capability (~75mA) is enhanced compared to AD805X. This enhancement, increases the output load range, adding to the LMH664X's versatility.

Because of the LMH664X's high output current capability attention should be given to device junction temperature in order not to exceed the Absolute Maximum Rating.

Circuit Description (continued)

This device family was designed to avoid output phase reversal. With input overdrive, the output is kept near supply rail (or as closed to it as mandated by the closed loop gain setting and the input voltage). See Figure 54:

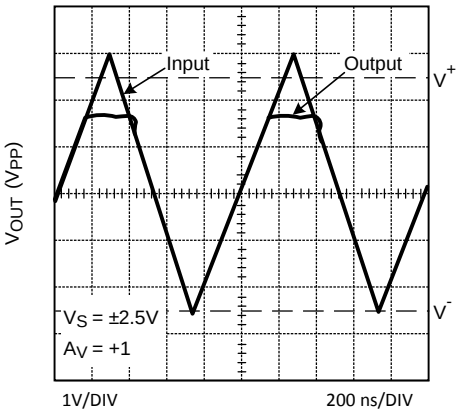


Figure 54. Input and Output Shown with CMVR Exceeded

However, if the input voltage range of −0.5V to 1V from V^+ is exceeded by more than a diode drop, the internal ESD protection diodes will start to conduct. The current in the diodes should be kept at or below 10mA.

Output overdrive recovery time is less than 100ns as can be seen from Figure 55 plot:

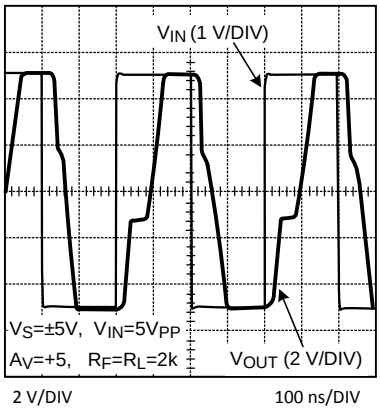


Figure 55. Overload Recovery Waveform

Circuit Description (continued)

8.1.2 Input and Output Topology

All input / output pins are protected against excessive voltages by ESD diodes connected to V^+ and V^- rails (see Figure 56). These diodes start conducting when the input / output pin voltage approaches $1V_{be}$ beyond V^+ or V^- to protect against over voltage. These diodes are normally reverse biased. Further protection of the inputs is provided by the two resistors (R in Figure 56), in conjunction with the string of anti-parallel diodes connected between both bases of the input stage. The combination of these resistors and diodes reduces excessive differential input voltages approaching $2V_{be}$. The most common situation when this occurs is when the device is used as a comparator (or with little or no feedback) and the device inputs no longer follow each other. In such a case, the diodes may conduct. As a consequence, input current increases and the differential input voltage is clamped. It is important to make sure that the subsequent current flow through the device input pins does not violate the Absolute Maximum Ratings of the device. To limit the current through this protection circuit, extra series resistors can be placed. Together with the built-in series resistors of several hundred ohms, these external resistors can limit the input current to a safe number (i.e. < 10mA). Be aware that these input series resistors may impact the switching speed of the device and could slow down the device.

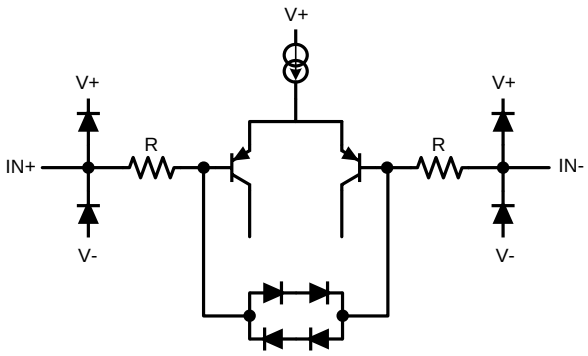


Figure 56. Input Equivalent Circuit

8.2 Single Supply, Low Power Photodiode Amplifier

The circuit shown in Figure 57 is used to amplify the current from a photo-diode into a voltage output. In this circuit, the emphasis is on achieving high bandwidth and the transimpedance gain setting is kept relatively low. Because of its high slew rate limit and high speed, the LMH664X family lends itself well to such an application.

This circuit achieves approximately 1V/mA of transimpedance gain and capable of handling up to $1mA_{pp}$ from the photodiode. Q1, in a common base configuration, isolates the high capacitance of the photodiode (C_d) from the Op Amp input in order to maximize speed. Input is AC coupled through C1 to ease biasing and allow single supply operation. With 5V single supply, the device input/output is shifted to near half supply using a voltage divider from V_{CC}. Note that Q1 collector does not have any voltage swing and the Miller effect is minimized. D1, tied to Q1 base, is for temperature compensation of Q1's bias point. Q1 collector current was set to be large enough to handle the peak-to-peak photodiode excitation and not too large to shift the U1 output too far from mid-supply.

No matter how low an R_f is selected, there is a need for C_f in order to stabilize the circuit. The reason for this is that the Op Amp input capacitance and Q1 equivalent collector capacitance together (C_{IN}) will cause additional phase shift to the signal fed back to the inverting node. C_f will function as a zero in the feedback path counter-acting the effect of the C_{IN} and acting to stabilized the circuit. By proper selection of C_f such that the Op Amp open loop gain is equal to the inverse of the feedback factor at that frequency, the response is optimized with a theoretical 45° phase margin.

$$C_F = \sim \text{SQRT}\left[(C_{IN})/(2\pi \cdot GBWP \cdot R_F)\right] \quad (1)$$

where GBWP is the Gain Bandwidth Product of the Op Amp

Optimized as such, the I-V converter will have a theoretical pole, f_p, at:

$$f_P = \text{SQRT}\left[GBWP/(2\pi R_F \cdot C_{IN})\right] \quad (2)$$

With Op Amp input capacitance of 3pF and an estimate for Q1 output capacitance of about 3pF as well, C_{IN} = 6pF. From *Typical Performance Characteristics*, LMH6642/6643 family GBWP is approximately 57 MHz. Therefore, with R_f = 1k, from Equation 1 and Equation 2 above.

C_f = ~4.1 pF, and f_p = 39 MHz

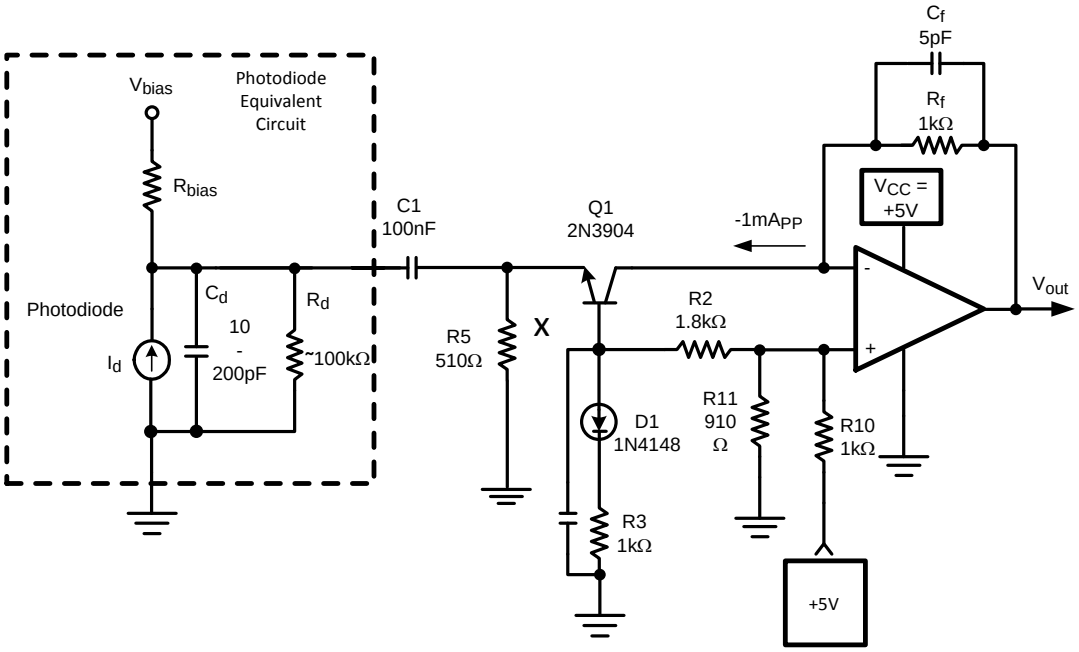


Figure 57. Single Supply Photodiode I-V Converter

Single Supply, Low Power Photodiode Amplifier (continued)

For this example, optimum C_f was empirically determined to be around 5pF. This time domain response is shown in Figure 58 below showing about 9 ns rise/fall times, corresponding to about 39 MHz for f_p. The overall supply current from the +5 V supply is around 5 mA with no load.

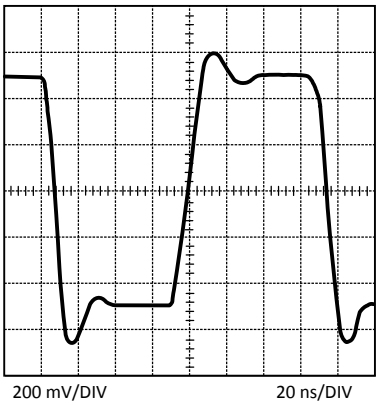


Figure 58. Converter Step Response ($1V_{PP}$, 20 ns/DIV)

8.3 Printed Circuit Board Layout and Component Values Section

Generally, a good high frequency layout will keep power supply and ground traces away from the inverting input and output pins. Parasitic capacitances on these nodes to ground will cause frequency response peaking and possible circuit oscillations (see Application Note OA-15 (SNOA367) for more information). Texas Instruments suggests the following evaluation boards as a guide for high frequency layout and as an aid in device testing and characterization:

DEVICE	PACKAGE	EVALUATION BOARD PN
LMH6642QMF	5-Pin SOT-23	LMH730216
LMH6643QMM	8-Pin VSSOP	LMH730123

Another important parameter in working with high speed/high performance amplifiers, is the component values selection. Choosing external resistors that are large in value will effect the closed loop behavior of the stage because of the interaction of these resistors with parasitic capacitances. These capacitors could be inherent to the device or a by-product of the board layout and component placement. Either way, keeping the resistor values lower, will diminish this interaction to a large extent. On the other hand, choosing very low value resistors could load down nodes and will contribute to higher overall power dissipation.

9 器件和文档支持

9.1 文档支持

9.1.1 相关文档

9.2 相关链接

以下表格列出了快速访问链接。 范围包括技术文档、支持与社区资源、工具和软件，并且可以快速访问样片或购买链接。

表 **1.** 相关链接

部件	产品文件夹	样片与购买	技术文档	工具与软件	支持与社区
LMH6642Q-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
LMH6643Q-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处

9.3 商标

All trademarks are the property of their respective owners.

9.4 静电放电警告

这些装置包含有限的内置 ESD 保护。 存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

9.5 术语表

SLYZ022 — *TI 术语表*。

这份术语表列出并解释术语、首字母缩略词和定义。

10 机械封装和可订购信息

以下页中包括机械封装和可订购信息。 这些信息是针对指定器件可提供的最新数据。 这些数据会在无通知且不对本文档进行修订的情况下发生改变。 欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LMH6642QMF/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	A64Q
LMH6642QMF/NOPB.A	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	A64Q
LMH6642QMFX/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	A64Q
LMH6642QMFX/NOPB.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	A64Q
LMH6643QMM/NOPB	Active	Production	VSSOP (DGK) | 8	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	643Q
LMH6643QMM/NOPB.A	Active	Production	VSSOP (DGK) | 8	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	643Q
LMH6643QMMX/NOPB	Active	Production	VSSOP (DGK) | 8	3500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	643Q
LMH6643QMMX/NOPB.A	Active	Production	VSSOP (DGK) | 8	3500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	643Q

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

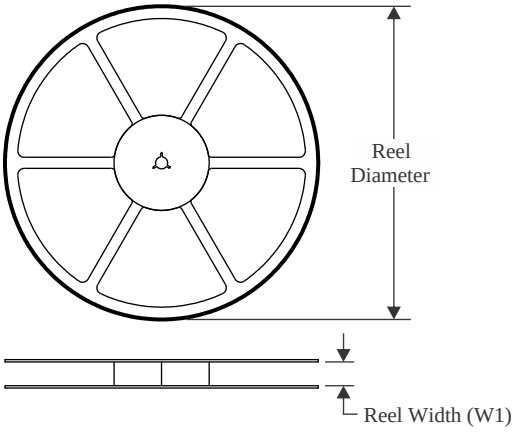
(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

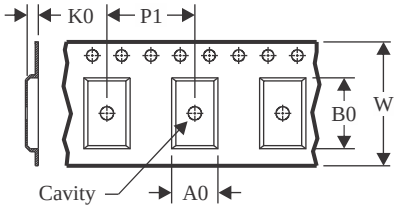
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

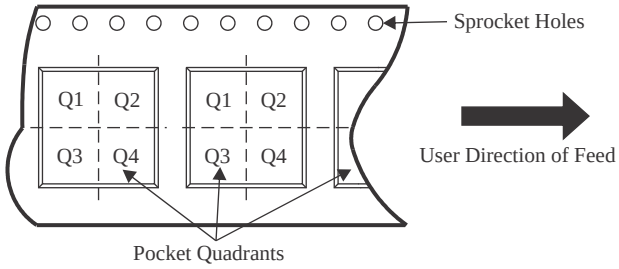


TAPE DIMENSIONS



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

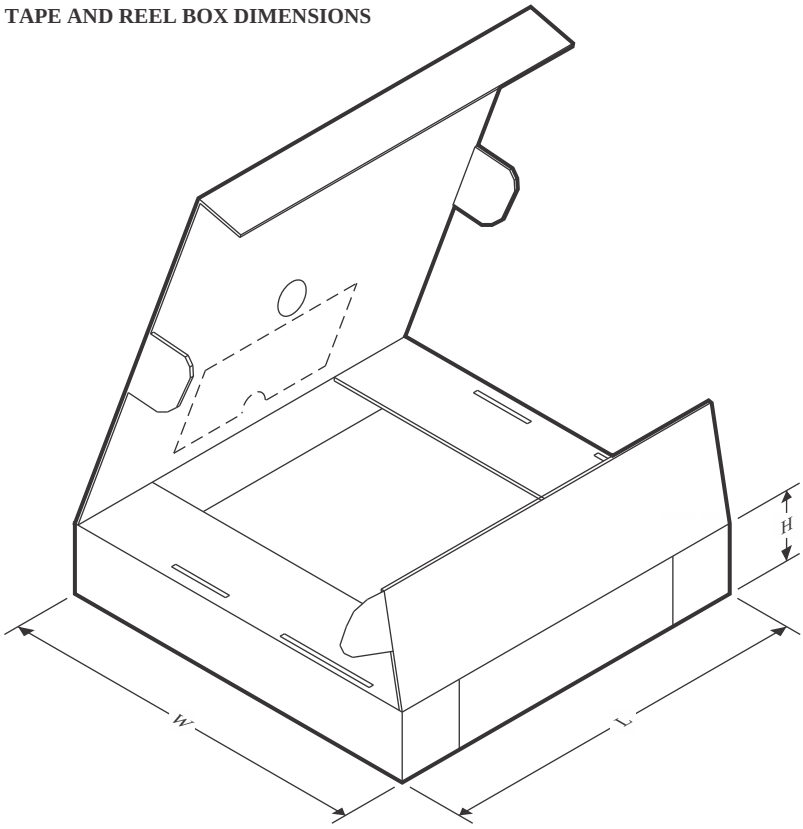
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LMH6642QMF/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMH6642QMFX/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMH6643QMM/NOPB	VSSOP	DGK	8	1000	177.8	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LMH6643QMMX/NOPB	VSSOP	DGK	8	3500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

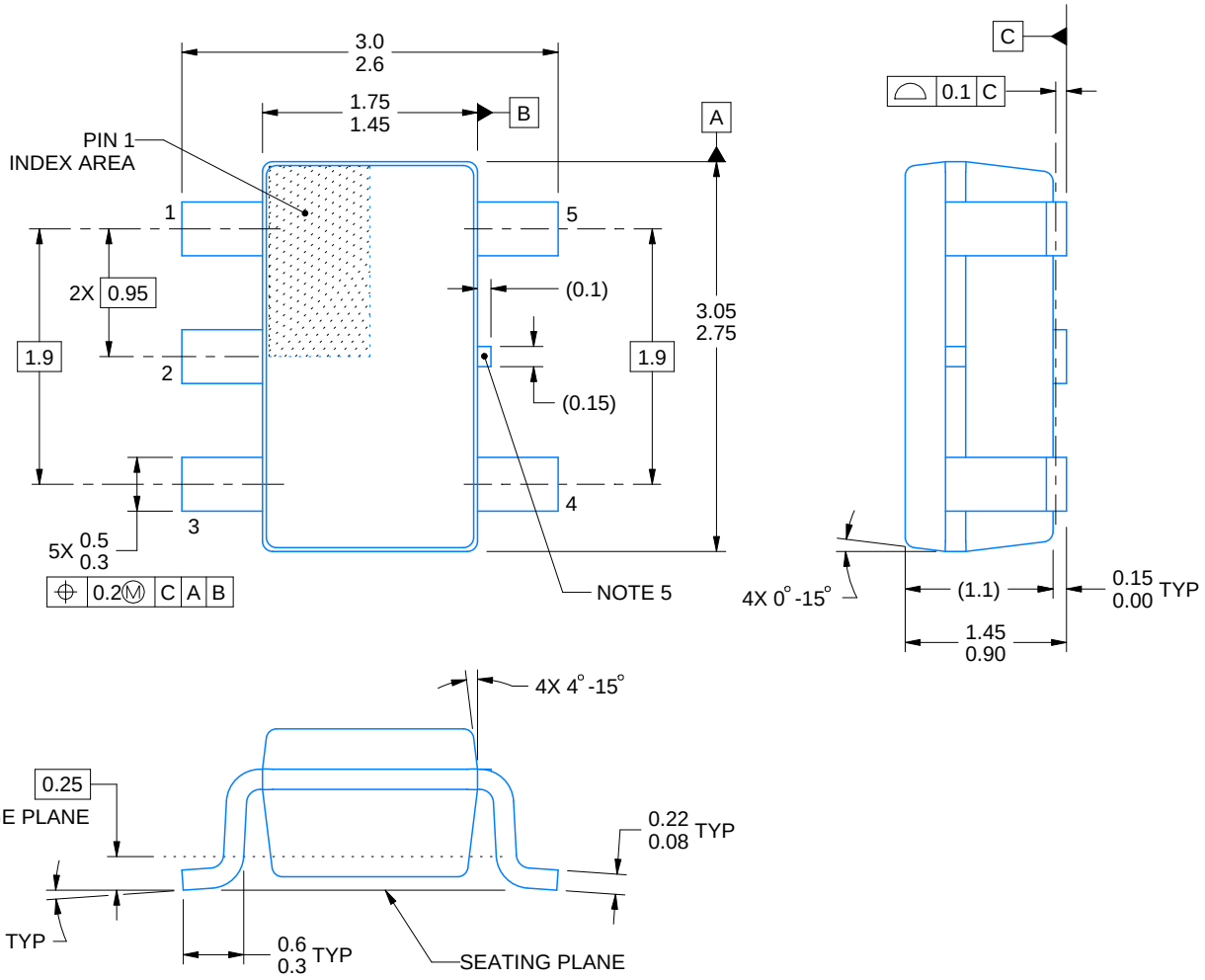
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMH6642QMF/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LMH6642QMFX/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0
LMH6643QMM/NOPB	VSSOP	DGK	8	1000	208.0	191.0	35.0
LMH6643QMMX/NOPB	VSSOP	DGK	8	3500	367.0	367.0	35.0

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

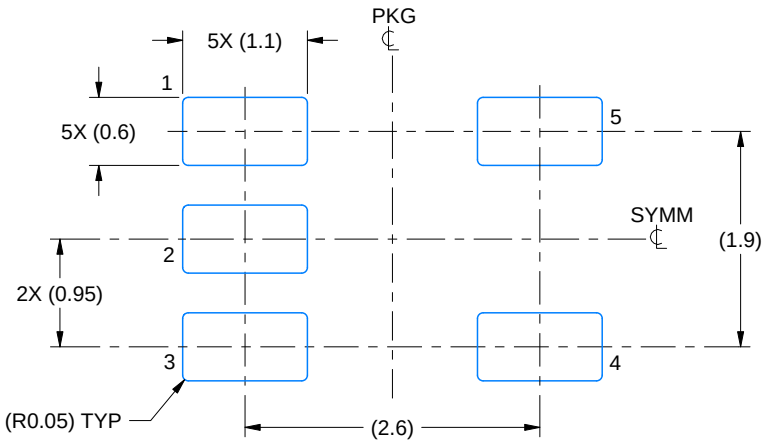
SMALL OUTLINE TRANSISTOR



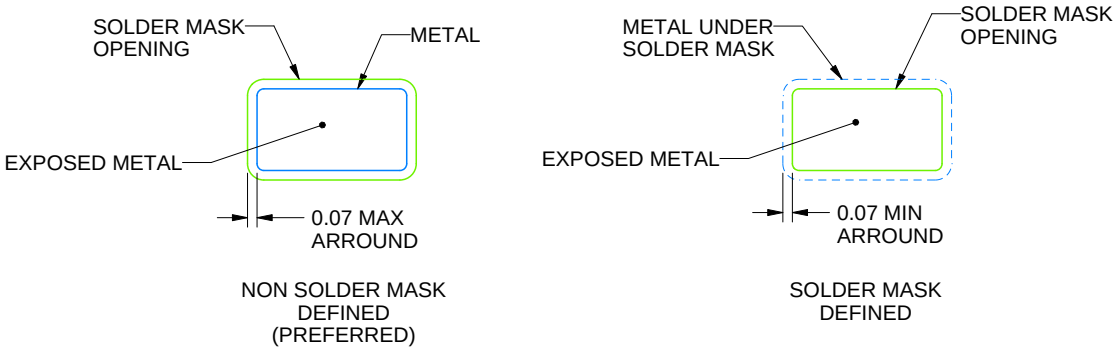
4214839/K 08/2024

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

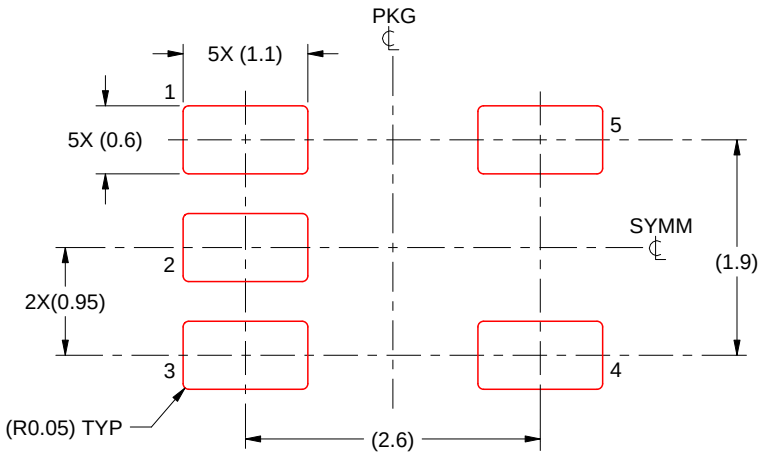


SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

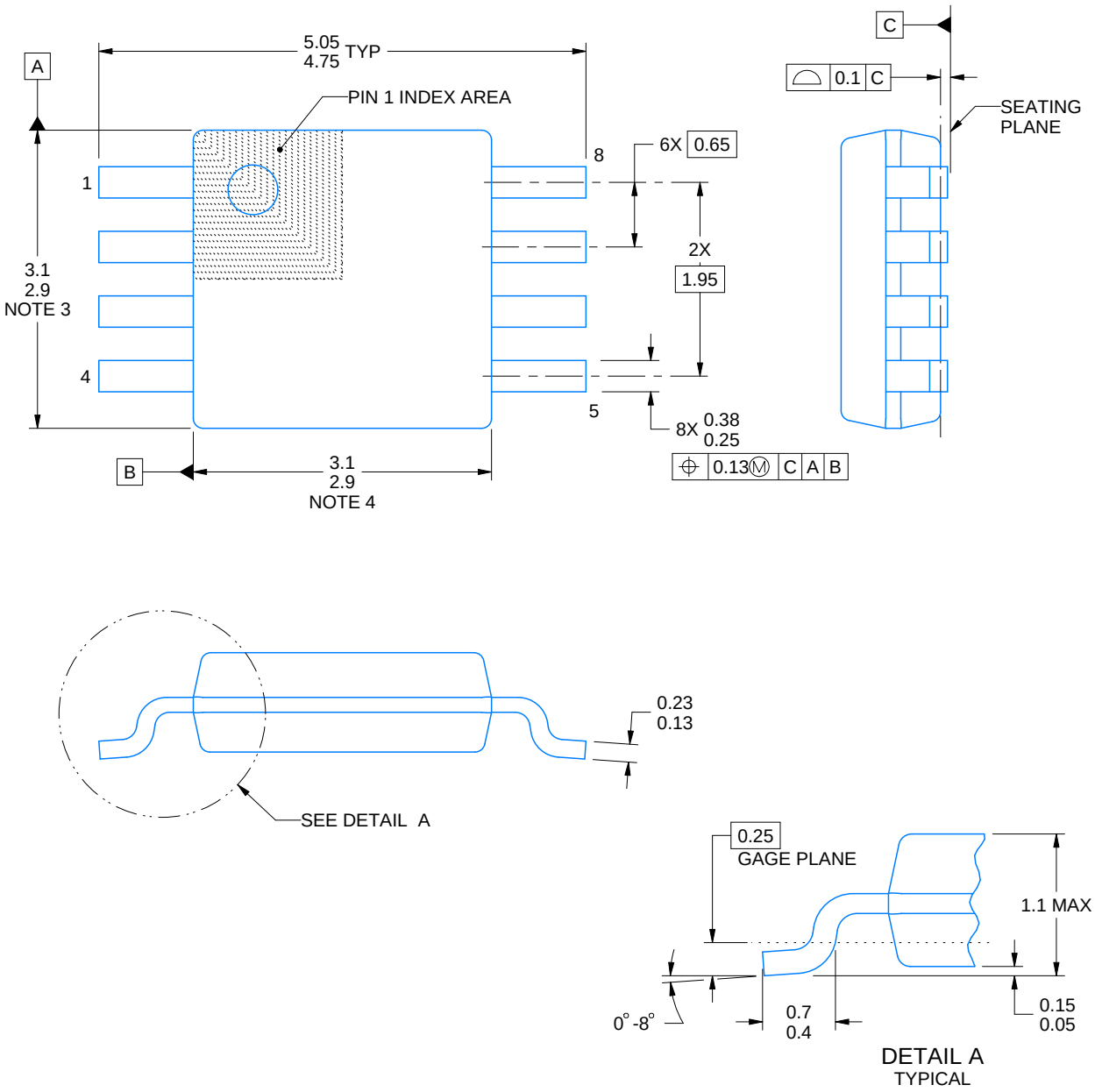
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

DGK0008A

VSSOP - 1.1 mm max height

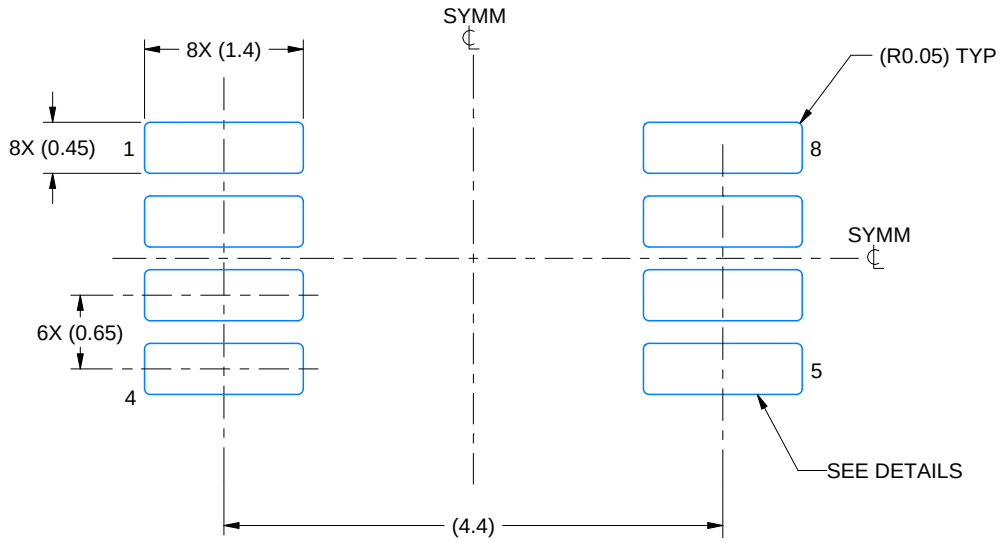
SMALL OUTLINE PACKAGE



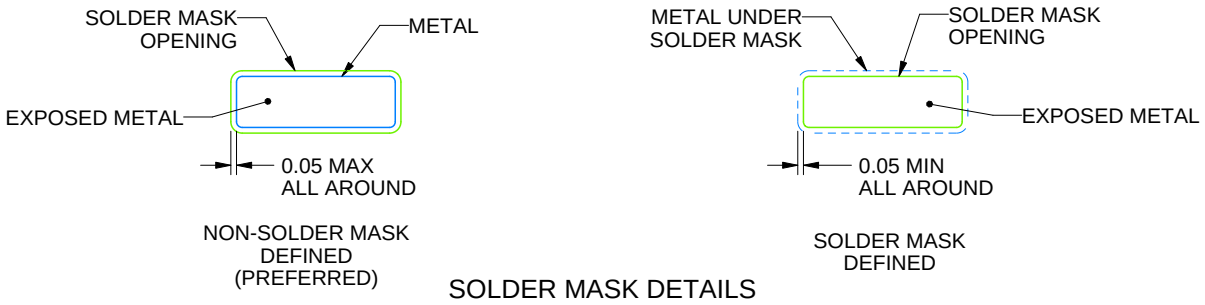
PowerPAD is a trademark of Texas Instruments.

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

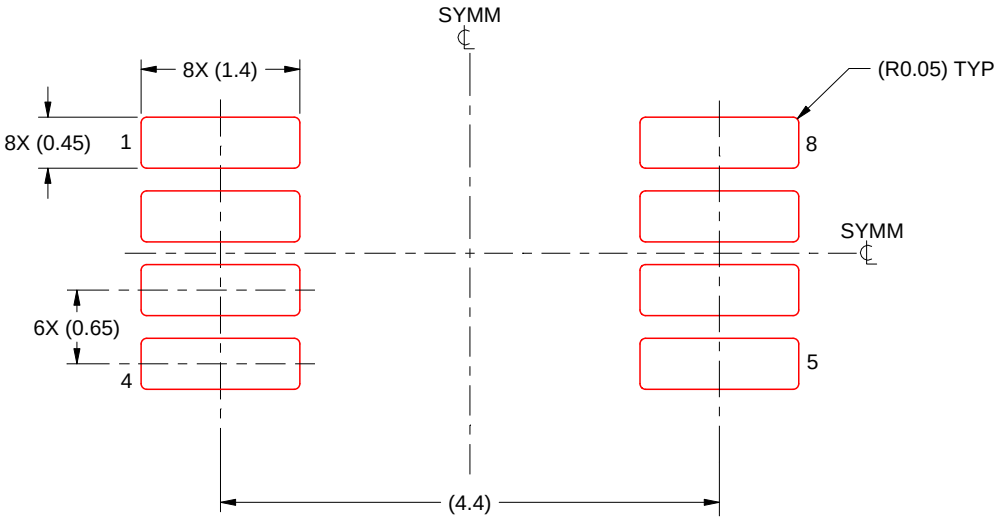


SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.



SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

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