National Semiconductor

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LMH6639
190MHz Rail-to-Rail Output Amplifier with Disable

General Description

The LMH6639 is a voltage feedback operational amplifier with a rail-to-rail output drive capability of 110mA. Employing National's patented VIP10 process, the LMH6639 delivers a bandwidth of 190MHz at a current consumption of only 3.6mA. An input common mode voltage range extending to 0.2V below the V^- and to within 1V of V^+, makes the LMH6639 a true single supply op-amp. The output voltage range extends to within 30mV of either supply rail providing the user with a dynamic range that is especially desirable in low voltage applications.

The LMH6639 offers a slew rate of 172V/µs resulting in a full power bandwidth of approximately 28MHz. The T_{ON} value of 83nsec combined with a settling time of 33nsec makes this device ideally suited for multiplexing applications. 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 for any gain setting including +1, and excellent specifications for driving video cables including harmonic distortion of −60dBc, differential gain of 0.12% and differential phase of 0.045˚

Features

(V_S = 5V, Typical values unless specified)

- Supply current (no load) 3.6mA
- Supply current (off mode) 400µA
- Output resistance (closed loop 1MHz) 0.186Ω
- −3dB BW (A_V = 1) 190MHz
- Settling time 33nsec
- Input common mode voltage −0.2V to 4V
- Output voltage swing 40mV from rails
- Linear output current 110mA
- Total harmonic distortion −60dBc
- Fully characterized for 3V, 5V and ±5V
- No output phase reversal with CMVR exceeded
- Excellent overdrive recovery
- Off Isolation 1MHz −70dB
- Differential Gain 0.12%
- Differential Phase 0.045˚

Applications

- Active filters
- CD/DVD ROM
- ADC buffer amplifier
- Portable video
- Current sense buffer

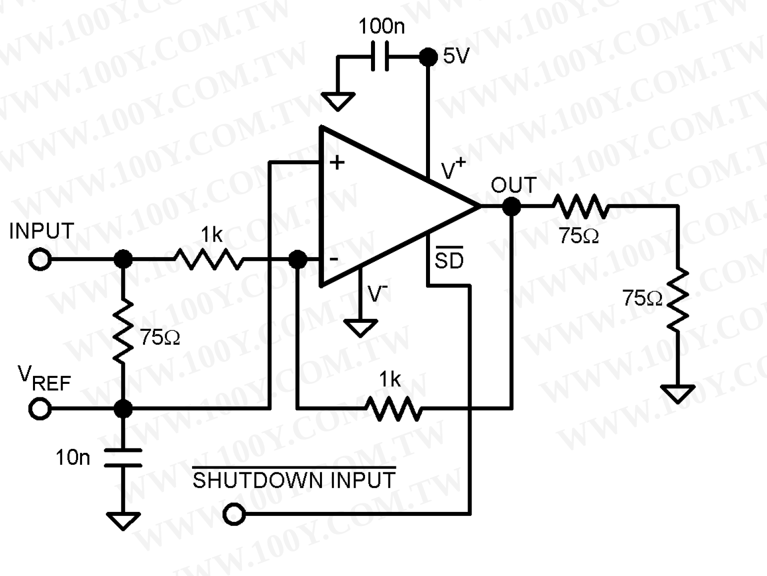


FIGURE 1. Typical Single Supply Schematic

 DS200302

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

ESD Tolerance	2KV (Note 2)
	200V (Note 9)
V_{IN} Differential	±2.5V
Input Current	±10mA
Supply Voltage ($V^+ - V^-$)	13.5V
Voltage at Input/Output pins	V^+ +0.8V, V^- −0.8V
Storage Temperature Range	−65˚C to +150˚C
Junction Temperature (Note 4)	+150˚C
Soldering Information	
Infrared or Convection (20 sec)	235˚C
Wave Soldering (10 sec)	260˚C

Operating Ratings (Note 1)

Operating Temperature Range (Note 4)	−40˚C to +85˚C
Package Thermal Resistance (θ_{JA}) (Note 4)	
SOT23-6	265˚C/W
SOIC-8	190˚C/W

3V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for at T_J = 25˚C, V^+ = 3V, V^- = 0V, $V_O = V_{CM} = V^+/2$, and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
BW	−3dB BW	A_V = +1	120	170		MHz
		A_V = −1		63		MHz
$BW_{0.1dB}$	0.1dB Gain Flatness	R_F = 2.65kΩ , R_L = 1kΩ,		16.4		MHz
FPBW	Full Power Bandwidth	A_V = +1, V_{OUT} = 2V_{PP}, −1dB V^+ = 1.8V, V^- = 1.2V		21		MHz
GBW	Gain Bandwidth product	A_V = +1		83		MHz
e_n	Input-Referred Voltage Noise	R_F = 33kΩ, f = 10kHz		19		nV/ $\sqrt{Hz}$
		R_F = 33kΩ, f = 1MHz		16		nV/ $\sqrt{Hz}$
i_n	Input-Referred Current Noise	R_F = 1MΩ, f = 10kHz		1.30		pA/ $\sqrt{Hz}$
		R_F = 1MΩ, f = 1MHz		0.36		pA/ $\sqrt{Hz}$
THD	Total Harmonic Distortion	f = 5MHz, V_O = 2V_{PP}, A_V = +2, R_L = 1kΩ to $V^+/2$		−50		dBc
T_S	Settling Time	V_O = 2V_{PP}, ±0.1%		37		ns
SR	Slew Rate	A_V = −1 (Note 8)	120	167		V/μs
V_{OS}	Input Offset Voltage			1.01	5 **7**	mV
TC V_{OS}	Input Offset Average Drift	(Note 11)		8		μV/˚C
I_B	Input Bias Current	(Note 7)		−1.02	−2.6 **−3.5**	μA
I_{OS}	Input Offset Current			20	800 **1000**	nA
R_{IN}	Common Mode Input Resistance	A_V = +1, f = 1kHz, R_S = 1MΩ		6.1		MΩ
C_{IN}	Common Mode Input Capacitance	A_V = +1, R_S = 100kΩ		1.35		pF
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 50dB		−0.3	−0.2 **−0.1**	V
			1.8 **1.6**	2		V
CMRR	Common Mode Rejection Ratio	(Note 12)	72	93		dB
A_{VOL}	Large Signal Voltage Gain	V_O = 2V_{PP}, R_L = 2kΩ to $V^+/2$	80 **76**	100		dB
		V_O = 2V_{PP}, R_L = 150Ω to $V^+/2$	74 **70**	78		dB

3V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for at T_J = 25˚C, V^+ = 3V, V^- = 0V, V_O = V_{CM} = V^+/2, and R_L = 2kΩ to V^+/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
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	2.75	2.93		
		R_L = 50Ω to V^+/2, V_{ID} = 200mV	2.6	2.85		
	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	200	
		R_L = 50Ω to V^+/2, V_{ID} = −200mV		130	300	
I_{SC}	Output Short Circuit Current	Sourcing to V^+/2, (Note 10)	50 **35**	120		mA
		Sinking to V^+/2, (Note 10)	67 **40**	140		
I_{OUT}	Output Current	V_O = 0.5V from either supply		99		mA
PSRR	Power Supply Rejection Ratio	(Note 12)	72	96		dB
I_S	Supply Current (Enabled)	No Load		3.5	5.6 **7.5**	mA
	Supply Current (Disabled)			0.3	0.5 **0.7**	
TH_SD	Threshold Voltage for Shutdown Mode			V^+−1.59		V
I_SD PIN	Shutdown Pin Input Current	SD Pin Connect to 0V (Note 7)		−13		µA
T_{ON}	On Time After Shutdown			83		nsec
T_{OFF}	Off Time to Shutdown			160		nsec
R_{OUT}	Output Resistance Closed Loop	R_F = 10kΩ, f = 1kHz, A_V = −1		27		mΩ
		R_F = 10kΩ, f = 1MHz, A_V = −1		266		

5V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for at T_J = 25˚C, V^+ = 5V, V^- = 0V, V_O = V_{CM} = V^+/2, and R_L = 2kΩ to V^+/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions		Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
BW	−3dB BW	A_V = +1		130	190		MHz
		A_V = −1			64		
$BW_{0.1dB}$	0.1dB Gain Flatness	R_F = 2.51kΩ, R_L = 1kΩ,			16.4		MHz
FPBW	Full Power Bandwidth	A_V = +1, V_{OUT} = $2V_{PP}$, −1dB			28		MHz
GBW	Gain Bandwidth Product	A_V = +1			86		MHz
e_n	Input-Referred Voltage Noise	R_F = 33kΩ	f = 10kHz		19		nV/ $\sqrt{Hz}$
			f = 1MHz		16		
i_n	Input-Referred Current Noise	R_F = 1MΩ	f = 10KHz		1.35		pA/ $\sqrt{Hz}$
			f = 1MHz		0.35		
THD	Total Harmonic Distortion	f = 5MHz, V_O = $2V_{PP}$, A_V = +2 R_L = 1kΩ to V^+/2			−60		dBc
DG	Differential Gain	NTSC, A_V = +2 R_L = 150Ω to V^+/2			0.12		%
DP	Differential Phase	NTSC, A_V = +2 R_L = 150Ω to V^+/2			0.045		deg
T_S	Settling Time	V_O = $2V_{PP}$, ±0.1%			33		ns
SR	Slew Rate	A_V = −1, (Note 8)		130	172		V/µs
V_{OS}	Input Offset Voltage				1.02	5 **7**	mV

5V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for at T_J = 25˚C, V^+ = 5V, V^- = 0V, V_O = V_{CM} = $V^+/2$, and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
TC V_{OS}	Input Offset Average Drift	(Note 11)		8		μV/˚C
I_B	Input Bias Current	(Note 7)		−1.2	−2.6 **−3.25**	μA
I_{OS}	Input Offset Current			20	800 **1000**	nA
R_{IN}	Common Mode Input Resistance	A_V = +1, f = 1kHz, R_S = 1MΩ		6.88		MΩ
C_{IN}	Common Mode Input Capacitance	A_V = +1, R_S = 100kΩ		1.32		pF
CMVR	Common-Mode Input Voltage Range	CMRR ≥ 50dB		−0.3	−0.2 **−0.1**	V
				4	3.8 **3.6**	V
CMRR	Common Mode Rejection Ratio	(Note 12)	72	95		dB
A_{VOL}	Large Signal Voltage Gain	V_O = $4V_{PP}$, R_L = 2kΩ to $V^+/2$	86 **82**	100		dB
		V_O = $3.75V_{PP}$, R_L = 150Ω to $V^+/2$	74 **70**	77		dB
V_O	Output Swing High	R_L = 2kΩ to $V^+/2$, V_{ID} = 200mV	4.90	4.97		V
		R_L = 150Ω to $V^+/2$, V_{ID} = 200mV	4.65	4.90		V
		R_L = 50Ω to $V^+/2$, V_{ID} = 200mV	4.40	4.77		V
	Output Swing Low	R_L = 2kΩ to $V^+/2$, V_{ID} = −200mV		25	100	mV
		R_L = 150Ω to $V^+/2$, V_{ID} = −200mV		85	200	mV
		R_L = 50Ω to $V^+/2$, V_{ID} = −200mV		190	400	mV
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$, (Note 10)	100 **79**	160		mA
		Sinking from $V^+/2$, (Note 10)	120 **85**	190		mA
I_{OUT}	Output Current	V_O = 0.5V from either supply		110		mA
PSRR	Power Supply Rejection Ratio	(Note 12)	72	96		dB
I_S	Supply Current (Enabled)	No Load		3.6	5.8 **8.0**	mA
	Supply Current (Disabled)			0.40	0.8 **1.0**	mA
TH_SD	Threshold Voltage for Shutdown Mode			V^+ −1.65		V
I_SD PIN	Shutdown Pin Input Current	SD Pin Connected to 0V (Note 7)		−30		μA
T_{ON}	On Time after Shutdown			83		nsec
T_{OFF}	Off Time to Shutdown			160		nsec
R_{OUT}	Output Resistance Closed Loop	R_F = 10kΩ, f = 1kHz, A_V = −1		29		mΩ
		R_F = 10kΩ, f = 1MHz, A_V = −1		253		mΩ

±5V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for at T_J = 25˚C, V_{SUPPLY} = ±5V, V_O = V_{CM} = GND, and R_L = 2kΩ to V^+/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions		Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
BW	−3dB BW	A_V = +1		150	228		MHz
		A_V = −1			65		
$BW_{0.1dB}$	0.1dB Gain Flatness	R_F = 2.26kΩ, R_L = 1kΩ			18		MHz
FPBW	Full Power Bandwidth	A_V = +1, V_{OUT} = $2V_{PP}$, −1dB			29		MHz
GBW	Gain Bandwidth Product	A_V = +1			90		MHz
e_n	Input-Referred Voltage Noise	R_F = 33kΩ	f = 10kHz		19		nV/$\sqrt{Hz}$
			f = 1MHz		16		
i_n	Input-Referred Current Noise	R_F = 1MΩ	f = 10kHz		1.13		pA/$\sqrt{Hz}$
			f = 1MHz		0.34		
THD	Total Harmonic Distortion	f = 5MHz, V_O = $2V_{PP}$, A_V = +2, R_L = 1kΩ			−71.2		dBc
DG	Differential Gain	NTSC, A_V = +2 R_L = 150Ω			0.11		%
DP	Differential Phase	NTSC, A_V = +2 R_L = 150Ω			0.053		deg
T_S	Settling Time	V_O = $2V_{PP}$, ±0.1%			33		ns
SR	Slew Rate	A_V = −1 (Note 8)		140	200		V/μs
V_{OS}	Input Offset Voltage				1.03	5 **7**	mV
TC V_{OS}	Input Offset Voltage Drift	(Note 11)			8		μV/˚C
I_B	Input Bias Current	(Note 7)			−1.40	−2.6 **−3.25**	μA
I_{OS}	Input Offset Current				20	800 **1000**	nA
R_{IN}	Common Mode Input Resistance	A_V +1, f = 1kHz, R_S = 1MΩ			7.5		MΩ
C_{IN}	Common Mode Input Capacitance	A_V = +1, R_S = 100kΩ			1.28		pF
CMVR	Common Mode Input Voltage Range	CMRR ≥ 50dB			−5.3	−5.2 **−5.1**	V
				3.8 **3.6**	4.0		
CMRR	Common Mode Rejection Ratio	(Note 12)		72	95		dB
A_{VOL}	Large Signal Voltage Gain	V_O = $9V_{PP}$, R_L = 2kΩ		88 **84**	100		dB
		V_O = $8V_{PP}$, R_L = 150Ω		74 **70**	77		
V_O	Output Swing High	R_L = 2kΩ, V_{ID} = 200mV		4.85	4.96		V
		R_L = 150Ω, V_{ID} = 200mV		4.55	4.80		
		R_L = 50Ω, V_{ID} = 200mV		3.60	4.55		
	Output Swing Low	R_L = 2kΩ, V_{ID} = −200mV			−4.97	−4.90	V
		R_L = 150Ω, V_{ID} = −200mV			−4.85	−4.55	
		R_L = 50Ω, V_{ID} = −200mV			−4.65	−4.30	
I_{SC}	Output Short Circuit Current	Sourcing to Ground, (Note 10)		100 **80**	168		mA
		Sinking to Ground, (Note 10)		110 **85**	190		

±5V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for at T_J = 25˚C, V_{SUPPLY} = ±5V, V_O = V_{CM} = GND, and R_L = 2kΩ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
I_{OUT}	Output Current	V_O = 0.5V from either supply		112		mA
PSRR	Power Supply Rejection Ratio	(Note 12)	72	96		dB
I_S	Supply Current (Enabled)	No Load		4.18	6.5 **8.5**	mA
	Supply Current (Disabled)			0.758	1.0 **1.3**	
TH_SD	Threshold Voltage for Shutdown Mode			V^+ – 1.67		V
I_SD PIN	Shutdown Pin Input Current	SD Pin Connected to –5V (Note 7)		–84		μA
T_{ON}	On Time after Shutdown			83		nsec
T_{OFF}	Off Time to Shutdown			160		nsec
R_{OUT}	Output Resistance Closed Loop	R_F = 10kΩ, f = 1kHz, A_V = –1		32		mΩ
		R_F = 10kΩ, f = 1MHz, A_V = –1		226		

Note 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 guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: Human body model, 1.5kΩ in series with 100pF.

Note 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.

Note 4: The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/\theta_{JA}$. All numbers apply for packages soldered directly onto a PC board.

Note 5: Typical values represent the most likely parametric norm.

Note 6: All limits are guaranteed by testing or statistical analysis.

Note 7: Positive current corresponds to current flowing into the device.

Note 8: Slew rate is the average of the rising and falling slew rates.

Note 9: Machine Model, 0Ω in series with 200pF.

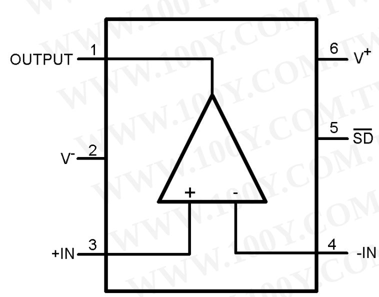
Note 10: Short circuit test is a momentary test.

Note 11: Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes into the total temperature change.

Note 12: f ≤ 1kHz (see typical performance Characteristics)

Connection Diagrams

SOT23-6



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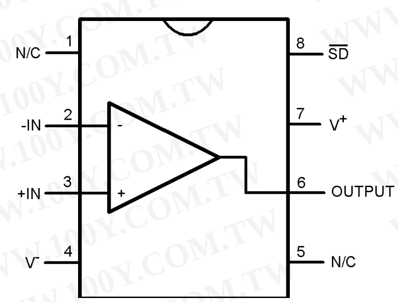
Top View

SOIC-8



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Top View

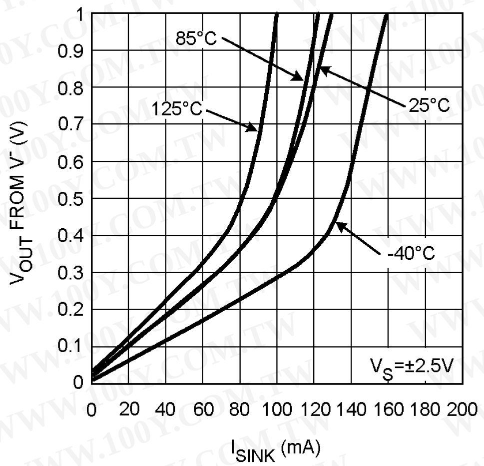
Ordering Information

Package	Part Number	Package Marking	Transport Media	NSC Drawing
6-Pin SOT-23	LMH6639MF	A81A	1k Units Tape and Reel	MF06A
	LMH6639MFX		3k Units Tape and Reel	
8-Pin SOIC	LMH6639MA	LMH6639MA	Rails	M08A
	LMH6639MAX		2.5k Units Tape and Reel	

Typical Performance Characteristics

At T_J = 25˚C, V^+ = +2.5, V^- = −2.5V, R_F = 330Ω for A_V = +2, R_F = 1kΩ for A_V = −1. Unless otherwise specified.

Output Sinking Saturation Voltage vs. I_{OUT} for Various Temperature



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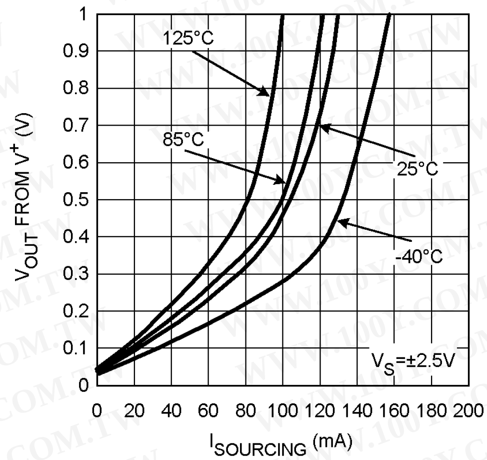
Output Sourcing Saturation Voltage vs. I_{OUT} for Various Temperature



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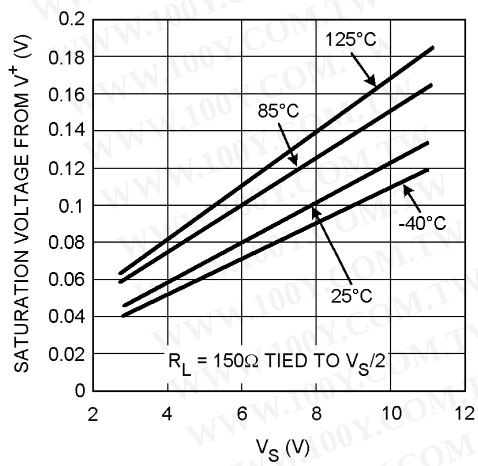
Positive Output Saturation Voltage vs. V_{SUPPLY} for Various Temperature



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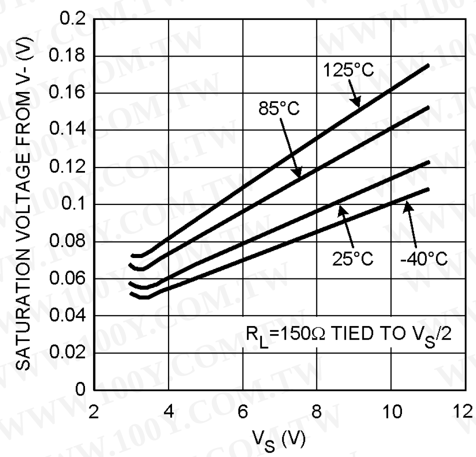
Negative Output Saturation Voltage vs. V_{SUPPLY} for Various Temperature



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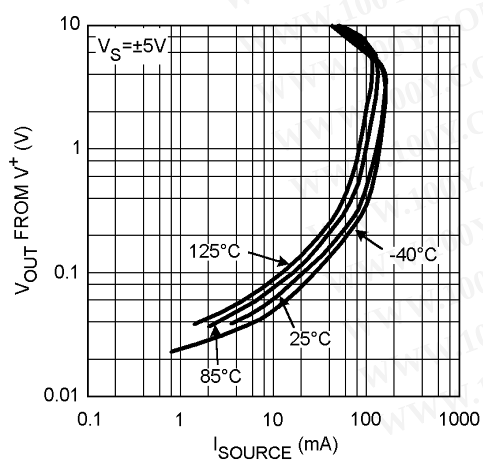
V_{OUT} from V^+ vs. I_{SOURCE}



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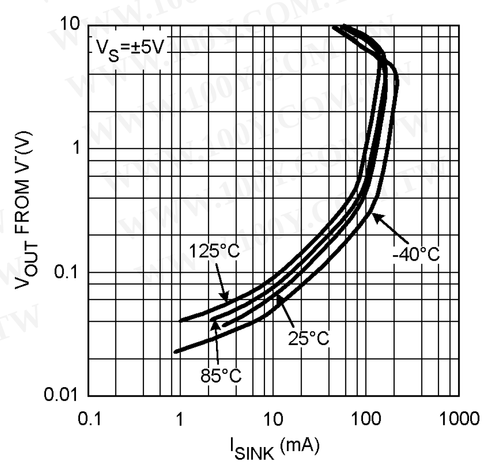
V_{OUT} from V^- vs. I_{SINK}



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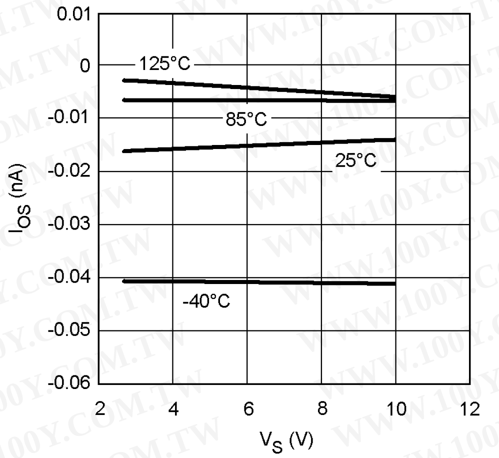
Typical Performance Characteristics

At T_J = 25˚C, V^+ = +2.5, V^- = −2.5V, R_F = 330Ω for A_V = +2, R_F = 1kΩ for A_V = −1. Unless otherwise specified. (Continued)

I_{OS} vs. V_S for Various Temperature



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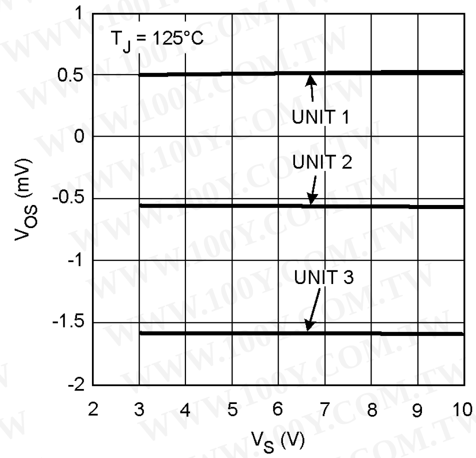
V_{OS} vs. V_S for 3 Representative Units



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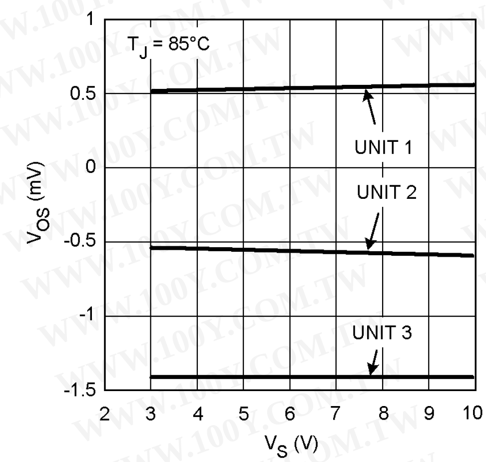
V_{OS} vs. V_S for 3 Representative Units



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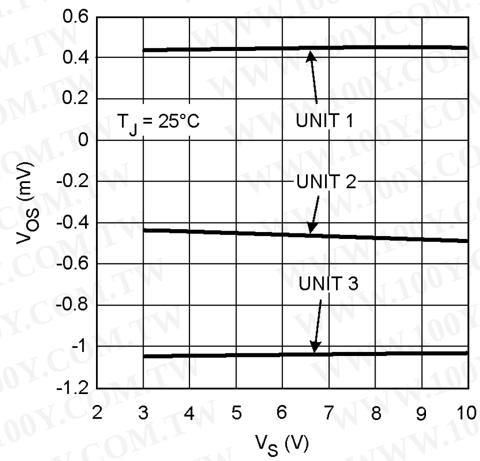
V_{OS} vs. V_S for 3 Representative Units



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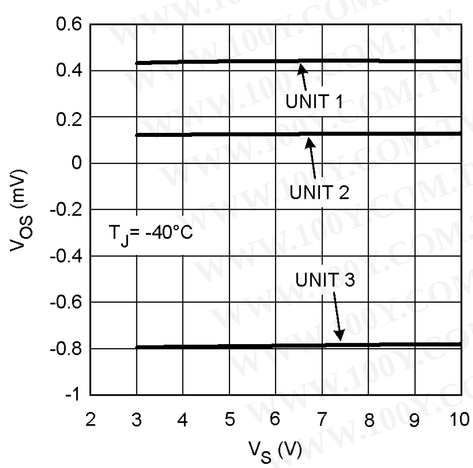
V_{OS} vs. V_S for 3 Representative Units



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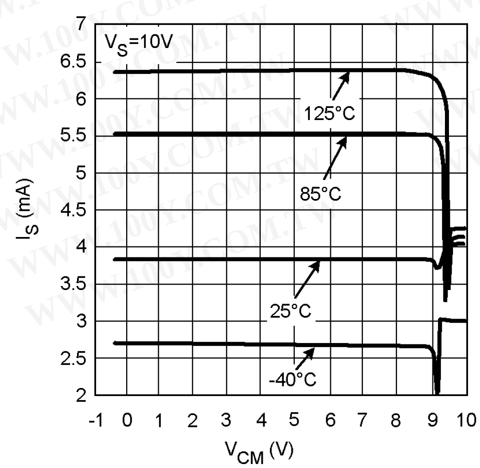
I_{SUPPLY} vs. V_{CM} for Various Temperature

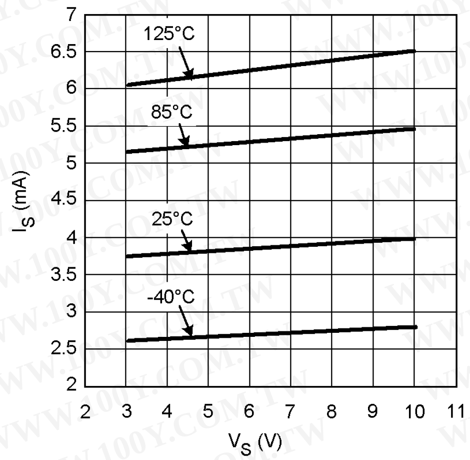


20030240

Typical Performance Characteristics

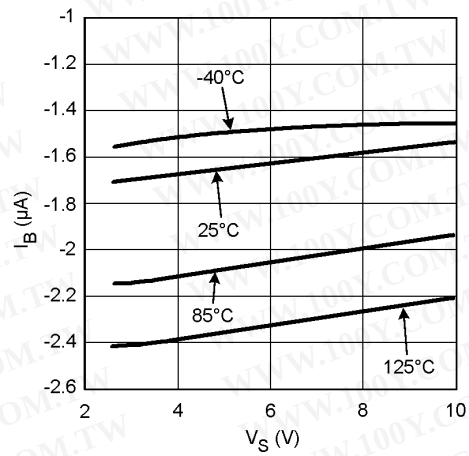
At T_J = 25˚C, V^+ = +2.5, V^- = −2.5V, R_F = 330Ω for A_V = +2, R_F = 1kΩ for A_V = −1. Unless otherwise specified. (Continued)

I_{SUPPLY} vs. V_S for Various Temperature



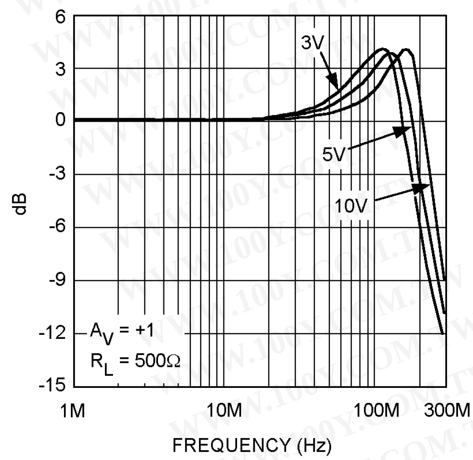
20030241

I_B vs. V_S for Various Temperature



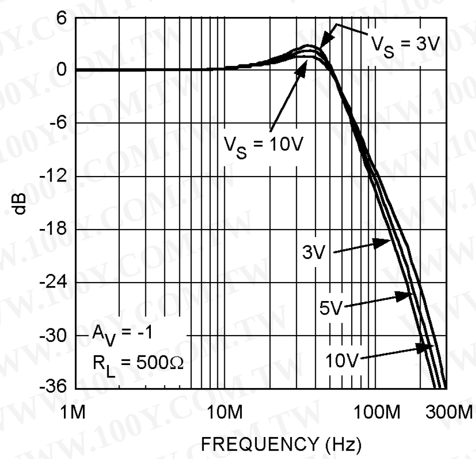
20030235

Bandwidth for Various V_S



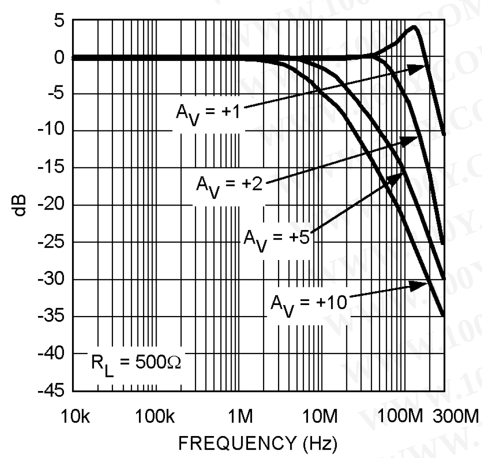
20030206

Bandwidth for Various V_S



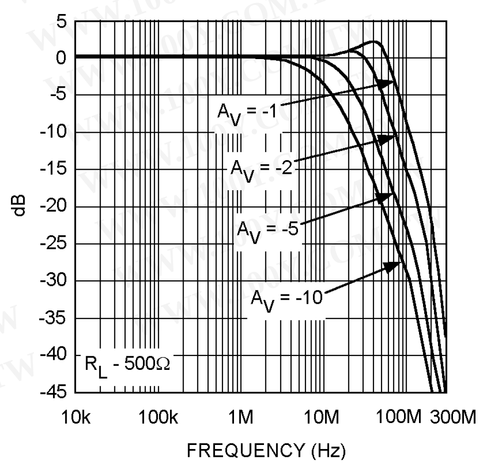
20030205

Gain vs. Frequency Normalized



20030207

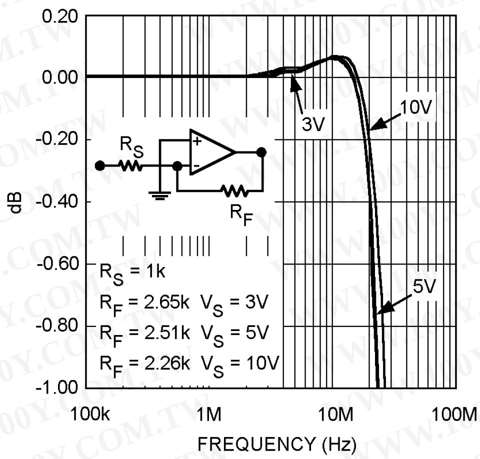
Gain vs. Frequency Normalized



20030208

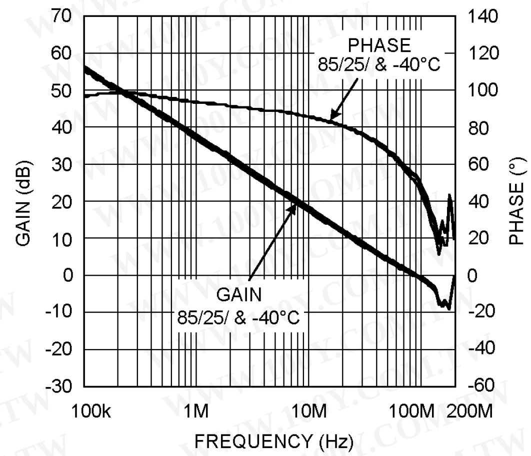
Typical Performance Characteristics
At T_J = 25˚C, V^+ = +2.5, V^- = −2.5V, R_F = 330Ω for A_V = +2, R_F = 1kΩ for A_V = −1. Unless otherwise specified. (Continued)

0.1dB Gain Flatness



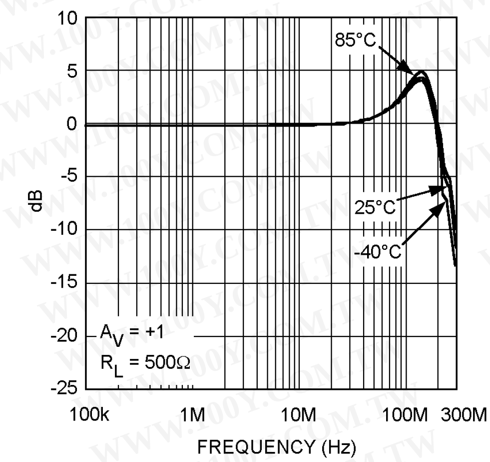
20030209

Gain and phase vs. Frequency for Various Temperature



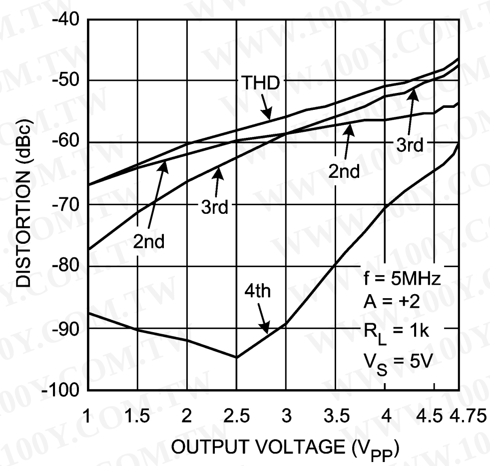
20030204

Frequency Response vs. Temperature



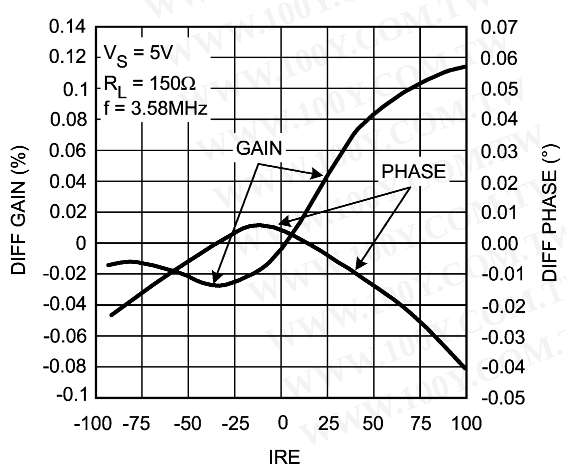
20030210

Harmonic Distortion



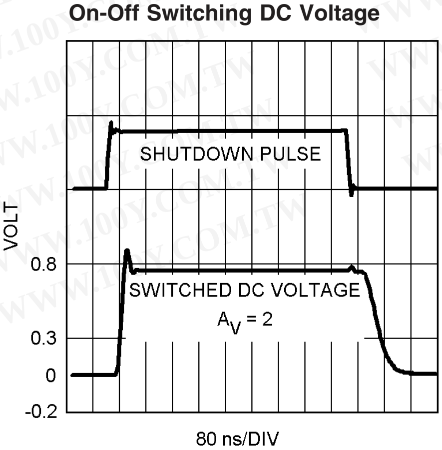
20030269

Differential Gain/Phase



20030270

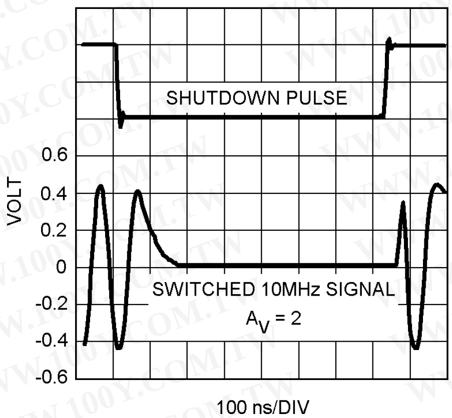
On-Off Switching DC Voltage



20030211

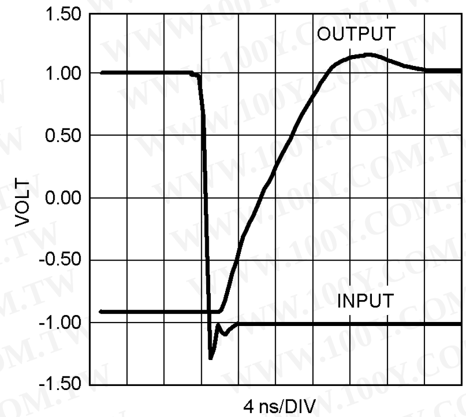
Typical Performance Characteristics At $T_J = 25^{\circ}C$, $V^+ = +2.5$, $V^- = -2.5V$, $R_F = 330\Omega$ for $A_V = +2$, $R_F = 1k\Omega$ for $A_V = -1$. Unless otherwise specified. (Continued)

On-Off Switching 10MHz



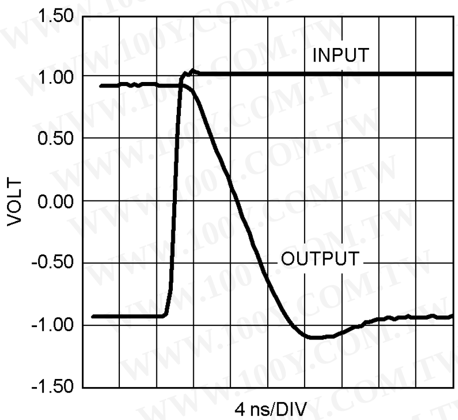
20030212

Slew Rate (Positive)



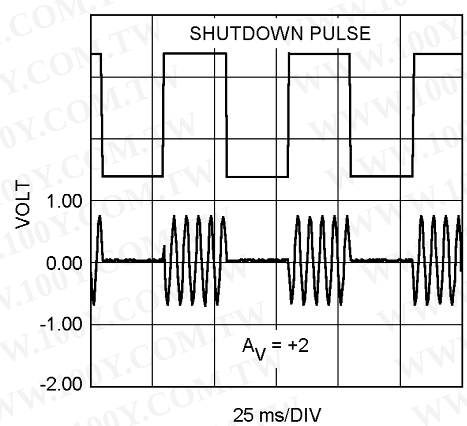
20030214

Slew Rate (Negative)



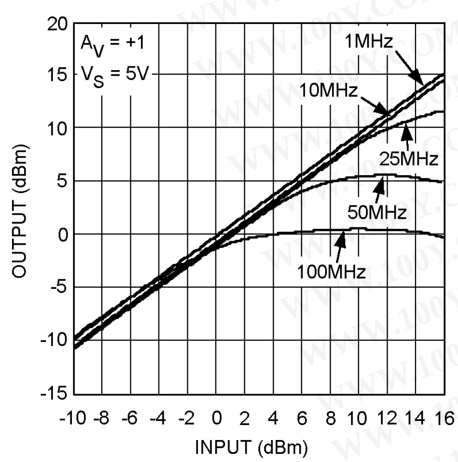
20030213

On-Off Switching of Sinewave



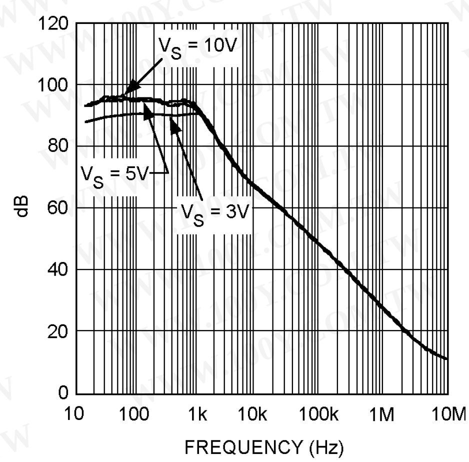
20030215

Power Sweep



20030216

CMRR vs. Frequency

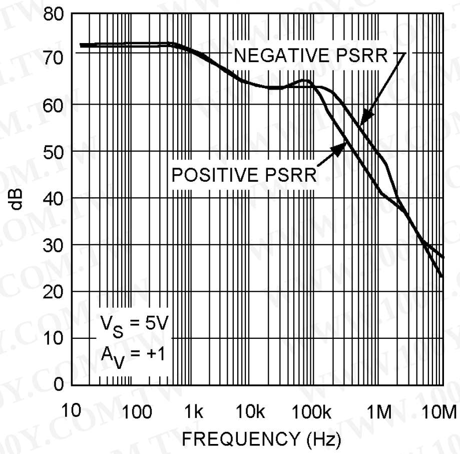


20030218

Typical Performance Characteristics

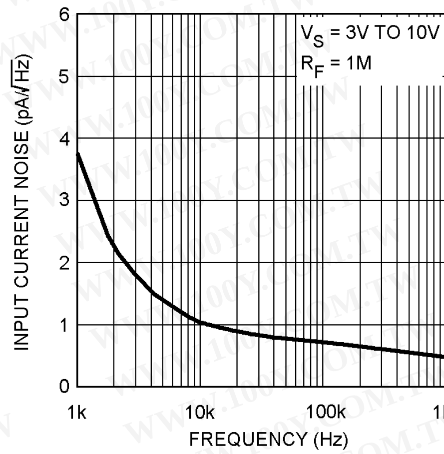
At T_J = 25°C, V^+ = +2.5, V^- = −2.5V, R_F = 330Ω for A_V = +2, R_F = 1kΩ for A_V = −1. Unless otherwise specified. (Continued)

PSRR vs. Frequency



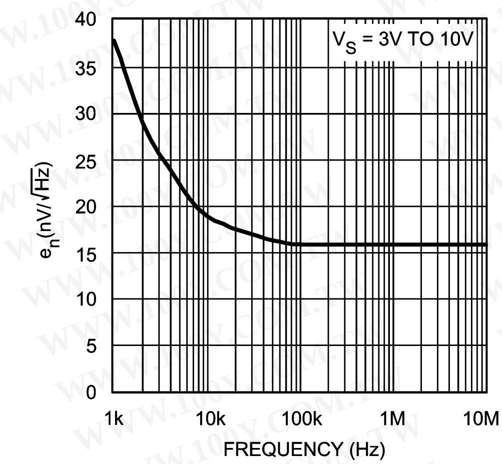
20030217

Current Noise



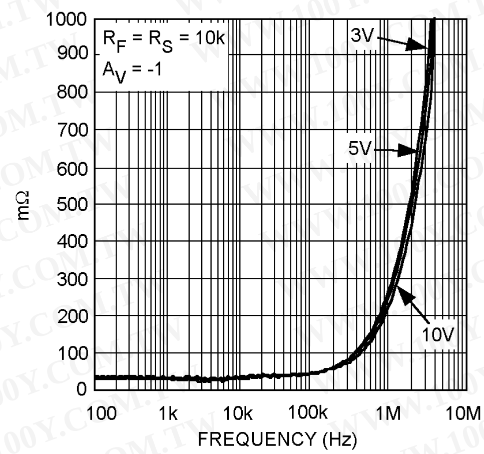
20030220

Voltage Noise



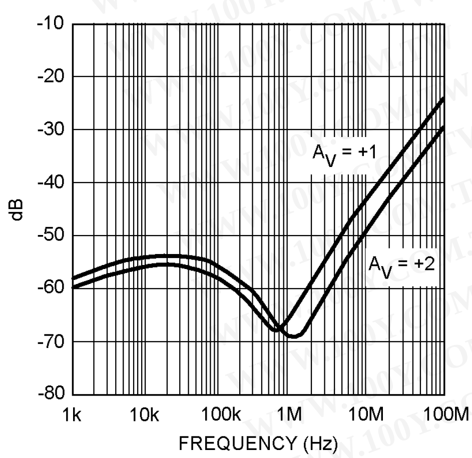
20030219

Closed Loop Output Resistance vs. Frequency



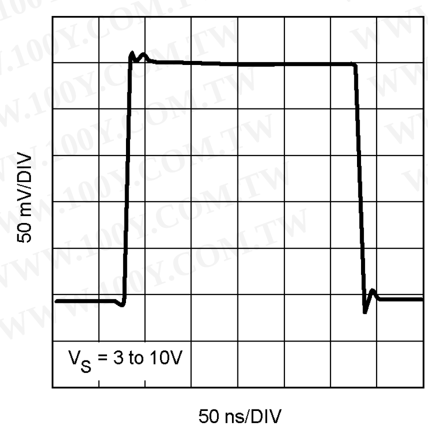
20030221

Off Isolation



20030222

Small Signal Pulse Response (A_V = +1, R_L = 2k)

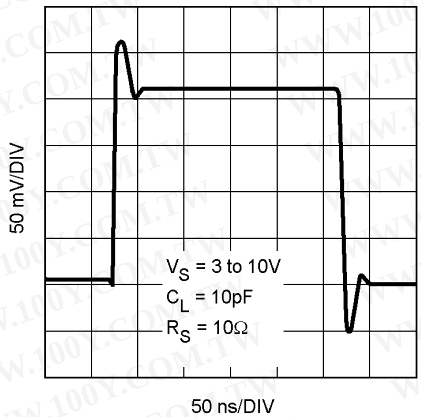


20030250

Typical Performance Characteristics

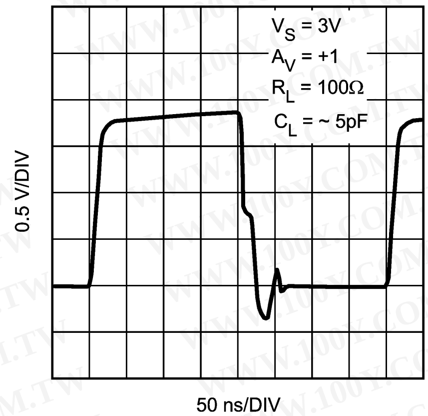
At T_J = 25˚C, V^+ = +2.5, V^- = −2.5V, R_F = 330Ω for A_V = +2, R_F = 1kΩ for A_V = −1. Unless otherwise specified. (Continued)

Small Signal Pulse Response (A_V = −1)



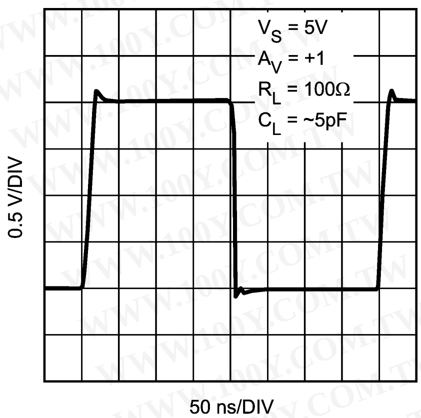
20030249

Large Signal Pulse Response (R_L = 2k)



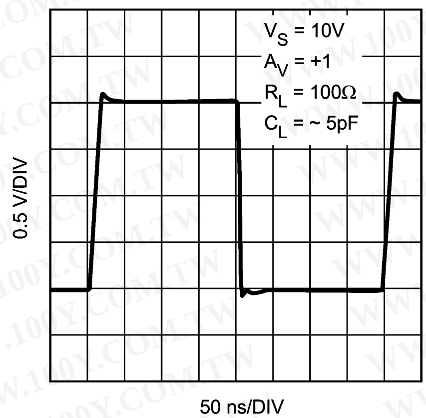
20030226

Large Signal Pulse Response



20030227

Large Signal Pulse Response

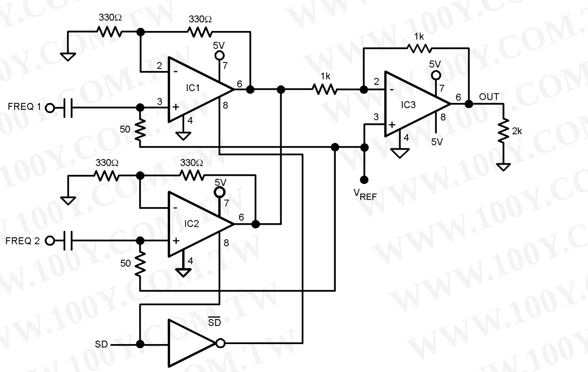


20030228

Application Notes

MULTIPLEXING 5 AND 10MHz

The LMH6639 may be used to implement a circuit which multiplexes two signals of different frequencies. Three LMH6639 high speed op-amps are used in the circuit of *Figure 2* to accomplish the multiplexing function. Two LMH6639 are used to provide gain for the input signals, and the third device is used to provide output gain for the selected signal.



Note: Pin numbers pertain to SOIC-8 package

FIGURE 2. Multiplexer

Multiplexing signals “FREQ 1” and “FREQ 2” exhibit closed loop non-inverting gain of +2 each based upon identical 330Ω resistors in the gain setting positions of IC1 and IC2. The two multiplexing signals are combined at the input of IC3, which is the third LMH6639. This amplifier may be used as a unity gain buffer or may be used to set a particular gain for the circuit.

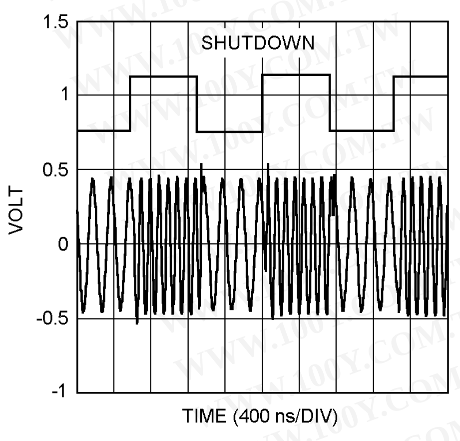


FIGURE 3. Switching between 5 and 10MHz

1k resistors are used to set an inverting gain of −1 for IC3 in the circuit of *Figure 2*. *Figure 3* illustrates the waveforms produced. The upper trace shows the switching waveform used to switch between the 5MHz and 10MHz multiplex signals. The lower trace shows the output waveform consisting of 5MHz and 10MHz signals corresponding to the high or low state of the switching signal.

In the circuit of *Figure 2*, the outputs of IC1 and IC2 are tied together such that their output impedances are placed in parallel at the input of IC3. The output impedance of the disabled amplifier is high compared both to the output impedance of the active amplifier and the 330Ω gain setting resistors. The closed loop output resistance for the LMH6639 is around 0.2Ω. Thus the active state amplifier output impedance dominates the input node to IC3, while the disabled amplifier is assured of a high level of suppression of unwanted signals which might be present at the output.

SHUTDOWN OPERATION

With $\overline{SD}$ pin left floating, the device enters normal operation. However, since the $\overline{SD}$ pin has high input impedance, it is best tied to V^+ for normal operation. This will avoid inadvertent shutdown due to capacitive pick-up from nearby nodes. LMH6639 will typically go into shutdown when $\overline{SD}$ pin is more than 1.7V below V^+, regardless of operating supplies.

The $\overline{SD}$ pin can be driven by push-pull or open collector (open drain) output logic. Because the LMH6639's shutdown is referenced to V+, interfacing to the shutdown logic is rather simple, for both single and dual supply operation, with either form of logic used. Typical configurations are shown in *Figure 4* and *Figure 5* below for push-pull output:

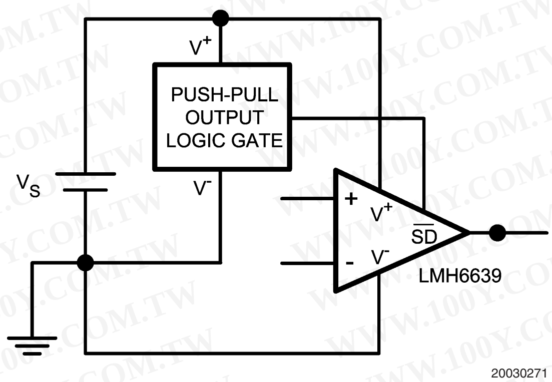


FIGURE 4. Shutdown Interface (Single Supply)

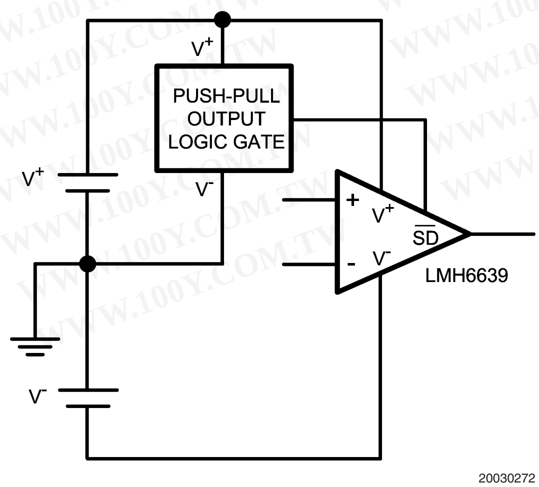


FIGURE 5. Shutdown Interface (Dual Supplies)

Common voltages for logic gates are +5V or +3V. To ensure proper power on/off with these supplies, the logic should be able to swing to 3.4V and 1.4V minimum, respectively.

Application Notes (Continued)

LMH6639's shutdown pin can also be easily controlled in applications where the analog and digital sections are operated at different supplies. *Figure 6* shows a configuration where a logic output, SD, can turn the LMH6639 on and off, independent of what supplies are used for the analog and the digital sections:

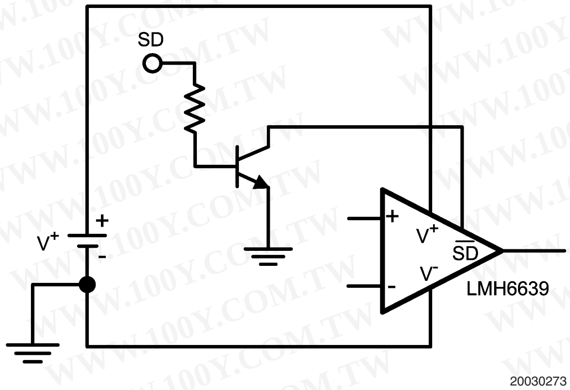


FIGURE 6. Shutdown Interface (Single Supply, Open Collector Logic)

The LMH6639 has an internal pull-up resistor on $\overline{SD}$ such that if left un-connected, the device will be in normal operation. Therefore, no pull-up resistor is needed on this pin. Another common application is where the transistor in *Figure 6* above, would be internal to an open collector (open drain) logic gate; the basic connections will remain the same as shown.

PCB LAYOUT CONSIDERATION AND COMPONENTS SELECTION

Care should be taken while placing components on a PCB. All standard rules should be followed especially the ones for high frequency and/ or high gain designs. Input and output pins should be separated to reduce cross-talk, especially under high gain conditions. A groundplane will be helpful to avoid oscillations. In addition, a ground plane can be used to create micro-strip transmission lines for matching purposes. Power supply, as well as shutdown pin de-coupling will reduce cross-talk and chances of oscillations.

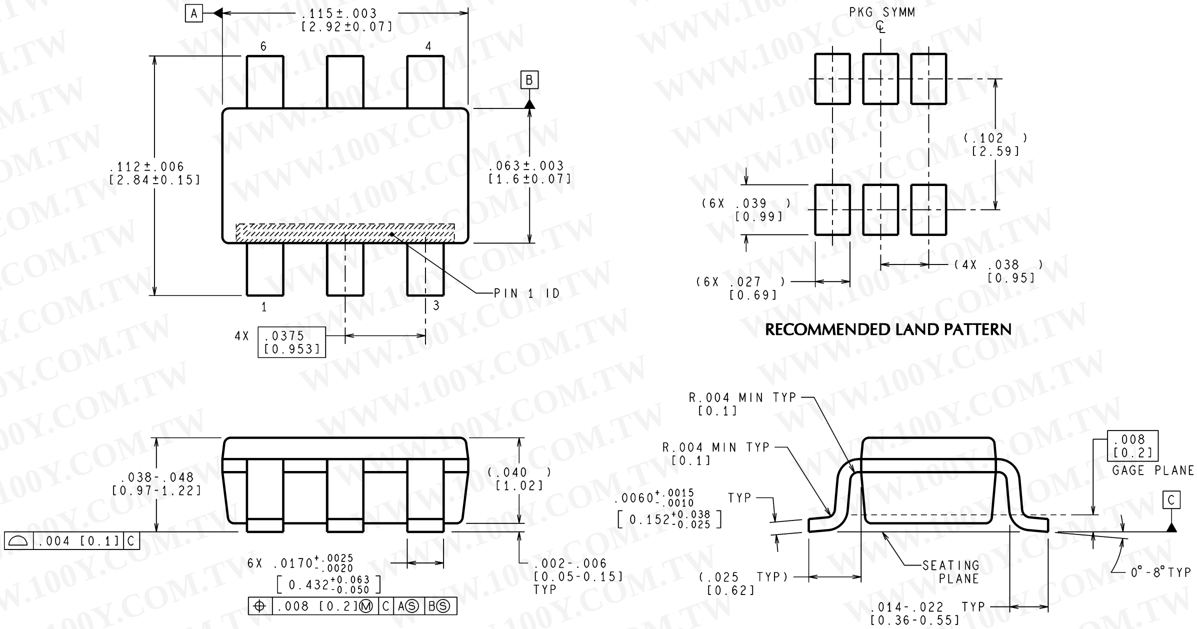
Another important parameter in working with high speed amplifiers is the component values selection. Choosing high value resistances reduces the cut-off frequency because of the influence of parasitic capacitances. On the other hand choosing the resistor values too low could "load down" the nodes and will contribute to higher overall power dissipation. Keeping resistor values at several hundreds of ohms up to several kΩ will offer good performance.

National Semiconductor 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
LMH6639MA	8-Pin SOIC	CLC730027
LMH6639MF	SOT23-6	CLC730116

These free evaluation boards are shipped when a device sample request is placed with National Semiconductor. For normal operation, tie the SD pin to V+.

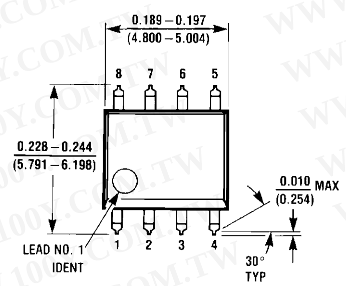
Physical Dimensions inches (millimeters) unless otherwise noted

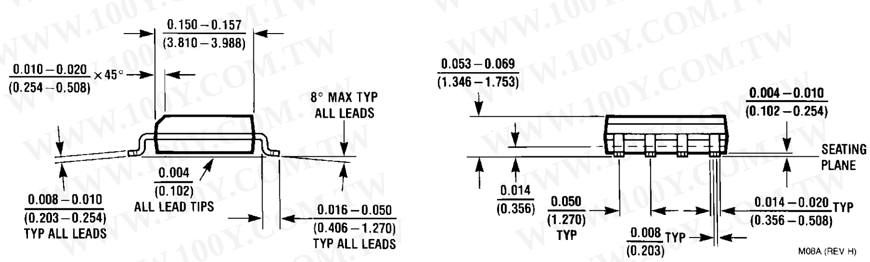


CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MF06A (Rev B)

6-Pin SOT23
NS Package Number MF06A





8-Pin SOIC
NS Package Number M08A

Notes

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.