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# High Temperature Quad Operational Amplifier HT1104

The High Temperature Quad Operational Amplifier, HT1104, is a versatile performer over an extremely wide temperature range. It is fabricated with Honeywell's dielectrically isolated high-temperature linear (HTMOS™) process, and is designed specifically for use in systems operating in severe high temperature environments.

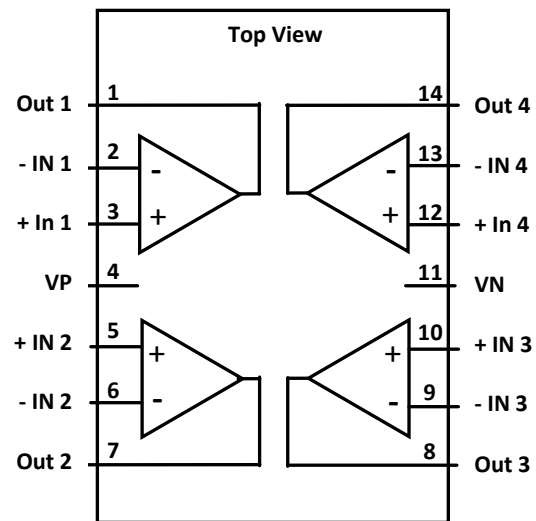


These amplifiers perform over the full -55°C to 225°C temperature range. All parts are burned in at 250°C. The HT1104 will operate with both single and split supplies. High temperature circuit applications such as transducer interfacing, amplification, active filtering, and signal buffering are all possible with the HT1104.

## APPLICATIONS:

- Down-Hole Oil Well
- Turbine Engine Control
- Avionics
- Industrial Process Control
- Electric Power Conversion
- Heavy Duty Internal Combustion Engine

## PINOUT DIAGRAM



## FEATURES

- ▶ Specified Over -55°C to +225°C
- ▶ Single or Split Supply Operation
- ▶ Low Input Bias and Offset Parameters
- ▶ ESD Protection Circuitry
- ▶ Latch-up Free Design with Dielectric Isolation
- ▶ Hermetic 14-Lead Ceramic DIP package

**ABSOLUTE MAXIMUM RATINGS (1)**

Symbol	Parameter	Rating		Units
		Min	Max	
VN to VP	Total Supply Voltage		13	V
VPIN	Voltage on Any Pin (excluding power pins)	VN - 0.5	VP + 0.5	V
IOUT	DC or Average Output Current (each output)	-50	+50	mA
IOS	Output Short Circuit Current (1 second)		110	mA
VHBM	ESD Input Protection Voltage (Human Body Model)		2000	V
ΘJC	Thermal Resistance (Jct-to-Case)		10	°C/W
TSTORE	Storage Temperature	-65	300	°C
TSOLDER	Lead Temperature (soldering, 10 seconds)		355	°C
TJ	Junction Temperature		315	°C

(1) Stresses in excess of those listed above may result in permanent damage. These are stress ratings only, and operation at these levels is not implied. Frequent or extended exposure to absolute maximum conditions may affect device reliability.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Min	Max	Units
VP	Positive Supply Voltage (Single supply)	5	10	V
VN	Negative Supply Voltage (Single supply)	0		V
VP	Positive Supply Voltage (Split supply)		+5	V
VN	Negative Supply Voltage (Split supply)	-5		V
IOUT	Continuous Output Current	-10	+10	mA
VPIN	Voltage on Any Pin (excluding power pins)	VN - 0.3	VP + 0.3	V
TC	Case Temperature	-55	225	°C

**ELECTRICAL SPECIFICATIONS**

Unless otherwise specified, specifications apply over the Recommended Operating Conditions.

VP = +5V, VN = -5V.

Symbol	Parameter	Conditions	Limits		Unit
			Min	Max	
IP	Supply Current			12.5	mA
VO	Output Voltage Swing	R = 10kΩ, C = 20pF	-4.8	+4.6	V
ISOH	Output Short Circuit Current High	Open Loop, VP > VN, Vo = 0V, Absolute value		110	mA
ISOL	Output Short Circuit Current Low	Open Loop, VN > VP, Vo = 0V, Absolute value		110	mA
ISOURCE	Output Drive Current - source	Open Loop, VP > VN, Vo = 0V, absolute value	10		mA
ISINK	Output Drive Current - sink	Open Loop, VN > VP, Vo = 0V, absolute value	10		mA
IIO	Input Offset Current	-55°C to 25°C	-10	10	nA
		+225°C	-50	50	nA
IB	Input Bias Current	-55°C to 25°C	-10	10	nA
		+225°C	-50	50	nA
VIO	Input Offset Voltage		-7	7	mV

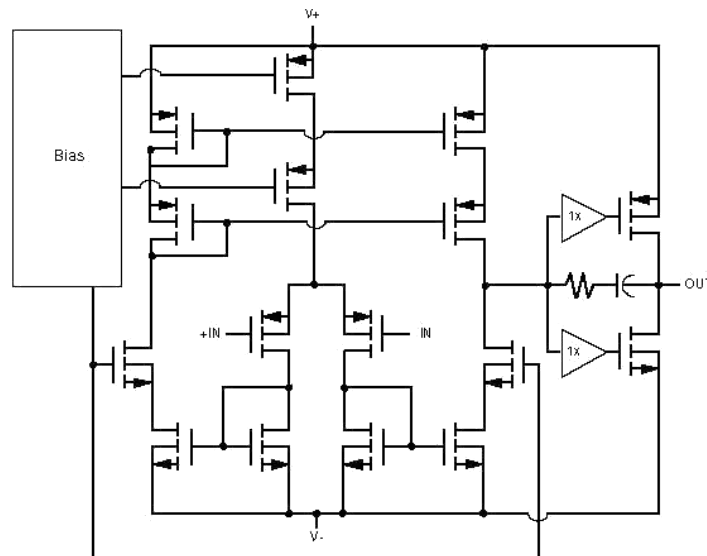
Symbol	Parameter	Conditions	Limits		Unit
			Min	Max	
V <sub>CM</sub>	Input Common Mode Voltage Range	25°C to +225°C, -55°C	VN+0.2	VP-2.2	V
			VN+0.2	VP-2.4	V
A <sub>VOL</sub>	DC Open Loop Gain		100		dB
CMRR	Common Mode Rejection Ratio		80		dB
PSRR	Power Supply Rejection Ratio		66		dB

## TYPICAL ELECTRICAL SPECIFICATIONS

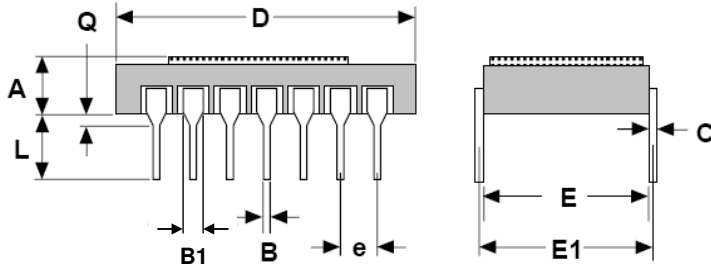
The following specifications are not tested on each device and are for reference only.

Symbol	Parameter	Conditions	Typical	Units
V <sub>IO</sub>	Input Offset Voltage	Drift with Temperature	10	μV/°C
N	Noise	f <sub>o</sub> = 10 Hz	200	nv/√Hz
		f <sub>o</sub> = 1 kHz	30	nv/√Hz
		f = 0.1 to 10 Hz	8	μV, p-p
SR	Slew Rate	R = 10kΩ, C = 20pF, 25°C	1.4	V/μsec
UGB	Unity Gain Bandwidth	R = 10kΩ, C = 20pF, 25°C	1.4	MHz
∅M	Phase Margin	C = 20pF	60	degrees
AM	Gain Margin	C = 20pF	8	dB

## SIMPLIFIED SCHEMATIC (each amplifier)



PACKAGE DETAIL

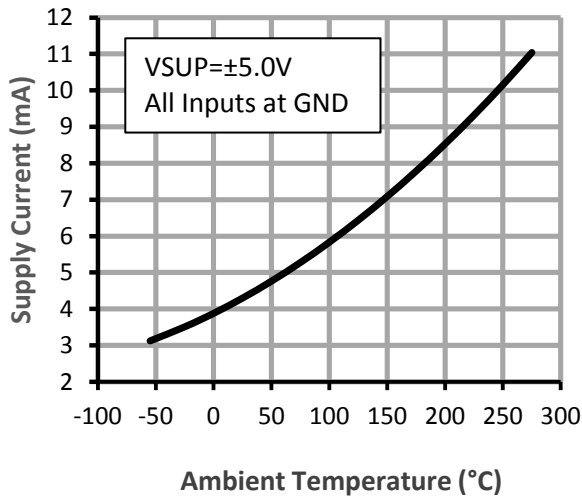


<b>A</b>	0.150 (max)	<b>E1</b>	0.300 ± 0.010
<b>B</b>	0.018 ± 0.002	<b>B1</b>	0.047 ± 0.002
<b>C</b>	0.010 ± 0.002	<b>e</b>	0.100 ± 0.005
<b>D</b>	0.700 ± 0.010	<b>L</b>	0.125 to 0.180
<b>E</b>	0.295 REF	<b>Q</b>	0.035 ± 0.010

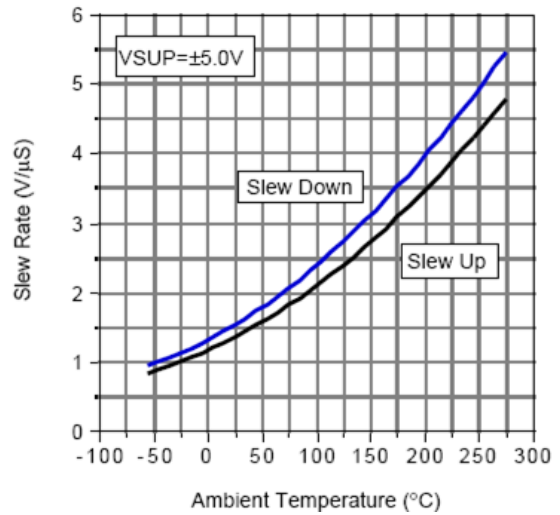
All dimensions in inches  
Leads are Gold Plated Nickel

TYPICAL PERFORMANCE PLOTS

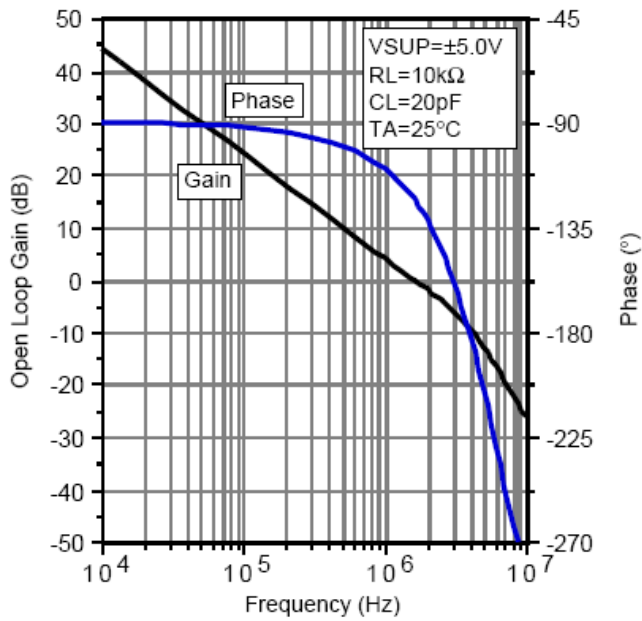
SUPPLY CURRENT vs. TEMPERATURE



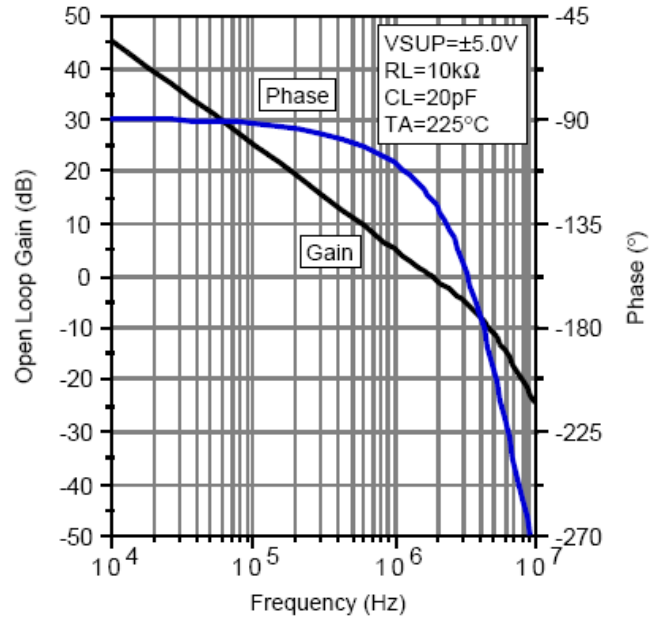
SLEW RATE vs. TEMPERATURE



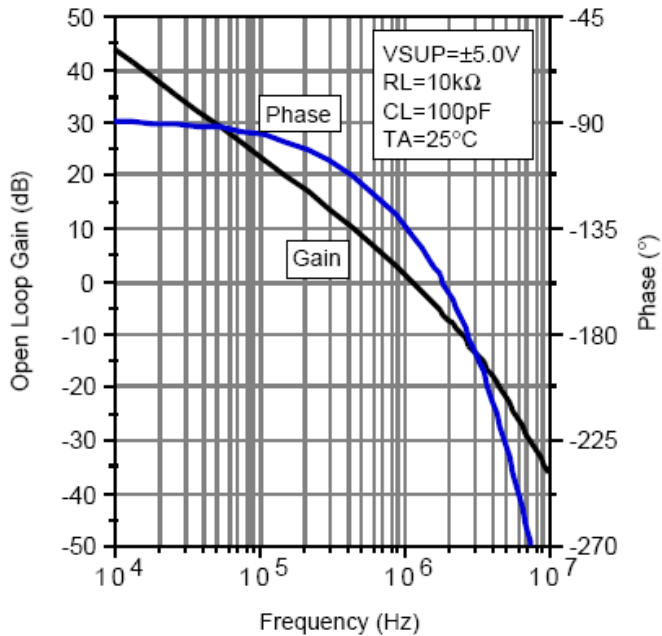
**OPEN LOOP GAIN and PHASE vs. FREQUENCY**



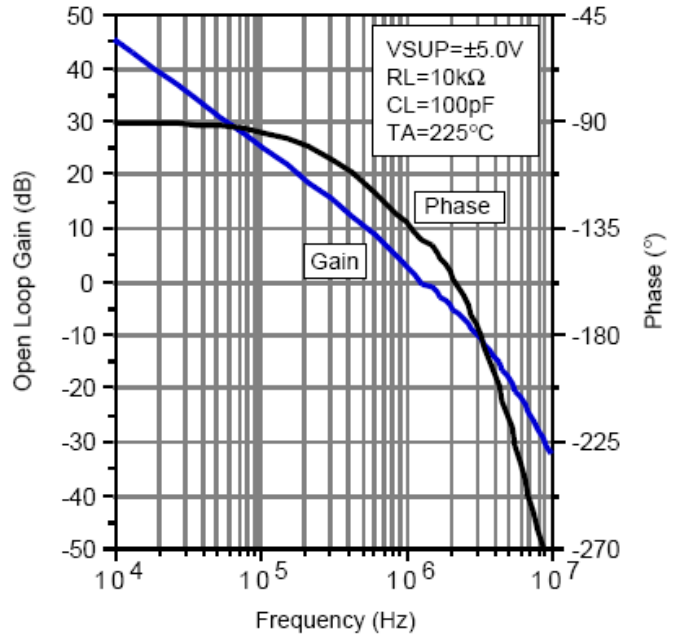
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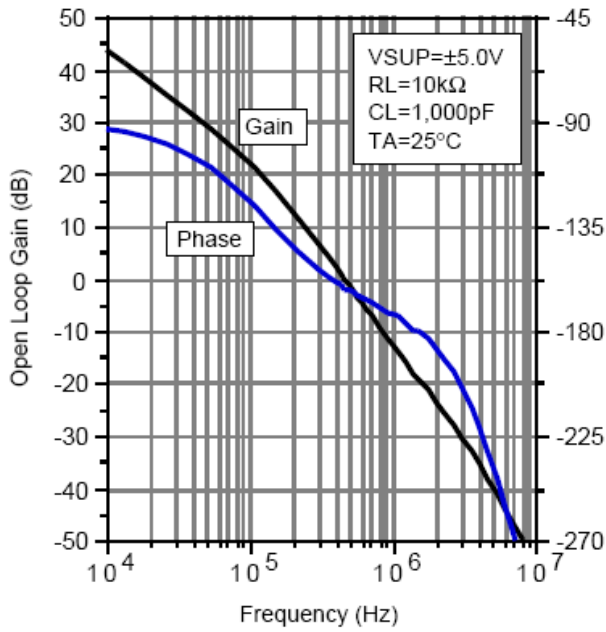
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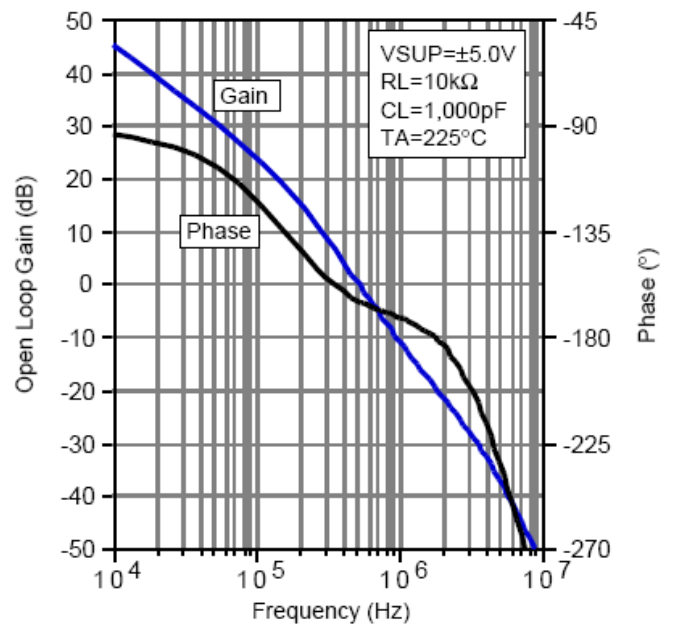
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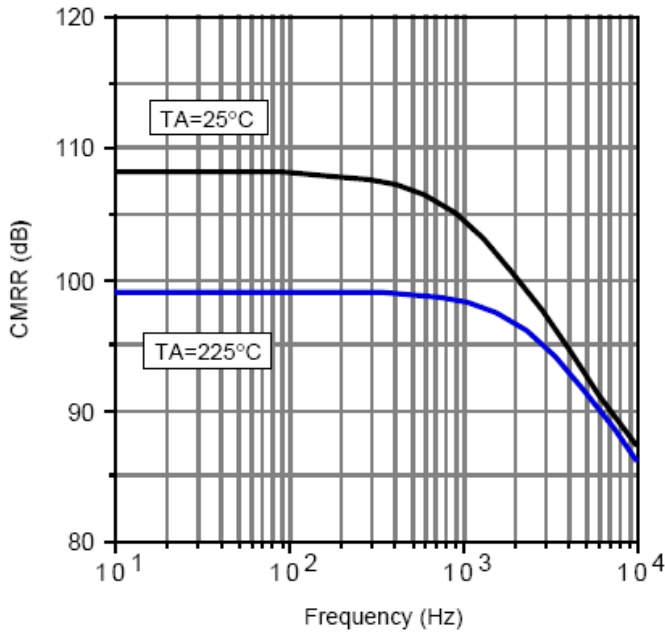
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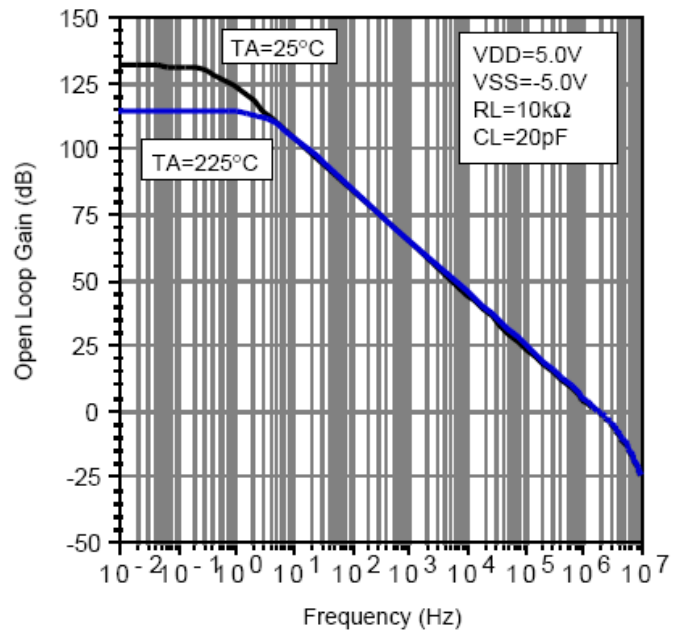
**OPEN LOOP GAIN and PHASE vs. FREQUENCY**



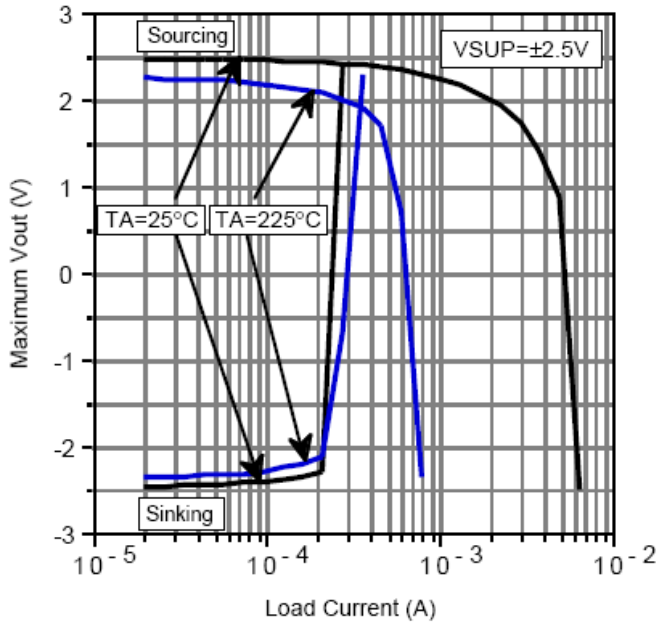
**COMMON MODE REJECTION RATIO vs. FREQUENCY**



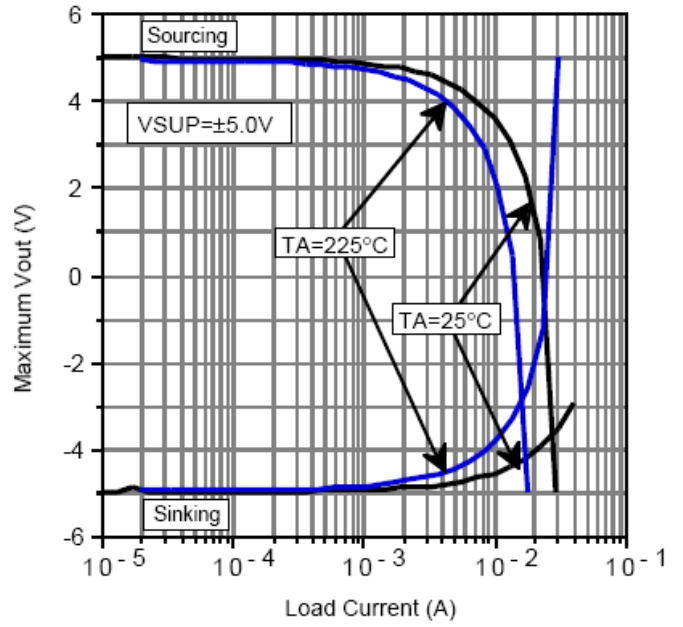
**OPEN LOOP GAIN vs. FREQUENCY**



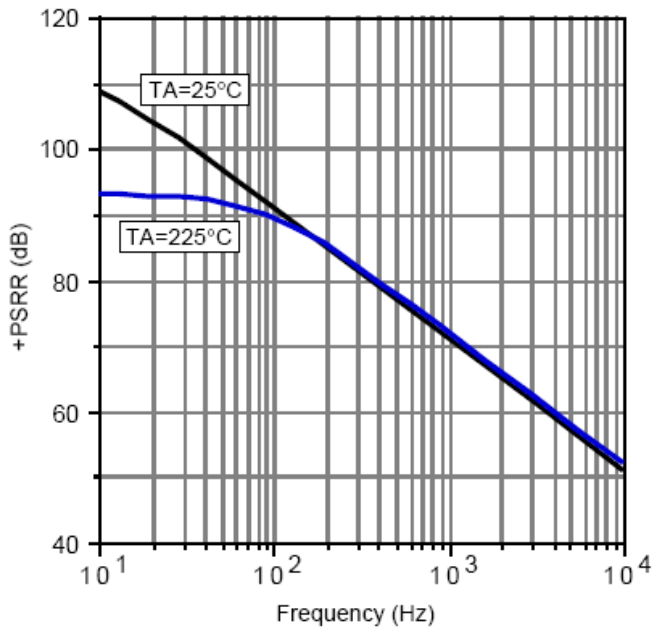
**MAXIMUM OUTPUT SWING vs. LOAD CURRENT**



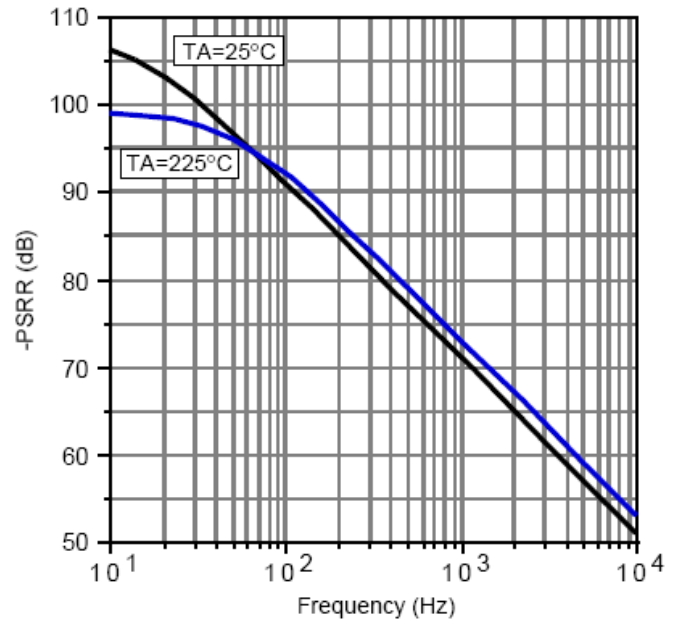
**MAXIMUM OUTPUT SWING vs. LOAD CURRENT**



**POSITIVE POWER SUPPLY REJECTION vs. FREQUENCY**

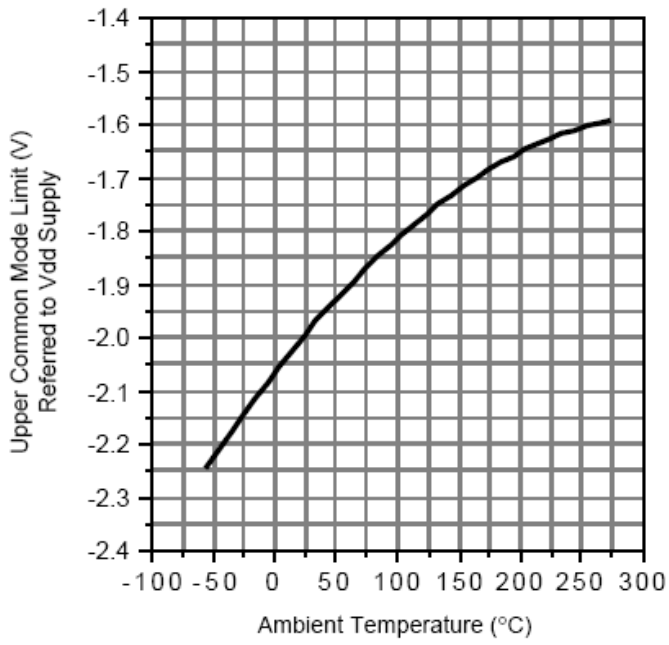


**NEGATIVE POWER SUPPLY REJECTION vs. FREQUENCY**

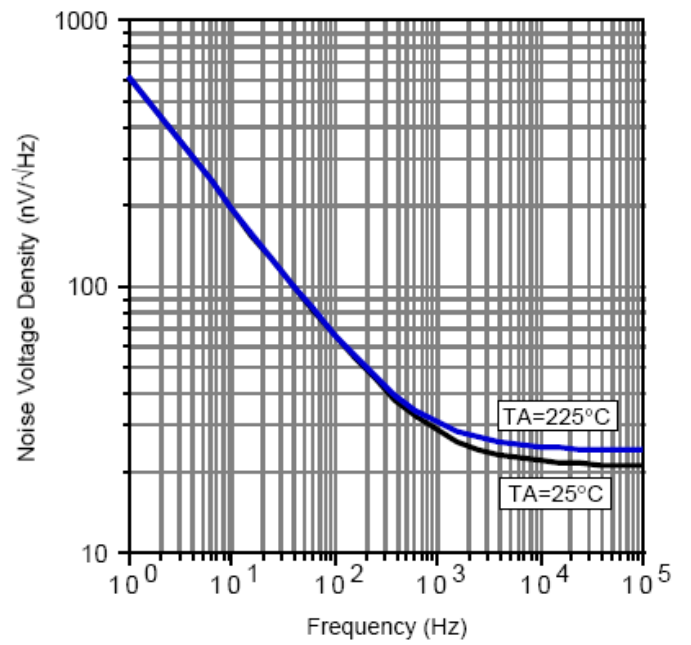




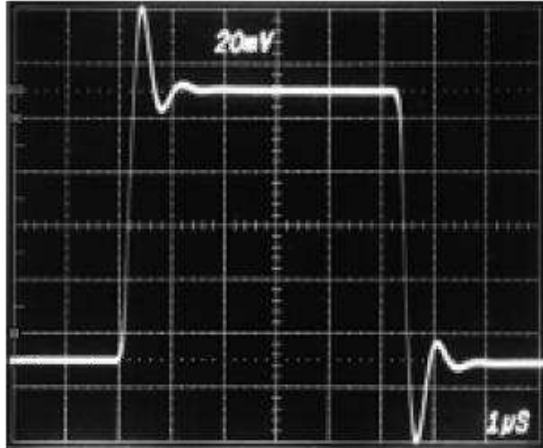
**UPPER COMMON MODE LIMIT vs. TEMPERATURE**



**INPUT REFERRED NOISE VOLTAGE vs. FREQUENCY**

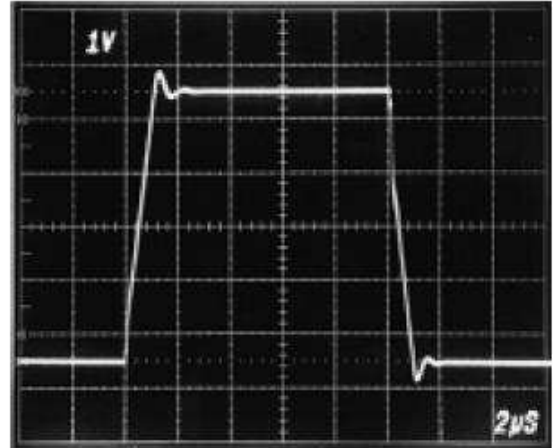


Small Signal Step Response

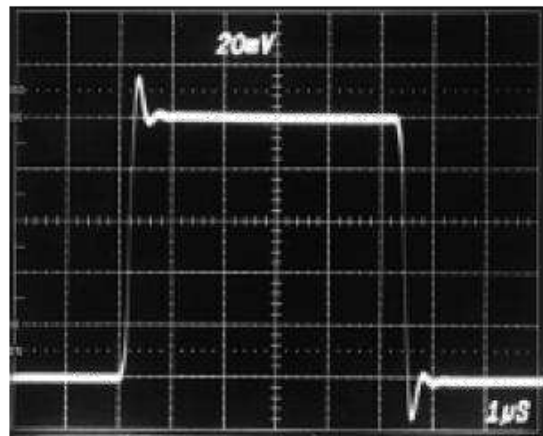


TA=225°C, CL=100pF  
Small Signal Step Response

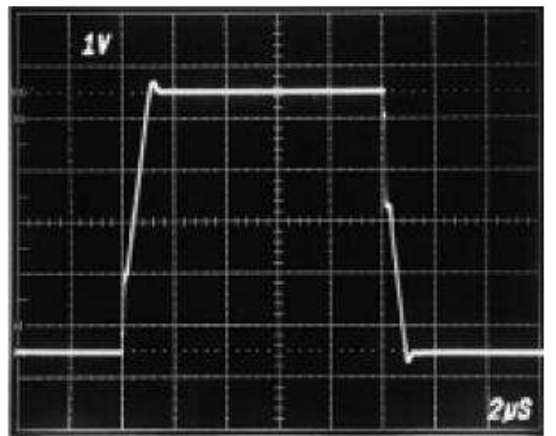
Large Signal Step Response



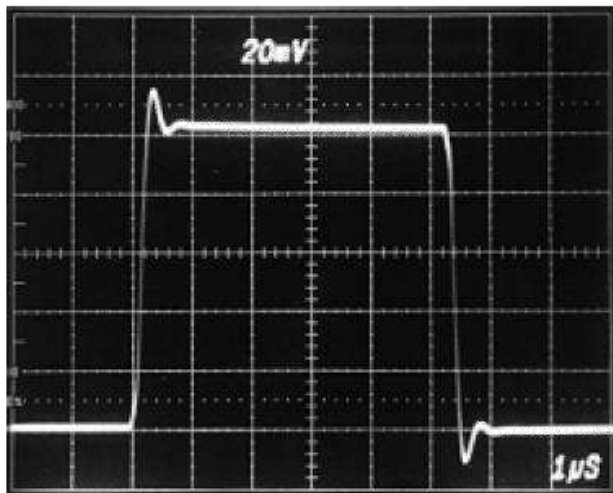
TA=225°C, CL=100pF  
Large Signal Step Response



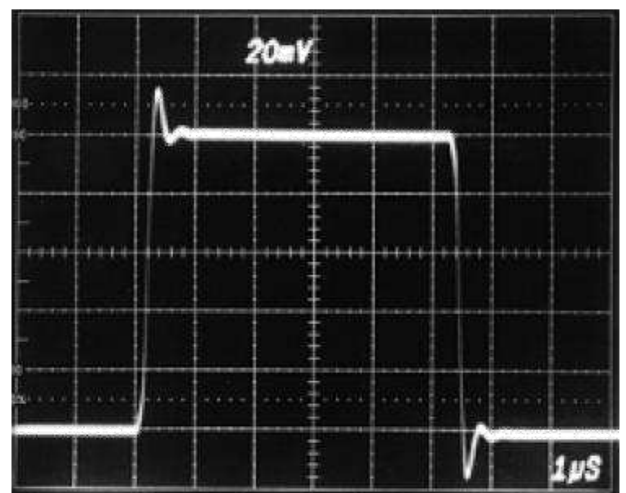
TA=225°C, CL=20pF  
**SMALL SIGNAL PULSE RESPONSE**



TA=225°C, CL=20pF  
**SMALL SIGNAL PULSE RESPONSE**

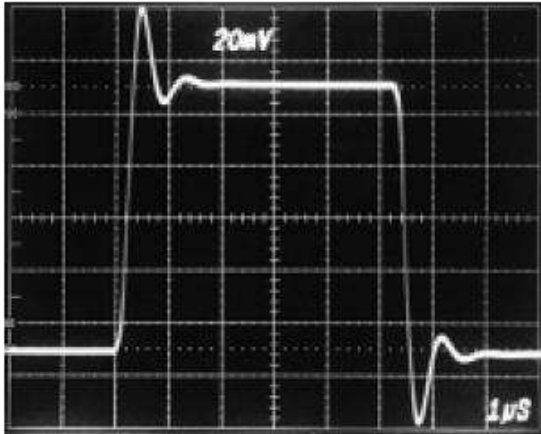


TA=25°C, CL=20pF, Av=+1



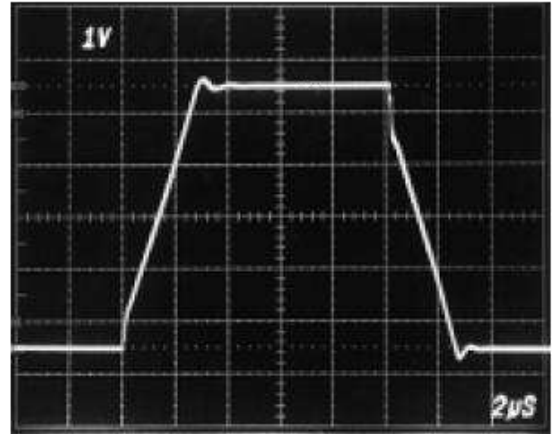
TA=225°C, CL=20pF, Av=+1

Small Signal Step Response



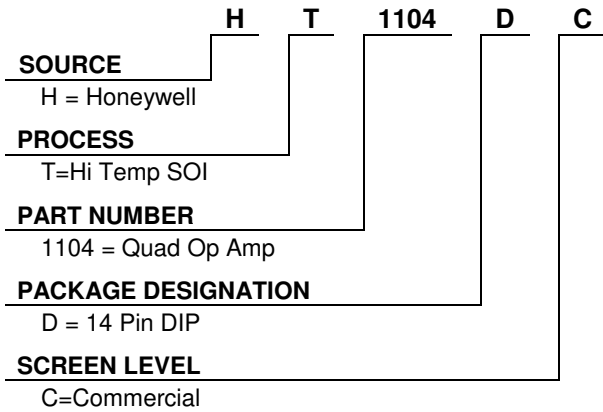
TA=25°C, CL=100pF

Large Signal Step Response



TA=25°C, CL=100pF

**ORDERING INFORMATION**



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