LOW POWER DUAL OPERATIONAL AMPLIFIERS SA/SE/NE532/LM158/258/358

DESCRIPTION

The 532/358 consists of two independent, high gain, internally frequency compensated operational amplifiers designed specifically to operate from a single power supply over a wide range of voltages. Operation from dual power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

FEATURES

- **Internally frequency compensated for unity gain**
- **Large dc voltage gain—(100dB)**
- **Wide bandwidth (unity gain)—1MHz (temperature compensated)**
- **Wide power supply range**
  single supply—(3Vdc to 30Vdc)
  or dual supplies—(±1.5Vdc to ±15Vdc)
- **Very low supply current drain (400μA)—essentially independent of supply voltage (1mW/op amp at +5Vdc)**
- **Low input biasing current—(45nA dc temperature compensated)**
- **Low input offset voltage—(2mVdc) and offset current—(5nA dc)**
- **Differential input voltage range equal to the power supply voltage**
- **Large output voltage—(0Vdc to V+—-1.5Vdc swing)**
- **SE532 MIL-STD-883A,B,C available**

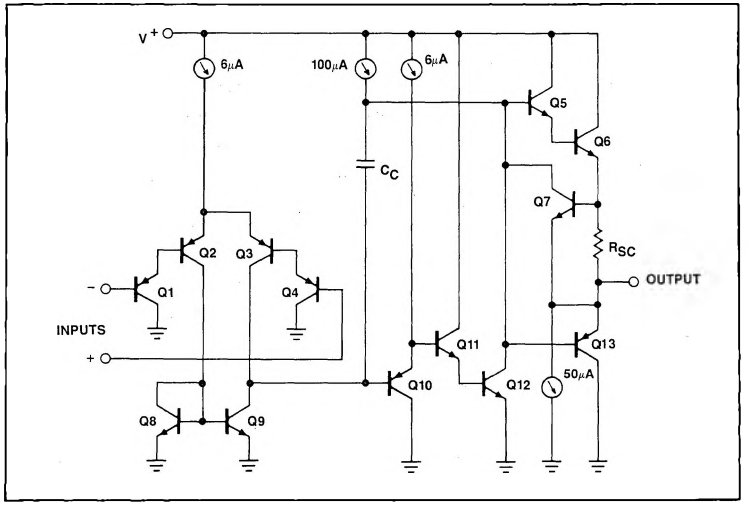
UNIQUE FEATURES

In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage. The unity gain cross frequency is temperature compensated. The input bias current is also temperature compensated.

ABSOLUTE MAXIMUM RATINGS

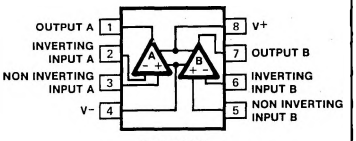
PARAMETER	RATING	UNIT
Supply voltage, V+	32 or ±16	Vdc
Differential input voltage	32	Vdc
Input voltage	-0.3 to +32	Vdc
Power dissipation[1]		
FE package	900	mW
H package	680	mW
N package	500	mW
Output short-circuit to GND[5]		
V+ < 15 Vdc and T_A = 25°C	Continuous	
Operating temperature range		
NE532/LM358	0 to +70	°C
LM258	-25 to +85	°C
SA532N	-40 to +85	°C
SE532/LM158	-55 to +125	°C
Storage temperature range	-65 to +150	°C
Lead temperature (soldering, 10sec)	300	°C

EQUIVALENT CIRCUIT



PIN CONFIGURATIONS

D,FE,N PACKAGE

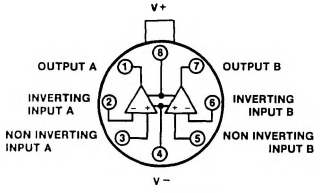


TOP VIEW

ORDER NUMBERS

LM158N, FE	NE532D, N, FE
LM258N, FE	SA532FE, N
LM358D, N, FE	SE532N, FE

H PACKAGE*



ORDER NUMBERS

LM158/258/358H
NE/SE532H

*Metal cans (H) not recommended for new designs

DC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V+ = +5V$ unless otherwise specified.

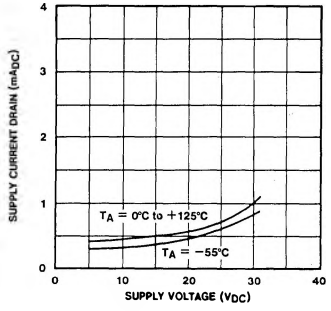
PARAMETER		TEST CONDITIONS	SE532, LM158/258			NE/SA532/LM358			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage[1]	$R_S \leq 0\Omega$		±2	±5		±2	±7	mV
		$R_S \leq 0\Omega$, over temp.			±7			±9	mV
V_{OS}	Drift	$R_S = 0\Omega$, over temp.		7			7		μV/°C
I_{OS}	Offset current	$I_{IN}(+) - I_{IN}(-)$		±3	±30		±5	±50	nA
		Over temp.			±100			±150	nA
I_{OS}	Drift	Over temp.		10			10		pA/°C
I_{BIAS}	Input current[2]	$I_{IN}(+)$ or $I_{IN}(-)$		45	150		45	250	nA
		Over temp., $I_{IN}(+)$ or $I_{IN}(-)$		40	300		40	500	nA
I_B	Drift	Over temp		50			50		pA/°C
V_{CM}	Common mode voltage range[3]	$V+ = 30V$	0		V+ −1.5	0		V+ −1.5	V
		Over temp., $V+ = 30V$	0		V+ −2.0	0		V+ −2.0	V
C_{MRR}	Common mode rejection ratio	$V+ = 30V$	70	85		65	70		dB
V_{OUT}	Output voltage swing (V_{OH})	$R_L \geq 2k\Omega$, $V+ = 30V$, over temp.	26			26			V
		$R_L \geq 10k\Omega$, $V+ = 30V$, over temp.	27	28		27	28		V
V_{OUT}	Output voltage swing (V_{OL})	$R_L \leq 10k\Omega$, over temp.		5	20		5	20	mV
I_{CC}	Supply current	$R_L = \infty$, $V+ = 30V$		1.0	2.0		1.0	2.0	mA
		$R_L = \infty$ on all amplifiers, over temp.		0.5	1.2		0.5	1.2	mA
A_{VOL}	Large signal voltage gain	$R_L \geq 2k\Omega$, $V_{OUT} \pm 10V$, $V+ = 15V$	50	100		25	100		V/mV
		(for large V_O swing) over temp.	25			15			V/mV
PSRR	Supply voltage rejection ratio	$R_S \leq 0\Omega$	65	100		65	100		dB
	Amplifier-to-amplifier coupling[4]	f = 1kHz to 20kHz (input referred)		−120			−120		dB
	Output current Source	$V_{IN+} = +1Vdc$, $V_{IN-} = 0Vdc$, $V+ = 15Vdc$	20	40		20	40		mA
		$V_{IN+} = +1Vdc$, $V_{IN-} = 0Vdc$, $V+ = 15Vdc$, over temp.	10	20		10	20		mA
	Sink	$V_{IN-} = +1Vdc$, $V_{IN+} = 0Vdc$, $V+ = 15Vdc$	10	20		10	20		mA
		$V_{IN-} = +1Vdc$, $V_{IN+} = 0Vdc$, $V+ = 15Vdc$, over temp.	5	8		5	8		mA
		$V_{IN+} = 0V$, $V_{IN-} = +1Vdc$, $V_O = 200mV$	12	50		12	50		μA
I_{SC}	Short circuit current[5]			40	60		40	60	mA
	Differential input voltage[6]				V+			V+	V
GBW	Unity gain bandwidth	$T_A = 25°C$		1			1		MHz
S.R.	Slew rate	$T_A = 25°C$		0.3			0.3		V/μs
Noise	Input Noise Voltage	$T_A = 25°C$, f = 1kHz		40			40		nV/√Hz

NOTES

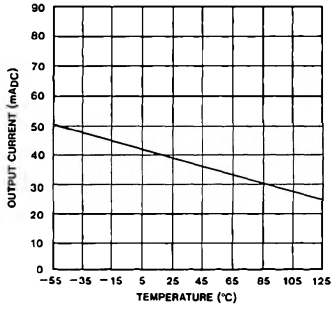
1. $V_O \cong 1.4V$, $R_S = 0\Omega$ with $V+$ from 5V to 30V; and over the full input common-mode range (0V to $V+ - 1.5V$).
2. The direction of the input current is out of the IC due to the pnp input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
3. The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is $V+ - 1.5V$, but either or both inputs can go to +32V without damage.
4. Due to proximity of external components, insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance coupling increases at higher frequencies.
5. Short circuits from the output to $V+$ can cause excessive heating and eventual destruction. The maximum output current is approximately 40mA independent of the magnitude of $V+$. At values of supply voltage in excess of +15Vdc, continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction.
6. The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is $V+ - 1.5V$, buteither or both inputs can go to +32Vdc without damage.
7. For operating at high temperatures, all devices must be derated based on a +125°C maximum junction temperature and a thermal resistance of 175°C/W which applies for the device soldered in a printed circuit board, operating in a still air ambient.

TYPICAL PERFORMANCE CHARACTERISTICS

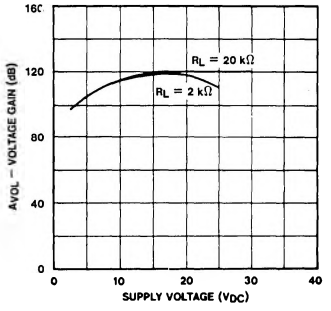
SUPPLY CURRENT



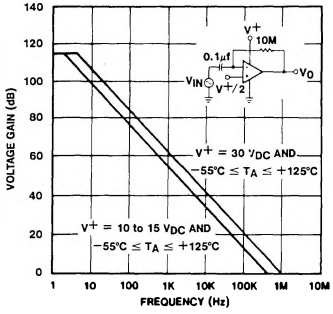
CURRENT LIMITING



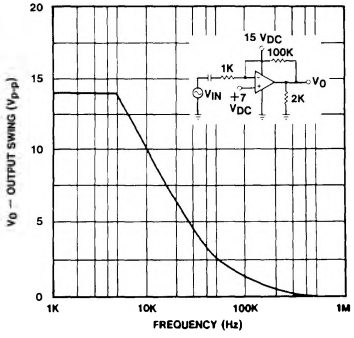
VOLTAGE GAIN



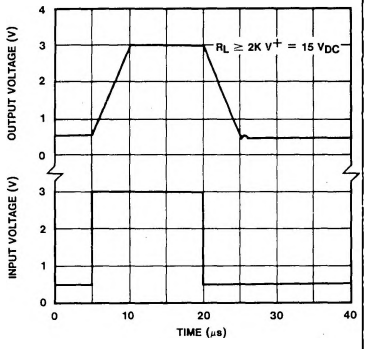
OPEN LOOP FREQUENCY RESPONSE



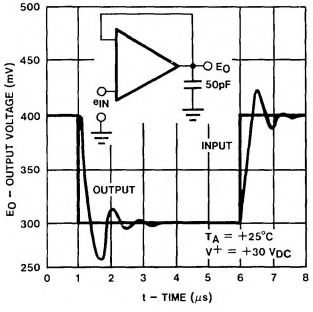
LARGE SIGNAL FREQUENCY RESPONSE



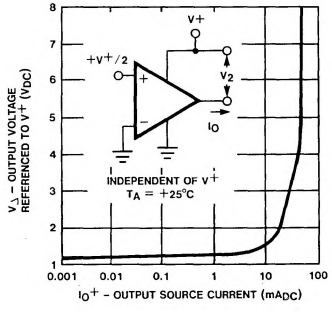
VOLTAGE FOLLOWER PULSE RESPONSE



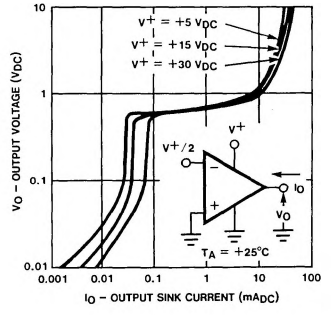
VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)



OUTPUT CHARACTERISTICS CURRENT SOURCING



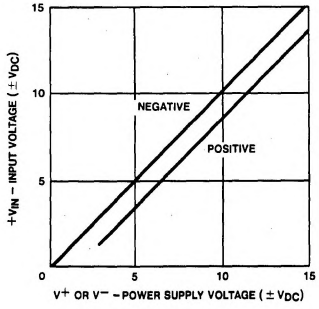
OUTPUT CHARACTERISTICS CURRENT SINKING



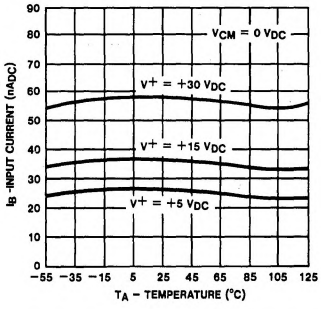
LOW POWER DUAL OPERATIONAL AMPLIFIERS SA/SE/NE532/LM158/258/358

TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

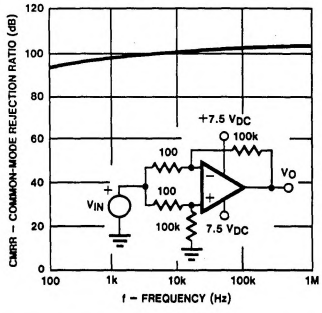
INPUT VOLTAGE RANGE



INPUT CURRENT

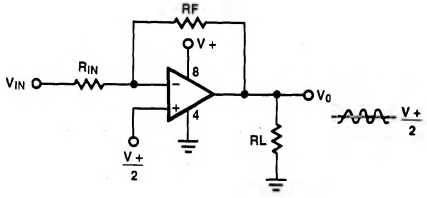


COMMON MODE REJECTION RATIO

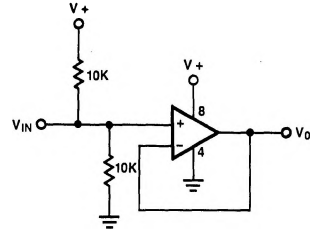


TYPICAL APPLICATIONS

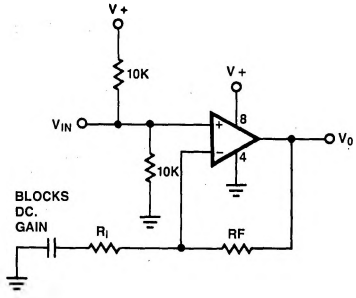
SINGLE SUPPLY INVERTING AMPLIFIER



INPUT BIASING *VOLTAGE FOLLOWER



NON-INVERTING AMPLIFIER



GENERAL PURPOSE OPERATIONAL AMPLIFIER — MC/SA1458/MC1558

DESCRIPTION

The MC1458 is a high performance operational amplifier with high open loop gain, internal compensation, high common mode range and exceptional temperature stability. The MC1458 is short-circuit protected and allows for nulling of offset voltage.

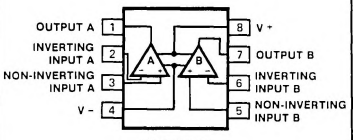
The MC1458/SA1458/MC1558 consists of a pair of 741 operational amplifiers on a single chip.

FEATURES

- **Internal frequency compensation**
- **Short circuit protection**
- **Excellent temperature stability**
- **High input voltage range**
- **No latch-up**
- **1558/1458 are 2 "op amps" in space of one 741 package**
- **MC1558 MIL-STD-883A,B,C available**

PIN CONFIGURATIONS

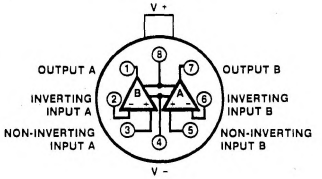
D,N, PACKAGE



TOP VIEW

ORDER NUMBERS
MC1458N
MC1558N
SA1458N

H PACKAGE*



ORDER NUMBERS
MC1458H
MC1558H

*Metal cans (H) not recommended for new designs

ABSOLUTE MAXIMUM RATINGS

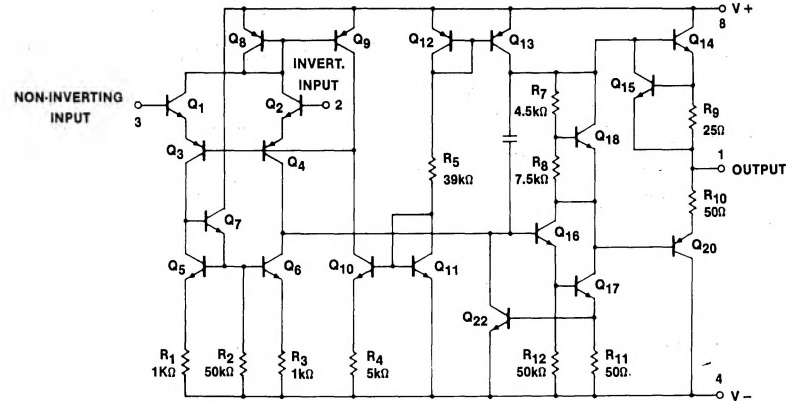
PARAMETER	RATING	UNIT
Supply voltage		
MC1458	±18	V
SA1458	±18	V
MC1558	±22	V
Internal power dissipation		
N package	500	mW
H package[1]	800	mW
F,FE package	1000	mW
Differential input voltage	±30	V
Input voltage[2]	±15	V
Output short-circuit duration	Continuous	
Operating temperature range		
MC1458	0 to +70	°C
SA1458	-40 to +85	°C
MC1558	-55 to +125	°C
Storage temperature range	-65 to +150	°C
Lead temperature (soldering 60sec)	300	°C

NOTES

1. Ratings based on thermal resistances, junction to ambient, of 240°C/W, 150°C/W, 110°C/W for N, H, F and FE packages respectively, and a maximum junction temperature of 150°C.
2. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

EQUIVALENT SCHEMATIC

AMPLIFIER "A" OF MC1458, SA1458, MC1558



DC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V_S = \pm 15V$, unless otherwise specified.

PARAMETER		TEST CONDITIONS	MC1558			UNIT
			Min	Typ	Max	
V_{OS}	Offset voltage	$R_S = 10k\Omega$		1.0	5.0	mV
		$R_S = 10k\Omega$, over temperature			6.0	mV
ΔV_{OS}	Offset voltage	Over temperature		10		$\mu V/°C$
I_{OS}	Offset current			20	200	nA
		Over temperature			500	nA
ΔI_{OS}	Offset current	Over temperature		0.10		nA/°C
I_{BIAS}	Input bias current			80	500	nA
		Over temperature			1500	nA
ΔI_B	Bias current	Over temperature		1.0		nA/°C
V_{OUT}	Output voltage swing	$R_L = 10k\Omega$, over temperature	± 12	± 14		V
		$R_L = 2k\Omega$, over temperature	± 10	± 13		V
A_{VOL}	Large signal voltage gain	$R_L = 2k\Omega$, $V_O = \pm 10V$	50	100		V/mV
		$R_L = 2k\Omega$, $V_O = \pm 10V$, over temperature	20			V/mV
	Offset voltage adjustment range			± 30		mV
PSRR	Supply voltage rejection ratio	$R_S \leq 10k\Omega$		30	150	$\mu V/V$
CMRR	Common mode rejection ratio		70	90		dB
I_{CC}	Supply current			2.3	5.0	mA
V_{IN}	Input voltage range		± 12	± 13		V
P_d	Power consumption			70	150	mW
	Channel separation			120		dB
R_{OUT}	Output resistance			75		Ω
I_{SC}	Output short-circuit current		10	26	60	mA

DC ELECTRICAL CHARACTERISTICS (Cont'd) $T_A = 25°C$, $V_{CC} = \pm 15V$, unless otherwise specified.[1]

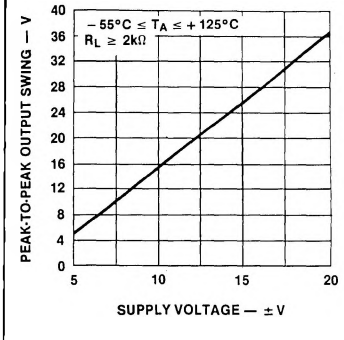
PARAMETER		TEST CONDITIONS	MC1458			SA1458			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage	$R_S = 10k\Omega$		2.0	6.0		2.0	6.0	mV
		$R_S = 10k\Omega$, over temp.			7.5			7.5	mV
ΔV_{OS}	Offset voltage	Over temperature		12			12		$\mu V/°C$
I_{OS}	Offset current			20	200		20	200	nA
		Over temperature			300			500	nA
ΔI_{OS}	Offset current	Over temperature		0.10			0.10		nA/°C
I_{BIAS}	Input bias current			80	500		80	500	nA
		Over temperature			800			1500	nA
ΔI_B	Bias current	Over temperature		1.0			1.0		nA/°C
V_{OUT}	Output voltage swing	$R_L = 10k\Omega$	± 12	± 14		± 12	± 14		V
		$R_L = 2k\Omega$, over temp.	± 10	± 13		± 10	± 13		V
A_{VOL}	Large signal voltage gain	$R_L = 2k\Omega$, $V_O = \pm 10V$	25	200		20	200		V/mV
		$R_L = 2k\Omega$, $V_O = \pm 10V$, Over temperature	15			15			V/mV
	Offset voltage adjustment range			± 30			± 30		mV
PSRR	Supply voltage rejection ratio	$R_S \leq 10k\Omega$		30	150		30	150	$\mu V/V$
CMRR	Common mode rejection ratio		70	90		70	90		dB
I_{CC}	Supply current			2.3	5.6		2.3	5.6	mA
V_{IN}	Input voltage range		± 12	± 13		± 12	± 13		V
R_{IN}	Input resistance								MΩ
P_d	Power consumption			70	170		70	170	mW
	Channel separation			120			120		dB
I_{SC}	Output short-circuit current			25			25		mA

AC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V_S = \pm 15V$, unless otherwise specified.

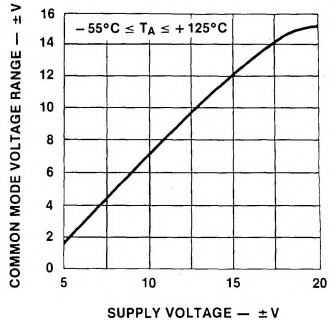
PARAMETER	TEST CONDITIONS	MC1458, SA1458, MC1558			UNIT
		Min	Typ	Max	
Parallel input resistance	Open loop, f = 20Hz	0.3			MΩ
Common mode input impedance	f = 20Hz		200		MΩ
Equivalent input noise voltage	$A_V = 100$, $R_S = 10k\Omega$, $B_W = 1.0kHz$, f = 1.0kHz		30		nV $\sqrt{Hz}$
Power bandwidth	$A_V = 1$, $R_L = 2.0k\Omega$, THD ≤ 5%, $V_{OUT} = 20Vp\text{-}p$		14		kHz
Phase margin			65		degrees
Gain margin			11		dB
Unity gain crossover frequency	Open loop		1.0		MHz
Transient response unity gain	$V_{IN} = 20mV$, $R_L = 2k\Omega$, $C_L \leq 100pF$				
Rise time			0.3		μs
Overshoot			5.0		%
Slew rate	C ≤ 100pF, $R_L \geq 2k$, $V_{IN} = \pm 10V$		0.8		V/μs

TYPICAL PERFORMANCE CHARACTERISTICS

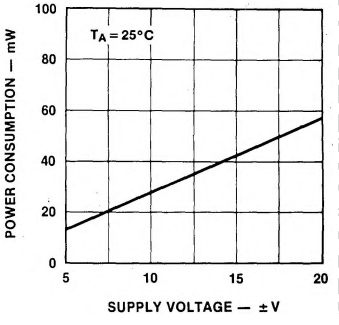
OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



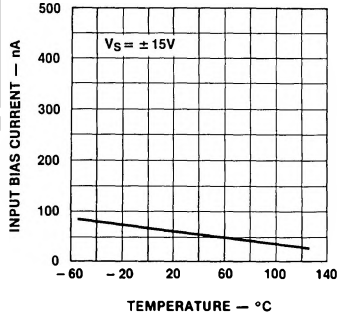
INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



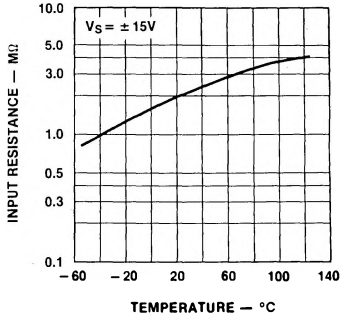
POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE



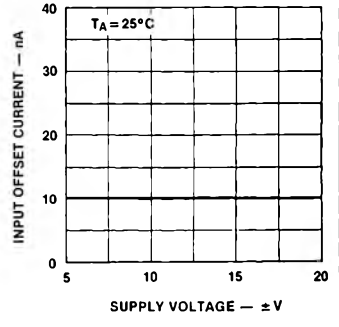
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE

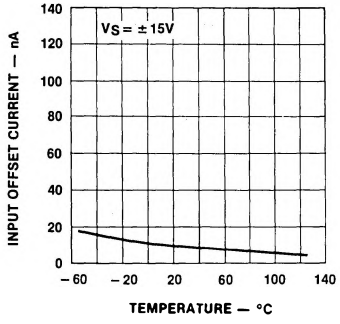


INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGE

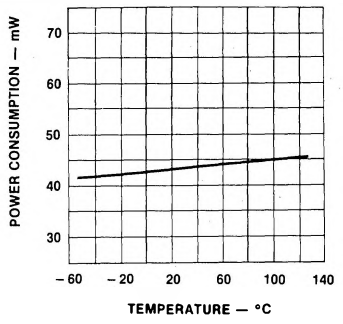


TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

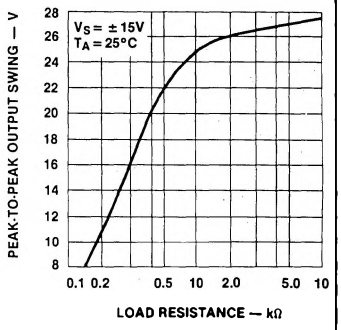
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



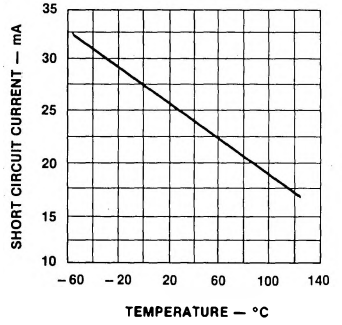
POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE



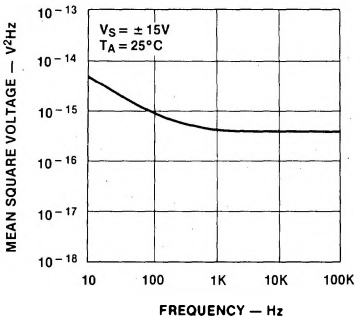
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



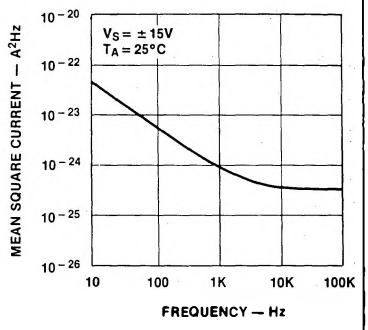
OUTPUT SHORT-CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



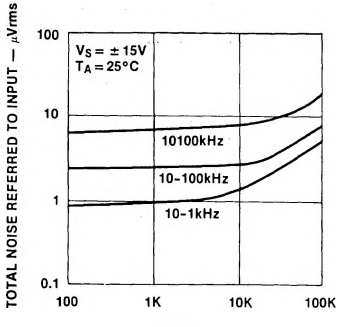
INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY



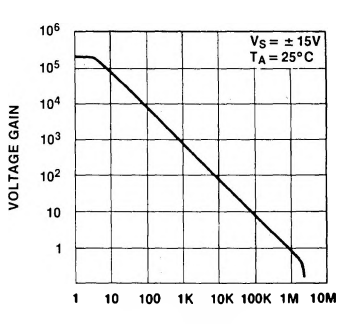
INPUT NOISE CURRENT AS A FUNCTION OF FREQUENCY



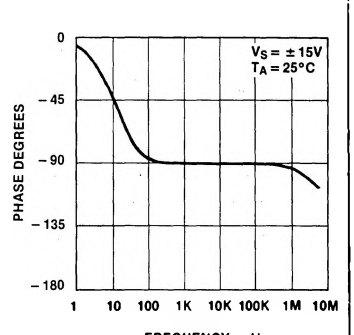
BROADBAND NOISE FOR VARIOUS BANDWIDTHS



OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY

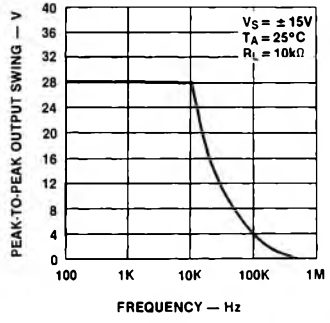


OPEN LOOP PHASE RESPONSE AS A FUNCTION OF FREQUENCY

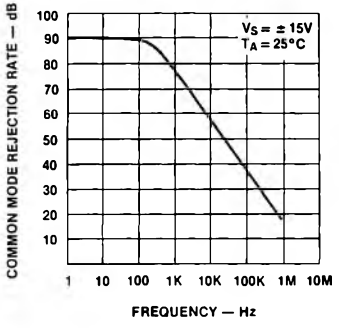


TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

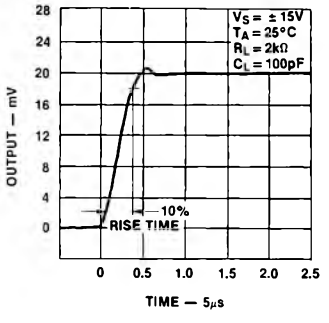
OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY



COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



TRANSIENT RESPONSE



POWER BANDWIDTH (Large Signal Swing vs Frequency)