signetics

HIGH SLEW RATE OPERATIONAL AMPLIFIER 531

LINEAR INTEGRATED CIRCUITS

DESCRIPTION

The 531 is a fast slewing high performance operational amplifier which retains D.C. performance equal to the best general purpose types while providing far superior large signal A.C. performance. A unique input stage design allows the amplifier to have a large signal response nearly identical to its small signal response. The amplifier can be compensated for truly negligible overshoot with a single capacitor. In applications where fast settling and superior large signal bandwidths are required, the amplifier out performs conventional designs which have much better small signal response. Also, because the small signal response is not extended, no special precautions need be taken with circuit board layout to achieve stability. The high gain, simple compensation and excellent stability of this amplifier allow its use in a wide variety of instrumentation applications.

FEATURES

- 35V/μsec SLEW RATE AT UNITY GAIN
- PIN FOR PIN REPLACEMENT FOR μA709, μA748 OR LM101
- COMPENSATED WITH A SINGLE CAPACITOR
- SAME LOW DRIFT OFFSET NULL CIRCUITRY AS μA741
- SMALL SIGNAL BANDWIDTH 1 MHz
- LARGE SIGNAL BANDWIDTH 500KHz
- TRUE OP AMP D.C. CHARACTERISTICS MAKE THE 531 THE IDEAL ANSWER TO ALL SLEW RATE LIMITED OPERATIONAL AMPLIFIER APPLICATIONS.

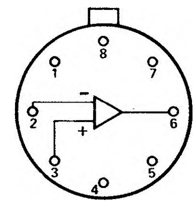
NOTES:
1. Rating applies for case temperatures to 125 °C, derate linearly at 6.5mW/°C for ambient temperatures above +75°C
2. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
3. Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±22V
Internal Power Dissipation (Note 1)	300mW
Differential Input Voltage	±15V
Common Mode Input Voltage (Note 2)	± 15V
Voltage Between Offset Null and V^-	±0.5V
Operating Temperature Range	
NE531	0°C to +70°C
SE531	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Solder, 60 sec.)	300°C
Output Short Circuit Duration (Note 3)	Indefinite

PIN CONFIGURATION

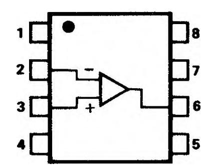
T PACKAGE
(Top View)



1. Offset Null
2. Inverting Input
3. Noninverting Input
4. V^-
5. Offset Null
6. Output
7. V^+
8. Freq. Comp.

ORDER PART NOS.
SE531T/NE531T

V PACKAGE

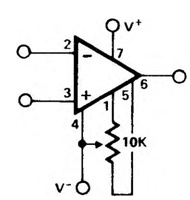


1. Offset Null
2. Inverting Input
3. Noninverting Input
4. V^-
5. Offset Null
6. Output
7. V^+
8. Freq. Comp.

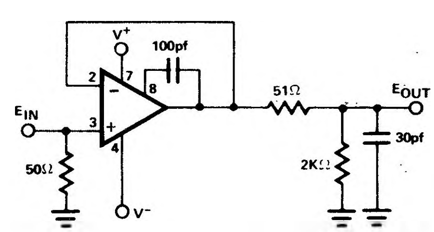
ORDER PART NO. NE531V

TEST CIRCUITS

OFFSET NULL CIRCUIT



TRANSIENT RESPONSE TEST CIRCUIT



GENERAL ELECTRICAL CHARACTERISTICS (V_S = ±15V, T_A = 25°C Unless Otherwise Specified)

NE531

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leq 10K\Omega$		2.0	6	mV
Input Offset Current			50	200	nA
Input Bias Current			0.4	1.5	μA
Input Resistance			20		MΩ
Input Voltage Range		±10			Volts
Common Mode Rejection Ratio	$R_S \leq 10K\Omega$	70	100		dB
Supply Voltage Rejection Ratio	$R_S \leq 10K\Omega$		10	150	μV/V
Large Signal Voltage Gain	$R_L \geq 2K\Omega$, V_{OUT} = ±10V	20,000	60,000		
Output Resistance			75		Ω
Supply Current			5.5	10	mA
Power Consumption			165	300	mW
Full Power Bandwidth			500		KHz
Settling Time, 1%	A_V = +1, V_{IN} = ±10V		1.5		μsec
Settling Time, .01%	A_V = +1, V_{IN} = ±10V		2.5		μsec
Large Signal Overshoot	A_V = +1, V_{IN} = ±10V		2		%
Small Signal Overshoot	A_V = +1, V_{IN} = 400mV		5		%
Small Signal Risetime	A_V = +1, V_{IN} = 400mV		300		nsec
The Following Apply for 0°C ≤ T_A ≤ +70°C:					
Input Offset Voltage	$R_S \leq 10K\Omega$			7.5	mV
Input Offset Current	T_A = +70°C			200	nA
	T_A = 0°C			300	nA
Input Bias Current	T_A = +70°C			1.5	μA
	T_A = 0°C			2.0	μA
Large Signal Voltage Gain	$R_L \geq 2K\Omega$, V_{OUT} = ±10V	15,000			
Output Voltage Swing	$R_L \geq 2K\Omega$	±10	±13		Volts
Slew Rate	A_V = 100		35		V/μs
	A_V = 10		35		V/μs
	A_V = 1 (non-inverting)		30		V/μs
	A_V = 1 (inverting)		35		V/μs
Supply Current	T_A = +70°C		4.5	5.5	mA

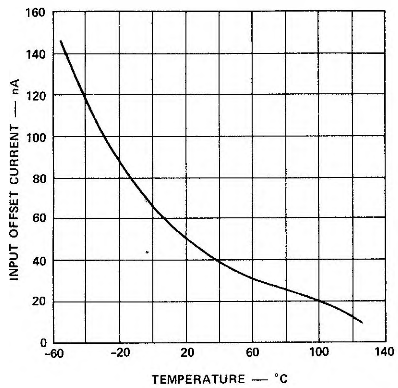
SE531

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leq 10K\Omega$		2.0	5.0	mV
Input Offset Current			30	200	nA
Input Bias Current			300	500	nA
Input Resistance			20		MΩ
Input Voltage Range		±10			Volts
Large Signal Voltage Gain	$R_L \geq 2K\Omega$, V_{OUT} = ±10V	50,000	100,000		
Output Resistance			75		Ω
Supply Current			5.5	7.0	mA
Power Consumption			165	210	mW
Full Power Bandwidth			500		KHz
Settling Time, 1%	A_V = +1, V_{IN} = ±10V		1.5		μsec
Settling Time, .01%	A_V = +1, V_{IN} = ±10V		2.5		μsec
Large Signal Overshoot	A_V = +1, V_{IN} = ±10V		2		%
Small Signal Risetime	A_V = +1, V_{IN} = 400mV		300		nsec
Small Signal Overshoot	A_V = +1, V_{IN} = 400mV		5		%
Slew Rate	A_V = 100		35		V/μs
	A_V = 10		35		V/μs
	A_V = 1 (non-inverting)		30		V/μs
	A_V = 1 (inverting)		35		V/μs
The following apply for -55°C ≤ T_A ≤ +125°C:					
Input Offset Voltage	$R_S \leq 10K\Omega$			6	mV
Input Offset Current	T_A = +125°C			200	nA
	T_A = -55°C			500	nA
Input Bias Current	T_A = +125°C			500	nA
	T_A = -55°C			1.5	μA
Common Mode Rejection Ratio	$R_S \leq 10K\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 10K\Omega$		10	150	μV/V
Large Signal Voltage Gain	R_L = 2KΩ, V_{OUT} = ±10V	25,000			
Output Voltage Swing	R_L = 2KΩ	±10	±13		V
Supply Current	T_A = +125°C		4.5	5.5	mA

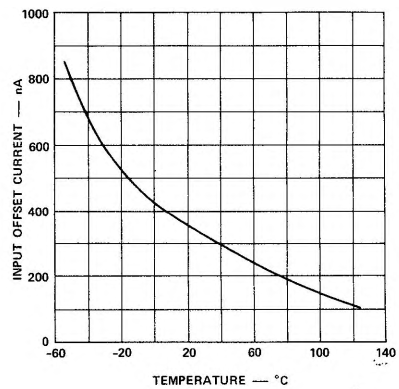
NOTES:
All AC parametric testing is performed using the conditions of the transient response test circuit, page 1.

TYPICAL PERFORMANCE CHARACTERISTICS ($V_S = \pm15V$, $T_A = +25°C$ unless otherwise noted)

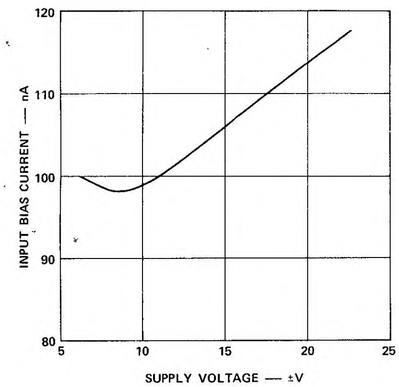
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



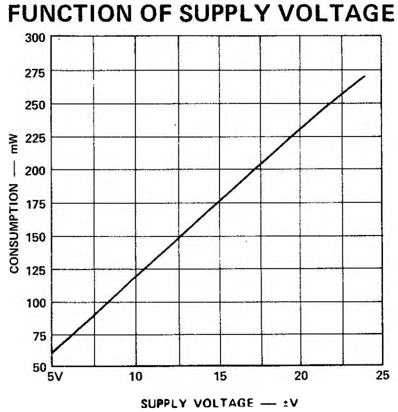
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



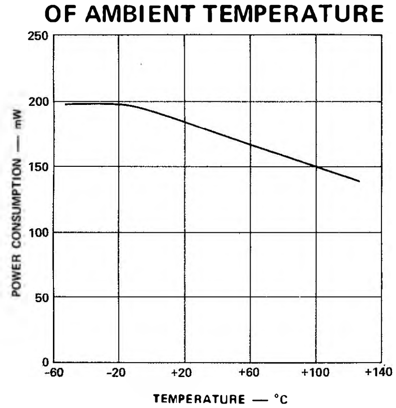
INPUT BIAS CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



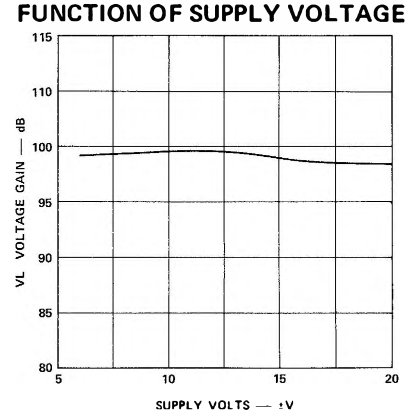
POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE



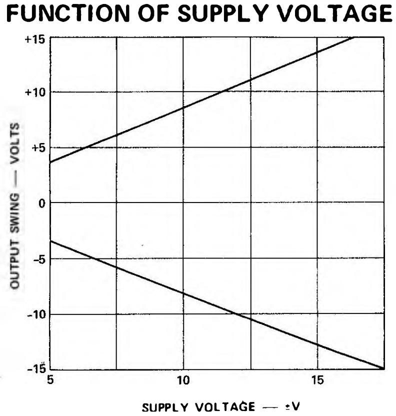
POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE



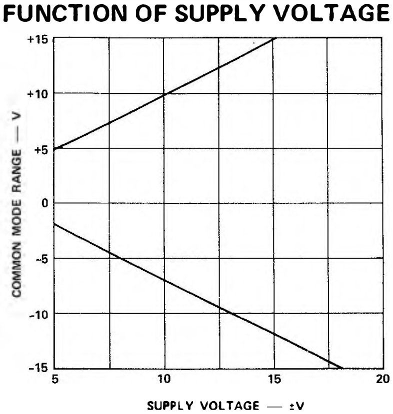
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE



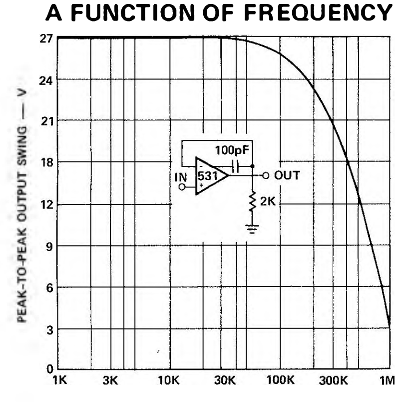
OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



INPUT VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE

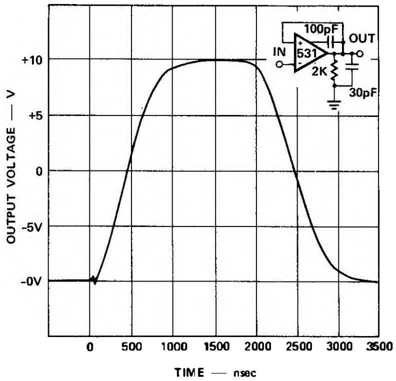


OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY

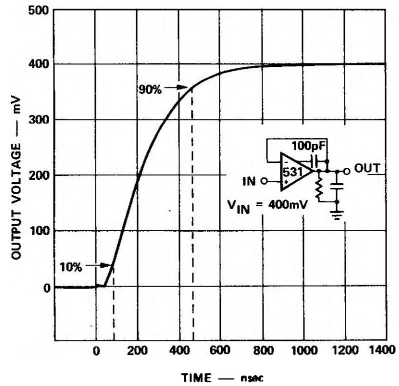


TYPICAL CHARACTERISTIC CURVES (Cont'd.)

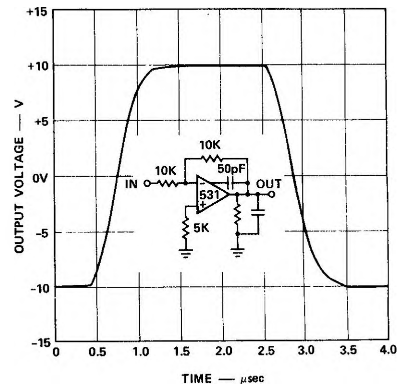
VOLTAGE FOLLOWER LARGE SIGNAL RESPONSE



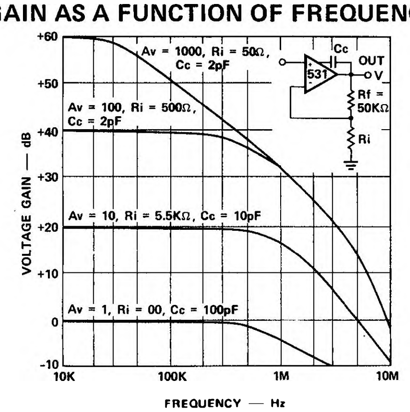
VOLTAGE FOLLOWER TRANSIENT RESPONSE



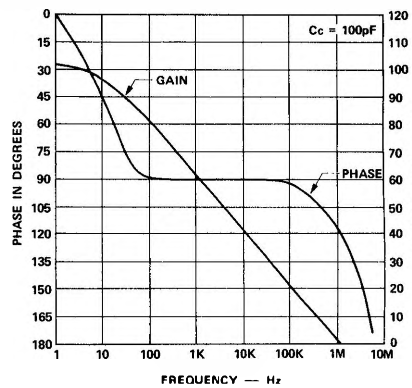
UNITY GAIN INVERTING AMPLIFIER LARGE SIGNAL RESPONSE



CLOSED LOOP NON-INVERTING VOLTAGE GAIN AS A FUNCTION OF FREQUENCY

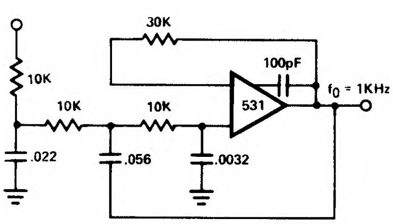


OPEN LOOP PHASE RESPONSE AND VOLTAGE GAIN AS A FUNCTION OF FREQUENCY

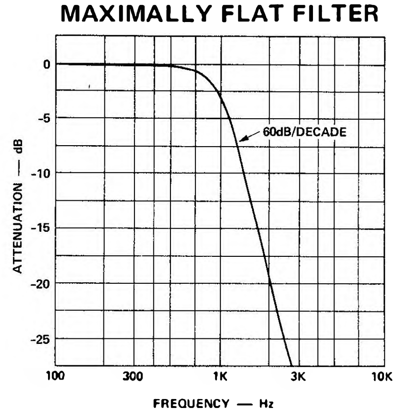


TYPICAL APPLICATIONS

3 POLE ACTIVE LOW PASS FILTER BUTTERWORTH MAXIMALLY FLAT RESPONSE*



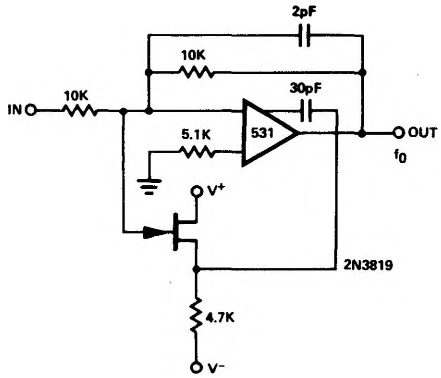
RESPONSE OF 3-POLE ACTIVE BUTTERWORTH MAXIMALLY FLAT FILTER



*Reference – EDN Dec. 15, 1970
Simplify 3-Pole Active Filter Design
A. Paul Brokow

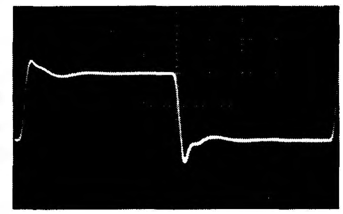
TYPICAL APPLICATIONS (Cont'd.)

HIGH SPEED INVERTER (10MHz Bandwidth)



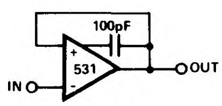
PULSE RESPONSE
HIGH SPEED INVERTER

0.5V/DIV.



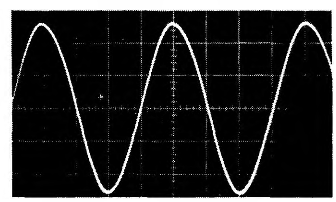
200nsec/DIV

FAST SETTLING VOLTAGE FOLLOWER



LARGE SIGNAL RESPONSE
VOLTAGE FOLLOWER

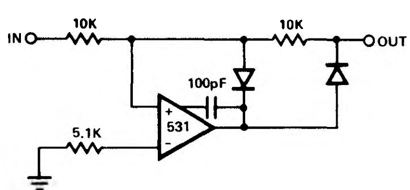
2V/DIV



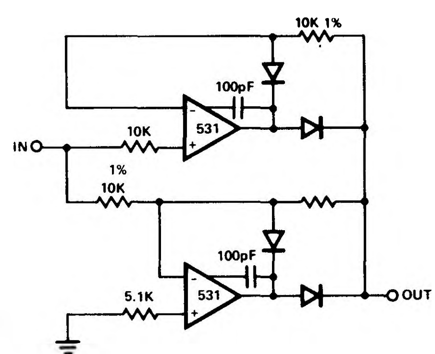
0.5μs/DIV f = 500KHz

PRECISION RECTIFIERS

(a) HALF WAVE

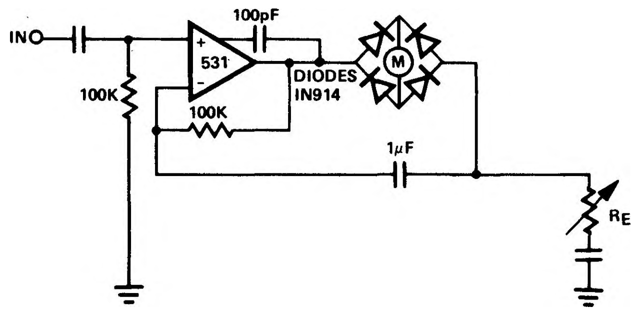


(b) FULL WAVE



TYPICAL APPLICATIONS (Cont'd.)

AC MILLIVOLTMETER



SAMPLE AND HOLD