signetics

HIGH PERFORMANCE OPERATIONAL AMPLIFIER

LM101A LM301A

LINEAR INTEGRATED CIRCUITS

DESCRIPTION

The LM101A and LM301A are high performance operational amplifiers featuring high gain, short circuit protection, simplified compensation and excellent temperature stability.

FEATURES

- **SHORT CIRCUIT PROTECTION**
- **OFFSET VOLTAGE NULL CAPABILITY**
- **LARGE COMMON-MODE AND DIFFERENTIAL VOLTAGE RANGES**
- **LOW POWER CONSUMPTION**
- **NO LATCH UP**

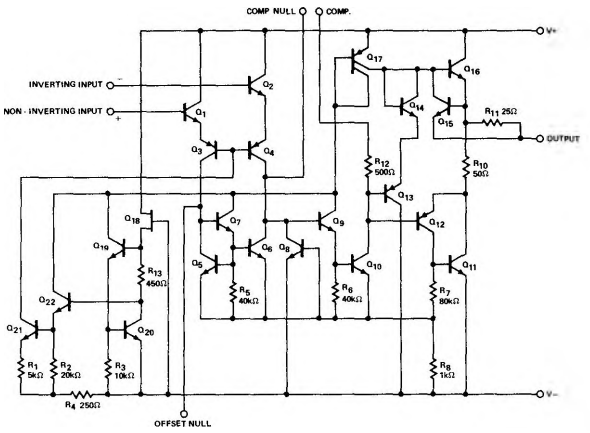
ABSOLUTE MAXIMUM RATINGS

Supply Voltage	LM101A	±22V
	LM301A	±18V
Power Dissipation (Note 1)		500mW
Differential Input Voltage		±30V
Input Voltage (Note 2)		±15V
Output Short Circuit Duration		Indefinite
Operating Temperature Range	LM101A	-55°C to 125°C
	LM301A	0°C to 70°C
Storage Temperature Range		-65°C to 150°C
Lead Temperature (Soldering, 60 sec.)		300°C

NOTES:

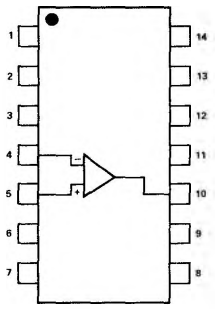
1. Absolute maximum rating holds for all packages. The maximum junction temperature is 150°C for the LM101A and 100°C for the LM301A. For operation at elevated temperatures, derate according to appropriate thermal resistances given under package information.
2. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

EQUIVALENT CIRCUIT



PIN CONFIGURATIONS

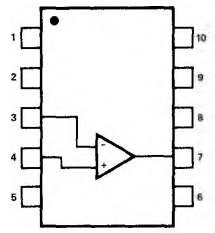
A & F PACKAGE (Top View)



1. NC
2. NC
3. Freq. Comp./Offset Null
4. Inverting Input
5. Noninverting Input
6. V^-
7. NC
8. NC
9. Offset Null
10. Output
11. V^+
12. Freq. Comp.
13. NC
14. NC

ORDER PART NOS.
LM101AD/LM301AD LM101AN-14/LM301AN-14

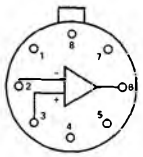
G PACKAGE



1. NC
2. Bal/Comp
3. Input
4. Input
5. V^-
6. Bal
7. Output
8. V^+
9. Comp
10. NC

ORDER PART NOS.
LM101AF/LM301AF

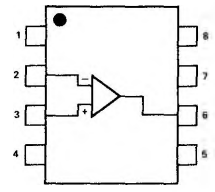
T PACKAGE



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

ORDER PART NOS.
LM101AH/LM301AH

V PACKAGE



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

ORDER PART NO.
LM301AN

LM101A

ELECTRICAL CHARACTERISTICS ($-55°C \leq T_A \leq 125°C$, $\pm 5V \leq V_S \leq \pm 20V$ and $C_1 = 30pF$ unless otherwise specified.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$T_A = 25°C$, $R_S \leq 50k\Omega$		0.7	2.0	mV
Input Offset Current	$T_A = 25°C$		1.5	10	nA
Input Bias Current	$T_A = 25°C$		30	75	nA
Input Resistance	$T_A = 25°C$	1.5	4		MΩ
Supply Current	$T_A = 25°C$, $V_S = \pm 20V$		1.8	3.0	mA
Large Signal Voltage Gain	$T_A = 25°C$, $V_S = \pm 15V$ $V_{OUT} = \pm 10V$, $R_L \geq 2k\Omega$	50	160		V/mV
Input Offset Voltage	$R_S \leq 50k\Omega$			3.0	mV
Average Temperature Coefficient of Input Offset Voltage			3.0	15	μV/°C
Input Offset Current				20	nA
Average Temperature Coefficient of Input Offset Current	$25°C \leq T_A \leq 125°C$ $-55°C \leq T_A \leq 25°C$		0.01 0.02	0.1 0.2	nA/°C nA/°C
Input Bias Current				100	nA
Supply Current	$T_A = +125°C$, $V_S = \pm 20V$		1.2	2.5	mA
Large Signal Voltage Gain	$V_S = \pm 15V$, $V_{OUT} = \pm 10V$ $R_L \geq 2k\Omega$	25			V/mV
Output Voltage Swing	$V_S = \pm 15V$, $R_L = 10k\Omega$ $R_L = 2k\Omega$	±12 ±10	±14 ±13		V V
Input Voltage Range	$V_S = \pm 20V$	±15			V
Common Mode Rejection Ratio	$R_S \leq 50k\Omega$	80	96		dB
Supply Voltage Rejection Ratio	$R_S \leq 50k\Omega$	80	96		dB

LM301A

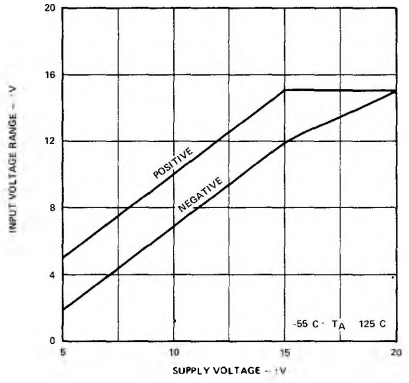
ELECTRICAL CHARACTERISTICS ($0°C \leq T_A < 70°C$, $\pm 5V, \leq V_S \leq \pm 15V$ and $C_1 = 30pF$ unless otherwise specified.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Input Offset Voltage	$T_A = 25°C$, $R_S \leq 50k\Omega$		2.0	7.5	mV
Input Offset Current	$T_A = 25°C$		3	50	nA
Input Bias Current	$T_A = 25°C$		70	250	nA
Input Resistance	$T_A = 25°C$	0.5	2		MΩ
Supply Current	$T_A = 25°C$, $V_S = \pm 15V$		1.8	3.0	mA
Large Signal Voltage Gain	$T_A = 25°C$, $V_S = \pm 15V$ $V_{OUT} = \pm 10V$; $R_L \geq 2k\Omega$	25	160		V/mV
Input Offset Voltage	$R_S \leq 50k\Omega$			10	mV
Average Temperature Coefficient of Input Offset Voltage			6.0	30	μV/°C
Input Offset Current				70	nA
Average Temperature Coefficient of Input Offset Current	$25°C \leq T_A \leq 70°C$ $0°C \leq T_A \leq 25°C$		0.01 0.02	0.3 0.6	nA/°C nA/°C
Input Bias Current				300	nA
Large Signal Voltage Gain	$V_S = \pm 15V$, $V_{OUT} = \pm 10V$ $R_L \geq 2k\Omega$	15			V/mV
Output Voltage Swing	$V_S = \pm 15V$, $R_L = 10k\Omega$ $R_L = 2k\Omega$	±12 ±10	±14 ±13		V V
Input Voltage Range	$V_S = \pm 15V$	±12			V
Common Mode Rejection Ratio	$R_S \leq 50k\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 50k\Omega$	70	96		dB

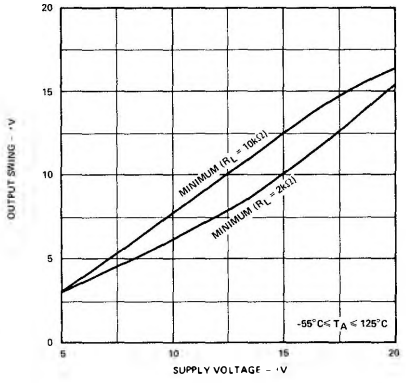
TYPICAL CHARACTERISTIC CURVES

LM101A

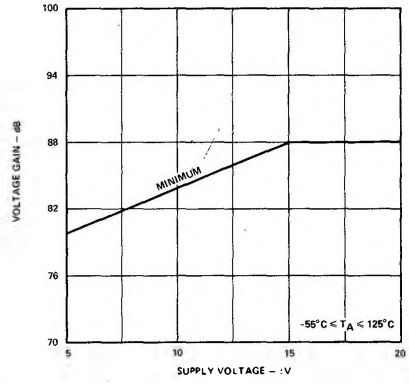
INPUT VOLTAGE RANGE VERSUS SUPPLY VOLTAGE



OUTPUT SWING VERSUS SUPPLY VOLTAGE

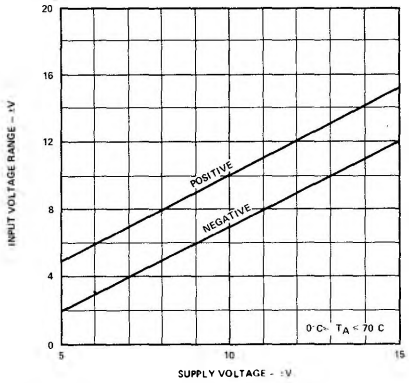


VOLTAGE GAIN VERSUS SUPPLY VOLTAGE

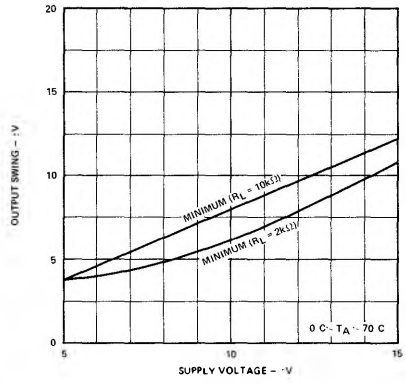


LM301A

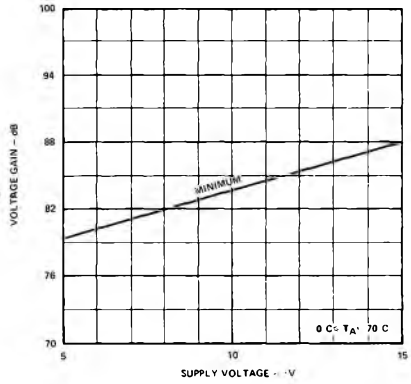
INPUT VOLTAGE RANGE VERSUS SUPPLY VOLTAGE



OUTPUT SWING VERSUS SUPPLY VOLTAGE

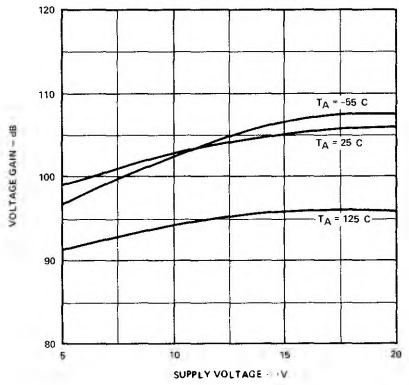


VOLTAGE GAIN VERSUS SUPPLY VOLTAGE

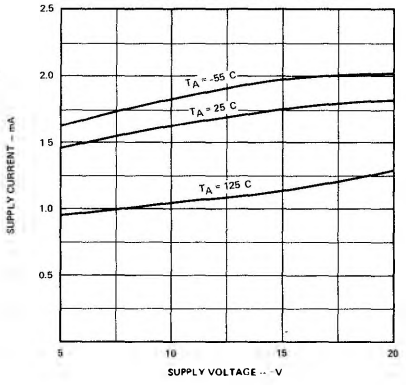


LM101A

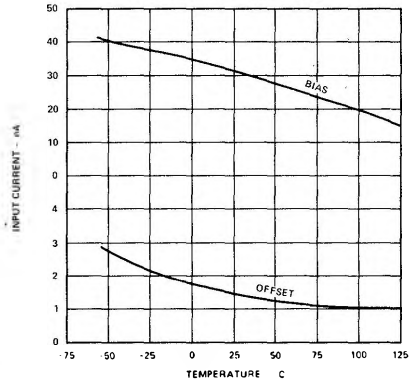
VOLTAGE GAIN



SUPPLY CURRENT



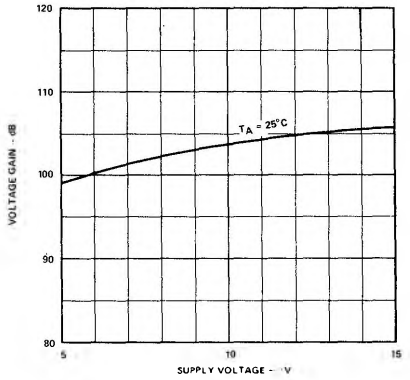
INPUT CURRENT



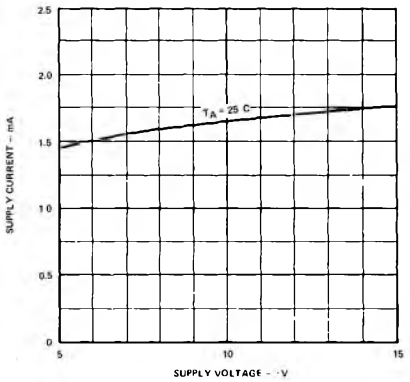
TYPICAL CHARACTERISTIC CURVES (Cont'd.)

LM301A

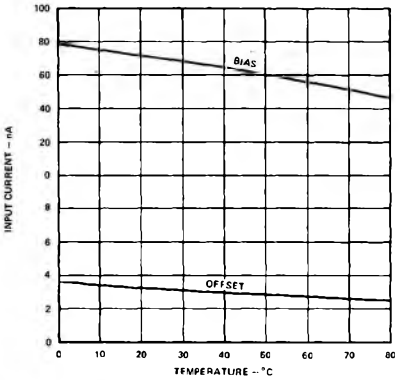
VOLTAGE GAIN



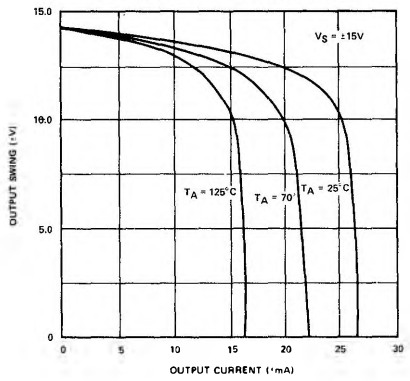
SUPPLY CURRENT



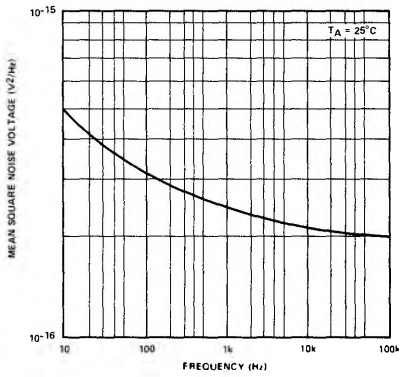
INPUT CURRENT



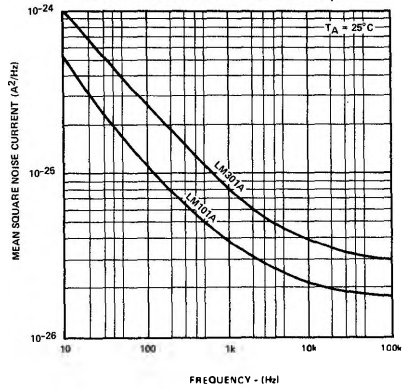
CURRENT LIMITING



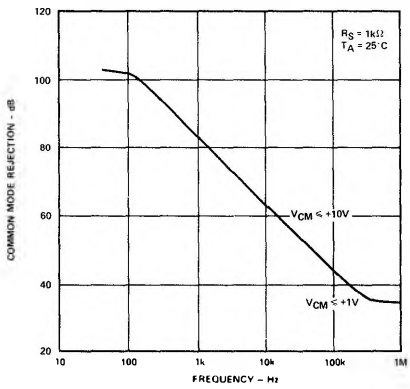
INPUT NOISE VOLTAGE



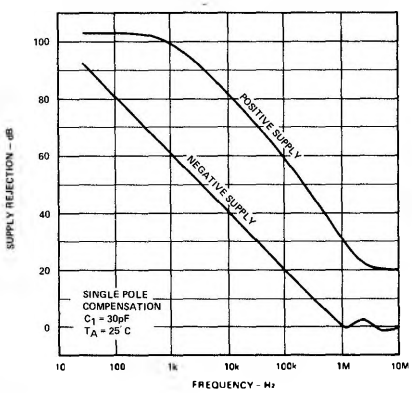
INPUT NOISE CURRENT



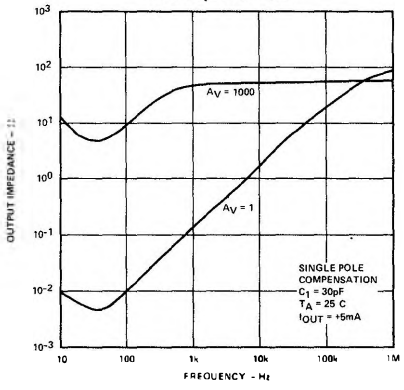
COMMON MODE REJECTION



POWER SUPPLY REJECTION



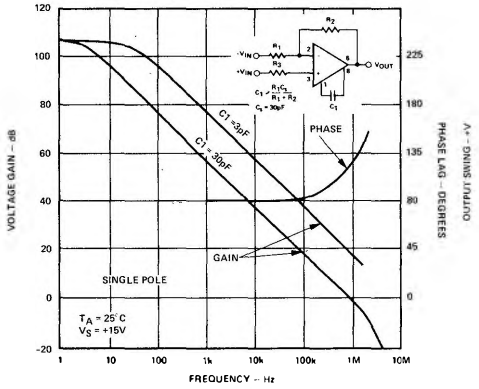
CLOSED LOOP OUTPUT IMPEDANCE



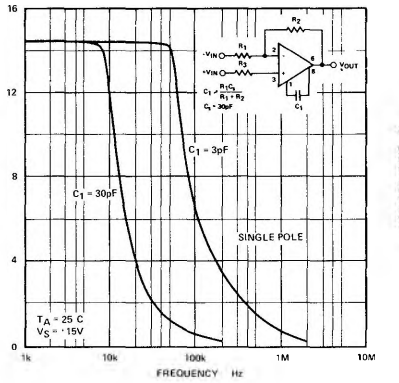
TYPICAL CHARACTERISTIC CURVES (Cont'd.)

SINGLE POLE COMPENSATION

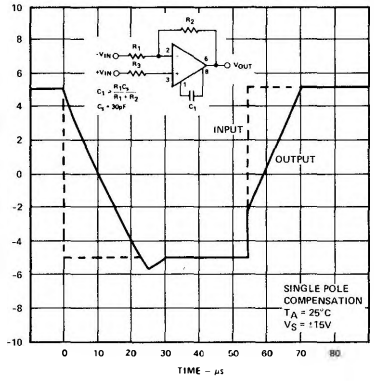
OPEN LOOP FREQUENCY RESPONSE



LARGE SIGNAL FREQUENCY RESPONSE

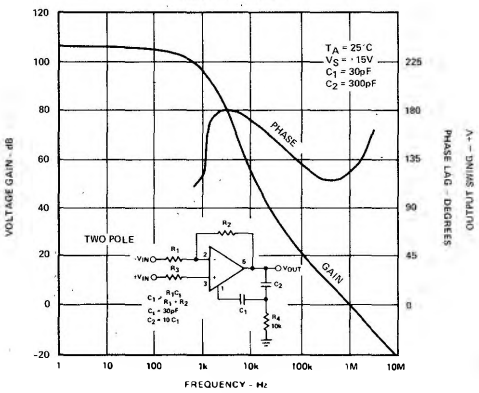


VOLTAGE FOLLOWER PULSE RESPONSE

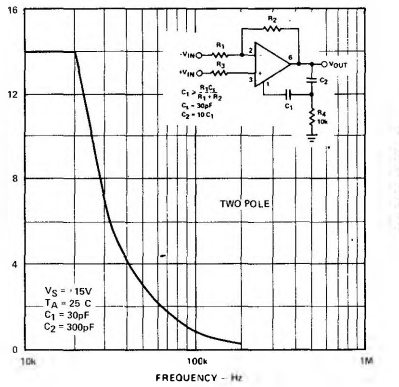


TWO POLE COMPENSATION

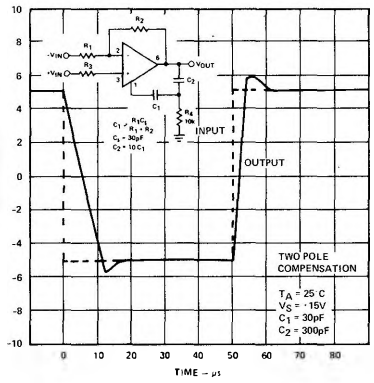
OPEN LOOP FREQUENCY RESPONSE



LARGE SIGNAL FREQUENCY RESPONSE

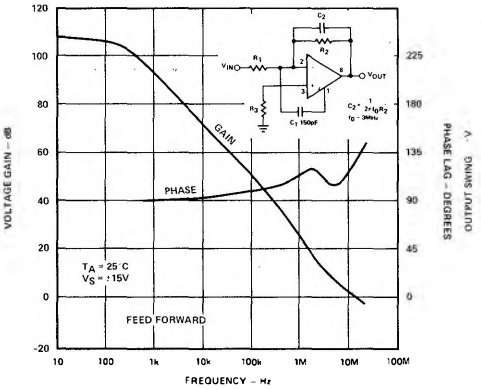


VOLTAGE FOLLOWER PULSE RESPONSE

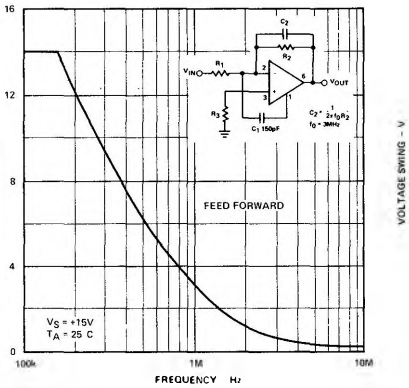


FEED FORWARD COMPENSATION

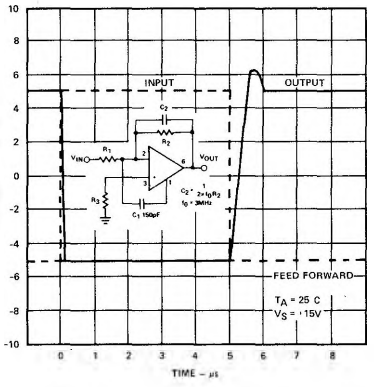
OPEN LOOP FREQUENCY RESPONSE



LARGE SIGNAL FREQUENCY RESPONSE

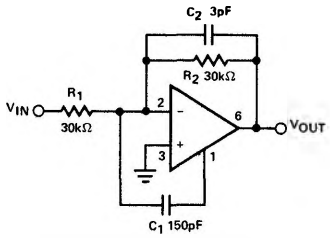


INVERTER PULSE RESPONSE



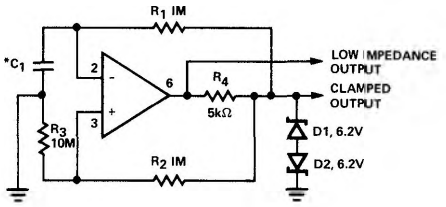
TYPICAL APPLICATIONS (Pin numbers shown refer to T or V package only)

FAST SUMMING AMPLIFIER



Power Bandwidth: 250kHz
Small Signal Bandwidth: 3.5MHz
Slew Rate: 10V/μs

LOW FREQUENCY SQUARE WAVE GENERATOR



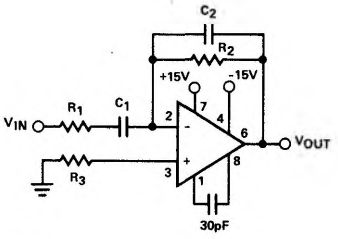
*Adjust C_1 for frequency

PRACTICAL DIFFERENTIATOR

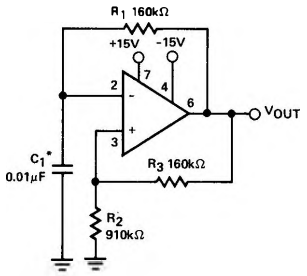
$$f_c = \frac{1}{2\pi R_2 C_1}$$

$$f_n = \frac{1}{2\pi R_1 C_1} = \frac{1}{2\pi R_2 C_2}$$

$f_c < f_n < f_{unity\ gain}$

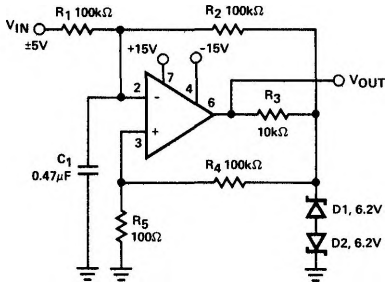


FREE-RUNNING MULTIVIBRATOR

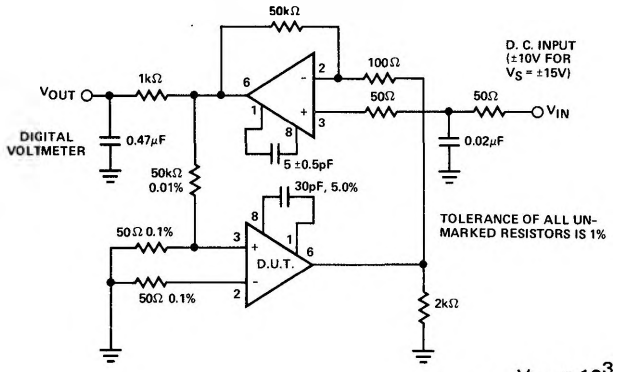


*Chosen for oscillation at 100Hz

PULSE WIDTH MODULATOR

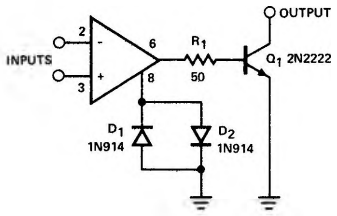


GAIN TEST CIRCUIT

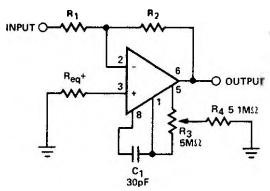


$$A_{VO} = \frac{V_{IN} \times 10^3}{V_{OUT}}$$

VOLTAGE COMPARATOR FOR DRIVING RTL LOGIC OR HIGH CURRENT DRIVER

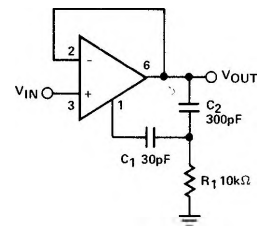


INVERTING AMPLIFIER WITH BALANCING CIRCUIT



†May be zero or equal to parallel combination of R_1 and R_2 for minimum offset.

FAST VOLTAGE FOLLOWER



Power Bandwidth: 15kHz
Slew Rate: 1V/μs