MOTOROLA
■ SEMICONDUCTOR
TECHNICAL DATA

MC1456
MC1456C
MC1556

2

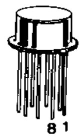
OPERATIONAL AMPLIFIER

SILICON MONOLITHIC
INTEGRATED CIRCUIT

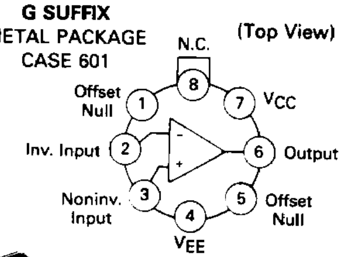
INTERNALLY COMPENSATED, HIGH PERFORMANCE OPERATONAL AMPLIFIER

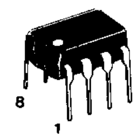
. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

- Low Input Bias Current — 15 nA max
- Low Input Offset Current — 2.0 nA max
- Low Input Offset Voltage — 4.0 mV max
- Fast Slew Rate — 2.5 V/µs typ
- Large Power Bandwidth — 40 kHz typ
- Low Power Consumption — 45 mW max
- Offset Voltage Null Capability
- Output Short-Circuit Protection
- Input Over-Voltage Protection

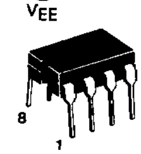


G SUFFIX
METAL PACKAGE
CASE 601

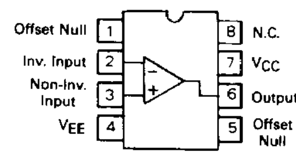




P1 SUFFIX
PLASTIC PACKAGE
CASE 626

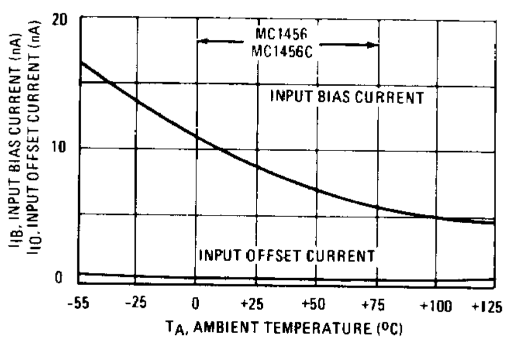


U SUFFIX
CERAMIC PACKAGE
CASE 693



(Top View)

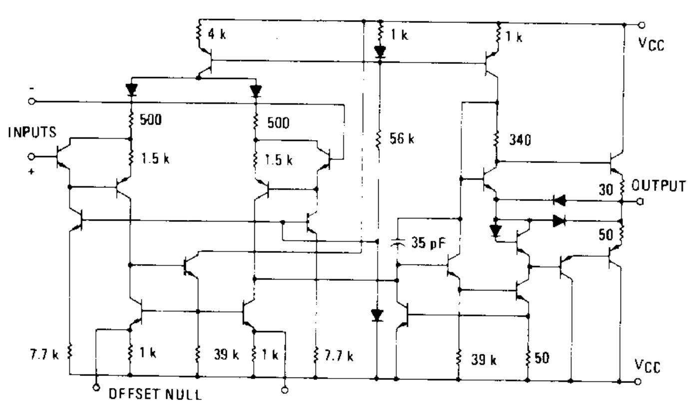
TYPICAL INPUT BIAS CURRENT AND INPUT OFFSET CURRENT versus TEMPERATURE for MC1556



ORDERING INFORMATION

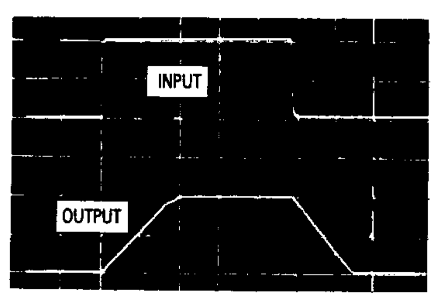
Device	Temperature Range	Package
MC1456G,CG MC1456CP1,P1	0°C to +70°C	Metal Can Plastic DIP
MC1556G MC1556U	−55°C to +125°C	Metal Can Ceramic DIP

REPRESENTATIVE CIRCUIT SCHEMATIC



VOLTAGE-FOLLOWER PULSE RESPONSE

5 VOLTS/DIVISION



2 µs/DIVISION

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MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

Rating	Symbol	MC1556	MC1456 MC1456C	Unit
Power Supply Voltage	V_{CC} V_{EE}	+22 -22	+18 -18	Vdc
Differential Input Voltage Range	V_{IDR}	±V_{CC}		Volts
Common-Mode Voltage Range	V_{ICR}	±V_{CC}		Volts
Load Current	I_L	20		mA
Output Short Circuit Duration	t_S	Continuous		
Power Dissipation (Package Limitation) Derate above T_A = +25°C	P_D	680 4.6		mW mW/°C
Operating Temperature Range	T_A	-55 to +125	0 to +70	°C
Storage Temperature Range	T_{stg}	-65 to +150	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (V_{CC} = +15 Vdc, V_{EE} = - 15 Vdc, T_A = +25°C unless otherwise noted).

Characteristic	Fig.	Symbol	MC1556 Min	MC1556 Typ	MC1556 Max	MC1456 Min	MC1456 Typ	MC1456 Max	MC1456C Min	MC1456C Typ	MC1456C Max	Unit
Input Bias Current T_A = +25°C T_A = T_{low} to T_{high} (See Note 1)		I_{IB}	 – –	 8.0 –	 15 30	 – –	 15 –	 30 40	 – –	 15 –	 90 –	nAdc
Input Offset Current T_A = +25°C T_A = +25°C to T_{high} T_A = T_{low} to +25°C		I_{IO}	 – – –	 1.0 – –	 2.0 3.0 5.0	 – – –	 5.0 – –	 10 14 14	 – – –	 5.0 – –	 30 – –	nAdc
Input Offset Voltage T_A = +25°C T_A = T_{low} to T_{high}		V_{IO}	 – –	 2.0 –	 4.0 6.0	 – –	 5.0 –	 10 14	 – –	 5.0 –	 12 –	mVdc
Differential Input Impedance (Open-Loop, f = 20 Hz) Parallel Input Resistance Parallel Input Capacitance		 r_p c_p	 – –	 5.0 6.0	 – –	 – –	 3.0 6.0	 – –	 – –	 3.0 6.0	 – –	 Megohms pF
Common-Mode Input Impedance (f = 20 Hz)		z_i	–	250	–	–	250		–	250	–	Megohms
Common-Mode Input Voltage Range	1	V_{ICR}	±12	±13	–	+11	±12	–	±10.5	±12	–	V_{pk}
Equivalent Input Noise Voltage (A_V = 100, R_s = 10 k ohms, f = 1.0 kHz, BW = 1.0 Hz)	2	e_n	–	45			45	–	–	45	–	nV/(Hz)½
Common-Mode Rejection Ratio (f = 100 Hz)	3	CMRR	80	110	–	70	110	–	–	110	–	dB
Open-Loop Voltage Gain, (V_O = ± 10 V, R_L = 2.0 k ohms) T_A = +25°C T_A = T_{low} to T_{high}	4,5,6	A_{VOL}	 100,000 40,000	 200,000 –	 – –	 70,000 40,000	 100,000 –	 – –	 25,000 –	 100,000 –	 – –	V/V
Power Bandwidth (A_V = 1, R_L = 2.0 k ohms, THD≤5%, V_O = 20 Vp-p)	9	BW_P	–	40	–	–	40	–		40	–	kHz
Unity Gain Crossover Frequency (open-loop)	5	BW	–	1.0	–	–	1.0	–	–	1.0	–	MHz
Phase Margin (open-loop, unity gain)	5,7		–	70	–	–	70	–	–	70	–	degrees
Gain Margin	5,7		–	18	–	–	18	–	–	18	–	dB
Slew Rate (Unity Gain)		SR	–	2.5	–	–	2.5	–	–	2.5	–	V/μs
Output Impedance (f = 20 Hz)		z_o	–	1.0	2.0	–	1.0	2.5	–	1.0	–	kohms
Short-Circuit Output Current	8	I_{OS}	–	-17, +9.0	–	–	-17, +9.0	–	–	-17, +9.0	–	mAdc
Output Voltage Swing (R_L = 2.0 k ohms)	10	V_{OR}	±12	±13	–	+11	±12	–	±10	±12	–	V_{pk}
Power Supply Rejection Ratio V_{CC} = constant, R_S ≤ 10 k ohms V_{EE} = constant, R_S ≤ 10 k ohms		 PSRR+ PSRR-		 50 50	 100 100	 – –	 75 75	 200 200	 – –	 75 75	 – –	μV/V
Power Supply Current		I_{CC} I_{EE}	– –	1.0 1.0	1.5 1.5	– –	1.3 1.3	3.0 3.0	– –	1.3 1.3	4.0 4.0	mAdc
DC Quiescent Power Dissipation (V_O = 0)	11	P_D	–	30	45	–	40	90	–	40	120	mW

Note 1: T_{low}: 0° for MC1456 and MC1456C
-55°C for MC1556
T_{high}: +70°C for MC1456 and MC1456C
+125°C for MC1556

TYPICAL CHARACTERISTICS

(V_{CC} = +15 Vdc, V_{EE} = −15 Vdc, T_A = +25°C unless otherwise noted).

FIGURE 1 — INPUT COMMON-MODE SWING versus POWER SUPPLY VOLTAGE

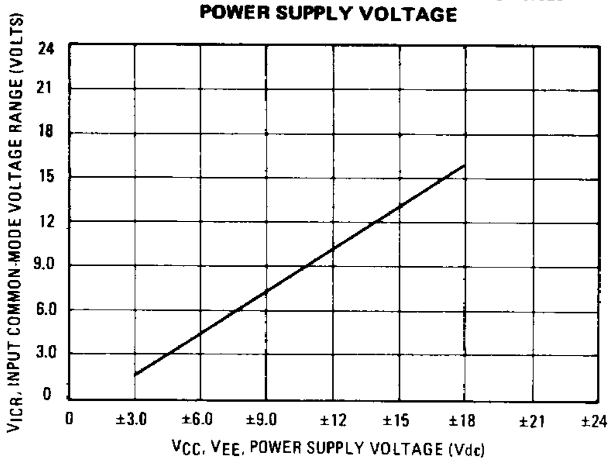


FIGURE 2 — SPECTRAL NOISE DENSITY

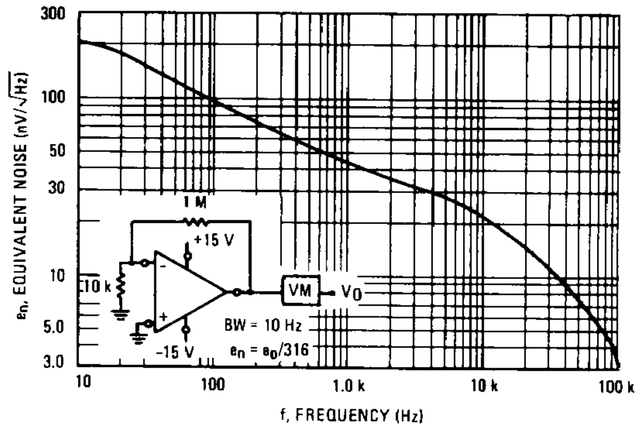


FIGURE 3 — COMMON-MODE REJECTION RATIO versus FREQUENCY

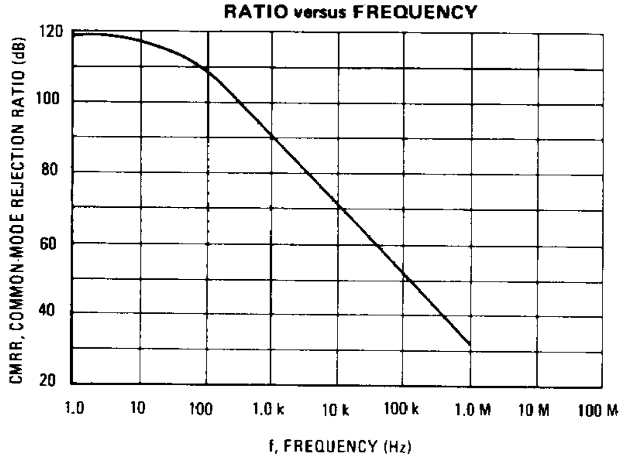


FIGURE 4 — OPEN-LOOP VOLTAGE GAIN versus TEMPERATURE

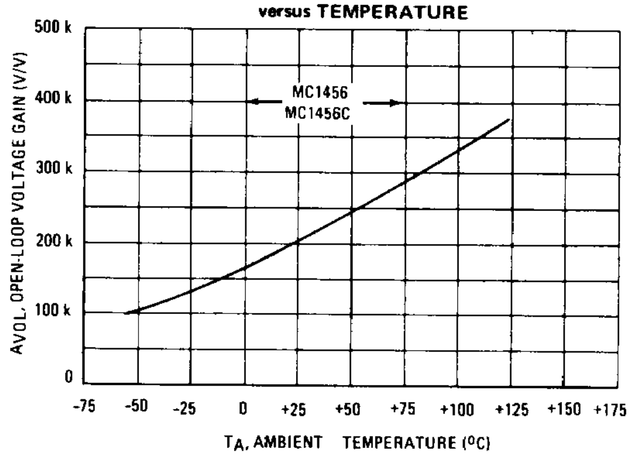


FIGURE 5 — OPEN-LOOP FREQUENCY RESPONSE

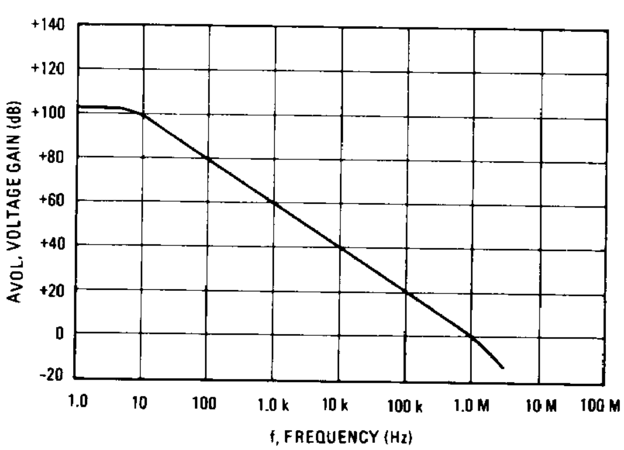
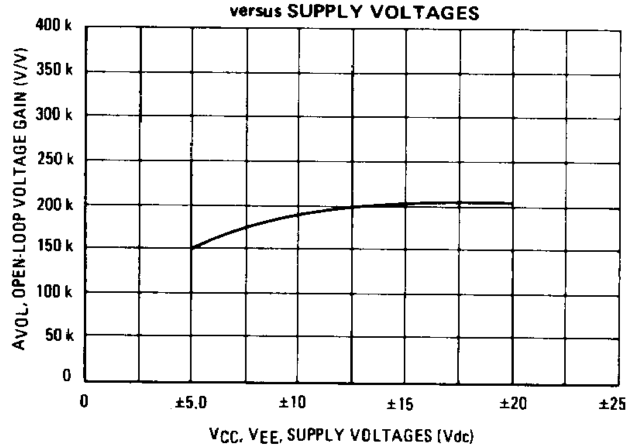


FIGURE 6 — OPEN-LOOP VOLTAGE GAIN versus SUPPLY VOLTAGES



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TYPICAL CHARACTERISTICS (continued)

FIGURE 7 – OPEN-LOOP PHASE SHIFT

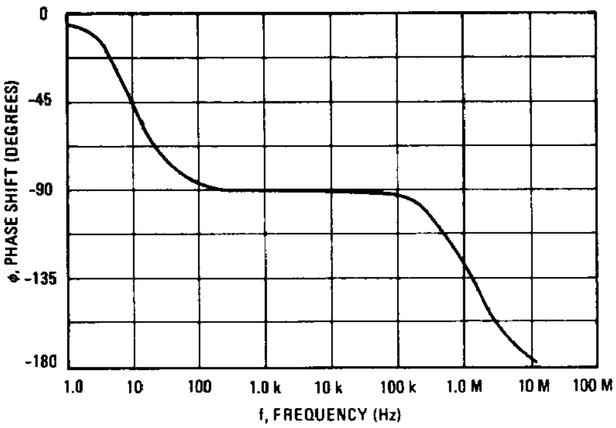


FIGURE 8 – OUTPUT SHORT-CIRCUIT CURRENT versus TEMPERATURE

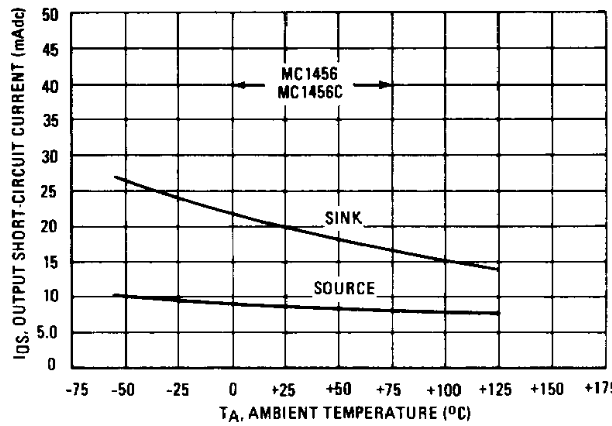


FIGURE 9 – POWER BANDWIDTH

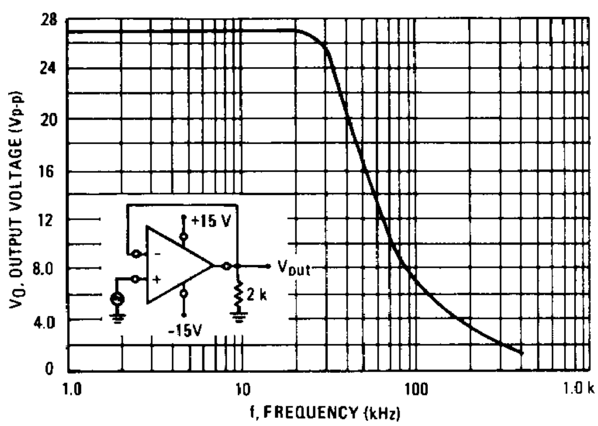


FIGURE 10 – OUTPUT VOLTAGE SWING versus LOAD RESISTANCE

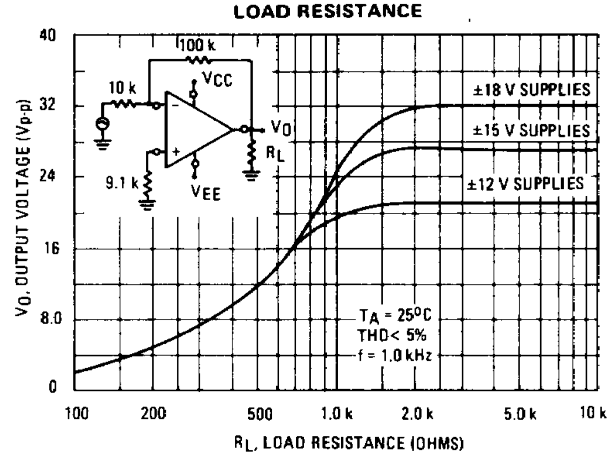
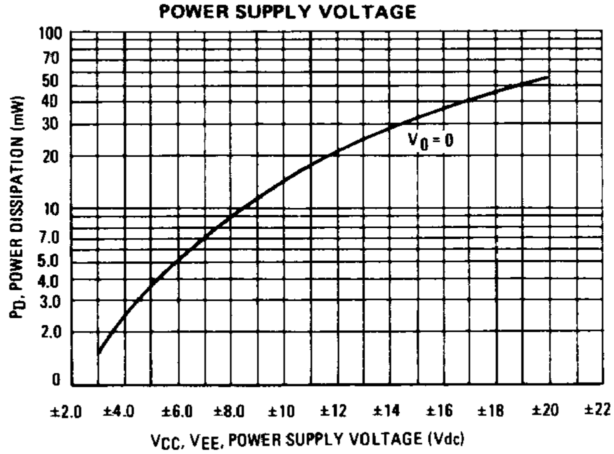


FIGURE 11 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE



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TYPICAL APPLICATIONS

Where values are not given for external components they must be selected by the designer to fit the requirements of the system.

FIGURE 12 — INVERTING FEEDBACK MODEL

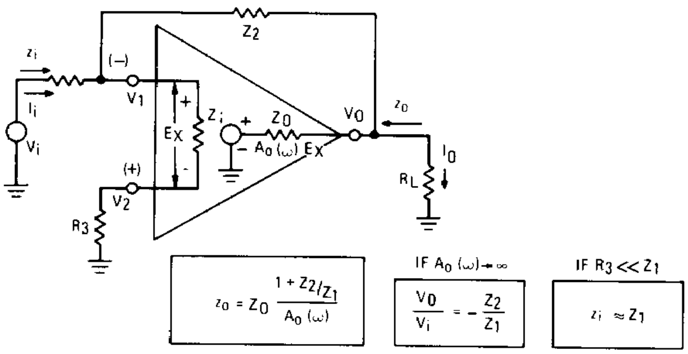


FIGURE 13 — NONINVERTING FEEDBACK MODEL

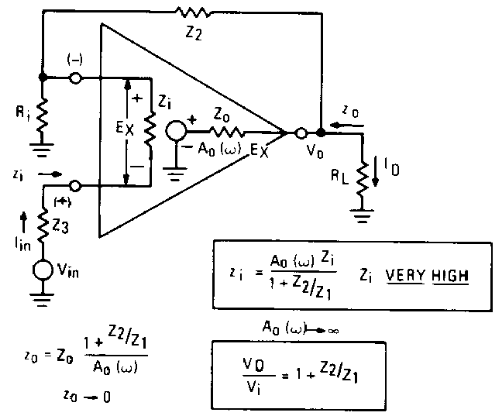


FIGURE 14 — LOW-DRIFT SAMPLE AND HOLD

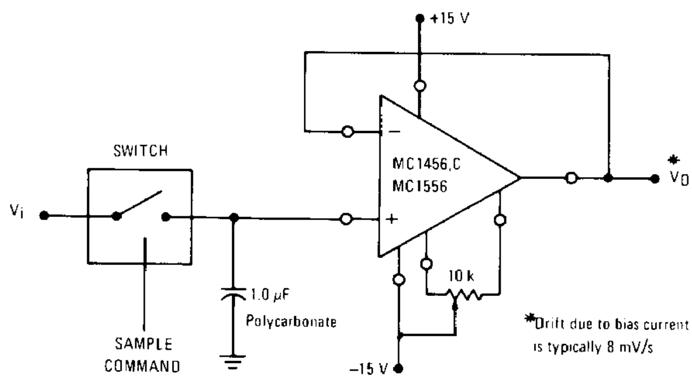
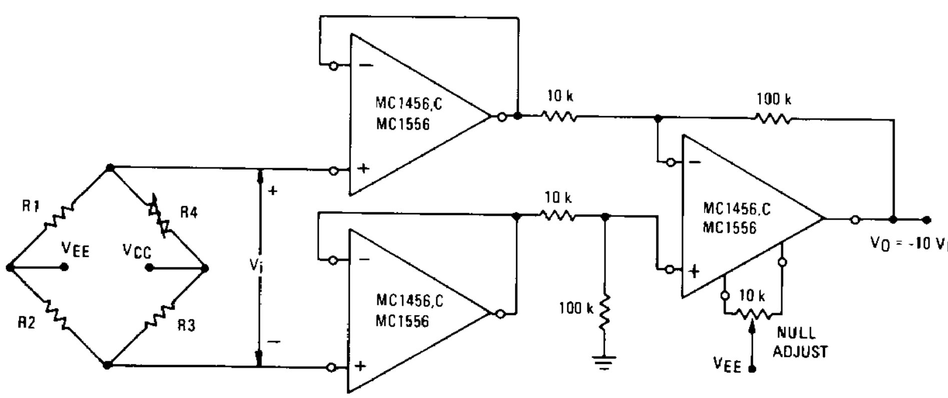


FIGURE 15 — HIGH IMPEDANCE BRIDGE AMPLIFIER



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TYPICAL APPLICATIONS (continued)

FIGURE 16 — LOGARITHMIC AMPLIFIER

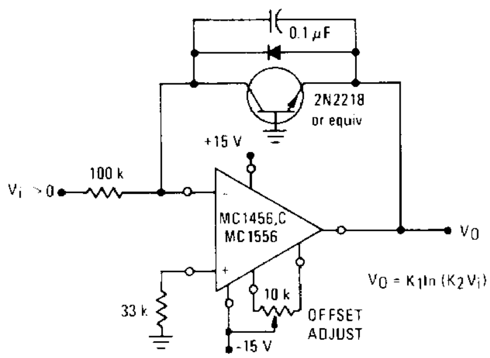

FIGURE 17 — VOLTAGE OFFSET NULL CIRCUIT