TL061
TL062
TL064

LOW POWER JFET INPUT OPERATIONAL AMPLIFIERS

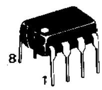
SILICON MONOLITHIC INTEGRATED CIRCUITS

LOW POWER JFET INPUT OPERATIONAL AMPLIFIER

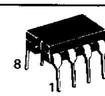
These JFET input operational amplifiers are designed for low power applications. They feature high input impedance, low input bias current and low input offset current. Advanced design techniques allow for higher slew rates, gain bandwidth products and output swing. The TL061 device provides for the external null adjustment of input offset voltage.

These devices are specified over the commercial, vehicular and military temperature ranges. The commercial and vehicular devices are available in Plastic dual in-line and SOIC packages. The military devices are available in Ceramic dual in-line packages.

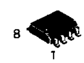
- Low Supply Current — 200 μA/Amplifier
- Low Input Bias Current — 5.0 pA
- High Gain Bandwidth — 2.0 MHz
- High Slew Rate — 6.0 V/μs
- High Input Impedance — 10^{12} Ω
- Large Output Voltage Swing — ±14 V
- Output Short Circuit Protection



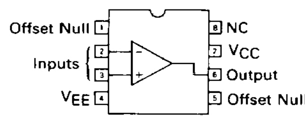
P SUFFIX
PLASTIC PACKAGE
CASE 626



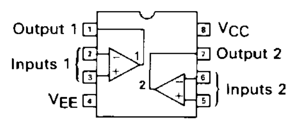
JG SUFFIX
CERAMIC PACKAGE
CASE 693



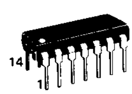
D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)



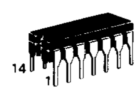
(Single, Top View)



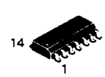
(Dual, Top View)



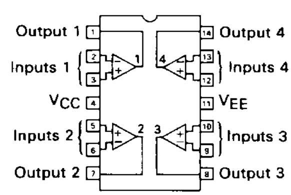
N SUFFIX
PLASTIC PACKAGE
CASE 646



J SUFFIX
CERAMIC PACKAGE
CASE 632



D SUFFIX
PLASTIC PACKAGE
CASE 751A
(SO-14)



(Quad, Top View)

ORDERING INFORMATION

Op Amp Function	Device	Tested Temperature Range	Package
Single	TL061CD, ACD TL061CP, ACP	0 to +70°C	SO-8 Plastic DIP
	TL061VD TL061VP	−40 to +85°C	SO-8 Plastic DIP
	TL061MJG	−55 to +125°C	Ceramic DIP
Dual	TL062CD, ACD TL062CP, ACP	0 to +70°C	SO-8 Plastic DIP
	TL062VD TL062VP	−40 to +85°C	SO-8 Plastic DIP
	TL062MJG	−55 to +125°C	Ceramic DIP
Quad	TL064CD, ACD TL064CN, ACN	0 to +70°C	SO-14 Plastic DIP
	TL064VD TL064VN	−40 to +85°C	SO-14 Plastic DIP
	TL064MJ	−55 to +125°C	Ceramic DIP

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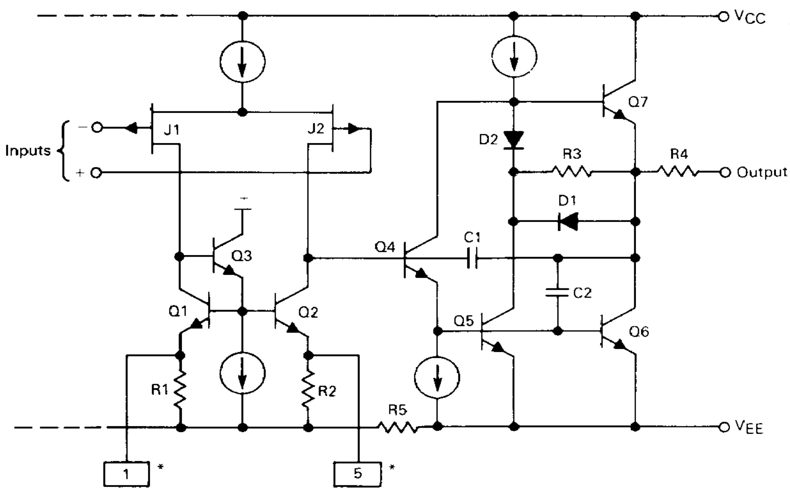
MAXIMUM RATINGS

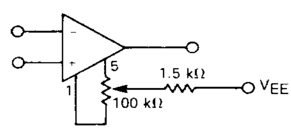
Rating	Symbol	Value	Unit
Supply Voltage (from V_{CC} to V_{EE})	V_S	+36	V
Input Differential Voltage Range (Note 1)	V_{IDR}	±30	V
Input Voltage Range (Notes 1 and 2)	V_{IR}	±15	V
Output Short-Circuit Duration (Note 3)	t_S	Indefinite	Seconds
Operating Junction Temperature (Note 3) Ceramic Package Plastic Package	T_J	 +160 +150	°C
Storage Temperature Range Ceramic Package Plastic Package	T_{stg}	 −65 to +160 −60 to +150	°C

NOTES:
1. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
2. The magnitude of the input voltage must never exceed the magnitude of the supply or 15 volts, whichever is less.
3. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded. (See Figure 1.)

EQUIVALENT CIRCUIT SCHEMATIC (EACH AMPLIFIER)



*Null adjustment pins for TL061 only.



TL061 input offset voltage null adjust circuit

ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = −15 V, T_A = 0°C to +70°C, unless otherwise noted)

Characteristic	Symbol	TL061AC TL062AC TL064AC Min	Typ	Max	TL061C TL062C TL064C Min	Typ	Max	Unit
Input Offset Voltage (R_S = 50 Ω, V_O = 0 V)	V_{IO}							mV
T_A = 25°C		—	3.0	6.0	—	3.0	15	
T_A = 0°C to +70°C		—	—	7.5	—	—	20	
Average Temperature Coefficient for Offset Voltage (R_S = 50 Ω, V_O = 0 V)	$\Delta V_{IO}/\Delta T$	—	10	—	—	10	—	μV/°C
Input Offset Current (V_{CM} = 0 V, V_O = 0 V)	I_{IO}							
T_A = 25°C		—	0.5	100	—	0.5	200	pA
T_A = 0°C to +70°C		—	—	2.0	—	—	2.0	nA
Input Bias Current (V_{CM} = 0 V, V_O = 0 V)	I_{IB}							
T_A = 25°C		—	3.0	200	—	3.0	200	pA
T_A = 0°C to +70°C		—	—	7.0	—	—	10	nA
Input Common Mode Voltage Range T_A = 25°C	V_{ICR}	— / −11.5	+14.5 / −12	+11.5 / —	— / −11	+14.5 / −12	+11 / —	V
Large Signal Voltage Gain (R_L = 10 kΩ, V_O = ±10 V)	A_{VOL}							V/mV
T_A = 25°C		4.0	58	—	3.0	58	—	
T_A = 0°C to +70°C		4.0	—	—	3.0	—	—	
Output Voltage Swing (R_L = 10 kΩ, V_{ID} = 1.0 V)								V
T_A = 25°C	V_O+	+10	+14	—	+10	+14	—	
	V_O-	—	−14	−10	—	−14	−10	
T_A = 0°C to +70°C	V_O+	+10	—	—	+10	—	—	
	V_O-	—	—	−10	—	—	−10	
Common Mode Rejection (R_S = 50 Ω, V_{CM} = V_{ICR} min, V_O = 0 V, T_A = 25°C)	CMR	80	84	—	70	84	—	dB
Power Supply Rejection (R_S = 50 Ω, V_{CM} = 0 V, V_O = 0, T_A = 25°C)	PSR	80	86	—	70	86	—	dB
Power Supply Current (each amplifier) (No Load, V_O = 0 V, T_A = 25°C)	I_D	—	200	250	—	200	250	μA
Total Power Dissipation (each amplifier) (No Load, V_O = 0 V, T_A = 25°C)	P_D	—	6.0	7.5	—	6.0	7.5	mW

DC ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = −15 V, T_A = T_{low} to T_{high} (Note 4), unless otherwise noted)

Characteristic	Symbol	TL061M,V TL062M,V Min	Typ	Max	TL064M,V Min	Typ	Max	Unit
Input Offset Voltage (R_S = 50 Ω, V_O = 0 V)	V_{IO}							mV
T_A = 25°C		—	3.0	6.0	—	3.0	9.0	
T_A = T_{low} to T_{high}		—	—	9.0	—	—	15	
Average Temperature Coefficient of Offset Voltage (R_S = 50 Ω, V_O = 0 V)	$\Delta V_{IO}/\Delta T$	—	10	—	—	10	—	μV/°C
Input Offset Current (V_{CM} = 0 V, V_O = 0 V)	I_{IO}							
T_A = 25°C		—	5.0	100	—	5.0	100	pA
T_A = T_{low} to T_{high}		—	—	20	—	—	20	nA
Input Bias Current (V_{CM} = 0 V, V_O = 0 V)	I_{IB}							
T_A = 25°C		—	30	200	—	30	200	pA
T_A = T_{low} to T_{high}		—	—	50	—	—	50	nA
Input Common Mode Voltage Range (T_A = 25°C)	V_{ICR}	—	+14.5	+11.5	—	+14.5	+11.5	V
		−11.5	−12	—	−11.5	−12	—	
Large Signal Voltage Gain (R_L = 10 kΩ, V_O = ±10 V)	A_{VOL}							V/mV
T_A = 25°C		4.0	58	—	4.0	58	—	
T_A = T_{low} to T_{high}		4.0	—	—	4.0	—	—	
Output Voltage Swing (R_L = 10 kΩ, V_{ID} = 1.0 V)								V
T_A = 25°C	V_{O+}	+10	+14	—	+10	+14	—	
	V_{O-}	—	−14	10	—	−14	−10	
T_A = T_{low} to T_{high}	V_{O+}	+10	—	—	+10	—	—	
	V_{O-}	—	—	−10	—	—	10	
Common Mode Rejection (R_S = 50 Ω, V_{CM} = V_{ICR} min, V_O = 0 V, T_A = 25°C)	CMR	80	84	—	80	84	—	dB
Power Supply Rejection (R_S = 50 Ω, V_{CM} = 0 V, V_O = 0 V, T_A = 25°C)	PSR	80	86	—	80	86	—	dB
Power Supply Current (each Amplifier) (No Load, V_O = 0 V, T_A = 25°C)	I_D	—	200	250	—	200	250	μA
Total Power Dissipation (each Amplifier) (No Load, V_O = 0 V, T_A = 25°C)	P_D	—	6.0	7.5	—	6.0	7.5	mW

Note 4. TL06XM T_{low} = −55°C T_{high} = +125°C
TL06XV T_{low} = −40°C T_{high} = +85°C

AC ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = −15 V, T_A = +25°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Slew Rate (V_{in} = −10 V to +10 V, R_L = 10 kΩ, C_L = 100 pF, A_V = +1.0)	SR	2.0	6.0	—	V/μs
Rise Time (V_{in} = 20 mV, R_L = 10 kΩ, C_L = 100 pF, A_V = +1.0)	t_r	—	0.1	—	μs
Overshoot (V_{in} = 20 mV, R_L = 10 kΩ, C_L = 100 pF, A_V = +1.0)	OS	—	10	—	%
Settling Time (V_{CC} = +15 V, V_{EE} = −15 V, A_V = −1.0, R_L = 10 kΩ, V_O = 0 V to +10 V step)	t_S				μs
To within 10 mV		—	1.6	—	
To within 1.0 mV		—	2.2	—	
Gain Bandwidth Product (f = 200 kHz)	GBW	—	2.0	—	MHz
Equivalent Input Noise (R_S = 100 Ω, f = 1.0 kHz)	e_n	—	47	—	nV/$\sqrt{Hz}$
Input Resistance	R_i	—	10^{12}	—	Ω
Channel Separation (f = 10 kHz)	CS	—	120	—	dB

TYPICAL PERFORMANCE CURVES

FIGURE 1 — MAXIMUM POWER DISSIPATION versus TEMPERATURE FOR PACKAGE VARIATIONS

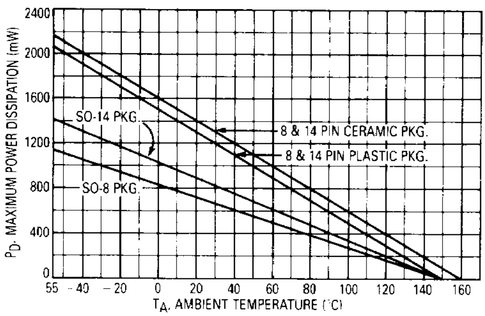


FIGURE 2 — OUTPUT VOLTAGE SWING versus SUPPLY VOLTAGE

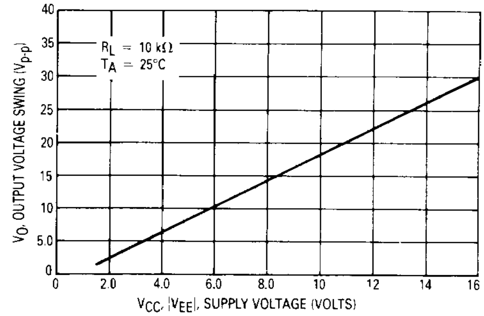


FIGURE 3 — OUTPUT VOLTAGE SWING versus TEMPERATURE

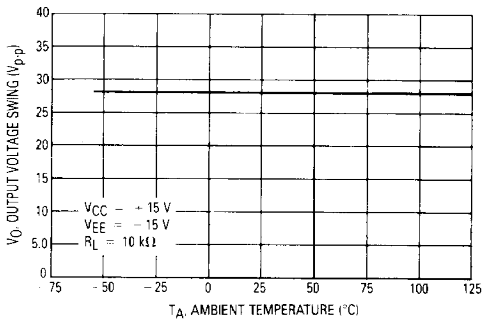


FIGURE 4 — OUTPUT VOLTAGE SWING versus LOAD RESISTANCE

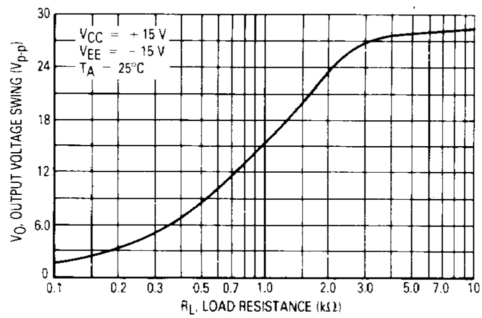


FIGURE 5 — OUTPUT VOLTAGE SWING versus FREQUENCY

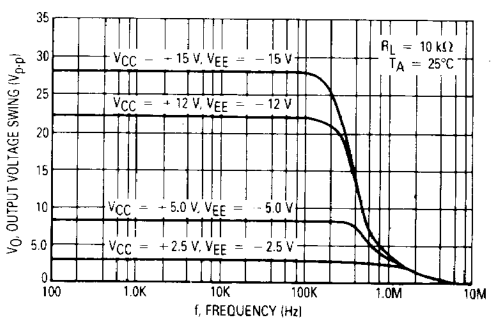


FIGURE 6 — LARGE SIGNAL VOLTAGE GAIN versus TEMPERATURE

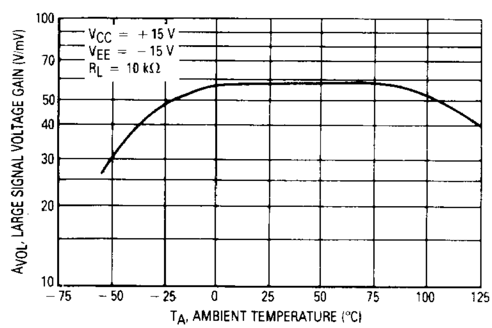


FIGURE 7 — OPEN-LOOP VOLTAGE GAIN AND PHASE versus FREQUENCY

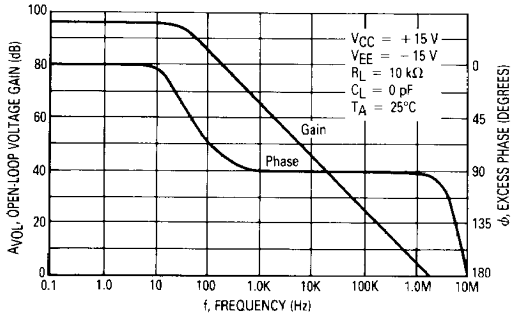


FIGURE 8 — SUPPLY CURRENT PER AMPLIFIER versus SUPPLY VOLTAGE

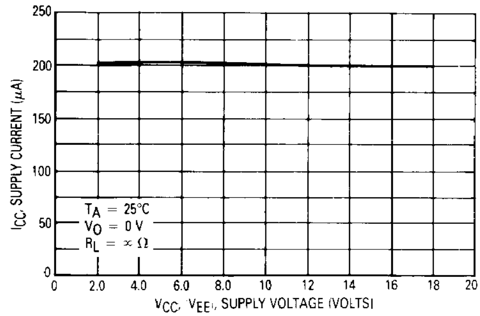


FIGURE 9 — SUPPLY CURRENT PER AMPLIFIER versus TEMPERATURE

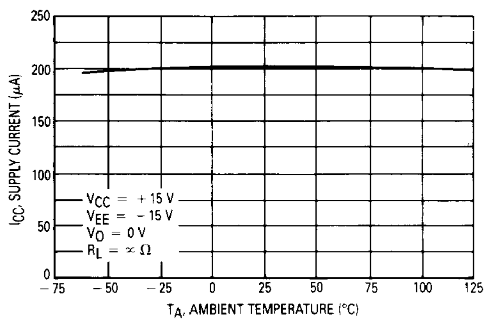


FIGURE 10 — TOTAL POWER DISSIPATION versus TEMPERATURE

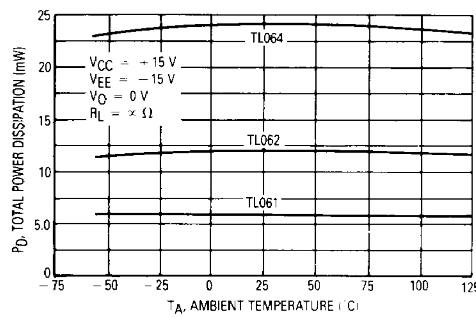


FIGURE 11 — COMMON-MODE REJECTION versus TEMPERATURE

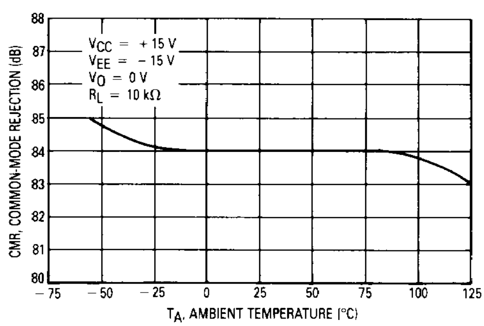


FIGURE 12 — COMMON-MODE REJECTION versus FREQUENCY

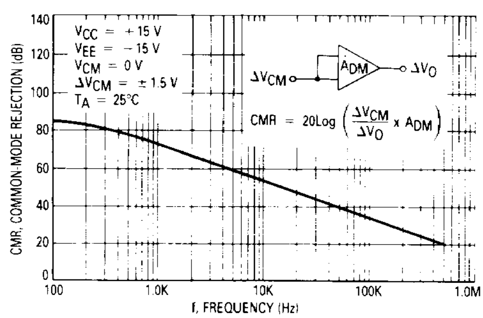


FIGURE 13 — POWER SUPPLY REJECTION versus FREQUENCY

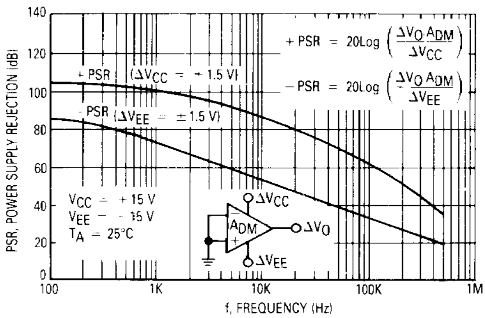


FIGURE 14 — NORMALIZED GAIN BANDWIDTH PRODUCT, SLEW RATE AND PHASE MARGIN versus TEMPERATURE

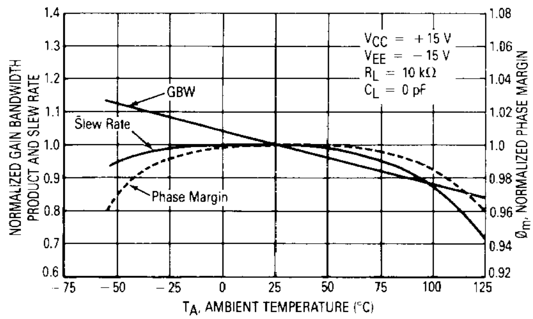


FIGURE 15 — INPUT BIAS CURRENT versus TEMPERATURE

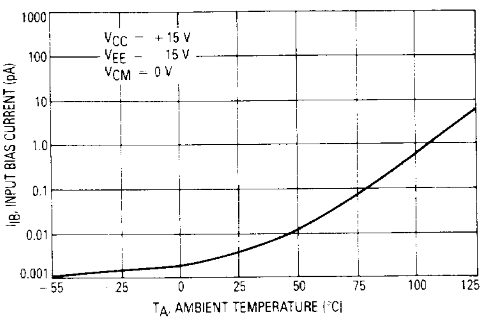


FIGURE 16 — INPUT NOISE VOLTAGE versus FREQUENCY

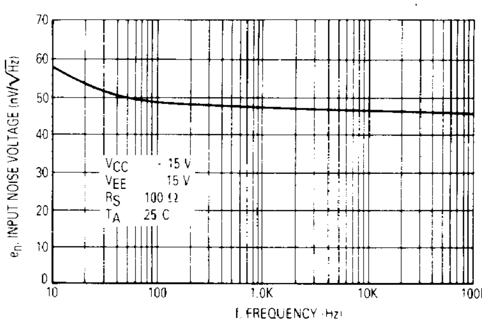


FIGURE 17 — SMALL SIGNAL RESPONSE

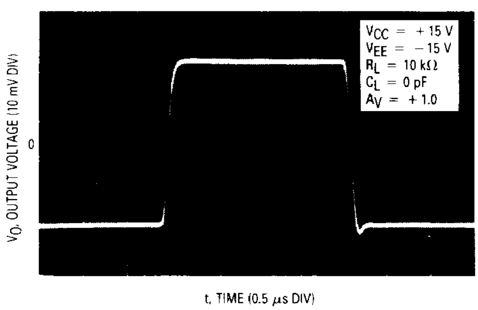


FIGURE 18 — LARGE SIGNAL RESPONSE

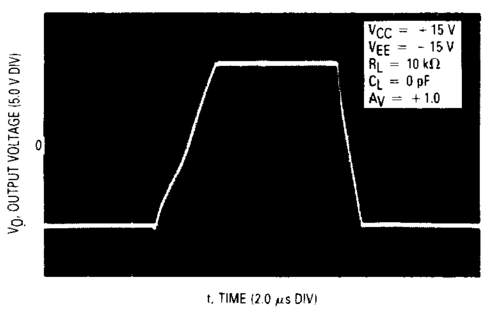


FIGURE 19 — AC AMPLIFIER

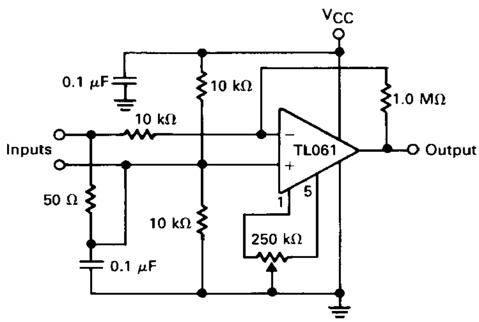


FIGURE 20 — HIGH-Q NOTCH FILTER

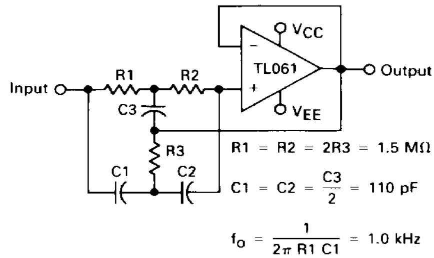


FIGURE 21 — INSTRUMENTATION AMPLIFIER

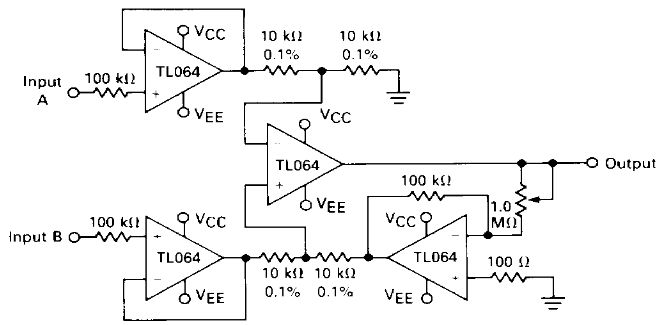


FIGURE 22 — 0.5 Hz SQUARE-WAVE OSCILLATOR

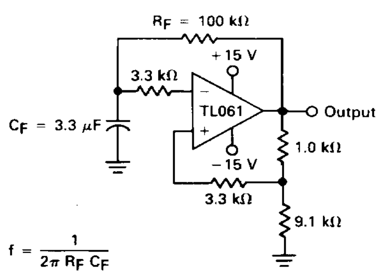


FIGURE 23 — AUDIO DISTRIBUTION AMPLIFIER