TYPES SN52770, SN72770 HIGH-PERFORMANCE OPERATIONAL AMPLIFIERS

BULLETIN NO. DL-S 7311465, MARCH 1971–REVISED SEPTEMBER 1973

- Adjustable Frequency and Transient Response Characteristics
- Offset-Voltage Null Capability
- No Latch-Up
- Low Power Consumption
- High Slew Rates
- Very Low Input Bias Currents
- Very Low Input Offset Parameters
- Short-Circuit Protection
- Wide Common-Mode and Differential Voltage Ranges

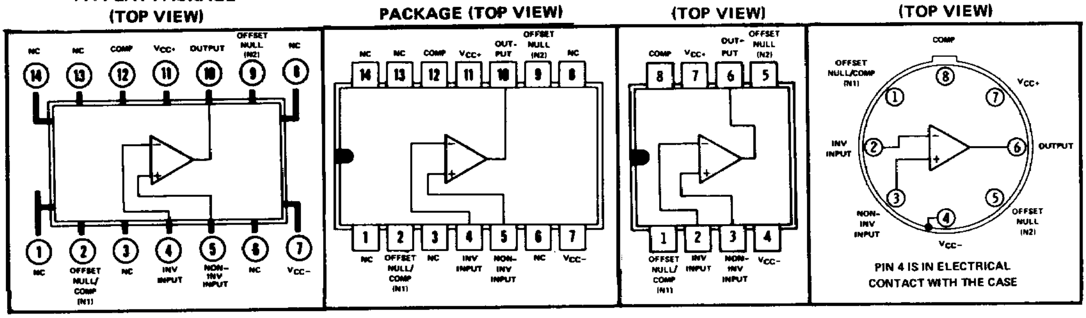
description

The SN52770 and SN72770 are high-performance general purpose integrated-circuit operational amplifiers. They offer the same advantages and desirable features as the SN52771 and SN72771 with the exception of internal compensation. The external compensation of the SN52770 and SN72770 allows the changing of the frequency response (when the closed-loop gain is greater than unity) for applications requiring wider bandwidth or higher slew rate. Unity-gain compensation is accomplished by means of a single 30-pF capacitor, and for higher gains, smaller capacitors may be used to obtain increased slew rate and bandwidth. High slew rate makes these amplifiers ideal for fast-rise-time signals, or large signals at high frequency. Very low input currents make them ideal for sample and hold, logarithmic amplifiers, and other low-level applications. A potentiometer may be connected between the offset null inputs, as shown in Figure 12, to null out the offset voltage.

The SN52770 is characterized for operation over the full military temperature range of –55°C to 125°C; the SN72770 is characterized for operation from 0°C to 70°C.

terminal assignments

FA FLAT PACKAGE (TOP VIEW) | JA OR N DUAL-IN-LINE PACKAGE (TOP VIEW) | JP OR P DUAL-IN-LINE PACKAGE (TOP VIEW) | L PLUG-IN PACKAGE (TOP VIEW)



NC—No internal connection

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

		SN52770	SN72770	UNIT
Supply voltage V_{CC+} (see Note 1)		22	18	V
Supply voltage V_{CC-} (see Note 1)		–22	–18	V
Differential input voltage (see Note 2)		±30	±30	V
Input voltage (either input, see Notes 1 and 3)		±15	±15	V
Voltage between either offset null terminal (N1/N2) and V_{CC-}		–0.5 to 2	–0.5 to 2	V
Duration of output short-circuit (see Note 4)		unlimited	unlimited	
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 5)		500	500	mW
Operating free-air temperature range		–55 to 125	0 to 70	°C
Storage temperature range		–65 to 150	–65 to 150	°C
Lead temperature 1/16 inch from case for 60 seconds	FA, JA, JP or L package	300	300	°C
Lead temperature 1/16 inch from case for 10 seconds	N or P package	260	260	°C

NOTES: 1. All voltage values, unless otherwise noted, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between V_{CC+} and V_{CC-}.
2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
4. The output may be shorted to ground or either power supply. For the **SN52770** only, the unlimited duration of the short-circuit applies at (or below) 125°C case temperature or 75°C free-air temperature.
5. For operation above 25°C free-air temperature, refer to Dissipation Derating Curve, Figure 1.

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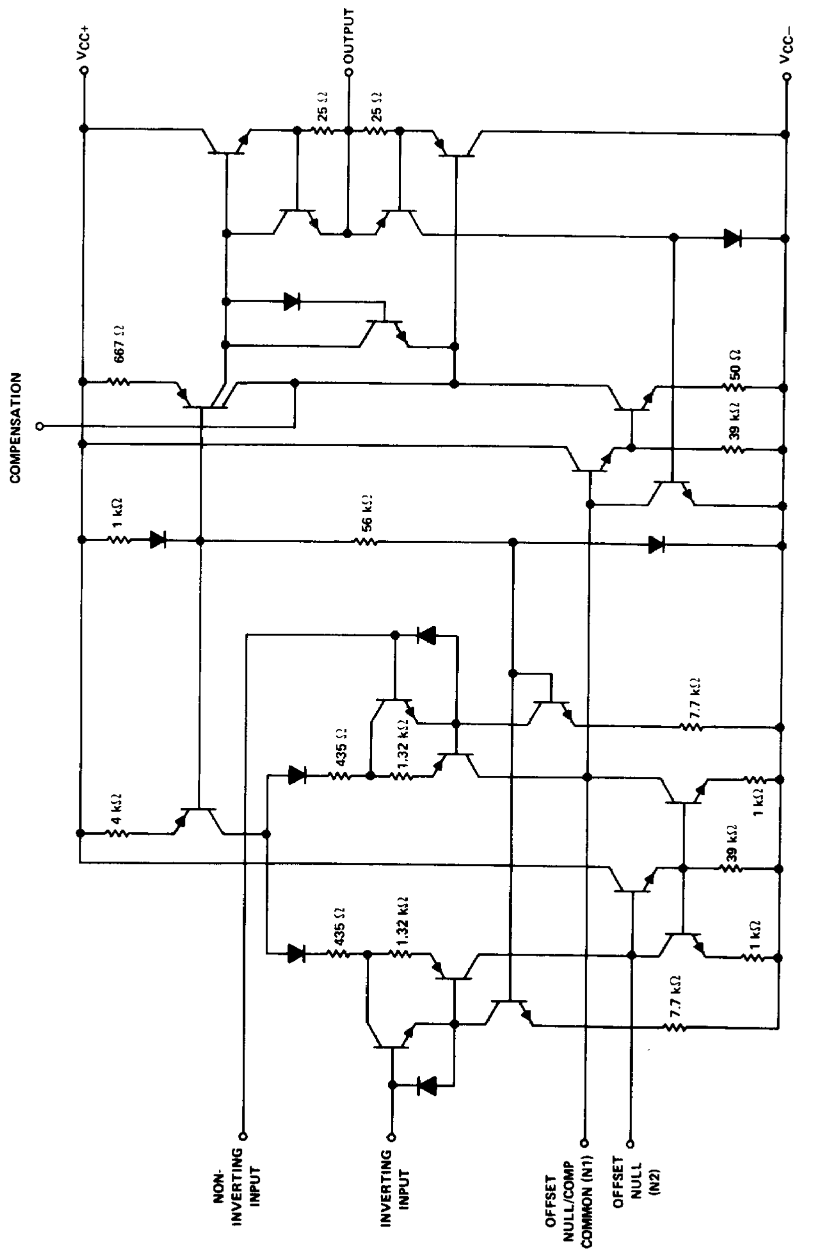
schematic



Component values shown are nominal.

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electrical characteristics at specified free-air temperature, V_{CC+} = 15 V, V_{CC-} = −15V, C_C = 30 pF

PARAMETER		TEST CONDITIONS†		SN52770			SN72770			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	R_S ≤ 10 kΩ	25°C		2	4		5	10	mV
			Full range			7			14	
I_{IO}	Input offset current		25°C		1	2		5	10	nA
			Full range			5			14	
I_{IB}	Input bias current		25°C		8	15		15	30	nA
			Full range			35			40	
V_{ICR}	Common-mode input voltage range		25°C	±12	±14		±11			V
V_{OPP}	Maximum peak-to-peak output voltage swing	R_L = 2 kΩ	25°C	24	26.5		22	26.5		
		R_L ≥ 2 kΩ	Full range	24			22			
A_{VD}	Large-signal differential voltage amplification	R_L = 2 kΩ, V_O = ±10 V	25°C	50,000	100,000		35,000	100,000		
		R_L ≥ 2 kΩ, V_O = ±10 V	Full range	25,000			25,000			
B_{OM}	Maximum-output-swing bandwidth (closed loop)	R_L = 2 kΩ, V_O ≥ ± 10 V, A_{VD} = 1, THD ≤ 5%	25°C		40			40		kHz
B_1	Unity-gain bandwidth		25°C		1.3			1.3		MHz
r_{id}	Differential input resistance		25°C		100			100		MΩ
z_{ic}	Common-mode input impedance	f = 10 Hz	25°C		500			500		MΩ
z_o	Output impedance	f = 10 Hz	25°C		2			2		kΩ
CMRR	Common-mode rejection ratio	R_S ≤ 10 kΩ	25°C	80	100		70	100		dB
$\Delta V_{IO}/\Delta V_{CC}$	Supply voltage sensitivity	R_S ≤ 10 kΩ	25°C		80	150			200	μV/V
V_n	Equivalent input noise voltage (closed loop)	A_{VD} = 100, BW = 1 Hz, f = 1 kHz	25°C		40			40		nV/√Hz
I_{OS}	Short-circuit output current, To V_{CC+}		25°C		24			24		mA
	Short-circuit output current, To V_{CC-}				−20			−20		
I_{CC}	Supply current	No load, No signal	25°C		1.3	2		1.7	4	mA
P_D	Total power dissipation	No load, No signal	25°C		40	60		50	120	mW

†All characteristics are specified under open-loop operation unless otherwise noted. Full range for SN52770 is −55°C to 125°C and for SN72770 is 0°C to 70°C.

operating characteristics, V_{CC+} = 15 V, V_{CC-} = −15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	SN52770			SN72770			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_r	Rise time	V_I = 200 mV, R_L = 2 kΩ, C_L = 200 pF, C_C = 30 pF, See Figure 2		130			130		ns
SR	Slew rate at unity gain	V_I = 10 V, R_L = 2 kΩ, C_L = 200 pF, C_C = 30 pF, See Figure 2		2.5			2.5		V/μs

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DEFINITION OF TERMS

Input Offset Voltage (V_{IO}) The d-c voltage which must be applied between the input terminals to force the quiescent d-c output voltage to zero. The input offset voltage may also be defined for the case where two equal resistances (R_S) are inserted in series with the input leads.

Input Offset Current (I_{IO}) The difference between the currents into the two input terminals with the output at zero volts.

Input Bias Current (I_{IB}) The average of the currents into the two input terminals with the output at zero volts.

Common-Mode Input Voltage Range (V_{ICR}) The range of common-mode voltage that if exceeded will cause the amplifier to cease functioning properly.

Maximum Peak-to-Peak Output Voltage Swing (V_{OPP}) The maximum peak-to-peak output voltage that can be obtained without waveform clipping when the quiescent d-c output voltage is zero.

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Large-Signal Differential Voltage Amplification (A_{VD}) The ratio of the peak-to-peak output voltage swing to the change in differential input voltage required to drive the output.

Maximum-Output-Swing Bandwidth (B_{OM}) The range of frequencies within which the maximum output voltage swing is above a specified value.

Unity-Gain Bandwidth (B_1) The range of frequencies within which the voltage amplification is greater than unity.

Differential Input Resistance (r_{id}) The small-signal resistance between the two ungrounded input terminals.

Common-Mode Input Impedance (z_{ic}) The parallel sum of the small-signal impedances between each input terminal and ground.

Output Impedance (z_o) The small-signal impedance between the output terminal and ground.

Common-Mode Rejection Ratio (CMRR) The ratio of differential voltage amplification to common-mode voltage amplification. This is measured by determining the ratio of a change in input common-mode voltage to the resulting change in input offset voltage.

Supply Voltage Sensitivity ($\Delta V_{IO}/\Delta V_{CC}$) The ratio of the change in input offset voltage to the change in supply voltages producing it. For these devices, both supply voltages are varied symmetrically.

Short-Circuit Output Current (I_{OS}) The maximum output current available from the amplifier with the output shorted to the specified supply.

Total Power Dissipation (P_D) The total d-c power supplied to the device less any power delivered from the device to a load. At no load: $P_D = V_{CC+} \cdot I_{CC+} + V_{CC-} \cdot I_{CC-}$.

Rise Time (t_r) The time required for an output voltage step to change from 10% to 90% of its final value.

Slew Rate (SR) The average time rate of change of the closed-loop amplifier output voltage for a step-signal input. Slew rate is measured between specified output levels (0 and 10 volts for this device) with feedback adjusted for unity gain.

THERMAL INFORMATION

DISSIPATION DERATING CURVE

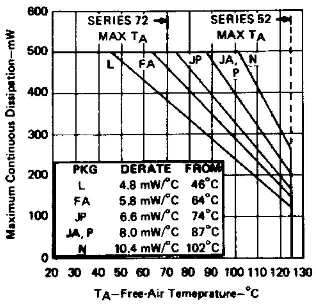
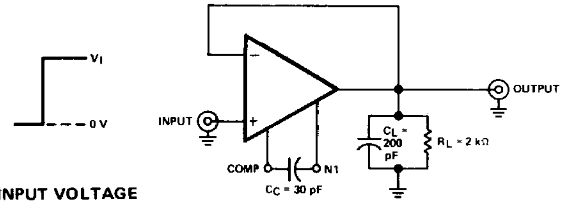


FIGURE 1

PARAMETER MEASUREMENT INFORMATION



INPUT VOLTAGE WAVEFORM

TEST CIRCUIT

FIGURE 2—BANDWIDTH, RISE TIME, AND SLEW RATE

TYPICAL CHARACTERISTICS

SN72770
COMMON-MODE INPUT VOLTAGE RANGE
vs
SUPPLY VOLTAGE

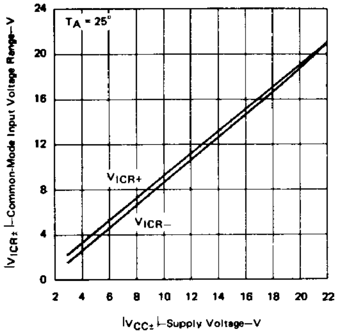


FIGURE 3

MAXIMUM OUTPUT VOLTAGE SWING
vs
SUPPLY VOLTAGE

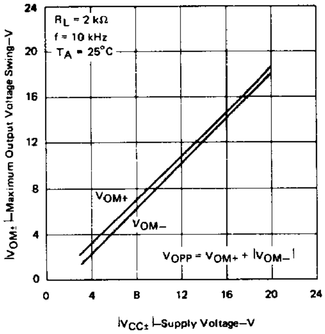


FIGURE 4

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE SWING
vs
FREQUENCY

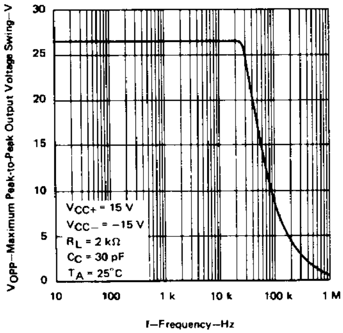


FIGURE 5

OPEN-LOOP LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
SUPPLY VOLTAGE

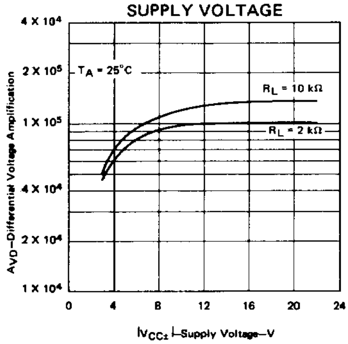


FIGURE 6

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREQUENCY

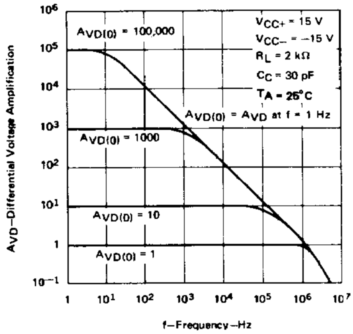


FIGURE 7

SHORT-CIRCUIT OUTPUT CURRENT
vs
FREE-AIR TEMPERATURE

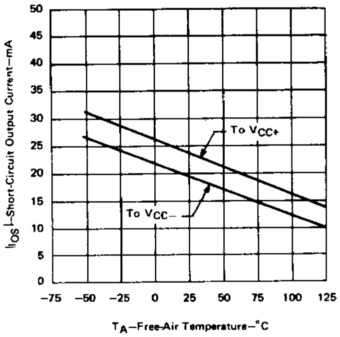


FIGURE 8

TYPICAL CHARACTERISTICS

TOTAL POWER DISSIPATION vs SUPPLY VOLTAGE

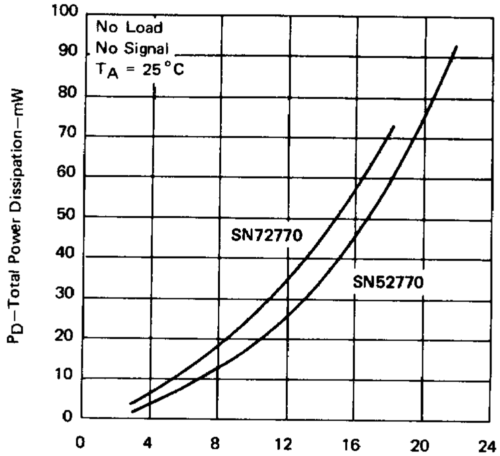


FIGURE 9

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

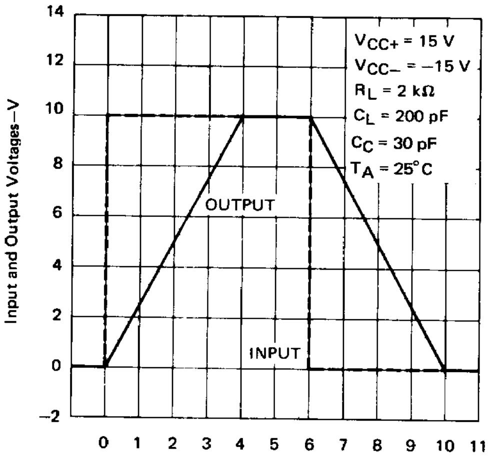
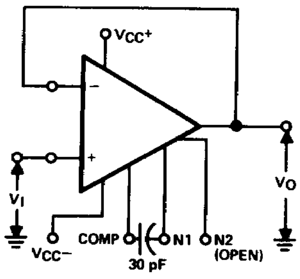


FIGURE 10

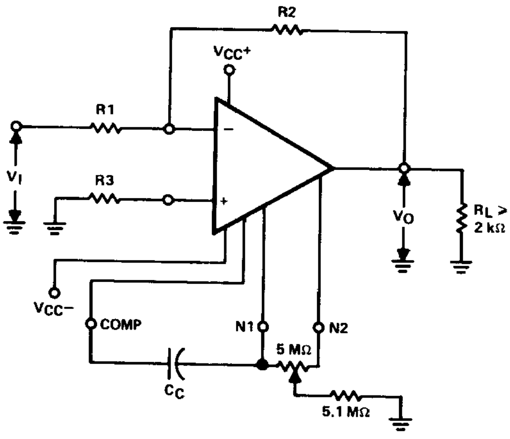
TYPICAL APPLICATION DATA



$r_i \approx$ 5,000 MΩ at 10 Hz $\quad r_o << 1\ \Omega$

$C_L \approx$ 1.5 pF $\quad B_1 \approx$ 1.3 MHz

FIGURE 11—UNITY-GAIN VOLTAGE FOLLOWER



$R3 = \frac{R1 \cdot R2}{R1 + R2} \qquad \frac{V_O}{V_1} = -\frac{R2}{R1} \qquad C_C \geq \frac{R1 \cdot 30\ pF}{R1 + R2}$

FIGURE 12—INVERTING CIRCUIT WITH ADJUSTABLE GAIN, COMPENSATION, AND OFFSET ADJUSTMENT

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