HC2000H File Number **566**

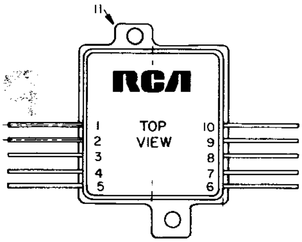
Multi-Purpose 7-Ampere Operational Amplifier

Linear Amplifiers for Applications in Industrial and Commercial Equipment

Features:

- *Bandwidth: 30 kHz at 60 W*
- *High power output: up to 100 W(rms)*
- *Built-in load-line-limiting circuit*
- *Reactive-load fault protection*
- *Provision for feedback control*

TERMINAL DESIGNATIONS



92CS-40377

The RCA-HC2000H is a complete solid-state hybrid operational amplifier in a metal hermetic package. The HC2000H is intended for military and critical industrial applications and can be supplied in accordance with applicable portions of MIL-STD.883.

The amplifier employs a quasi-complementary-symmetry class B output circuit with built-in load-fault protection.

Type HC2000H is recommended for the following applications: servo-amplifiers (ac, dc, PWM): deflection amplifiers; power operational amplifiers; audio amplifiers; voltage regulators; and driven inverters.

Additional information on hybrid power amplifiers is contained in RCA Application Notes AN-4483 and AN-4782.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

V_S:
Between leads 1 and 10 .... 75 V
I_{OM} .... 7 A
P_T:
Per Output Device .... See Fig. 4 & 5
T_{stg} .... -55 to +125°C
T_J .... -55 to +150°C
T_L (During Soldering):
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max. .... 235°C
ϕL (Min):
At distance ≥ 0.075 (1.91 mm) from case .... 0.04 in. (1.02 mm)

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS				LIMITS			UNITS
	V_S –V	f –kHz	P_O –W	R_L –Ω	MIN.	TYP.	MAX.	
V_{OUT}/V_{IN} Open-Loop	±37.5	4	25	4	–	2000	–	
Closed-Loop (See Fig. 3)	±37.5	1	1	4	26	30	–	
Z_{IN} Measured between leads 7 & 8 (See Fig. 3)	–	–	–	–	16	18	–	kΩ
I_o	±37.5	–	–	–	15	–	30	mA
V_{IO} Measured between leads 4 & 5 (See Fig. 3)	±37.5	–	–	4	0	±30	±250	mV
V_{OUT}	±37.5	1	100	4	28	32	–	V
f_H (See Figs. 3 & 8)	±37.5	–	1	4	43	–	–	kHz
THD (See Figs. 3 & 9)	±37.5	1	60	4	–	0.4	0.5	%
I_S (See Fig. 11)	±37.5	1	–	0	±2	–	±3.85	A
S/N Z_G = 600 Ω	±37.5	–	–	–	–	78	–	dB
SR (Unity gain, I_{OM} = 4A)	±37.5	1	100	4	5	–	–	V/μs
$R_{\theta JC}$ Per Output Device (See Figs. 4 & 5)	–	–	–	–	–	–	2	°C/W

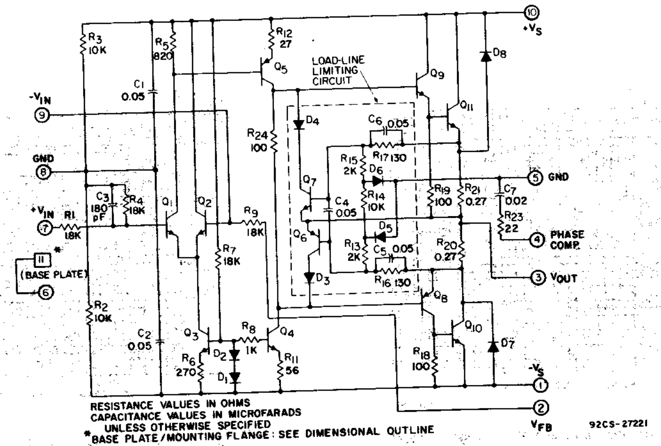


Fig. 1 – Schematic diagram of type HC2000H power hybrid circuit operational amplifier.

HC2000H

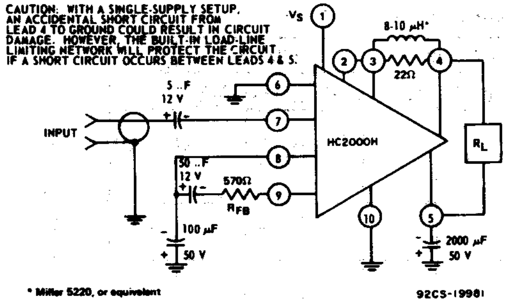


Fig. 2 – Type HC2000H power hybrid circuit with external connections for operation with a single power supply.

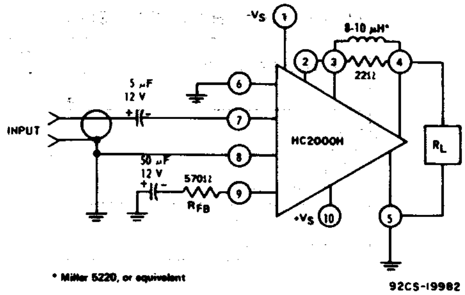


Fig. 3 – Type HC2000H power hybrid circuit with external connections (and split power supply) for measuring relative response and distortion; see Figs. 8 & 9.

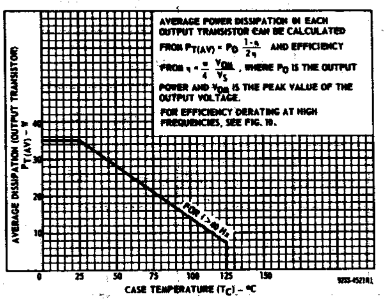


Fig. 4 – Dissipation (average) derating curve for each output transistor (for symmetrical waveforms with f > 40 Hz).

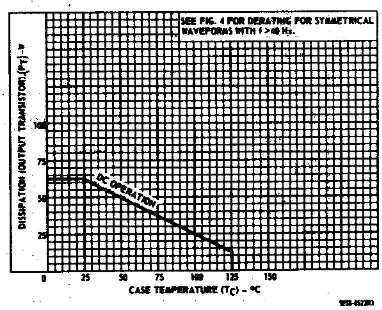


Fig. 5 – Dissipation (dc) derating curve for each output transistor.

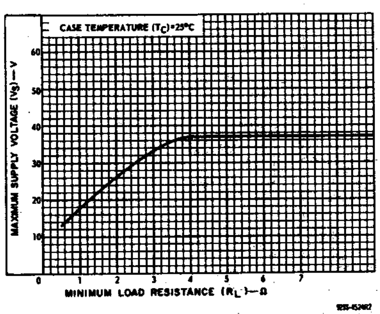


Fig. 6 – Maximum allowable supply voltage vs. load resistance.

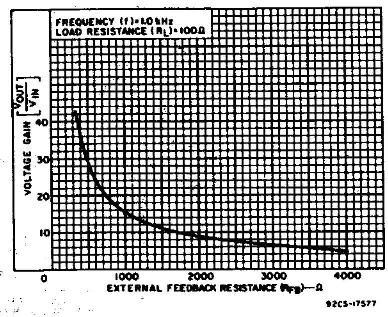


Fig. 7 – Closed-loop voltage gain vs. external feedback resistance.

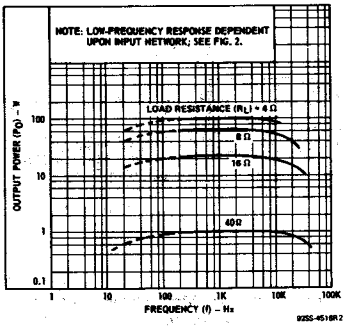


Fig. 8 – Output power vs. frequency.

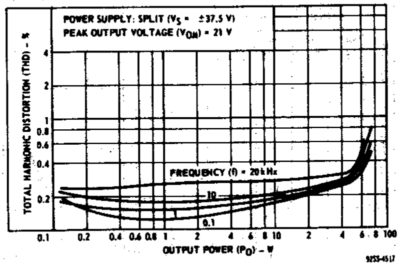


Fig. 9 – Total harmonic distortion with split power supply.

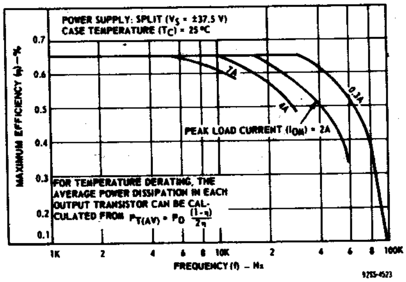


Fig. 10 – Maximum efficiency vs. frequency for several values of peak load current.

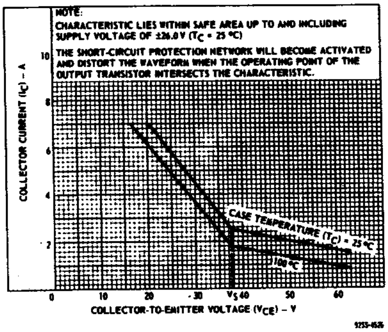


Fig. 11 – Characteristics of built-in load-line-limiting circuit.

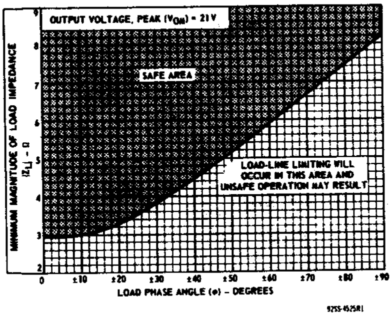


Fig. 12 – Minimum load impedance vs. load phase angle and safe area of operation.

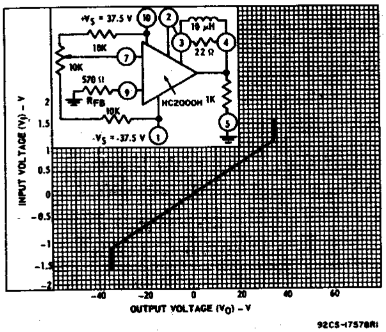


Fig. 13 – Gain linearity characteristic.

HC2000H

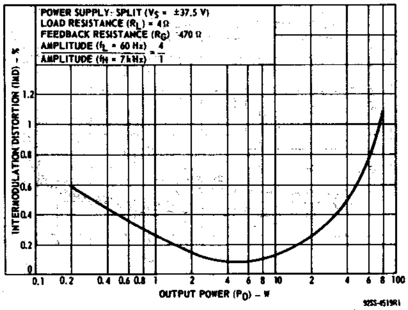


Fig. 14 — Intermodulation distortion with split supply and 4-ohm load.

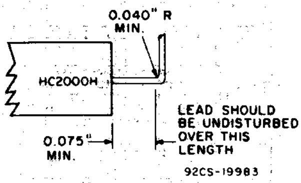


Fig. 15 — Recommended lead-bending specification.

File Number **681**

HC2500

Multi-Purpose, Low-Distortion 7-Ampere Operational Amplifier

Linear Amplifier for Applications in Industrial and Commercial Equipment

Features:

- *Bandwidth: 30 kHz at 60 W*
- *High power output: up to 100 W(rms)*
- *Adjustable idling current*

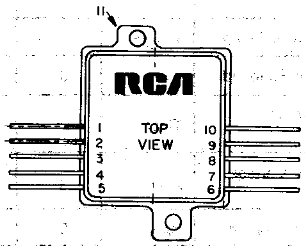
RCA type HC2500• is a complete solid-state hybrid amplifier in a compact hermetic package. It employs a quasi-complementary-symmetry output circuit.

The HC2500 is a low-distortion, 100-watt linear amplifier. The output section can be externally biased class AB for low inter-modulation and total harmonic distortion. Terminals are available for external frequency compensation, external short-circuit protection, and inverting and non-inverting inputs.

The HC2500 is recommended for the following applications; servo amplifiers (ac, dc, PWM), deflection amplifiers, power operational amplifiers, voltage regulators, driven inverters, hi-fi amplifiers, PA systems, and solenoid drivers.

•Derived from RCA Dev. No. TA8651A.

TERMINAL DESIGNATIONS



92CS-40377

MAXIMUM RATINGS, *Absolute-Maximum Values:*

SUPPLY VOLTAGE:		
Between leads 1 and 10	75	V
OUTPUT CURRENT (Peak)	7	A
TOTAL DISSIPATION:		
Per output device	See Figs. 4 & 5	
TEMPERATURE RANGE:		
Storage	−55 to +125°C	
Output junction	−55 to +150°C	
LEAD TEMPERATURE (During Soldering):		
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235°C	

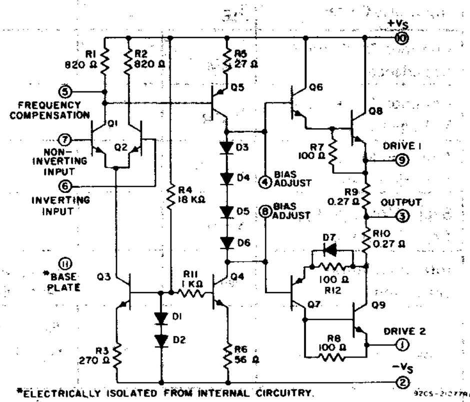


Fig. 1 – Schematic diagram of type HC2500 operational amplifier.

COMPARISON CHART

TYPE	IM DIST. @ 50 mW	OUTPUT PROTECTION NETWORK	OPERATING MODE	FREQUENCY COMPENSATION	COMMUTATING DIODES
HC2500	0.06%	NO	CLASS AB	CAPACITOR ON SIGNAL TERMINALS	NO
HC2000H	5.8%	YES	CLASS B	LC FILTER ON OUTPUT	YES

HC2500

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C and Supply Voltage (V_S) = ±37.5 V*

CHARACTERISTIC	SYMBOL	REFERENCE FIG. NO.	TEST CONDITIONS: SPECIAL NOTES	FREQ. (f)–kHz	OUTPUT POWER (P_O)–W	LOAD RESIST. (R_L)–Ω	LIMITS: MIN.	TYP.	MAX.	UNITS
Offset Voltage	V_{offset}	3	Measured Pin 3 to Gnd	–	–	4	–	–	±250	mV
Quiescent Current	I_o	3	Idling Current < 1 mA	–	–	Open	–	–	±30	mA
Output Voltage Swing	V_{OUT}		Peak dc voltage	0	200	4	28	–	–	V
Closed-Loop Bandwidth	f_H	3		–	1	4	43	–	–	kHz
Total Harmonic Distortion	THD	15		1	60	4	–	0.3	0.5	%
Closed-Loop Voltage Gain	A_{CL}	3		1	1	4	31	32	–	
Thermal Resistance	$R_{\theta JC}$	5		–	–	–	–	–	2	°C/W

ELECTRICAL CHARACTERISTICS
Typical Values (for Design Guidance), *At Case Temperature (T_C) = 25°C and Supply Voltage (V_S) = ±37.5*

CHARACTERISTIC	SYMBOL	REFERENCE FIG. NO.	SPECIAL NOTES	FREQ. (f)–kHz	OUTPUT POWER (P_O)–W	LOAD RESIST. (R_L)–Ω	MIN.	TYP.	MAX.	UNITS
Open-Loop Voltage Gain	A_{OL}	8, 19	Idling current = 50 mA	1	25	4	–	70	–	dB
Input Offset Voltage	V_{IO}	20		–	0	Open	–	±10	–	mV
Input Offset Current	I_{IO}	20		–	0	Open	–	7	–	μA
Input Bias Current	I_{IB}	20		–	0	Open	–	20	–	μA
Common-Mode Input Impedance	R_{CM}	22		0.005	0	Open	–	1	–	MΩ
Common-Mode Input-Voltage Range	V_{ICR}			0.5	100	4	–	32	–	V
Common-Mode-Rejection Ratio	CMRR			0.005	0	Open	–	50	–	dB
Supply-Voltage Ripple-Rejection Ratio	V_{RR}			0.06	0	4	–	30	–	dB
Intermodulation Distortion	IMD	14	Idling current = 50 mA	–	0.05	4	–	0.06	–	%
Slew Rate	SR	18	A_{CL} = 2, C_c = 100 pF	0.5 Square Wave	–	4	–	4.3	–	V/μs
Idling-Current Drift	ΔI_i	17	25°C to 100°C	–	–	4	–	1	–	mA/°C

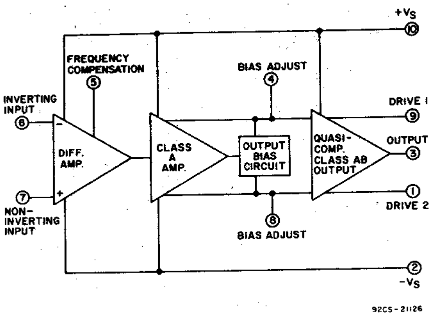


Fig. 2 – Block diagram of HC2500 100-watt class AB amplifier.

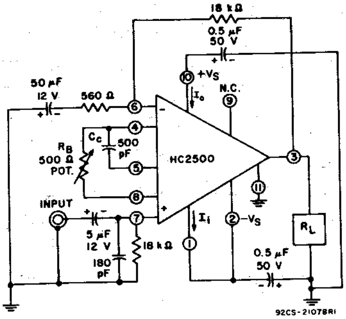


Fig. 3 – Typical test circuit with split supply for measuring A_{CL}, I_i, I_o, V_{offset}, f_H, THD, and IMD.

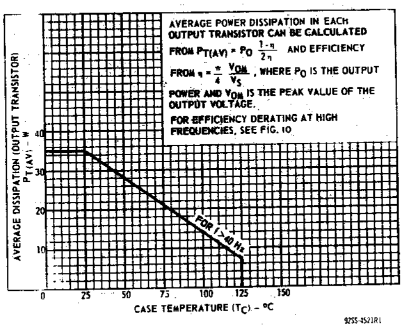


Fig. 4 – Dissipation (average) derating curve for each output transistor (for symmetrical waveforms with f >40 Hz).

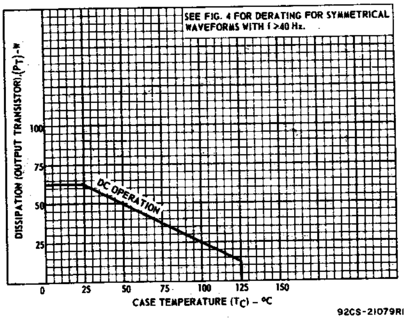


Fig. 5 – Dissipation derating curve for each output transistor.

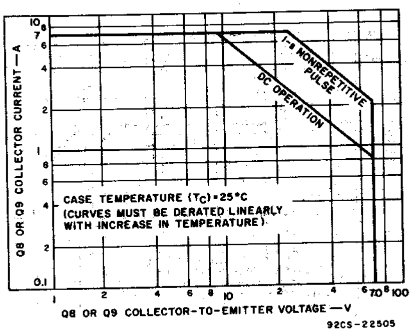


Fig. 6 – Maximum operating area for HC2500.

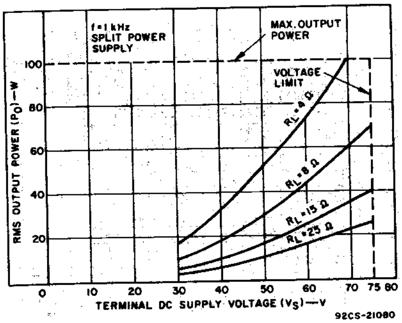


Fig. 7 – Output power as a function of supply voltage, with various values of load resistance, for symmetrical sine-wave operation.

HC2500

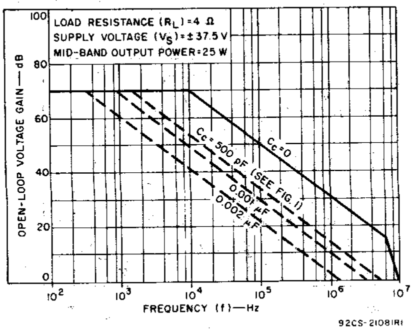


Fig. 8 – Typical open-loop voltage gain vs. frequency.

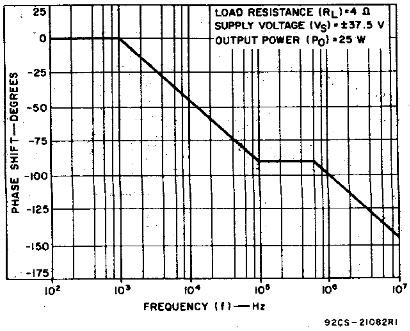


Fig. 9 – Typical open-loop phase shift vs. frequency.

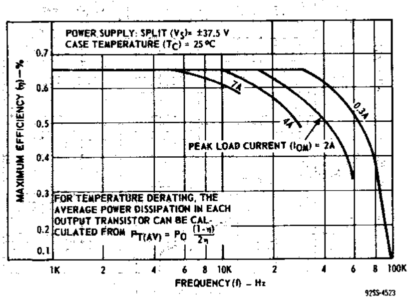


Fig. 10 – Maximum efficiency vs. frequency for several values of peak load current.

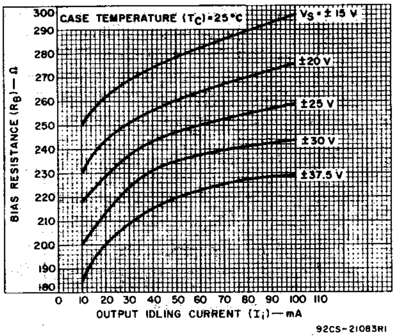


Fig. 11 – Bias resistor (R_B in Fig. 3) value vs. output idling current (I_i).

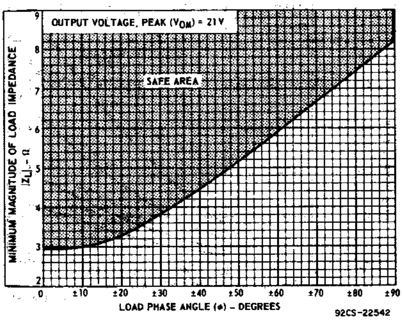


Fig. 12 – Minimum load impedance vs. load phase angle and safe area of operation.

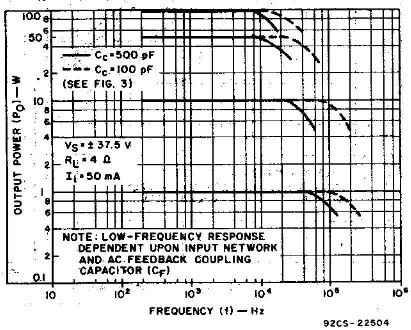


Fig. 13 – Output power vs. frequency.

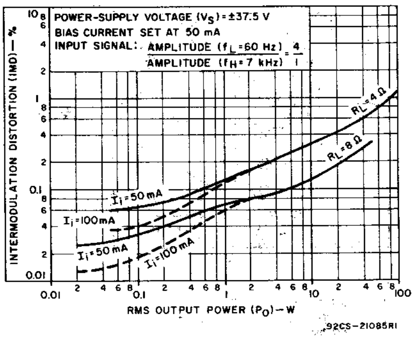


Fig. 14 — Typical intermodulation distortion vs. rms output power.

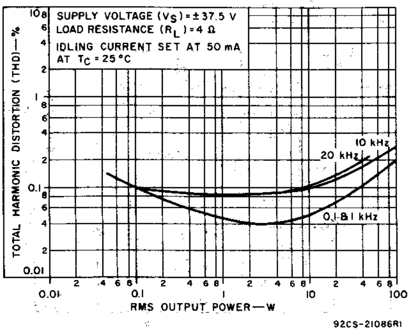


Fig. 15 — Typical total harmonic distortion vs. rms output power.

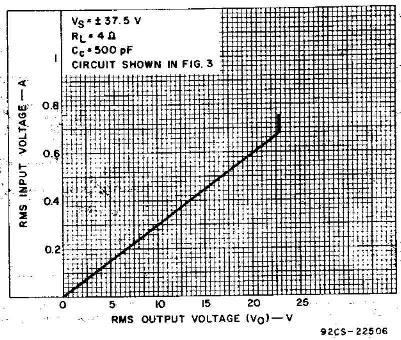


Fig. 16 — Input sensitivity.

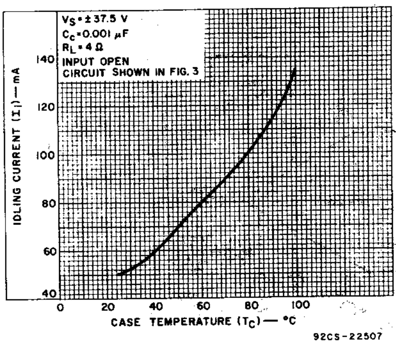


Fig. 17 — Typical idling-current dirft.

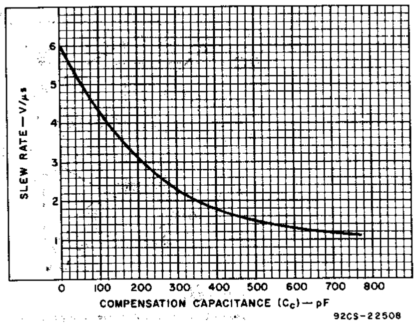


Fig. 18 — Typical slew rate vs. value of compensation capacitor, C_c (test circuit shown in Fig. 21).

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HC2500

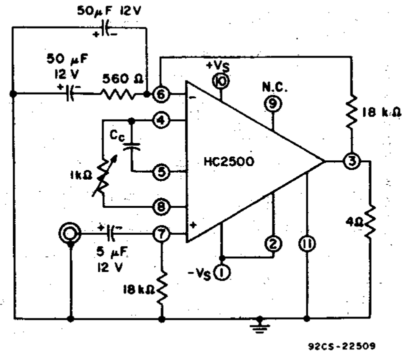
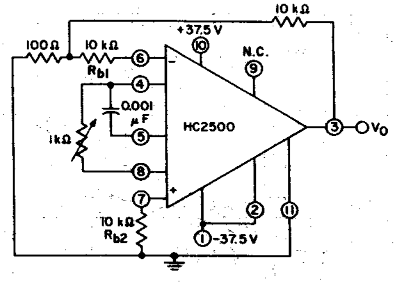


Fig. 19 — Test circuit for open-loop gain and phase response.



$V_{IO} = -\frac{V_O}{100}$ with R_{b1} and R_{b2} shorted

$I_{IO} = -\frac{V_O}{100\,R_{b2}}$

$I_{Ib} = \frac{\pm V_O}{100\,R_{b2}}$ with R_{b1} shorted

92CS-22510

Fig. 20 — Test circuit for input offset voltage and current test.

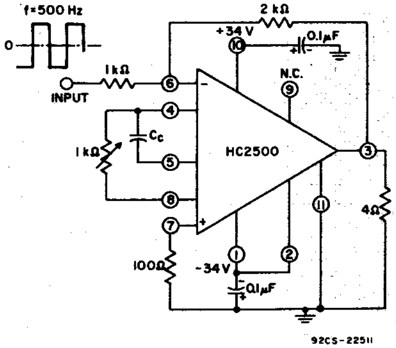
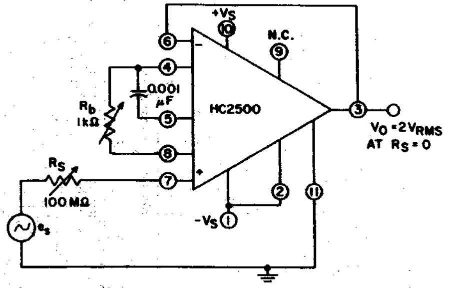


Fig. 21 — Circuit used to test slew rate.

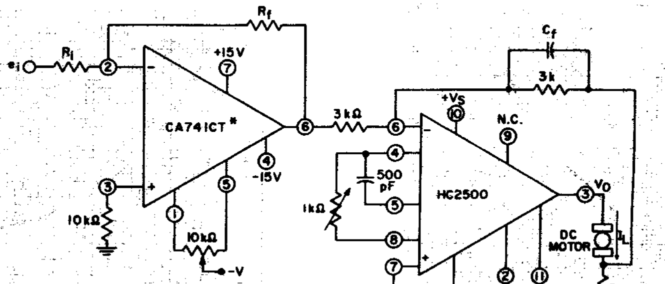


$R_{CM} = 9\,R_S$ with series resistance (R_S) increased from zero until output voltage (V_O) is reduced by 10%.

92CS-22512

Fig. 22 — Test circuit for measuring common-mode input resistance.

TYPICAL APPLICATION CIRCUITS



$|i_L| = |e_i| \frac{R_f}{R_i R_S}$

C_f should be chosen to limit $L(di_L/dt)$ during rapid transitions of the input waveform without limiting required output performance. R_S should be chosen as high as possible without limiting required output performance.

*See Data Bulletin File 531.

92CM-22513

Fig. 23 — Current-feedback motor-control circuit.

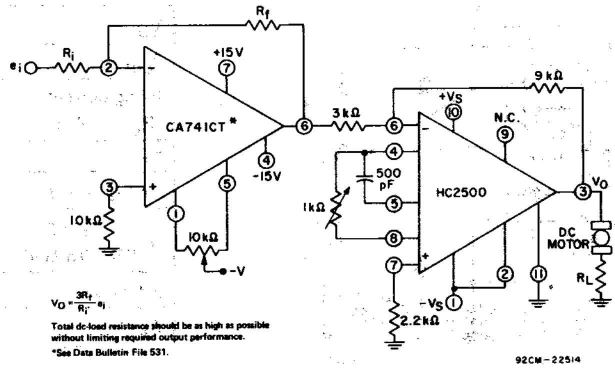


Fig. 24 — Voltage-feedback motor-control circuit.

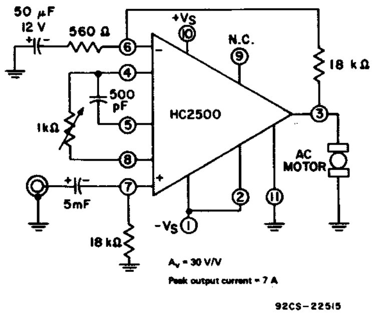


Fig. 25 — AC motor control.

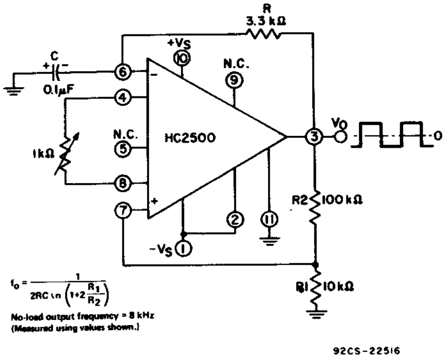


Fig. 26 — High-power astable multivibrator.

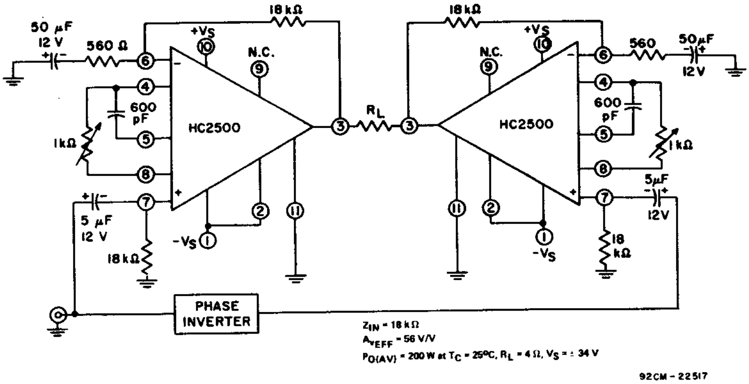


Fig. 27 — Bridge circuit for loads greater than 100 watts.