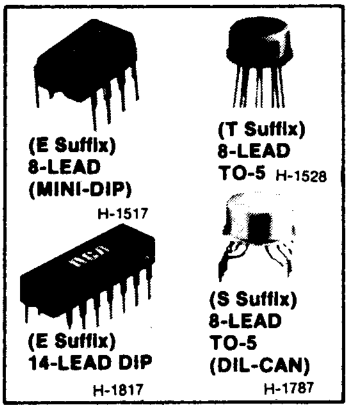
CA080, CA081, CA082, CA083, CA084 Series



BiMOS Operational Amplifiers

With MOS/FET Input, Composite Bipolar/MOS Output

Single Amplifier: CA080, CA081
Dual Amplifier: CA082, CA083
Quad Amplifier: CA084

Features:

- *Very low input bias and offset currents*
- *Input impedance typically 1.5 x 10^{12} Ω*
- *Low input offset voltage*
- *Wide common-mode input voltage range*
- *Low power consumption*
- *Fast slew rate*
- *Unity-gain bandwidth = 5 MHz (typ.)*
- *Wide output voltage swing*
- *Low distortion*
- *Continuous short circuit protection*
- *Direct replacement for industry type TL080 series in most applications*

The RCA-CA080, CA081, CA082, CA083, and CA084 BiMOS operational amplifiers combine the advantages of MOS and bipolar transistors on the same monolithic chip. The gate-protected MOS/FET (PMOS) input transistors provide high input impedance and a wide common-mode input voltage range. The bipolar and MOS output transistors allow a wide output voltage swing and provide a high output current capability.

Applications:

- *Inverters*
- *High-Q notch filters*
- *IC preamplifiers*
- *Unity Gain Absolute Value Amplifiers*
- *Sample and hold amplifiers*
- *Active filters*

The CA080 is externally phase-compensated, and the CA081, CA082, CA083, and CA084 are internally phase-compensated. All types except the CA082 have provisions for external offset nulling.

The CA080, CA081, CA082, CA083, and CA084 are available in chip form (H Suffix).

Package Selection Chart

Type No.	Package Type & Suffix			
	8L TO-5	DIL-CAN	Mini-DIP	14L DIP
CA080	T	S	E	
CA080A	T	S	E	
CA080B			E	
CA080C	T	S		
CA081	T	S	E	
CA081A	T	S	E	
CA081B			E	
CA081C	T	S		
CA082	T	S	E	
CA082A	T	S	E	
CA082B			E	
CA082C	T	S		
CA083				E
CA083A				E
CA083B				E
CA084				E
CA084A				E
CA084B				E

Operating Temperature Ranges:

-55 to +125°C	0 to +70°C
CA080T, CA080S	CA080CT, CA080CS
CA080AT, CA080AS	CA080BE
CA081T, CA081S	CA081CT, CA081CS
CA081AT, CA081AS	CA081BE
CA082T, CA082S	CA082CT, CA082CS
CA082AT, CA082AS	CA082BE
	CA083BE, CA083AE
	CA083BE
	CA084, CA084AE
	CA084BE

CA080, CA081, CA082, CA083, CA084 Series

MAXIMUM RATINGS, *Absolute Maximum Values:*

DC SUPPLY VOLTAGE V± ....
DIFFERENTIAL INPUT VOLTAGE .... ±18 V
INPUT VOLTAGE RANGE .... ±16 V
INPUT CURRENT .... ± 15 V
OUTPUT SHORT-CIRCUIT DURATION .... 1 mA
POWER DISSIPATION, P_D: .... UNLIMITED*
  At T_A = 25°C:
    E Suffix ....
    T Suffix .... 625 mW
  Derating Factors: .... 680 mW
    Mini-DIP ....
    14-Lead DIP .... Derate linearly at 6.67 mW/°C above 56°C
    TO-5 .... Derate linearly at 6.67 mW/°C above 56°C
AMBIENT TEMPERATURE RANGE: .... Derate linearly at 6.67 mW/°C above 56°C
  CT, CS, E, Suffixes ....
  T, S, Suffixes .... 0 to +70°C
STORAGE TEMPERATURE RANGE, ALL TYPES .... -55 to +125°C
LEAD TEMPERATURE (DURING SOLDERING): .... -65 to +150°C
  At distance 1/16 ± 1/32 (1.59 ± 0.79 mm) from case for 10 seconds max. .... +265°C

* The output may be shorted to ground or either supply if the maximum temperature and dissipation ratings are observed.

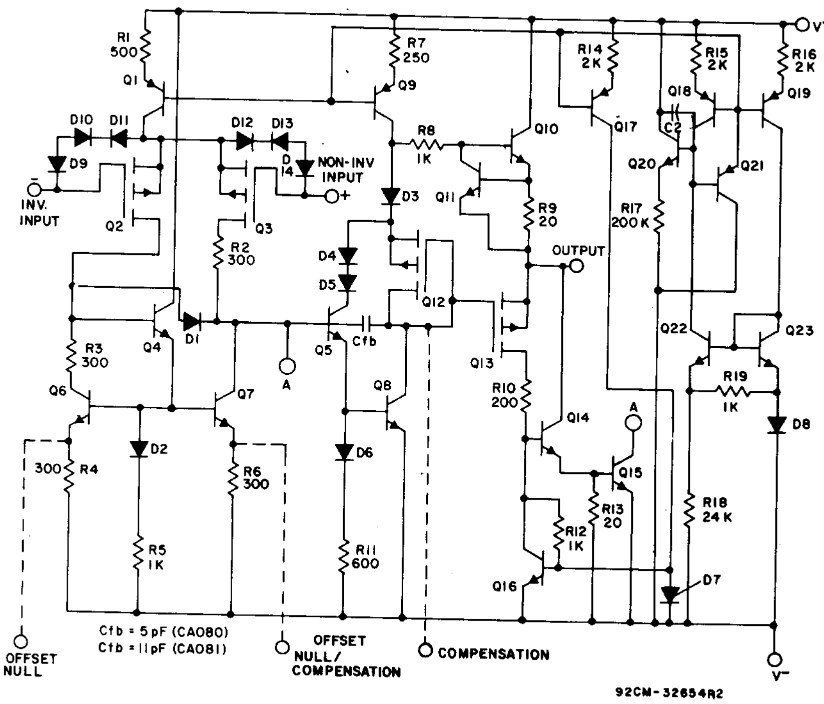
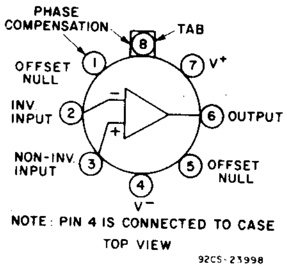


Fig. 1 - Schematic diagram of the CA080, CA081, CA082, CA083, and CA084.

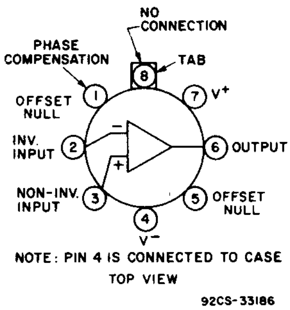
CA080, CA081, CA082, CA083, CA084 Series

Texas Instruments-to-RCA Package Suffix Cross Reference Chart

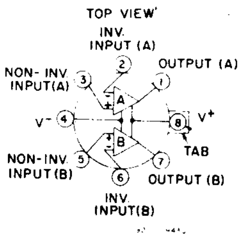
Texas Instruments Suffix	Texas Instruments Description	RCA Suffix	RCA Description
ACJG	Ceramic DIL	AS	DILCAN TO-5
ACL	TO-5	AT	TO-5
ACN	Plastic DIL	AE	Plastic DIL
ACP	Plastic DIL	AE	Plastic DIL
CJG	Ceramic DIL	CS	DILCAN TO-5
CL	TO-5	CT	TO-5
CN	Plastic DIL	E	Plastic DIL
CP	Plastic DIL	E	Plastic DIL
IJG	Ceramic DIL	S	DILCAN TO-5
IL	TO-5	T	TO-5
IP	Plastic DIL	E	DILCAN TO-5
MJG	Ceramic DIL	S	DILCAN TO-5
ML	TO-5	T	TO-5
AML	TO-5	AT	TO-5
BCP	Plastic DIL	BE	Plastic DIL



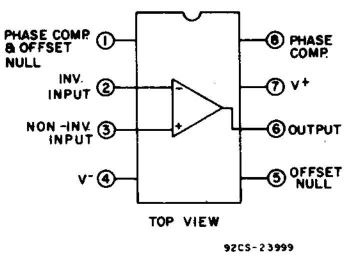
CA080
T, S Suffixes



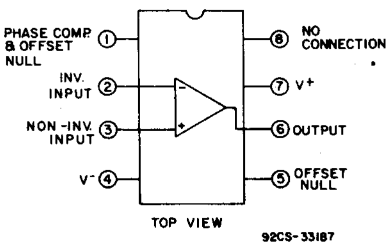
CA081
T, S Suffixes



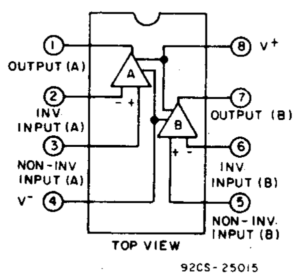
CA082
T, S Suffixes



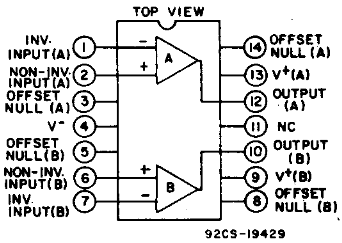
CA080
E Suffix



CA081
E Suffix

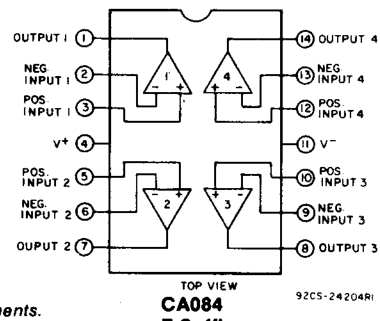


CA082
E Suffix



CA083
E Suffix

Fig. 2 - Terminal assignments.



CA084
E Suffix

CA080, CA081, CA082, CA083, CA084 Series

TYPICAL OPERATING CHARACTERISTICS at $V\pm = 15\ V$, $T_A = 25°C$

CHARACTERISTIC	TEST CONDITIONS	VALUE	UNITS
Slew Rate at Unity Gain, SR	$V_I = 10\ V$, $R_L = 2\ k\Omega$, $C_L = 100\ pF$, $A_{VD} = 1$	13	V/µs
Rise Time, t_r	$V_I = 10\ V$, $R_L = 2\ k\Omega$, $C_L = 100\ pF$, $A_{VD} = 1$	0.1	µs
Overshoot Factor		10	%
Equivalent Input Noise Voltage, e_n	$R_S = 100\ \Omega$, f = 1 kHz	40	nV/√Hz

ELECTRICAL CHARACTERISTICS at $T_A = 25°C$ and $T_A = -55$ to $+125°C$ for types supplied in TO-5 style packages (T, S Suffixes). $V^+ = \pm 15\ V$

This does not include CA080C, CA081C, or CA082C. These types are supplied in TO-5 packages, but they are specified over the range of 0 to 70°C, and their limits are the same as those for the CA080, CA081, CA082, and CA083 in plastic packages over the range 0 to 70°C.

CHARACTERISTIC	TEST CONDITIONS	+25°C	−55 to +125°C	LIMITS CA080T, S CA081T, S CA082T, S Min.	Typ.	Max.	LIMITS CA080AT, S CA081AT, S CA082AT, S Min.	Typ.	Max.	UNITS
Input Offset Voltage, V_{IO}	$R_S = 50\Omega$	X		—	3	6	—	2	3	mV
			X	—	—	9	—	—	5	mV
Temperature Coefficient of Input Offset Voltage, αV_{IO}	$R_S = 50\ \Omega$		X	—	10	—	—	10	—	µV/°C
Input Offset Current, I_{IO}		X		—	5	20	—	5	20	pA
			X	—	—	4	—	—	2	nA
Input Current		X		—	15	40	—	15	40	pA
			X	—	—	10	—	—	5	nA
Common-Mode Input Voltage Range, V_{ICR}		X		±12	—	—	±12	—	—	V
Maximum Output Voltage Swing, V_{OP-P}	$R_L = 10\ k\Omega$	X		24	27	—	24	27	—	V
	$R_L \geq 10\ k\Omega$		X	24	—	—	24	—	—	V
	$R_L \geq 2\ k\Omega$		X	20	24	—	20	24	—	V
Large-Signal Differential Voltage Gain, A_{VD}	$R_L \geq 2\ k\Omega$, $V_O = \pm 10V$	X		50	200	—	50	200	—	V/mV
			X	25	—	—	25	—	—	V/mV
Unity-Gain Bandwidth		X		—	5	—	—	5	—	MHz
Input Resistance, R_I		X		—	1.5	—	—	1.5	—	TΩ
Common-Mode Rejection Ratio, CMRR	$R_S \leq 10\ k\Omega$	X		80	86	—	80	86	—	dB
Power Supply Rejection Ratio, PSRR ($\Delta V^+ / \pm \Delta V_{IO}$)	$R_S \leq 10\ k\Omega$	X		80	86	—	80	86	—	dB
Supply Current, I^+ (per amp., CA082, CA083)	No load, No Signal	X		—	1.4	2.8	—	1.4	2.8	mA
Channel Separation, V_{O1}/V_{O2} (between amps., CA082, CA083)	$A_{VD} = 100$	X		—	120	—	—	120	—	dB

ELECTRICAL CHARACTERISTICS at T_A = 25°C, T_A = 0 to +70°C for types supplied in plastic dual-in-line packages (E Suffix). V^+ = ±15 V

CHARACTERISTIC	TEST CONDITIONS	+25°C	0 to 70°C	LIMITS CA080BE, CA081BE, CA082BE, CA083BE, CA084BE Min.	Typ.	Max.	LIMITS CA080AE, CA081AE, CA082AE, CA083AE, CA084AE Min.	Typ.	Max.	UNITS
Input Offset Voltage, V_{IO}	R_S = 50Ω	X		—	2	3	—	3	6	mV
			X	—	—	5	—	—	7.5	mV
Temperature Coefficient of Input Offset Voltage, αV_{IO}	R_S = 50 Ω		X	—	10	—	—	10	—	μV/°C
Input Offset Current, I_{IO}		X		—	5	10	—	5	20	pA
			X	—	—	0.4	—	—	0.6	nA
Input Current		X		—	15	30	—	15	40	pA
			X	—	—	0.7	—	—	1	nA
Common-Mode Input Voltage Range, V_{ICR}		X		±12	—	—	±12	—	—	V
Maximum Output Voltage Swing, V_{OP-P}	R_L = 10 kΩ	X		24	27	—	24	27	—	V
	R_L ≥ 10 kΩ		X	24	—	—	24	—	—	V
	R_L ≥ 2 kΩ		X	20	24	—	20	24	—	V
Large-Signal Differential Voltage Gain, A_{VD}	R_L ≥ 2 kΩ, V_O = ±10V	X		50	200	—	50	200	—	V/mV
			X	—	—	—	—	—	—	V/mV
Unity-Gain Bandwidth		X		—	5	—	—	5	—	MHz
Input Resistance, R_I		X		—	1.5	—	—	1.5	—	TΩ
Common-Mode Rejection Ratio, CMRR	R_S ≤ 10 kΩ	X		80	86	—	80	86	—	dB
Power Supply Rejection Ratio, PSRR ($\Delta V^+/\pm\Delta V_{IO}$)	R_S ≤ 10 kΩ	X		80	86	—	80	86	—	dB
Supply Current, I^+ (per amp., CA082, CA083, CA084)	No load, No Signal	X		—	1.4	2.8	—	1.4	2.8	mA
Channel Separation, V_{01}/V_{02} (between amps., CA082, CA083)	A_{VD} = 100	X		—	120	—	—	120	—	dB

CA080, CA081, CA082, CA083, CA084 Series

ELECTRICAL CHARACTERISTICS at T_A = 25°C, T_A = 0 to 70°C for types supplied in plastic dual-in-line packages (E Suffix). V+ = ±15 V

The limits for the CA080C, CA081C, and CA082C in TO-5 packages are the same as those for the types in this chart.

CHARACTERISTIC	TEST CONDITIONS	+25°C	0 to 70°C	LIMITS CA080E, T CA081E, T CA082E, T CA083E CA084E Min.	Typ.	Max.	UNITS
Input Offset Voltage, V_{IO}	R_S = 50Ω	X		—	5	15	mV
			X	—	—	20	
Temperature Coefficient of Input Offset Voltage, $\propto V_{IO}$	R_S = 50 Ω		X	—	10	—	µV/°C
Input Offset Current, I_{IO}		X		—	5	30	pA
			X	—	—	1	nA
Input Current		X		—	15	50	pA
			X	—	—	2	nA
Common-Mode Input Voltage Range, V_{ICR}		X		±10	—	—	V
Maximum Output Voltage Swing, V_{OP-P}	R_L = 10 kΩ	X		24	27	—	V
	$R_L \geq$ 10 kΩ		X	24	—	—	
	$R_L \geq$ 2 kΩ		X	20	24	—	
Large-Signal Differential Voltage Gain, A_{VD}	$R_L \geq$ 2 kΩ, V_O = ±10V	X		25	200	—	V/mV
			X	—	—	—	
Unity-Gain Bandwidth		X		—	5	—	MHz
Input Resistance, R_I		X		—	1.5	—	TΩ
Common-Mode Rejection Ratio, CMRR	$R_S \leq$ 10 kΩ	X		70	76	—	dB
Power Supply Rejection Ratio, PSRR ($\Delta V+/\pm\Delta V_{IO}$)	$R_S \leq$ 10 kΩ	X		70	76	—	dB
Supply Current, I+ (per amp., CA082, CA083)	No load, No Signal	X		—	1.4	2.8	mA
Channel Separation, V_{01}/V_{02} (between amps., CA082, CA083)	A_{VD} = 100	X		—	120	—	dB

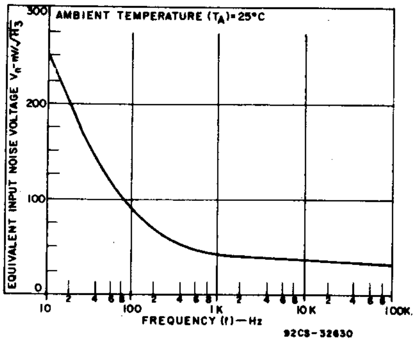


Fig. 3 - Noise voltage as a function of frequency.

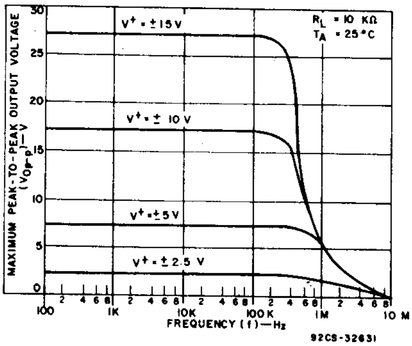


Fig. 4 - Output voltage as a function of frequency.

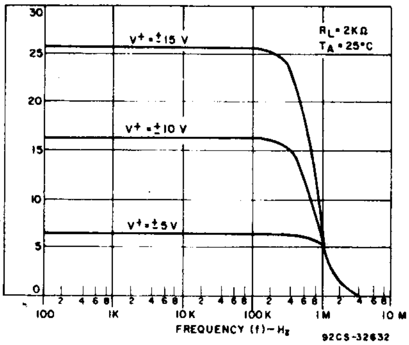


Fig. 5 - Output voltage as a function of frequency.

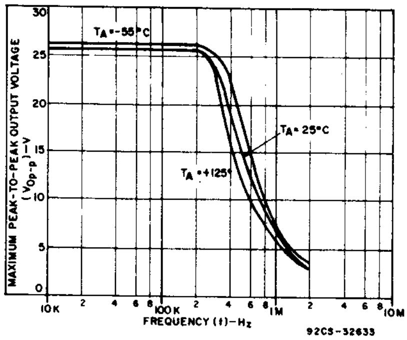


Fig. 6 - Output voltage as a function of frequency.

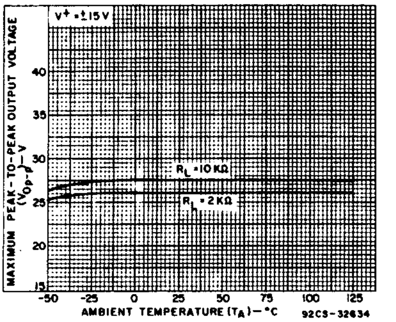


Fig. 7 - Output voltage as a function of ambient temperature.

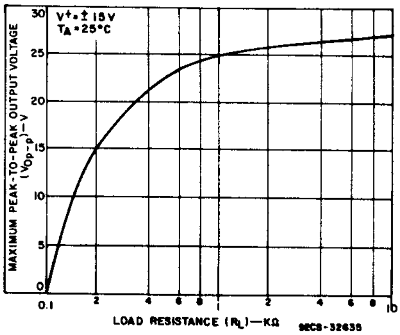


Fig. 8 - Output voltage as a function of load resistance.

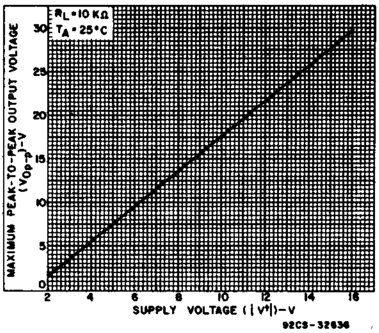


Fig. 9 - Output voltage as a function of supply voltage.

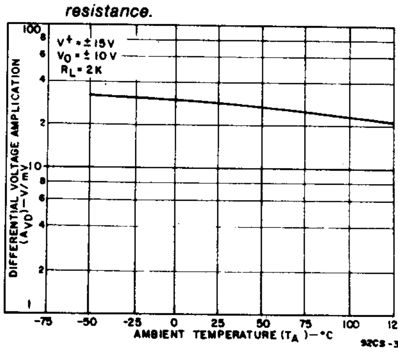


Fig. 10 - Differential voltage amplification as a function of ambient temperature.

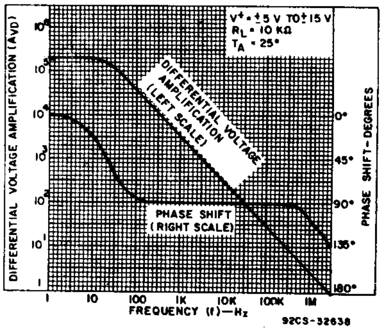


Fig. 11 - Differential voltage amplification as a function of frequency.

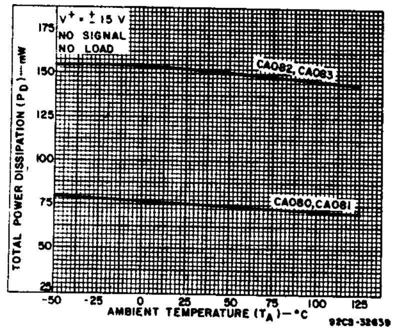


Fig. 12 - Total power dissipation as a function of ambient temperature.

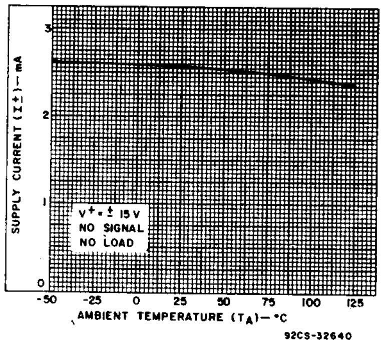


Fig. 13 - Supply current as a function of ambient temperature.

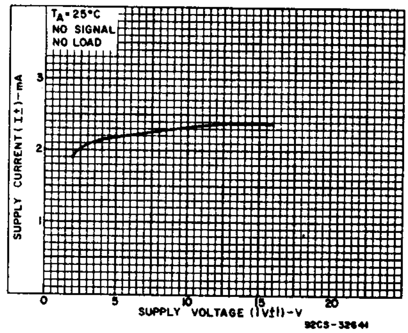


Fig. 14 - Supply current as a function of supply voltage.

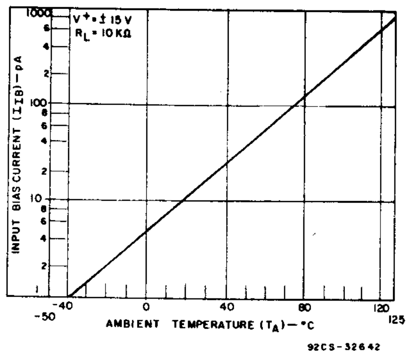


Fig. 15 - Input bias current as a function of ambient temperature.

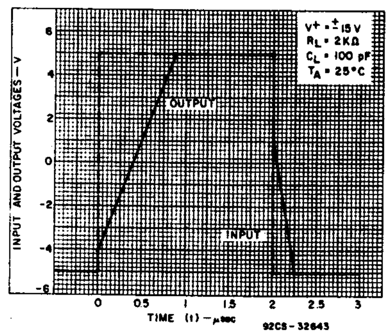


Fig. 16 - Voltage follower large-signal pulse response.

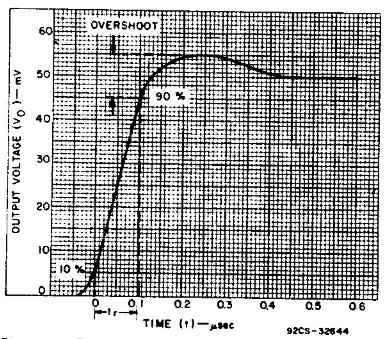


Fig. 17 - Output voltage as a function of elapsed time.

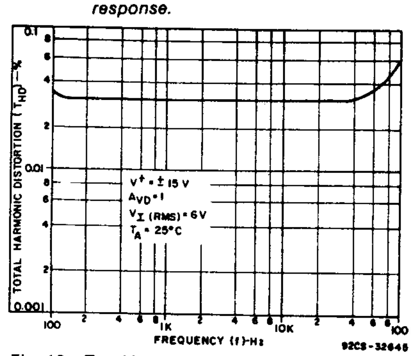


Fig. 18 - Total harmonic distortion as a function of frequency.

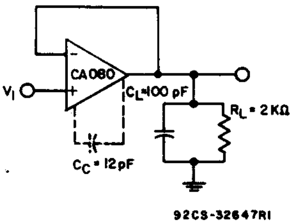


Fig. 19 - Unity-gain amplifier.

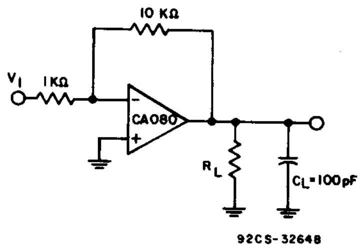


Fig. 20 - 10X inverting amplifier.

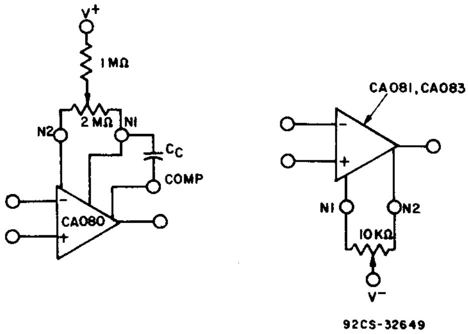


Fig. 21 - Input-offset voltage null circuits.

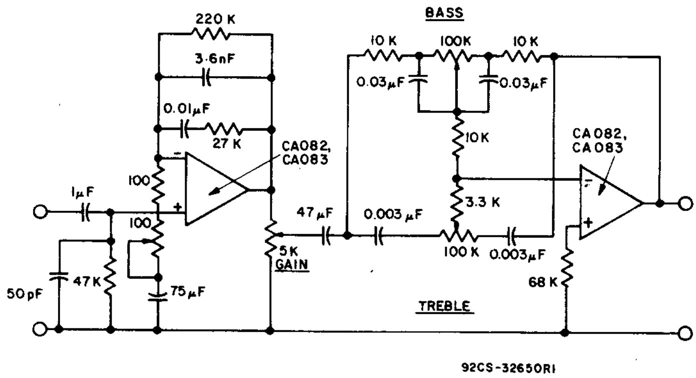


Fig. 22 - IC preamplifier.

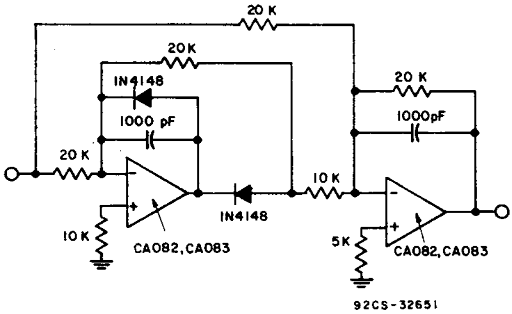


Fig. 23 - Unity-gain absolute-value amplifier.

CA080, CA081, CA082, CA083, CA084 Series

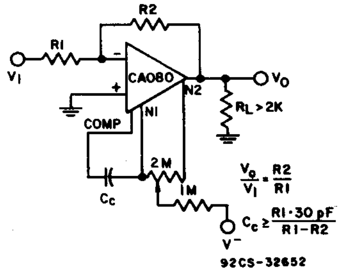


Fig. 24 - Inverting amplifier with single-pole compensation and offset adjustment.

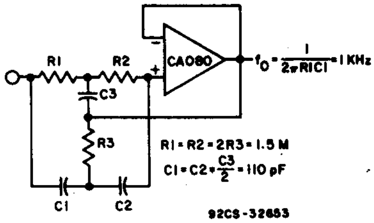


Fig. 25 - High Q notch filter.

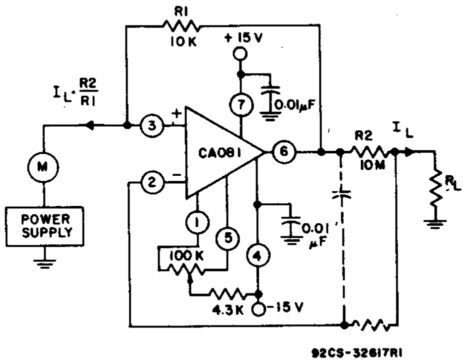


Fig. 26 - Basic current amplifier for low-current measurement systems.

CURRENT AMPLIFIER

The low input-terminal current needed to drive the CA081 makes it ideal for use in current-amplifier applications such as the one shown in Fig.26. In this circuit, low current is supplied at the input potential as the power supply to load resistor R_L. This load current is increased by the multiplication factor R2/R1, when the load current is monitored by the power supply meter M. Thus, if the load current is 100 nA, with values shown, the load current presented to the supply will be 100 μA; a much easier current to measure in many systems.

Note that the input and output voltages are transferred at the same potential and only the output current is multiplied by the scale factor.

The dotted components show a method of decoupling the circuit from the effects of high output-load capacitance and the potential oscillation in this situation. Essentially, the necessary high-frequency feedback is provided by the capacitor with the dotted series resistor providing load decoupling.