CA3008, CA3010, CA3015, CA3016, CA3029, CA3030, CA3037, CA3038

Operational Amplifiers

6-VOLT TYPES	12-VOLT TYPES	PACKAGE
CA3008	CA3016	14-Lead Flat Pack
CA3010	CA3015	12-Lead TO-5 Style
CA3029	CA3015L	Beam-Lead Device
CA3037	CA3030	14-Lead Plastic Dual In-Line (TO-116)
	CA3038	14-Lead Ceramic Dual In-Line (TO-116)

HIGHLIGHTS

	6 V Types	12 V Types	
• Open-Loop Voltage Gain	60	70	dB typ.
• Common-Mode Rejection Ratio	94	103	dB typ.
• Output Impedance	200	92	Ω typ.
• Input Offset Voltage	1	1	mV typ.
• Static Power Drain at ± 12 V	-	175	mW typ.
± 6 V	30	30	mW typ.
± 3 V	7	7	mW typ.

- All types are electrically identical within their voltage groups
- The CA3105 is available in a sealed-junction Beam-Lead version (CA3015L). For further information see File No. 515, "Beam-Lead Devices for Hybrid Circuit Applications.
- Designed for use in Telemetry, Data-Processing, Instrumentation, and Communication Equipment
- Built-in temperature stability from -55°C to +125°C for flatpack, TO-5 style, and ceramic dual in-line packages; 0°C to +70°C for plastic dual in-line package
- Companion Application Notes ICAN-5290, "Integrated Circuit Operational Amplifiers"; ICAN-5213, "Application of the RCA-CA3015, CA3016 Integrated Circuit Operational Amplifiers"; and ICAN-5015, "Application of the RCA-CA3008, CA3010 Integrated Circuit Operational Amplifiers".

APPLICATIONS

- Narrow-Band and Band-pass Amplifier
- Operational Functions
- Feedback Amplifier
- DC and Video Amplifier
- Multivibrator
- Oscillator
- Comparator
- Servo Driver
- Scaling Adder
- Balanced Modulator-Driver

ABSOLUTE-MAXIMUM VOLTAGE AND CURRENT LIMITS, T_A = 25°C

Voltage or current limits shown for each terminal can be applied under the indicated voltage or other circuit conditions for other terminals

All voltages are with respect to ground (common terminal of Positive and Negative DC Supplies)

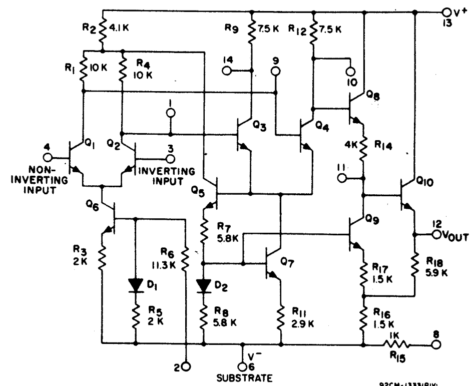
Terminal CA3010	Terminal CA3008 CA3029 CA3037	Voltage or Current Limits Negative	Voltage or Current Limits Positive	Circuit Conditions Terminal CA3010	Circuit Conditions Terminal CA3008 CA3029 CA3037	Circuit Conditions Voltage
12	1	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
1	2	-8 V	0 V	4 10	6 13	-8 +6
2	3	-4 V	+1 V	1 3 4 10	2 4 6 13	0 0 -6 +6
3	4	-4 V	+1 V	1 2 4 10	2 3 6 13	0 0 -6 +6
	5	NO CONNECTION				
4	6	-10 V	0 V	1 10	2 13	0 +6
	7	NO CONNECTION				
5	8	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
6	9	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
7	10	0 V	+7 V	1 4 10	2 6 13	0 -6 +6
8	11	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
9	12	30 mA		4 10	6 13	-6 +6
				200 Ω Between Terminals 6 & 12 (CA3008, CA3029, CA3037) 4 & 9 (CA3010)		
10	13	0 V	+10 V	1 4	2 6	0 -6
11	14	0 V	+7 V	1 4 10	2 6 13	0 -6 +6
CASE		Internally connected to Terminal No.4, CA3010 (Substrate) DO NOT GROUND				

Terminal CA3015	Terminal CA3016 CA3030 CA3038	Voltage or Current Limits Negative	Voltage or Current Limits Positive	Circuit Conditions Terminal CA3015	Circuit Conditions Terminal CA3016 CA3030 CA3038	Circuit Conditions Voltage
12	1	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
1	2	-16 V	0 V	4 10	6 13	-16 +12
2	3	-8 V	+1 V	1 3 4 10	2 4 6 13	0 0 -12 +12
3	4	-8 V	+1 V	1 2 4 10	2 3 6 13	0 0 -12 +12
	5	NO CONNECTION				
4	6	-20 V	0 V	1 10	2 13	0 +12
	7	NO CONNECTION				
5	8	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
6	9	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
7	10	0 V	+14 V	1 4 10	2 6 13	0 -12 +12
8	11	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
9	12	30 mA		4 10	6 13	-12 +12
				400 Ω Between Terminals 6 & 12 (CA3016, CA3030, CA3038) 4 & 9 (CA3015)		
10	13	0 V	+20 V	1 4	2 6	0 -12
11	14	0 V	+14 V	1 4 10	2 6 13	0 -12 +12
CASE		Internally connected to Terminal No.4, CA3015 (Substrate) DO NOT GROUND				

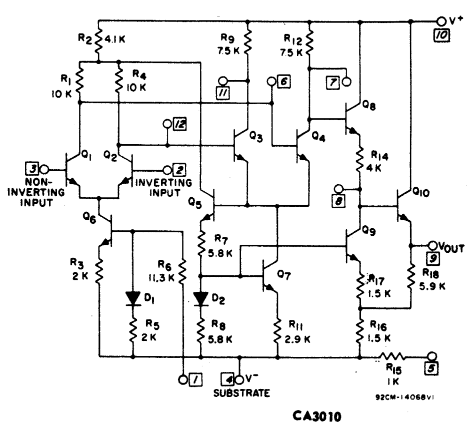
	CA3008 CA3016 CA3037 / CA3010 CA3015 CA3038	CA3029 CA3030
OPERATING TEMPERATURE RANGE	-55°C to +125°C	-40°C to +85°C
STORAGE TEMPERATURE RANGE	-65°C to +150°C	-65°C to +150°C

	CA3016 CA3030 / CA3015 CA3038	CA3008 CA3029 / CA3010 CA3037
MAXIMUM SIGNAL VOLTAGE	-8 V to +1 V	-4 V to +1 V
MAXIMUM DEVICE DISSIPATION	600 mW	300 mW

SCHEMATIC DIAGRAMS



CA3008 CA3016 CA3029 CA3030 CA3037 CA3038



CA3010 CA3015

Fig.1

CA3008, CA3010, CA3015, CA3016, CA3029, CA3030, CA3037, CA3038

ELECTRICAL CHARACTERISTICS at T_A = 25°C

Characteristics	Symbols	Special Test Conditions Terminal No.8 (CA3008, CA3016, CA3029, CA3030, CA3037, CA3038) Terminal No.5 (CA3010, CA3015) Not Connected Unless Otherwise Specified	Test Circuit Fig.	CA3008 CA3010 CA3029 CA3037 Min.	Typ.	Max.	CA3016 CA3015 CA3030 CA3038 Min.	Typ.	Max.	Units	Typical Characteristic Curves Fig.
STATIC CHARACTERISTICS:											
Input Offset Voltage	V_{IO}	V_{CC} = +6V, V_{EE} = -6V = +12V, = -12V	4	- -	1.08 -	5 -	- -	- 1.37	- 5	mV	2
Input Offset Current	I_{IO}	= +6V, = -6V = +12V, = -12V	5	- -	0.54 -	5 -	- -	- 1.07	- 5	μA	2
Input Bias Current	I_{IB}	= +6V, = -6V = +12V, = -12V	5	- -	5.3 -	12 -	- -	- 9.6	- 24	μA	3
Input Offset Voltage Sensitivity: Positive	$\Delta V_{IO}/\Delta V_{CC}$	= +6V, = -6V = +12V, = -12V	4	- -	0.10 -	1 -	- -	- 0.096	- 0.5	mV/V	none
Negative	$\Delta V_{IO}/\Delta V_{EE}$	= +6V, = -6V = +12V, = -12V	4	- -	0.26 -	1 -	- -	- 0.156	- 0.5	mV/V	none
Device Dissipation	P_D	= +6 V, = -6 V = +12V, = -12V	4	- -	30 -	- -	- -	- 175	- -	mW	none
		[5] shorted to [9] V_{CC} = +6V, V_{EE} = -6V 8 shorted to 12 V_{CC} = +12V, V_{EE} = -12V	4	- -	102 -	- -	- -	- 500	- -	mW	none
DYNAMIC CHARACTERISTICS: All tests at f = 1 kHz except BW_{OL}											
Open-Loop Differential Voltage Gain	A_{OL}	V_{CC} = +6V, V_{EE} = -6V = +12V, = -12V	8	57 -	60 -	- -	- 66	- 70	- -	dB	6 & 7
Open-Loop Bandwidth at -3 dB Point	BW_{OL}	= +6V, = -6V = +12V, = -12V	8	200 -	300 -	- -	- 200	- 320	- -	kHz	6 & 7
Common-Mode Rejection Ratio	CMRR	V_{CC} = +6V, V_{EE} = -6V = +12V, = -12V	11	70 -	94 -	- -	- 80	- 103	- -	dB	12
Maximum Output-Voltage Swing	$V_{O(P-P)}$	= +6V, = -6V = +12V, = -12V	8	4 -	6.75 -	- -	- 12	- 14	- -	V_{P-P}	9 & 10
Input Impedance	Z_{IN}	= +6V, = -6V = +12V, = -12V	14	10 -	14 -	- -	- 5	- 7.8	- -	kΩ	13
Output Impedance	Z_{OUT}	= +6V, = -6V = +12V, = -12V	15	- -	200 -	- -	- -	- 92	- -	Ω	15
Common-Mode Input-Voltage Range	V_{ICR}	= +6V, = -6V = +12V, = -12V	11	0.5 to -4 -	- -	- -	- 0.65 to -8	- -	- -	V	none

LEAD TEMPERATURE (During Soldering):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10 seconds max. .... +265°C

TYPICAL STATIC CHARACTERISTICS AND TEST CIRCUITS

INPUT OFFSET VOLTAGE AND CURRENT

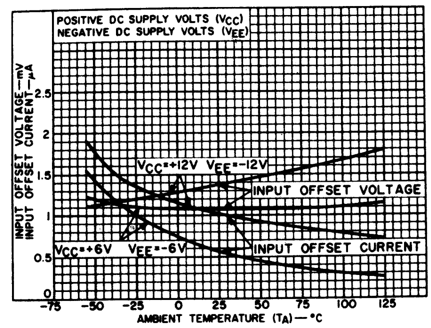


Fig.2

INPUT BIAS CURRENT

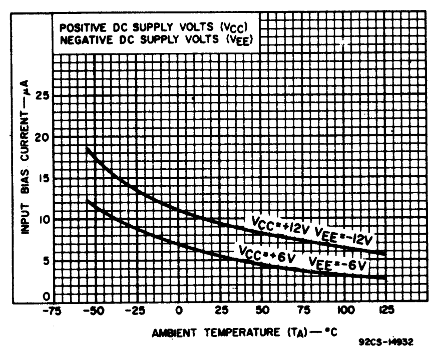


Fig.3

Terminal Numbers in Circles are for CA3008, CA3016, CA3029, CA3030, CA3037, CA3038;
Italic Numbers in Square Boxes are for CA3010, CA3015

INPUT OFFSET VOLTAGE, INPUT OFFSET VOLTAGE SENSITIVITY, AND DEVICE DISSIPATION TEST CIRCUIT

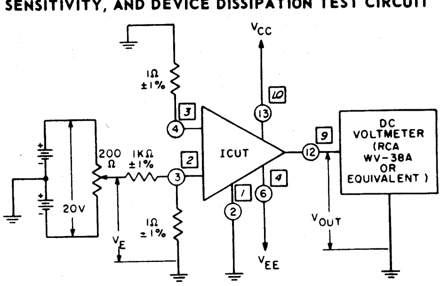


Fig.4

Procedure:

Input Offset Voltage

1. Adjust V_E for a DC Output Voltage (V_{OUT}) of 0 ± 0.1 volts.
2. Measure V_E and record Input Offset Voltage in millivolts as V_E/1000.

Input Offset Voltage Sensitivity

1. Adjust V_E for a DC Output Voltage (V_{OUT}) of 0 ± 0.1 volts.
2. Increase $|V_{CC}|$ by 1 volt and record output voltage (V_{OUT}).
3. Decrease $|V_{CC}|$ by 1 volt and record output voltage (V_{OUT}).
4. Divide the difference between V_{OUT} measured in steps 2 and 3 by the change in V_{CC} in steps 2 and 3.

$$\frac{V_{OUT}}{V_{CC}} = \frac{V_{OUT}\text{ (Step 2)} - V_{OUT}\text{ (Step 3)}}{2\text{ volts}}$$

5. Refer the reading to the input by dividing by Open Loop Voltage Gain (A_{OL}).

$$V_{IO}/V_{CC} = \frac{V_{OUT}/V_{CC}}{A_{OL}}$$

6. Repeat procedures 1 through 5 for the Negative Supply (V_{EE}).
7. Device Dissipation

$P_T = V_{CC}I_C + V_{EE}I_E$
I_C = Direct Current into Terminal (13) or [10]
I_E = Direct Current out of Terminal (6) or [4]

INPUT OFFSET CURRENT AND INPUT BIAS CURRENT TEST CIRCUIT

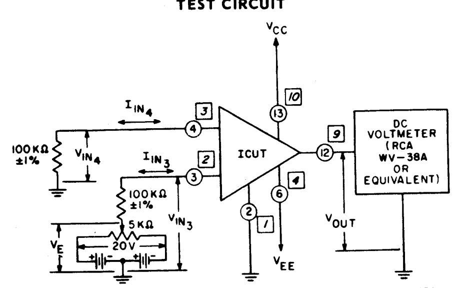


Fig.5

Procedure:

Input Bias Current and Input Offset Current

1. Adjust V_E for $|V_{OUT}|$ < 0.1 V DC.
2. Measure and record V_E and V_{IN_4}.
3. Calculate the Input Bias Current using the following equation:

$$I_{I4} = \frac{V_{IN_4}}{100\ k\Omega}$$

4. Calculate the Input Offset Current using the following equation:

$$I_{IO} = V_E/100\ k\Omega$$

CA3008, CA3010, CA3015, CA3016, CA3029, CA3030, CA3037, CA3038

TYPICAL DYNAMIC CHARACTERISTICS AND TEST CIRCUITS

Terminal Numbers in Circles are for CA3008, CA3016, CA3029, CA3030, CA3037, CA3038; Italic Numbers in Square Boxes are for CA3010, CA3015

OPEN-LOOP VOLTAGE GAIN vs. FREQUENCY FOR CA3008, CA3010, CA3015, CA3016, CA3037, CA3038

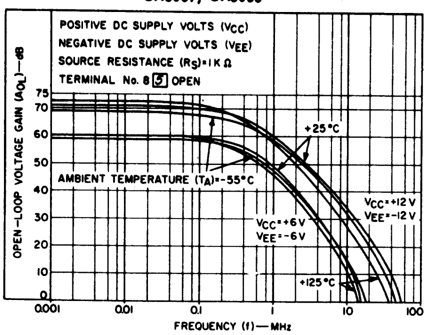


Fig.6

OPEN-LOOP VOLTAGE GAIN vs. FREQUENCY FOR CA3029 AND CA3030

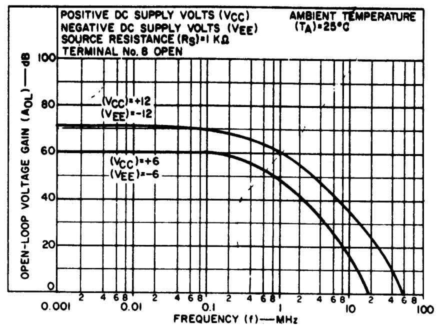
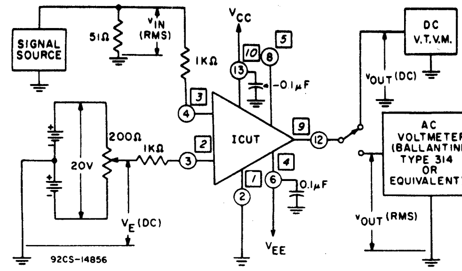


Fig.7

OPEN-LOOP DIFFERENTIAL VOLTAGE GAIN, MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE, AND OPEN-LOOP BANDWIDTH AT −3 dB POINT TEST CIRCUIT



Procedure:

1. Adjust V_E for V_{OUT} = ±0.1 V DC.
2. Measure Open-Loop Differential Voltage Gain (A_{OL}) at f = 1 kHz.

$$A_{OL} = 20 \, Log_{10} \frac{V_{OUT}}{V_{IN}}$$

3. Measure Maximum Peak-to-Peak Output Voltage at f = 1 kHz.
4. Measure Open-Loop Bandwidth at -3 dB Point.

Reference Level = A_{OL} at 1 kHz.

Fig.8

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs. LOAD RESISTANCE FOR CA3008, CA3010, CA3015, CA3016, CA3037, CA3038

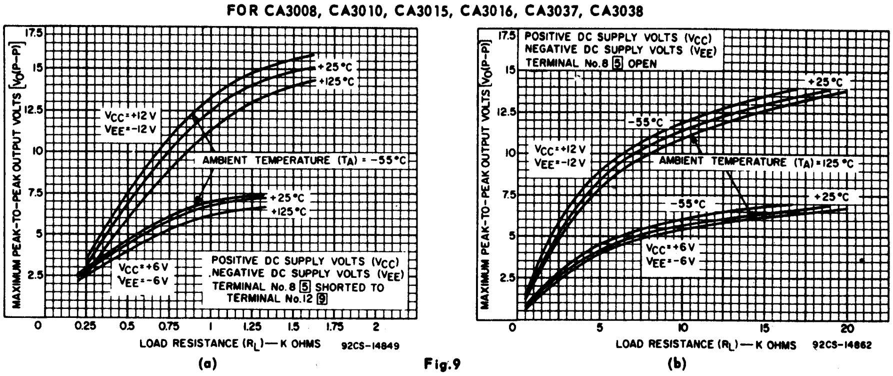
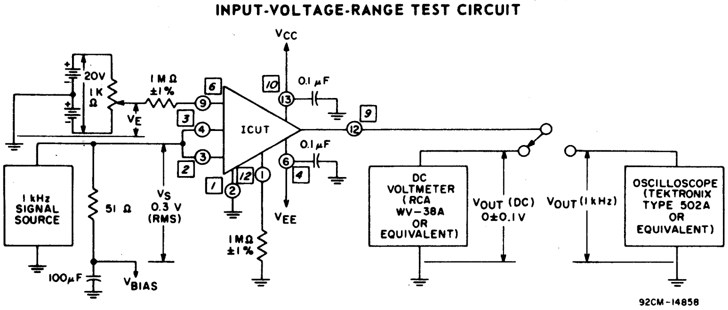


Fig.9

Terminal Numbers in Circles are for CA3008, CA3016, CA3029, CA3030, CA3037, CA3038; Italic Numbers in Square Boxes are for CA3010, CA3015

COMMON-MODE REJECTION RATIO AND COMMON-MODE INPUT-VOLTAGE-RANGE TEST CIRCUIT



Procedures:

Common-Mode Rejection Ratio:

1. Set V_{BIAS} = 0. Adjust V_E for $V_{OUT}(DC)$ = 0 ± 0.1 V.
2. Apply 1-kHz sinusodial input signal and adjust for V_S = 0.3 V (RMS).
3. Measure and record the RMS value of V_{OUT}. An oscilloscope is used for this measurement so that the output signal may be visually separated from noise output.
4. Calculate Common-Mode Voltage Gain:

$$A_{CM} = V_{OUT}/V_S$$

$$A_{CM} \text{ in dB} = -20 \, LOG_{10} \, V_S/V_{OUT}$$

5. Calculate Common-Mode Rejection Ratio:

$$\text{CMR in dB} = A_{DIFF} \text{ in dB} - A_{CM} \text{ in dB.}$$

Common-Mode Input-Voltage Range:

1. Calculate and record CMR for various positive and negative values of V_{BIAS} within the maximum limits shown on Page 2. The Common-Mode Input-Voltage Range limits are those values of V_{BIAS} at which CMR is 6 dB less than that calculated in Step 5 of the procedure given above.

Fig.11

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs. LOAD RESISTANCE FOR CA3029 AND CA3030

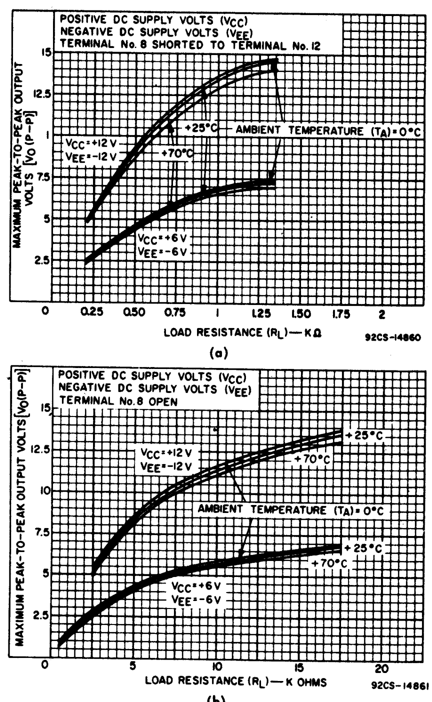


Fig.10

COMMON-MODE REJECTION RATIO vs. FREQUENCY

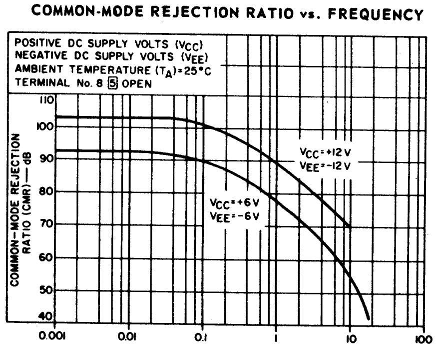


Fig.12

CA3008, CA3010, CA3015, CA3016, CA3029, CA3030, CA3037, CA3038

TYPICAL DYNAMIC CHARACTERISTICS AND TEST CIRCUITS

Terminal Numbers in Circles are for CA3008, CA3016, CA3029, CA3030, CA3037, CA3038; Italic Numbers in Square Boxes are for CA3010, CA3015

SINGLE-ENDED INPUT IMPEDANCE vs. TEMPERATURE

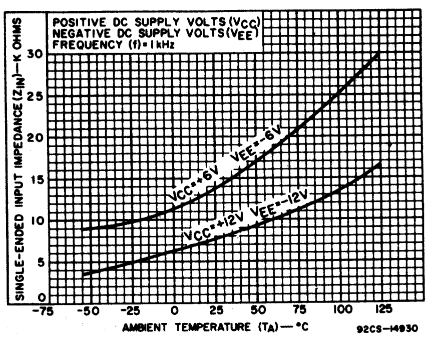


Fig.13

SINGLE-ENDED INPUT IMPEDANCE TEST CIRCUIT

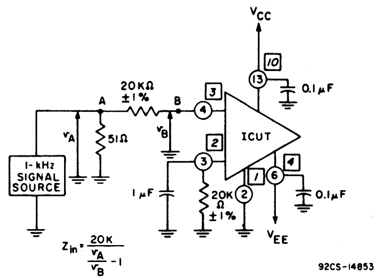


Fig.14

OUTPUT IMPEDANCE vs. TEMPERATURE

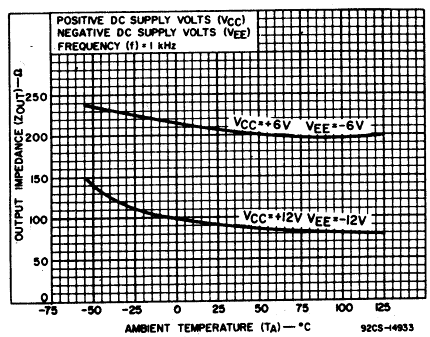


Fig.15

OUTPUT IMPEDANCE TEST CIRCUIT

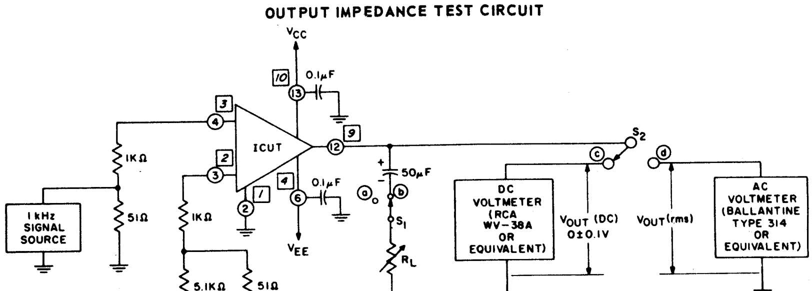


Fig.16

Procedure:

1. With S_2 in position (c), adjust V_E for $V_{OUT}(DC) = 0 \pm 0.1$ volt.
2. With S_1 in position (a), and S_2 in position (d), record $V_{OUT_1}(rms)$.
3. With Switch S_1 in position (b), and S_2 in position (d), adjust R_L until

$$V_{OUT_2}(rms) = \frac{V_{OUT_1}(rms)}{2}.$$ Record value of R_L as Z_{OUT}.

CA3008A, CA3010A, CA3015A, CA3016A, CA3029A, CA3030A, CA3037A,CA3038A

Operational Amplifiers

6-VOLT TYPES	12-VOLT TYPES	PACKAGE
CA3008A	CA3016A	14-Lead Flat Pack
CA3010A	CA3015A	12-Lead TO-5 Style
CA3029A	CA3030A	14-Lead Plastic Dual In-Line (TO-116)
CA3037A	CA3038A	14-Lead Ceramic Dual In-Line (TO-116)

- These new types have all the desirable features and characteristics of their prototypes plus lower noise figures and improved input characteristics for offset voltage, offset current, bias current, and impedance.
- All types are electrically identical within their voltage groups
- Designed for use in Telemetry, Data-Processing, Instrumentation, and Communication Equipment
- Built-in temperature stability from -55°C to +125°C for Flatpack, TO-5 style, and ceramic dual in-line packages; 0°C to +70°C for plastic dual in-line package
- Companion Application Notes ICAN-5290, "Integrated Circuit Operational Amplifiers"; ICAN-5213, "Application of the RCA-CA3015, CA3016 Integrated Circuit Operational Amplifiers"; and ICAN-5015, "Application of the RCA-CA3008, CA3010 Integrated Circuit Operational Amplifiers" cover Bode characteristics, phase compensation, frequency shaping, and amplifier design.

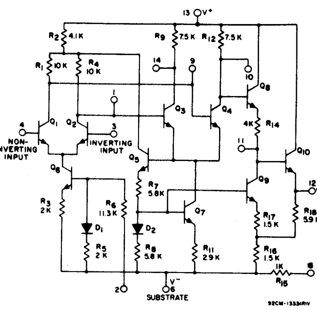
HIGHLIGHTS

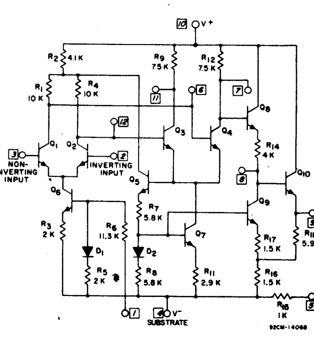
	6 V Types	12 V Types	
• Open-Loop Voltage Gain	60	70	dB typ.
• Common-Mode Rejection Ratio	94	103	dB typ.
• Input Impedance	20	10	k typ.
• Input Offset Voltage	0.9	1	mV typ.
• Input Offset Current	0.3	0.5	A typ.
• Input Bias Current	2.5	4.7	A typ.
• Static Power Drain at 12 V	-	175	mW typ.
at 6 V	30	30	mW typ.
at 3 V	7	7	mW typ.

APPLICATIONS

- Narrow-Band and Band-pass Amplifier
- Operational Functions
- Feedback Amplifier
- DC and Video Amplifier
- Multivibrator
- Oscillator
- Comparator
- Servo Driver
- Scaling Adder
- Balanced Modulator-Driver

CA3008A
CA3016A
CA3029A
CA3030A
CA3037A
CA3038A





CA3010A
CA3015A

Fig.1

SCHEMATIC DIAGRAMS

ELECTRICAL CHARACTERISTICS at T_A = 25°C

Characteristics	Symbols	Special Test Conditions Terminal No.8 (CA3008A, CA3016A, CA3029A, CA3030A, CA3037A, CA3038A), Terminal No.5 (CA3010A, CA3015A) Not Connected Unless Otherwise Specified	Test Circuit	CA3008A CA3010A CA3029A CA3037A			CA3016A CA3015A CA3030A CA3038A			Units	Typical Characteristic Curves
			Fig.	Min.	Typ.	Max.	Min.	Typ.	Max.		Fig.
STATIC CHARACTERISTICS:											
Input Offset Voltage	V_{IO}	V_{CC} = +6V, V_{EE} = -6V = +12V = -12V	4	- -	0.9 -	2 -	- -	- 1	- 2	mV	2
Input Offset Current	I_{IO}	= +6V = -6V = +12V = -12V	5	- -	0.3 -	1.5 -	- -	- 0.5	- 1.6	µA	2
Input Bias Current	I_{IB}	= +6V = -6V = +12V = -12V	5	- -	2.5 -	4 -	- -	- 4.7	- 6	µA	3
Input Offset Voltage Sensitivity: Positive Negative	$\Delta V_{IO}/\Delta V_{CC}$ $\Delta V_{IO}/\Delta V_{EE}$	= +6V = -6V = +12V = -12V = +6V = -6V = +12V = -12V	4	- - - -	0.10 - 0.26 -	1 - 1 -	- - - -	- 0.096 - 0.156	- 0.5 - 0.5	mV/V	none
Device Dissipation	P_D	= +6 V = -6 V = +12V = -12V 5 shorted to 9 V_{CC} = +6V, V_{EE} = -6V 8 shorted to 12 V_{CC} = +12V, V_{EE} = -12V	4	- - - -	40 - 102 -	- - - -	- - - -	- 175 - 500	- - - -	mW	none
DYNAMIC CHARACTERISTICS: All tests at f = 1 kHz except BW_{OL}											
Open-Loop Differential Voltage Gain	A_{OL}	V_{CC} = +6V, V_{EE} = -6V = +12V = -12V	8	57 -	60 -	- -	- 66	- 70	- -	dB	6 & 7
Open-Loop Bandwidth at -3 dB Point	BW_{OL}	= +6V = -6V = +12V = -12V	8	200 -	300 -	- -	- 200	- 320	- -	kHz	6 & 7
Slew Rate	SR	V_{CC} = +6V V_{EE} = -6V = +12V = -12V; R_S = 1 kΩ	none	- -	3 -	- -	- -	- 7	- -	V/µs	none
Common-Mode Rejection Ratio	CMR	V_{CC} = +6V, V_{EE} = -6V = +12V = -12V	11	70 -	94 -	- -	- 80	- 103	- -	dB	12
Maximum Output-Voltage Swing	$V_{O(P-P)}$	= +6V = -6V = +12V = -12V	8	4 -	6.75 -	- -	- 12	- 14	- -	V_{P-P}	9 & 10
Input Impedance	Z_{IN}	= +6V = -6V = +12V = -12V	14	15 -	20 -	- -	- 7.5	- 10	- -	kΩ	13
Output Impedance	Z_{OUT}	= +6V = -6V = +12V = -12V	15	- -	160 -	- -	- -	- 85	- -	Ω	16
Common-Mode Input-Voltage Range	V_{ICR}	= +6V = -6V = +12V = -12V	11	+0.5 -4 -	- -	- -	- +0.65 -8	- -	- -	V	none
Noise Figure	NF	V_{CC} = +3V, V_{EE} = -3V = +6V = -6V = +9V = -9V = +12V = -12V; R_S = 1 kΩ	18	- - - -	6.3 8.3 - -	9 12 - -	- - - -	6.3 8.3 10 11	9 12 14 16	dB	17

LEAD TEMPERATURE (During Soldering): ALL TYPES
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10 seconds max. .... +265°C

CA3008A, CA3010A, CA3015A, CA3016A, CA3029A, CA3030A, CA3037A, CA3038A

ABSOLUTE-MAXIMUM VOLTAGE AND CURRENT LIMITS, T_A = 25°C

Voltage or current limits shown for each terminal can be applied under the indicated voltage or other circuit conditions for other terminals

All voltages are with respect to ground (common terminal of Positive and Negative DC Supplies)

Terminal CA3010A	Terminal CA3008A CA3029A CA3037A	Voltage or Current Limits: Negative	Voltage or Current Limits: Positive	Circuit Conditions: Terminal CA3010A	Circuit Conditions: Terminal CA3008A CA3029A CA3037A	Circuit Conditions: Voltage
12	1	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
1	2	-8 V	0 V	4 10	6 13	-8 +6
2	3	-4 V	+1 V	1 3 4 10	2 4 6 13	0 0 -6 +6
3	4	-4 V	+1 V	1 2 4 10	2 3 6 13	0 0 -6 +6
-	5	NO CONNECTION				
4	6	-10 V	0 V	1 10	2 13	0 +6
-	7	NO CONNECTION				
5	8	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
6	9	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
7	10	0 V	+7 V	1 4 10	2 6 13	0 -6 +6
8	11	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
9	12	30 mA		4 10 200 Ω Between Terminals 6 & 12 (CA3008A, CA3029A, CA3037A) 4 & 9 (CA3010A)	6 13	-6 +6
10	13	0 V	+10 V	1 4	2 6	0 -6
11	14	0 V	+7 V	1 4 10	2 6 13	0 -6 +6
CASE		Internally connected to Terminal No.4, CA3010A (Substrate) DO NOT GROUND				

Terminal CA3015A	Terminal CA3016A CA3030A CA3038A	Voltage or Current Limits: Negative	Voltage or Current Limits: Positive	Circuit Conditions: Terminal CA3015A	Circuit Conditions: Terminal CA3016A CA3030A CA3038A	Circuit Conditions: Voltage
12	1	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
1	2	-16 V	0 V	4 10	6 13	-16 +12
2	3	-8 V	+1 V	1 3 4 10	2 4 6 13	0 0 -12 +12
3	4	-8 V	+1 V	1 2 4 10	2 3 6 13	0 0 -12 +12
-	5	NO CONNECTION				
4	6	-20 V	0 V	1 10	2 13	0 +12
-	7	NO CONNECTION				
5	8	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
6	9	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
7	10	0 V	+14 V	1 4 10	2 6 13	0 -12 +12
8	11	DO NOT APPLY VOLTAGE FROM AN EXTERNAL SOURCE TO THIS TERMINAL				
9	12	30 mA		4 10 400 Ω Between Terminals 6 & 12 (CA3016A, CA3030A, CA3038A) 4 & 9 (CA3015A)	6 13	-12 +12
10	13	0 V	+20 V	1 4	2 6	0 -12
11	14	0 V	+14 V	1 4 10	2 6 13	0 -12 +12
CASE		Internally connected to Terminal No.4, CA3015A (Substrate) DO NOT GROUND				

	CA3008A CA3010A CA3016A CA3015A CA3037A CA3038A	CA3029A CA3030A
OPERATING TEMPERATURE RANGE	-55°C to +125°C	-40°C to +80°C
STORAGE TEMPERATURE RANGE	-65°C to +200°C	-65°C to +150°C

	CA3016A CA3015A CA3030A CA3038A	CA3008A CA3010A CA3029A CA3037A
MAXIMUM SIGNAL VOLTAGE	-8 V to +1 V	-4 V to +1 V
MAXIMUM DEVICE DISSIPATION	600 mW	300 mW

INPUT OFFSET CURRENT AND INPUT BIAS CURRENT TEST CIRCUIT

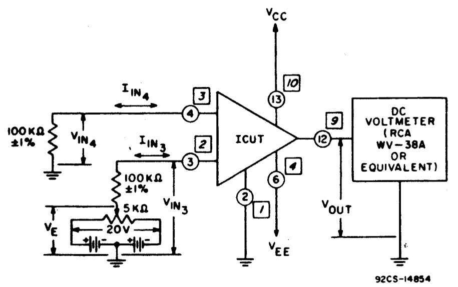


Fig.5

Procedure:

Input Bias Current and Input Offset Current

1. Adjust V_E for $|V_{OUT}| < 0.1$ V DC.
2. Measure and record V_E and V_{IN_4}
3. Calculate the Input Bias Current using the following equation:

$$I_{I4} = \frac{V_{IN_4}}{100\ k\Omega}$$

4. Calculate the Input Offset Current using the following equation:

$$I_{IO} = V_E/100\ k\Omega$$

TYPICAL STATIC CHARACTERISTICS AND TEST CIRCUITS

Terminal Numbers in Circles are for CA3008A, CA3016A, CA3029A, CA3030A, CA3037A, CA3038A;

Italic Numbers in Square Boxes are for CA3010A, CA3015A

INPUT OFFSET VOLTAGE AND CURRENT

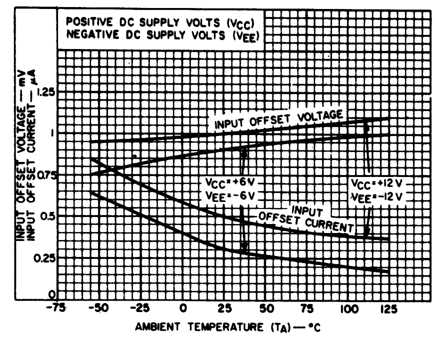


Fig.2

INPUT BIAS CURRENT

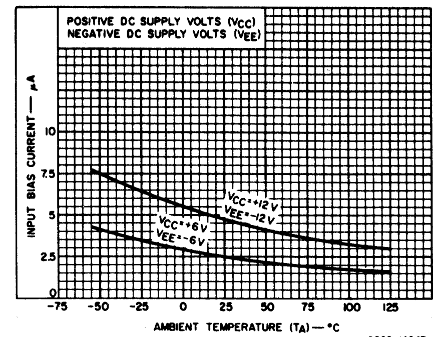


Fig.3

INPUT OFFSET VOLTAGE, INPUT OFFSET VOLTAGE SENSITIVITY, AND DEVICE DISSIPATION TEST CIRCUIT

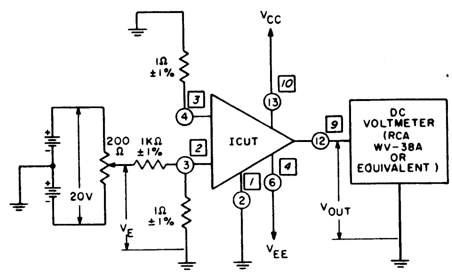


Fig.4

Procedure:

Input Offset Voltage

1. Adjust V_E for a DC Output Voltage (V_{OUT}) of 0 ± 0.1 volts.
2. Measure V_E and record Input Offset Voltage in millivolts as V_E/1000.

Input Offset Voltage Sensitivity

1. Adjust V_E for a DC Output Voltage (V_{OUT}) of 0 ± 0.1 volts.
2. Increase $|V_{CC}|$ by 1 volt and record output voltage (V_{OUT}).
3. Decrease $|V_{CC}|$ by 1 volt and record output voltage (V_{OUT}).
4. Divide the difference between V_{OUT} measured in steps 2 and 3 by the change in V_{CC} in steps 2 and 3.

$$\frac{V_{OUT}}{V_{CC}} = \frac{V_{OUT}\ (\text{Step 2}) - V_{OUT}\ (\text{Step 3})}{2\ \text{volts}}$$

5. Refer the reading to the input by dividing by Open Loop Voltage Gain (A_{OL}).

$$V_{IO}/V_{CC} = \frac{V_{OUT}/V_{CC}}{A_{OL}}$$

6. Repeat procedures 1 through 5 for the Negative Supply (V_{EE}).
7. Device Dissipation

$P_T = V_{CC}I_C + V_{EE}I_E$

I_C = Direct Current into Terminal 13 or [10]

I_E = Direct Current out of Terminal 6 or [4]

CA3008A, CA3010A, CA3015A, CA3016A, CA3029A, CA3030A, CA3037A, CA3038A

OPEN LOOP VOLTAGE GAIN vs. FREQUENCY FOR CA3008A, CA3010A, CA3015A, CA3016A, CA3037A, CA3038A

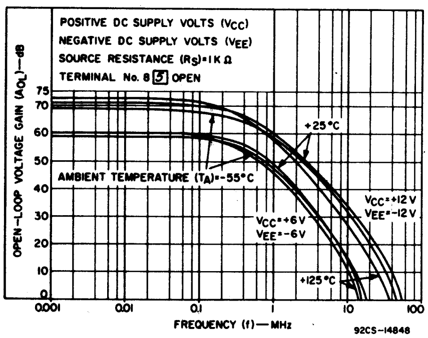


Fig.6

OPEN LOOP VOLTAGE GAIN vs. FREQUENCY FOR CA3029A AND CA3030A.

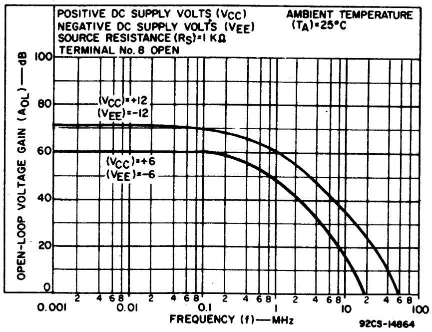
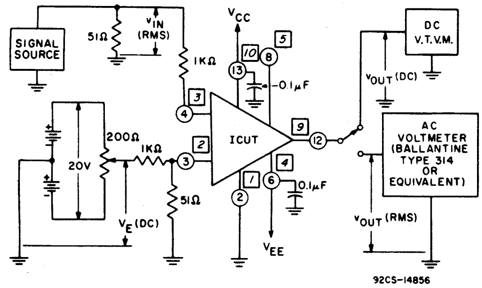


Fig.7

OPEN-LOOP DIFFERENTIAL VOLTAGE GAIN, MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE, AND OPEN-LOOP BAND WIDTH AT −3 POINT TEST CIRCUIT



Procedure:

1. Adjust V_E for V_{OUT} = ±0.1 V DC.
2. Measure Open-Loop Differential Voltage Gain (A_{OL}) at f = 1 kHz

$$A_{OL} = 20\ \text{Log}_{10} \frac{V_{OUT}}{V_{IN}}$$

3. Measure Maximum Peak-to-Peak Output Voltage at f = 1 kHz
4. Measure Open-Loop Bandwidth at -3 dB Point

Reference Level = A_{OL} at 1 kHz

Fig.8

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs. LOAD RESISTANCE FOR CA3008A, CA3010A, CA3015A, CA3016A, CA3037A, CA3038A

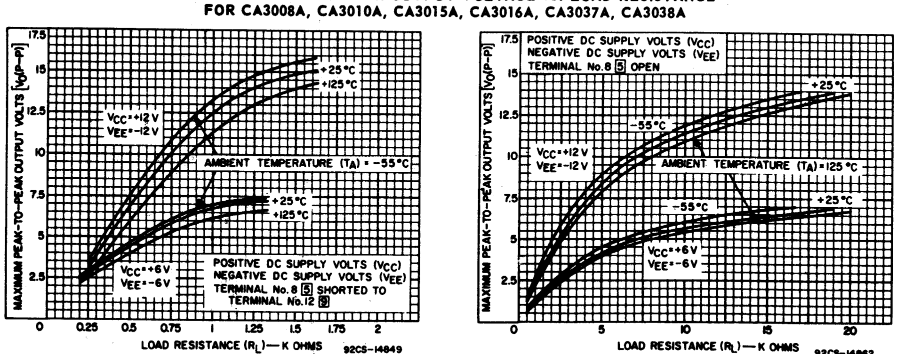


Fig.9

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs. LOAD RESISTANCE FOR CA3029A AND CA3030A

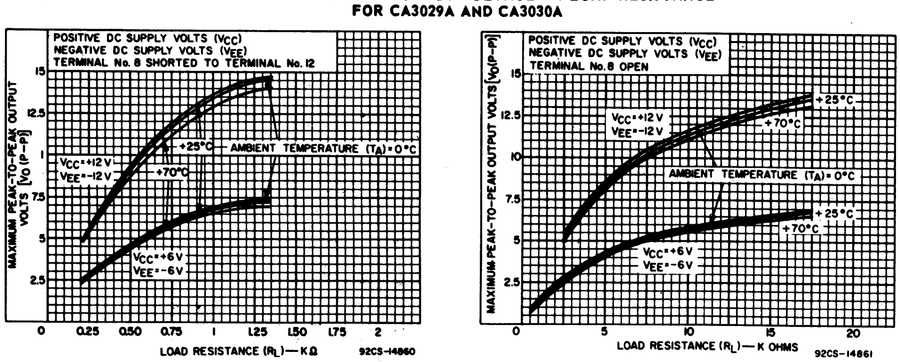


Fig.10

COMMON-MODE REJECTION RATIO AND COMMON-MODE INPUT-VOLTAGE-RANGE TEST CIRCUIT

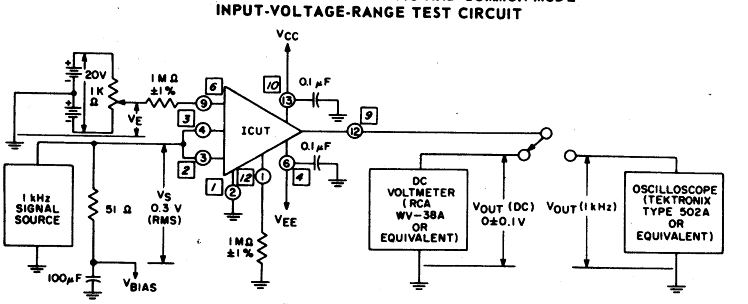


Fig.11

Procedures:

Common-Mode Rejection Ratio:

1. Set V_{BIAS} = 0. Adjust V_E for $V_{OUT(DC)}$ = 0 ± 0.1 V.
2. Apply 1-kHz sinusodial input signal and adjust for V_S = 0.3 V (RMS).
3. Measure and record the RMS value of V_{OUT}. An oscilloscope is used for this measurement so that the output signal may be visually separated from noise output.
4. Calculate Common-Mode Voltage Gain:

$$A_{CM} = V_{OUT}/V_S$$

$$A_{CM} \text{ in dB} = -20\ \text{LOG}_{10}\ V_S/V_{OUT}$$

5. Calculate Common-Mode Rejection Ratio:

CMR in dB = A_{DIFF} in dB - A_{CM} in dB.

Common-Mode Input-Voltage Range:

1. Calculate and record CMR for various positive and negative values of V_{BIAS} within the maximum limits shown on Page 2. The Common-Mode Input-Voltage Range limits are those values of V_{BIAS} at which CMR is 6 dB less than that calculated in Step 5 of the procedure given above.

CA3008A, CA3010A, CA3015A, CA3016A, CA3029A, CA3030A, CA3037A, CA3038A

COMMON-MODE REJECTION RATIO vs. FREQUENCY

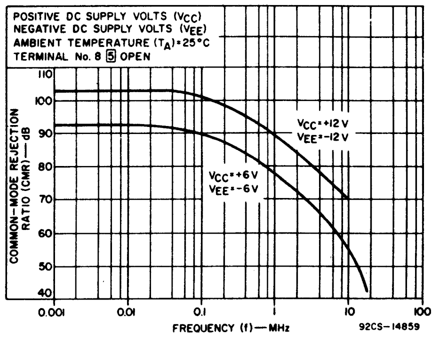


Fig.12

SINGLE-ENDED INPUT IMPEDANCE vs. TEMPERATURE

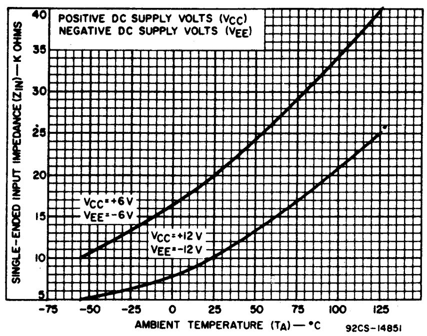


Fig.13

SINGLE-ENDED INPUT IMPEDANCE TEST CIRCUIT

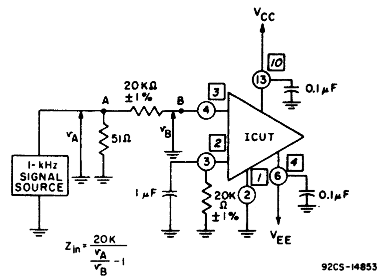


Fig.14

OUTPUT IMPEDANCE TEST CIRCUIT

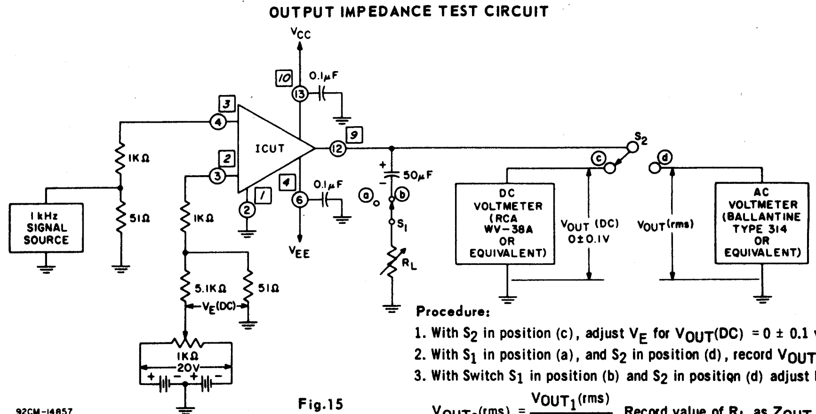
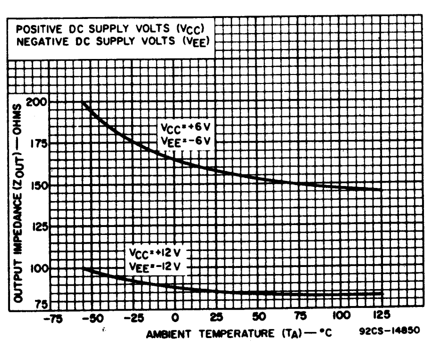


Fig.15

Procedure:

1. With S_2 in position (c), adjust V_E for $V_{OUT}(DC) = 0 \pm 0.1$ volt.
2. With S_1 in position (a), and S_2 in position (d), record V_{OUT_1}(rms).
3. With Switch S_1 in position (b) and S_2 in position (d) adjust R_L until $V_{OUT_2}(rms) = \frac{V_{OUT_1}(rms)}{2}$. Record value of R_L as Z_{OUT}.



OUTPUT IMPEDANCE vs. TEMPERATURE

Fig.16

NOISE FIGURE vs. FREQUENCY

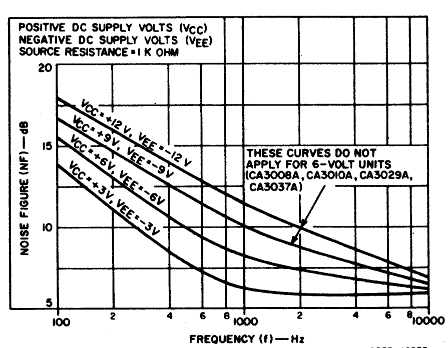


Fig.17