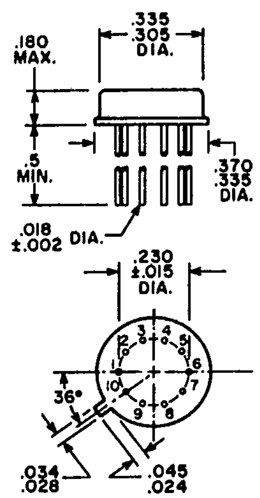
ECG semiconductors

ECG900

DC AMPLIFIER

DIMENSIONAL OUTLINE FOR ECG900



- Designed for use in Communication, Telemetry, Instrumentation, and Data-Processing Equipment
- Balanced differential-amplifier configuration with controlled constant-current source to provide outstanding versatility
- Built-in temperature stability for operation from −55°C to +125°C

HIGHLIGHTS

- Input Impedance . . . . 195 KΩ typ.
- Voltage Gain. . . . . 37 dB typ.
- Common-Mode Rejection Ratio . . . 98 dB typ.
- Input Offset Voltage. . . . . . . 1.4 mV typ.
- Push-Pull Input and Output
- Frequency Capability DC to 30 Mc/s (with external C and R)
- Wide AGC Range. . . . . 90 dB typ.

APPLICATIONS

- Schmitt Trigger
- RC-Coupled Feedback Amplifier
- Mixer
- Comparator
- Modulator
- Crystal Oscillator
- Sense Amplifier

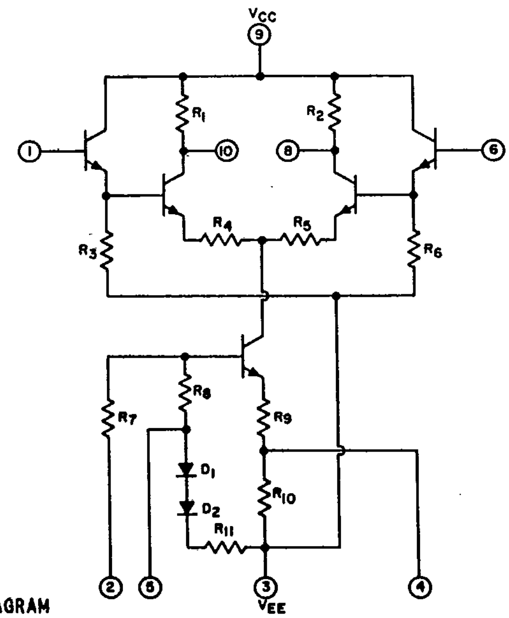


Fig.1
SCHEMATIC DIAGRAM

ABSOLUTE-MAXIMUM VOLTAGE LIMITS, at T_{FA} = 25°C

Indicated voltage limits for each terminal can be used under specified voltage conditions for other terminals

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

TERMINAL	VOLTAGE LIMITS NEGATIVE	VOLTAGE LIMITS POSITIVE	CONDITIONS TERMINAL	CONDITIONS VOLTAGE
1	-2	+2	2 3 6 9	0 -6 0 +6
2	-8	0	1 3 6 9	0 -8 0 +6
3	-10	0	1 2 6 9	0 0 0 +6
4	-8	0	1 2 6 9	0 0 0 +6
5	-6	0	1 2 3 6 9	0 0 -6 0 +6

TERMINAL	VOLTAGE LIMITS NEGATIVE	VOLTAGE LIMITS POSITIVE	CONDITIONS TERMINAL	CONDITIONS VOLTAGE
6	-2	+2	1 2 3 9	0 0 -6 +6
7	NO CONNECTION			
8	0	+6	1 2 3 6	0 0 -6 0
9	0	+10	1 2 3 6	0 0 -6 0
10	0	+6	1 2 3 6	0 0 -6 0
CASE	Internally Connected to Terminal No.3 (Substrate) DO NOT GROUND			

OPERATING-TEMPERATURE RANGE .... -55°C to +125°C
STORAGE-TEMPERATURE RANGE .... -65°C to +200°C
MAXIMUM SINGLE-ENDED INPUT-SIGNAL VOLTAGE ±2 V
MAXIMUM COMMON-MODE INPUT-SIGNAL VOLTAGE. ±2 V
MAXIMUM DEVICE DISSIPATION .... 300 mW

ELECTRICAL CHARACTERISTICS,

at T_{FA} = 25°C, V_{CC} = +6V, V_{EE} = -6V, unless otherwise specified

CHARACTERISTICS	SYMBOLS	SPECIAL TEST CONDITIONS Terminals No.4 & No.5 Not Connected Unless Specified		TEST CIRCUITS	LIMITS TYPE ECG900				TYPICAL CHARACTERISTICS CURVES
				Fig.	Min.	Typ.	Max.	Units	Fig.
STATIC CHARACTERISTICS									
Input Offset Voltage	V_{IO}			4	-	1.4	8	mV	2
Input Offset Current	I_{IO}			5	-	1.2	10	µA	2
Input Bias Current	I_I			5	-	23	36	µA	3
Quiescent Operating Voltage	V_8 or V_{10}	TERMINALS 4	TERMINALS 5						
		NC	NC	7	-	2.6	-	V	6
		NC	VEE	7	-	4.2	-	V	6
		VEE	NC	7	-	-1.5	-	V	6
		VEE	VEE	7	-	0.6	-	V	6
Device Dissipation	P_T	NC	NC	7	-	30	-	mW	NONE

ELECTRICAL CHARACTERISTICS, at T_{FA} = 25°C, V_{CC} = +6V, V_{EE} = -6V, unless otherwise specified

DYNAMIC CHARACTERISTICS								
Differential Voltage Gain Single-Ended Input	ADIFF	Single-Ended Output f = 1 kc/s	9	28	32	-	dB	8
		Double-Ended Output f = 1 kc/s	9	-	37	-	dB	8
Bandwidth at -3 dB Point	BW		11	-	650	-	kc/s	10
Maximum Output Voltage Swing	VOUT(P-P)	f = 1 kc/s	9	-	6.4	-	V(P-P)	NONE
Common-Mode Rejection Ratio	CMR	f = 1 kc/s	13	80	98	-	dB	12
Single-Ended Input Impedance	ZIN	f = 1 kc/s	15	70K	195K	-	Ω	14
Single-Ended Output Impedance	ZOUT	f = 1 kc/s	17	5.5K	8K	10.5K	Ω	16
Total Harmonic Distortion	THD	f = 1 kc/s	19	-	0.2	5	%	18
AGC Range (Maximum Voltage Gain to Complete Cutoff)	AGC	f = 1 kc/s	20	80	90	-	dB	NONE

DEFINITIONS OF TERMS FOR ECG900

Total Harmonic Distortion

The ratio of the total rms voltage of all harmonics to the rms voltage of the Fundamental, expressed in per cent. This voltage is measured at either output terminal with respect to ground.

Input Offset Voltage

The difference in the dc voltages which must be applied to the input terminals to obtain equal quiescent operating voltages (zero output offset voltage) at the output terminals.

Input Offset Current

The difference in the currents at the two input terminals.

Input Bias Current

The average value (one-half the sum) of the currents at the two input terminals.

Quiescent Operating Voltage

The dc voltage at either output terminal, with respect to ground.

DC Device Dissipation

The total power drain of the device with no signal applied and no external load current.

Common-Mode Voltage Gain

The ratio of the signal voltages developed between the two output terminals to the signal voltage applied to the two input terminals connected in parallel for ac.

Differential Voltage Gain — Single-Ended Input/Output

The ratio of the change in output voltage at either output terminal with respect to ground, to a change in input voltage at either input terminal with respect to ground.

Common-Mode Rejection Ratio

The ratio of the full differential voltage gain to the common-mode voltage gain.

AGC Range

The total change in voltage gain (from maximum gain to complete cutoff) which may be achieved by application of the specified range of dc voltage to the AGC input terminal of the device.

Bandwidth at -3-dB Point (BW)

The frequency at which the voltage gain of the device is 3 dB below the voltage gain at a specifed lower frequency.

Maximum Output Voltage VOUT(P-P)

The maximum peak-to-peak output-voltage swing, measured with respect to ground, which can be achieved without clipping of the signal waveform.

Single-Ended Input Impedance (ZIN)

The ratio of the change in input voltage to the change in input current measured at either input terminal with respect to ground.

Single-Ended Output Impedance (ZOUT)

The ratio of the change in output voltage to the change in output current measured at either output terminal with respect to ground.

STATIC CHARACTERISTICS AND TEST CIRCUITS FOR TYPE ECG900

INPUT OFFSET VOLTAGE AND CURRENT vs TEMPERATURE

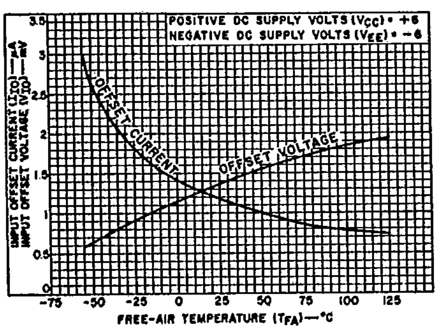


Fig.2

INPUT BIAS CURRENT vs TEMPERATURE

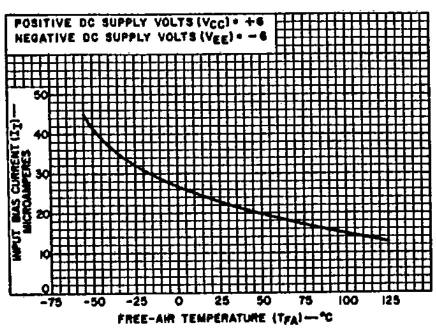
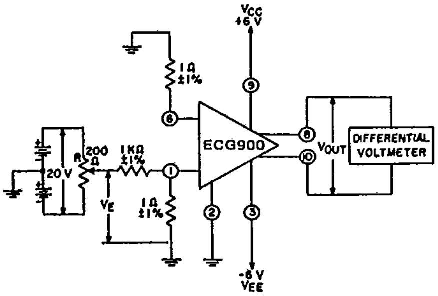


Fig.3

INPUT OFFSET VOLTAGE TEST CIRCUIT



1. Adjust R for V_{OUT} (DC) = 0 ± 0.1 V.
2. Measure V_E and record Input Offset Voltage in mV;

$$V_{IO} = \frac{V_E}{1000}$$

Fig.4

INPUT OFFSET CURRENT AND INPUT BIAS CURRENT TEST CIRCUIT

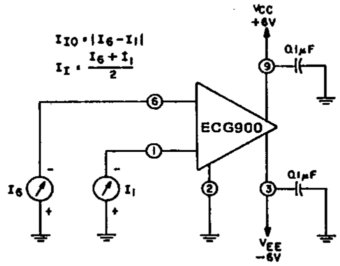


Fig.5

QUIESCENT OPERATING VOLTAGE vs TEMPERATURE

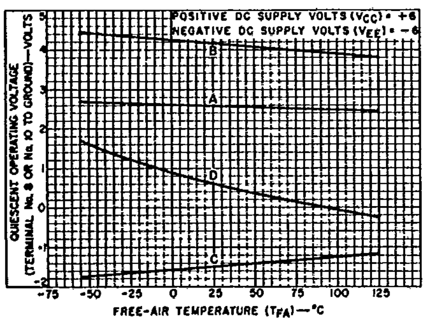
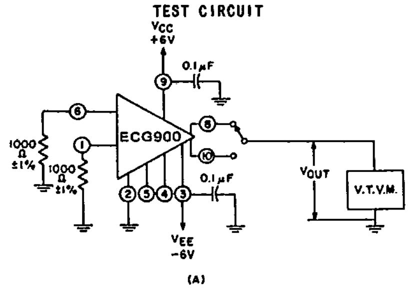


Fig.6

QUIESCENT OPERATING VOLTAGE AND DEVICE DISSIPATION TEST CIRCUIT



$P_T = V_{EE}\, I_3 + V_{CC}\, I_9$

I_3 = Direct Current out of Terminal No.3

I_9 = Direct Current into Terminal No.9

Fig.7

DYNAMIC CHARACTERISTICS AND TEST CIRCUIT FOR TYPE ECG900

DIFFERENTIAL VOLTAGE GAIN vs TEMPERATURE

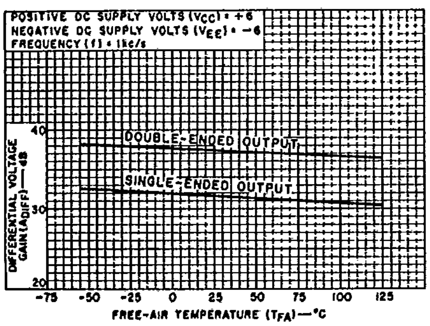
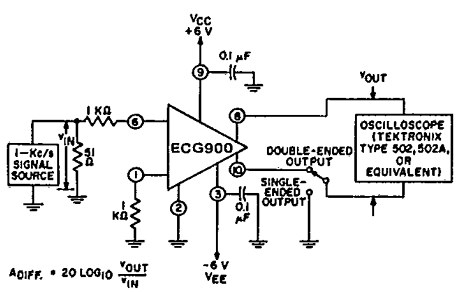


Fig.8

DIFFERENTIAL VOLTAGE GAIN AND MAXIMUM OUTPUT VOLTAGE SWING TEST CIRCUIT



$A_{DIFF} = 20 \log_{10} \frac{V_{OUT}}{V_{IN}}$

Fig.9

DYNAMIC CHARACTERISTICS AND TEST CIRCUITS FOR TYPE ECG900

BANDWIDTH AT -3 dB POINT vs TEMPERATURE

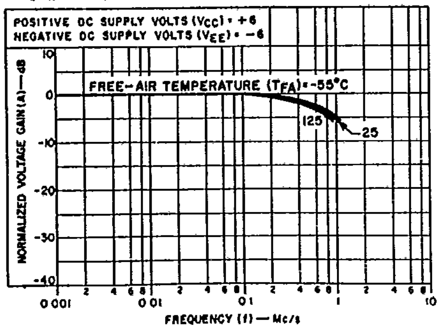
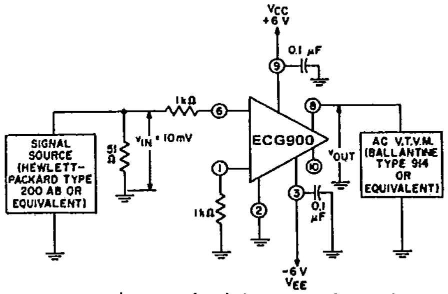


Fig.10

BANDWIDTH AT -3 dB POINT TEST CIRCUIT



1. Apply 1 kc/s, 10 mV(rms) input signal to set reference level.
2. Increase frequency (Keeping V_{IN} equal to 10 mV(rms)) until V_{OUT}/V_{IN} is 3 dB down from 1 kc/s reference level.
3. Record Bandwidth.

Fig.11

COMMON-MODE REJECTION RATIO vs TEMPERATURE

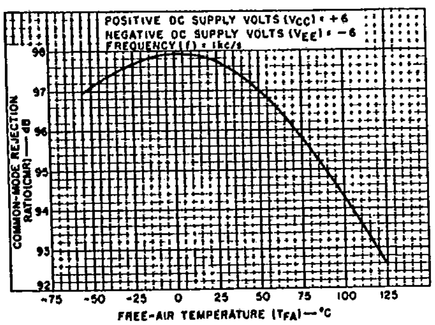
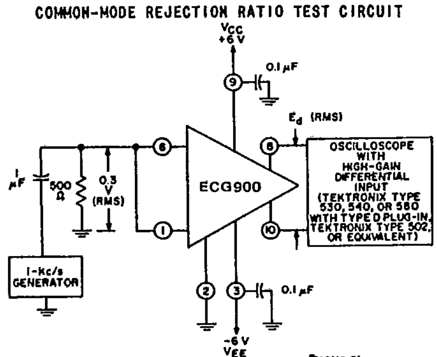


Fig.12

COMMON-MODE REJECTION RATIO TEST CIRCUIT



COMMON-MODE REJECTION RATIO (CMR) = $20 \log \frac{(A^{*})(2)(0.3)}{E_d (RMS)}$

*A = SINGLE-ENDED VOLTAGE GAIN

Fig.13

SINGLE-ENDED INPUT IMPEDANCE vs TEMPERATURE

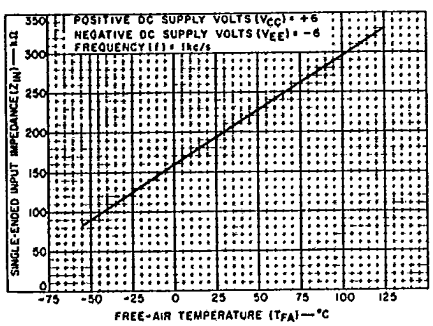
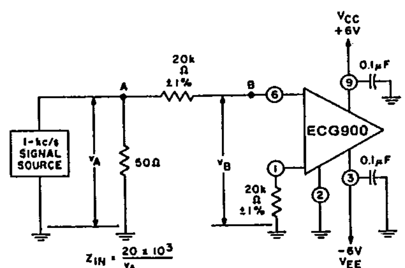


Fig.14

SINGLE-ENDED INPUT IMPEDANCE TEST CIRCUIT



$$Z_{IN} = \frac{20 \times 10^3}{\frac{V_A}{V_B} - 1}$$

Fig.15

SINGLE-ENDED OUTPUT IMPEDANCE vs TEMPERATURE

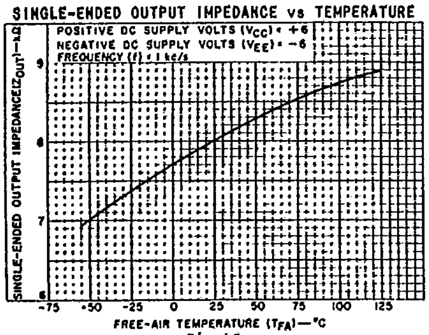
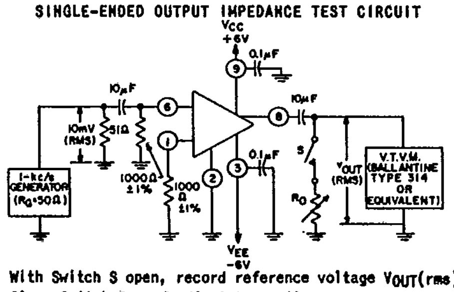


Fig.16

SINGLE-ENDED OUTPUT IMPEDANCE TEST CIRCUIT



1. With Switch S open, record reference voltage V_{OUT}(rms).
2. Close Switch S, and adjust R_O until

$$V_{OUT} = \frac{\text{Reference Voltage}}{2}$$

3. Record value of R_O as Z_{OUT}.

Fig.17

TOTAL HARMONIC DISTORTION vs TEMPERATURE

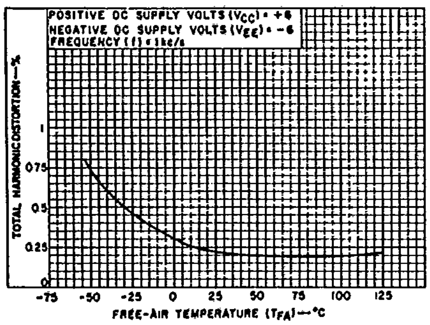


Fig.18

TOTAL HARMONIC DISTORTION TEST CIRCUIT

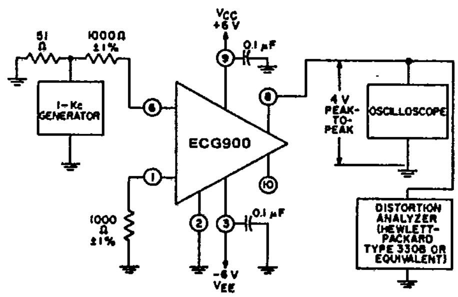
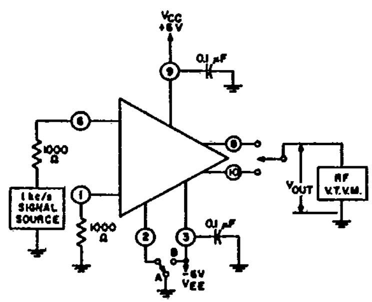


Fig.19

AGC RANGE TEST CIRCUIT



$$\text{AGC Range} = 20\ \text{Log}_{10}\ \frac{\text{A with S in Position A}}{\text{A with S in Position B}}$$

Fig.20