ECG semiconductors

ECG909,ECG909D

HIGH PERFORMANCE OPERATIONAL AMPLIFIER

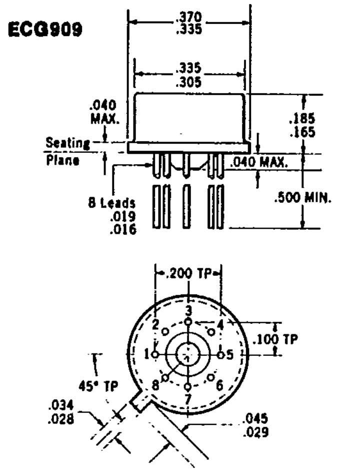
- 2 mV Maximum Offset Voltage
- 50 nA Maximum Offset Current

General Description - High-gain operational amplifier constructed on a single silicon chip. It features low offset, high input impedance, large input common mode range, high output swing under load, and low power consumption. The device displays exceptional temperature stability and will operate over a 14-36 V range of total supply voltage with little degradation of performance. The amplifier is intended for use in DC servo systems, high impedance analog computers, low-level instrumentation applications, and for the generation of special linear and nonlinear transfer functions.

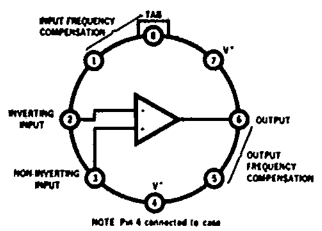
Absolute Maximum Ratings

Total Supply Voltage	36 V
Internal Power Dissipation	
ECG909	500 mW
ECG909D	670 mW
Differential Input Voltage	±5.0 V
Input Voltage	±10 V
Output Short-Circuit Duration (T_A = +25° C)	5 sec
Storage Temperature Range	-65° C to +150° C
Operating Temperature Range	0° C to +70° C
Lead Temperature (Soldering, 60 Seconds)	300° C

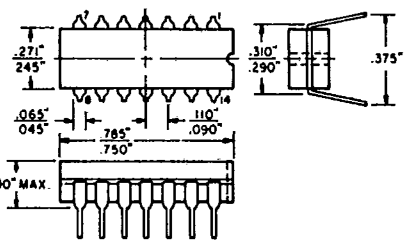
ECG909

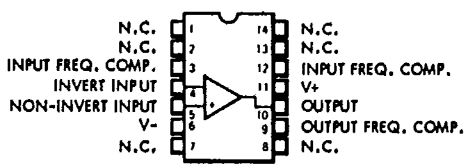


(Top View)



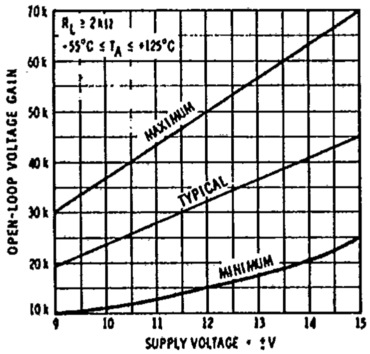
ECG909D



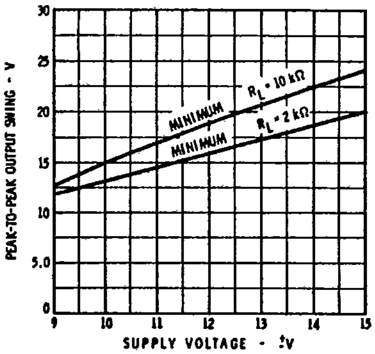


ELECTRICAL CHARACTERISTICS

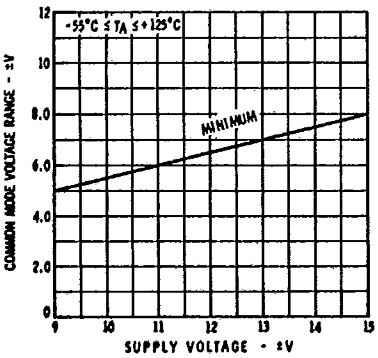
VOLTAGE GAIN



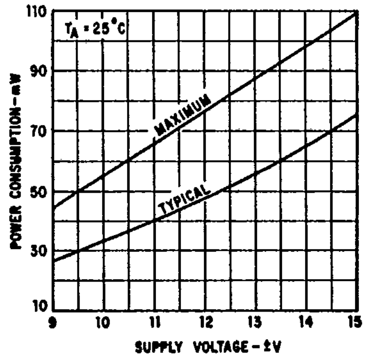
OUTPUT VOLTAGE SWING



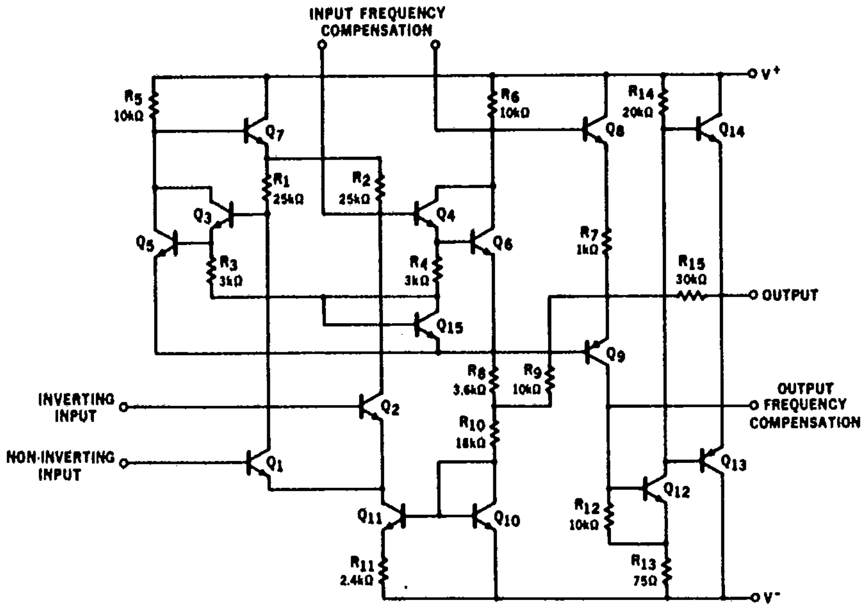
INPUT COMMON MODE VOLTAGE RANGE



POWER CONSUMPTION



SCHEMATIC DIAGRAM

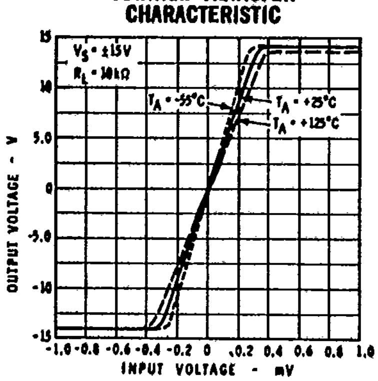


ELECTRICAL CHARACTERISTICS ($T_A = +25°C$, $\pm9\,V \le V_S \le \pm15\,V$ unless otherwise specified)

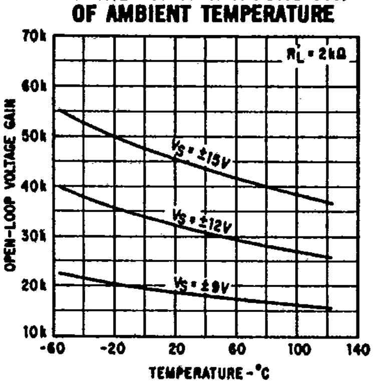
PARAMETER (see definitions)	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input Offset Voltage	$R_S \le 10\,k\Omega$		0.6	2.0	mV
Input Offset Current			10	50	nA
Input Bias Current			100	200	nA
Input Resistance		350	700		kΩ
Output Resistance			150		Ω
Supply Current	$V_S = \pm15\,V$		2.5	3.6	mA
Power Consumption	$V_S = \pm15\,V$		75	108	mW
Transient Response	$V_S = \pm15\,V$, $V_{in} = 20\,mV$, $R_L = 2\,k\Omega$, $C_1 = 5\,nF$, $R_1 = 1.5\,k\Omega$, $C_2 = 200\,pF$, $R_2 = 50\,\Omega$				
Risetime				1.5	µs
Overshoot	$C_L \le 100\,pF$			30	%
The following specifications apply for $-55°C \le T_A \le +125°C$:					
Input Offset Voltage	$R_S \le 10\,k\Omega$			3.0	mV
Average Temperature Coefficient	$R_S = 50\,\Omega$, $T_A = +25°C$ to $T_A = +125°C$		1.8	10	µV/°C
of Input Offset Voltage	$R_S = 50\,\Omega$, $T_A = +25°C$ to $T_A = -55°C$		1.8	10	µV/°C
	$R_S = 10\,k\Omega$, $T_A = +25°C$ to $T_A = +125°C$		2.0	15	µV/°C
	$R_S = 10\,k\Omega$, $T_A = +25°C$ to $T_A = -55°C$		4.8	25	µV/°C
Input Offset Current	$T_A = +125°C$		3.5	50	nA
	$T_A = -55°C$		40	250	nA
Average Temperature Coefficient	$T_A = +25°C$ to $T_A = +125°C$		0.08	0.5	nA/°C
of Input Offset Current	$T_A = +25°C$ to $T_A = -55°C$		0.45	2.8	nA/°C
Input Bias Current	$T_A = -55°C$		300	600	nA
Input Resistance	$T_A = -55°C$	85	170		kΩ
Input Voltage Range	$V_S = \pm15\,V$	±8.0			V
Common Mode Rejection Ratio	$R_S \le 10\,k\Omega$	80	110		dB
Supply Voltage Rejection Ratio	$R_S \le 10\,k\Omega$		40	100	µV/V
Large-Signal Voltage Gain	$V_S = \pm15\,V$, $R_L \ge 2\,k\Omega$, $V_{out} = \pm15\,V$	25,000		70,000	
Output Voltage Swing	$V_S = \pm15\,V$, $R_L \ge 10\,k\Omega$	±12	±14		V
	$V_S = \pm15\,V$, $R_L \ge 2\,k\Omega$	±10	±13		V
Supply Current	$T_A = +125°C$, $V_S = \pm15\,V$		2.1	3.0	mA
	$T_A = -55°C$, $V_S = \pm15\,V$		2.7	4.5	mA
Power Consumption	$T_A = +125°C$, $V_S = \pm15\,V$		63	90	mW
	$T_A = -55°C$, $V_S = \pm15\,V$		81	135	mW

TYPICAL PERFORMANCE CURVES

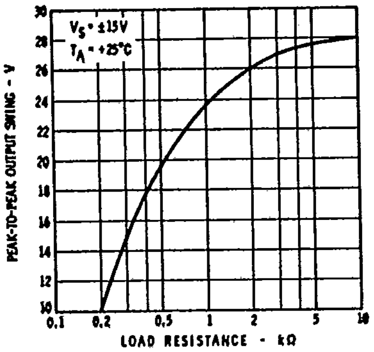
VOLTAGE TRANSFER CHARACTERISTIC



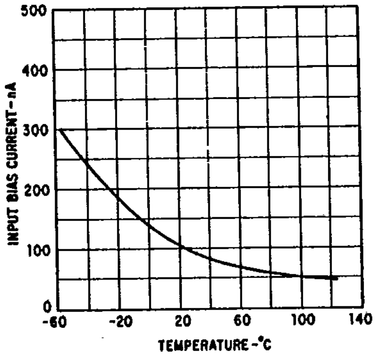
VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE



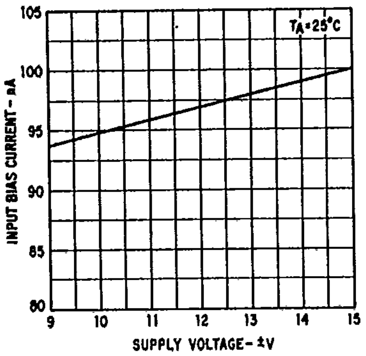
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



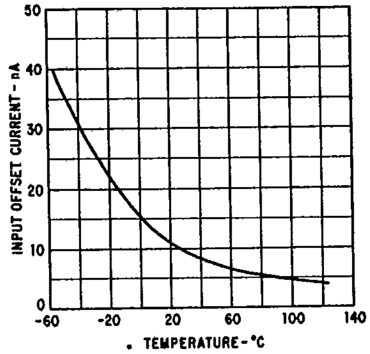
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



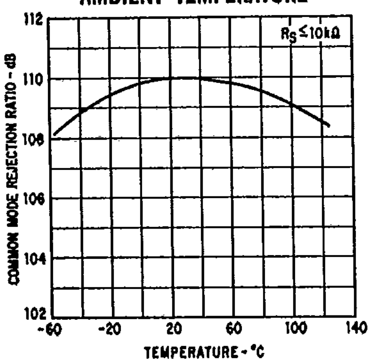
INPUT BIAS CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



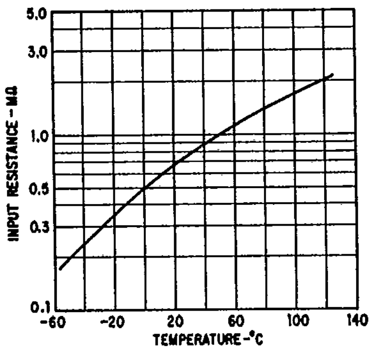
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



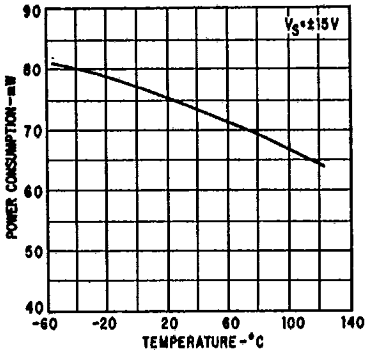
COMMON MODE REJECTION RATIO AS A FUNCTION OF AMBIENT TEMPERATURE



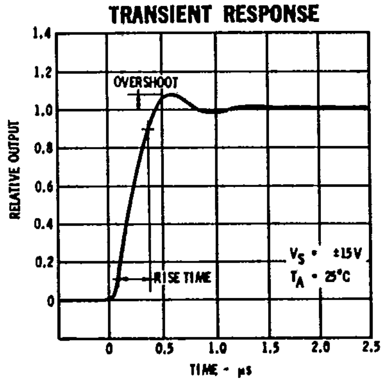
INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE



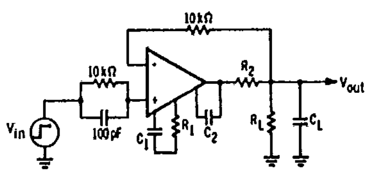
POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE



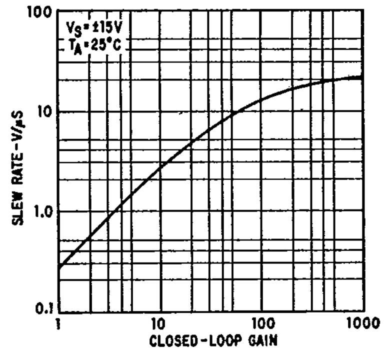
TRANSIENT RESPONSE



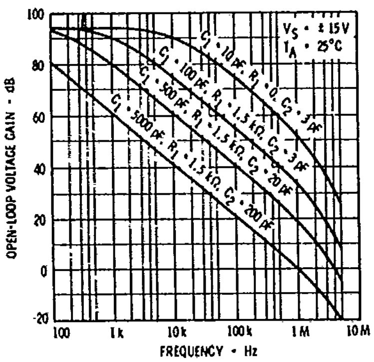
TRANSIENT RESPONSE TEST CIRCUIT



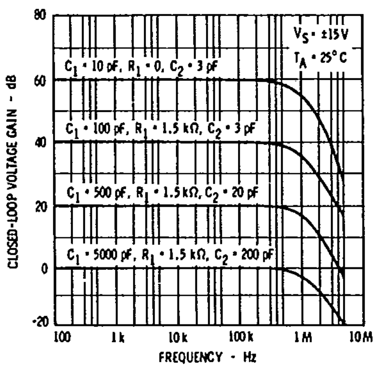
SLEW RATE AS A FUNCTION OF CLOSED-LOOP GAIN USING RECOMMENDED COMPENSATION NETWORKS



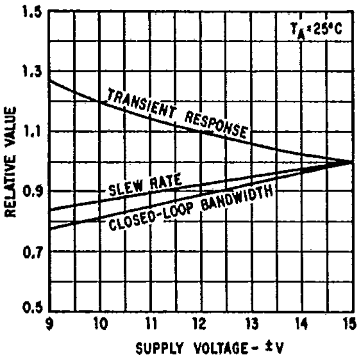
OPEN-LOOP FREQUENCY RESPONSE FOR VARIOUS VALUES OF COMPENSATION



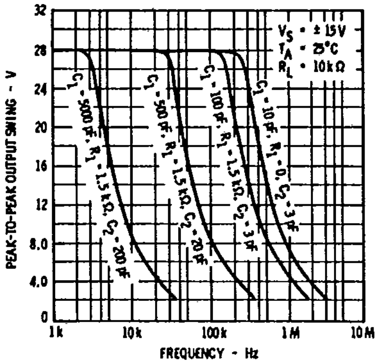
FREQUENCY RESPONSE FOR VARIOUS CLOSED-LOOP GAINS



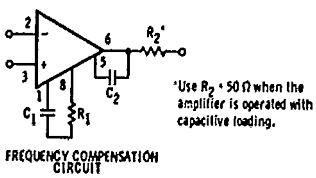
FREQUENCY CHARACTERISTICS AS A FUNCTION OF SUPPLY VOLTAGE



OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY FOR VARIOUS COMPENSATION NETWORKS

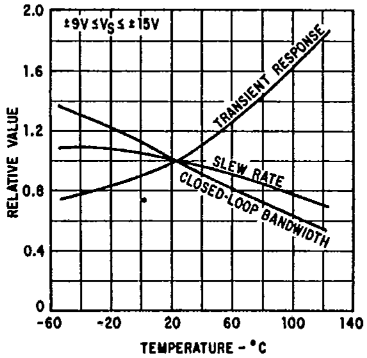


FREQUENCY COMPENSATION CIRCUIT



FREQUENCY COMPENSATION CIRCUIT

FREQUENCY CHARACTERISTICS AS A FUNCTION OF AMBIENT TEMPERATURE



DEFINITION OF TERMS

INPUT OFFSET VOLTAGE — That voltage which must be applied between the input terminals to obtain zero output voltage. The input offset voltage may also be defined for the case where two equal resistances are inserted in series with the input leads.

INPUT OFFSET CURRENT — The difference in the currents into the two input terminals with the output at zero volts.

INPUT RESISTANCE — The resistance looking into either input terminal with the other grounded.

INPUT BIAS CURRENT — The average of the two input currents.

INPUT VOLTAGE RANGE — The range of voltage which, if exceeded on either input terminal, could cause the amplifier to cease functioning properly.

INPUT COMMON MODE REJECTION RATIO — The ratio of the input voltage range to the maximum change in input offset voltage over this range.

SUPPLY VOLTAGE REJECTION RATIO — The ratio of the change in input offset voltage to the change in supply voltage producing it.

LARGE-SIGNAL VOLTAGE GAIN — The ratio of the maximum output voltage swing with load to the change in input voltage required to drive the output from zero to this voltage.

OUTPUT VOLTAGE SWING — The peak output swing, referred to zero, that can be obtained without clipping.

OUTPUT RESISTANCE — The resistance seen looking into the output terminal with the output at null. This parameter is defined only under small signal conditions at frequencies above a few hundred cycles to eliminate the influence of drift and thermal feedback.

POWER CONSUMPTION — The DC power required to operate the amplifier with the output at zero and with no load current.

TRANSIENT RESPONSE — The closed-loop step-function response of the amplifier under small-signal conditions.