



ECG941, ECG941D, ECG941M INTERNALLY-COMPENSATED OPERATIONAL AMPLIFIER

Features:

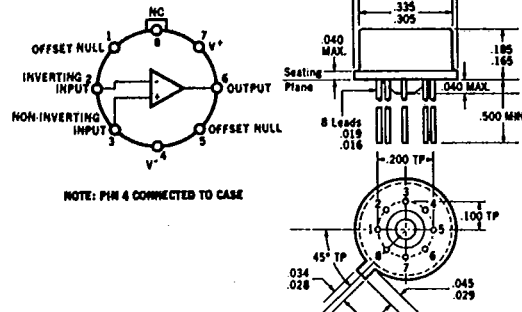
- No Frequency Compensation Required
- Short-Circuit Protection
- Offset Voltage Null Capability
- Large Common-Mode and Differential Voltage Ranges
- Low Power Consumption
- No Latch Up

General Description - High performance monolithic operational amplifier constructed on a single silicon chip. It is intended for a wide range of analog applications. High common mode voltage range and absence of "latch-up" tendencies make it ideal for use as a voltage follower. The high gain and wide range of operating voltages provide superior performance in integrator, summing amplifier, and general feedback applications. The device is short-circuit protected and requires no external components for frequency compensation. The internal 6 dB/octave roll-off insures stability in closed loop applications.

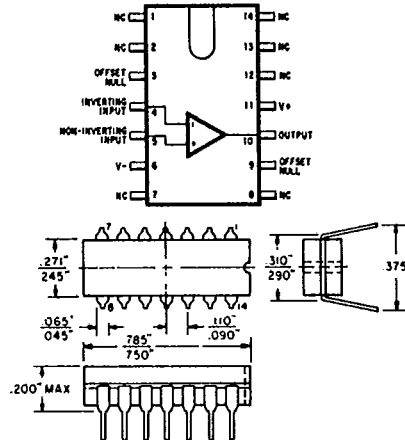
Absolute Maximum Ratings

Supply Voltage ± 18 V
 Internal Power Dissipation (Note 1)
 Metal Can 500 mW
 Plastic & Mini DIP 310 mW
 Differential Input Voltage ± 30 V
 Input Voltage (Note 2) ± 15 V
 Storage Temperature Range
 Metal Can,
 Plastic & Mini DIP, ... -55°C to $+125^{\circ}\text{C}$
 Operating Temperature Range
 0°C to $+70^{\circ}\text{C}$
 Lead Temperature (Soldering)
 Metal Can
 (60 seconds) 300°C
 Plastic & Mini DIP (10 seconds) .. 260°C
 Output Short Circuit Duration
 (Note 3) Indefinite

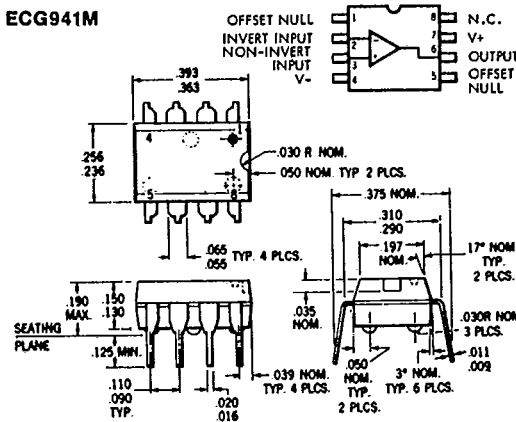
ECG941



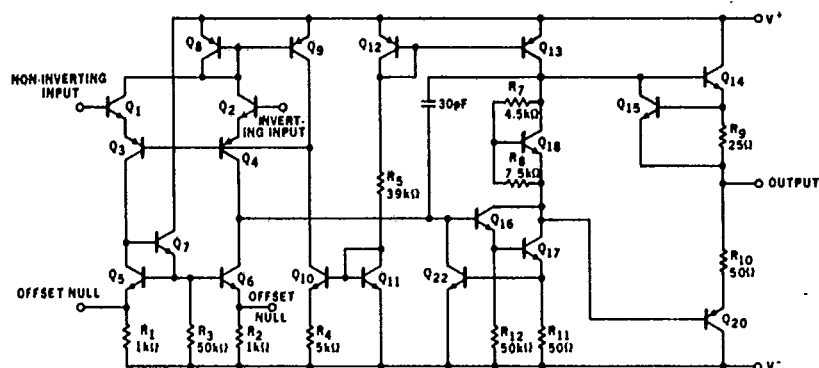
ECG941D



ECG941M



EQUIVALENT CIRCUIT

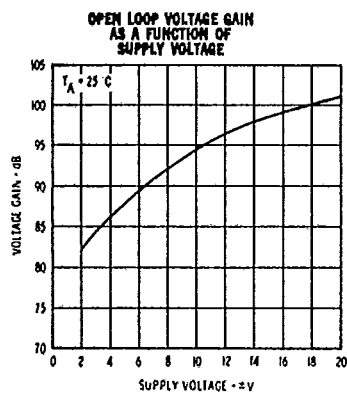
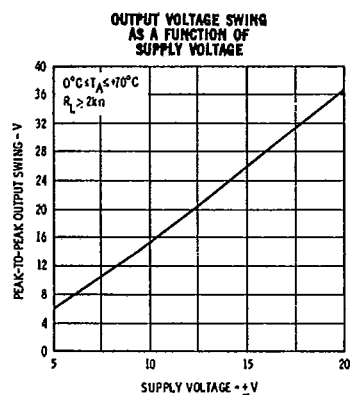
ELECTRICAL CHARACTERISTICS ($V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$ unless otherwise specified)

PARAMETERS (see definitions)	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input Offset Voltage	$R_S \leq 10\text{ k}\Omega$		2.0	6.0	mV
Input Offset Current			20	200	nA
Input Bias Current			80	500	nA
Input Resistance		0.3	2.0		M Ω
Input Capacitance			1.4		pF
Offset Voltage Adjustment Range			± 15		mV
Input Voltage Range		± 12	± 13		V
Common Mode Rejection Ratio	$R_S \leq 10\text{ k}\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 10\text{ k}\Omega$		30	150	$\mu\text{V/V}$
Large-Signal Voltage Gain	$R_L \geq 2\text{ k}\Omega$, $V_{out} = \pm 10\text{ V}$	20,000	200,000		
Output Voltage Swing	$R_L \geq 10\text{ k}\Omega$	± 12	± 14		V
	$R_L \geq 2\text{ k}\Omega$	± 10	± 13		V
Output Resistance			75		Ω
Output Short-Circuit Current			25		mA
Supply Current			1.7	2.8	mA
Power Consumption			50	85	mW
Transient Response (unity gain)	$V_{in} = 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$				
Risetime			0.3		μs
Overshoot			5.0		%
Slew Rate	$R_L \geq 2\text{ k}\Omega$		0.5		V/ μs

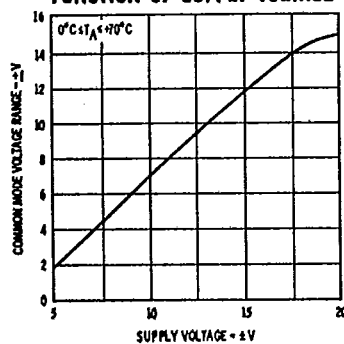
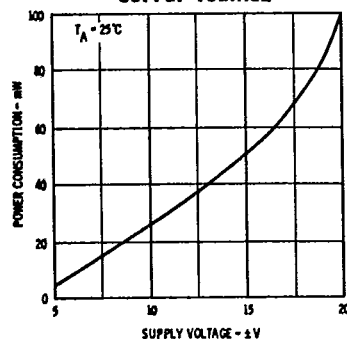
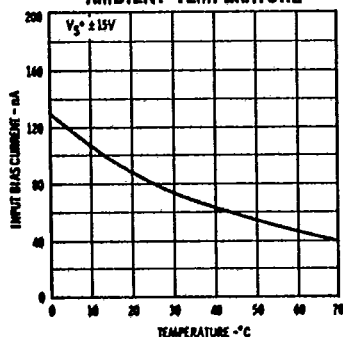
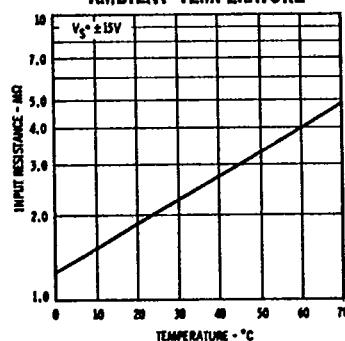
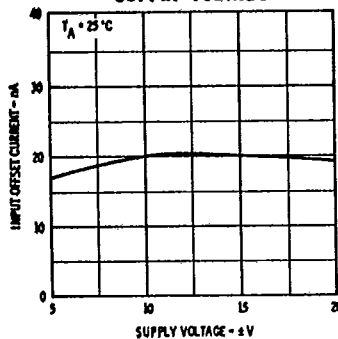
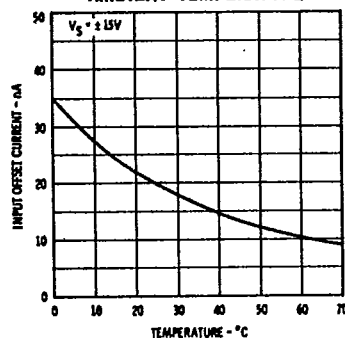
The following specifications apply for $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$:

Input Offset Voltage				7.5	mV
Input Offset Current				300	nA
Input Bias Current				800	nA
Large-Signal Voltage Gain	$R_L \geq 2\text{ k}\Omega$, $V_{out} = \pm 10\text{ V}$	15,000			
Output Voltage Swing	$R_L \geq 2\text{ k}\Omega$	± 10	± 13		V

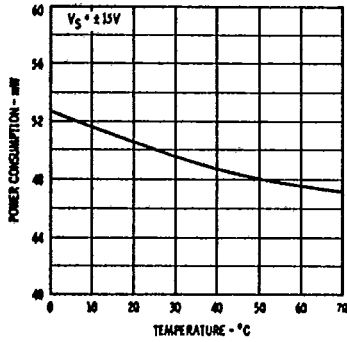
TYPICAL PERFORMANCE CURVES



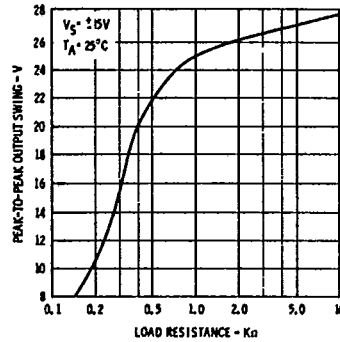
TYPICAL PERFORMANCE CURVES

INPUT COMMON MODE
VOLTAGE RANGE AS A
FUNCTION OF SUPPLY VOLTAGEPOWER CONSUMPTION
AS A FUNCTION OF
SUPPLY VOLTAGEINPUT BIAS CURRENT
AS A FUNCTION OF
AMBIENT TEMPERATUREINPUT RESISTANCE
AS A FUNCTION OF
AMBIENT TEMPERATUREINPUT OFFSET CURRENT
AS A FUNCTION OF
SUPPLY VOLTAGEINPUT OFFSET CURRENT
AS A FUNCTION OF
AMBIENT TEMPERATURE

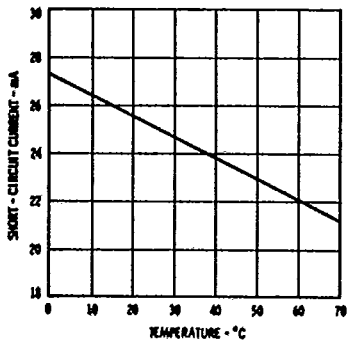
**POWER CONSUMPTION
AS A FUNCTION OF
AMBIENT TEMPERATURE**



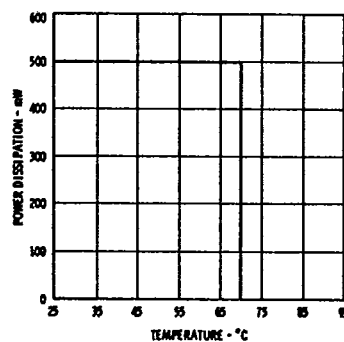
**OUTPUT VOLTAGE SWING
AS A FUNCTION OF
LOAD RESISTANCE**



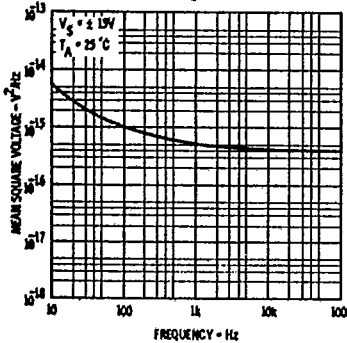
**OUTPUT SHORT-CIRCUIT CURRENT
AS A FUNCTION OF
AMBIENT TEMPERATURE**



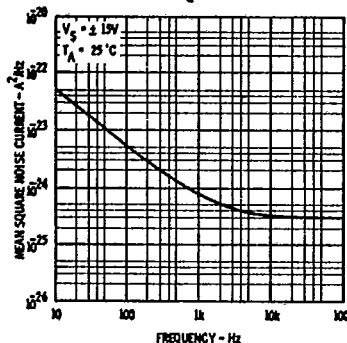
**ABSOLUTE MAXIMUM POWER
DISSIPATION AS A FUNCTION
OF AMBIENT TEMPERATURE**



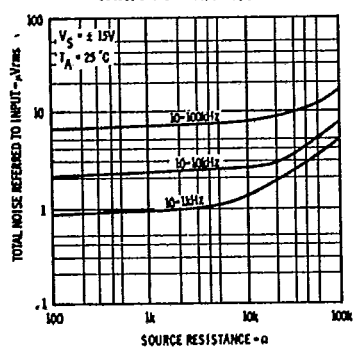
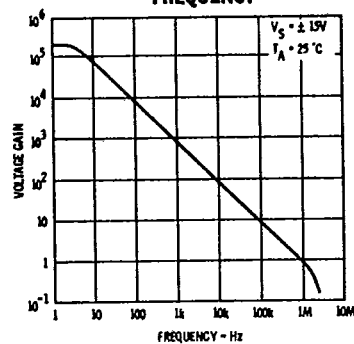
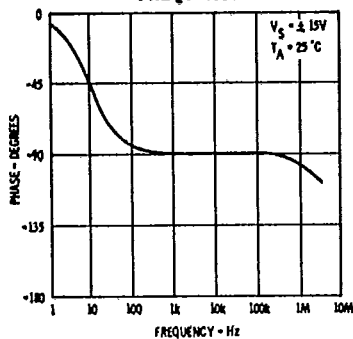
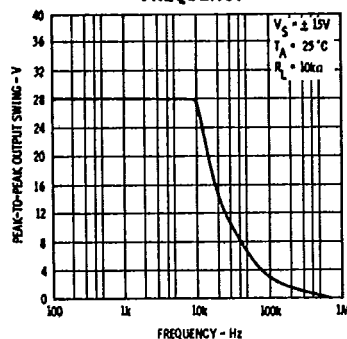
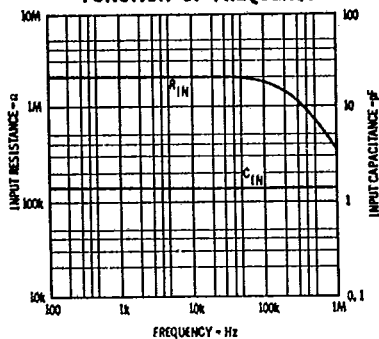
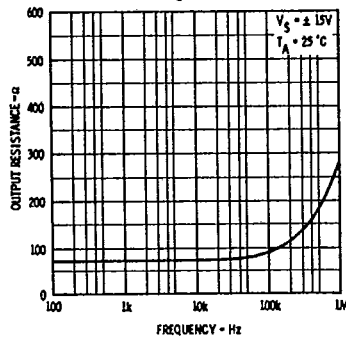
**INPUT NOISE VOLTAGE
AS A FUNCTION OF
FREQUENCY**



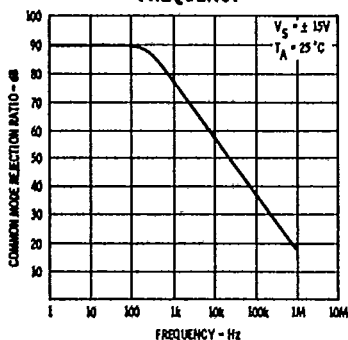
**INPUT NOISE CURRENT
AS A FUNCTION OF
FREQUENCY**



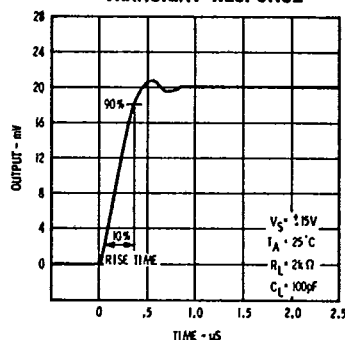
TYPICAL PERFORMANCE CURVES

BROADBAND NOISE FOR
VARIOUS BANDWIDTHSOPEN LOOP VOLTAGE GAIN
AS A FUNCTION OF
FREQUENCYOPEN LOOP PHASE RESPONSE
AS A FUNCTION OF
FREQUENCYOUTPUT VOLTAGE SWING
AS A FUNCTION OF
FREQUENCYINPUT RESISTANCE AND
INPUT CAPACITANCE AS A
FUNCTION OF FREQUENCYOUTPUT RESISTANCE
AS A FUNCTION OF
FREQUENCY

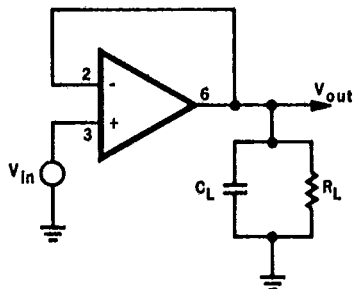
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



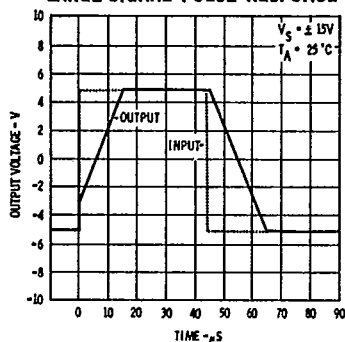
TRANSIENT RESPONSE



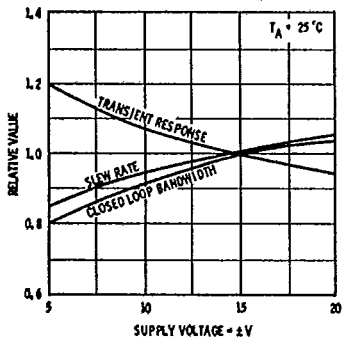
TRANSIENT RESPONSE TEST CIRCUIT



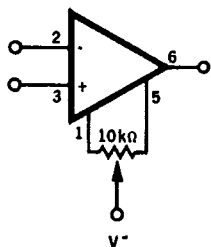
VOLTAGE FOLLOWER LARGE-SIGNAL PULSE RESPONSE



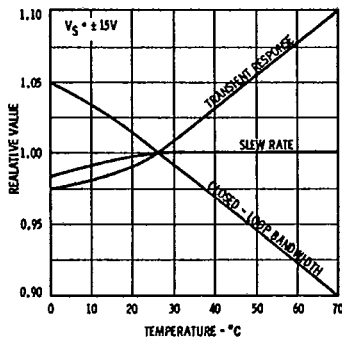
FREQUENCY CHARACTERISTICS AS A FUNCTION OF SUPPLY VOLTAGE



VOLTAGE OFFSET NULL CIRCUIT

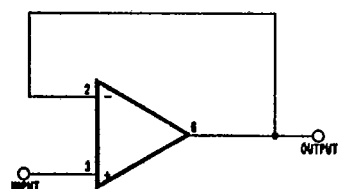


FREQUENCY CHARACTERISTICS AS A FUNCTION OF AMBIENT TEMPERATURE



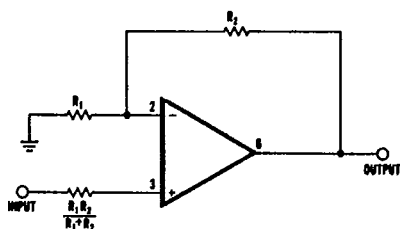
TYPICAL APPLICATIONS

UNITY-GAIN VOLTAGE FOLLOWER



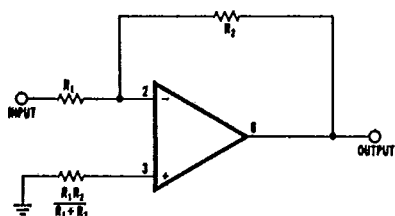
$R_{IH} = 400 \text{ M}\Omega$
 $C_{IH} = 1 \text{ pF}$
 $R_{out} < 1 \Omega$
 $\text{B.W.} = 1 \text{ MHz}$

NON-INVERTING AMPLIFIER



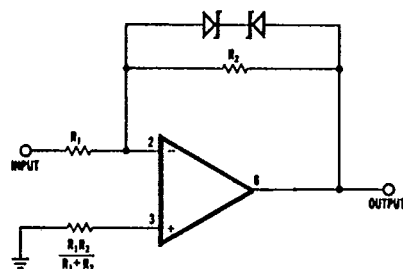
GAIN	R_1	R_2	B.W.	R_{IH}
10	1 k Ω	9 k Ω	100 kHz	400 M Ω
100	100 Ω	9.9 k Ω	10 kHz	280 M Ω
1000	100 Ω	99.9 k Ω	1 kHz	80 M Ω

INVERTING AMPLIFIER



GAIN	R_1	R_2	B.W.	R_{IH}
1	10 k Ω	10 k Ω	1 MHz	10 k Ω
10	1 k Ω	10 k Ω	100 kHz	1 k Ω
100	1 k Ω	100 k Ω	10 kHz	1 k Ω
1000	100 Ω	100 k Ω	1 kHz	100 Ω

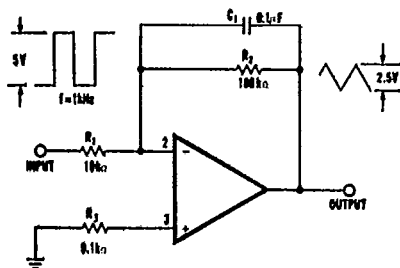
CLIPPING AMPLIFIER



$$\frac{E_{out}}{E_{in}} = \frac{R_2}{R_1} \text{ if } |E_{out}| \leq V_z + 0.7 \text{ V}$$

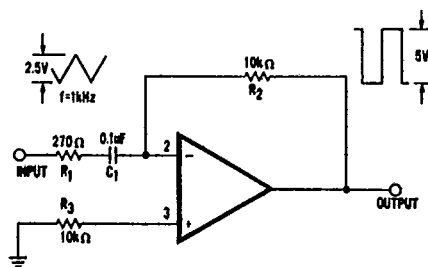
where V_z = Zener breakdown voltage

SIMPLE INTEGRATOR



$$E_{out} = -\frac{1}{R_1 C_1} \int E_{in} dt$$

SIMPLE DIFFERENTIATOR



$$E_{out} = -R_1 C_1 \frac{dE_{in}}{dt}$$

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