ECG® Semiconductors

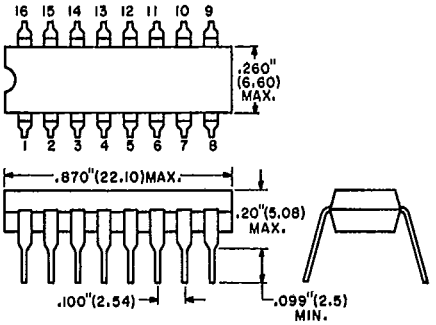
ECG861

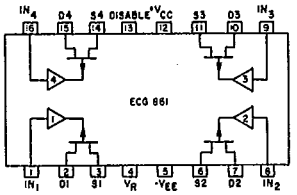
Quad Single Pole Analog Sw

Features

- Analog signals are not loaded
- Constant "ON" resistance for signals up to ±10 V and 100 kHz
- Small signal analog signals to 60 MHz
- Break-before-make action: $t_{OFF} < t_{ON}$
- High open switch isolation at 1.0 MHz: −60 dB
- Low leakage in "OFF" state: <1.0 nA
- TTL, DTL, RTL compatibility

This device is a monolithic combination of bipolar and JFET technology producing a one chip quad JFET switch. The circuit technique employed maintains a constant resistance over the analog voltage range of ±10 V. The input is designed to operate from minimum TTL levels, and switch operation also ensures a break-before-make action.





Absolute Maximum Ratings

Characteristic	Symbol	Rating	Unit
Positive/Negative Supply	V_{cc}	36	V
Reference Voltage		$V_{EE} \leq V_R \leq V_{cc}$	
Logic Input Voltage		$V_R - 4.0\ V \leq V_{IN} \leq V_R + 6.0\ V$	
Analog Voltage		$V_{EE} \leq V_A \leq V_{cc} + 6\ V$ $V_A \leq V_{EE} + 36\ V$	
Analog Current		$(I_A) < 20$ mA	
Power Dissipation (Note 1)	P_D	500	mW
Operating Temperature	T_{opg}	0 to 70	°c
Storage Temperature	T_{stg}	−65 to +150	°C
Lead Temperature (Soldering, 10 sec)		300	°C

Note 1: For operating at high temperature the ECG861 must be derated based on a +100°C maximum junction temperature and a thermal resistance of +150°C/W.

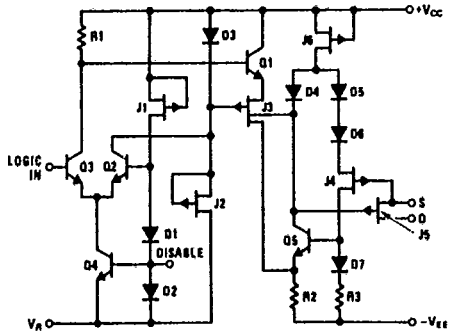
Electrical Characteristics ($T_A = 25°C$, $V_{CC} = +15$ V, $V_{EE} = -15$ V, $V_R = 0$ V unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
"ON" Resistance	R_{ON}	$V_A = 0$, $I_D = 1$ mA	--	150	250	Ω
"ON" Resistance Matching	R_{ON} Match		--	10	50	Ω
Analog Range	V_A		±10	+11	--	V
Leakage Current in "ON" Condition	$I_{S(ON)}+$	Switch "ON", $V_S = V_D = \pm 10$ V	--	0.3	10	nA
	$I_{D(ON)}$		--	3	30	nA
Source Current in 'OFF" Condition	$I_{S(OFF)}$	Switch "OFF", $V_S = +10$ V, $V_D = -10$ V	--	0.4	10	nA
Drain Current in "OFF" Condition	$I_{D(OFF)}$	Switch "OFF", $V_S = +10$ V, $V_D = -10$ V	--	0.1	10	nA
Logical "1" Input Voltage	V_{INH}		2.0	--	--	V
Logical "0" Input Voltage	V_{INL}		--	--	0.8	V
Logical "1" Input Current	I_{INH}	$V_{IN} = 5$ V	--	3.6	40	μA
Logical "0" Input Current	I_{INL}	$V_{IN} = 0.8$	--	--	0.1	μA
Delay Time "ON"	t_{ON}	$V_S = \pm 10$ V, (Figure 1)	--	500	--	ns
Delay Time 'OFF"	t_{OFF}	$V_S = \pm 10$ V, (Figure 1)	--	90	--	ns
Break-Before-Make	t_{ON}-t_{OFF}	$V_S = \pm 10$ V, (Figure 1)	--	80	--	ns
Source Capacitance	$C_{S(OFF)}$	Switch "OFF", $V_S = \pm 10$ V	--	4.0	--	pF
Drain Capacitance	$C_{D(OFF)}$	Switch "OFF", $V_D = \pm 10$ V	--	3.0	--	pF
Active Source and Drain Capacitance	$C_{S(ON)}+$ $C_{D(ON)}$	Switch "ON", $V_S = V_D = 0$ V	--	5.0	--	pF
"OFF" Isolation	$I_{SO(OFF)}$	Figure 2, Note 2	--	−50	--	dB
Crosstalk	CT	Figure 2, Note 2	--	−65	--	dB
Analog Slew Rate	SR	Note 3	--	50	--	V/μs
Disable Current	I_{DIS}	Figure 3, Note 4	--	0.6	1.5	mA
Negative Supply Current	I_{EE}	All Switches "OFF", $V_S = \pm 10$ V	--	4.3	7.0	mA
			--	6.0	10.5	mA
Reference Supply Current	I_R	All Switches "OFF", $V_S = \pm 10$ V	--	2.7	5.0	mA
Positive Supply Current	I_{CC}	All Switches "OFF", $V_S = \pm 10$ V	--	7.0	9.0	mA

Notes:

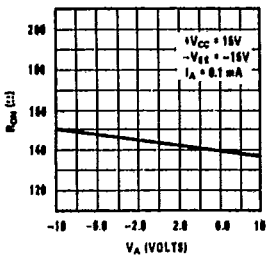
2. These parameters are limited by the pin to pin capacitance of the package.
3. This is the analog signal slew rate above which the signal is distorted as a result of finite internal slew rates.
4. All switches in the device are turned "OFF" by saturating a transistor at the disable node. The delay times will be approximately equal to the t_{ON} or t_{OFF} plus the delay introduced by the external transistor.
5. This graph indicates the analog current at which 1% of the analog current is lost when the drain is positive with respect to the source.

Schematic Diagram
(Normally Open)

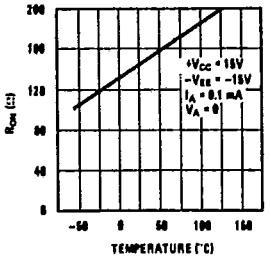


Typical Characteristics

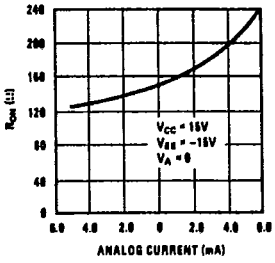
"ON" Resistance



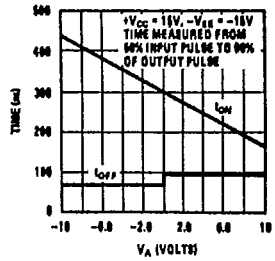
"ON" Resistance



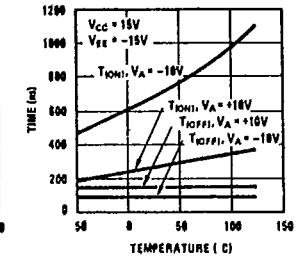
"ON" Resistance



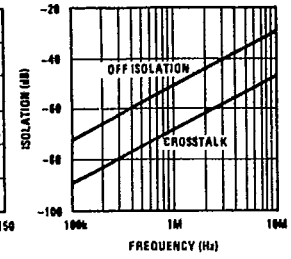
Break-Before-Make Action



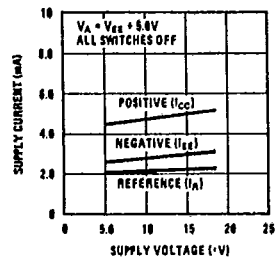
Switching Times



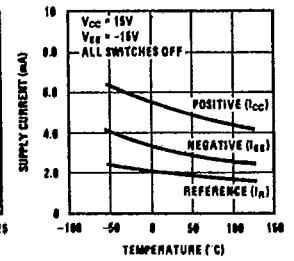
Crosstalk and "OFF" Isolation vs Frequency



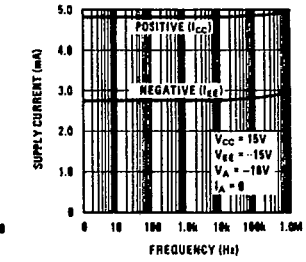
Supply Current



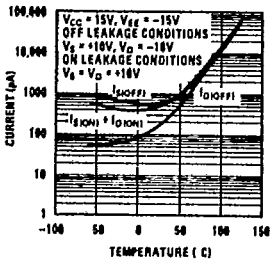
Supply Current



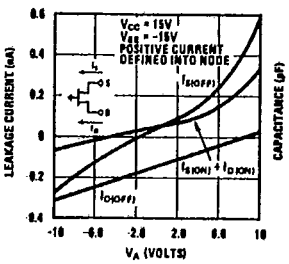
Supply Current



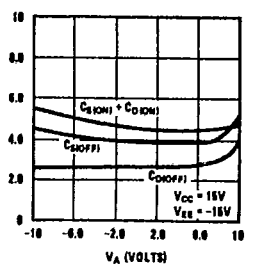
Switch Leakage Currents



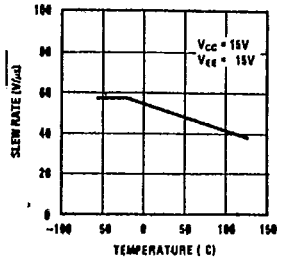
Switching Leakage Current



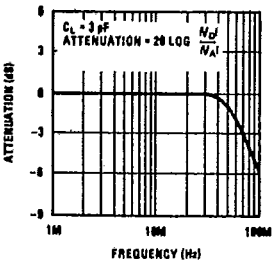
Switch Capacitances



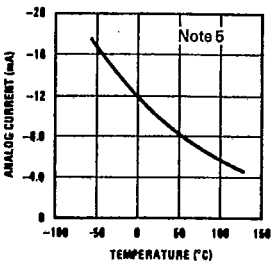
Slew Rate of Analog Voltage Above Which Signal Loading Occurs



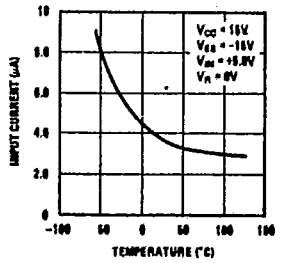
Small Signal Response



Maximum Accurate Analog Current vs Temperature

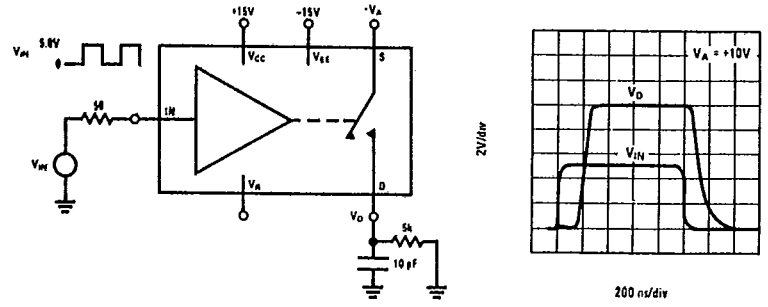


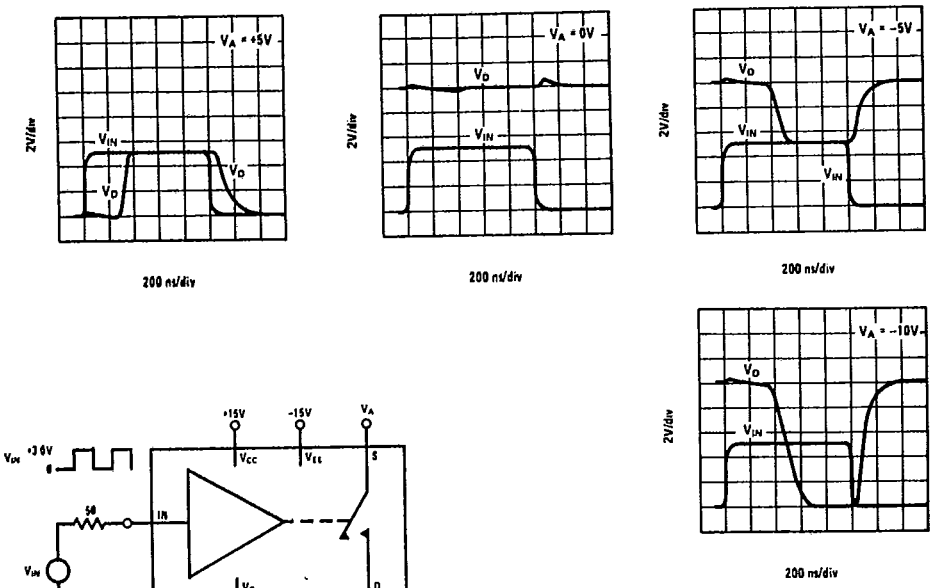
Logical "1" Input Bias Current



Test Circuits and Typical Performance Curves

Delay Time, Rise Time, Settling Time, and Switching Transients





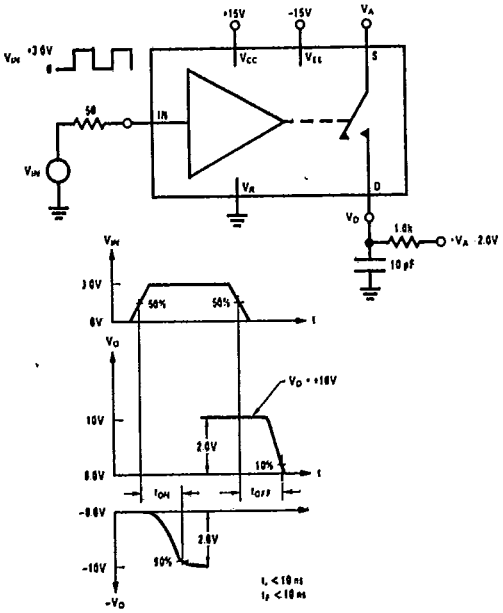


Figure 1. t_{ON}, t_{OFF} Test Circuit and Waveforms for a Normally Open Switch

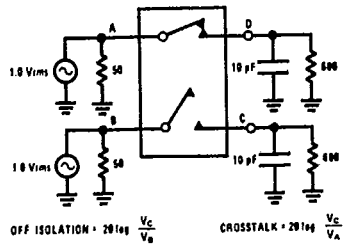


Figure 2. "OFF" Isolation, Crosstalk, Small Signal Response

Application Hints

GENERAL INFORMATION

The ECG861 is a monolithic quad JFET analog switch with "ON" resistances which are essentially independent of analog voltage or analog current. The leakage currents are typically less than 1 nA at 25°C in both the "OFF" and "ON" switch states and introduce negligible errors in most applications. Each switch is controlled by minimum TTL logic levels at its input and is designed to turn "OFF" faster than it will turn "ON". This prevents two analog sources from being transiently connected together during switching. The switches were designed for applications which require break-before-make action, no analog current loss, medium speed switching times and moderate analog currents.

Because this analog switch is a JFET rather than CMOS, it does not require special handling.

LOGIC INPUTS

The logic input (IN), of each switch, is referenced to two forward diode drops (1.4 V at 25°C) from the reference supply (V_R) which makes it compatible with DTL, RTL, and TTL logic families. For normal operation, the logic "0" voltage can range from 0.8 V to −4.0 V with respect to V_R and the logic "1" voltage can range from 2.0 V to 6.0 V with respect to V_R, provided V_{IN} is not greater than (V_{CC} − 2.5 V). If the input voltage is greater than (V_{CC} − 2.5 V), the input current will increase. If the input voltage exceeds 6.0 V or −4.0 V with respect to V_R, a resistor in series with the input should be used to limit the input current to less than 100 μA.

ANALOG VOLTAGE AND CURRENT

Analog Voltage

Each switch has a constant "ON" resistance (R_{ON}) for analog voltages form (V_{EE} + 5 V) to (V_{CC} − 5 V). For analog voltages greater than (V_{CC} − 5 V), the switch will remain ON independent of the logic input voltage. For analog voltages less than (V_{EE} + 5 V), the ON resistance of the switch will increase. Although the switch will not operate normally when the analog voltage is out of the previously mentioned range, the source voltage can go to either (V_{EE} + 36 V) or (V_{CC} + 6 V), whichever is more positive, and can go as negative as V_{EE} without damage. The drain (D) voltage can also go to either (V_{EE} + 36 V) or (V_{CC} + 6 V), whichever is more positive, and can go as negative as (V_{CC} − 36 V) without damage.

Analog Current

With the source (S) positive with respect to the drain (D), the R_{ON} is constant for low analog currents, but will increase at higher currents (>5 mA) when the FET enters the saturation region. However, if the drain is positive with respect to the source and a small analog current loss at high analog currents (Note 5) is tolerable, a low R_{ON} can be maintained for analog currents greater than 5 mA at 25°C.

LEAKAGE CURRENTS

The drain and source leakage currents, in both the ON and the OFF states of each switch, are typically less than 1 nA at 25°C and less than 100 nA at 125°C. As shown in the typical curves, these leakage currents are dependent on power supply voltages, analog voltage, analog current and the source to drain voltage.

DELAY TIMES

The delay time OFF (t_{OFF}) is essentially independent of both the analog voltage and temperature. The delay time ON (t_{ON}) will decrease as either (V_{CC} − V_A) decreases or the temperature decreases.

POWER SUPPLIES

The voltage between the positive supply (V_{CC}) and either the negative supply (V_{EE}) or the reference supply (V_R) can be as much as 36 V. To accommodate variations in input logic reference voltages, V_R can range from V_{EE} to (V_{CC} − 4.5 V). Care should be taken to ensure that the power supply leads for the device never become reversed in polarity or that the device is never inadvertantly installed backwards in a test socket. It one of these conditons occurs, the supplies would zener an internal diode to an unlimited current; and result in a damaged device.

SWITCHING TRANSIENTS

When a switch is turned OFF or ON, transients will appear at the load due to the internal transient voltage at the gate of the switch JFET being coupled to the drain and source by the junction capacitances of the JFET. The magnitude of these transients is dependent on the load. A lower value R_L produces a lower transient voltage. A negative transient occurs during the delay time ON, while a positive transient occurs during the delay time OFF. These transients are relatively small when compared to faster switch families.

DISABLE NODE

This node can be used, as shown in Figure 3 to turn all the switchs in the unit off independent of logic inputs. Normally, the node floats freely at an internal diode drop (≈0.7 V) above V_R. When the external transistor in Figure 3 is saturated, the node is pulled very close to V_R and the unit is disabled. Typically, the current from the node will be less than 1 mA.

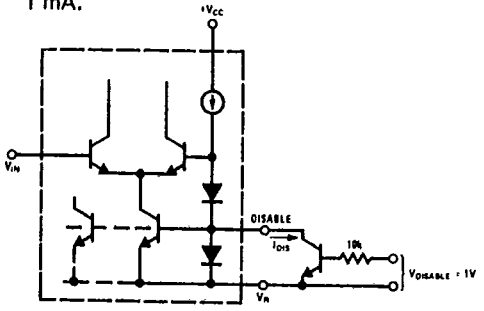
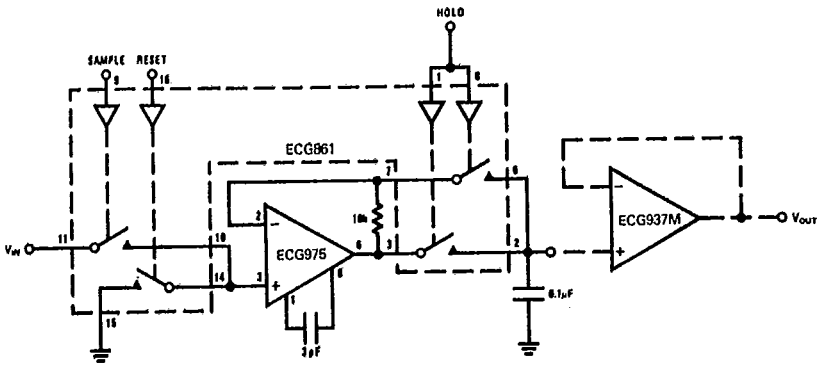


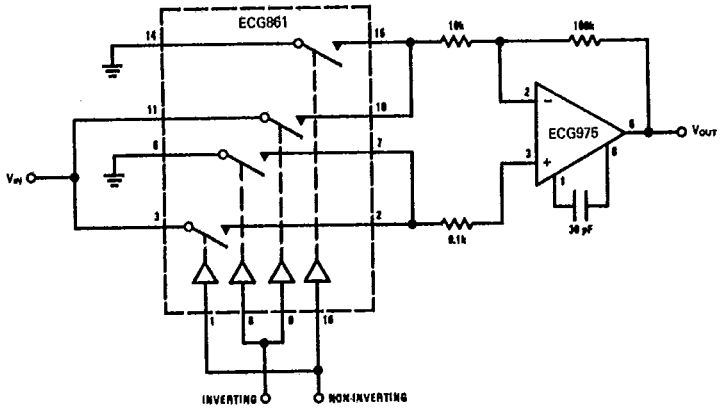
Figure 3. Disable Function

Typical Applications

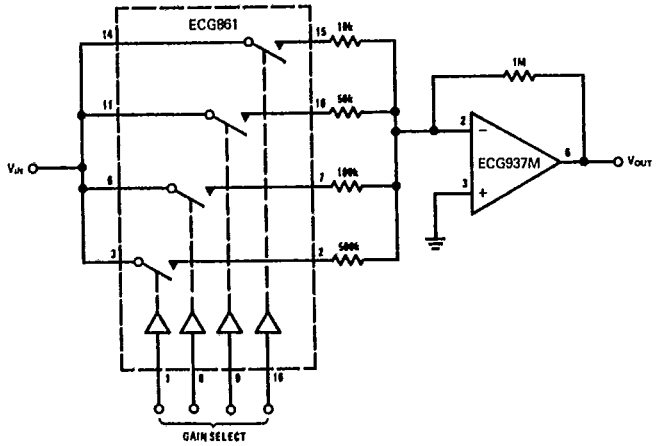
Sample and Hold with Reset



Programmable Inverting Non-Inverting Operational Amplifier



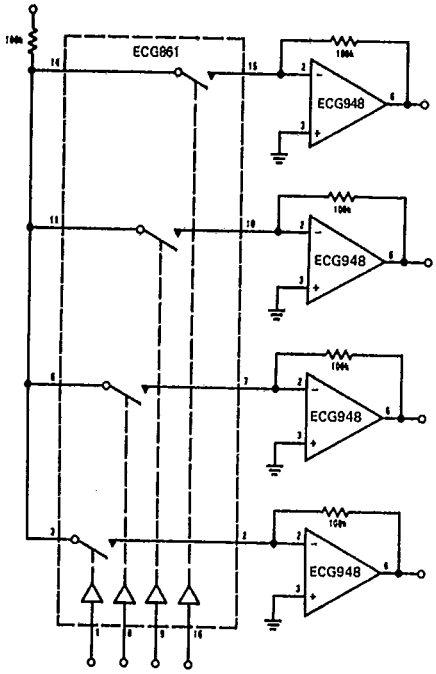
Programmable Gain Operational Amplifier



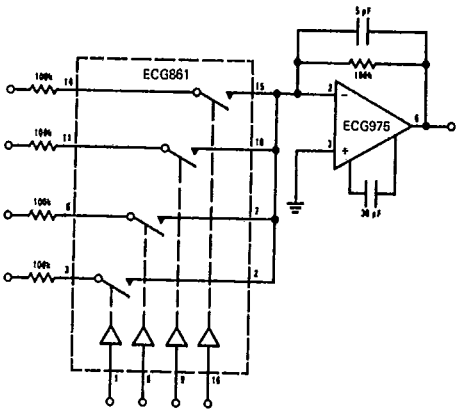
Note: The application circuits for ECG861 show the individual analog switches as single pole mechanical switches for clarity and simplicity of presentation.

Typical Applications (Cont.)

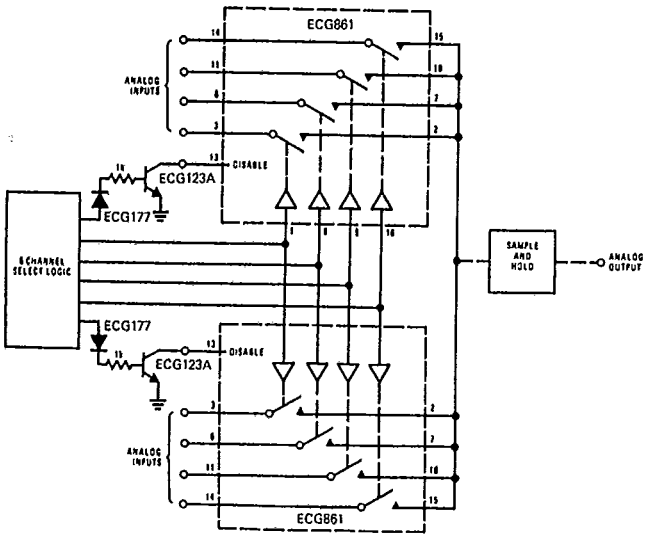
Demultiplexer



Multiplexer/Mixer



8-Channel Analog Commutator with 6-Channel Select Logic



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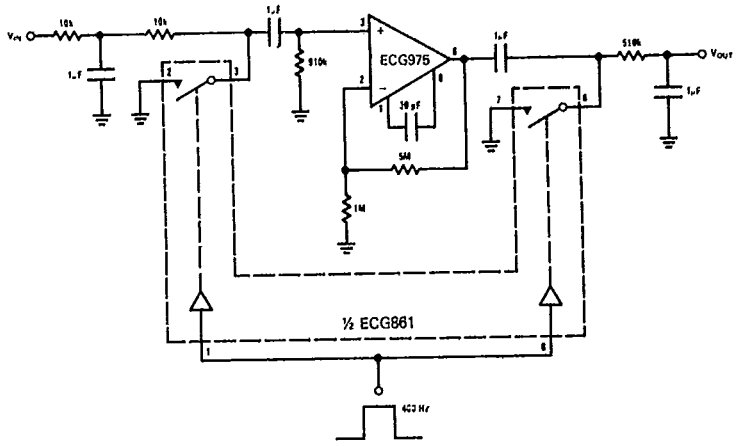
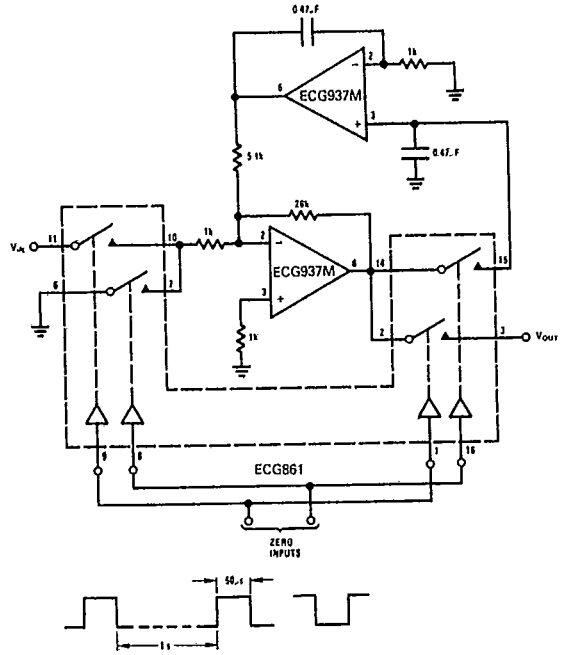
Typical Applications (Cont.)

Chopper Channel Amplifier



Self-Zeroing Operational Amplifier



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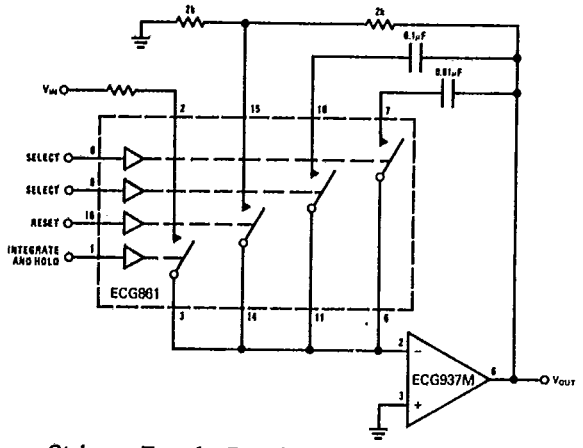
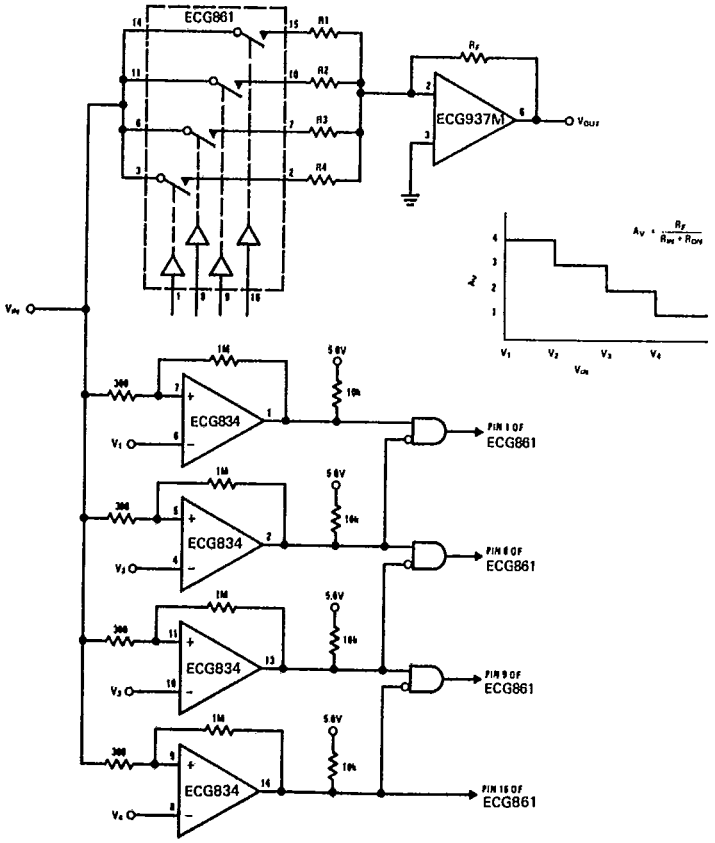
Typical Applications (Cont.)

Programmable Integrator with Reset and Hold



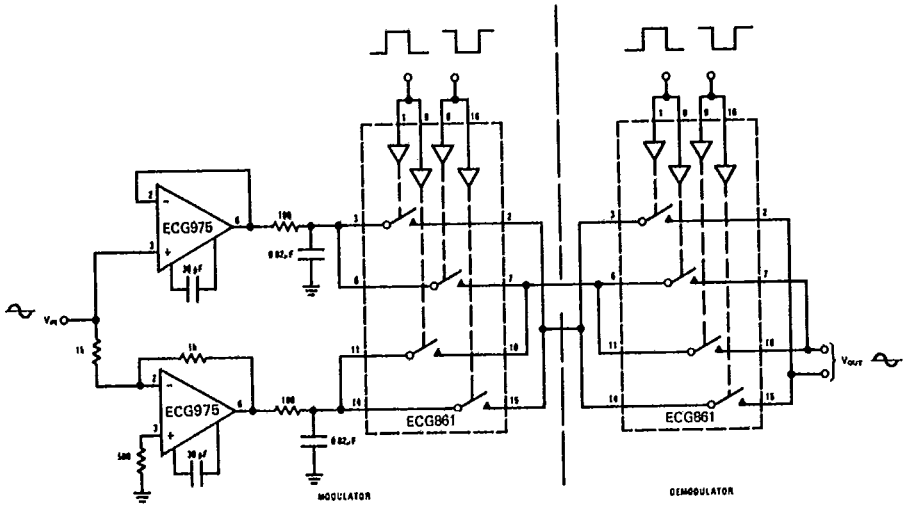
Staircase Transfer Function Operational Amplifier



Note: The application circuits for ECG861 show the individual analog switches as single pole mechanical switches for clarity and simplicity of presentation.

Typical Applications (Cont.)

DSB Modulator-Demodulator



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