ECG® Semiconductors

ECG936, ECG939

Phase and Burst Control for SCR or TRIAC

ECG936 — Phase Control

ECG939 — Burst Control

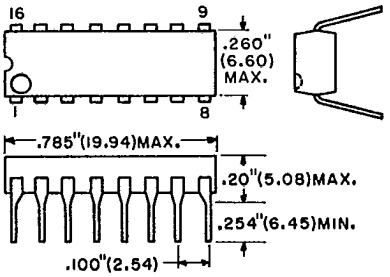
Features

- **AC supply 50/60 Hz**
- **Zero-voltage and zero-current detector**
- **Ramp generator**
- **Inhibition of casual firing pulses**
- **Stabilization of the internal positive DC supply**
- **High gain operational amplifier**
- **Output short-circuit protection**

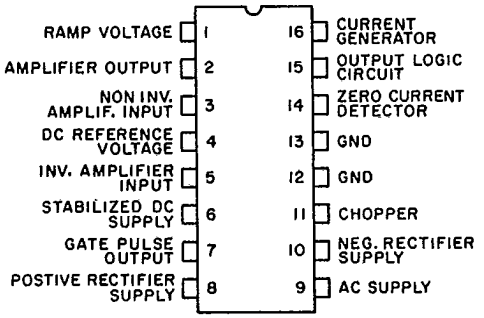
The ECG936 and ECG939 are linear integrated circuits specially designed for triggering SCRs and TRIACs. These two ECG devices are complete control systems enabling their use in a wide range of applications.

The ECG936, as may be noted in the block diagram Figure 1, is for use in phase control systems where the AC line supply is continuously regulated by varying the firing angle of the SCR or TRIAC.

The ECG939, block diagram Figure 2, is for use in burst control systems where the AC line supply is varied proportionally for firing the SCR or TRIAC.



Top View



ECG939 Pin 14 = Zero Low Voltage Detector

Absolute Maximum Ratings

Characteristic	Symbol	Rating	Unit
AC Peak Supply Current	I_9	60	mA
Maximum Input Current (Pin 14)	I_{14}	20	mA
Input Diodes Peak Current	I_{D1}, I_{D2}	1	A
Positive Clamp Voltage	$V_{8\text{-}12}$	15	V
Negative Clamp Voltage	$V_{10\text{-}12}$	15	V
Differential Input Voltage	$V_{1\text{-}2}$	±7	V
Differential Input Voltage	$V_{3\text{-}5}$	±8	V
Total Power Dissipation at $T_A = 85°C$	P_D	800	mW
Storage Temperature	T_{stg}	−55 to 150	°C
Operating Junction Temperature	T_{opg}	−25 to 150	°C

ECG936 Electrical Characteristics ($T_A = 25°C$, refer to the test circuit unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Positive Clamp Voltage	$V_{8\text{-}12}$		10	11.5	13	V
Negative Clamp Voltage	$V_{10\text{-}12}$		10	11.5	13	V
External DC Supply Voltage	$V_{8\text{-}12}$		10.5	--	--	V
External DC Supply Voltage	$V_{10\text{-}12}$		-10.5	--	--	V
Sync Input Threshold	$V_{9\text{-}12}$		--	±12.5	--	V
Zero Current Threshold	$V_{14\text{-}12}$		±8.8	±10	±11.2	V
Zero Current Threshold	$V_{10\text{-}14}$ $V_{8\text{-}14}$		1.2	--	--	V
Operative Input Current to to Avoid Inhibition (Pin 14)	I_{14}		0.4	--	--	mA
Ramp Discharge Level	$V_{1\text{-}12}$		--	--	1.1	V
Maximum Ramp Level	$V_{1\text{-}12}$		7.2	--	--	V
Comparator Differential Trigger Level	$V_{1\text{-}2}$		--	70	100	mV
Amplifier Voltage Gain (Open Loop)	G_V	V_2 (Peak to Peak) = 6 V	60	70	--	dB
Maximum Output Voltage	$V_{2\text{-}13}$		7	--	--	V
Minimum Output Voltage	$V_{2\text{-}13}$		--	--	0.9	V
Input Offset Voltage	$V_{3\text{-}13}$, $V_{5\text{-}13}$	$R_{3\text{-}13} = R_{5\text{-}13} = 50\ \Omega$	--	3	6	mV
Input Bias Current	I_b		--	0.1	1	μA
Differential Input Voltage	$V_{3\text{-}5}$		--	--	±7	V
Input Voltage Range	$V_{3\text{-}13}$, $V_{5\text{-}13}$		0.5	--	7.5	V
Common Mode Rejection	CMR	$R_{3\text{-}13} = R_{5\text{-}13} \leq 1\ k\Omega$	--	60	--	dB
Regulator Output Voltage	$V_{6\text{-}13}$		8.3	--	9.5	V
Maximum Regulator Output Current	I_6		3	--	--	mA
Load Regulation	$\frac{\Delta V_6}{V_6}$	$I_6 = 0$ to 3 mA	--	0.5	2	%
Line Regulation	$\frac{\Delta V_6}{\Delta V_8}$	$V_8 = 12$ to 14 V, $I_6 = 0$	--	46	--	dB
Supply Voltage Rejection	SVR	$V_8 = 12$ V, $f_{ripple} = 50$ Hz V_{ripple} (Peak to Peak) = 4 V	--	46	--	dB
Reference Voltage	V_4	$I_4 = 10\ \mu A$	--	1.5	--	V
Firing Pulse Amplitude	$V_{7\text{-}12}$	$R_{7\text{-}12} = 1\ k\Omega$ Positive	4.5	5.5	--	V
		Negative	8	9.5	--	V
Maximum Output Current	I_7	$R_{7\text{-}12} = 10\ \Omega$	80	--	--	mA
Output Pulse Width	t_{pw}	$R_{7\text{-}12} = 50\ \Omega$	--	200	--	μs
Output Pulse Rise Time	t_r		--	200	--	ns

ECG939 Electrical Characteristics (T_A = 25°C, refer to the test circuit unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Positive Clamp Voltage	$V_{8\text{-}12}$		10	11.5	13	V
Negative Clamp Voltage	$V_{10\text{-}12}$		10	11.5	13	V
External DC Supply Voltage	$V_{8\text{-}12}$		10.5	--	--	V
External DC Supply Voltage	$V_{10\text{-}12}$		−10.5	--	--	V
Sync Input Threshold	$V_{9\text{-}12}$		--	±12.5	--	V
Minimum Input Voltage	$V_{14\text{-}12}$	(Pin 9 Open)	±2.5	--	--	V
Ramp Discharge Level	$V_{1\text{-}12}$		--	--	1.2	V
Maximum Ramp Level	$V_{1\text{-}12}$		5.2	--	--	V
Comparator Differential Trigger Level	$V_{1\text{-}2}$		--	70	100	mV
Amplifier Voltage Gain (Open Loop)	G_V	V_2 (Peak to Peak) = 6 V	60	70	--	dB
Maximum Output Voltage	$V_{2\text{-}13}$		7	--	--	V
Minimum Output Voltage	$V_{2\text{-}13}$		--	--	0.9	V
Input Offset Voltage	$V_{3\text{-}13}$, $V_{5\text{-}13}$	$R_{3\text{-}13} = R_{5\text{-}13} = 50\ \Omega$	--	3	6	mV
Input Bias Current	I_b		--	0.1	1	μA
Differential Input Voltage	$V_{3\text{-}5}$		--	--	±7	V
Input Voltage Range	$V_{3\text{-}13}$, $V_{5\text{-}13}$		0.5	--	7.5	V
Common Mode Rejection	CMR	$R_{3\text{-}13} = R_{5\text{-}13} \leq 1\ k\Omega$	--	60	--	dB
Regulator Output Voltage	$V_{6\text{-}13}$		8.3	--	9.5	V
Maximum Regulator Output Current	I_6		3	--	--	mA
Load Regulation	$\frac{\Delta V_6}{V_6}$	I_6 = 0 to 3 mA	--	0.5	2	%
Line Regulation	$\frac{\Delta V_6}{\Delta V_8}$	V_8 = 12 to 14 V, I_6 = 0	--	46	--	dB
Supply Voltage Rejection	SVR	V_8 = 12 V, f_{ripple} = 50 Hz, V_{ripple} (Peak to Peak) = 4 V	--	46	--	dB
Reference Voltage	V_4	I_4 = 10 μA	--	1.5	--	V
Firing Pulse Amplitude	$V_{7\text{-}12}$	$R_{7\text{-}12}$ = 1 kΩ, Positive	4.5	5.5	--	V
		Negative	8	9.5	--	V
Maximum Output Current	I_7	$R_{7\text{-}12} = 10\ \Omega$	80	--	--	mA
Output Pulse Width	t_{pw}	$R_{7\text{-}12} = 50\ \Omega$	--	200	--	μs
Output Pulse Rise Time	t_r		--	200	--	ns

Figure 1. ECG936 Block Diagram

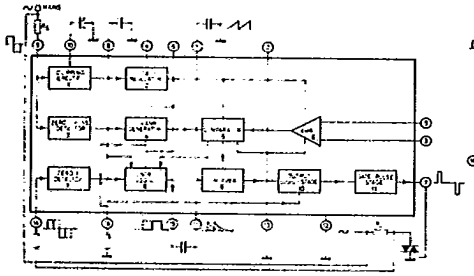
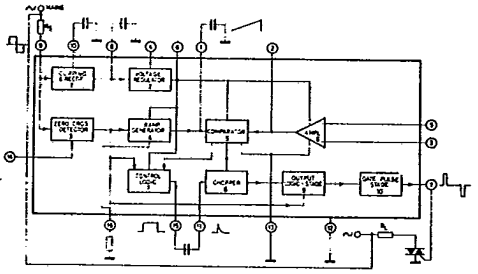


Figure 2. ECG939 Block Diagram

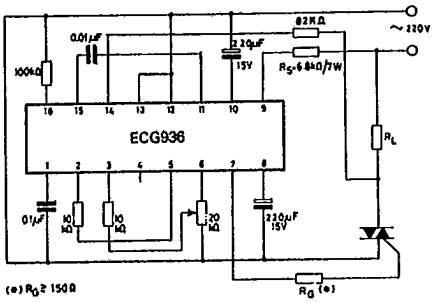


Typical Performance (T_A = 25°C, Reference Figures 1 and 2)

Characteristics	Rating	Unit
Voltage Regulator (Block 2)		
Output Voltage	8	V
Minimum Input Voltage	9	V
Load Regulation	46	dB
Line Rejection	50	dB
Thermal Drift	1.5	mV/°C
Zero Voltage Detector (Block 3)		
Threshold Voltage	±12	V
Thermal Drift	1.5	mV/°C
Sawtooth Generator (Block 4)		
Current Thermal Drift (for R_E = 130 kΩ)	50	nA/°C
Voltage Thermal Drift (for C_E = 0.1 μF)	0.5	mV/°C/ms
Comparator (Block 5)		
Triggering Voltage	70	mV
Triggering Voltage Thermal Drift	100	μV/°C
Amplifier (Block 6)		
Open-Loop Gain	80	dB
Offset Voltage	3	mV
Offset Current	0.1	μA
Bandwidth Product	3	MHz
Thermal Drift	10	μV/°C
Bias Current	0.3	μA
Output Stage (Block 11, Figure 1 only)		
Gate Current	120	mA
Thermal Drift	0.4	mA/°C

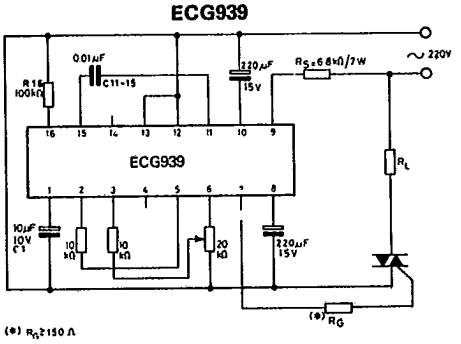
Test Circuits

ECG936



(⊕) $R_G \geq 150\,\Omega$

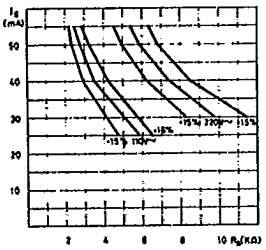
ECG939



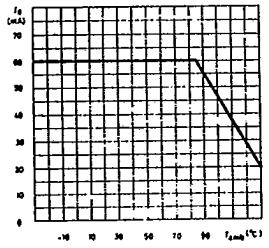
(⊕) $R_G \geq 150\,\Omega$

Typical Characteristics

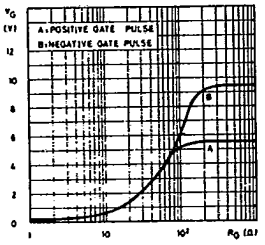
Peak Supply Current vs Dropping Resistor R_S



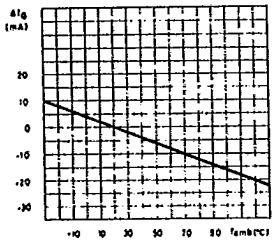
Maximum Allowable Average Supply Current vs Ambient Temperature



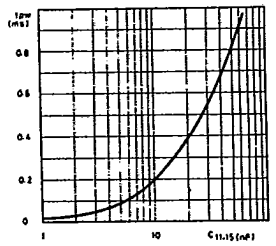
Gate Pulse Amplitude vs Gate Resistance



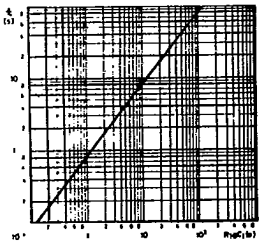
Gate Current Variation vs Ambient Temperature



Gate Pulse Width vs $C_{11\text{-}15}$

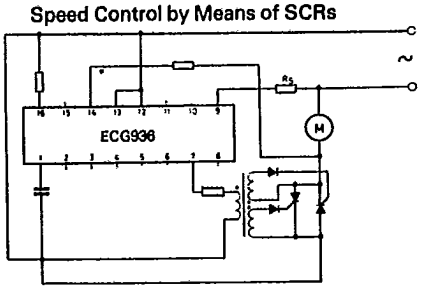


ECG939 Only Ramp Width vs External Time Constant R_{16} © C_1

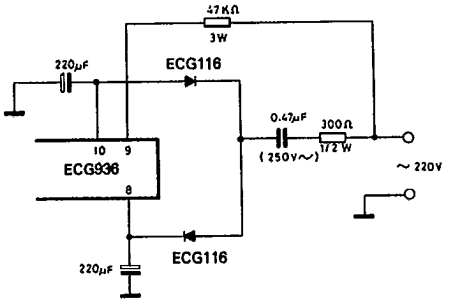


Application Circuits ECG936

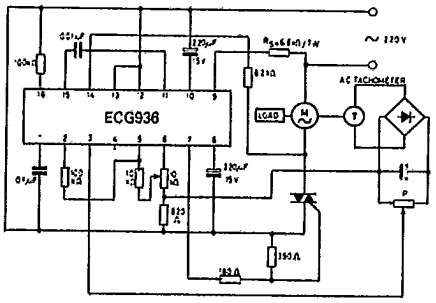
Speed Control by Means of SCRs



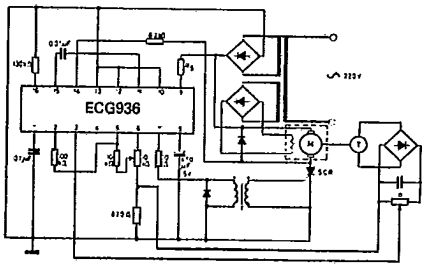
Alternative System for ECG936 Power Supply (Reduction of Power Dissipation)



AC Motor Speed Regulators

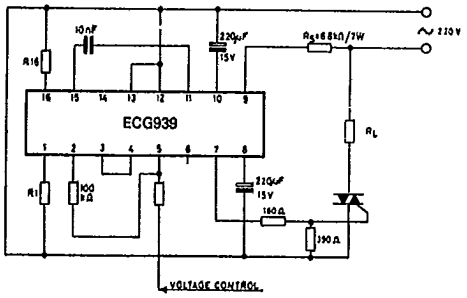


DC Motor Speed Regulators

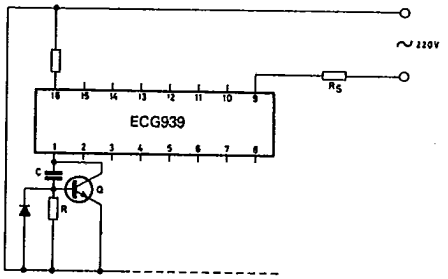


Application Circuits ECG939

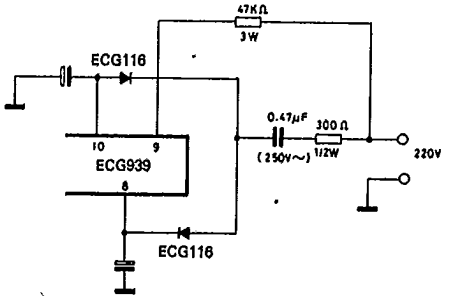
ON-OFF Control with Single Pulses for TRIAC Firing



Integrator for High Time Constants



Alternative System for ECG939 Power Supply (Reduction of Power Dissipation)



Temperature Control (ON-OFF Type)