UNIJUNCTIONS, TRIGGERS AND SWITCHES

Since the introduction of the commercial silicon unijunction transistor in 1956, General Electric has continued developing an extensive line of negative resistance threshold and four-layer switch devices. Each of these devices can be used as a power thyristor trigger, and each offers a special advantage for a particular trigger function. In addltion, each can be used for various non-trigger applications.

The features—both in design and characteristics—which you receive with these products are concisely defined for each series:

TYPES

CONVENTIONAL UNIJUNCTIONS 2N489-494—proved reliability, MIL spec version.
2N2646-47—low cost, proved hermetic sealed device.

PROGRAMMABLE UNIJUNCTION TRANSISTOR (PUT)—variable threshold, low cost, fast switching speed, and circuit adjustable electrical characteristics.

COMPLEMENTARY UNIJUNCTION TRANSISTOR—ultimate in temperature stability for timing and oscillator applications.

SILICON UNILATERAL SWITCH (SUS)—a stable fixed low voltage threshold, low cost, high performance "4-layer diode."

SILICON BILATERAL SWITCH (SBS)—low voltage triac trigger, two silicon unilateral switches connected back to back.

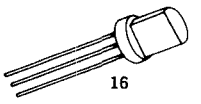
SILICON CONTROLLED SWITCH (SCS)—high triggering sensitivity, 4-lead capability for multiple loads or dv/dt suppression.

APPLICATIONS

Use	Device	Unijunctions: Conventional 2N489-94, 2N1671, 2N2160	Unijunctions: Conventional 2N2646 2N2647	Unijunctions: Complementary D5K1 D5K2	Unijunctions: Programmable 2N6027 2N6028	Triggers: SUS 2N4983-90	Triggers: SBS 2N4991-93
Trigger for SCR's	DC, Lo Cost	P	F	P	E	E	E
	DC, Hi Perf.	F	F	F	E	F	F
	DC, Volt Regulator	P	P	F	F	E	E
	DC, Inverter	F	F	E	E	F	F
	DC, Hi ΔI/ΔT	P	P	P	E[1]	P	P
	AC, ϕ, Hi Perf.	F	F	E	E[1]	F	F
	AC, ϕ, Hi f	F	F	F	E	P	P
	AC, Lo RFI	P	P	P	F	E	E
	AC, ϕ, Lo Cost	P	F	P	E	E	E
Timers	>1 hr.	F[1]	P	F[1]	E[1]	N	N
	>1 min, Lo Cost	P	F	P	E	N	N
	>1 min, Stable	F	P	E	P	N	N
	<1 min, Lo Cost	P	F	P	E	F	F
	<1 min, Stable	F	P	E	P	F	N
	<10V	P	P	F	E	N	N
	10V-25V	E	E	E	E	F	F
	>25V	P	P	P	E	F	F
Oscillators	Stability	F	F	E	F	N	N
	Cost	P	F	P	E	N	N
	Adjust, Range	E	E	F	F[1]	N	N
Markets	Military	E	P	F	F[2]	P	P
	Hi-Rel	E	P	E	F[2]	F	F
	Economy	P	F	P	E	E	E

E = Excellent, F = Fair, P = Poor, N = Not Applicable
[1] With additional circuitry
[2] Hermetic version 2N6116-18

SILICON UNILATERAL AND BILATERAL SWITCHES
(SUS, SBS)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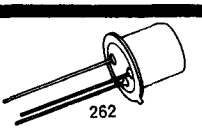
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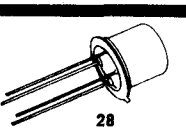
The General Electric SUS is a silicon, planar monolithic integrated circuit having thyristor electrical characteristics closely approximating those of an "ideal" four-layer diode. The device is designed to switch at 8 volts with a typical temperature coefficient of 0.02%/°C. A gate lead is provided to eliminate rate effect, obtain triggering at lower voltages, and to obtain transient-free waveforms.

The SBS is a bilateral version of the forward characteristics of the SUS. It provides excellently matched characteristics in both directions with the same low temperature coefficient.

	GE Type	V_{ACR} Reverse Voltage Max. (V)	I_F Continuous Forward Current Max. (mA)	I_F Peak Recurrent Forward Current @ 100°C, 10 μs, 1% duty cycle (A)	P_T Dissipation (mW)	T_C Temperature Coefficient of Switching Voltage (%/°C)	V_S Switching Voltage Min. (V)	V_S Switching Voltage Max. (V)	I_S Switching Current Max. (μA)	I_B Forward Blocking Current @ 5V (μA)	V_F Forward Voltage @ 200mA (V)	I_H Holding Current (mA)	V_O Peak Pulse Voltage Min. (V)	Package
Unilateral	2N4987	30	175	1.0	300	—	6	10	500	1.0	1.5	1.5	3.5	16
	2N4988	30	200	1.0	350	±.05	7.5	9	150	0.1	1.5	.5	3.5	
	2N4989	30	200	1.0	350	±.02	7.5	8.2	300	0.01	1.5	1.0	3.5	H
	2N4990	30	175	1.0	300	—	7	9	200	0.1	1.5	.75	3.5	
	2N4983	30	175	1.0	300	—	6	10	500	1.0	1.5	1.5	3.5	G
	2N4984	30	200	1.0	350	±.05	7.5	9	150	0.1	1.5	.5	3.5	
	2N4985	30	200	1.0	350	±.02	7.5	8.2	300	0.01	1.5	1.0	3.5	262
	2N4986	30	175	1.0	300	—	7	9	200	0.1	1.5	.75	3.5	
Bilateral	2N4991	—	175	1.0	300	—	6	10	500	1.0	1.7	1.5	3.5	16
	2N4992	—	200	1.0	350	±.05	7.5	9	120	0.1	1.7	.5	3.5	
	2N4993	—	175	1.0	300	—	6	10	500	1.0	1.7	1.5	3.5	262

SILICON CONTROL SWITCHES
(SCS)

High triggering sensitivity. 4 lead capability for multiple load or dv/dt suppression.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						Cutoff Characteristics	Conducting Characteristics	Max. Gate Ratings		Gate triggering Characteristics					
GE Type	V_{AK} Anode Voltage Blocking (V)	I_F Continuous DC Forward Current (mA)	Peak Recurrent Forward Current @ 100μsec (A)	Cathode Gate Peak Current (mA)	P_T (mW)	I_B @ V_{AK} R_{GK}= 10KΩ 150°C (μA)	I_H R_{GK}= 10KΩ (mA)	V_{GK} I_{GK}= 20μA (V)	V_{GA} I_{GA}= 1μA (V)	I_{GTK} @ V_{AK}=40V, R_L=800Ω, R_{GA}=∞ (μA)	V_{GTK} (V)	I_{GTA} @ V_{AK}=40V, R_L=800Ω, R_{GK}=10K (mA)	V_{GTA} (V)	Package
3N81	65	200	1.0	500	400	20	1.5	5	65	1.0	.4 to .65	1.5	—.4 to —.8	28
3N82	100	200	1.0	500	400	20	1.5	5	100	1.0	.4 to .65	1.5	—.4 to —.8	28
3N83	70	50	0.1	50	200	20 *	4.0 †	5	70	150 †	.4 to .80	—	—	28
3N84	40	175	0.5	100	320	20 *	2.0	5	40	10	.4 to .65	—	—	28
3N85	100	175	0.5	100	320	20 *	2.0	5	100	10	.4 to .65	—	—	28
3N86	65	200	1.0	500	400	20	0.2	5	65	1.0	.4 to .65	0.1	—.4 to —.8	28

* Measured @125°C. † Measured in special test circuit (See specification sheet).

ADDITIONAL REFERENCE PUBLICATIONS
ORDER BY PUBLICATION NUMBER

90.10 The Unijunction Transistor Characteristics and Applications
90.12 Unijunction Temperature Compensation
90.19 Unijunction Frequency Divider
90.70 The D13T—A Programmable Unijunction Transistor
90.72 Complementary Unijunction Transistors

Silicon Economy

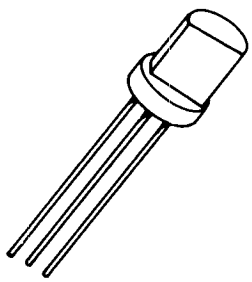
Bilateral Switch

(SBS)

2N4991

The General Electric SBS is a silicon planar, monolithic integrated circuit having the electrical characteristics of a bilateral thyristor. The device is designed to switch at 8 volts with a 0.02%/°C temperature coefficient and excellently matched characteristics in both directions. A gate lead is provided to eliminate rate effect and to obtain triggering at lower voltages.

The Silicon Bilateral Switches are specifically designed and characterized for applications where stability of switching voltage over a wide temperature range and well matched bilateral characteristics are an asset. They are ideally suited for half wave and full wave triggering in low voltage SCR and Triac phase control circuits. The 2N4991 is in the low cost, TO-98 plastic package.

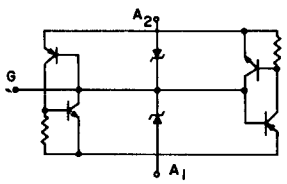


absolute maximum ratings: (25°C free air) (unless otherwise specified)

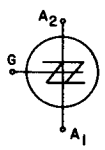
Storage Temperature Range	−65 to +150	°C
Operating Junction Temperature Range	−55 to +125	°C
Power Dissipation*	300	mW
DC Forward Anode Current*	175	mA
DC Gate Current *†	5	mA
Peak Recurrent Forward Current (1% duty cycle, 10 μsec pulse width, $T_A = 100°C$)	1.0	Amp
Peak Non-Recurrent Forward Current (10 μsec pulse width, $T_A = 25°C$)	5.0	Amps

*Derate linearly to zero at 125°C.

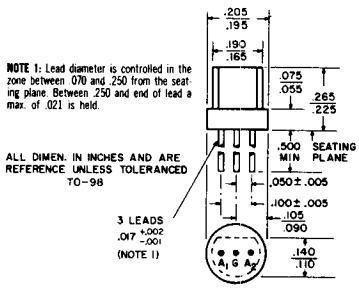
†This rating applicable only on OFF state. Maximum gate current in conducting state limited by maximum power rating.



EQUIVALENT CIRCUIT



CIRCUIT SYMBOL

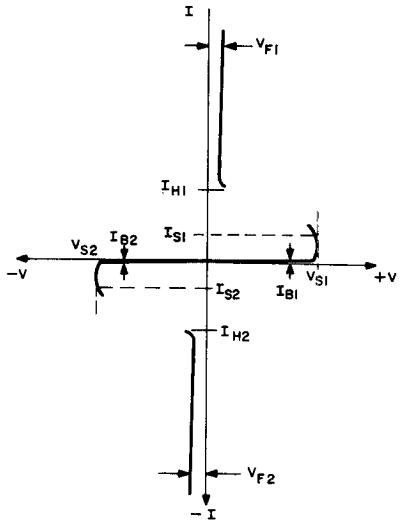


electrical characteristics:** (25°C) (unless otherwise specified)

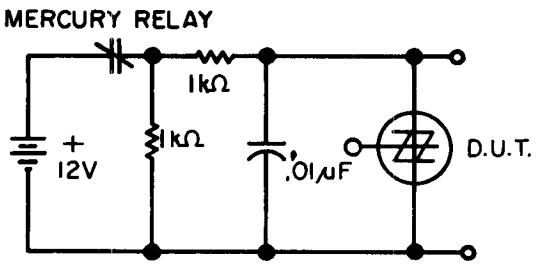
		Min.	Typ.	Max.	
STATIC					
Switching Voltage	V_S	6		10	V
Switching Current	I_S			500	μA
Absolute Switching Voltage Difference	$\lvert V_{S2} - V_{S1} \rvert$			.5	V
Absolute Switching Current Difference	$\lvert I_{S2} - I_{S1} \rvert$			100	μA
Holding Current	I_H			1.5	mA
Current (Off State) ($V_F = 5V$, $T_A = 25°C$)	I_B			1.0	μA
($V_F = 5V$, $T_A = 85°C$)	I_B			10.0	μA
Temperature Coefficient of Switching Voltage ($T_A = -55°C$ to $+85°C$)	T_C		±.02		%/°C
Forward Voltage Drop (On State) ($I_F = 175$ mA)	V_F			1.70	V
DYNAMIC					
Turn-on Time (See Circuit 1)	t_{on}			1.0	μsec
Peak Pulse Amplitude (See Circuit 3)	V_o	3.5			V
Turn-off Time (See Circuit 2)	t_{off}			30.0	μsec

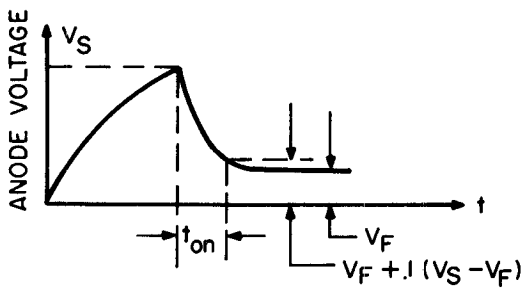
**This device is a symmetrical negative resistance diode. All electrical limits shown apply in either direction of current flow.

STATIC CHARACTERISTICS

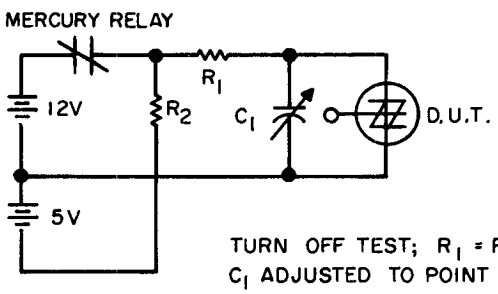


TEST CIRCUITS





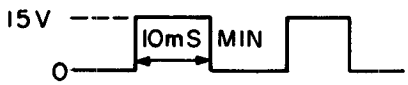
Circuit 1
Turn-on Time, t_{on}

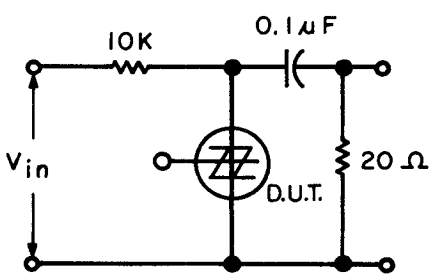


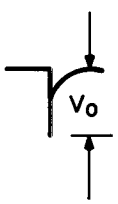
TURN OFF TEST; $R_1 = R_2 = 500\ \Omega$
C_1 ADJUSTED TO POINT WHERE
TURN – OFF JUST OCCURS

$t_{off} \triangleq (R_1 + R_2) C_1$

Circuit 2
Turn-off Time, t_{off}

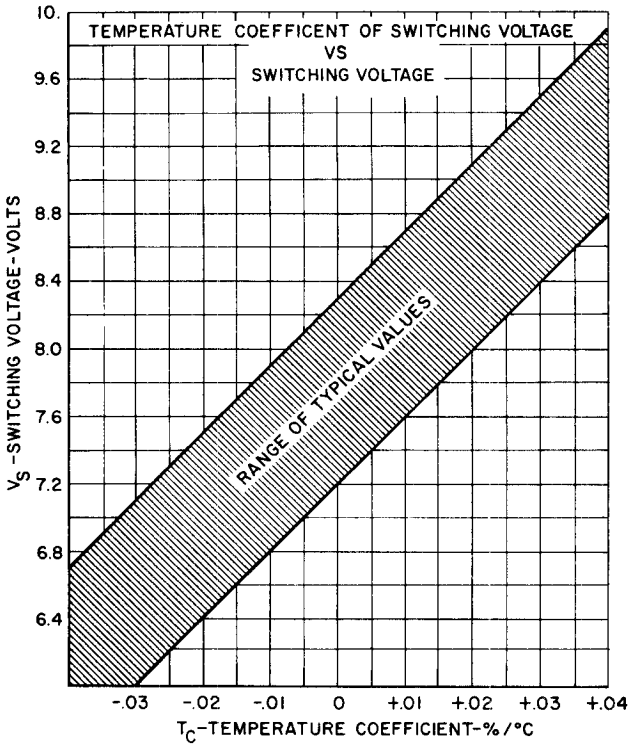


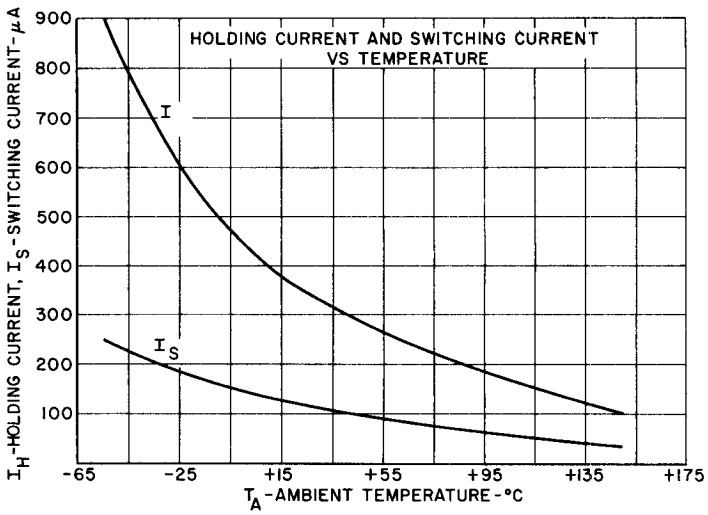


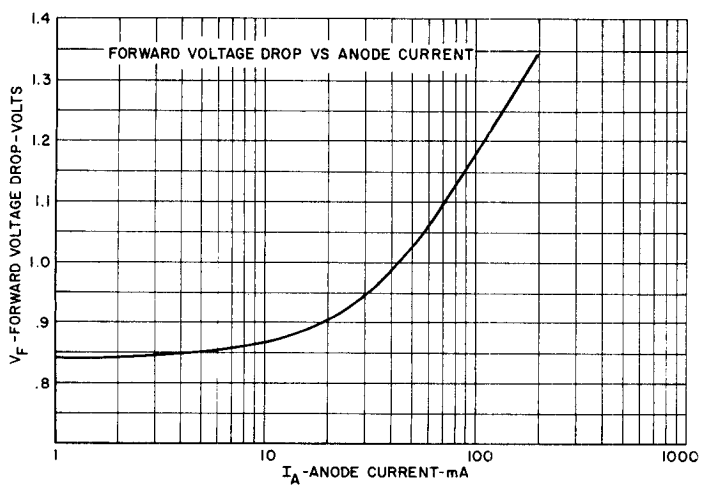


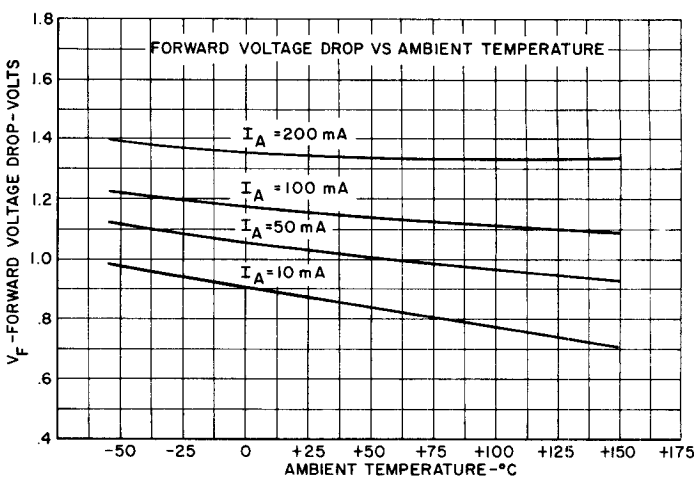
Circuit 3
Peak Pulse Amplitude, V_o

TYPICAL CHARACTERISTICS









TYPICAL CHARACTERISTICS