

UNIUNCTIONS, 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 addition, 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 UNIUNCTIONS 2N489-494—proved reliability, MIL spec version.

2N2646-47—low cost, proved hermetic sealed device.

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

COMPLEMENTARY UNIUNJECTION 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				Triggers	
		Conventional	Complementary	Programmable			
		2N489-94, 2N1671, 2N2160	2N2646 2N2647	D5K1 D5K2	2N6027 2N6028	SUS 2N4983-90	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 $\Delta I/\Delta T$	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	F	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

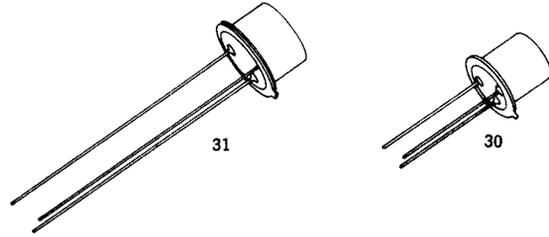
CONVENTIONAL UNIJUNCTIONS

General Electric produces a very broad line of standard UJT's. The TO-5 ceramic disc bar structure device has been the workhorse of the unijunction industry for over 10 years. MIL versions are available on the 2N489-494 series. The cube structure TO-18 series offers excellent value for those requiring proved, low cost units.

Applications

Oscillators
Timers
Sawtooth Generators

SCR Triggers
Frequency Divider
Stable Voltage Sensing



	GE Type	R _{BO} Interbase Resistance @ V _{BB} = 3V I _E = 0 (K Ω)	η Intrinsic Standoff Ratio @ V _{BB} = 10V	I _V Valley Current Min. (mA)	I _P Peak Point Emitter Current Max. (μ A)	I _{EO} Emitter Reverse Current		V _{OB1} Base One Peak Pulse Voltage Min. (V)	Comments	Package		
						Max. (μ A)	T _J = 25°C @ V _{B2E}					
TO-5 Bar Structure	2N489 2N489A* 2N489B	4.7-8.8	.51-.62	8	12 12 6	2 2 0.2	60 60 30	3 3	"A" versions are guaranteed in recommended circuit to trigger GE SCR's over range T _A = -55°C to 125°C. "B" versions in addition to SCR triggering guarantees lower I _{EO} and I _P for long timing periods with a smaller capacitor.	31		
	2N490 2N490A* 2N490B 2N490C	6.2-9.1	.51-.62	8	12 12 6 2	2 2 0.2 .02	60 60 30 30	3 3 3 3				
	2N491 2N491A* 2N491B	4.7-6.8	.56-.68	8	12 12 6	2 2 0.2	60 60 30	3 3				
	2N492 2N492A* 2N492B 2N492C	6.2-9.1	.56-.68	8	12 12 6 2	2 2 0.2 .02	60 60 30 30	3 3 3 3				
	2N493 2N493A* 2N493B	4.7-6.8	.62-.75	8	12 12 6	2 2 0.2	60 60 30	3 3				
	2N494 2N494A* 2N494B 2N494C	6.2-9.1	.62-.75	8	12 12 6 2	2 2 0.2 .02	60 60 30 30	3 3 3 3				
	2N1671 2N1671A 2N1671B 2N1671C	4.7-9.1	.47-.62	8	25 25 6 2	12 12 0.2 .02	30 30 30 30	3 3 3 3			Industrial types.	31
	2N2160	4.0-12.0	.47-.80	8	25	12	30	3			General purpose—low cost.	31
	2N2646	4.7-9.1	.56-.75	4	5	12	30	3			General purpose.	30
	2N2647	4.7-9.1	.68-.82	8	2	0.2	30	6			For long timing periods and triggering high current SCR's.	30
	D5J-43	4.7-9.1	.68-.82	6	2	1	30	5			General purpose.	30
	D5J-44	4.7-9.1	.68-.82	4	5	12	30	4			General purpose—low cost.	30
2N2840	4.7-9.1 ²	.62 Typical	2	10	1	30	—	For 1.5 volt applications.	30			

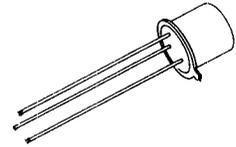
* JAN & JANTX types available

² V_{BB} = 1.5V

Silicon Unijunction Transistors

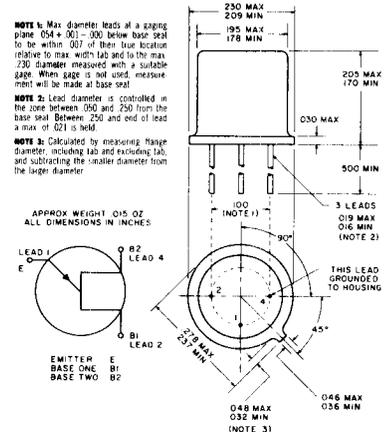


The General Electric 2N2646 and 2N2647 Silicon Unijunction Transistors have an entirely new structure resulting in lower saturation voltage, peak-point current and valley current as well as a much higher base-one peak pulse voltage. In addition, these devices are much faster switches. The 2N2646 is intended for general purpose industrial applications where circuit economy is of primary importance, and is ideal for use in firing circuits for Silicon Controlled Rectifiers and other applications where a guaranteed minimum pulse amplitude is required. The 2N2647 is intended for applications where a low emitter leakage current and a low peak point emitter current (trigger current) are required (i.e. long timing applications), and also for triggering high power SCR's.



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

Power Dissipation (Note 1)	300 mw
RMS Emitter Current	50 ma
Peak Emitter Current (Note 2)	2 amperes
Emitter Reverse Voltage	30 volts
Interbase Voltage	35 volts
Operating Temperature Range	-65°C to +125°C
Storage Temperature Range	-65°C to +150°C



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

PARAMETER

- Intrinsic Standoff Ratio ($V_{BB} = 10V$)
- Interbase Resistance ($V_{BB} = 3V, I_E = 0$)
- Emitter Saturation Voltage ($V_{BB} = 10V, I_E = 50 \text{ ma}$)
- Modulated Interbase Current ($V_{BB} = 10V, I_{B1} = 0$)
- Emitter Reverse Current ($V_{B2E} = 30V, I_{B1} = 0$)
- Peak Point Emitter Current ($V_{BB} = 25V$)
- Valley Point Current ($V_{BB} = 20V, R_{B2} = 100\Omega$)
- Base-One Peak Pulse Voltage (Note 3)
- SCR Firing Conditions (See Figure 26, back page)

PARAMETER	2N2646			2N2647			Units
	Min.	Typ.	Max.	Min.	Typ.	Max.	
η	0.56	0.69	0.75	0.68	0.77	0.82	
R_{BBO}	4.7	6.7	9.1	4.7	6.7	9.1	K Ω
$V_{E(SAT)}$		2		2			volts
$I_{B2(MOD)}$		24		27			ma
I_{EO}		.001	12	.001	.200		μa
I_P		0.8	5	1.0	2		ma
I_V	4	5		8	9	18	ma
V_{OB1}	3.0	8.5		6.0	9.5		volts

- Derate 3.0 MW/°C increase in ambient temperature. The total power dissipation (available power to Emitter and Base-Two) must be limited by the external circuitry.
- Capacitor discharge—10 μfd or less, 30 volts or less.
- The Base-One Peak Pulse Voltage is measured in the circuit below. This specification on the 2N2646 and 2N2647 is used to ensure a minimum pulse amplitude for applications in SCR firing circuits and other types of pulse circuits.
- The intrinsic standoff ratio, η , is essentially constant with temperature and interbase voltage. η is defined by the equation:

$$V_P = \eta V_{BB} + V_D$$
 Where V_P = Peak Point Emitter Voltage
 V_{BB} = Interbase Voltage
 V_D = Junction Diode Drop (Approx. .5V)

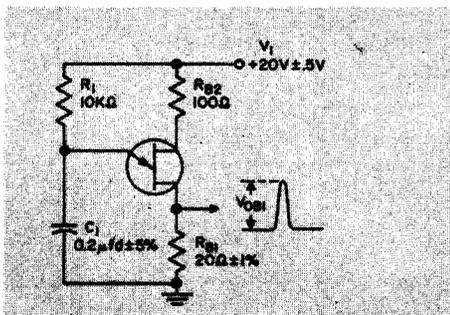


FIGURE 1

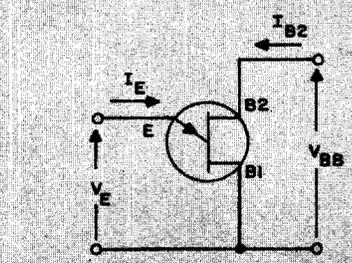


FIGURE 2
Unijunction Transistor Symbol with Nomenclature used for voltage and currents.

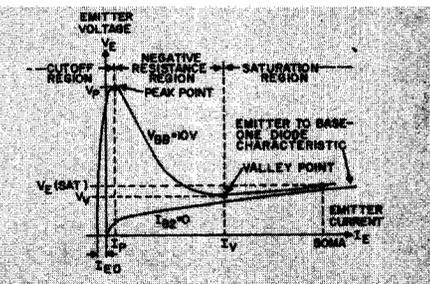


FIGURE 3
Static Emitter Characteristics curves showing important parameters and measurement points (exaggerated to show details).

$T_A = 125^\circ\text{C}$

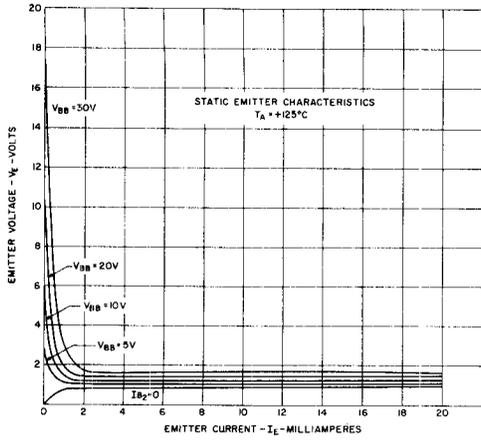


FIGURE 4

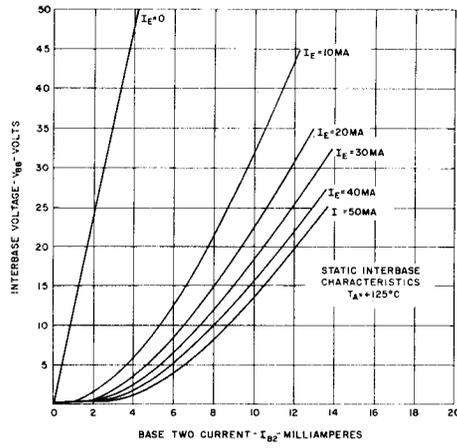


FIGURE 5

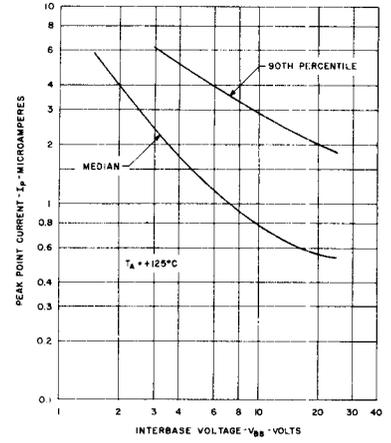


FIGURE 6

$T_A = 25^\circ\text{C}$

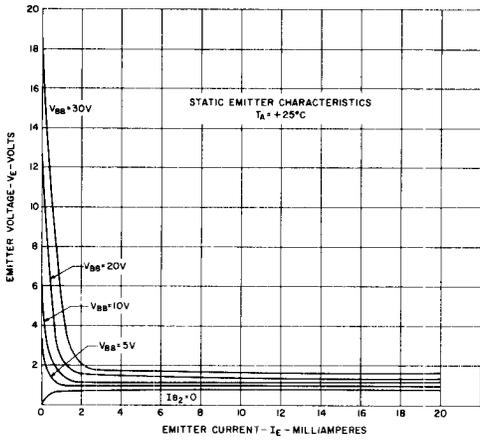


FIGURE 7

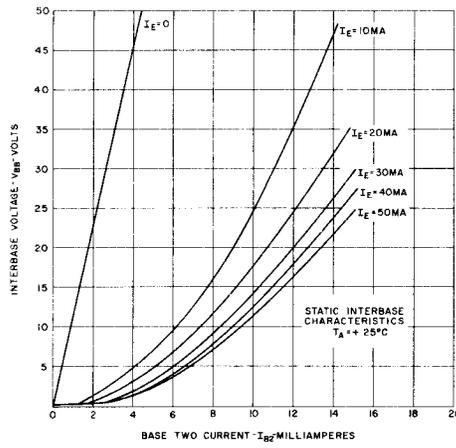


FIGURE 8

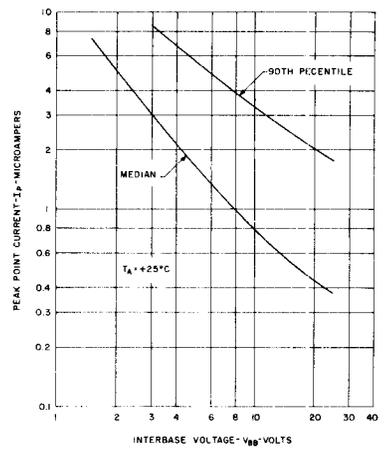


FIGURE 9

$T_A = -55^\circ\text{C}$

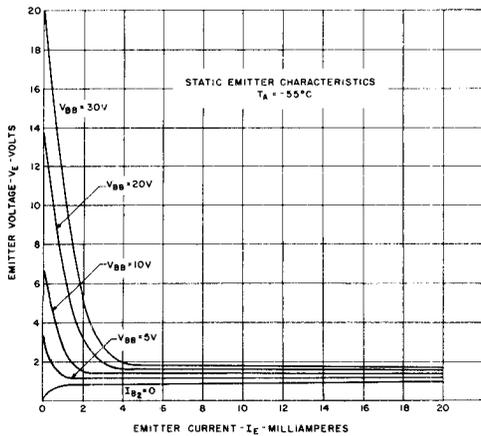


FIGURE 10

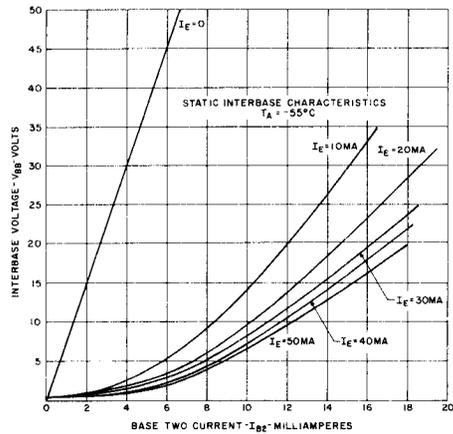


FIGURE 11

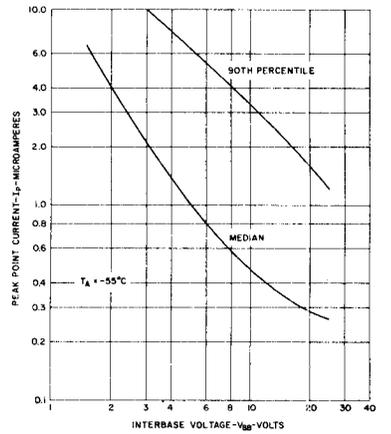


FIGURE 12

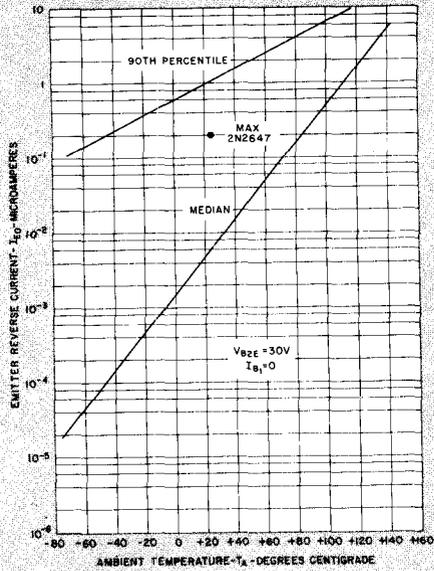


FIGURE 13

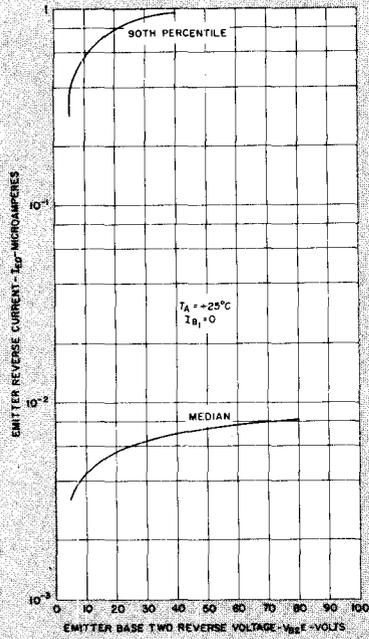


FIGURE 14

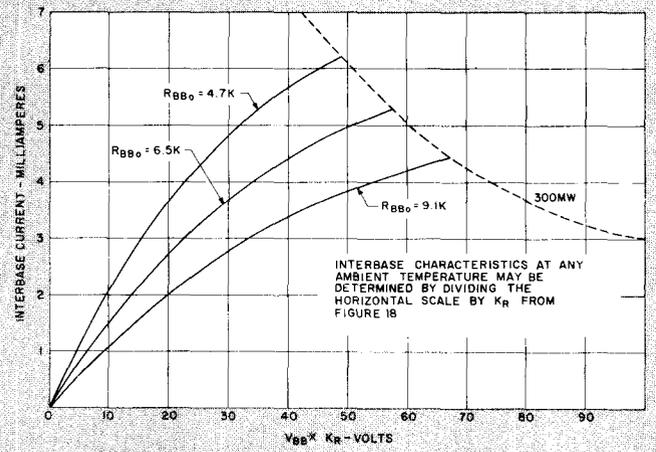


FIGURE 15

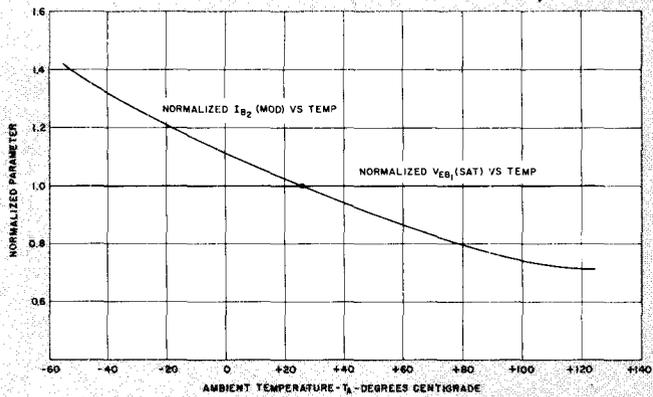


FIGURE 16

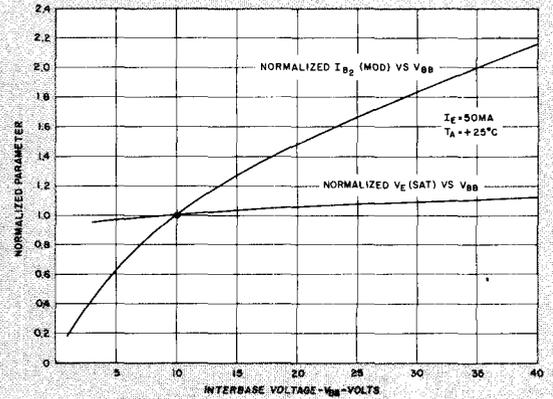


FIGURE 17

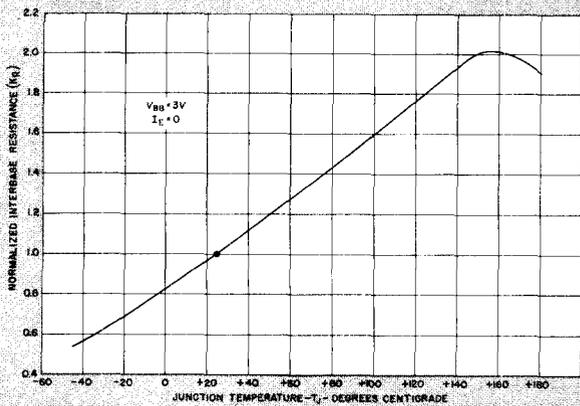


FIGURE 18

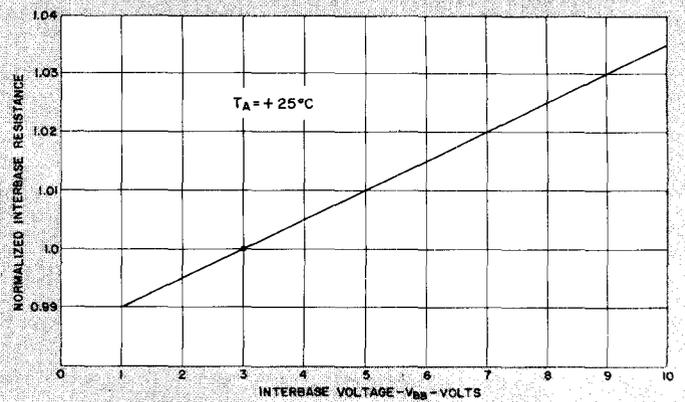


FIGURE 19

2N2646, 7

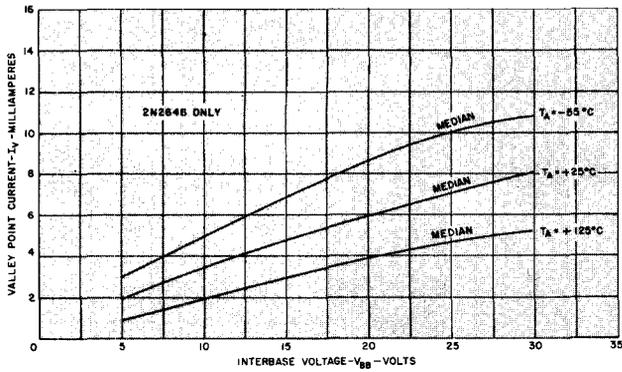


FIGURE 20

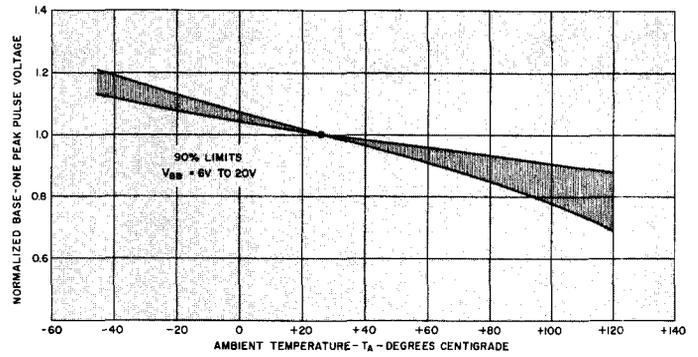


FIGURE 21

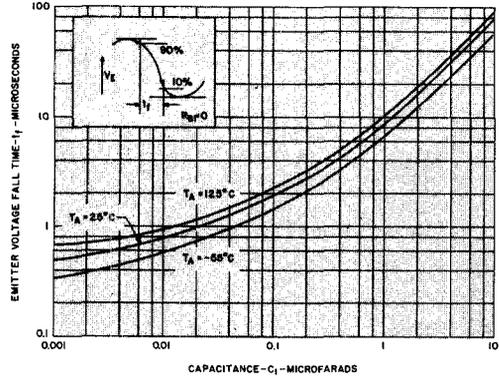


FIGURE 22

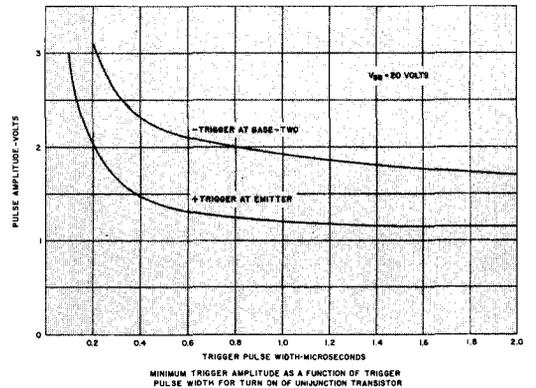


FIGURE 23

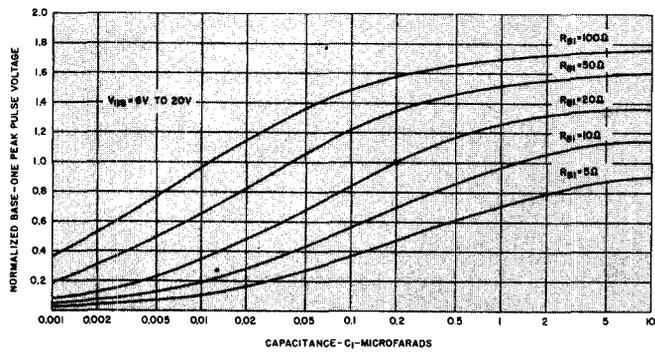


FIGURE 24

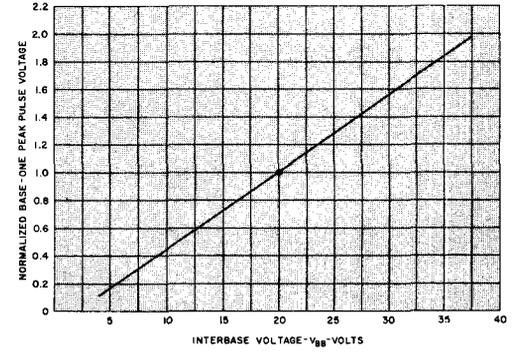


FIGURE 25

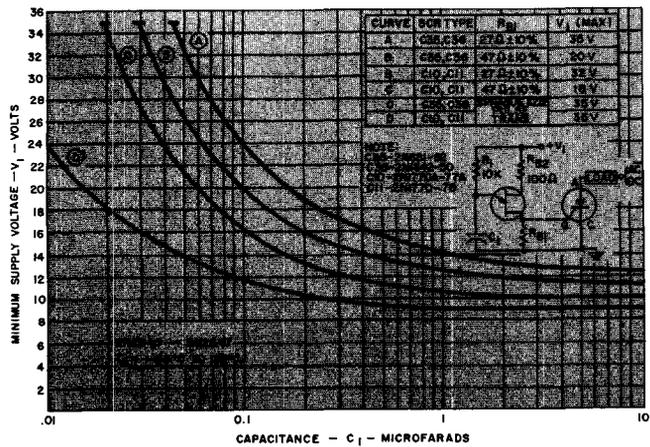


FIGURE 26A-Both types- Lo & Med. SCR's

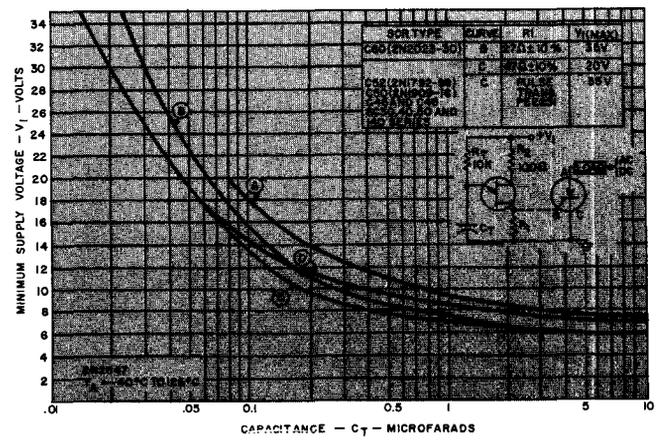


FIGURE 26B-2N2647-Hi Current SCR's