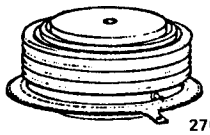
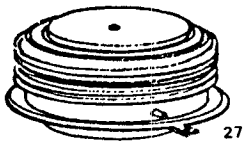


276

PHASE CONTROL SCR's
940 TO 1950 AMPERES



276.1

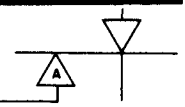
GE TYPE		C602	C601	C441	C440	C701	C702
ELECTRICAL SPECIFICATIONS							
VOLTAGE RANGE		1700-2600	1100-2000	1200-1800	500-1300	1100-2000	2000-2400
FORWARD CONDUCTION							
$I_{T(RMS)}$		940	1100	1100	1400	1950	1950
$I_{T(AV)}$	Max. average on-state current @ 180° conduction (A) @ T_C	600 @ 72°C	750 @ 72°C	700 @ 65°C	800 @ 75°C	1250 @ 70°C	1250 @ 70°C
$I_{T(AV)}$	Max. average on-state current for 3ϕ conduction (A) @ T_C	510 @ 80°C	620 @ 80°C	575 @ 80°C	650 @ 80°C	1040 @ 80°C	1040 @ 80°C
I_{TSM}	Max. peak one cycle, non-repetitive surge current (A)	10,000	11,000	11,000	13,000	18,000	15,000
I^2t	Max. I^2t for fusing for 5 to 8.3 msec (A^2 sec)	415,000	516,000	500,000	700,000	1,300,000	933,000
V_{TM}	Peak on-state voltage @ 125°C, 180° conduction, rated $I_{T(AV)}$ (V)	1.9	1.5	1.5	1.3	1.8	2.0
$R_{\theta JC}$	Max. internal thermal resistance, dc, junction-to-case (°C/W)	.036	.041	.04	.04	.025	.023
t_q	Typical turn-off time (μsec)	125	175	125	125	125	125
$t_d + t_r$	Typical turn-on time (μsec)	1.5	1.5	5	1.5	1.5	—
di/dt	Rate-of-rise turned-on current (A/μsec)	35-75	80-150	150	800	100	125
T_J	Junction operating temperature range (°C)	-40 to 125°C	-40 to 125°C	-40 to 125°C	-40 to 125°C	-40 to 125°C	-40 to 125°C
BLOCKING							
dv/dt	Min. critical rate-of-rise of off-state voltage. Exponential @ rated T_J (V/μsec)	200	200	200	200	200	200
FIRING							
I_{GT}	Max. required gate current to trigger (mA) @ −40°C	275	275	300	300	275	275
	@ 125°C	75	75	125	125	50	35
V_{GT}	Max. required gate voltage to trigger (V) @ −40°C	4.5	4.5	5	5	5.5	4.5
V_{GT}	Min. required gate voltage to trigger (V) @ 125°C	.2	.2	.15	.15	.3	.3
VOLTAGE TYPES							
Repetitive Peak Forward and Reverse Voltages							
500		—	—	—	C440E	—	—
600		—	—	—	C440M	—	—
700		—	—	—	C440S	—	—
800		—	—	—	C440N	—	—
900		—	—	—	C440T	—	—
1000		—	—	—	C440P	—	—
1100		—	C601PA	—	C440PA	C701PA	—
1200		—	C601PB	C441PB	C440PB	C701PB	—
1300		—	C601PC	C441PC	C440PC	C701PC	—
1400		—	C601PD	C441PD	—	C701PD	—
1500		—	C601PE	C441PE	—	C701PE	—
1600		—	C601PM	C441PM	—	C701PM	—
1700		C602PS	C601PS	C441PS	—	C701PS	—
1800		C602PN	C601PN	C441PN	—	C701PN	—
1900		C602PT	C601PT	—	—	C701PT	—
2000		C602L	C601L	—	—	C701L	C702L
2100		C602LA	—	—	—	—	C702LA
2200		C602LB	—	—	—	—	C702LB
2300		C602LC	—	—	—	—	C702LC
2400		C602LD	—	—	—	—	C702LD
2500		C602LE	—	—	—	—	—
2600		C602LM	—	—	—	—	—
PACKAGE TYPE		PRESS PAK	PRESS PAK	PRESS PAK	PRESS PAK	PRESS PAK	PRESS PAK
PACKAGE OUTLINE NO.		276	276	276	276	276.1	276.1

High Power Silicon Controlled Rectifier

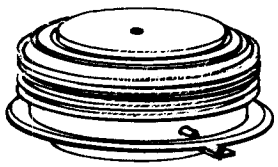
1250 A Avg., up to 2000 Volts

C701

AMPLIFYING GATE



The C701 Series of high power SCR's feature the newly developed multi-diffusion technology using 53mm diameter silicon in a new, pressure-mounted package for phase control.



FEATURES:

- 1250 Amps. Average Single Phase Current @ T_C = 60°C
- 20,000 Amps. Surge Current
- Glazed Ceramic Hermetic Package with 1" Creepage Path
- Reliability of Pressure Contacts Plus Reversibility of the Package
- Available in Factory Assembled Heat Exchanger or Ready-to-Mount
- Complementary Rectifiers

IMPORTANT: Mounting instructions on the last page of this specification **must** be followed.

MAXIMUM ALLOWABLE RATINGS

TYPE	REPETITIVE PEAK OFF-STATE AND REVERSE VOLTAGE, V_{DRM}/V_{RRM}[1] T_J = -40°C to +125°C	REPETITIVE PEAK OFF-STATE AND REVERSE VOLTAGE, V_{DRM}/V_{RRM}[1] T_J = 0°C to +125°C	TRANSIENT PEAK REVERSE VOLTAGE (NON-RECURRENT <5 MILLISEC.), V_{RSM} T_J = -40°C to +125°C
C701PA	1100 Volts	1200 Volts	1200 Volts
C701PB	1200	1300	1300
C701PC	1300	1400	1400
C701PD	1400	1500	1500
C701PE	1500	1600	1600
C701PM	1600	1700	1700
C701PS	1700	1800	1800
C701PN	1800	1900	1900
C701PT	1900	2000	2000
C701L	2000	2100	2100

[1] V_{DRM}/V_{RRM} ratings assume Presspak mounted to a heat dissipator of less than 0.3°C/W.

Average Forward Current, On-State ..... Depends on Conduction Angle
Peak One-Cycle Surge On-State Current, I_{TSM} ..... 20,000 Amperes
Maximum Rate-of-Rise of Anode Current Turn-On Interval
(Switching Rates ≤ 60 Hz) ..... Switch From <1000V 150A/μsec
I^2t (for fusing) (at 8.3 milliseconds) ..... 1,660,000 Ampere^2 Seconds
Peak Gate Power Dissipation, P_{GM} ..... 40 Watts
Average Gate Power Dissipation, $P_{G(AV)}$ ..... 5 Watts
Peak Reverse Gate Voltage, V_{GRM} ..... 5 Volts
Storage Temperature, T_{STG} ..... -40°C to +125°C
Operating Temperature, T_J ..... -40°C to +125°C
Mounting Force Required ..... **5000 – 7000 Lbs.**
22.2 – 31.2 KN

NOTES:

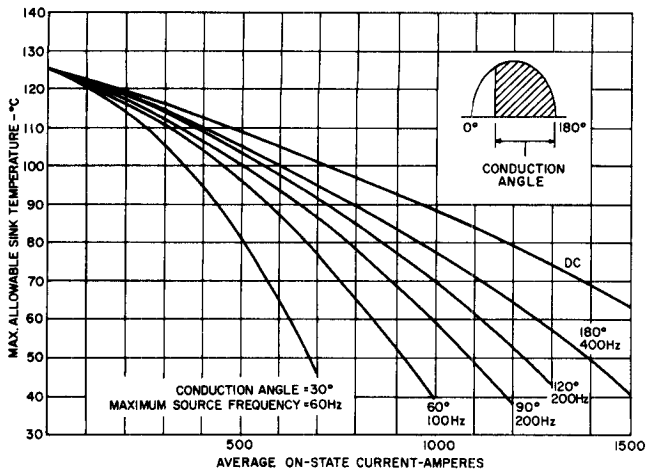
Surge current rating is established in accordance with EIA-NEMA Standard RS-397, Paragraph 5.2.2.1.

Required trigger source – 20 volts, 10 ohms; maximum switching voltage – 1000 volts; short-circuit gate supply current risetime – 0.5μsec. (This short-circuit current may be measured with a TEKTRONICS current probe): RC Snubber circuit used across SCR: 22 ohms, 0.5μf.

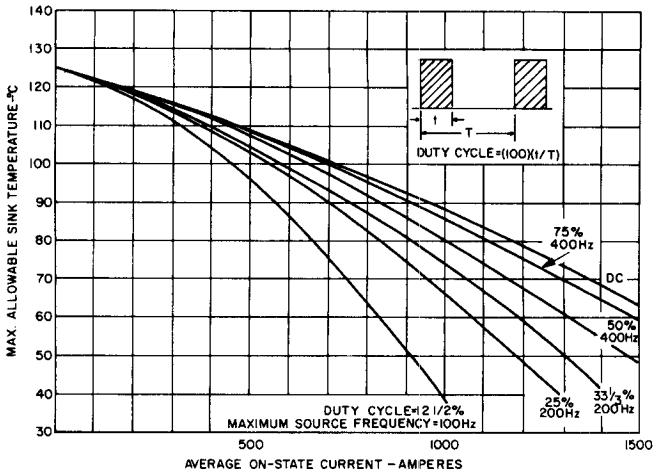
Repetitive di/dt rating is established in accordance with EIA-NEMA Standard RS-397, Section 5.2.2.6.

CHARACTERISTICS

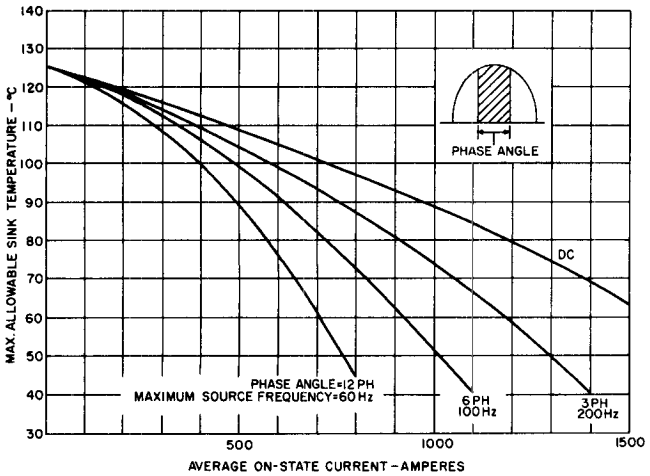
TEST	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Peak Reverse and Off-State Blocking Current	I_{DRM} and I_{RRM}	–	10	15	mA	T_J = +25°C, V = V_{DRM} = V_{RRM}
Peak Reverse and Off-State Blocking Current	I_{DRM} and I_{RRM}	–	45	65	mA	T_J = +125°C, V = V_{DRM} = V_{RRM}
Effective Thermal Resistance, Junction-to-Case	$R\theta_{JC}$	–	–	.023	°C/Watt	Junction-to-Case – Double Side Cooled (DC)
Critical Linear Rate-of-Rise of Forward Blocking Voltage (Higher values may cause device switching)	dv/dt	200	500	–	V/μsec	T_J = +125°C, V_{DRM} = .80 Rated, Gate Gate Open.
Holding Current	I_H	–	–	500	mAdc	T_C = +25°C, Anode supply = 20 Vdc. Initial On-State Current = 500 amps.
Latching Current	I_L	–	–	1.5	Adc	T_C = +25°C, Anode voltage = 24 Vdc. Load resistance 12 ohms max.
Delay Time	t_d	–	1.5	–	μsec	Switching From 300 Volts. 20 volt, 10 ohm Gate. 0.5 μsec Rise Time, T_J = 25°C
Gate Pulse Width Necessary to Trigger		–	–	10	μsec	See Figure 8
Gate Trigger Current	I_{GT}	–	60	150	mAdc	T_C = 25°C, V_D = 10 Vdc, R_L = 3 ohms
See Figure 8		5.0	15	50		T_C = +125° C, V_D = .5 x Rated, R_L = 1000 ohms
Gate Trigger Voltage	V_{GT}	–	2.5	4.5	Vdc	T_C = 0°C to +125°C, V_D = 10 Vdc, R_L = 1000 ohms
See Figure 8		.3	–	–		T_C = +125°C, V_D = .5 x Rated, R_L = 1000 ohms
Peak On-State Voltage	V_{TM}	–	–	1.70	Volts	T_C = -40°C to +125°C, I_T = 3000 Amps. Peak. Duty Cycle ⩽ 0.01%
Circuit Commutated Turn-Off Time	t_q	–	125	250	μsec	(1) T_C = +125°C (2) I_T = 1000 Amps. (3) V_R = 75 Volts min. (4) 0.5 V_{DRM} Reapplied (5) Rate-of-rise of reapplied forward blocking voltage = 50V/μsec. (linear) (6) Gate bias during turn-off interval, Duty cycle ⩽ 0.01%
Suppressible Surge Current	$I_{TM(SUP)}$	–	1800	–	Amps	(1) T_C = 115°C (2) V_R = .67 V_{DRM} (3) .67 V_{RRM} Applied, 8.3 msec after completion of surge. (4) Figure 10.



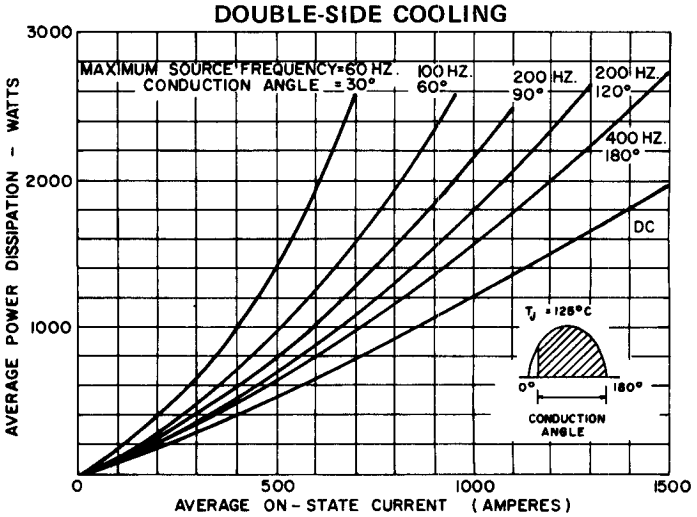
1. MAXIMUM ALLOWABLE HEATSINK TEMPERATURE FOR SINUSOIDAL CURRENT WAVEFORM – DOUBLE-SIDE COOLING



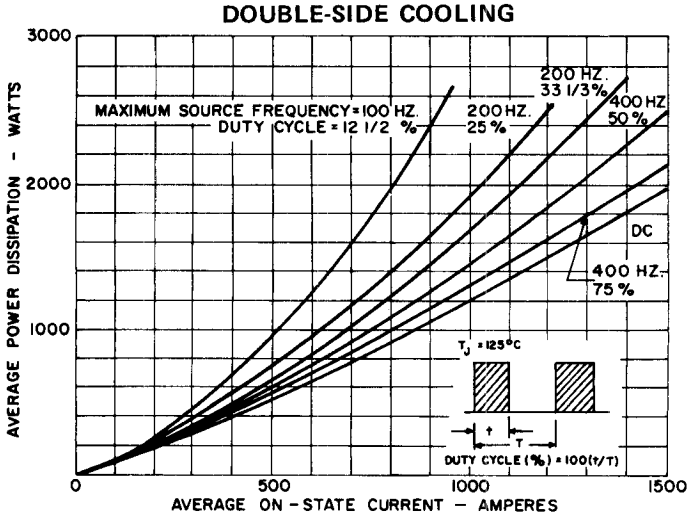
2. MAXIMUM ALLOWABLE HEATSINK TEMPERATURE FOR RECTANGULAR CURRENT WAVEFORM – DOUBLE-SIDE COOLING



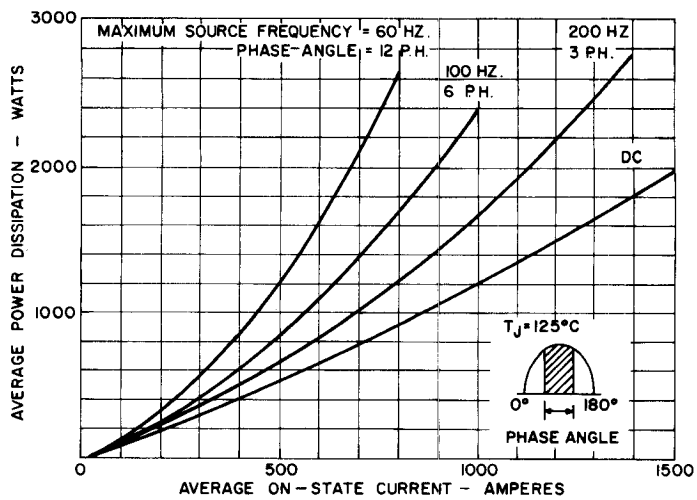
3. MAXIMUM ALLOWABLE HEATSINK HEATSINK TEMPERATURE – CIRCUIT PHASE CURRENT WAVEFORM – DOUBLE-SIDE COOLING



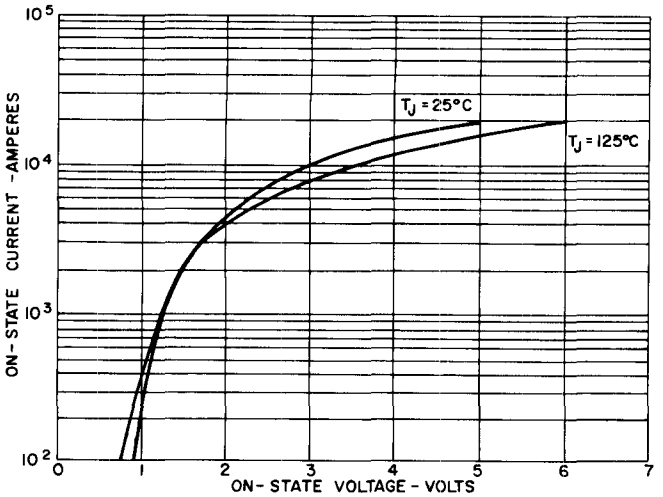
4. AVERAGE FORWARD POWER DISSIPATION FOR SINUSOIDAL CURRENT WAVEFORM



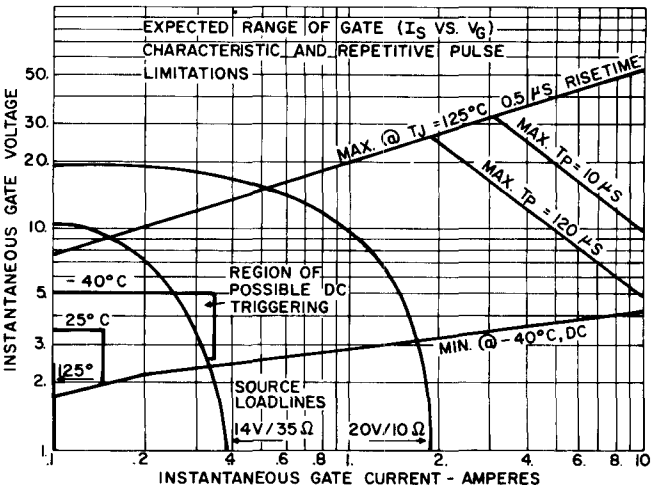
5. FORWARD POWER DISSIPATION FOR RECTANGULAR CURRENT WAVEFORM



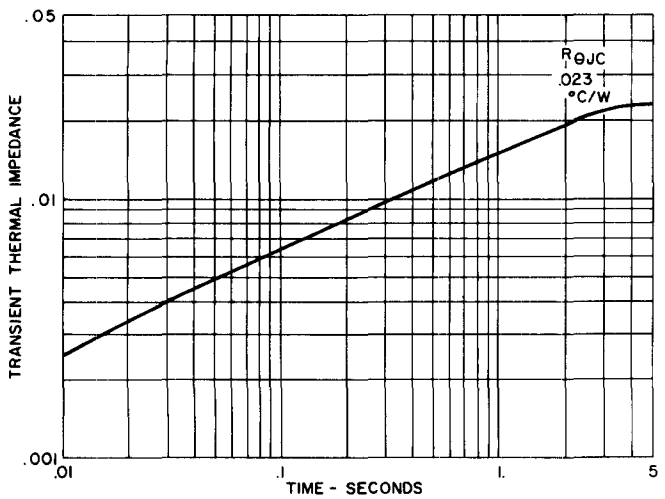
6. AVERAGE FORWARD POWER DISSIPATION



7. MAXIMUM ON-STATE CHARACTERISTICS



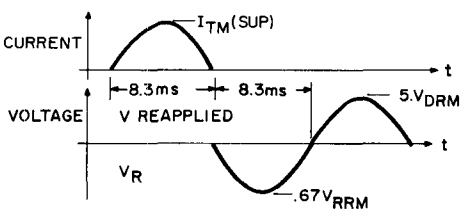
8. TRIGGERING CHARACTERISTICS



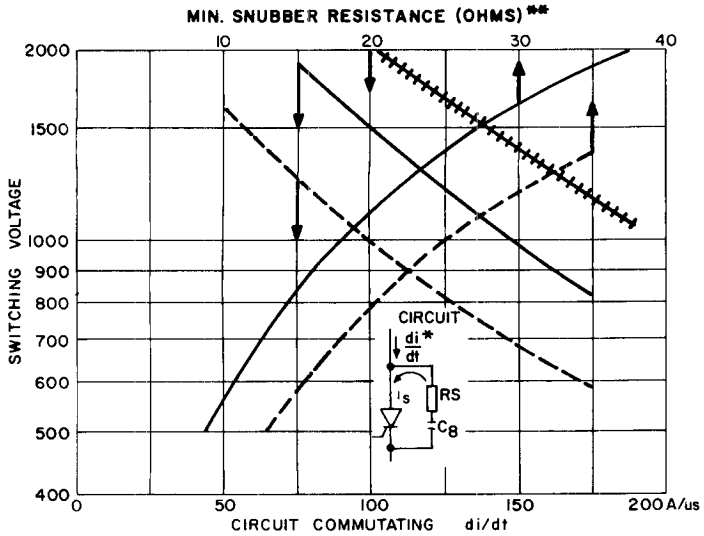
NOTES:

1. Add .006°C/W to account for both case to dissipator interfaces when properly mounted; e.g., $R_{\theta JS}$ = .029° C/W. See Mounting Instructions.
2. DC Thermal Impedance is based on average full cycle junction temperature. Instantaneous junction temperature may be calculated using the following modifications:
   - end of conducting portion of cycle
     - 120° sq. wave add .0025°C/W along entire curve
     - 180° sq. wave add .0018°C/W along entire curve
     - 180° sine wave add .0010°C/W along entire curve
   - end of full cycle
     - any wave, subtract .001°C/W along entire curve.

9. TRANSIENT THERMAL RESISTANCE – JUNCTION-TO-HEATSINK



10. SUPPRESSIBLE SURGE CURRENT TEST



NOTES:

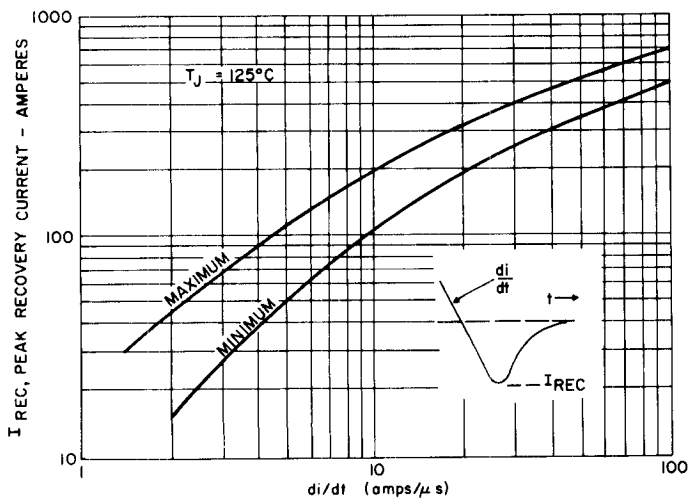
Code:
- +++++ Non-Repetitive High Gate Drive
- ——— Repetitive High Gate Drive
- ——— Non-Repetitive Low Gate Drive
- – – – Repetitive Low Gate Drive

	Low Gate Drive	High Gate Drive
Source	14V/35 ohms	20V/10 ohms
Pulse Width, t_p	$\geqslant 20\ \mu s$	$\geqslant 10\ \mu s$
Current Rise Time, t_r	$\leqslant 2$	$\leqslant 0.5\ \mu s$

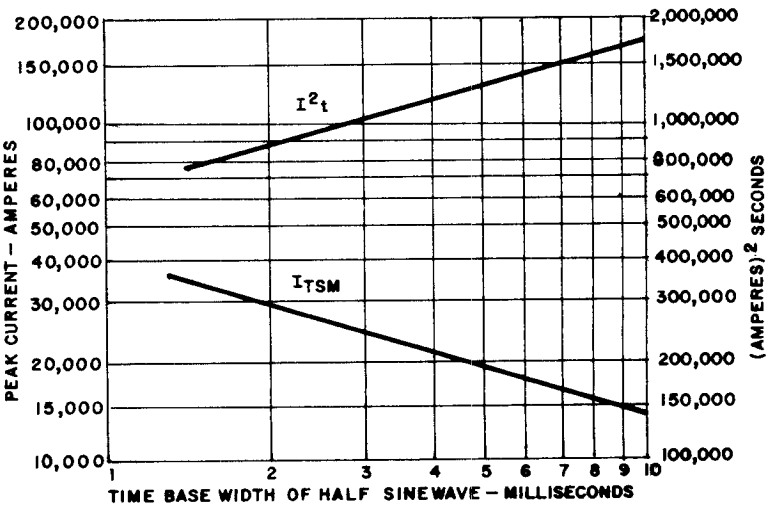
*Permissible circuit di/dt excluding snubber discharge. Repetitive di/dt is SPCO recommended maximum condition to achieve most industrial requirements for service life. It meets or exceeds the JEDEC test requirements for certification set forth in NEMA Std. Sk. 516 (1972). Non-repetitive di/dt meets the JEDEC 5 second rating.

**Snubber discharge, i_s, is treated separately using the minimum value of snubber resistance indicated above. This applies for long industrial life (20 — 30 years) in combination with circuit di/dt.

11. ALLOWABLE DI/DT AND SNUBBER RESISTANCE

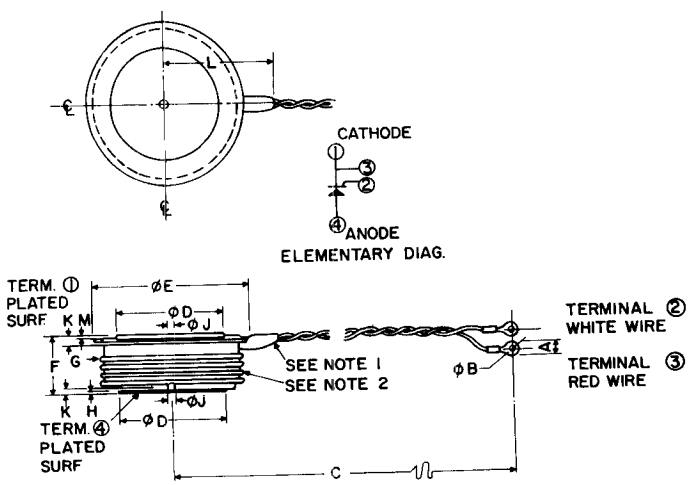


12. PEAK RECOVERY CURRENT



13. NON-REPETITIVE I_{TSM} AND I^2t CAPABILITY FOR FUSE COORDINATION

OUTLINE DRAWING



SYMBOL	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	NOTES
A	0.200	0.240	5.08	6.10	1
ΦB	0.140		3.56		
C	16.000	20.000	406.40	508.00	
ΦD	1.700	1.900	43.18	48.26	
ΦE		2.960		75.18	
F	1.000	1.070	25.40	27.18	
G					2
H	.005	.067	0.13	1.70	
ΦJ	0.136	0.146	3.45	3.71	
K	.070		1.78		
L		2.500		63.50	
M	.030		0.76		

C701
ASSEMBLY OF PRESSPAKS TO HEAT DISSIPATORS

The following instruction is essential for maintaining low, stable thermal and electrical resistances associated with the Presspak to heat dissipator surfaces.

1. INSPECTION OF MATING SURFACES

Check each mating surface for nicks, scratches, flames and surface finish. The Presspak surface has a total indicator reading TIR < .0005 inch and surface ^{32} finish prior to factory electrical test in pressure fixtures. The dissipator surface should be equally as good. The TIR of a fully tested Presspak may run higher but not exceed .001 inch not including some minor nicks and scratches also associated with test fixtures. (Recommended mounting force is based upon these requirements.)

2. SURFACE DEOXIDATION AND CLEANING

Although plated surfaces are recommended for aluminum and copper heat dissipators, bare surfaces may be used if careful attention to cleaning and treating is assured. Plated surfaces and Presspaks should be *lightly sanded* with 600 grit paper, then oil or compound applied as recommended. Unplated surfaces should be vigorously abraided with a fine wire brush or 3M "Scotchbrite" coated with Alcoa #2 compound. The Alcoa #2 should be removed and the recommended compound applied.

3. FINAL SURFACE TREATMENT [a] [b]

Apply silicone oil or *thin layer* of grease or compound as indicated below. Rotate the Presspak to properly distribute the applied agent.

- bare copper – use G322L or LS2037*;
- bare aluminum – use Alcoa #2 or G322L;
- tin-plated copper or aluminum – use SF1154 preferably, or G623 or G322L;
- nickel-plated aluminum – use SF1154 or G623;
- silver-plating is not recommended.

4. MOUNTING

Assemble with specified mounting force applied through a self-leveling swivel connection. The force has to be evenly distributed over the full area. Center holes on top and bottom of the Presspak are for locating.

NOTES:

a) Silicone oil SF1154, 200 centistoke, clear silicone grease G623, and yellow compound G322L are products of the General Electric Company; compound Alcoa #2 is a product of Aluminum Company of America; and LS2037 black compound is product of Arco Company, 7301 Bessemer Avenue, Cleveland, Ohio.

b) Limit maximum joint temperature to 95°C, except for those prepared with SF1154 or G322L, which are limited to 150°C.