POWEREX

Thyristor
Silicon Controlled Rectifiers

Type T620
600 to 850 A RMS
200 to 300 A AVE

Features

- all diffused design
- guaranteed high dv/dt
- low gate current
- guaranteed value of di/dt
- low thermal impedance
- high RMS current capability
- high surge current capability
- high voltage availability
- single or double-sided cooling
- reverse mounting polarity
- compact size and weight

Application

Designed for cycling loads especially suitable for such applications as motor control, starters and primary controlled power systems, where high inrush currents are encountered.

Ordering Information

Obtain optimum device performance for your application by selecting proper order code from the table below.

Type	Voltage		Current		Turn-off	Gate-current		Leads		dv/dt	
Same for all devices on this data sheet	V_{DRM} and V_{RRM} (V)	Code	$I_{T(AVE)}$ (A)	Code	Same for all devices on this data sheet	I_{GT} (mA)	Code	Case	Code	For standard product	
T620	100	01	200	20	0	150	4	T62	DN	NO CODE	
	200	02	250	25							
	300	03	300	30							
	400	04				Same for all devices on this data sheet					
	500	05									
	600	06									
	700	07									
	800	08									
	900	09									
	1000	10									
	1100	11									
	1200	12			For coding information for special turn-off time refer to the HIGH FREQUENCY DATA BOOK	For special requirements				For special selection	
	1300	13				200	3			dv/dt (V/μsec)	Code
	1400	14				100	5			at V_{DRM} = 100 %	
	1500	15								500	51
	1600	16								750	52
										1000	53
										1500	54
										at V_{DRM} = 50 %	
										500	56
										750	57
										1000	58
										1500	59

Example : Type T620 rated at 200 amps average with V_{DRM}=1600 V, T62 case, dv/dt = 300 V/μsec. to full voltage reapplied
Order as T620162004DN

T620	16	20	0	4	DN	

Example : Type T620 rated at 300 amps average with V_{DRM} = 1200 V, T62 case, dv/dt 1000 V/μsec. to full voltage reapplied
Order as T620123004DN53

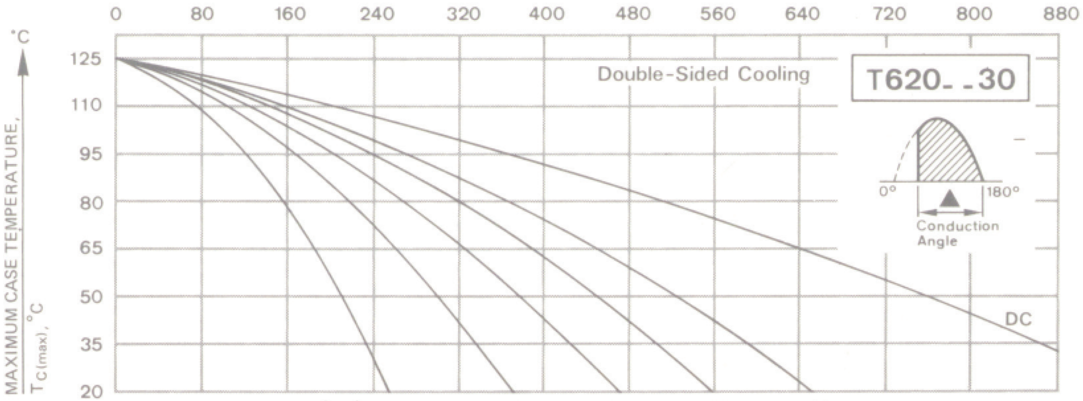
T620	12	30	0	4	DN	53

CHARACTERISTIC	SYMBOL	UNIT	MIN.	TYP.	MAX.	ORDER CODE	TEST CONDITIONS
Current (for double-sided cooling)							T_J = + 125°C. Sinusoidal wave form 180° conduction angle. T_C = + 90° C assumes a thermal resistance $R_{(th)CA}$ of less than 0.12°C/W and an ambient temperature of +40°C.
T620--20 RMS for all conduction angles	I_{TRMS}	A			600	20	Under test conditions
Average on-state	I_{TAV}	A			200		
Peak surge on-state non-repetitive 10 ms	I_{TSM}	A			5200		No voltage reapplied
1 ms	I_{TSM}	A			9300		No voltage reapplied
10 ms	I_{TSM}	A			4700		50 % voltage reapplied
10 ms	I_{TSM}	A			4100		100 % voltage reapplied
I^2t for fusing ⩾ 10 ms	I^2t	A^2s			84000		100 % voltage reapplied
$I^2\sqrt{t}$ for fusing ⩽ 10 ms	$I^2\sqrt{t}$	$A^2\sqrt{s}$			1352000		No voltage reapplied
Threshold voltage	$V_{T(TO)}$	V			1.27		
Slope resistance	r_T	mΩ			1.30		
T620--25 RMS for all conduction angles	I_{TRMS}	A			750	25	Under test conditions
Average on-state	I_{TAV}	A			250		
Peak surge on-state non-repetitive 10 ms	I_{TSM}	A			6400		No voltage reapplied
1 ms	I_{TSM}	A			11350		No voltage reapplied
10 ms	I_{TSM}	A			5750		50 % voltage reapplied
10 ms	I_{TSM}	A			5000		100 % voltage reapplied
I^2t for fusing ⩾ 10 ms	I^2t	A^2s			125000		100 % voltage reapplied
$I^2\sqrt{t}$ for fusing ⩽ 10 ms	$I^2\sqrt{t}$	$A^2\sqrt{s}$			2048000		No voltage reapplied
Threshold voltage	$V_{T(TO)}$	V			1.02		
Slope resistance	r_T	mΩ			0.90		
T620--30 RMS for all conduction angles	I_{TRMS}	A			850	30	Under test conditions
Average on-state	I_{TAV}	A			300		
Peak surge on-state non-repetitive 10 ms	I_{TSM}	A			7300		No voltage reapplied
1 ms	I_{TSM}	A			12900		No voltage reapplied
10 ms	I_{TSM}	A			6500		50 % voltage reapplied
10 ms	I_{TSM}	A			5700		100 % voltage reapplied
I^2t for fusing ⩾ 10 ms	I^2t	A^2s			162500		100 % voltage reapplied
$I^2\sqrt{t}$ for fusing ⩽ 10 ms	$I^2\sqrt{t}$	$A^2\sqrt{s}$			2664500		No voltage reapplied
Threshold voltage	$V_{T(TO)}$	V			0.88		
Slope resistance	r_T	mΩ			0.70		
RMS for all conduction angles	I_{TRMS}	A	RESERVED FOR FUTURE PRODUCT INTRODUCTION				Under test conditions
Average on-state	I_{TAV}	A					
Peak surge on-state non-repetitive 10 ms	I_{TSM}	A					No voltage reapplied
1 ms	I_{TSM}	A					No voltage reapplied
10 ms	I_{TSM}	A					50 % voltage reapplied
10 ms	I_{TSM}	A					100 % voltage reapplied
I^2t for fusing ⩾ 10 ms	I^2t	A^2s					100 % voltage reapplied
$I^2\sqrt{t}$ for fusing ⩽ 10 ms	$I^2\sqrt{t}$	$A^2\sqrt{s}$					No voltage reapplied
Threshold voltage	$V_{T(TO)}$	V					
Slope resistance	r_T	mΩ					
RMS for all conduction angles	I_{TRMS}	A	RESERVED FOR FUTURE PRODUCT INTRODUCTION				Under test conditions
Average on-state	I_{TAV}	A					
Peak surge on-state non-repetitive 10 ms	I_{TSM}	A					No voltage reapplied
1 ms	I_{TSM}	A					No voltage reapplied
10 ms	I_{TSM}	A					50 % voltage reapplied
10 ms	I_{TSM}	A					100 % voltage reapplied
I^2t for fusing ⩾ 10 ms	I^2t	A^2s					100 % voltage reapplied
$I^2\sqrt{t}$ for fusing ⩽ 10 ms	$I^2\sqrt{t}$	$A^2\sqrt{s}$					No voltage reapplied
Threshold voltage	$V_{T(TO)}$	V					
Slope resistance	r_T	mΩ					
RMS for all conduction angles	I_{TRMS}	A	RESERVED FOR FUTURE PRODUCT INTRODUCTION				Under test conditions
Average on-state	I_{TAV}	A					
Peak surge on-state non-repetitive 10 ms	I_{TSM}	A					No voltage reapplied
1 ms	I_{TSM}	A					No voltage reapplied
10 ms	I_{TSM}	A					50 % voltage reapplied
10 ms	I_{TSM}	A					100 % voltage reapplied
I^2t for fusing ⩾ 10 ms	I^2t	A^2s					100 % voltage reapplied
$I^2\sqrt{t}$ for fusing ⩽ 10 ms	$I^2\sqrt{t}$	$A^2\sqrt{s}$					No voltage reapplied
Threshold voltage	$V_{T(TO)}$	V					
Slope resistance	r_T	mΩ					
Voltage							T_J = + 125°C. Sinusoidal wave form 180° conduction angle.
Repetitive peak off-state or Repetitive peak reverse	V_{DRM} / V_{RRM}					Refer to ordering information	$V = V_{DRM} = V_{RRM}$
T620 - - 20		V	100		1600		
T620 - - 25		V	100		1400		
T620 - - 30		V	100		1200		
Non repetitive peak reverse for all voltage classes	V_{RSM}	V			V_{RRM} + 100		Non-recurrent voltage ⩽ 5 ms $V = V_{RRM}$ + 100 Volts

Thyristor T620

	CHARACTERISTIC	SYMBOL	UNIT	MIN.	TYP.	MAX.	ORDER CODE	TEST CONDITIONS
Gate SEE AD 54-560 - ALL TYPES	Trigger continuous (direct) current Trigger continuous (direct) voltage	I_{GT} V_{GT}	mA V		75	150 3	4	T_J = + 25°C V_D = 12 V , R_L = 10 Ω
	Trigger continuous (direct) current Trigger continuous (direct) voltage	I_{GT} V_{GT}	mA V		25	75 3		T_J = + 125°C V_D = 12 V , R_L = 10 Ω
	Trigger continuous (direct) current Trigger continuous (direct) voltage	I_{GT} V_{GT}	mA V		100	300 4		T_J = – 40°C V_D = 12 V , R_L = 10 Ω
	Non-Trigger continuous (direct) voltage	V_{GDM}	V	0.15				T_J = + 125°C V_{DRM} , R_L = 1000 Ω
	Peak forward current Peak forward voltage Peak reverse voltage Peak power Average power	I_{FGM} V_{FGM} V_{RGM} P_{GM} $P_{G(AV)M}$	A V V W W			4 20 5 16 3		} Minimum circuit resistance : 5 Ω
Switching SEE AD 54-560 54-580 - ALL TYPES	Gate controlled turn-on time (t_d + t_r)	t_{gt}	μs		5			T_J = + 25°C V = V 100 V I_{TM} = 100 A C = 40 μF R = 1 Ω V_G = 20 V , R_G = 30 Ω t_{pulse} = 10 μsec
	Delay time	t_d	μs		3 1			T_J = + 125°C T_J = + 25°C
	Circuit commutated turn-off time	t_q	μs		100		0	T_J = + 125°C I_{TM} = 150 A d_{IR}/dt = 12.5 A/μsec V_{RRM} = 100 V dv/dt linear reapplied up to 80% V_{DRM} = 100 V/μsec
	Rate of rise of on-state voltage	dv / dt	V / μs	300 500 750 1000 1500			51 52 53 54	T_J = + 125°C Gate open Exponential up to 100 % V_{DRM}
		dv / dt	V / μs	500 750 1000 1500			56 57 58 59	T_J = + 125°C Gate open Exponential up to 50 % V_{DRM}
	Rate of rise of on-state current	di / dt	A / μs	100				T_J = + 125°C Linear up to 5 x I_{TAV}
Thermal - ALL TYPES	Operating junction temperature	T_J	°C	– 40		+ 125		
	Operating storage temperature	T_{STG}	°C	– 40		+ 150		
	Thermal resistance junction to case for double-sided cooling. (For single-sided cooling multiply by 1.9)	$R_{(th)JC}$	°C/W			0.070 0.080 0.084 0.091 0.100 0.112 0.081 0.090 0.094 0.100 0.108		D.C. 180° conduction angle ∩ 120° conduction angle ∩ 90° conduction angle ∩ 60° conduction angle ∩ 30° conduction angle ∩ 180° conduction angle ⊓ 120° conduction angle ⊓ 90° conduction angle ⊓ 60° conduction angle ⊓ 30° conduction angle ⊓
	Thermal resistance case to heat sink – for double-sided cooling – for single-sided cooling	$R_{(th)CS}$	°C/W			0.020 0.030		Lubricated heat sink cleaned surface finish 30-60 μin, flat to .001.
	Recommended thermal resistance heat sink to ambient (For double-sided cooling)	$R_{(th)SA}$	°C/W			0.100 0.350 0.040		Air cooling = 1000 LFM Natural cooling Water cooling = 1 GPM
	Recommended thermal resistance junction to ambient for double sides $R_{(th)JA} = R_{(th)JC} + R_{(th)CS} + R_{(th)SA}$	$R_{(th)JA}$	°C/W			0.200		Air cooling = 1000 LFM 180° conduction angle sinusoidal wave form
Others - ALL TYPES	Repetitive peak off-state current Repetitive peak reverse current	I_{DRM} I_{RRM}	mA mA			15 15		T_J = + 125°C V = V_{DRM} = V_{RRM}
	Continuous (direct) holding current	I_H	mA		80			T_J = + 25°C V_D = 30 V I_F > 500 mA Refer to SCR Handbook Page 5.2
	Continuous (direct) latching current	I_L	mA		200			T_J = + 25°C V_D = 30 V I_G = 400 mA Refer to SCR Handbook Page 5.2

Figure 13 – Case Temperature vs Forward Current, Half-Wave Sinusoid, for Various Conduction Angles.



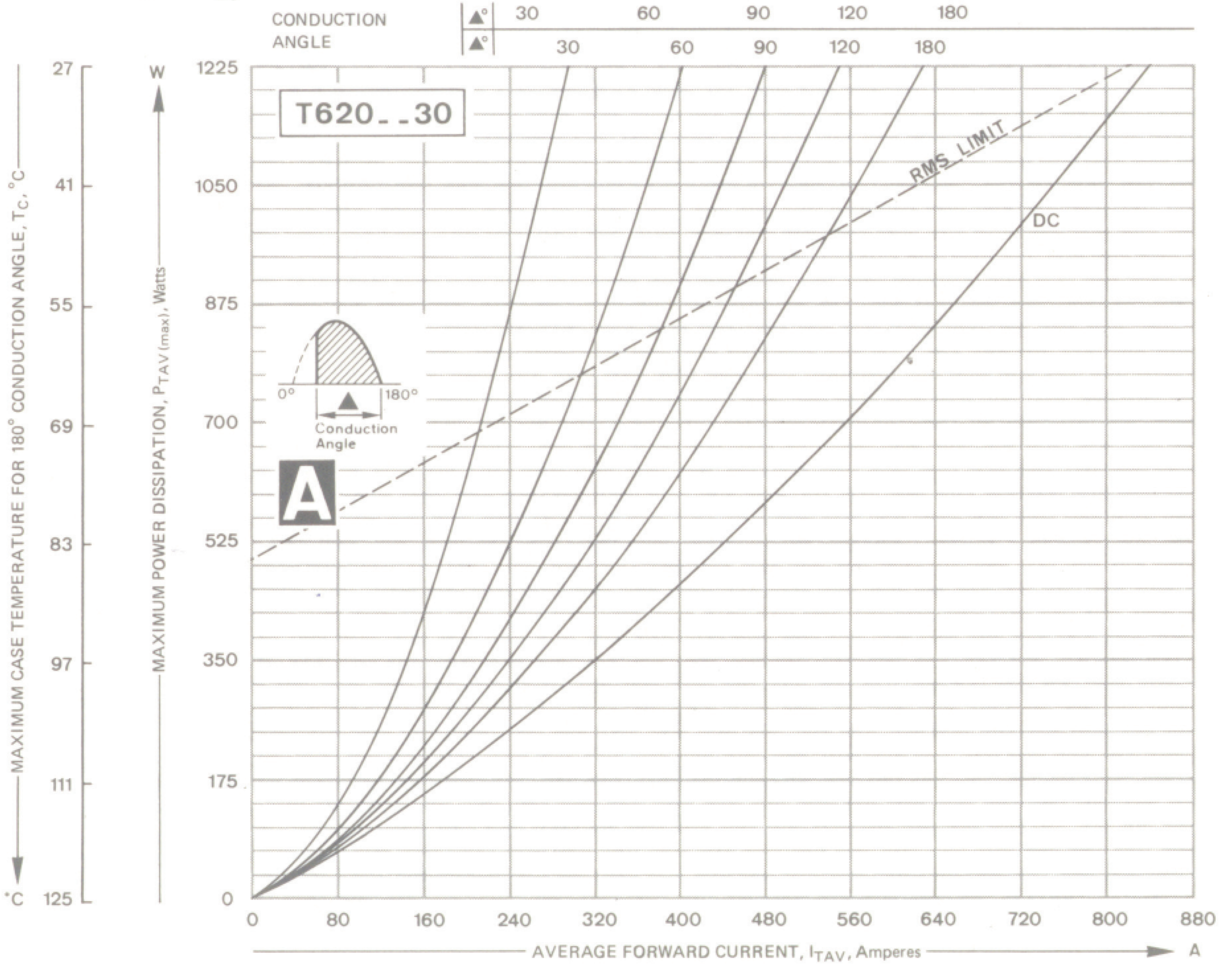


Figure 14 – Power Dissipation vs Forward Current, Half-Wave Sinusoid, for Various Conduction Angles.

NOMOGRAPH for DETERMINATION of ALLOWABLE OPERATING LOADS.

GRAPH **A** IN COMBINATION WITH GRAPH **B** MAY BE USED TO DETERMINE :

1. **Allowable** I_{AV} vs. a specific junction-to-ambient thermal resistance ($R_{(th)JA}$) and specified ambient temperature.
2. **Maximum allowable junction-to-ambient thermal resistance** ($R_{(th)JA}$) for a specified I_{AV} and specified ambient temperature.
3. **Maximum allowable ambient temperature** for a specified I_{AV} and a specified junction-to-ambient thermal resistance ($R_{(th)JA}$).

In determining the junction-to-ambient thermal resistance ($R_{(th)JA}$), attention must be given to selecting the correct junction-to-case thermal resistance ($R_{(th)JC}$) which is related to the conduction angle to be considered (refer to page 3, Thermal Data).

To calculate the required heat sink thermal resistance, use :

$$R_{(th)SA} = R_{(th)JA} - \left[R_{(th)JC\,(\text{conduction angle})} + R_{(th)CS} \right]$$

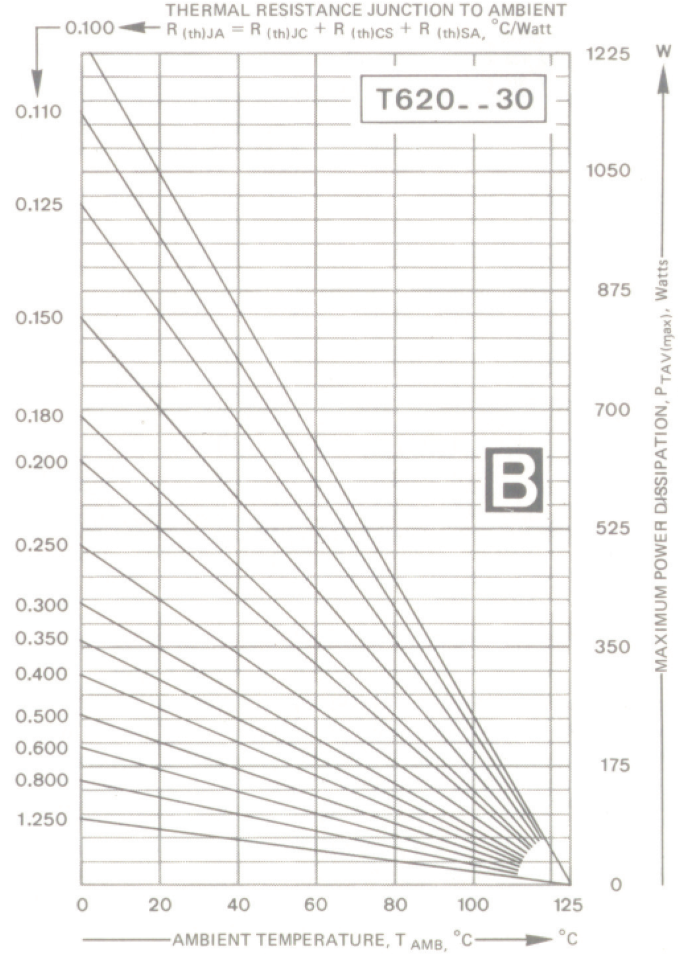
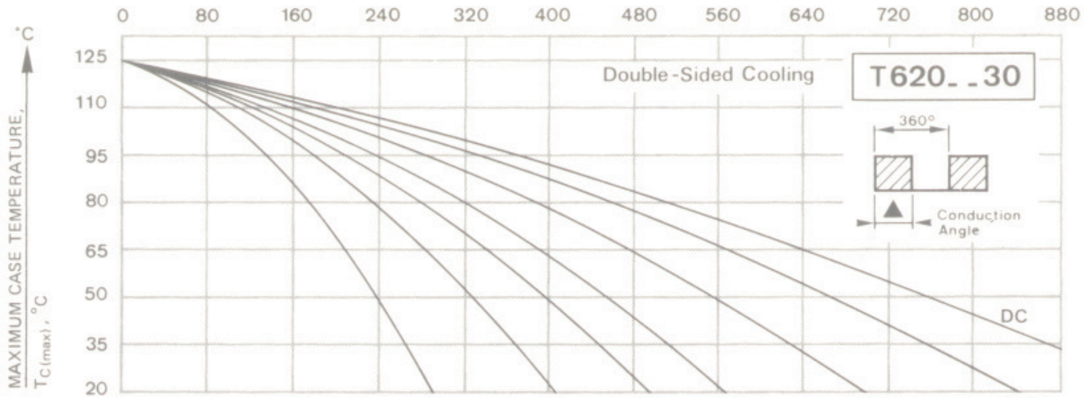


Figure 15 – Maximum Allowable Power Dissipation vs Ambient Temperature for Various Thermal Resistances Junction to Ambient.

Figure 16 — Case Temperature vs Forward Current, Rectangular Wave, for Various Conduction Angles.



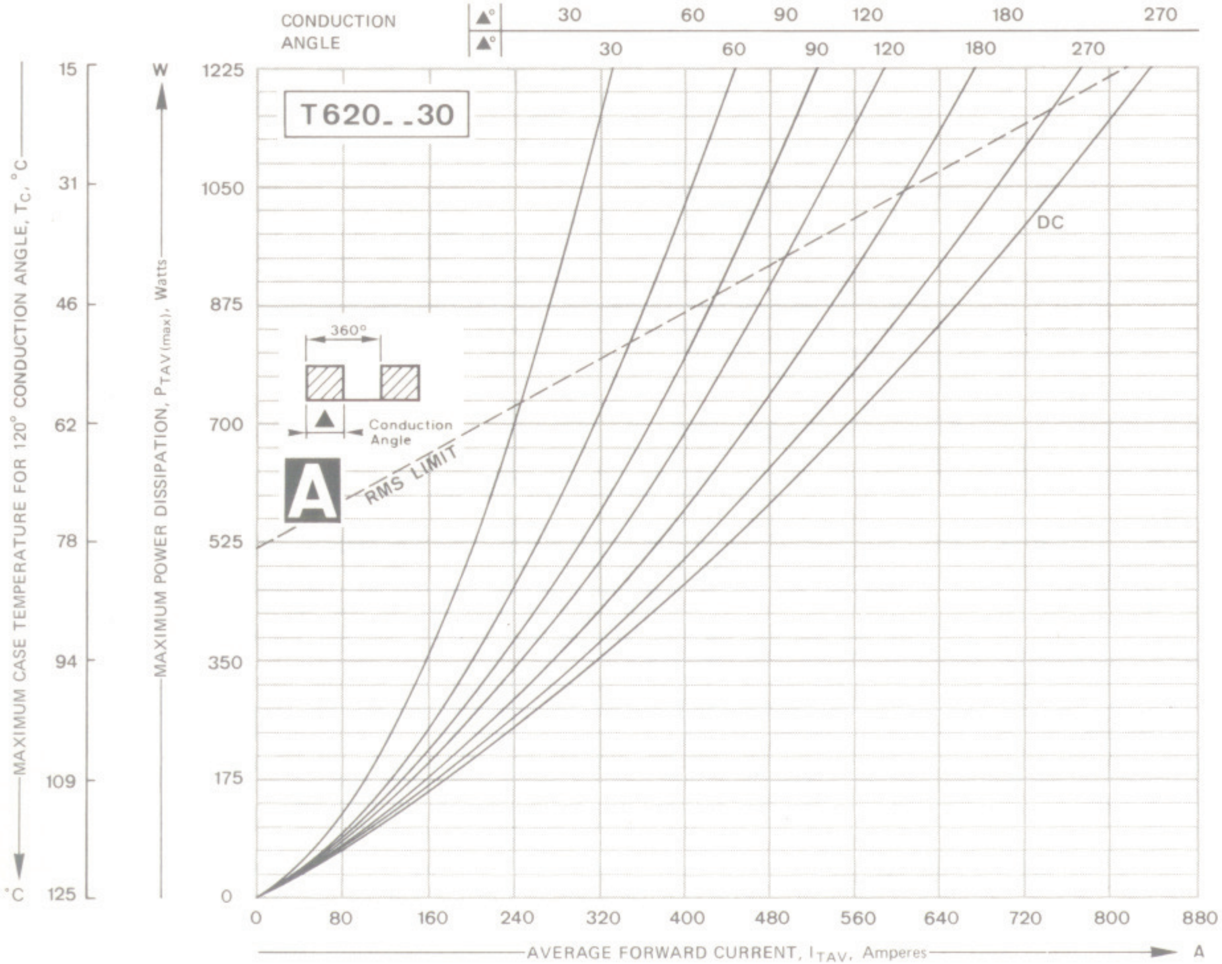


Figure 17 — Power Dissipation vs Forward Current, Rectangular Wave, for Various Conduction Angles.

HOW TO USE THE NOMOGRAPH.

For solution to (1) enter graph **B** at the specified T_A. Draw a vertical line to the specified $R_{(th)JA}$ line. Draw a horizontal line left to the power dissipation curve associated with the conduction angle considered in graph **A**. Drawing a vertical line down to the I_{AV} axis provides the desired answer.

For solution to (2) enter graphs **A** and **B** at the specified values. Draw two vertical lines. At the point where the drawn line and the power dissipation curve intersect, draw a horizontal line to the right. The intersection of the two drawn lines in graph **B** is one point on the desired junction-to-ambient thermal resistance line. If this point falls between two lines, use the lower value of $R_{(th)JA}$.

For a solution to (3) simply reverse the path of the solution proposed for (1).

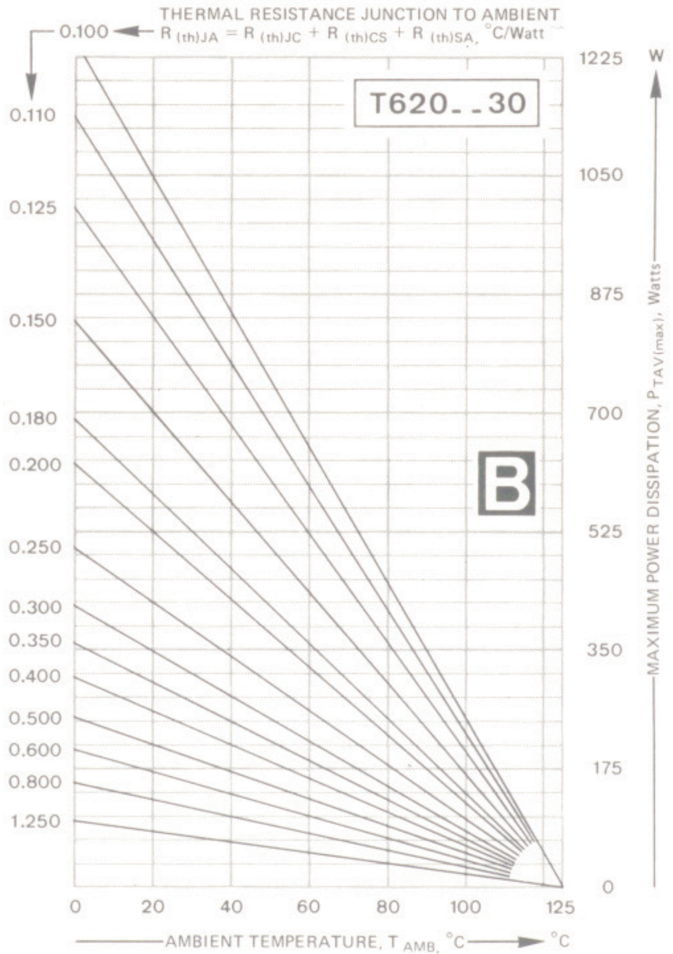


Figure 18 — Maximum Allowable Power Dissipation vs Ambient Temperature for Various Thermal Resistances Junction to Ambient.

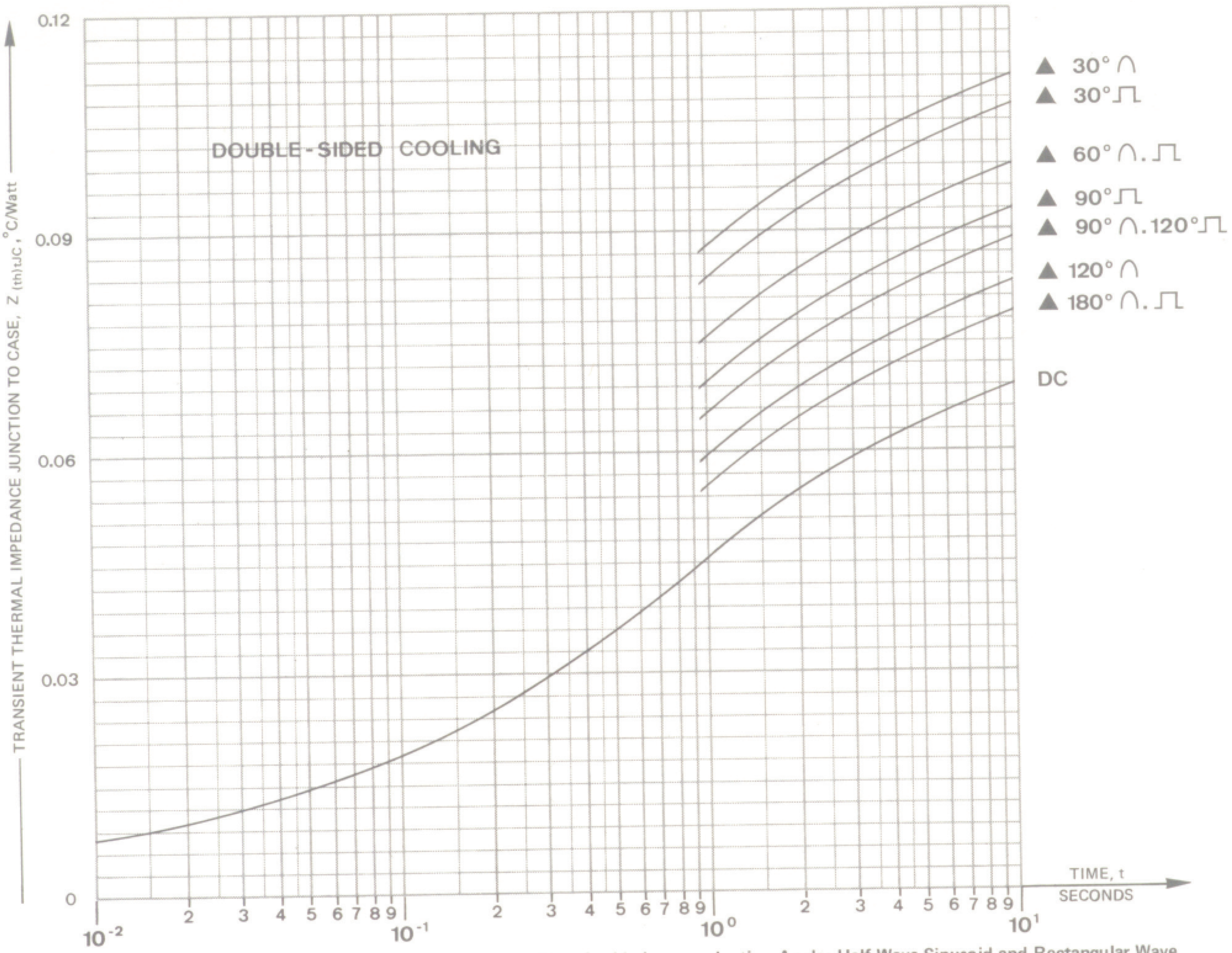


Figure 19 – Device Transient Thermal Impedance vs Time for Various conduction Angles Half-Wave Sinusoid and Rectangular Wave

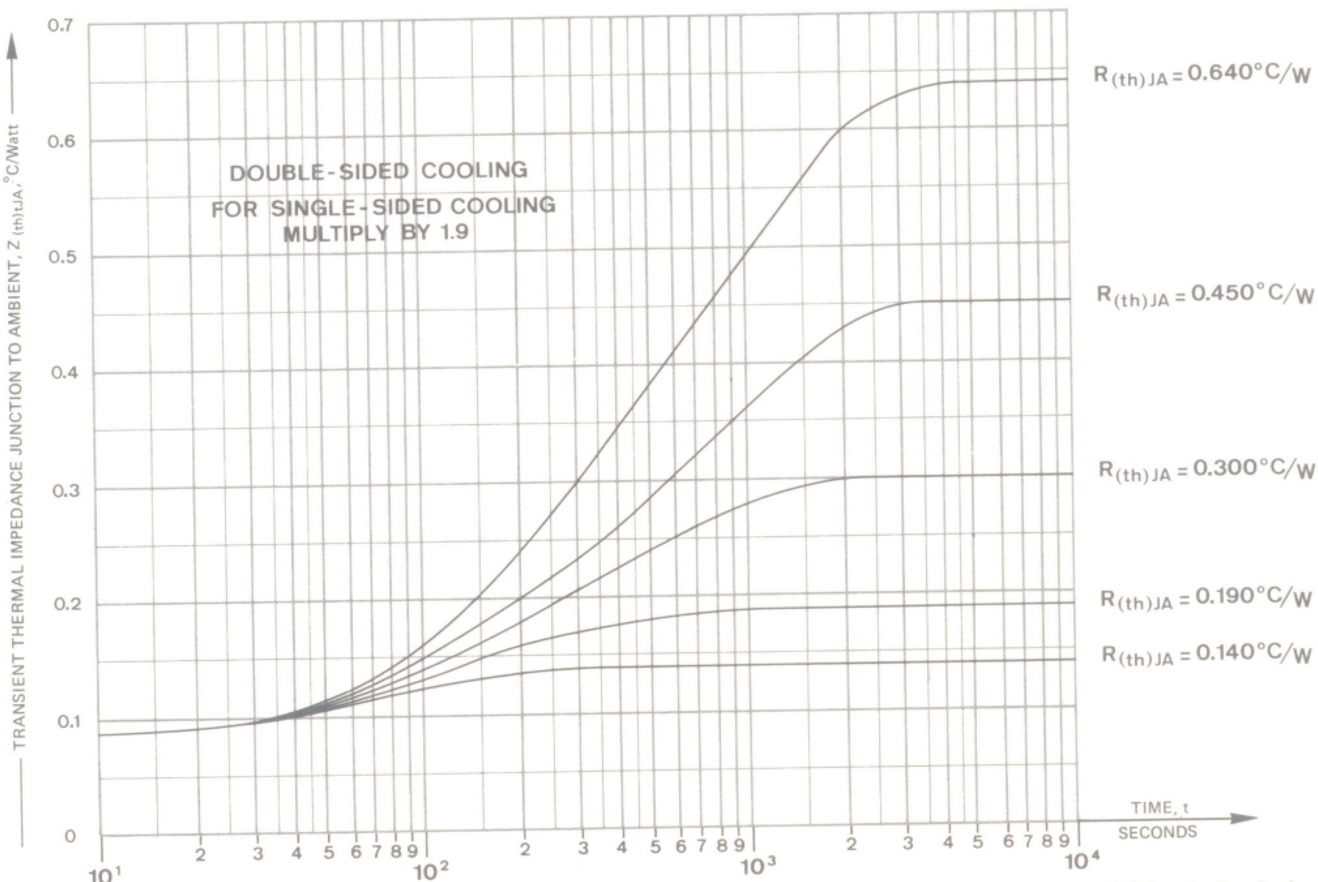


Figure 20 – Transient Thermal Impedance vs Time for Various Heat Sink Thermal Resistances, Half-Wave Sinusoid 180° Conduction Angle

Surge and Fusing limits	V_{RRM} reapplied 0% A	V_{RRM} reapplied 100% B	Type
I_{TSM} 10 ms I^2t 10 ms $I^2t \geq$ 10 ms	5200 A 135200 A^2s	4100 A 84000 A^2s	T620_ _20
I_{TSM} 10 ms I^2t 10 ms $I^2t \geq$ 10 ms	6400 A 204800 A^2s	5000 A 125000 A^2s	T620_ _25
I_{TSM} 10 ms I^2t 10 ms $I^2t \geq$ 10 ms	7300 A 266450 A^2s	5700 A 162500 A^2s	T620_ _30

Junction temperature 125°C

This nomograph may be used to determine :

1. **Maximum allowable surge current** following rated load conditions for a specified surge duration from 1 to 50 cycles, sinusoidal wave form 180° conduction angle.
2. **Maximum allowable sub-cycle surge current** with or without reverse voltage reapplied after surge from 1 to 10 milliseconds pulse width.
   Note – The sub-cycle surge curves are given following the concept
   $I^2\sqrt{t} = K$
3. **I^2t limitation** from 1 to 10 milliseconds pulse width without reverve voltage reapplied.

For solution to (1) use the formula :
$I_{TMS\ (10\ ms)}$ B x **Multiplier** at the specified number of cycles

For solution to (2) use the formula :
$I_{TMS\ (10\ ms)}$ A or B x **Multiplier** at the specified pulse width duration

For solution to (3) use the formula :
$I^2t_{\ (10\ ms)}$ A x **Multiplier** at the specified pulse width duration

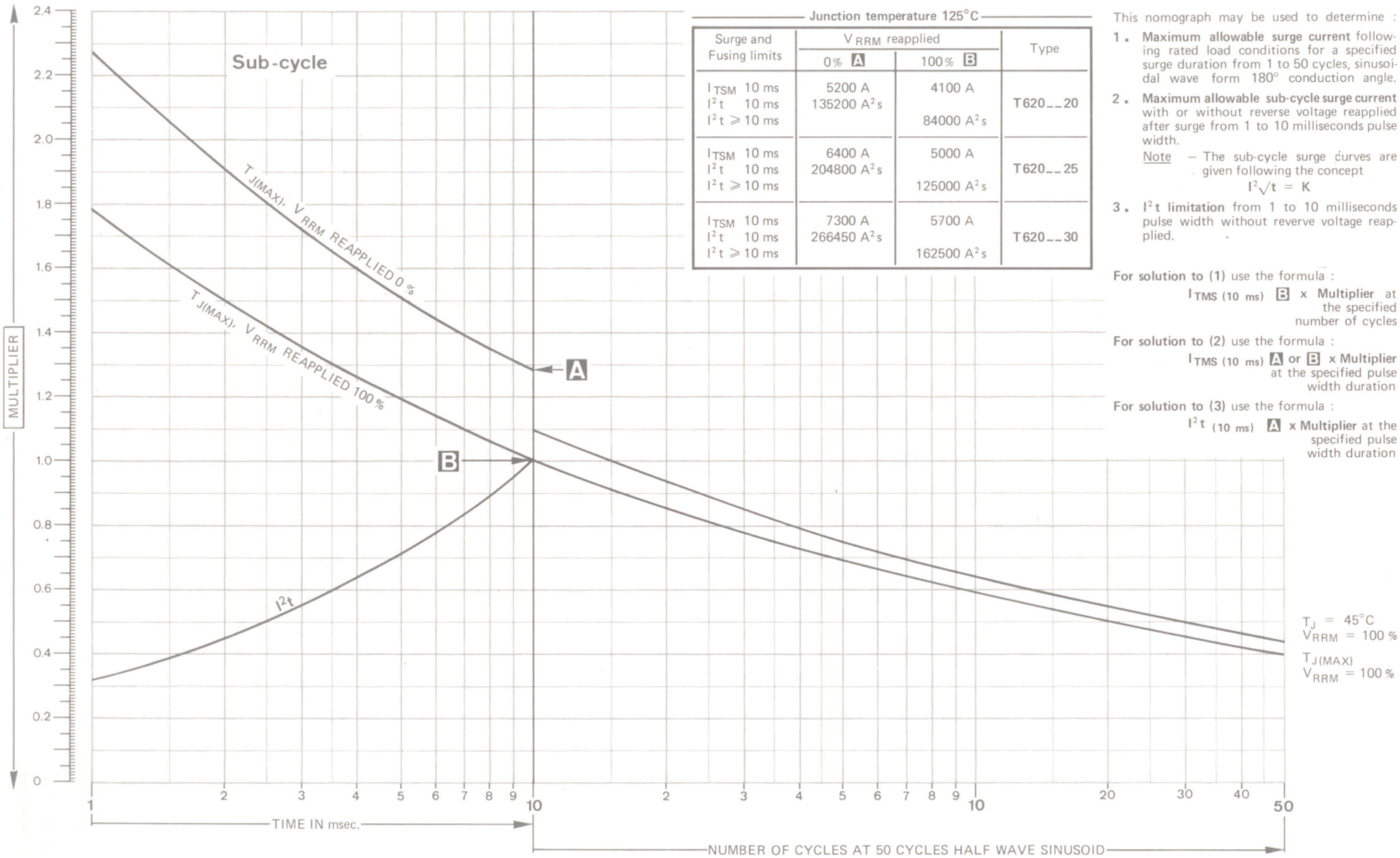


Figure 21 – Nomograph for Maximum Allowable Surge , Peak Sub-Cycle Surge and I^2t

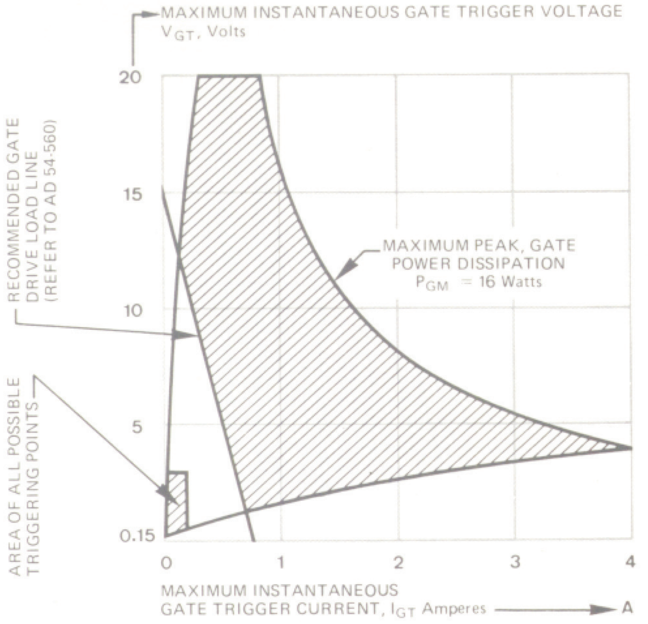


Figure 22 — Maximum Gate Triggering Characteristics

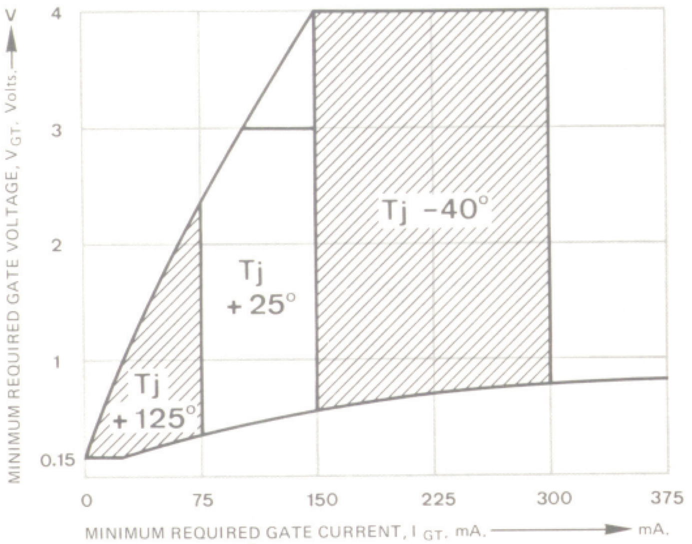


Figure 23 — Gate Triggering Range for Various Junction Temperatures.

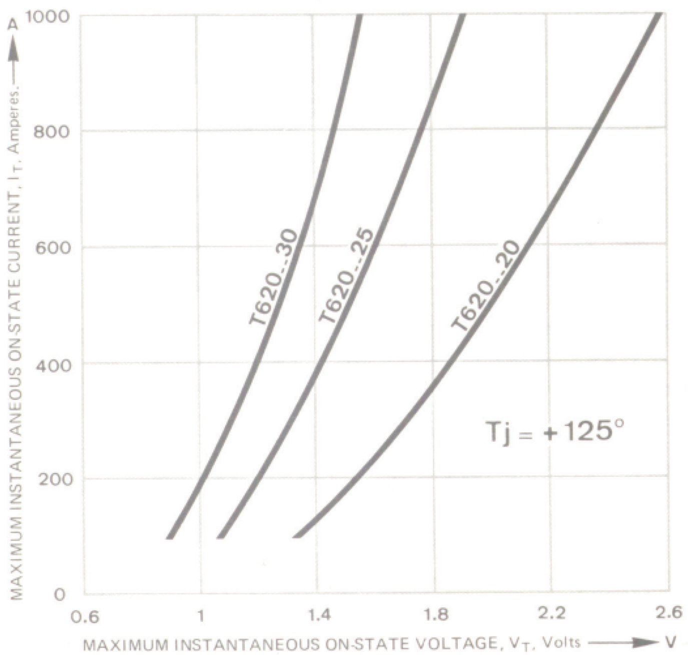


Figure 24 — Maximum Forward Conduction Characteristics, On-State.

Mechanical Data

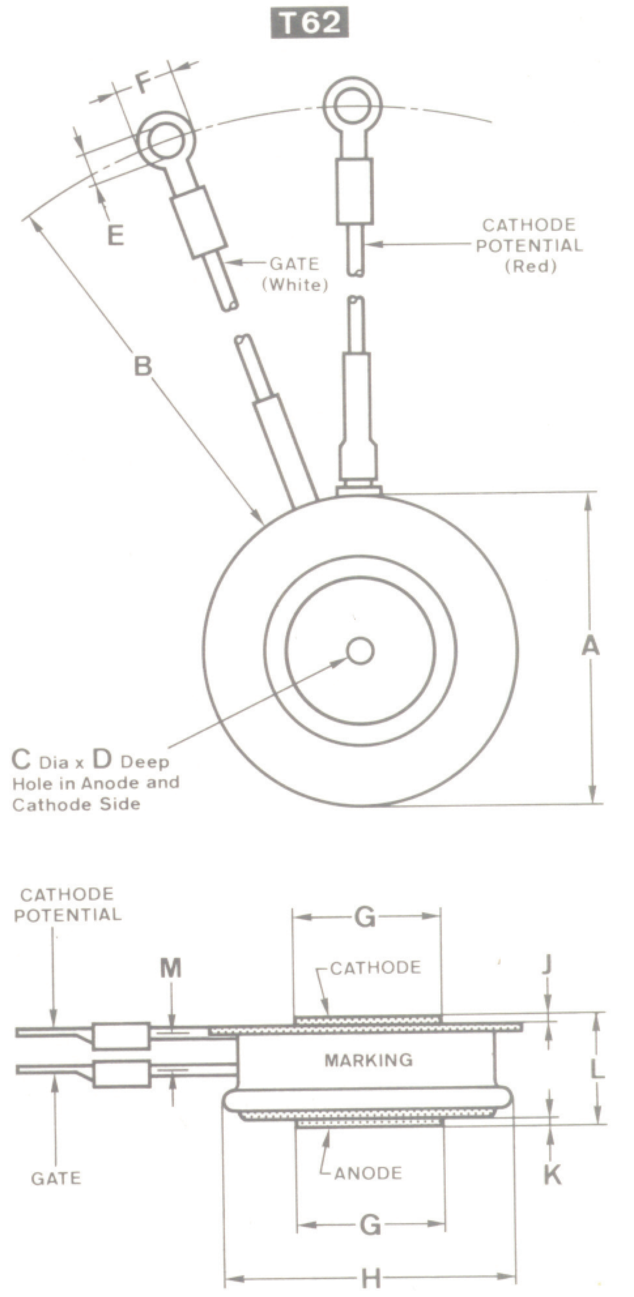
ORDER CODE — DN

MAXIMUM MOUNTING FORCE — 1200 lbs — 550 kg

APPROXIMATE WEIGHT — 2.3 oz — 65 g

NICKEL PLATED FINISH

Outline



Dimensions

	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	1.61		40.90	
B	7.93	8.17	201.5	207.5
C	0.140		3.56	
D	0.075		1.90	
E	0.145		3.70	
F	0.225		5.70	
G	0.750		19.05	
H	1.440		36.60	
J	0.030		0.76	
K	0.030		0.76	
L	0.535		13.60	
M	0.120		3.00	

NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS APPROVED