

# ST650C..L SERIES

## PHASE CONTROL THYRISTORS

## Hockey Puk Version

### Features

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AC (B-PUK)

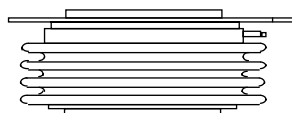
### Typical Applications

- DC motor control
- Controlled DC power supplies
- AC controllers

### Major Ratings and Characteristics

Parameters	ST650C..L	Units
$I_{T(AV)}$	790	A
@ $T_{hs}$	55	°C
$I_{T(RMS)}$	1557	A
@ $T_{hs}$	25	°C
$I_{TSM}$	@ 50Hz	10100
	@ 60Hz	10700
$I^2t$	@ 50Hz	510
	@ 60Hz	475
$V_{DRM}/V_{RRM}$	2000 to 2400	V
$t_q$ typical	200	μs
$T_J$	- 40 to 125	°C

790A



case style TO-200AC (B-PUK)

**ST650C..L Series**

Bulletin I25203 rev. B 04/00

International  
**IRF** Rectifier**ELECTRICAL SPECIFICATIONS****Voltage Ratings**

Type number	Voltage Code	$V_{DRM}/V_{RRM}$ , max. repetitive peak and off-state voltage V	$V_{RSM}$ , maximum non-repetitive peak voltage V	$I_{DRM}/I_{RRM}$ max. @ $T_J = T_J \text{ max}$ mA
ST650C..L	20	2000	2100	80
	22	2200	2300	
	24	2400	2500	

**On-state Conduction**

Parameter	ST650C..L	Units	Conditions
$I_{T(AV)}$ Max. average on-state current @ Heatsink temperature	790 (324)	A	180° conduction, half sine wave
	55 (85)	°C	double side (single side) cooled
$I_{T(RMS)}$ Max. RMS on-state current	1857		DC @ 25°C heatsink temperature double side cooled
$I_{TSM}$ Max. peak, one-cycle non-repetitive surge current	10100	A	t = 10ms No voltage
	10700		t = 8.3ms reappplied
	8600		t = 10ms 100% $V_{RRM}$
	9150		t = 8.3ms reappplied
$I^2t$ Maximum $I^2t$ for fusing	510	KA <sup>2</sup> s	t = 10ms No voltage
	475		t = 8.3ms reappplied
	370		t = 10ms 100% $V_{RRM}$
	347		t = 8.3ms reappplied
$I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing	5100	KA <sup>2</sup> √s	t = 0.1 to 10ms, no voltage reappplied
$V_{T(TO)1}$ Low level value of threshold voltage	1.04	V	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}), T_J = T_J \text{ max.}$
$V_{T(TO)2}$ High level value of threshold voltage	1.13		$(I > \pi \times I_{T(AV)}), T_J = T_J \text{ max.}$
$r_{t1}$ Low level value of on-state slope resistance	0.61	mΩ	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}), T_J = T_J \text{ max.}$
$r_{t2}$ High level value of on-state slope resistance	0.35		$(I > \pi \times I_{T(AV)}), T_J = T_J \text{ max.}$
$V_{TM}$ Max. on-state voltage	2.07	V	$I_{pk} = 1700A, T_J = T_J \text{ max, } t_p = 10ms$ sine pulse
$I_H$ Maximum holding current	600	mA	$T_J = 25^\circ C$ , anode supply 12V resistive load
$I_L$ Typical latching current	1000		

### Switching

Parameter	ST650C..L	Units	Conditions
$di/dt$ Max. non-repetitive rate of rise of turned-on current	1000	A/ $\mu$ s	Gate drive 20V, 20 $\Omega$ , $t_r \leq 1\mu$ s $T_J = T_J$ max, anode voltage $\leq 80\% V_{DRM}$
$t_d$ Typical delay time	1.0	$\mu$ s	Gate current 1A, $di_g/dt = 1A/\mu$ s $V_d = 0.67\% V_{DRM}$ , $T_J = 25^\circ\text{C}$
$t_q$ Typical turn-off time	200		$I_{TM} = 750A$ , $T_J = T_J$ max, $di/dt = 60A/\mu$ s, $V_R = 50V$ $dv/dt = 20V/\mu$ s, Gate 0V 100 $\Omega$ , $t_p = 500\mu$ s

### Blocking

Parameter	ST650C..L	Units	Conditions
$dv/dt$ Maximum critical rate of rise of off-state voltage	500	V/ $\mu$ s	$T_J = T_J$ max. linear to 80% rated $V_{DRM}$
$I_{DRM}$ $I_{RRM}$ Max. peak reverse and off-state leakage current	80	mA	$T_J = T_J$ max, rated $V_{DRM}/V_{RRM}$ applied

### Triggering

Parameter		ST650C..L		Units	Conditions
P <sub>GM</sub>	Maximum peak gate power	10.0		W	T <sub>J</sub> = T <sub>J</sub> max, t <sub>p</sub> ≤ 5ms
P <sub>G(AV)</sub>	Maximum average gate power	2.0			T <sub>J</sub> = T <sub>J</sub> max, f = 50Hz, d% = 50
I <sub>GM</sub>	Max. peak positive gate current	3.0		A	T <sub>J</sub> = T <sub>J</sub> max, t <sub>p</sub> ≤ 5ms
+V <sub>GM</sub>	Maximum peak positive gate voltage	20		V	T <sub>J</sub> = T <sub>J</sub> max, t <sub>p</sub> ≤ 5ms
-V <sub>GM</sub>	Maximum peak negative gate voltage	5.0			
I <sub>GT</sub>	DC gate current required to trigger	TYP.	MAX.	mA	T <sub>J</sub> = - 40°C T <sub>J</sub> = 25°C T <sub>J</sub> = 125°C  Max. required gate trigger/ current/ voltage are the lowest value which will trigger all units 12V anode-to-cathode applied
		200	-		
		100	200		
		50	-		
V <sub>GT</sub>	DC gate voltage required to trigger	2.5	-	V	T <sub>J</sub> = - 40°C T <sub>J</sub> = 25°C T <sub>J</sub> = 125°C
		1.8	3.0		
		1.1	-		
I <sub>GD</sub>	DC gate current not to trigger	10		mA	Max. gate current/voltage not to trigger is the max. value which will not trigger any unit with rated V <sub>DRM</sub> anode-to-cathode applied
V <sub>GD</sub>	DC gate voltage not to trigger	0.25		V	

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International  
**IR** Rectifier

### Thermal and Mechanical Specification

Parameter	ST650C..L	Units	Conditions
$T_J$ Max. operating temperature range	-40 to 125	°C	
$T_{stg}$ Max. storage temperature range	-40 to 150		
$R_{thJ-hs}$ Max. thermal resistance, junction to heatsink	0.073 0.031	K/W	DC operation single side cooled DC operation double side cooled
$R_{thC-hs}$ Max. thermal resistance, case to heatsink	0.011 0.006		DC operation single side cooled DC operation double side cooled
F Mounting force, $\pm 10\%$	14700 (1500)	N (Kg)	
wt Approximate weight	255	g	
Case style	TO - 200AC (B-PUK)		See Outline Table

### $\Delta R_{thJ-hs}$ Conduction

(The following table shows the increment of thermal resistance  $R_{thJ-hs}$  when devices operate at different conduction angles than DC)

Conduction angle	Sinusoidal conduction		Rectangular conduction		Units	Conditions
	Single Side	Double Side	Single Side	Double Side		
180°	0.009	0.009	0.006	0.006	K/W	$T_J = T_J \text{ max.}$
120°	0.011	0.011	0.011	0.011		
90°	0.014	0.014	0.015	0.015		
60°	0.020	0.020	0.021	0.021		
30°	0.036	0.036	0.036	0.036		

### Ordering Information Table

Device Code							
ST	65	0	C	24	L	1	
1	2	3	4	5	6	7	8
1	- Thyristor						
2	- Essential part number						
3	- 0 = Converter grade						
4	- C = Ceramic Puk						
5	- Voltage code: Code x 100 = $V_{RRM}$ (See Voltage Rating Table)						
6	- L = Puk Case TO-200AC (B-PUK)						
7	- 0 = Eyelet terminals (Gate and Auxiliary Cathode Unsoldered Leads)						
	1 = Fast-on terminals (Gate and Auxiliary Cathode Unsoldered Leads)						
	2 = Eyelet terminals (Gate and Auxiliary Cathode Soldered Leads)						
	3 = Fast-on terminals (Gate and Auxiliary Cathode Soldered Leads)						
8	- Critical dv/dt: None = 500V/ $\mu$ sec (Standard selection)						
	L = 1000V/ $\mu$ sec (Special selection)						

Outline Table

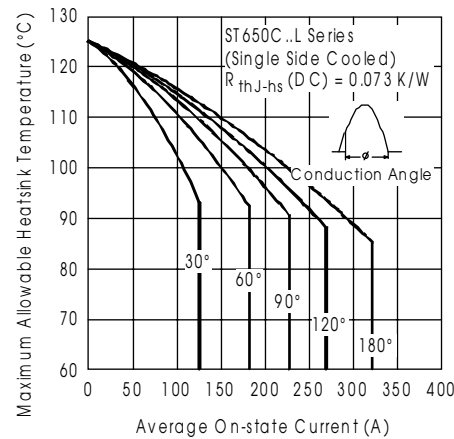
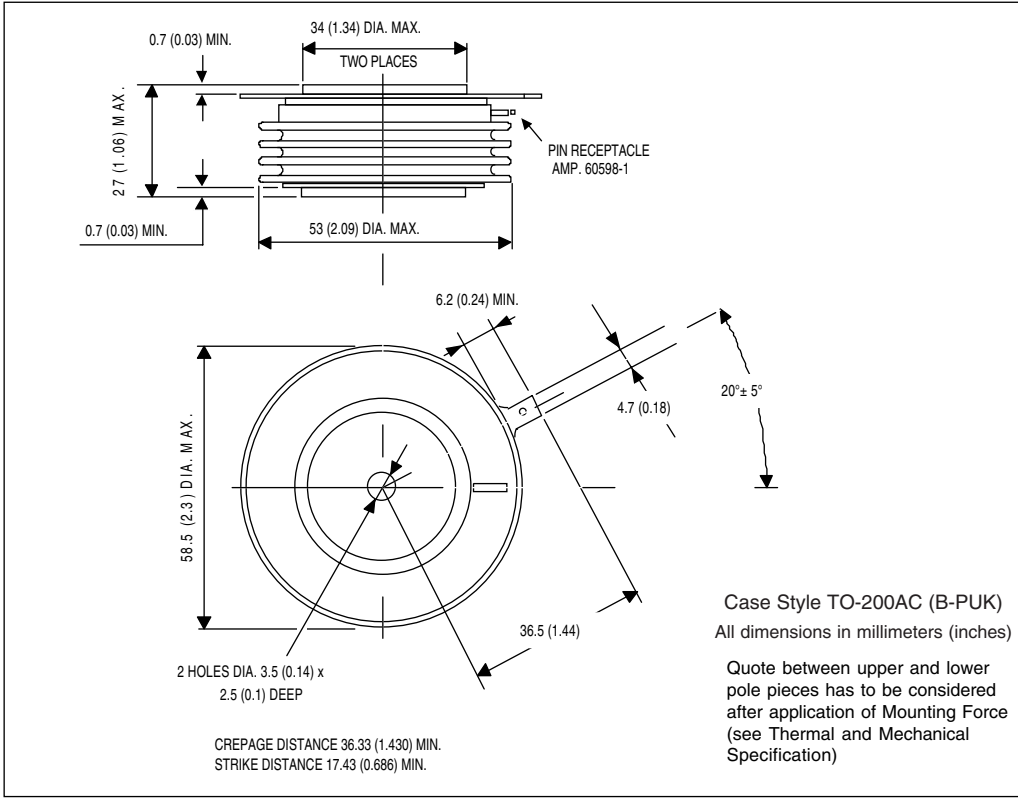


Fig. 1 - Current Ratings Characteristics

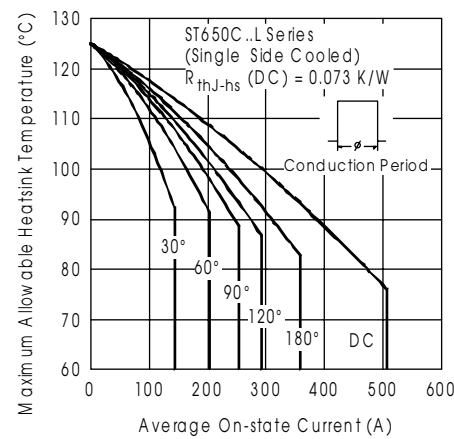


Fig. 2 - Current Ratings Characteristics

## ST650C..L Series

Bulletin I25203 rev. B 04/00

International  
IOR Rectifier

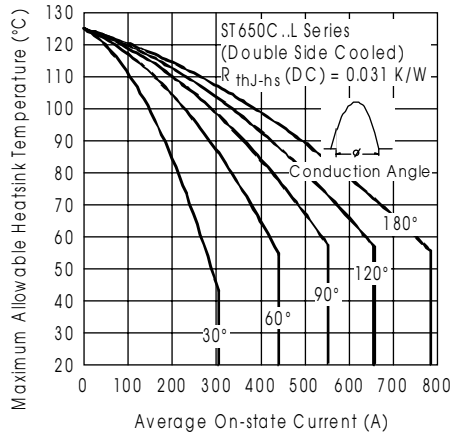


Fig. 3 - Current Ratings Characteristics

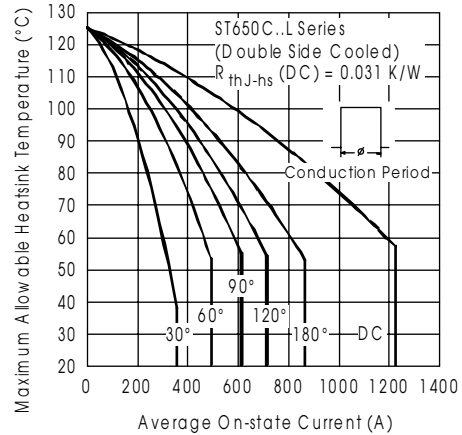


Fig. 4 - Current Ratings Characteristics

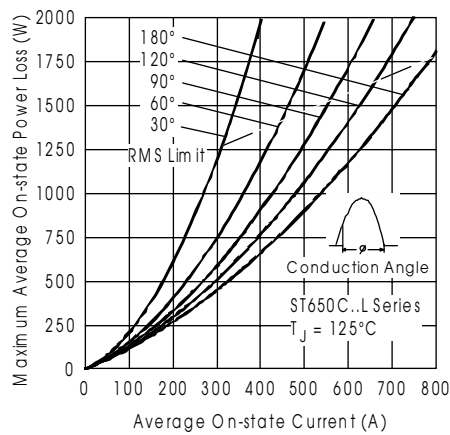


Fig. 5 - On-state Power Loss Characteristics

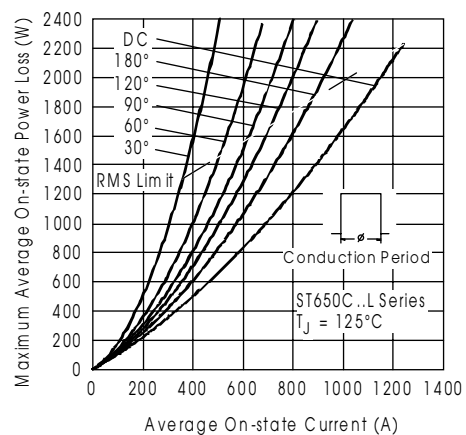


Fig. 6 - On-state Power Loss Characteristics

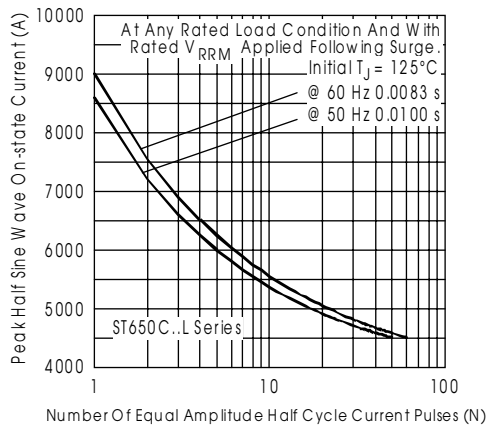


Fig. 7 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

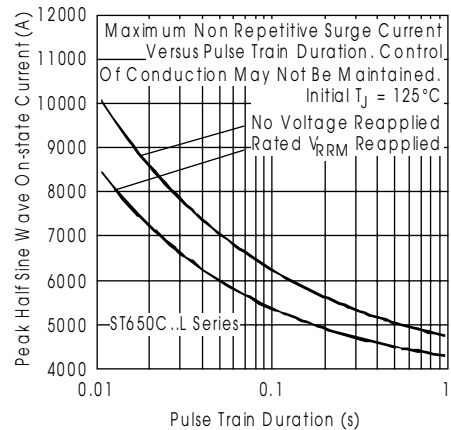


Fig. 8 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

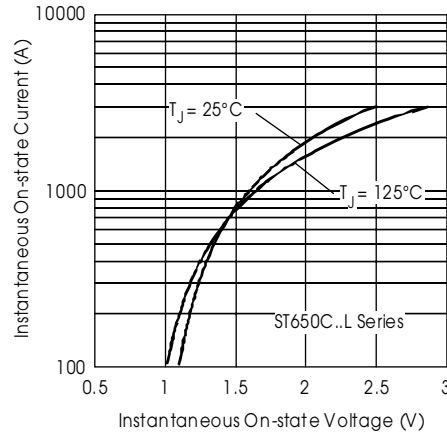


Fig. 9 - On-state Voltage Drop Characteristics

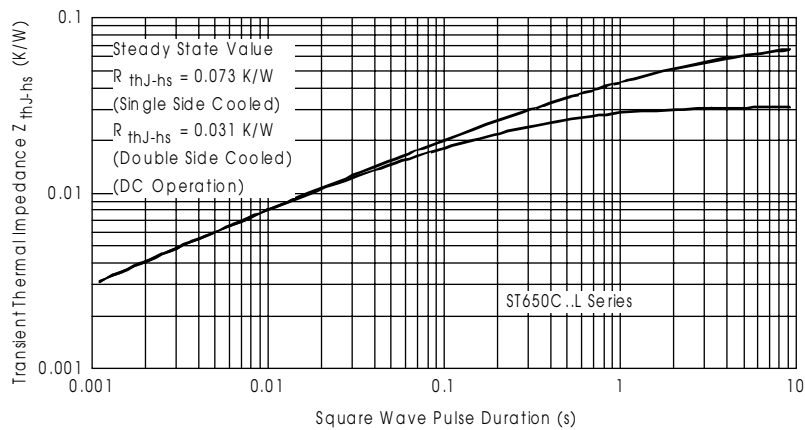


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

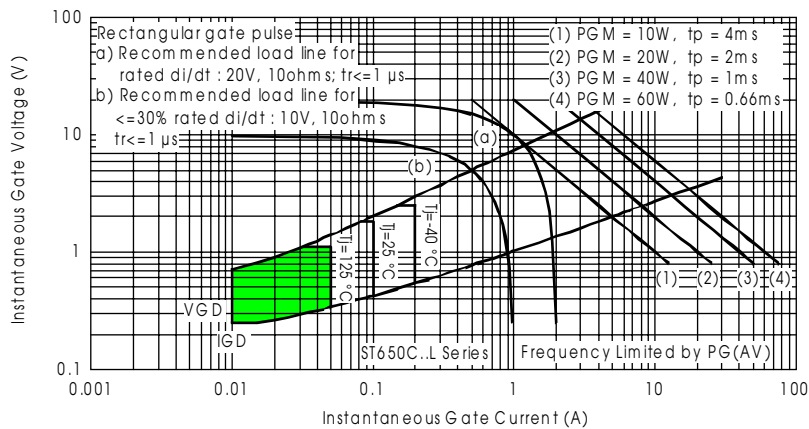


Fig. 11 - Gate Characteristics