


### THREE PHASE CONTROLLED BRIDGE

### Power Modules

#### Features

- Package fully compatible with the industry standard INT-A-pak power modules series
- High thermal conductivity package, electrically insulated case
- Outstanding number of power encapsulated components
- Excellent power volume ratio
- 4000 V<sub>RMS</sub> isolating voltage
- UL E78996 approved 

55 A  
90 A  
110 A

#### Description

A range of extremely compact, encapsulated three phase controlled bridge rectifiers offering efficient and reliable operation. They are intended for use in general purpose and heavy duty applications.

#### Major Ratings and Characteristics

Parameters	53MT.KB 52MT.KB 51MT.KB	93MT.KB 92MT.KB 91MT.KB	113MT.KB 112MT.KB 111MT.KB	Units
$I_o$	55	90	110	A
@ $T_c$	85	85	85	°C
$I_{FSM}$ @ 50Hz	390	950	1130	A
@ 60Hz	410	1000	1180	A
$I^2t$ @ 50Hz	770	4525	6380	A <sup>2</sup> s
@ 60Hz	700	4130	5830	A <sup>2</sup> s
$I^2\sqrt{t}$	7700	45250	63800	A <sup>2</sup> √s
$V_{RRM}$ range	800 to 1600			V
$T_{STG}$ range	-40 to 125			°C
$T_J$ range	-40 to 125			°C

## 53-93-113MT..KB Series

Bulletin I27503 08/97

International  
 Rectifier

### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

Type number	Voltage Code	$V_{RRM}$ , maximum repetitive peak reverse voltage V	$V_{RSM}$ , maximum non-repetitive peak reverse voltage V	$V_{DRM}$ , max. repetitive peak off-state voltage gate open circuit V	$I_{RRM}/I_{DRM}$ max. @ $T_J = 125^\circ\text{C}$ mA
53/52/51MT..KB	80	800	900	800	10
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	
93/92/91MT..KB 113/112/111MT..KB	80	800	900	800	20
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	

#### Forward Conduction

Parameter	53MT.KB 52MT.KB 51MT.KB	93MT.KB 92MT.KB 91MT.KB	113MT.KB 112MT.KB 111MT.KB	Units	Conditions
$I_O$ Maximum DC output current @ Case temperature	55	90	110	A	120° Rect conduction angle
	85	85	85	°C	
$I_{TSM}$ Maximum peak, one-cycle forward, non-repetitive on state surge current	390	950	1130	A	t = 10ms No voltage reappplied
	410	1000	1180		t = 8.3ms
	330	800	950		t = 10ms 100% $V_{RRM}$ reappplied
	345	840	1000		t = 8.3ms
$I^2t$ Maximum $I^2t$ for fusing	770	4525	6380	A <sup>2</sup> s	t = 10ms No voltage reappplied
	700	4130	5830		t = 8.3ms
	540	3200	4510		t = 10ms 100% $V_{RRM}$ reappplied
	500	2920	4120		t = 8.3ms
$I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing	7700	45250	63800	A <sup>2</sup> √s	t = 0.1 to 10ms, no voltage reappplied
$V_{T(TO)1}$ Low level value of threshold voltage	1.17	1.09	1.04	V	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , @ $T_J$ max.
$V_{T(TO)2}$ High level value of threshold voltage	1.45	1.27	1.27		$(I > \pi \times I_{T(AV)})$ , @ $T_J$ max.
$r_{\theta 1}$ Low level value on-state slope resistance	12.40	4.10	3.93	mΩ	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , @ $T_J$ max.
$r_{\theta 2}$ High level value on-state slope resistance	11.04	3.59	3.37		$(I > \pi \times I_{T(AV)})$ , @ $T_J$ max.
$V_{TM}$ Maximum on-state voltage drop	2.68	1.65	1.57	V	$I_{pk} = 150\text{A}$ , $T_J = 25^\circ\text{C}$ $t_p = 400\mu\text{s}$ single junction
$di/dt$ Max. non-repetitive rate of rise of turned on current	150			A/μs	$T_J = 25^\circ\text{C}$ , from 0.67 $V_{DRM}$ , $I_{TM} = \pi \times I_{T(AV)}$ , $I_g = 500\text{mA}$ , $t_r < 0.5\mu\text{s}$ , $t_p > 6\mu\text{s}$
$I_H$ Max. holding current	200			mA	$T_J = 25^\circ\text{C}$ , anode supply = 6V, resistive load, gate open circuit
$I_L$ Max. latching current	400				$T_J = 25^\circ\text{C}$ , anode supply = 6V, resistive load

**Blocking**

Parameter	53MT.KB 52MT.KB 51MT.KB	93MT.KB 92MT.KB 91MT.KB	113MT.KB 112MT.KB 111MT.KB	Units	Conditions
V <sub>INS</sub> RMS isolation voltage	4000			V	T <sub>J</sub> = 25°C all terminal shorted f = 50Hz, t = 1s
dv/dt Max. critical rate of rise of off-state voltage (*)	500			V/μs	T <sub>J</sub> = T <sub>J</sub> max., linear to 0.67 V <sub>DRM</sub> , gate open circuit

(\*) Available with dv/dt = 1000V/ms, to complete code add S90 i.e. 113MT160KBS90.

**Triggering**

Parameter	53MT.KB 52MT.KB 51MT.KB	93MT.KB 92MT.KB 91MT.KB	113MT.KB 112MT.KB 111MT.KB	Units	Conditions	
P <sub>GM</sub> Max. peak gate power	10			W	T <sub>J</sub> = T <sub>J</sub> max.	
P <sub>G(AV)</sub> Max. average gate power	2.5					
I <sub>GM</sub> Max. peak gate current	2.5			A		
-V <sub>GT</sub> Max. peak negative gate voltage	10			V		
V <sub>GT</sub> Max. required DC gate voltage to trigger	4.0			V	T <sub>J</sub> = -40°C	
	2.5				T <sub>J</sub> = 25°C	Anode supply = 6V, resistive load
	1.7				T <sub>J</sub> = 125°C	
I <sub>GT</sub> Max. required DC gate current to trigger	270			mA	T <sub>J</sub> = -40°C	
	150				T <sub>J</sub> = 25°C	Anode supply = 6V, resistive load
	80				T <sub>J</sub> = 125°C	
V <sub>GD</sub> Max. gate voltage that will not trigger	0.25			V	@ T <sub>J</sub> = T <sub>J</sub> max., rated V <sub>DRM</sub> applied	
I <sub>GD</sub> Max. gate current that will not trigger	6			mA		

**Thermal and Mechanical Specifications**

Parameter	53MT.KB 52MT.KB 51MT.KB	93MT.KB 92MT.KB 91MT.KB	113MT.KB 112MT.KB 111MT.KB	Units	Conditions
T <sub>J</sub> Max. junction operating temperature range	-40 to 125			°C	
T <sub>stg</sub> Max. storage temperature range	-40 to 125			°C	
R <sub>thJC</sub> Max. thermal resistance, junction to case	0.18	0.14	0.12	K/W	DC operation per module
	1.07	0.86	0.70		DC operation per junction
	0.19	0.15	0.12		120° Rect conduction angle per module
	1.17	0.91	0.74		120° Rect conduction angle per junction
R <sub>thCS</sub> Max. thermal resistance, case to heatsink	0.03			K/W	Per module Mounting surface smooth, flat and greased
T Mounting torque ± 10%	to heatsink	4 to 6		Nm	A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound. Lubricated threads.
	to terminal	3 to 4			
wt Approximate weight	225			g	

## 53-93-113MT.KB Series

Bulletin I27503 08/97

International  
**IR** Rectifier

### ΔR Conduction (per Junction)

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

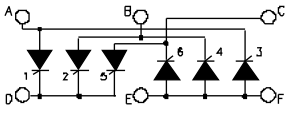
Devices	Sinusoidal conduction @ $T_J$ max.					Rectangular conduction @ $T_J$ max.					Units
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
53/52/51MT.KB	0.072	0.085	0.108	0.152	0.233	0.055	0.091	0.117	0.157	0.236	K/W
93/92/91MT.KB	0.033	0.039	0.051	0.069	0.099	0.027	0.044	0.055	0.071	0.100	
113/112/111MT.KB	0.027	0.033	0.042	0.057	0.081	0.023	0.037	0.046	0.059	0.082	

### Ordering Information Table

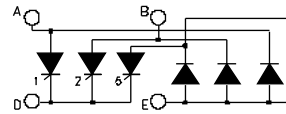
**Device Code**

11	3	MT	160	K	B	S90
①	②	③	④	⑤	⑥	

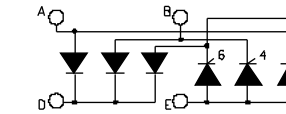
- 1** - Current rating code: 5 = 55 A (Avg)  
9 = 90 A (Avg)  
11 = 110 A (Avg)
- 2** - Circuit configuration code: 3 = Full-controlled bridge  
2 = Positive half-controlled bridge  
1 = Negative half-controlled bridge
- 3** - Essential part number
- 4** - Voltage code: Code x 10 =  $V_{RRM}$  (See Voltage Ratings Table)
- 5** - Generation II
- 6** - Critical dv/dt: None = 500V/μs (Standard value)  
S90 = 1000V/μs (Special selection)



full-controlled bridge  
(53, 93, 113MT..KB)



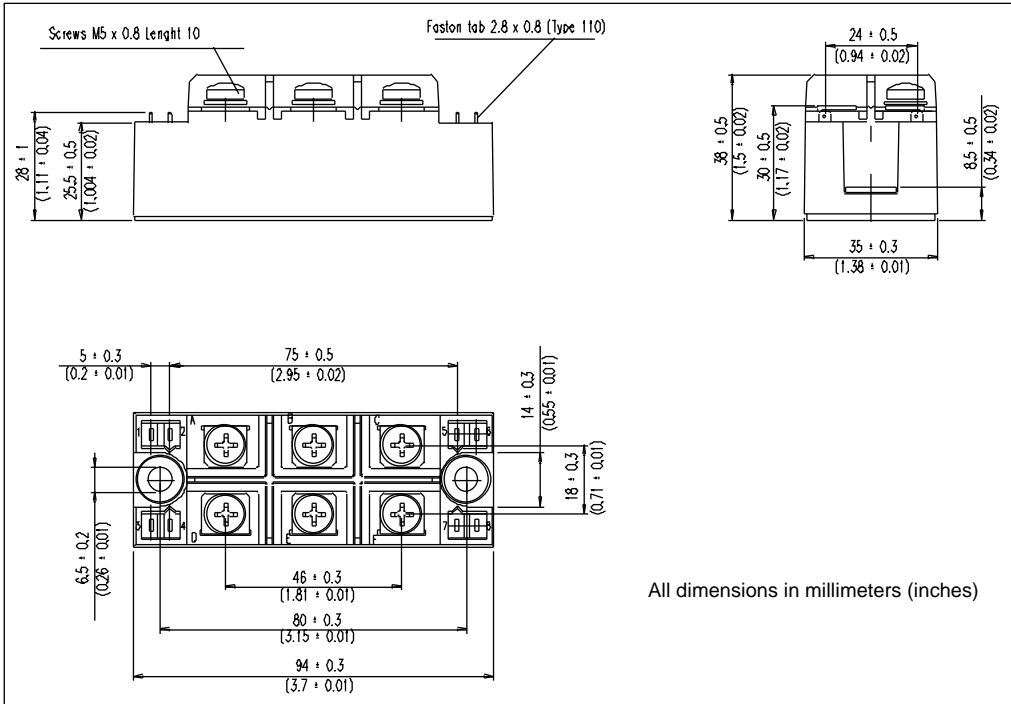
positive half-controlled bridge  
(52, 92, 112MT..KB)



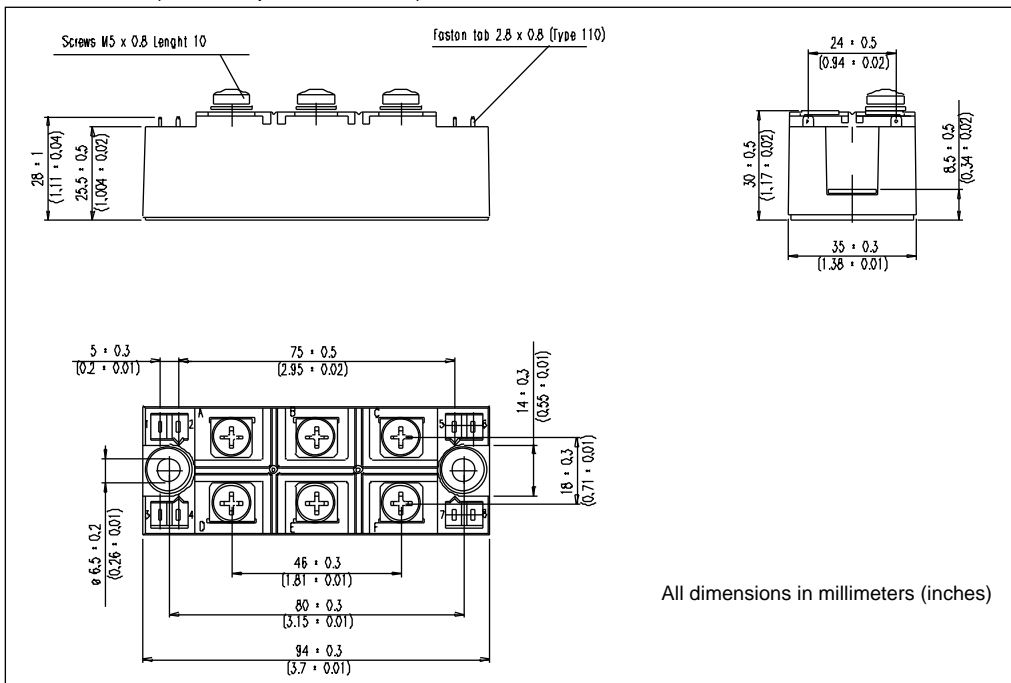
negative half-controlled bridge  
(51, 91, 111MT..KB)

**NOTE: To order the Optional Hardware see Bulletin I27900**

Outline Table (with optional barriers)



Outline Table (without optional barriers)



# 53-93-113MT..KB Series

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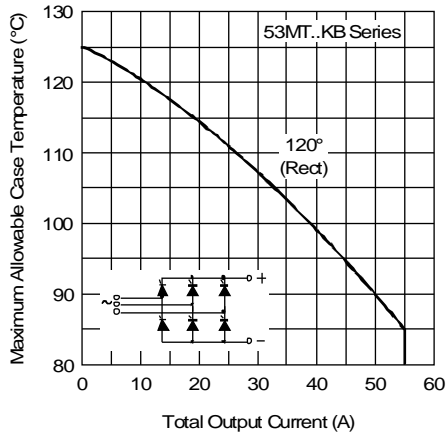


Fig. 1 - Current Ratings Characteristic

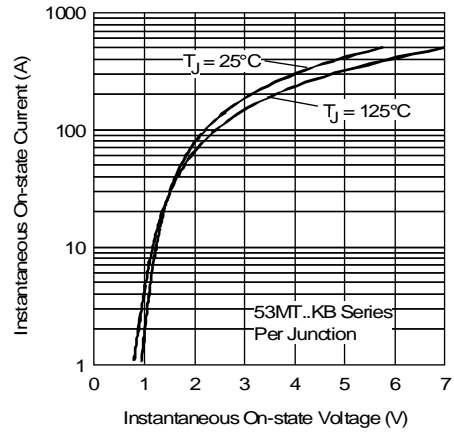


Fig. 2 - Forward Voltage Drop Characteristics

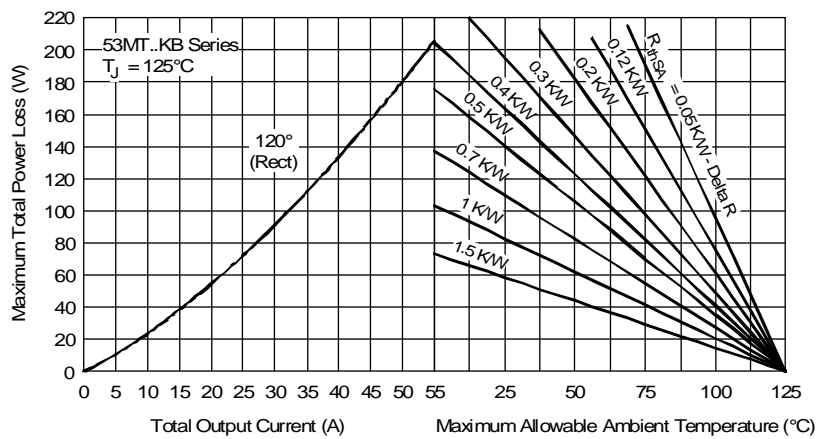


Fig. 3 - Total Power Loss Characteristics

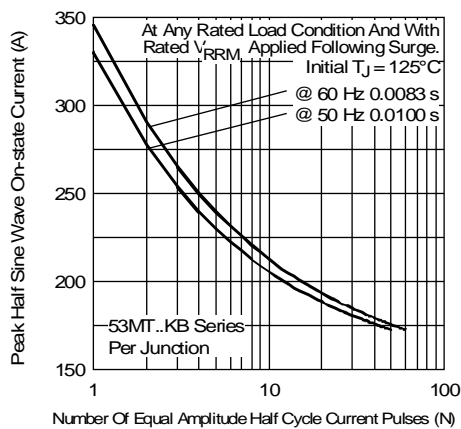


Fig. 4 - Maximum Non-Repetitive Surge Current

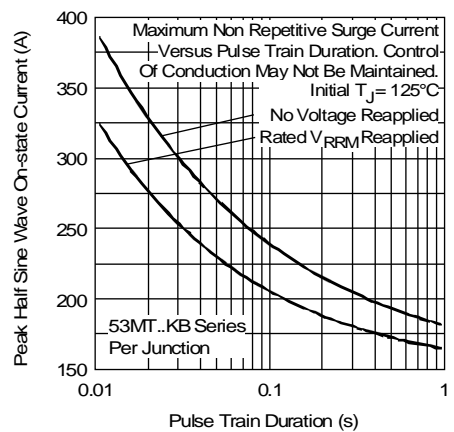


Fig. 5 - Maximum Non-Repetitive Surge Current

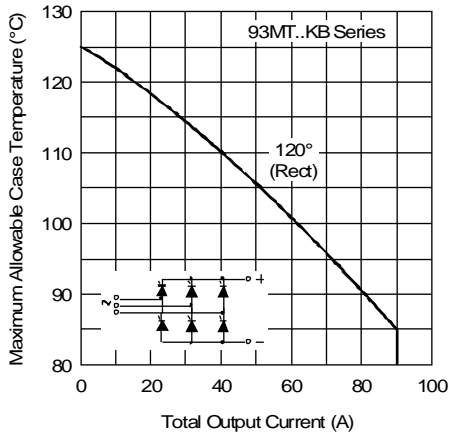


Fig. 6 - Current Ratings Characteristic

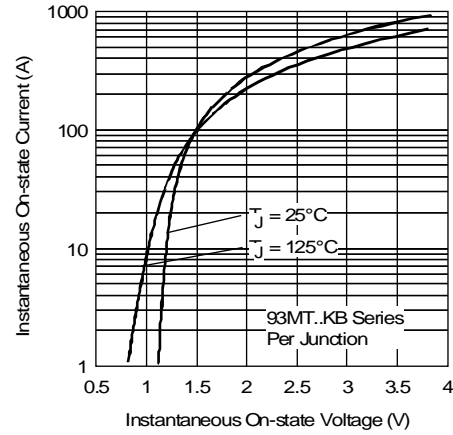


Fig. 7 - Forward Voltage Drop Characteristics

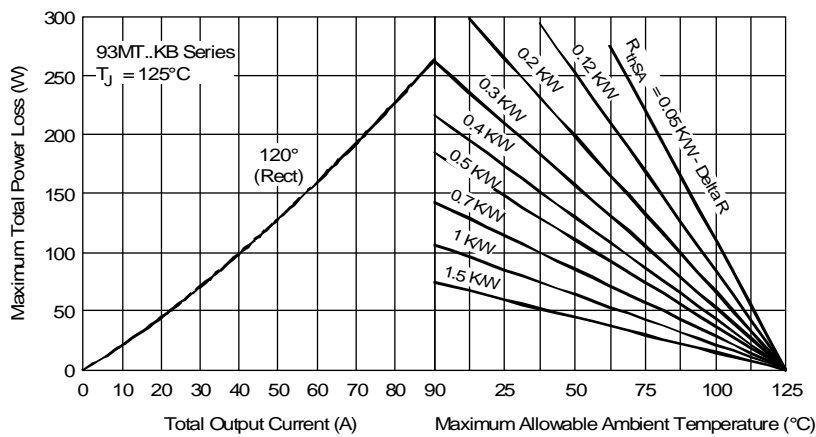


Fig. 8 - Total Power Loss Characteristics

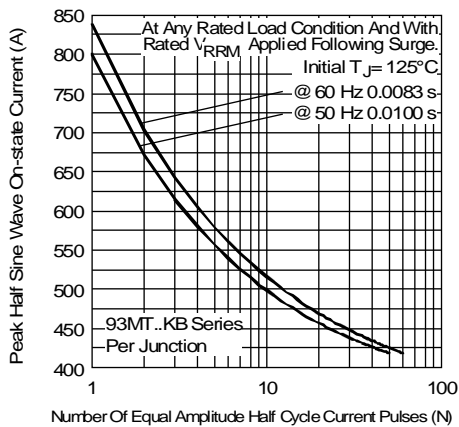


Fig. 9 - Maximum Non-Repetitive Surge Current

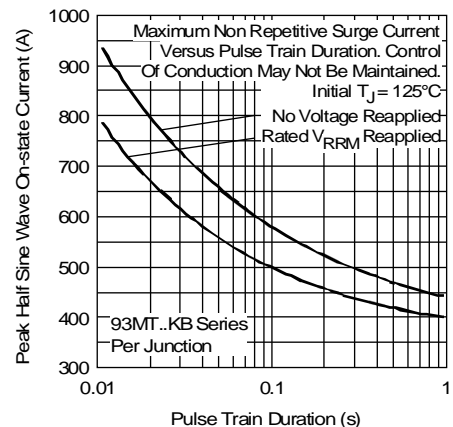


Fig. 10 - Maximum Non-Repetitive Surge Current

**53-93-113MT..KB Series**

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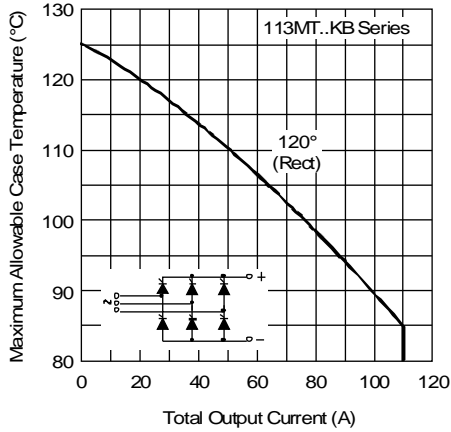


Fig. 11 - Current Ratings Characteristic

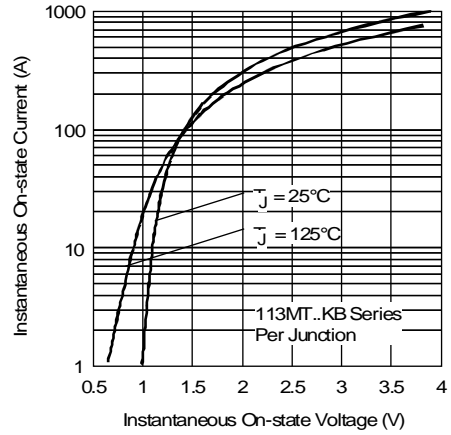


Fig. 12 - Forward Voltage Drop Characteristics

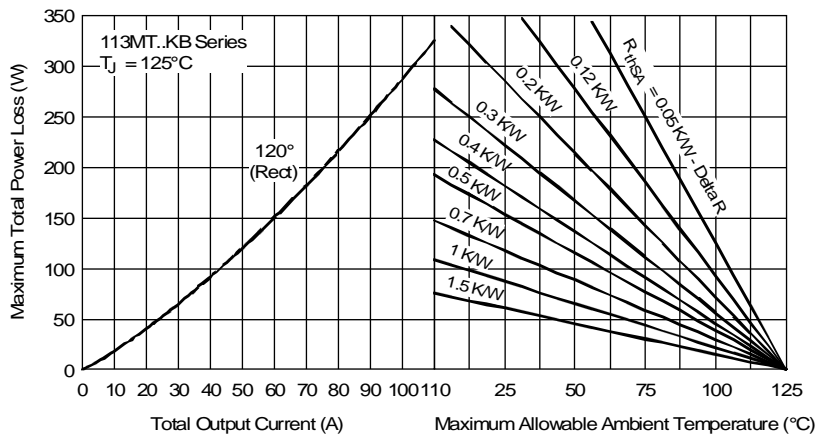


Fig. 13 - Total Power Loss Characteristics

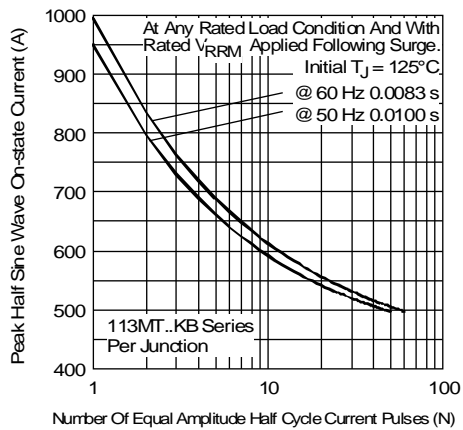


Fig. 14 - Maximum Non-Repetitive Surge Current

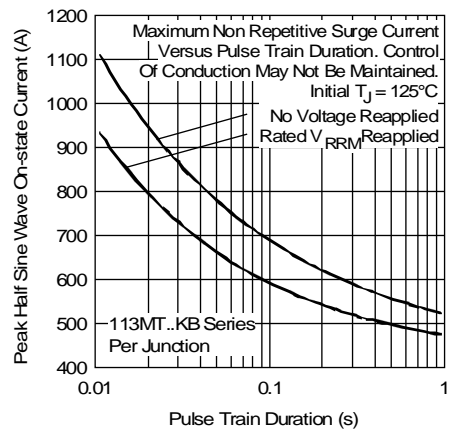


Fig. 15 - Maximum Non-Repetitive Surge Current



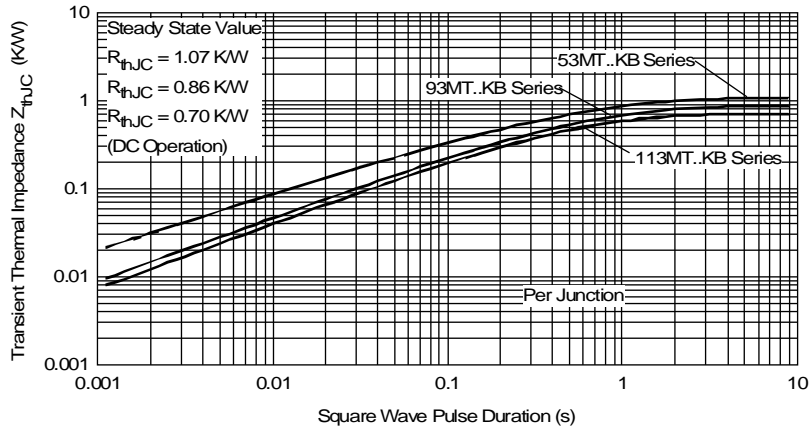


Fig. 16 - Thermal Impedance  $Z_{thJC}$  Characteristics

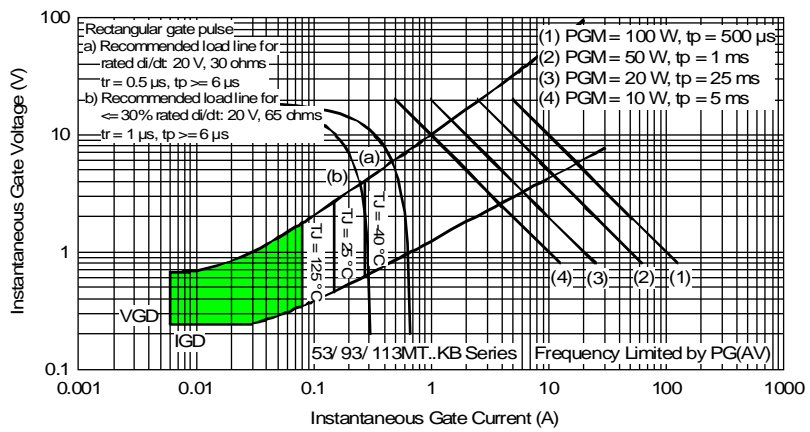


Fig. 17 - Gate Characteristics