


### 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 <sub>O</sub>	55	90	110	A
@ T <sub>C</sub>	85	85	85	°C
I <sub>FSM</sub> @ 50Hz	390	950	1130	A
@ 60Hz	410	1000	1180	A
i <sup>2</sup> t @ 50Hz	770	4525	6380	A <sup>2</sup> s
@ 60Hz	700	4130	5830	A <sup>2</sup> s
i <sup>2</sup> √t	7700	45250	63800	A <sup>2</sup> √s
V <sub>RRM</sub> range	800 to 1600			V
T <sub>STG</sub> range	-40 to 125			°C
T <sub>J</sub> range	-40 to 125			°C

**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 85	90 85	110 85	A $^\circ\text{C}$	120° Rect conduction angle
$I_{TSM}$ 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	$\text{A}^2\text{s}$	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	$\text{A}^2\sqrt{\text{s}}$	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	$\text{m}\Omega$	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , @ $T_J$ 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		$\text{A}/\mu\text{s}$	$T_J = 25^\circ\text{C}$ , 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				
-V <sub>GT</sub> Max. peak negative gate voltage	10				
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
	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
	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 an 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  
IRF 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)

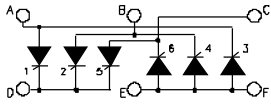
Devices	Sinusoidal conduction @ $T_j$ max.					Rectangular conduction @ $T_j$ max.					Units
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
53/52/51MT.KB	0.072	0.085	0.108	0.152	0.233	0.055	0.091	0.117	0.157	0.236	K/W
93/92/91MT.KB	0.033	0.039	0.051	0.069	0.099	0.027	0.044	0.055	0.071	0.100	
113/112/111MT.KB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

### Ordering Information Table

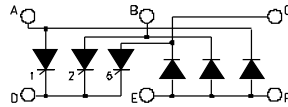
**Device Code**

11	3	MT	160	K	B	S90
①	②	③	④	⑤	⑥	

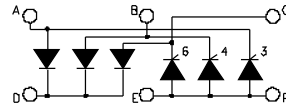
- 1** - Current rating code: 5 = 55 A (Avg)  
9 = 90 A (Avg)  
11 = 110 A (Avg)
- 2** - Circuit configuration code: 3 = Full-controlled bridge  
2 = Positive half-controlled bridge  
1 = Negative half-controlled bridge
- 3** - Essential part number
- 4** - Voltage code: Code x 10 =  $V_{RRM}$  (See Voltage 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)



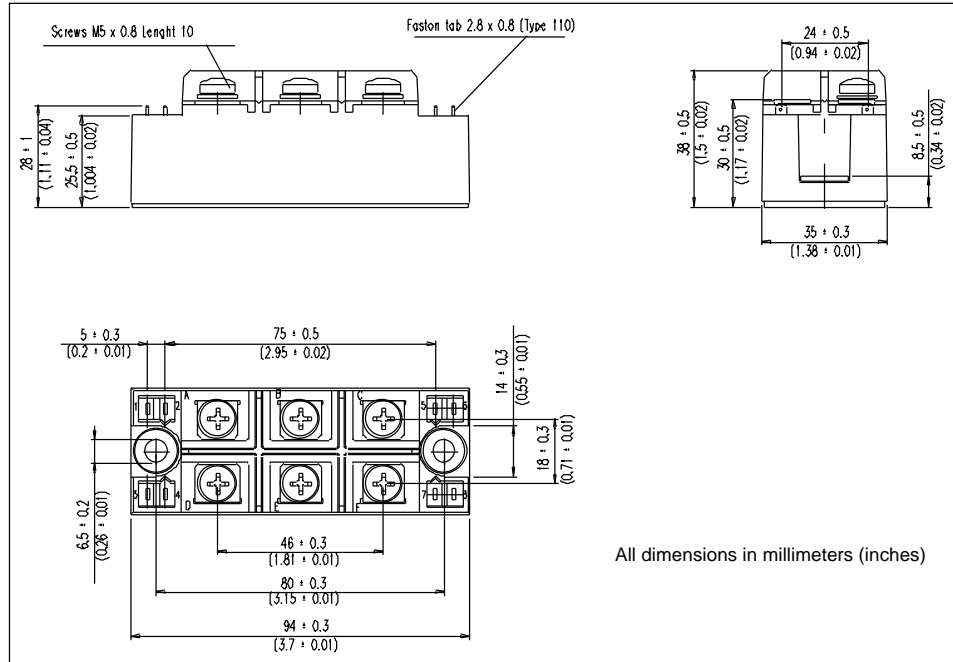
positive half-controlled bridge  
(52, 92, 112MT..KB)



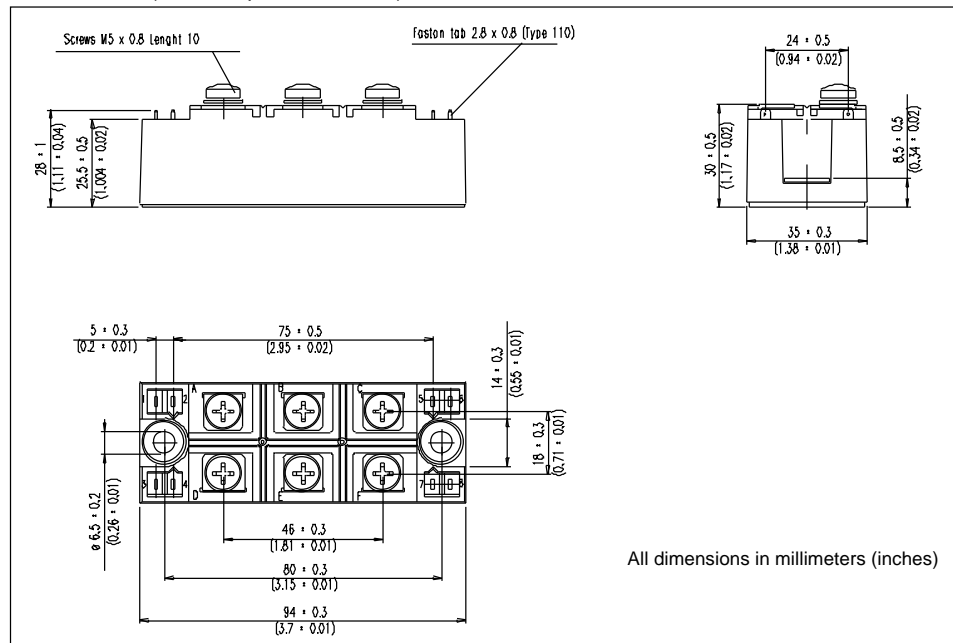
negative half-controlled bridge  
(51, 91, 111MT..KB)

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

Outline Table (with optional barriers)



Outline Table (without optional barriers)



# 53-93-113MT..KB Series

Bulletin I27503 08/97

International  
**IRF** Rectifier

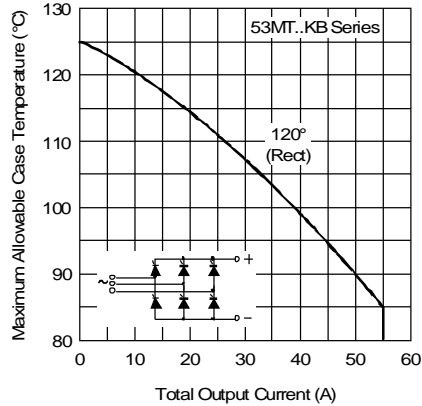


Fig. 1 - Current Ratings Characteristic

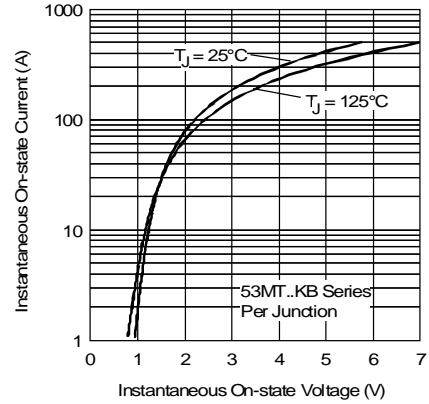


Fig. 2 - Forward Voltage Drop Characteristics

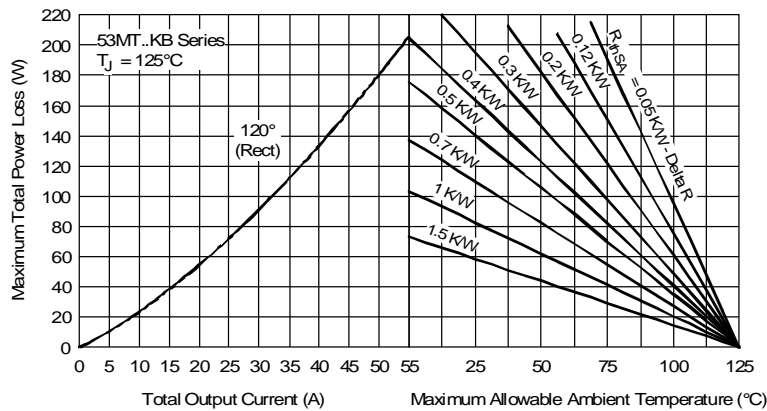


Fig. 3 - Total Power Loss Characteristics

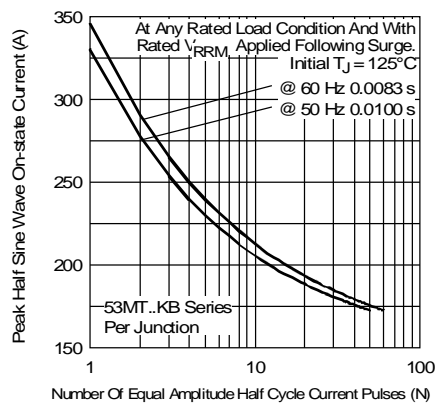


Fig. 4 - Maximum Non-Repetitive Surge Current

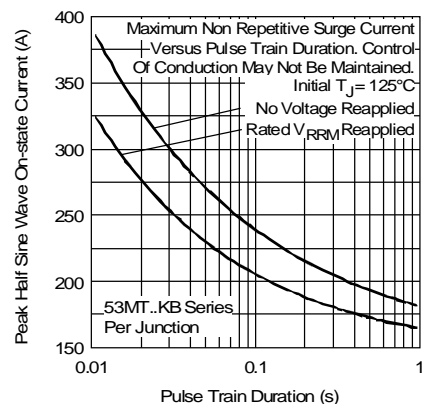


Fig. 5 - Maximum Non-Repetitive Surge Current

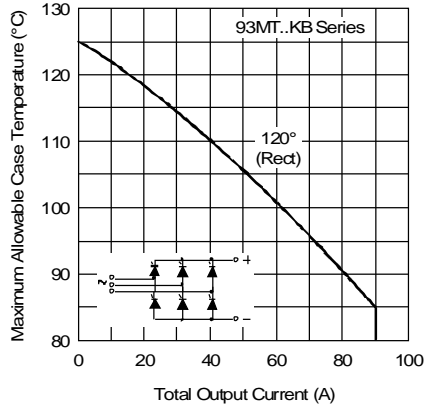


Fig. 6 - Current Ratings Characteristic

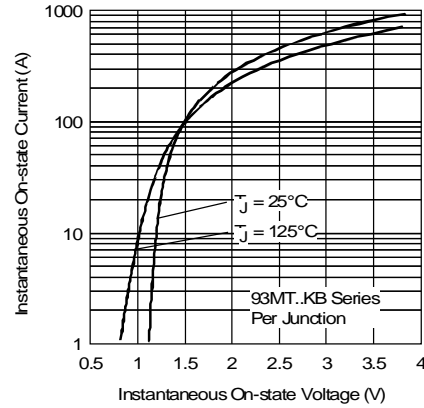


Fig. 7 - Forward Voltage Drop Characteristics

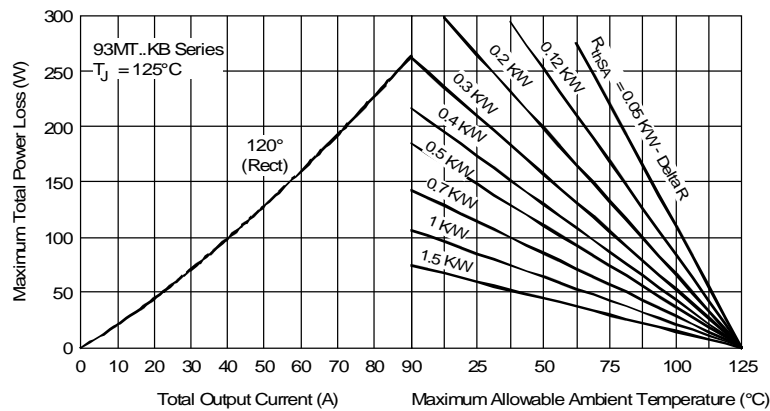


Fig. 8 - Total Power Loss Characteristics

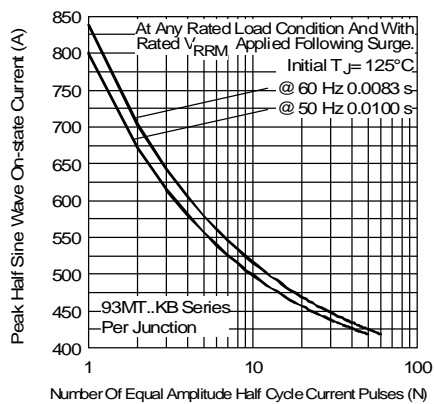


Fig. 9 - Maximum Non-Repetitive Surge Current

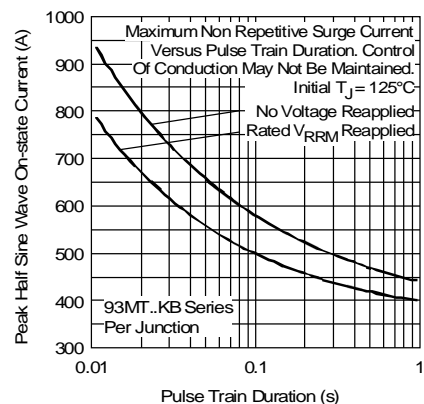


Fig. 10 - Maximum Non-Repetitive Surge Current

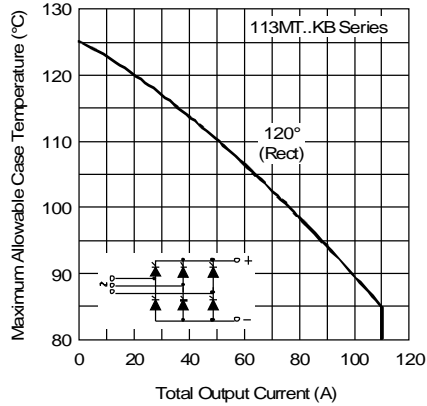


Fig. 11 - Current Ratings Characteristic

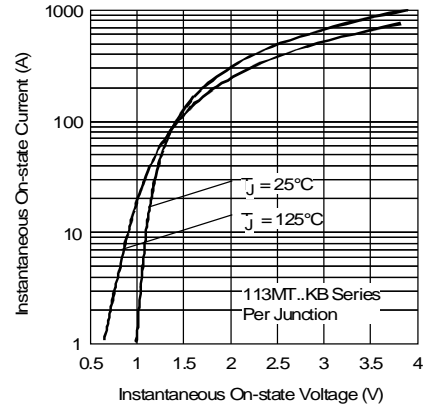


Fig. 12 - Forward Voltage Drop Characteristics

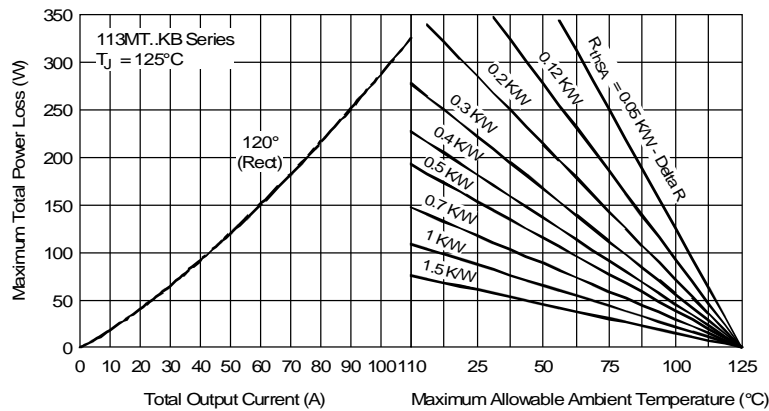


Fig. 13 - Total Power Loss Characteristics

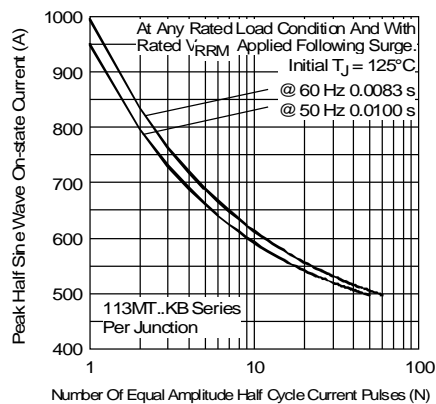


Fig. 14 - Maximum Non-Repetitive Surge Current

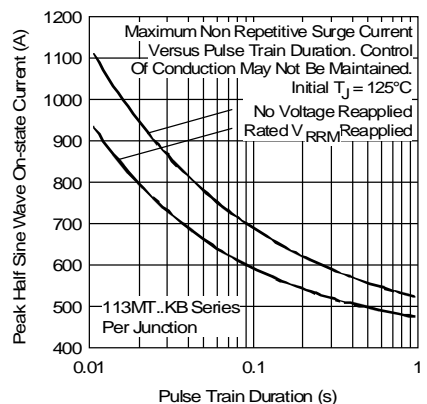


Fig. 15 - Maximum Non-Repetitive Surge Current



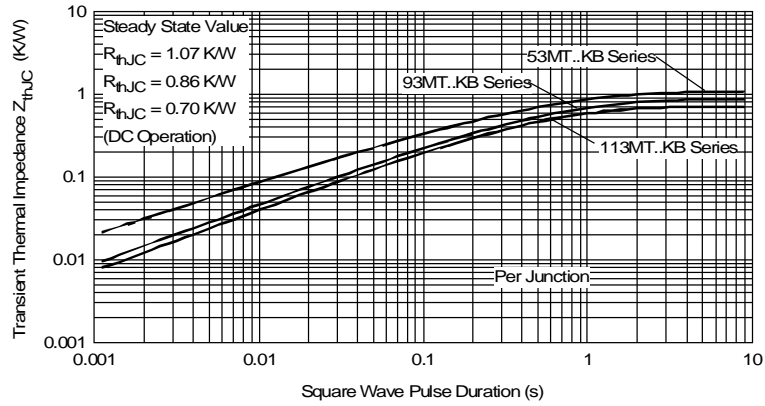


Fig. 16 - Thermal Impedance  $Z_{thJC}$  Characteristics

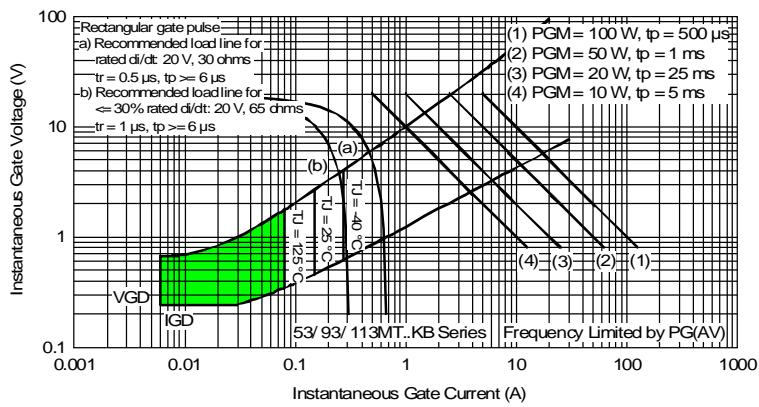


Fig. 17 - Gate Characteristics