

# International IR Rectifier

## SERIES IRK.136, .142, .162

**THYRISTOR/DIODE and  
THYRISTOR/THYRISTOR**

**NEW INT-A-pak Power Modules**

### Features

- High Voltage
- Electrically Isolated by DBC Ceramic ( $Al_2O_3$ )
- 3500  $V_{RMS}$  Isolating Voltage
- Industrial Standard Package
- High Surge Capability
- Glass Passivated Chips
- Modules uses High Voltage Power thyristor/diodes in three Basic Configurations
- Simple Mounting
- UL E78996 approved 

135 A  
140 A  
160 A

### Applications

- DC Motor Control and Drives
- Battery Charges
- Welders
- Power Converters
- Lighting Control
- Heat and Temperature Control

### Major Ratings and Characteristics

Parameters	IRK.136..	IRK.142..	IRK.162..	Units	
$I_{T(AV)}$	135	140	160	A	
@ $T_C$	85	85	85	°C	
$I_{T(RMS)}$	300	310	355	A	
$I_{TSM}$	@ 50Hz	3200	4500	4870	A
	@ 60Hz	3360	4712	5100	A
$I^2t$	@ 50Hz	51.5	102	119	KA <sup>2</sup> s
	@ 60Hz	47	92.5	108	KA <sup>2</sup> s
$I^2\sqrt{t}$	515.5	1013	1190	KA <sup>2</sup> √s	
$V_{RRM}$	400 to 1600			V	
$T_J$ range	-40 to 125			°C	

CASE STYLE NEW INT-A-PAK



**Electrical Specifications**

**Voltage Ratings**

Type number	Voltage Code	$V_{RRM}/V_{DRM}$ , Maximum repetitive peak reverse voltage V	$V_{RSM}/V_{DSM}$ , Maximum non-repetitive peak reverse voltage V	$I_{RRM}/I_{DRM}$ @ 125°C mA
IRK.136	04	400	500	50
IRK.142	08	800	900	
IRK.162	12	1200	1300	
	14	1400	1500	
	16	1600	1700	

**Forward Conduction**

Parameter	IRK.136	IRK.142	IRK.162	Units	Conditions
$I_{T(AV)}$ Max. average on-state current @ Case temperature	135	140	160	A	180° conduction, half sine wave
	85	85	85	°C	
$I_{T(RMS)}$ Max. RMS on-state current	300	310	355	A	as AC switch
$I_{TSM}$ Maximum peak, one-cycle on-state, non-repetitive surge current	3200	4500	4870	A	t = 10ms No voltage
	3360	4712	5100		t = 8.3ms reappplied
	2700	3785	4100		t = 10ms 100% $V_{RRM}$
	2800	3963	4300		t = 8.3ms reappplied
$I^2t$ Maximum $I^2t$ for fusing	51.5	102	119	KA <sup>2</sup> s	t = 10ms No voltage
	47	92.5	108		t = 8.3ms reappplied
	36.5	71.6	84		t = 10ms 100% $V_{RRM}$
	33.3	65.4	76.7		t = 8.3ms reappplied
$I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing	515.5	1013	1190	KA <sup>2</sup> √s	t = 0.1 to 10ms, no voltage reappplied
	$V_{T(TO)1}$ Low level value of threshold voltage	0.86	0.83		0.8
$V_{T(TO)2}$ High level value of threshold voltage	1.05	1	0.98		$(I > \pi \times I_{T(AV)})$ , @ $T_J$ max.
$r_{\theta 1}$ Low level value on-state slope resistance	2.02	1.78	1.67	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	1.65	1.43		1.38
$V_{TM}$ Maximum forward voltage drop	1.57	1.55	1.54	V	$I_{TM} = \pi \times I_{T(AV)}$ , $T_J = 25^\circ\text{C}$ , 180° conduction
$I_H$ Maximum holding current	200			mA	Anode supply = 6V initial $I_r = 30A$ , $T_J = 25^\circ\text{C}$
$I_L$ Maximum latching current	400			mA	Anode supply = 6V resistive load = 1Ω Gate pulse: 10V, 100μs, $T_J = 25^\circ\text{C}$

**Switching**

$t_{gd}$ Typical delay time	1	μs	$T_J = 25^\circ\text{C}$	Gate Current=1A $dI_g/dt=1A/\mu s$
$t_{gr}$ Typical rise time	2		$T_J = 25^\circ\text{C}$	$V_d=0,67\% V_{DRM}$
$t_q$ Typical turn-off time	50 - 200		$I_{TM} = 300A$ ; $-dI/dt = 15A/\mu s$ ; $T_J = T_J$ max $V_r = 50V$ ; $dV/dt = 20V/\mu s$ ; Gate 0V, 100Ω	

**Blocking**

$I_{RRM}$	Maximum peak reverse and off-state leakage current	50	mA	$T_J = 125^\circ\text{C}$
$I_{DRM}$	Maximum peak reverse and off-state leakage current			
$V_{INS}$	RMS isolation voltage	3500	V	50Hz, circuit to base, all terminals shorted, $t = 1\text{s}$
$dV/dt$	critical rate of rise of off-state voltage	1000	V/ $\mu\text{s}$	$T_J = T_{J\text{max.}}$ , exponential to 67% rated $V_{DRM}$

**Triggering**

Parameter	IRK.136	IRK.142	IRK.162	Units	Conditions	
$P_{GM}$	Max. peak gate power			12	W	$t_p \leq 5\text{ms}$ , $T_J = T_{J\text{max.}}$
$P_{G(AV)}$	Max. average gate power			3	W	$f = 50\text{Hz}$ , $T_J = T_{J\text{max.}}$
$I_{GM}$	Max. peak gate current			3	A	$t_p \leq 5\text{ms}$ , $T_J = T_{J\text{max.}}$
$-V_{GT}$	Max. peak negative gate voltage			10	V	
$V_{GT}$	Max. required DC gate voltage to trigger			4	V	$T_J = -40^\circ\text{C}$ $T_J = 25^\circ\text{C}$ $T_J = T_{J\text{max.}}$ Anode supply = 6V, resistive load; $R_a = 1\Omega$
				2.5		
				1.7		
$I_{GT}$	Max. required DC gate current to trigger			270	mA	$T_J = -40^\circ\text{C}$ $T_J = 25^\circ\text{C}$ $T_J = T_{J\text{max.}}$ Anode supply = 6V, resistive load; $R_a = 1\Omega$
				150		
				80		
$V_{GD}$	Max. gate voltage that will not trigger			0.3	V	@ $T_J = T_{J\text{max.}}$ , rated $V_{DRM}$ applied
$I_{GD}$	Max. gate current that will not trigger			10	mA	
$di/dt$	Max. rate of rise of turned-on current			300	A/ $\mu\text{s}$	@ $T_J = T_{J\text{max.}}$ , $I_{TM} = 400\text{A}$ rated $V_{DRM}$ applied

**Thermal and Mechanical Specifications**

Parameter	IRK.136	IRK.142	IRK.162	Units	Conditions	
$T_J$	Max. junction operating temperature range			-40 to 125	$^\circ\text{C}$	
$T_{stg}$	Max. storage temperature range			-40 to 150	$^\circ\text{C}$	
$R_{thJC}$	0.18	0.18	0.16	K/W	DC operation, per junction	
$R_{thCS}$	Max. thermal resistance, case to heatsink			0.05	K/W	Mounting surface smooth, flat and greased Per module
T	Mounting torque $\pm 10\%$	IAP 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.
		busbar to IAP		4 to 6		
wt	Approximate weight			200 (7.1)	g(oz)	
	Case Style			New Int-A-Pak		

**$\Delta R$  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 @ $T_J\text{max.}$					Rectangular conduction @ $T_J\text{max.}$					Units
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
IRK.136	0.007	0.01	0.013	0.0155	0.017	0.009	0.012	0.014	0.015	0.017	K/W
IRK.142	0.0019	0.0019	0.0020	0.0020	0.0021	0.0018	0.0022	0.0023	0.0023	0.0020	
IRK.162	0.0030	0.0031	0.0032	0.0033	0.0034	0.0029	0.0036	0.0039	0.0041	0.0040	

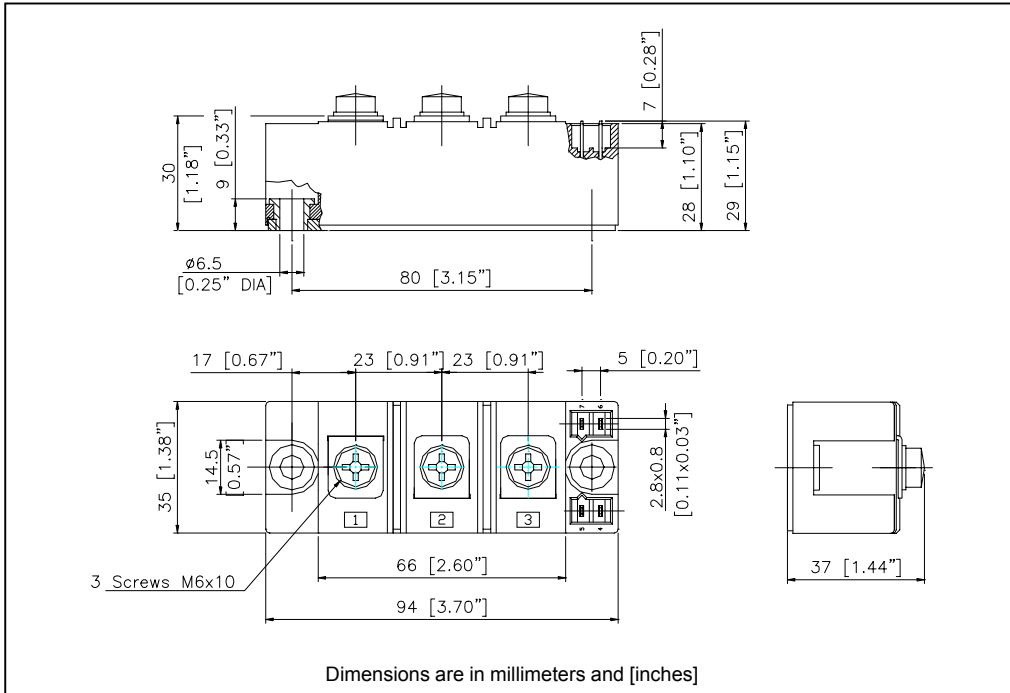
**IRK.136, .142, .162 Series**

Bulletin I27117 rev. C 03/02

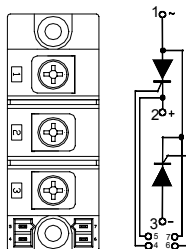
Ordering Information Table

Device Code				
1	2	3	4	
IRK	T	162	/	16
1	- Module Type			
2	- Circuit Configuration			
3	- Current Rating: $I_{T(AV)}$			
4	- Voltage Code: Code x 100 = $V_{RRM}$			

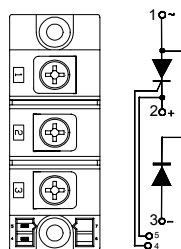
Outline Table



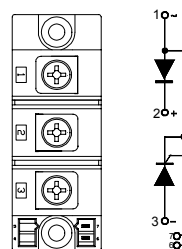
**IRKT**



**IRKH**



**IRKL**



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



Fig. 1 - Current Ratings Characteristics

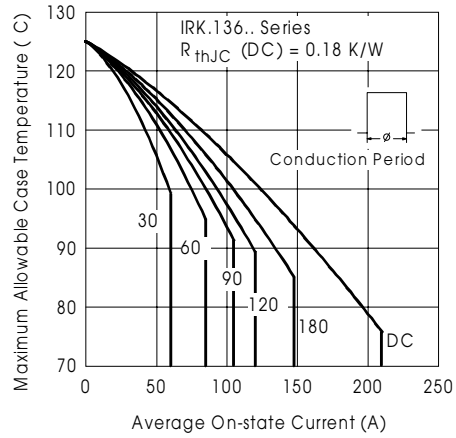


Fig. 2 - Current Ratings Characteristics



Fig. 3 - On-State Power Loss Characteristics

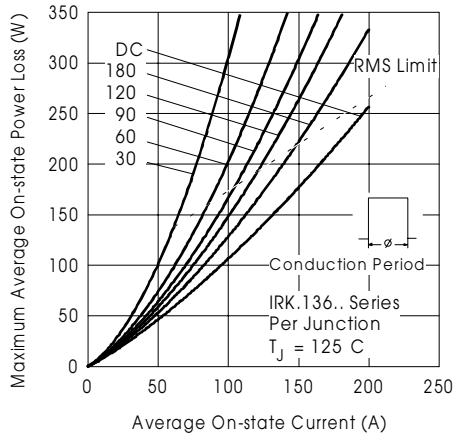


Fig. 4 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current

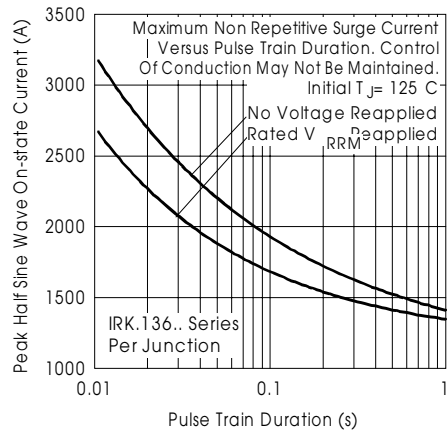


Fig. 6 - Maximum Non-Repetitive Surge Current

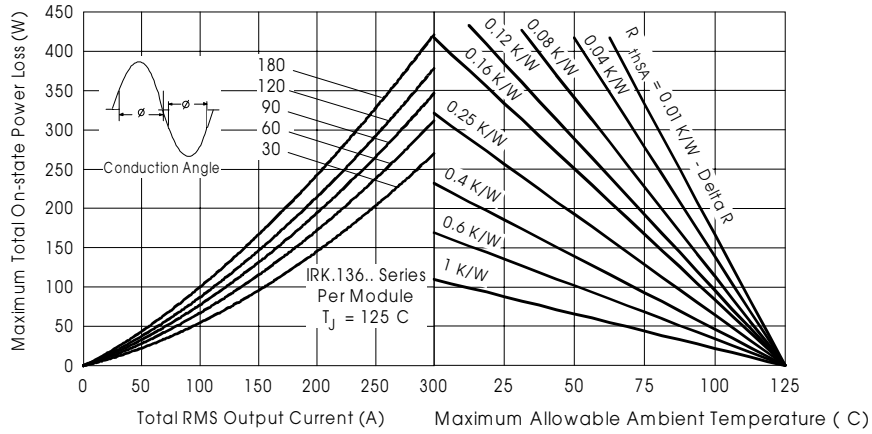


Fig.7 - On State Power Loss Characteristics

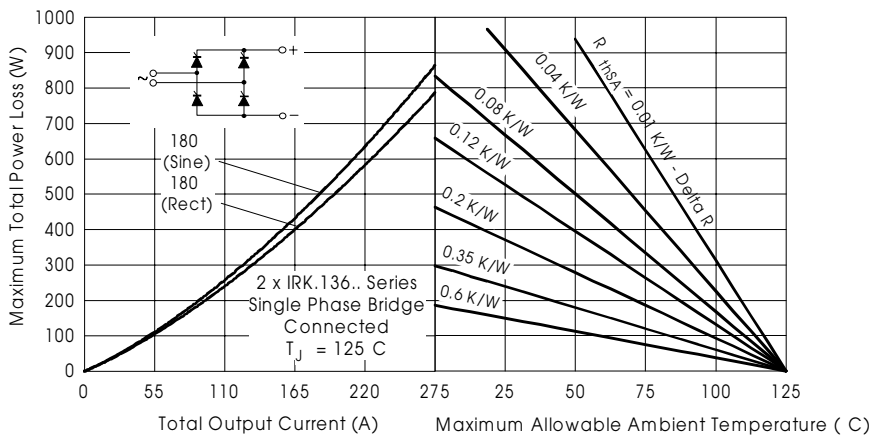


Fig.8 - On State Power Loss Characteristics

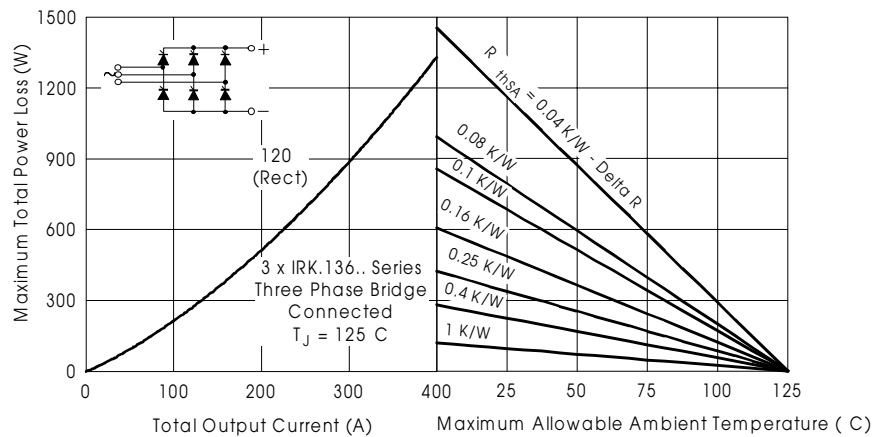


Fig.9 - On State Power Loss Characteristics

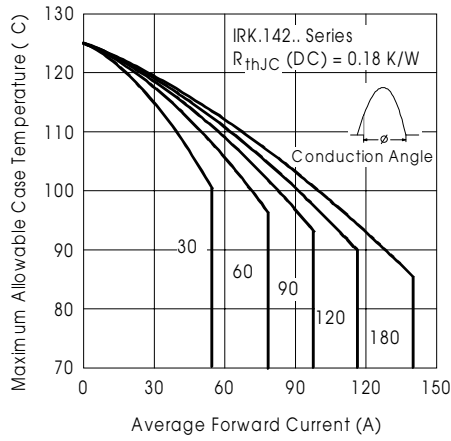


Fig. 10 - Current Ratings Characteristics

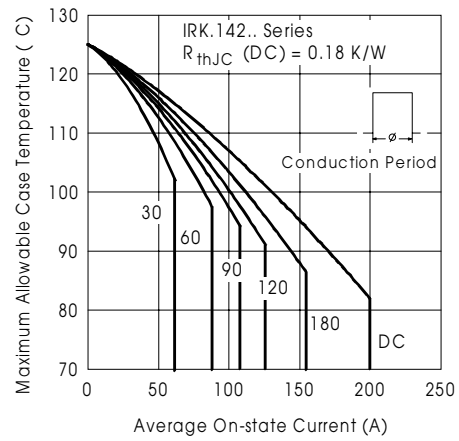


Fig. 11 - Current Ratings Characteristics

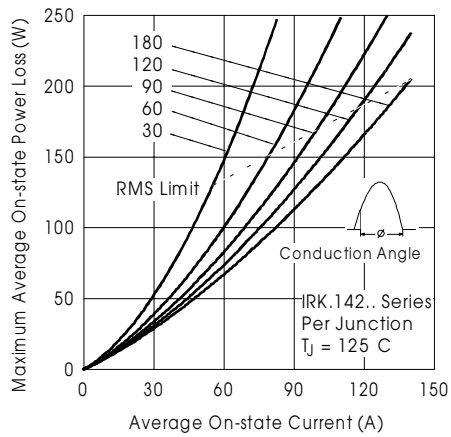


Fig. 12 - On-State Power Loss Characteristics

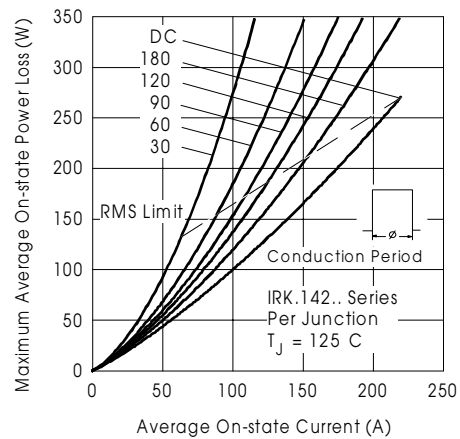


Fig. 13 - On-State Power Loss Characteristics

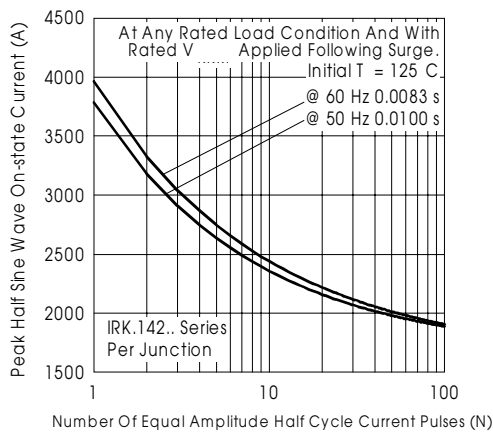


Fig. 14 - Maximum Non-Repetitive Surge Current

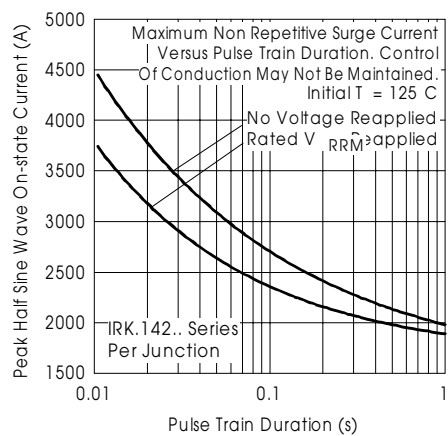


Fig. 15 - Maximum Non-Repetitive Surge Current

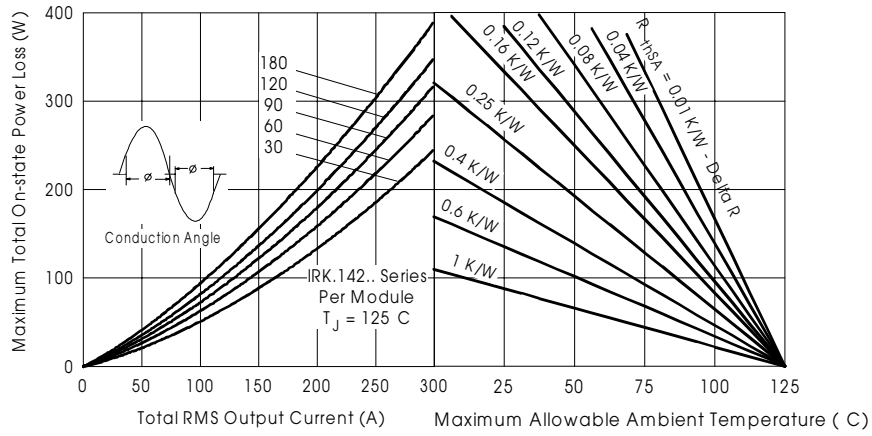


Fig.16 - On State Power Loss Characteristics

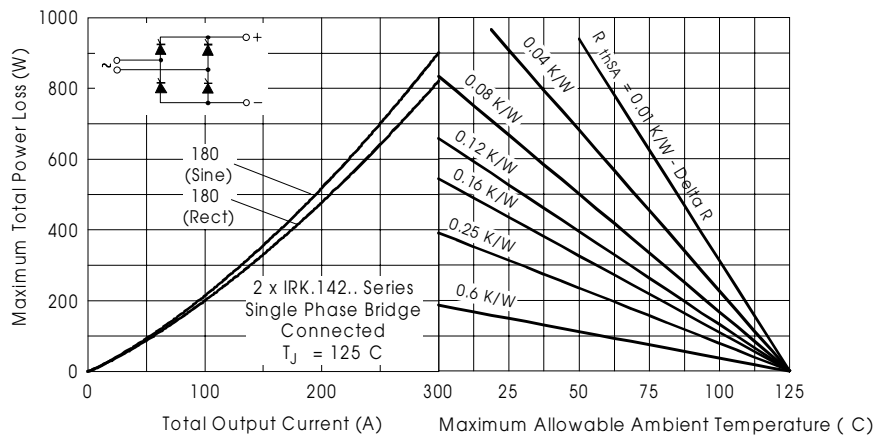


Fig.17 - On State Power Loss Characteristics

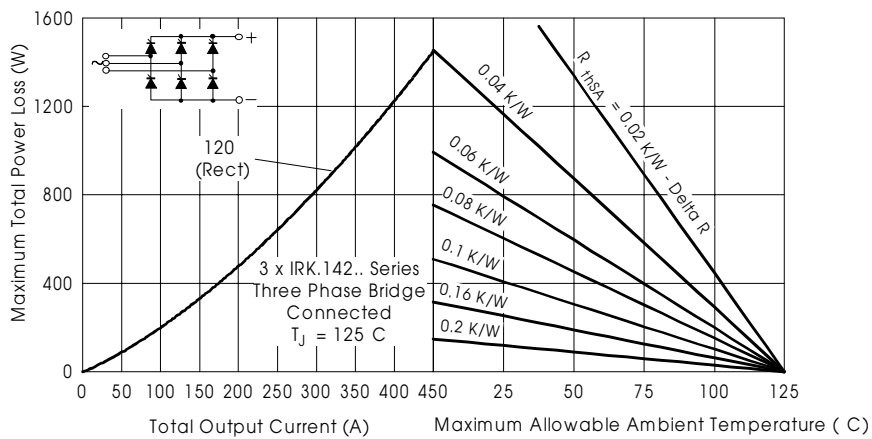


Fig.18 - On State Power Loss Characteristics





Fig. 19 - Current Ratings Characteristics



Fig. 20 - Current Ratings Characteristics

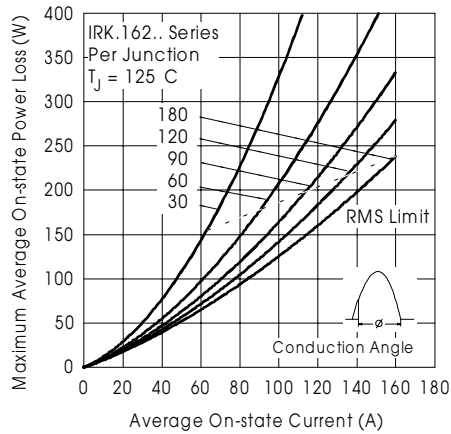


Fig. 21 - On-State Power Loss Characteristics

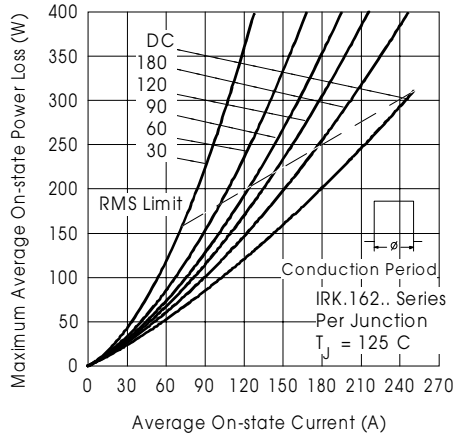


Fig. 22 - On-State Power Loss Characteristics



Fig. 23 - Maximum Non-Repetitive Surge Current

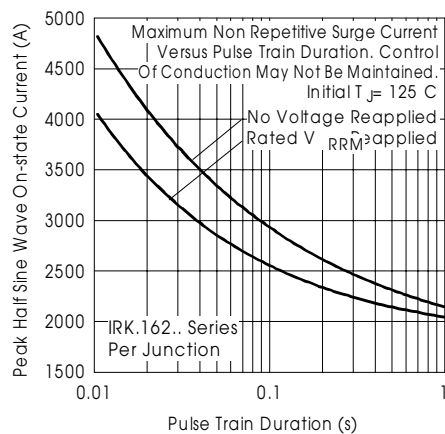


Fig. 24 - Maximum Non-Repetitive Surge Current

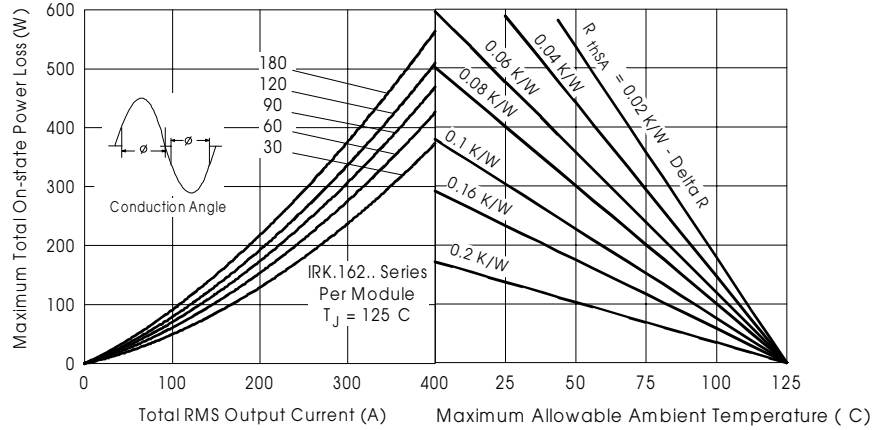


Fig.25 - On State Power Loss Characteristics

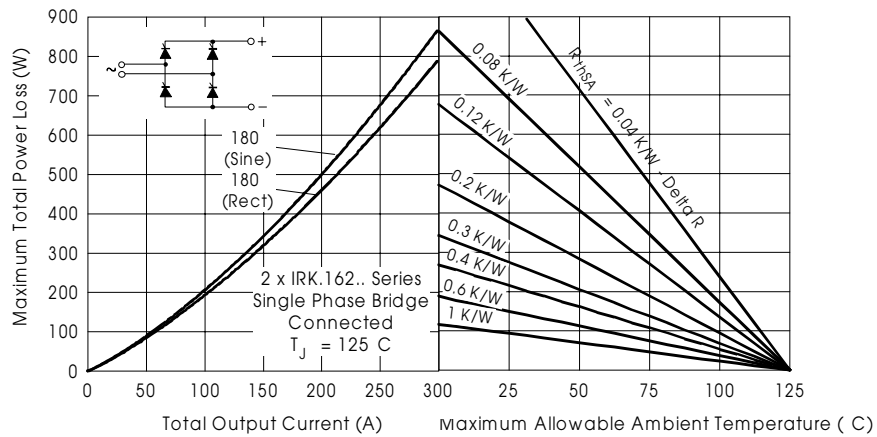


Fig.26 - On State Power Loss Characteristics

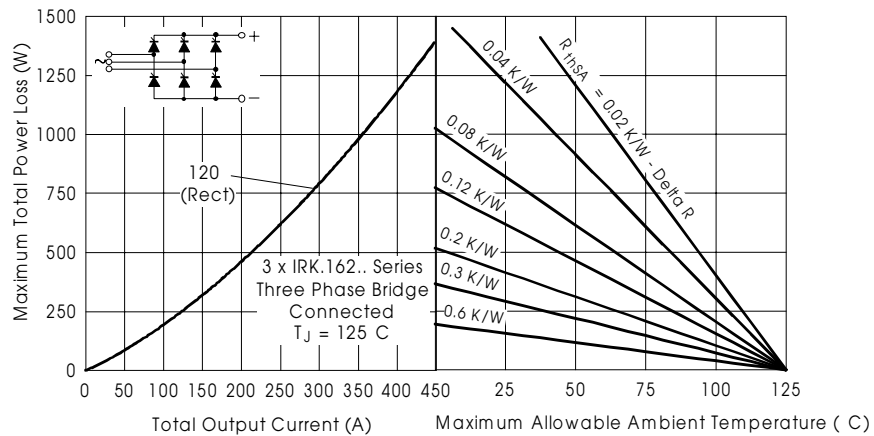


Fig.27 - On State Power Loss Characteristics



Fig.28 - On State Voltage Drop Characteristics



Fig.29 - On State Voltage Drop Characteristics

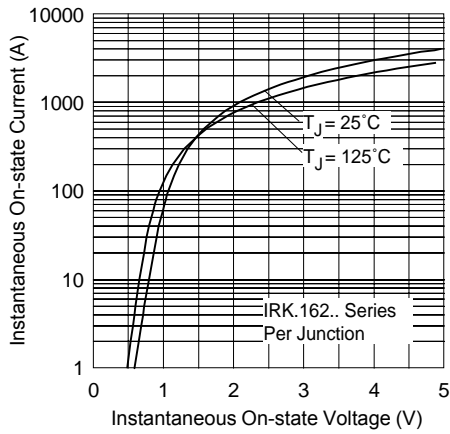


Fig.30 - On State Voltage Drop Characteristics

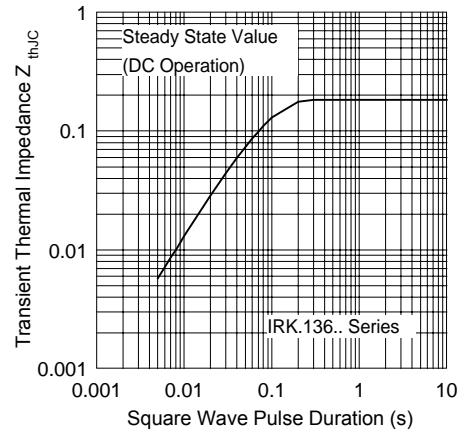


Fig.31 - Thermal Impedance ZthJC Characteristics



Fig.32 - Thermal Impedance ZthJC Characteristics

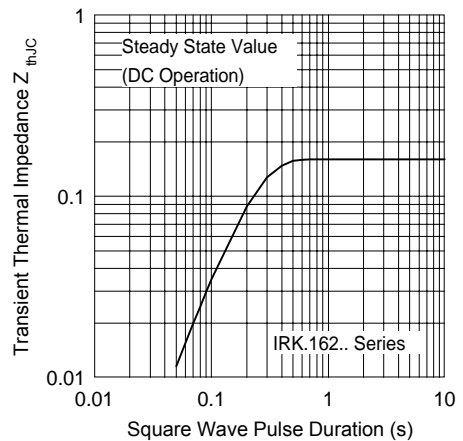


Fig.33 - Thermal Impedance ZthJC Characteristics

**IRK.136, .142, .162 Series**

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Fig. 34 - Gate Characteristics

Data and specifications subject to change without notice.  
 This product has been designed and qualified for Multiple Level.  
 Qualification Standards can be found on IR's Web site.

International  
**IR** Rectifier

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