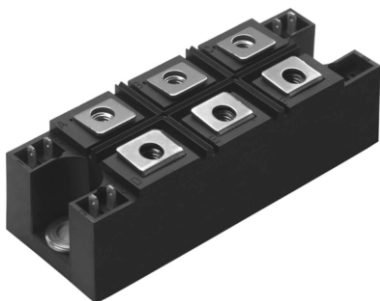



## Three Phase Controlled Bridge (Power Modules), 55 A to 110 A



MTK

### FEATURES

- Package fully compatible with the industry standard INT-A-PAK power modules series
- High thermal conductivity package, electrically insulated case
- Excellent power volume ratio
- 4000 V<sub>RMS</sub> isolating voltage
- UL E78996 approved 
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level



**RoHS**  
COMPLIANT

### PRODUCT SUMMARY

$I_o$	55 A to 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

SYMBOL	CHARACTERISTICS	5.MT...K	9.MT...K	11.MT...K	UNITS
$I_o$		55	90	110	A
	$T_C$	85	85	85	°C
$I_{FSM}$	50 Hz	390	950	1130	A
	60 Hz	410	1000	1180	
$I^2t$	50 Hz	770	4525	6380	A <sup>2</sup> s
	60 Hz	700	4130	5830	
$I^2\sqrt{t}$		7700	45 250	63 800	A <sup>2</sup> √s
$V_{RRM}$	Range	800 to 1600			V
$T_{Stg}, T_J$	Range	- 40 to 125			°C



## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series



Vishay High Power Products Three Phase Controlled Bridge  
(Power Modules), 55 A to 110 A

### 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	$V_{DRM}$ , MAXIMUM REPETITIVE PEAK OFF-STATE VOLTAGE, GATE OPEN CIRCUIT V	$I_{RRM}/I_{DRM}$ , MAXIMUM AT $T_J = 125^\circ\text{C}$ mA
5.MT...K	80	800	900	800	10
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	
9.MT...K 11.MT...K	80	800	900	800	20
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	

FORWARD CONDUCTION									
PARAMETER	SYMBOL	TEST CONDITIONS			5.MT...K	9.MT...K	11.MT...K	UNITS	
Maximum DC output current at case temperature	I <sub>O</sub>	120° rect. conduction angle			55	90	110	A	
					85	85	85	°C	
Maximum peak, one-cycle forward, non-repetitive on state surge current	I <sub>TSM</sub>	t = 10 ms	No voltage reapplied	Initial T <sub>J</sub> = T <sub>J</sub> maximum	390	950	1130	A	
		t = 8.3 ms			410	1000	1180		
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		330	800	950		
		t = 8.3 ms			345	840	1000		
Maximum I <sup>2</sup> t for fusing	I <sup>2</sup> t	t = 10 ms	No voltage reapplied		770	4525	6380	A <sup>2</sup> s	
		t = 8.3 ms			700	4130	5830		
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		540	3200	4510		
		t = 8.3 ms			500	2920	4120		
Maximum I <sup>2</sup> √t for fusing	I <sup>2</sup> √t	t = 0.1 ms to 10 ms, no voltage reapplied			7700	45 250	63 800	A <sup>2</sup> √s	
Low level value of threshold voltage	V <sub>T(TO)1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> maximum			1.17	1.09	1.04	V	
High level value of threshold voltage	V <sub>T(TO)2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> maximum			1.45	1.27	1.27		
Low level value on-state slope resistance	r <sub>t1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> maximum			12.40	4.10	3.93	mΩ	
High level value on-state slope resistance	r <sub>t2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> maximum			11.04	3.59	3.37		
Maximum on-state voltage drop	V <sub>TM</sub>	I <sub>pk</sub> = 150 A, T <sub>J</sub> = 25 °C, t <sub>p</sub> = 400 μs single junction			2.68	1.65	1.57	V	
Maximum non-repetitive rate of rise of turned on current	dI/dt	T <sub>J</sub> = 25 °C, from 0.67 V <sub>DRM</sub> , I <sub>TM</sub> = π × I <sub>T(AV)</sub> , I <sub>g</sub> = 500 mA, t <sub>r</sub> < 0.5 μs, t <sub>p</sub> > 6 μs			150			A/μs	
Maximum holding current	I <sub>H</sub>	T <sub>J</sub> = 25 °C, anode supply = 6 V, resistive load, gate open circuit			200			mA	
Maximum latching current	I <sub>L</sub>	T <sub>J</sub> = 25 °C, anode supply = 6 V, resistive load			400				





## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series

Three Phase Controlled Bridge Vishay High Power Products  
(Power Modules), 55 A to 110 A

BLOCKING						
PARAMETER	SYMBOL	TEST CONDITIONS	5.MT...K	9.MT...K	11.MT...K	UNITS
RMS isolation voltage	$V_{ISOL}$	$T_J = 25\text{ °C}$ all terminal shorted, $f = 50\text{ Hz}$ , $t = 1\text{ s}$	4000			V
Maximum critical rate of rise of off-state voltage	$dV/dt$ <sup>(1)</sup>	$T_J = T_J$ maximum, linear to $0.67 V_{DRM}$ , gate open circuit	500			V/ $\mu$ s

### Note

<sup>(1)</sup> Available with  $dV/dt = 1000\text{ V}/\mu\text{s}$ , to complete code add S90 i. e. 113MT160KBS90

TRIGGERING							
PARAMETER	SYMBOL	TEST CONDITIONS		5.MT...K	9.MT...K	11.MT...K	UNITS
Maximum peak gate power	P <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum		10			W
Maximum average gate power	P <sub>G(AV)</sub>			2.5			
Maximum peak gate current	I <sub>GM</sub>			2.5			A
Maximum peak negative gate voltage	- V <sub>GT</sub>			10			V
Maximum required DC gate voltage to trigger	V <sub>GT</sub>	T <sub>J</sub> = - 40 °C	Anode supply = 6 V, resistive load	4.0			
		T <sub>J</sub> = 25 °C		2.5			
		T <sub>J</sub> = 125 °C		1.7			
Maximum required DC gate current to trigger	I <sub>GT</sub>	T <sub>J</sub> = - 40 °C		270		mA	
		T <sub>J</sub> = 25 °C		150			
		T <sub>J</sub> = 125 °C		80			
Maximum gate voltage that will not trigger	V <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> applied		0.25		V	
Maximum gate current that will not trigger	I <sub>GD</sub>			6		mA	

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	5.MT...K	9.MT...K	11.MT...K	UNITS
Maximum junction operating and storage temperature range	T <sub>J</sub> , T <sub>Stg</sub>		- 40 to 125			°C
Maximum thermal resistance, junction to case	R <sub>thJC</sub>	DC operation per module	0.18	0.14	0.12	K/W
		DC operation per junction	1.07	0.86	0.70	
		120 °C rect. conduction angle per module	0.19	0.15	0.12	
		120 °C rect. conduction angle per junction	1.17	0.91	0.74	
Maximum thermal resistance, case to heatsink per module	R <sub>thCS</sub>	Mounting surface smooth, flat and grased	0.03			
Mounting torque ± 10 %	to heatsink to terminal	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.	4 to 6			Nm
			3 to 4			
Approximate weight			225			g



## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series



Vishay High Power Products Three Phase Controlled Bridge  
(Power Modules), 55 A to 110 A

<b>ΔR CONDUCTION PER JUNCTION</b>											
DEVICES	SINUSOIDAL CONDUCTION AT T <sub>J</sub> MAXIMUM					RECTANGULAR CONDUCTION AT T <sub>J</sub> MAXIMUM					UNITS
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
5.MT...K	0.072	0.085	0.108	0.152	0.233	0.055	0.091	0.117	0.157	0.236	K/W
9.MT...K	0.033	0.039	0.051	0.069	0.099	0.027	0.044	0.055	0.071	0.100	
11.MT...K	0.027	0.033	0.042	0.057	0.081	0.023	0.037	0.046	0.059	0.082	

### Note

- Table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC

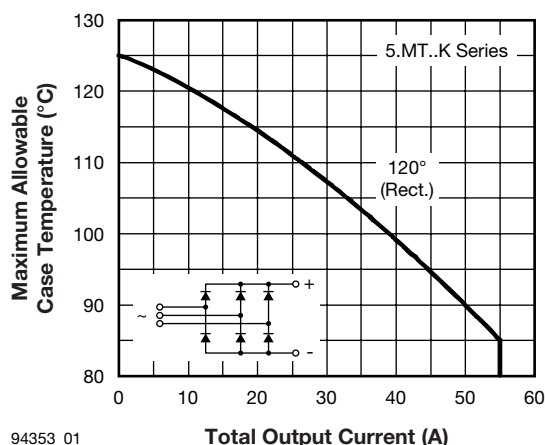


Fig. 1 - Current Ratings Characteristic

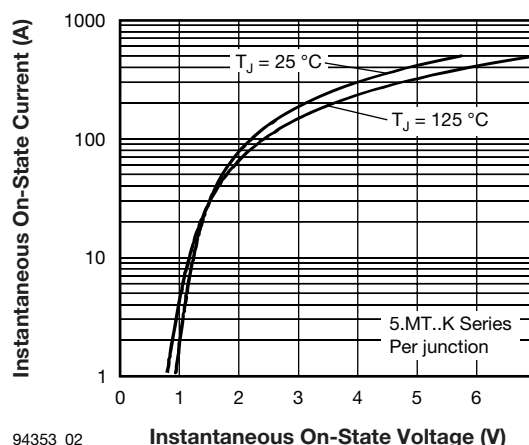


Fig. 2 - Forward Voltage Drop Characteristics

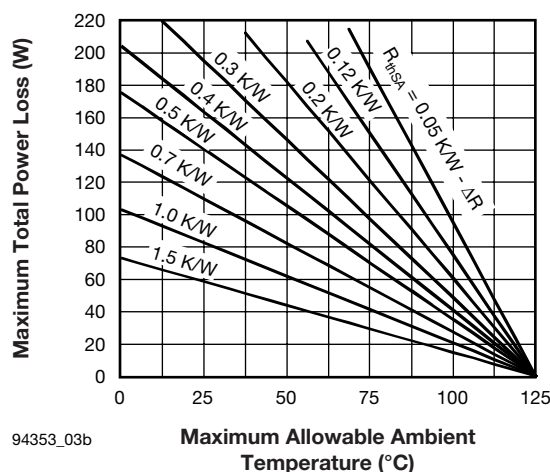
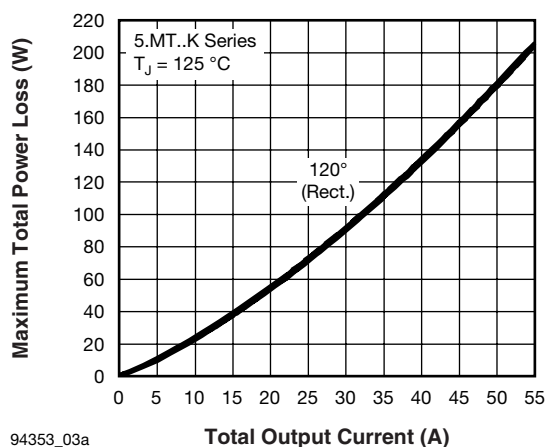


Fig. 3 - Total Power Loss Characteristics





## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series

Three Phase Controlled Bridge Vishay High Power Products  
(Power Modules), 55 A to 110 A

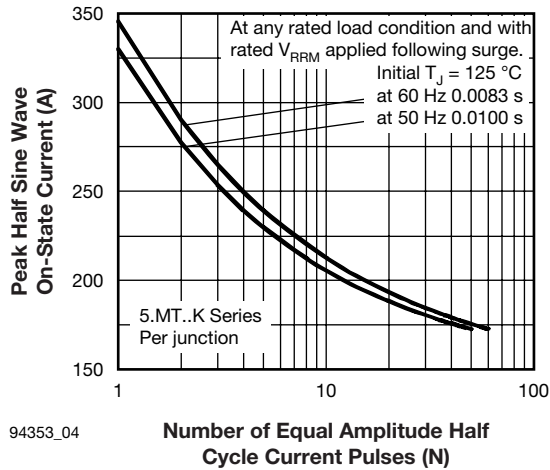


Fig. 4 - Maximum Non-Repetitive Surge Current

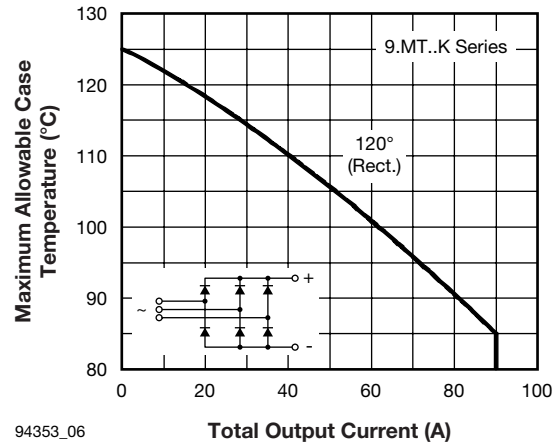


Fig. 6 - Current Ratings Characteristic

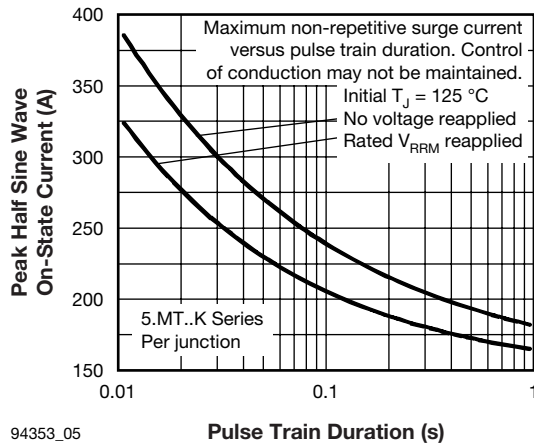


Fig. 5 - Maximum Non-Repetitive Surge Current

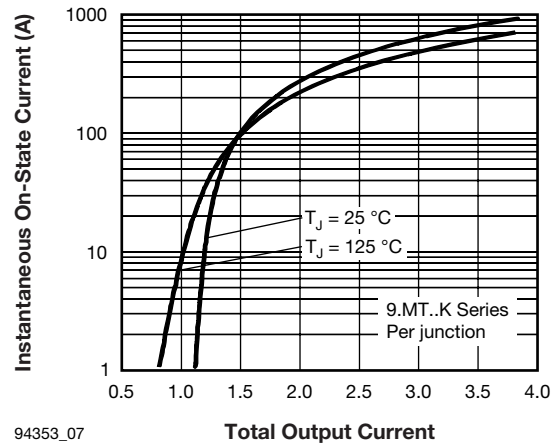


Fig. 7 - Forward Voltage Drop Characteristics

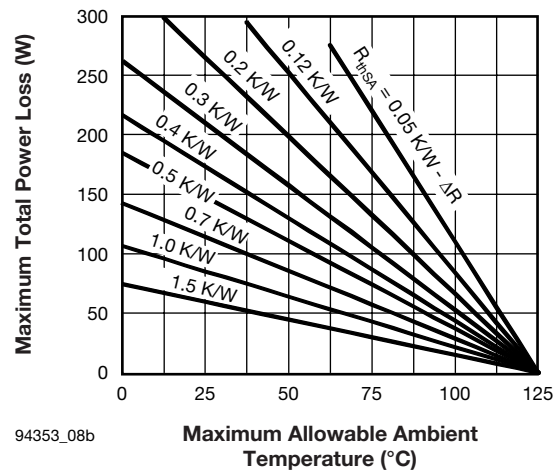
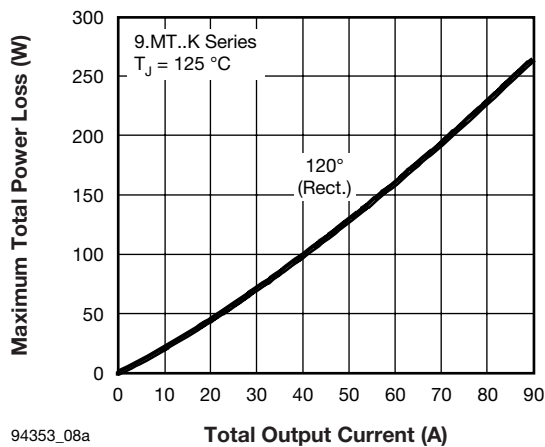


Fig. 8 - Total Power Loss Characteristics



## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series



Vishay High Power Products Three Phase Controlled Bridge  
(Power Modules), 55 A to 110 A

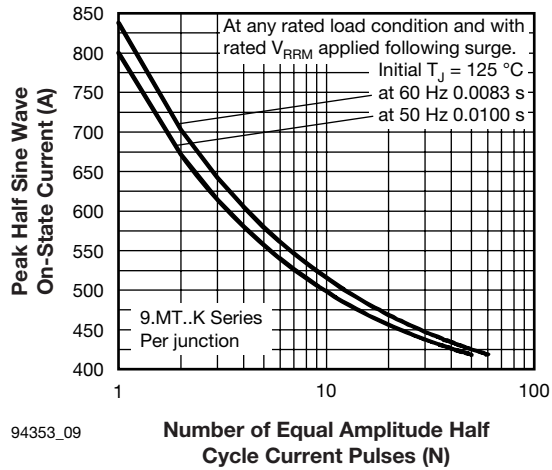


Fig. 9 - Maximum Non-Repetitive Surge Current

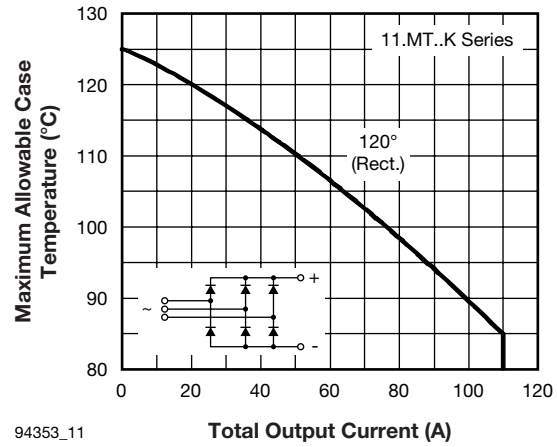


Fig. 11 - Current Ratings Characteristic

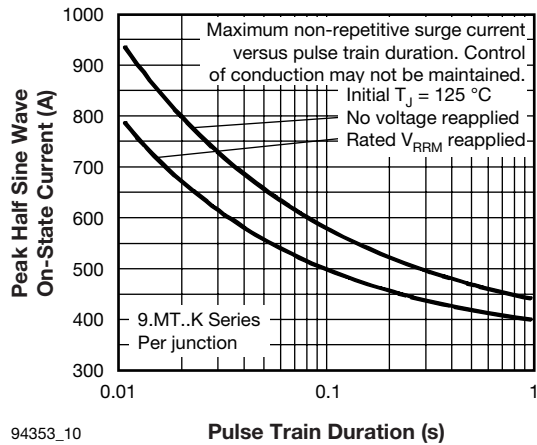


Fig. 10 - Maximum Non-Repetitive Surge Current

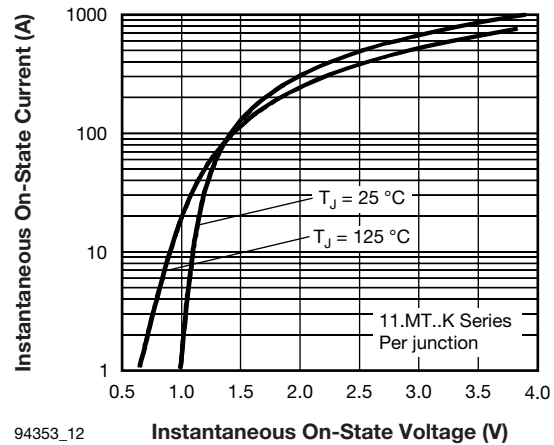


Fig. 12 - Forward Voltage Drop Characteristics

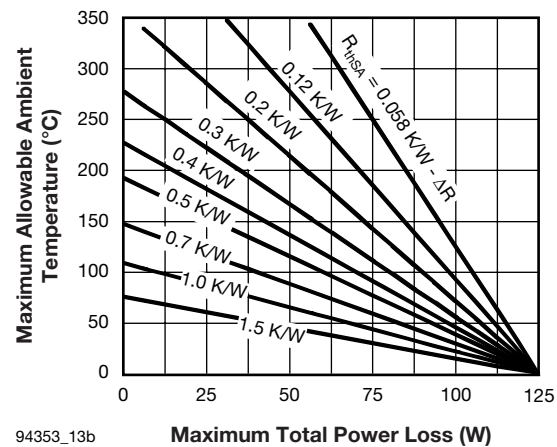
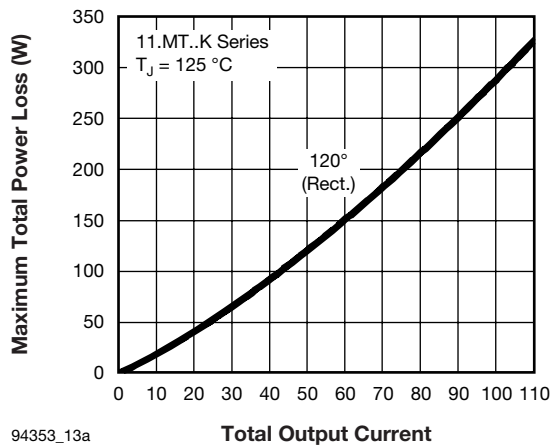


Fig. 13 - Total Power Loss Characteristics





## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series

Three Phase Controlled Bridge Vishay High Power Products  
(Power Modules), 55 A to 110 A

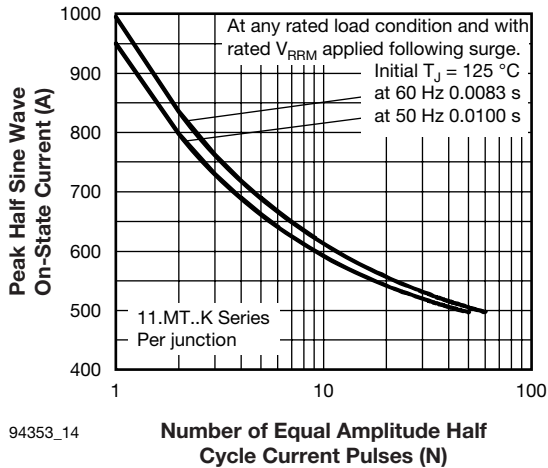


Fig. 14 - Maximum Non-Repetitive Surge Current

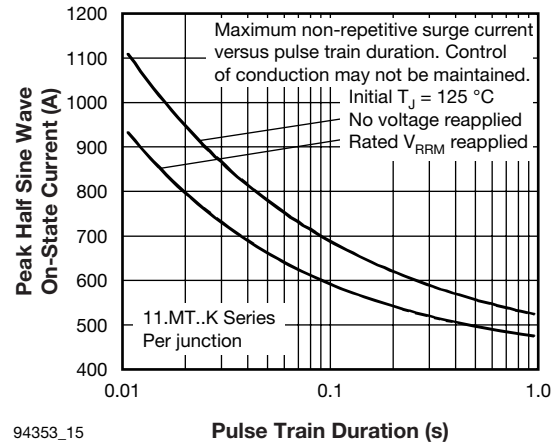


Fig. 15 - Maximum Non-Repetitive Surge Current

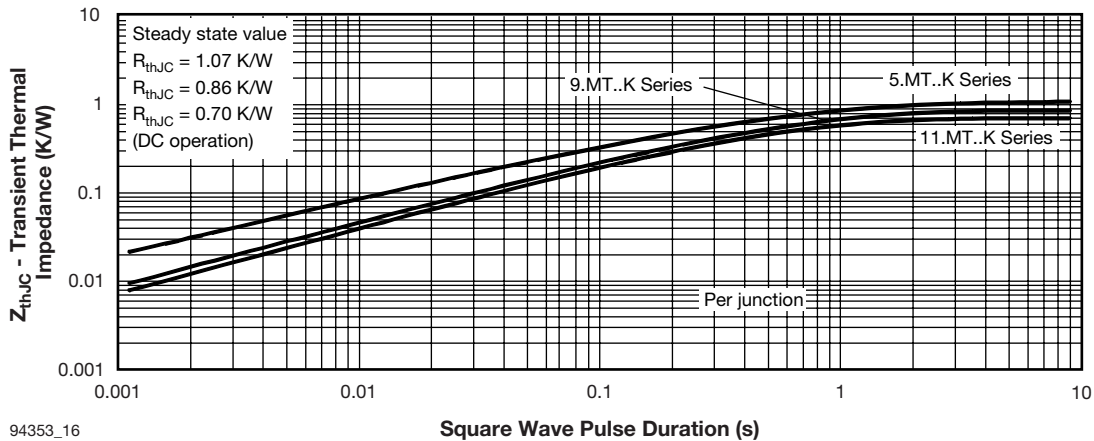


Fig. 16 - Thermal Impedance  $Z_{thJC}$  Characteristics

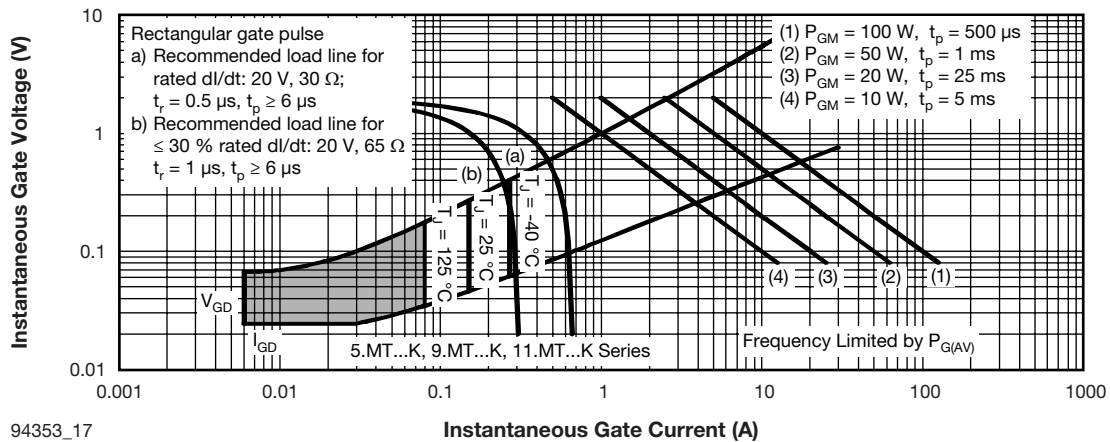


Fig. 17 - Gate Characteristics



## 5.MT...KPbF, 9.MT...KPbF, 11.MT...KPbF Series



Vishay High Power Products Three Phase Controlled Bridge  
(Power Modules), 55 A to 110 A

### ORDERING INFORMATION TABLE

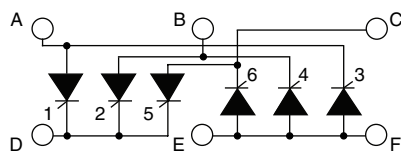
Device code	11	3	MT	160	K	S90	PbF
	①	②	③	④	⑤	⑥	

- 1** - Current rating code:
  - 5 = 55 A (average)
  - 9 = 90 A (average)
  - 11 = 110 A (average)
- 2** - Circuit configuration code:
  - 1 = Negative half-controlled bridge
  - 2 = Positive half-controlled bridge
  - 3 = Full-controlled bridge
- 3** - Essential part number
- 4** - Voltage code x 10 =  $V_{RRM}$  (see Voltage Ratings table)
- 5** - Critical dV/dt:
  - None = 500 V/ $\mu$ s (standard value)
  - S90 = 1000 V/ $\mu$ s (special selection)
- 6** - PbF = Lead (Pb)-free

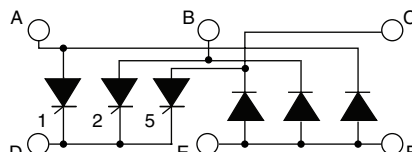
#### Note

- To order the optional hardware go to [www.vishay.com/doc?95172](http://www.vishay.com/doc?95172)

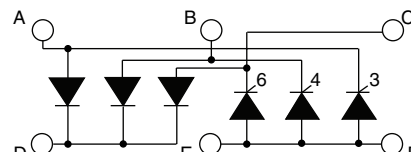
### CIRCUIT CONFIGURATION



Full-controlled bridge  
(5.MT...K, 9.MT...K, 11.MT..K)



Positive half-controlled bridge  
(5.MT...K, 9.MT...K, 11.MT..K)



Negative half-controlled bridge  
(5.MT...K, 9.MT...K, 11.MT..K)

#### LINKS TO RELATED DOCUMENTS

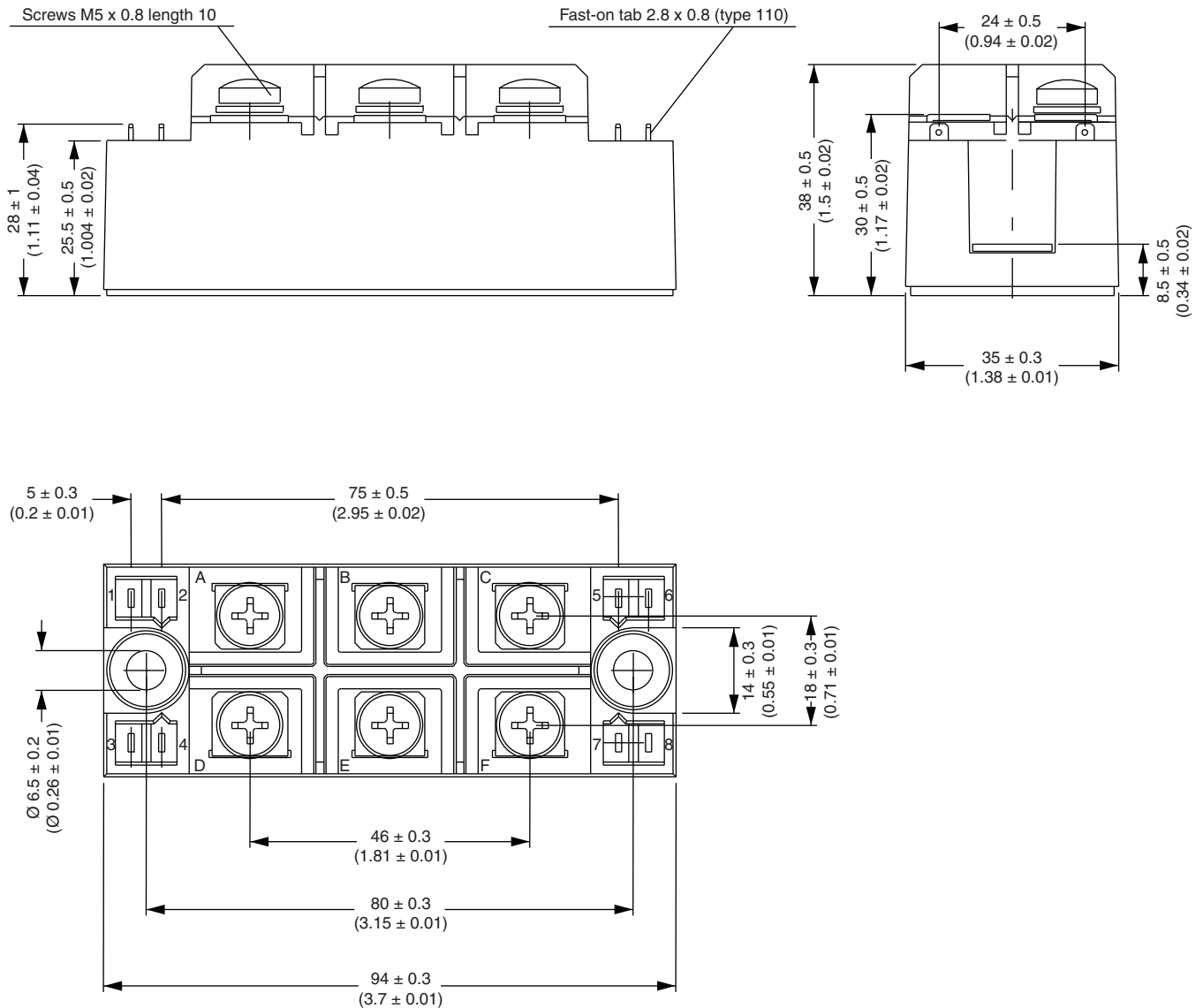
Dimensions

[www.vishay.com/doc?95004](http://www.vishay.com/doc?95004)



## MTK (with and without optional barrier)

### DIMENSIONS WITH OPTIONAL BARRIERS in millimeters (inches)



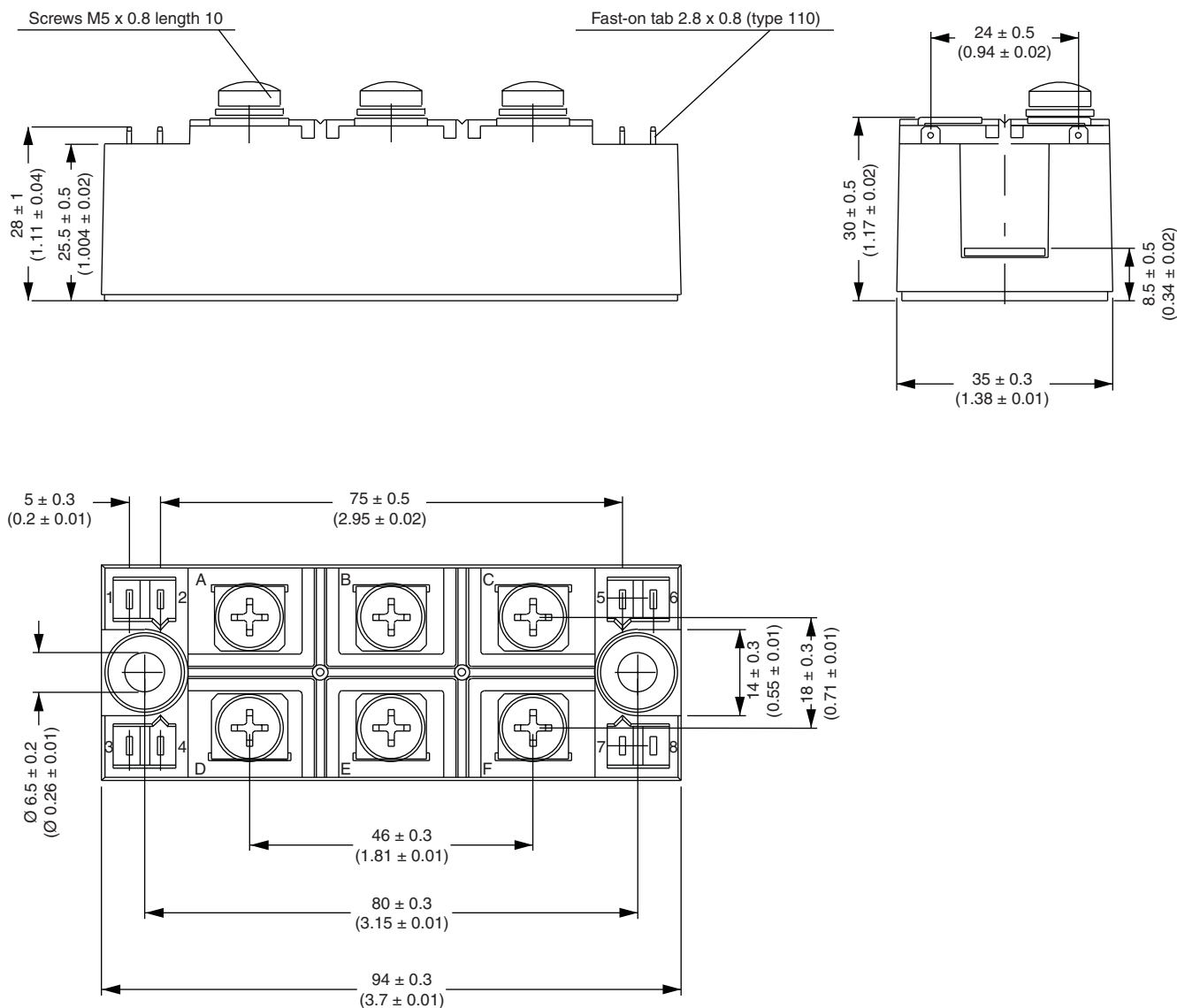


# Outline Dimensions

Vishay Semiconductors MTK (with and without optional barrier)



## DIMENSIONS WITHOUT OPTIONAL BARRIERS in millimeters (inches)







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