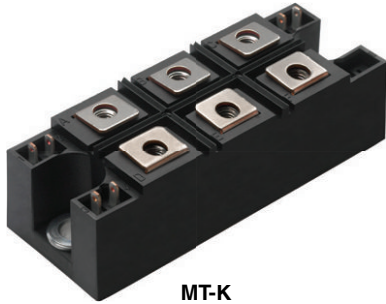





## Three Phase Controlled Bridge (Power Modules), 55 A to 110 A



MT-K

PRODUCT SUMMARY	
$I_o$	55 A to 110 A
$V_{RRM}$	800 V to 1600 V
Package	MT-K
Circuit	Three phase bridge

### 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  $V_{RMS}$  isolating voltage
- UL E78996 approved 
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT

### 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	VALUES 5.MT...K	VALUES 9.MT...K	VALUES 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
$T_{Stg}$	Range	-40 to 125			°C
$T_J$	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	$V_{DRM}$ , MAXIMUM REPETITIVE PEAK OFF-STATE VOLTAGE, GATE OPEN CIRCUIT V	$I_{RRM}/I_{DRM}$ , MAXIMUM AT $T_J = 125\text{ °C}$ mA
VS-5.MT...K	80	800	900	800	10
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	
VS-9.MT...K VS-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		VALUES 5.MT...K	VALUES 9.MT...K	VALUES 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 reappplied	390	950	1130	A
		t = 8.3 ms		410	1000	1180	
		t = 10 ms	100 % V <sub>RRM</sub> reappplied	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 reappplied	770	4525	6380	A <sup>2</sup> s
		t = 8.3 ms		700	4130	5830	
		t = 10 ms	100 % V <sub>RRM</sub> reappplied	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 reappplied		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			

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

**Note**

(1) Available with dV/dt = 1000 V/μs, 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	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

ΔR CONDUCTION PER JUNCTION											
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<sub>thJC</sub> when devices operate at different conduction angles than DC

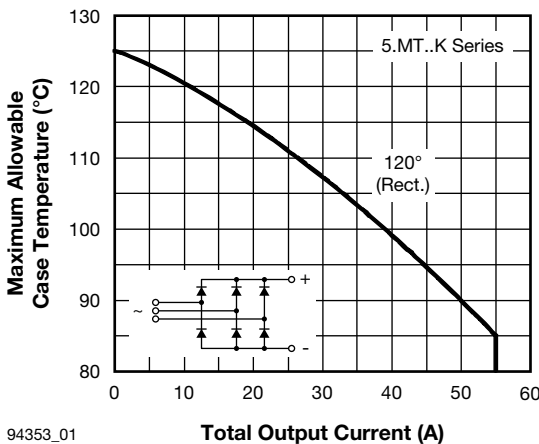


Fig. 1 - Current Ratings Characteristic

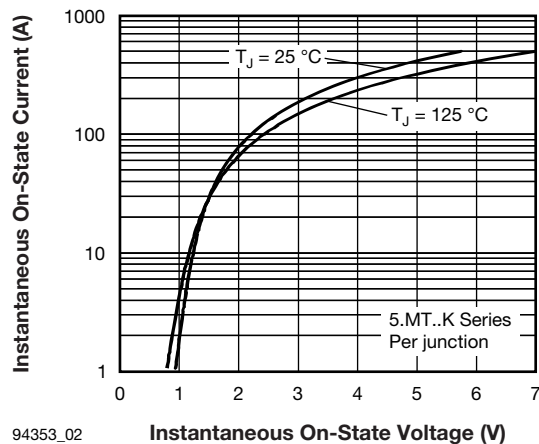
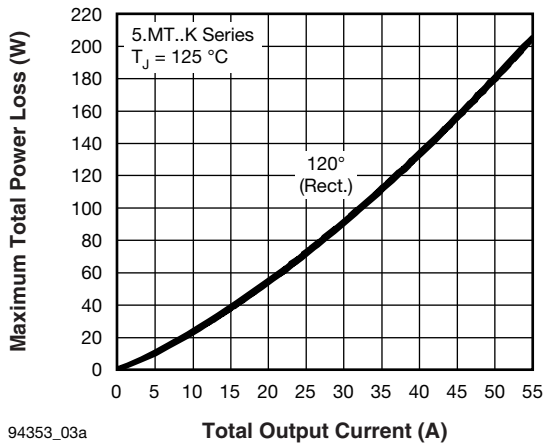
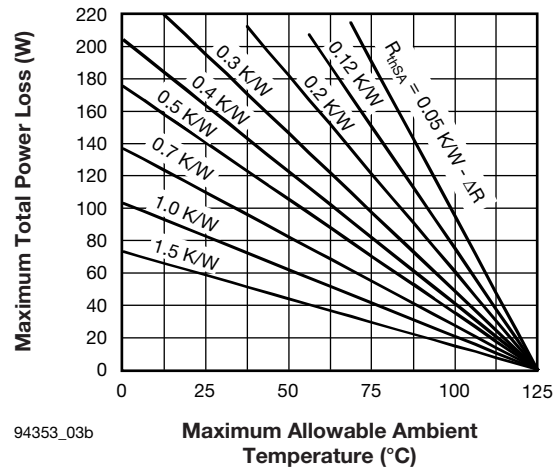


Fig. 2 - Forward Voltage Drop Characteristics

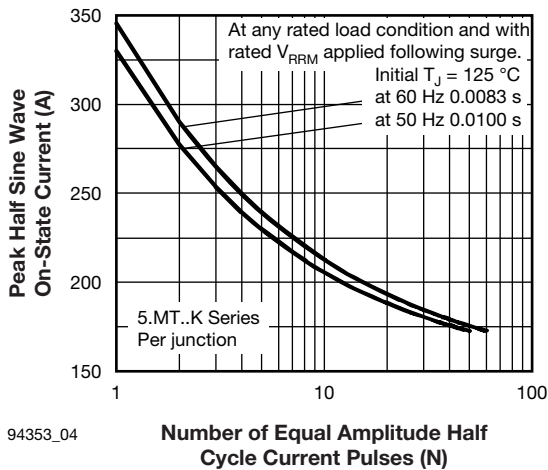


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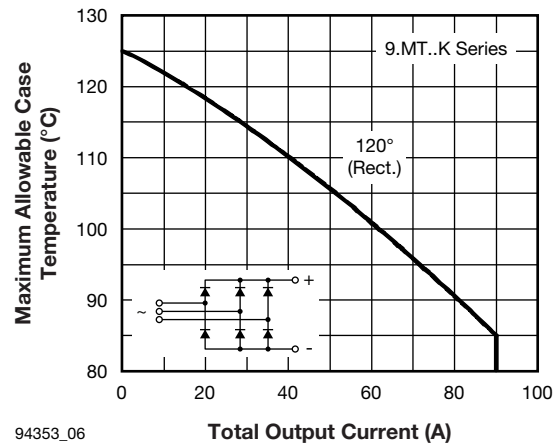
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Fig. 3 - Total Power Loss Characteristics



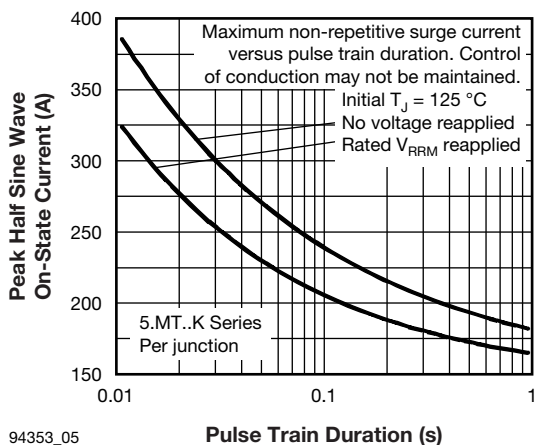
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Fig. 4 - Maximum Non-Repetitive Surge Current



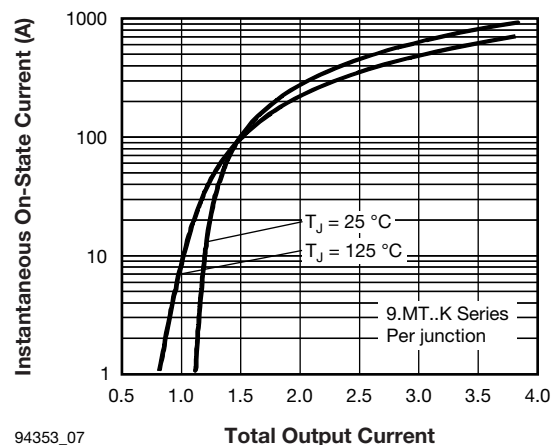
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Fig. 6 - Current Ratings Characteristic



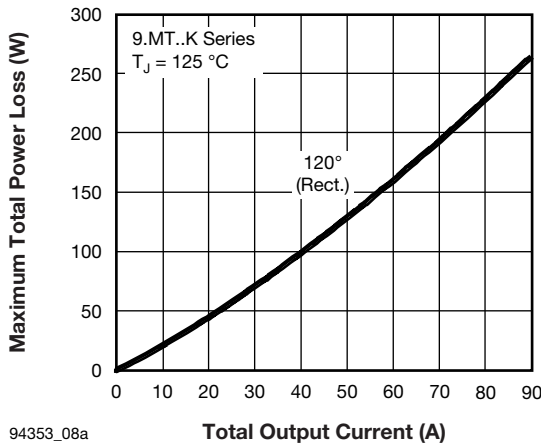
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Fig. 5 - Maximum Non-Repetitive Surge Current

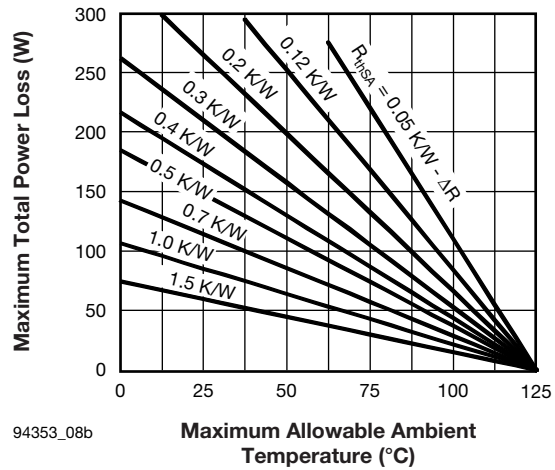


94353\_07

Fig. 7 - Forward Voltage Drop Characteristics

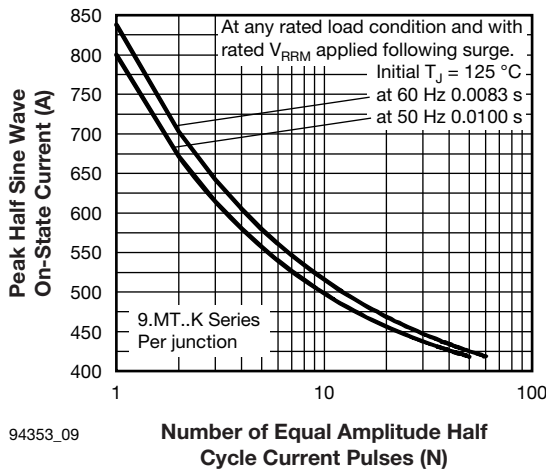


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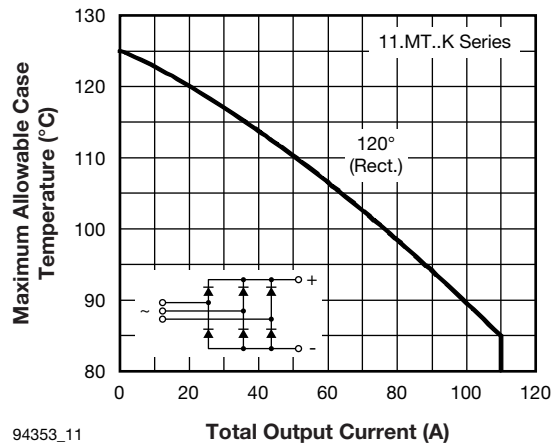
94353\_08b

Fig. 8 - Total Power Loss Characteristics



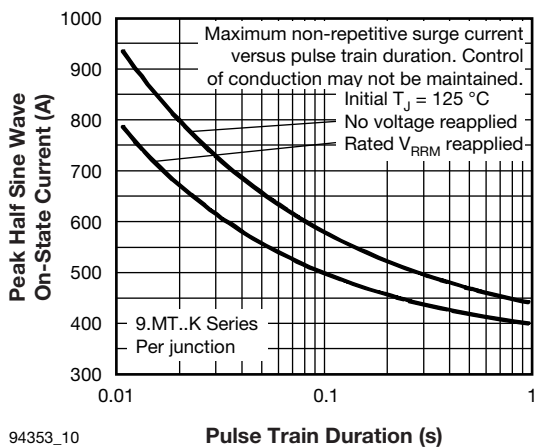
94353\_09

Fig. 9 - Maximum Non-Repetitive Surge Current



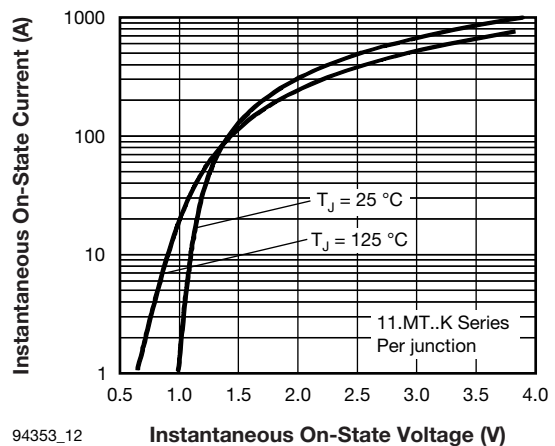
94353\_11

Fig. 11 - Current Ratings Characteristic



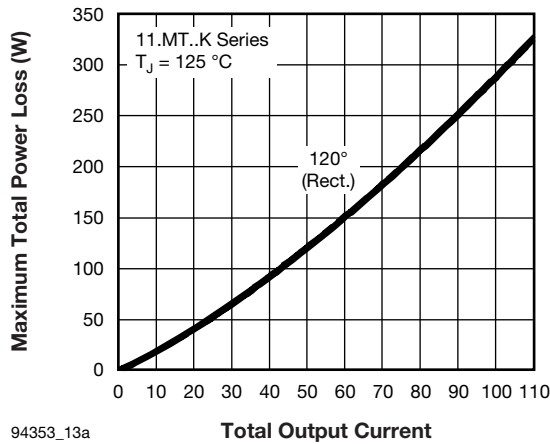
94353\_10

Fig. 10 - Maximum Non-Repetitive Surge Current

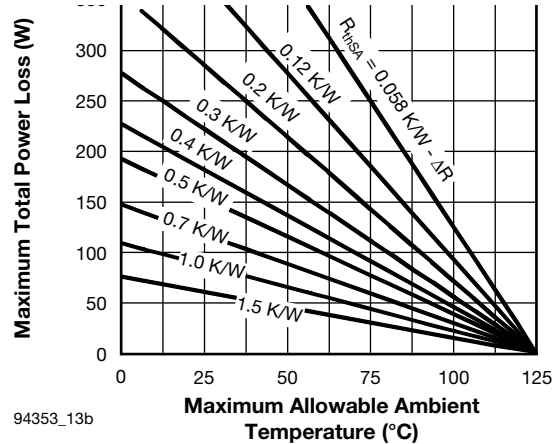


94353\_12

Fig. 12 - Forward Voltage Drop Characteristics

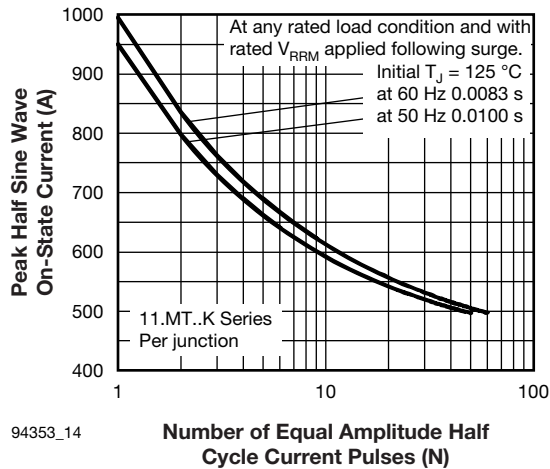


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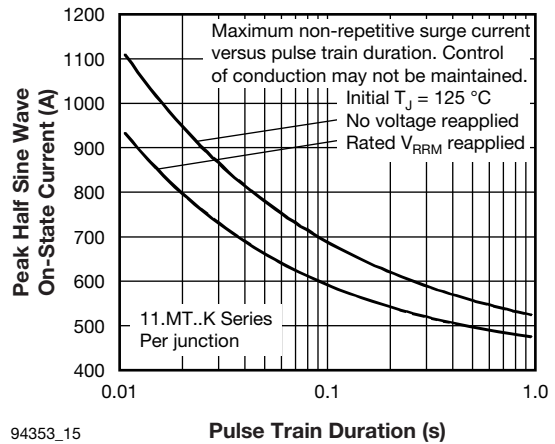
94353\_13b

Fig. 13 - Total Power Loss Characteristics



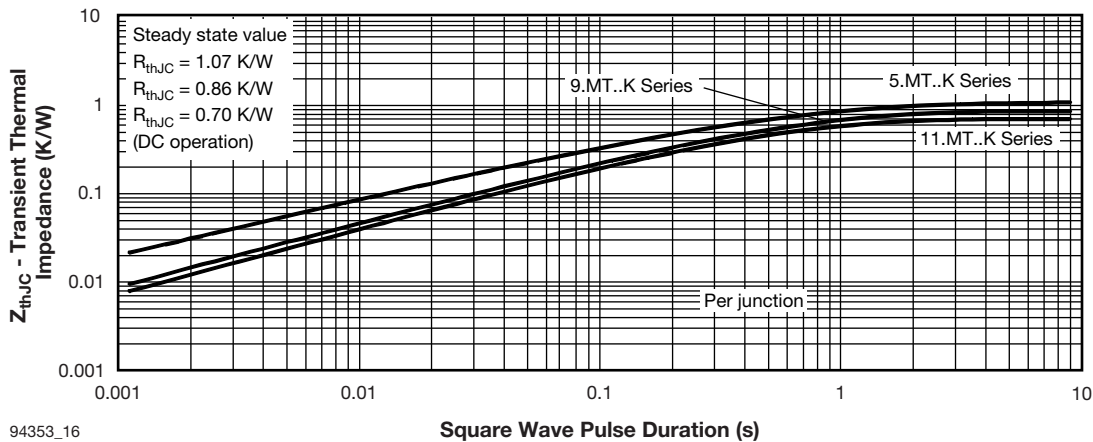
94353\_14

Fig. 14 - Maximum Non-Repetitive Surge Current



94353\_15

Fig. 15 - Maximum Non-Repetitive Surge Current



94353\_16

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

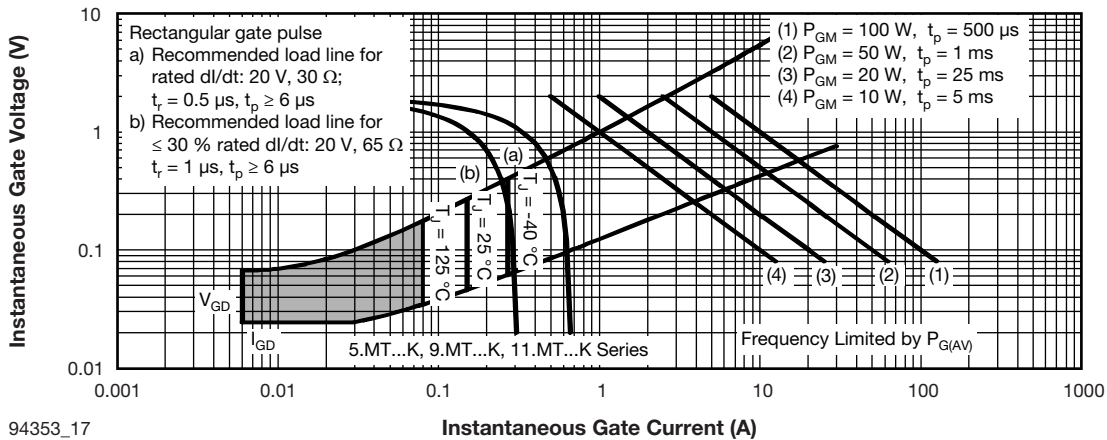


Fig. 17 - Gate Characteristics

### ORDERING INFORMATION TABLE

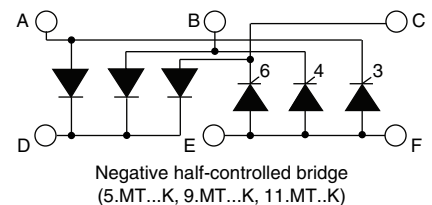
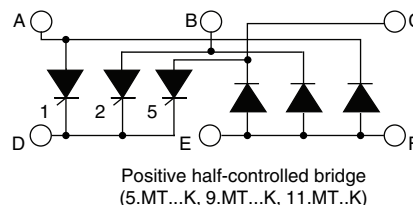
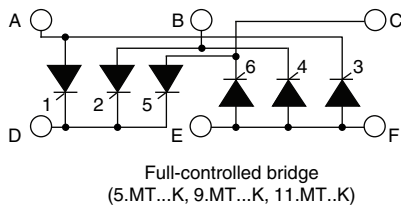
Device code	<b>VS-</b>	<b>11</b>	<b>3</b>	<b>MT</b>	<b>160</b>	<b>K</b>	<b>S90</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥	⑦	

- 1** - Vishay Semiconductors product
- 2** - Current rating code:
  - 5 = 55 A (average)
  - 9 = 90 A (average)
  - 11 = 110 A (average)
- 3** - Circuit configuration code:
  - 1 = Negative half-controlled bridge
  - 2 = Positive half-controlled bridge
  - 3 = Full-controlled bridge
- 4** - Essential part number
- 5** - Voltage code x 10 =  $V_{RRM}$  (see Voltage Ratings table)
- 6** - Critical  $dV/dt$ :
  - None = 500 V/ $\mu s$  (standard value)
  - S90 = 1000 V/ $\mu s$  (special selection)
- 7** - 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

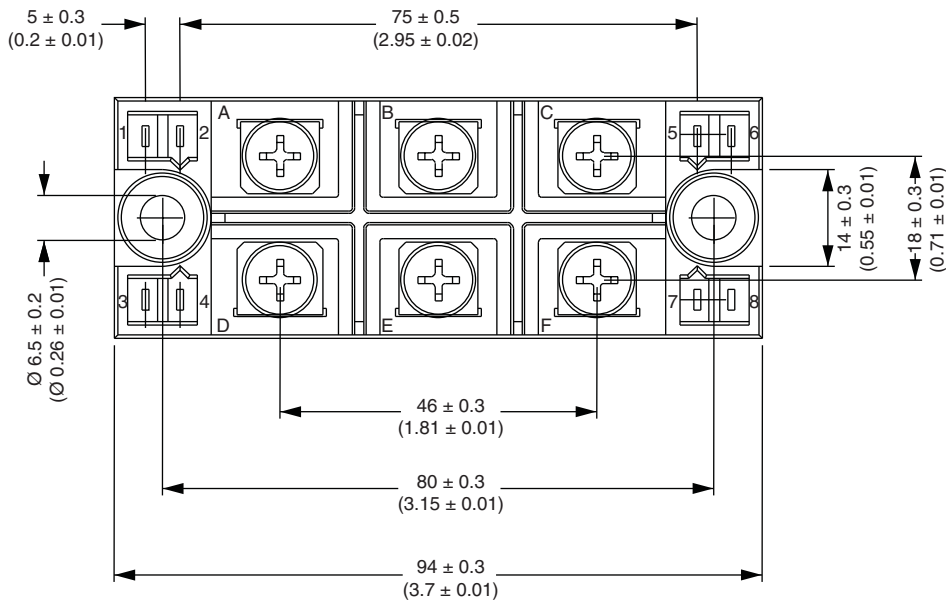
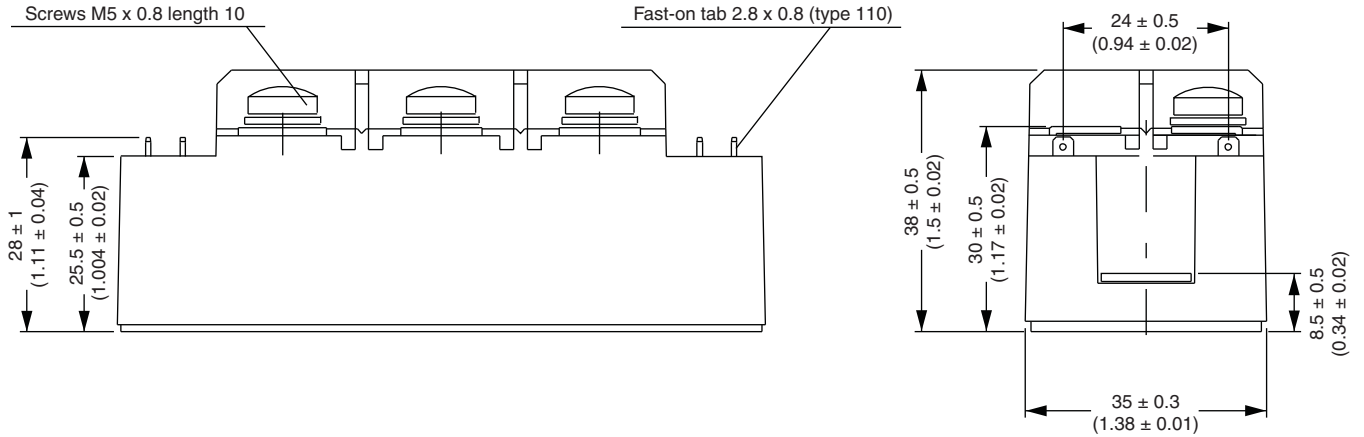


### LINKS TO RELATED DOCUMENTS

Dimensions	<a href="http://www.vishay.com/doc?95004">www.vishay.com/doc?95004</a>
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## MTK (with and without optional barrier)

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



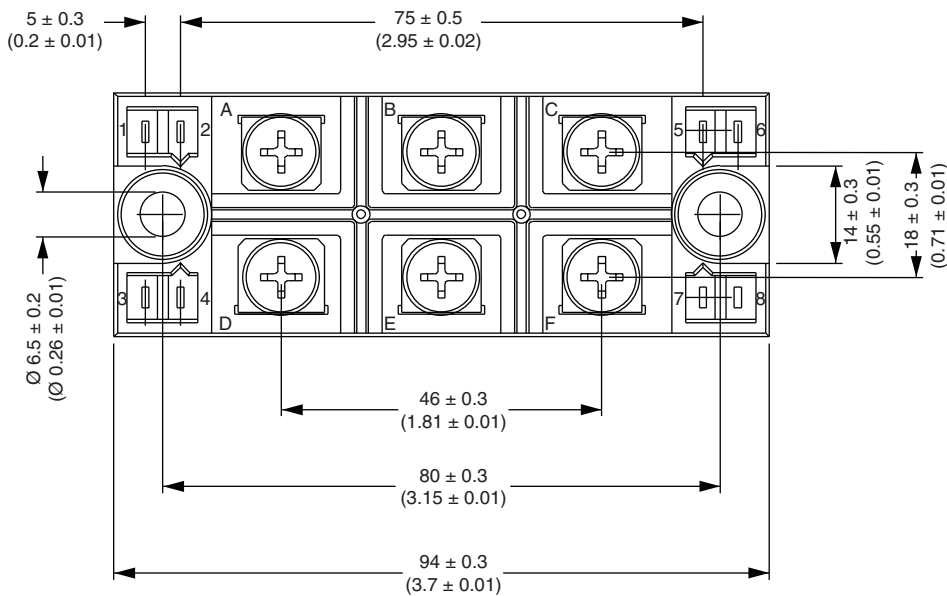
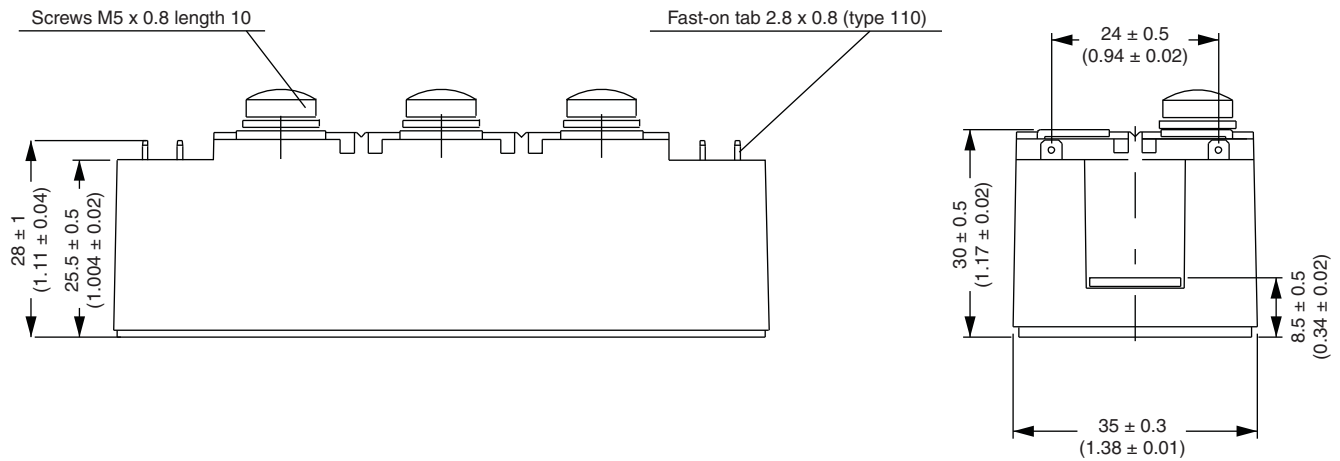


# Outline Dimensions

Vishay Semiconductors MTK (with and without optional barrier)



## DIMENSIONS WITHOUT OPTIONAL BARRIERS in millimeters (inches)





## **Disclaimer**

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