

## Three Phase AC Switch (Power Modules), 50 A to 100 A



MT-K

**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
- 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**

PRODUCT SUMMARY	
I <sub>O</sub>	50 A to 100 A
V <sub>RRM</sub>	800 V to 1600 V
Package	MT-K
Circuit	Three phase AC switch

**DESCRIPTION**

A range of extremely compact, encapsulated three phase AC switches offering efficient and reliable operation. They are intended for use in general purpose and heavy duty applications as control motor starter.

MAJOR RATINGS AND CHARACTERISTICS					
SYMBOL	CHARACTERISTICS	VALUES 54MT.K	VALUES 94MT.K	VALUES 104MT.K	UNITS
I <sub>O</sub>		50	90	100	A
	T <sub>C</sub>	80	80	80	°C
I <sub>FSM</sub>	50 Hz	390	950	1130	A
	60 Hz	410	1000	1180	
I <sup>2</sup> <sub>t</sub>	50 Hz	770	4525	6380	A <sup>2</sup> s
	60 Hz	700	4130	5830	
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 <sub>RRM</sub> , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE V	V <sub>RSM</sub> , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V	V <sub>DRM</sub> , MAXIMUM REPETITIVE PEAK OFF-STATE VOLTAGE, GATE OPEN CIRCUIT V	I <sub>RRM</sub> /I <sub>DRM</sub> , MAXIMUM AT T <sub>J</sub> = 125 °C mA
VS-54MT..K	80	800	900	800	20 (1)
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	
VS-94/104MT..K	80	800	900	800	40 (1)
	100	1000	1100	1000	
	120	1200	1300	1200	
	140	1400	1500	1400	
	160	1600	1700	1600	

**Note**

(1) For single AC switch



FORWARD CONDUCTION								
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES 54MT.K	VALUES 94MT.K	VALUES 104MT.K	UNITS	
Maximum I <sub>RMS</sub> output current at case temperature	I <sub>O</sub>	For all conduction angle		50	90	100	A	
				80	80	80	°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	Initial T <sub>J</sub> = T <sub>J</sub> maximum	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		1.16	0.99	0.99	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		1.44	1.19	1.15		
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		12.54	4.16	3.90	mΩ	
High level value on-state slope resistance	r <sub>t2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> maximum		11.00	3.56	3.48		
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	1.55	1.53	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, grate 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		54MT.K	94MT.K	104MT.K	UNITS
RMS isolation voltage	V <sub>INS</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 (1)	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. 104MT160KBS90

TRIGGERING								
PARAMETER	SYMBOL	TEST CONDITIONS		54MT.K	94MT.K	104MT.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>	Anode supply = 6 V, resistive load		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	54MT.K	94MT.K	104MT.K	UNITS
Maximum junction operating and storage temperature range	$T_J, T_{Stg}$		-40 to 125			°C
Maximum thermal resistance, junction to case	$R_{thJC}$	DC operation per single AC switch	0.52	0.39	0.34	K/W
		DC operation per junction	1.05	0.77	0.69	
		180 °C sine cond. angle per single AC switch	0.56	0.40	0.36	
		180 °C sine cond. angle per junction	1.12	0.80	0.72	
Maximum thermal resistance, case to heatsink	$R_{thCS}$	Per module Mounting surface smooth, flat and grased	0.03			
Mounting torque $\pm 100\%$	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

$\Delta R$ CONDUCTION PER JUNCTION											
DEVICES	SINUSOIDAL CONDUCTION AT $T_J$ MAXIMUM					RECTANGULAR CONDUCTION AT $T_J$ MAXIMUM					UNITS
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
54MT.K	0.072	0.085	0.108	0.152	0.233	0.055	0.091	0.117	0.157	0.236	K/W
94MT.K	0.033	0.039	0.051	0.069	0.099	0.027	0.044	0.055	0.071	0.100	
104MT.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

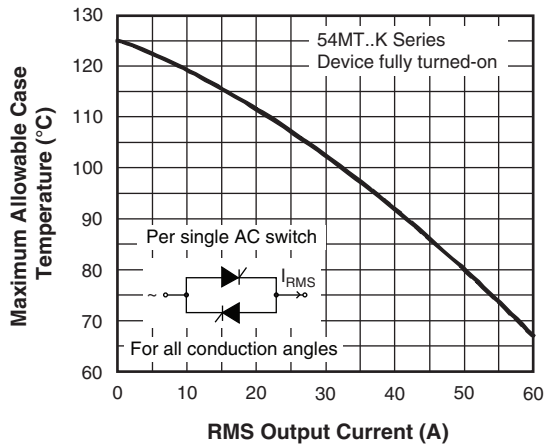


Fig. 1 - Current Ratings Characteristic

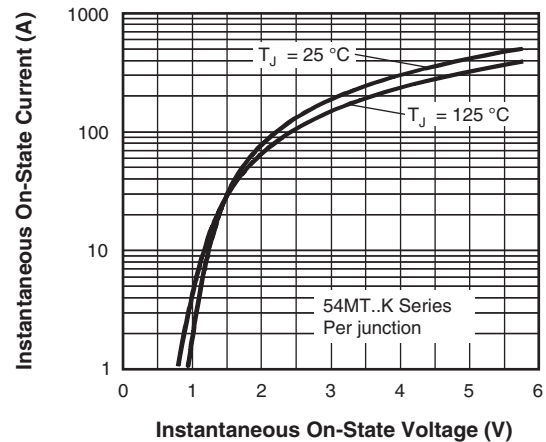


Fig. 2 - Forward Voltage Drop Characteristics

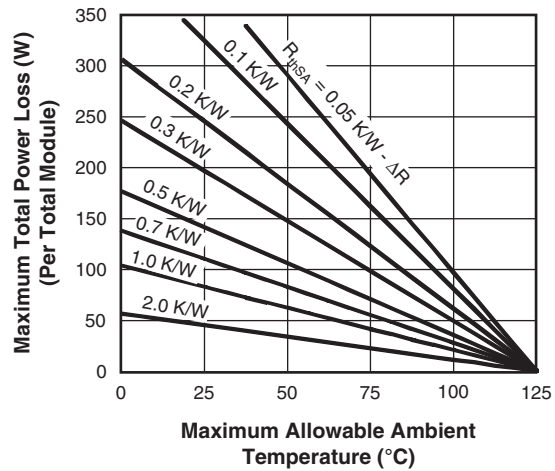
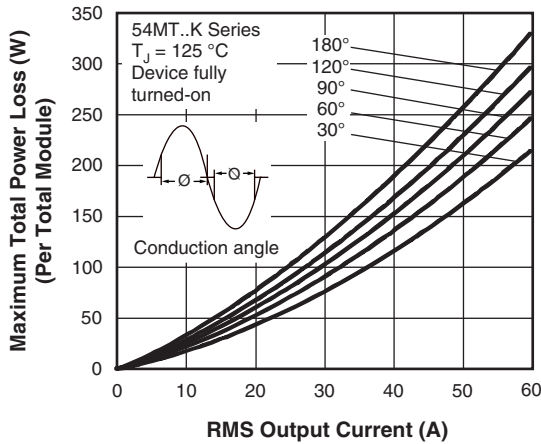


Fig. 3 - Total Power Loss Characteristics

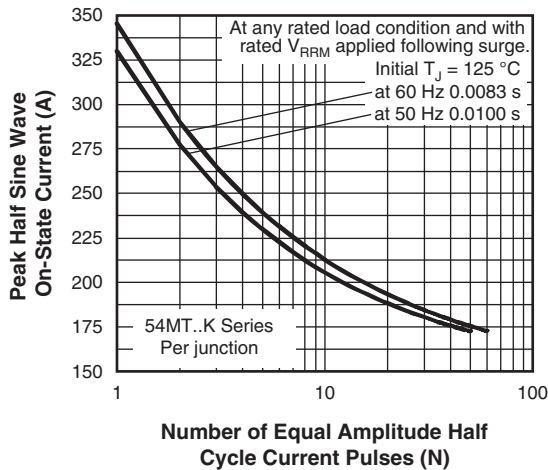


Fig. 4 - Maximum Non-Repetitive Surge Current

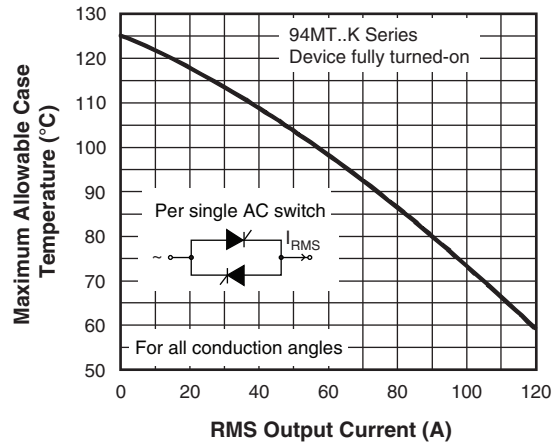


Fig. 6 - Current Ratings Characteristic

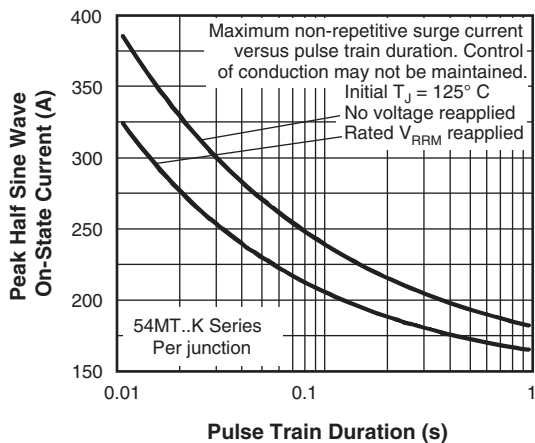


Fig. 5 - Maximum Non-Repetitive Surge Current

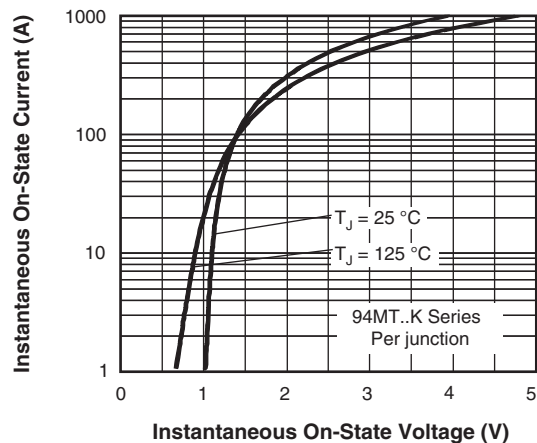


Fig. 7 - Forward Voltage Drop Characteristics

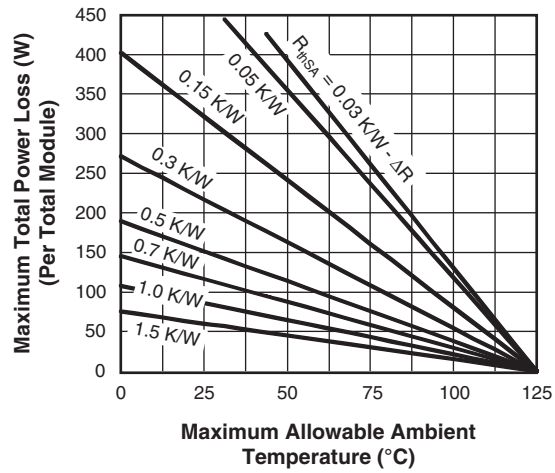
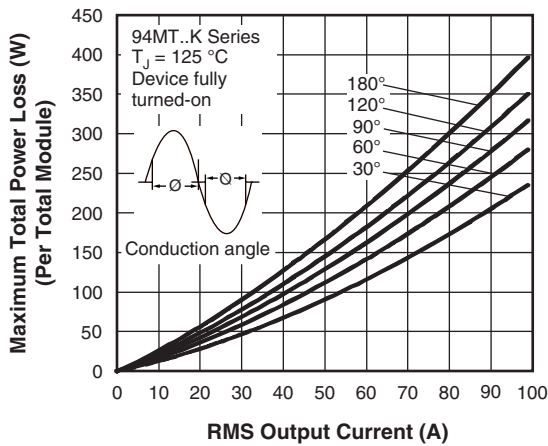


Fig. 8 - Total Power Loss Characteristics

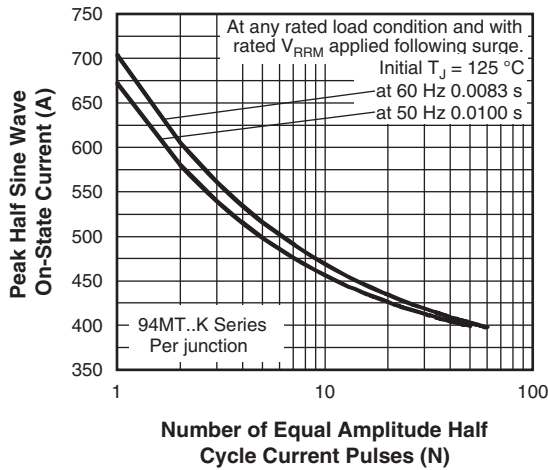


Fig. 9 - Maximum Non-Repetitive Surge Current

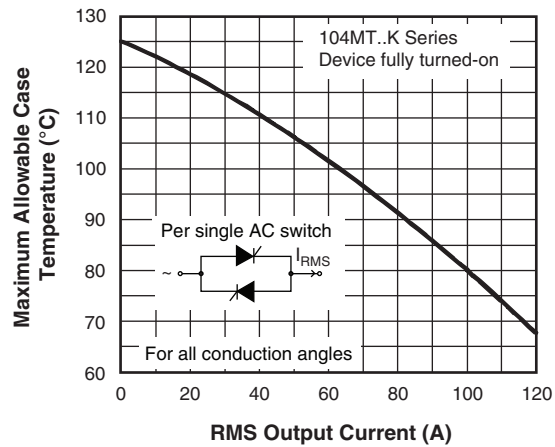


Fig. 11 - Current Ratings Characteristic

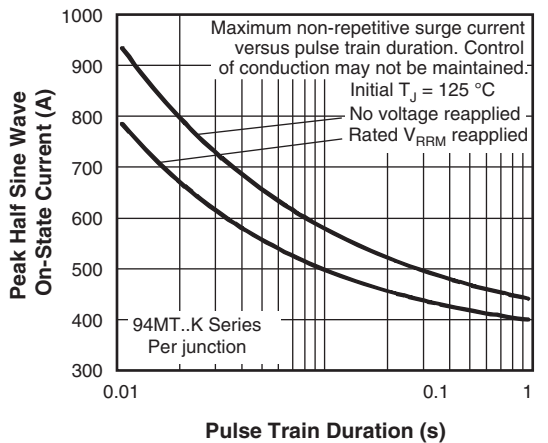


Fig. 10 - Maximum Non-Repetitive Surge Current

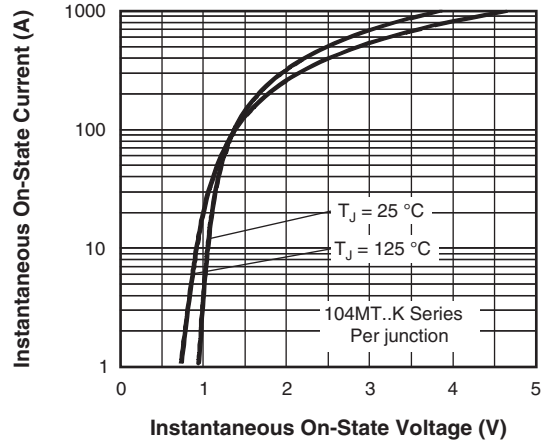


Fig. 12 - Forward Voltage Drop Characteristics

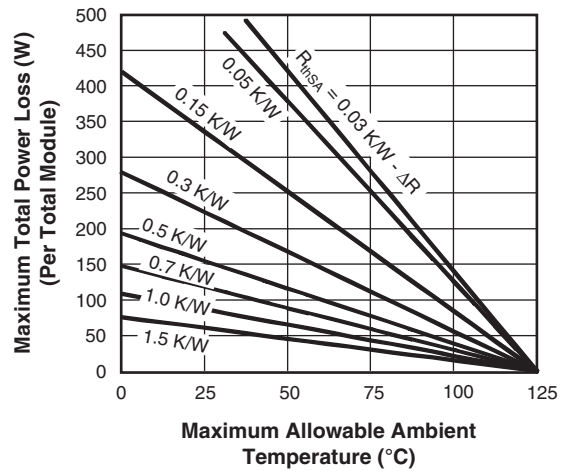
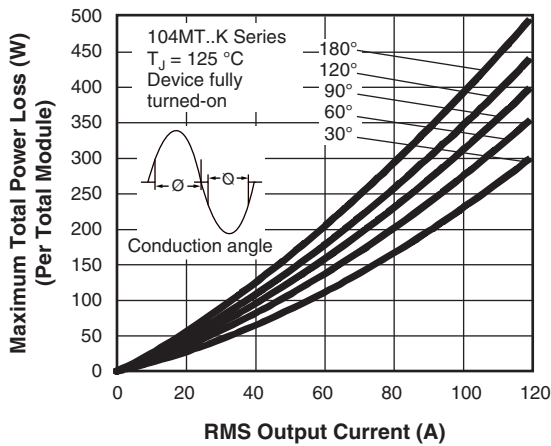


Fig. 13 - Total Power Loss Characteristics

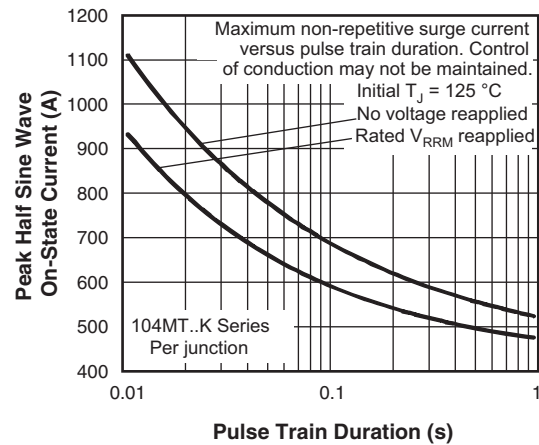
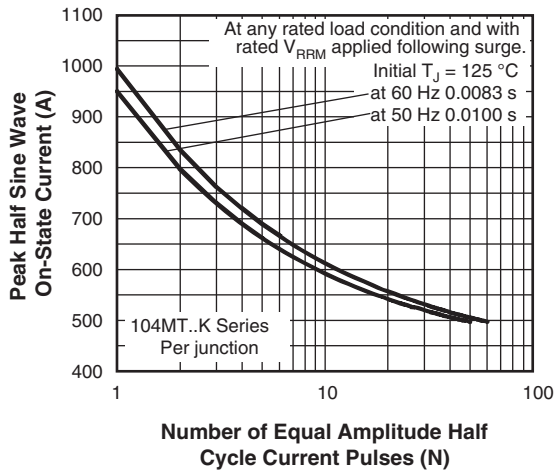


Fig. 14 - Maximum Non-Repetitive Surge Current

Fig. 15 - Maximum Non-Repetitive Surge Current

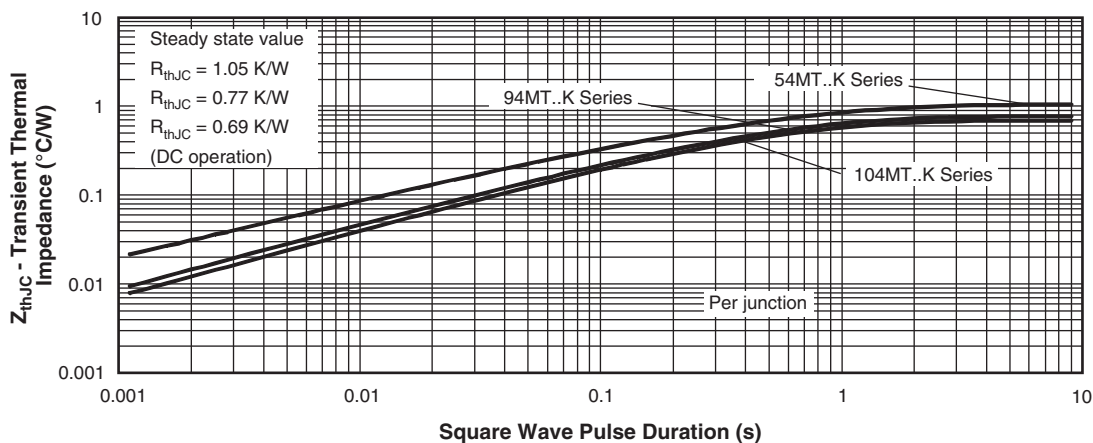


Fig. 16 - Thermal Impedance  $Z_{thJC}$  Characteristics

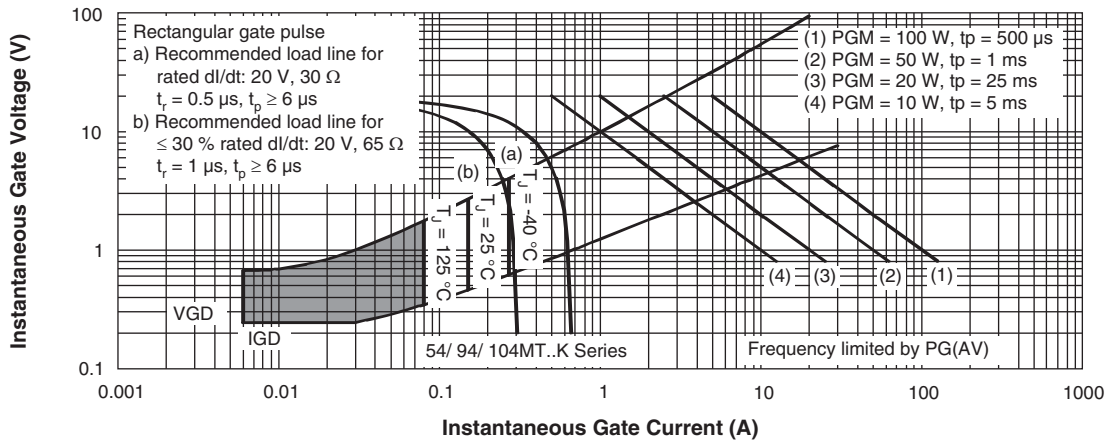


Fig. 17 - Gate Characteristics

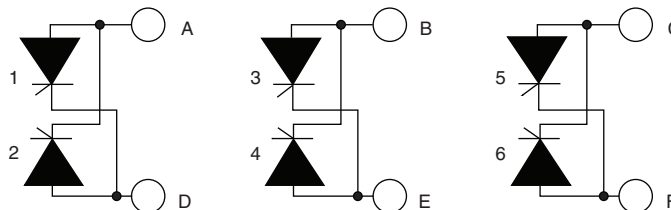
## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>10</b>	<b>4</b>	<b>MT</b>	<b>160</b>	<b>K</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥	
	<b>1</b>	-		Vishay Semiconductors product			
	<b>2</b>	-		Current rating code: 5 = 50 A (average) 9 = 90 A (average) 10 = 100 A (average)			
	<b>3</b>	-		AC switch			
	<b>4</b>	-		Essential part number			
	<b>5</b>	-		Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)			
	<b>6</b>	-		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

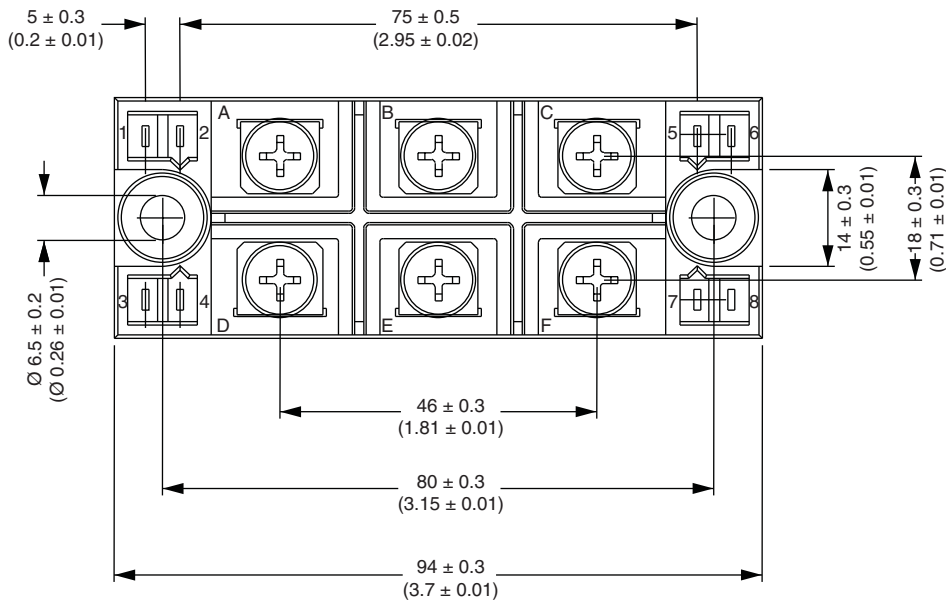
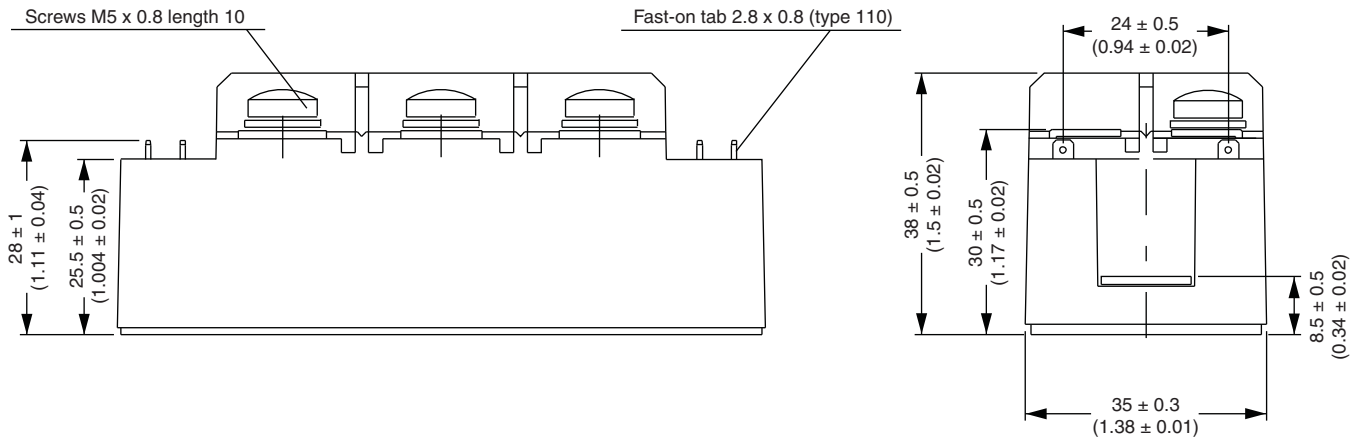


### LINKS TO RELATED DOCUMENTS

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)



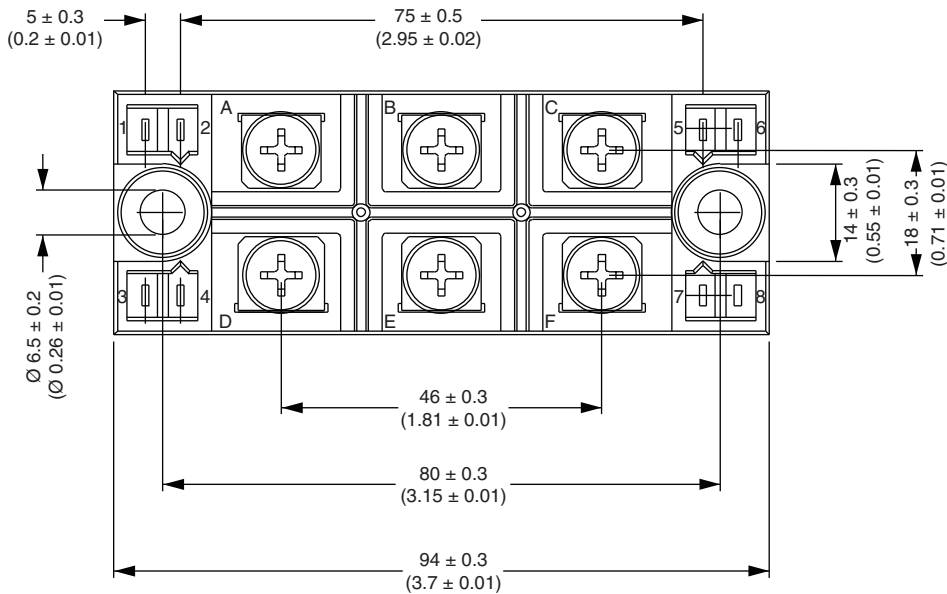
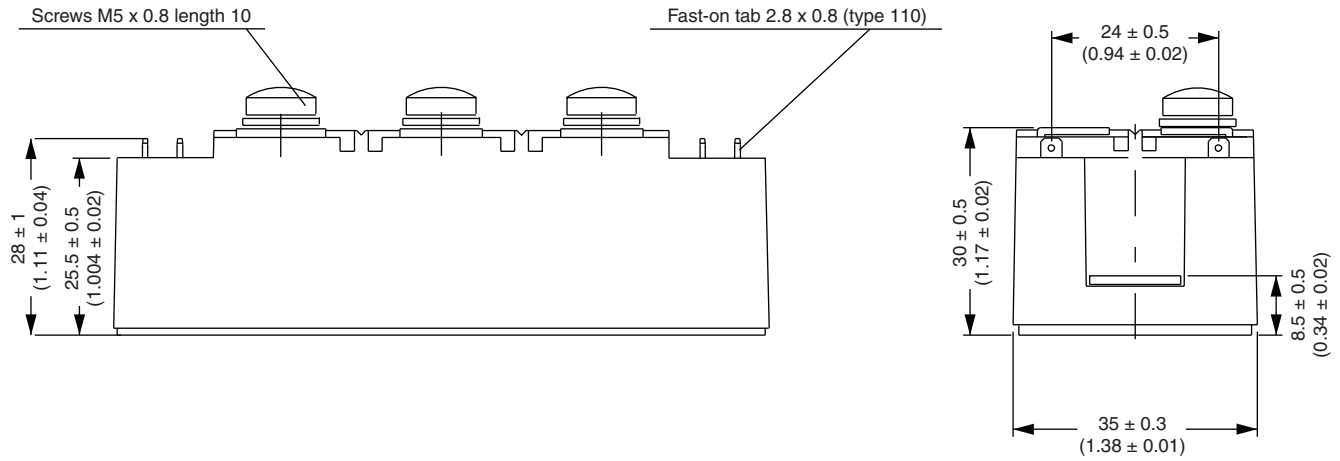


# Outline Dimensions

Vishay Semiconductors MTK (with and without optional barrier)



## DIMENSIONS WITHOUT OPTIONAL BARRIERS in millimeters (inches)





## Disclaimer

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