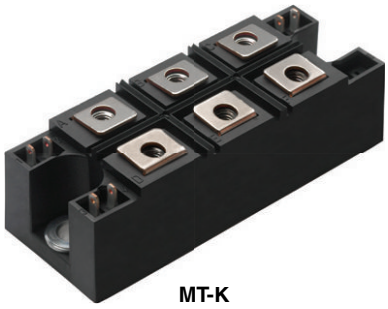
Three Phase Controlled Bridge (Power Modules), 55 A to 110 A



MT-K

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

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.

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

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^2s
	60 Hz	700	4130	5830	
$I^2\sqrt{t}$		7700	45 250	63 800	$A^2\sqrt{s}$
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 °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_O	120° rect. conduction angle			55	90	110	A
					85	85	85	°C
Maximum peak, one-cycle forward, non-repetitive on state surge current	I_{TSM}	t = 10 ms	No voltage reapplied	Initial $T_J = T_J$ max.	390	950	1130	A
		t = 8.3 ms			410	1000	1180	
		t = 10 ms	100 % V_{RRM} reapplied		330	800	950	
		t = 8.3 ms			345	840	1000	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		770	4525	6380	A^2s
		t = 8.3 ms			700	4130	5830	
		t = 10 ms	100 % V_{RRM} reapplied		540	3200	4510	
		t = 8.3 ms			500	2920	4120	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied			7700	45 250	63 800	$A^2\sqrt{s}$
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), T_J maximum			1.17	1.09	1.04	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > π x $I_{T(AV)}$), T_J maximum			1.45	1.27	1.27	
Low level value on-state slope resistance	r_{t1}	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), T_J maximum			12.40	4.10	3.93	mΩ
High level value on-state slope resistance	r_{t2}	(I > π x $I_{T(AV)}$), T_J maximum			11.04	3.59	3.37	
Maximum on-state voltage drop	V_{TM}	I_{pk} = 150 A, T_J = 25 °C, t_p = 400 µs single junction			2.68	1.65	1.57	V
Maximum non-repetitve rate of rise of turned on current	dI/dt	T_J = 25 °C, from 0.67 V_{DRM}, I_{TM} = π x $I_{T(AV)}$, I_g = 500 mA, t_r < 0.5 µs, t_p > 6 µs			150			A/µs
Maximum holding current	I_H	T_J = 25 °C, anode supply = 6 V, resistive load, gate open circuit			200			mA
Maximum latching current	I_L	T_J = 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_{ISOL}	T_J = 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)	$T_J = T_J$ maximum, linear to 0.67 V_{DRM}, 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_{GM}	$T_J = T_J$ maximum		10			W
Maximum average gate power	$P_{G(AV)}$			2.5			
Maximum peak gate current	I_{GM}			2.5			A
Maximum peak negative gate voltage	- V_{GT}			10			V
Maximum required DC gate voltage to trigger	V_{GT}	T_J = - 40 °C	Anode supply = 6 V, resistive load	4.0			
		T_J = 25 °C		2.5			
		T_J = 125 °C		1.7			
Maximum required DC gate current to trigger	I_{GT}	T_J = - 40 °C		270			mA
		T_J = 25 °C		150			
		T_J = 125 °C		80			
Maximum gate voltage that will not trigger	V_{GD}	$T_J = T_J$ maximum, rated V_{DRM} applied		0.25			V
Maximum gate current that will not trigger	I_{GD}			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_J, T_{Stg}		- 40 to 125			°C
Maximum thermal resistance, junction to case	R_{thJC}	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_{thCS}	Mounting surface smooth, flat and grased	0.03			
Mounting torque ± 10 % to heatsink		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
Mounting torque ± 10 % to terminal			3 to 4			
Approximate weight			225			g

ΔR 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°	
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

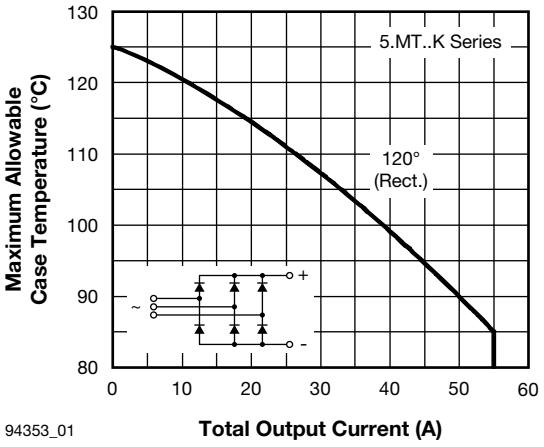


Fig. 1 - Current Ratings Characteristic

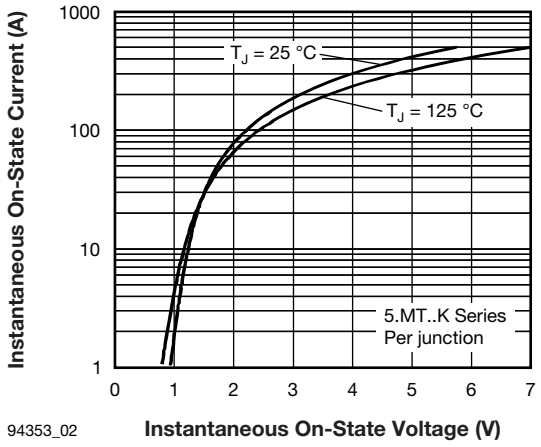
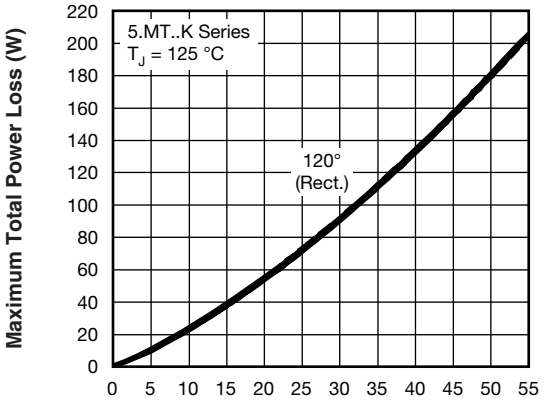


Fig. 2 - Forward Voltage Drop Characteristics



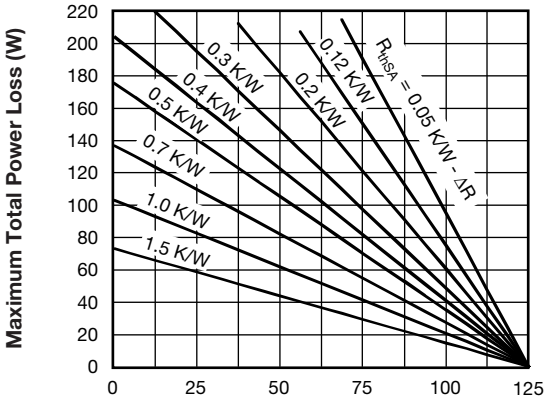


Fig. 3 - Total Power Loss Characteristics

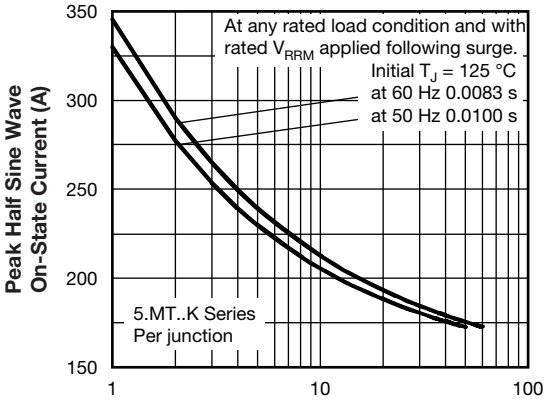


Fig. 4 - Maximum Non-Repetitive Surge Current

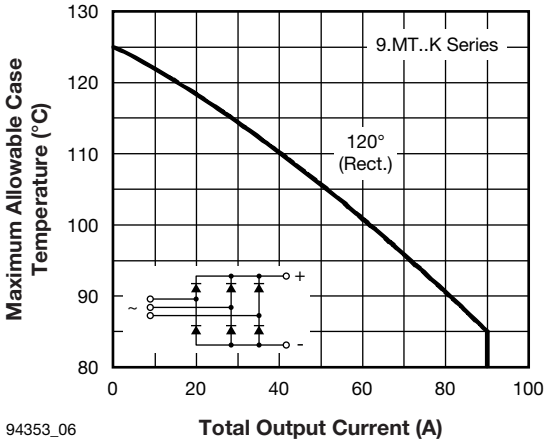


Fig. 6 - Current Ratings Characteristic

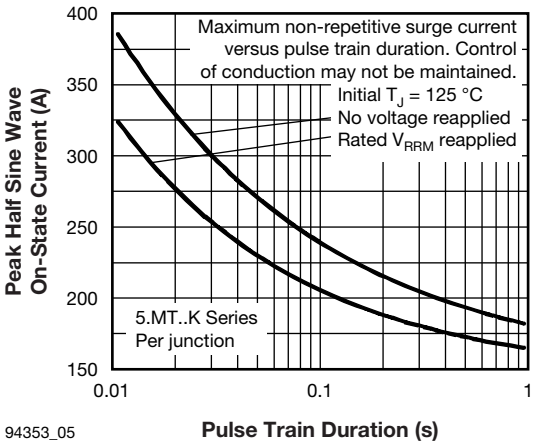


Fig. 5 - Maximum Non-Repetitive Surge Current

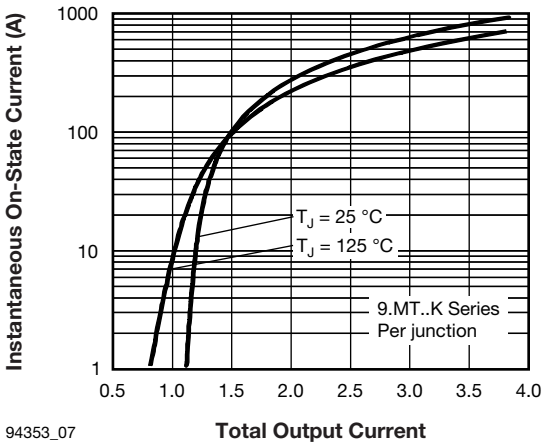
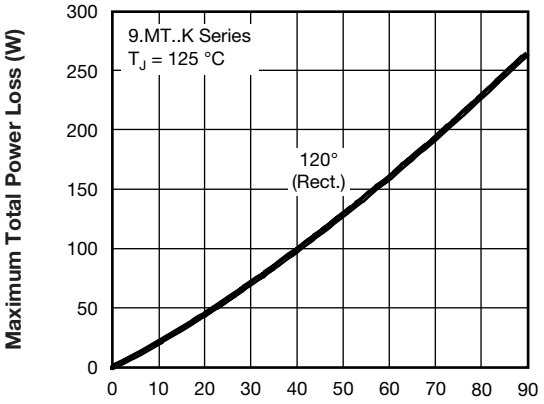


Fig. 7 - Forward Voltage Drop Characteristics



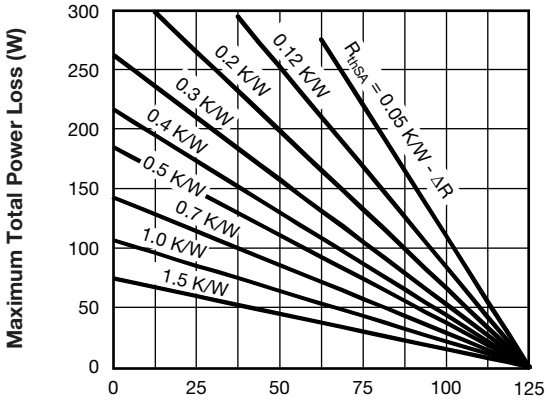


Fig. 8 - Total Power Loss Characteristics

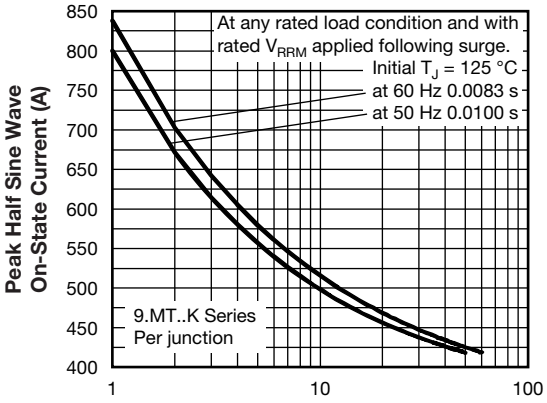


Fig. 9 - Maximum Non-Repetitive Surge Current

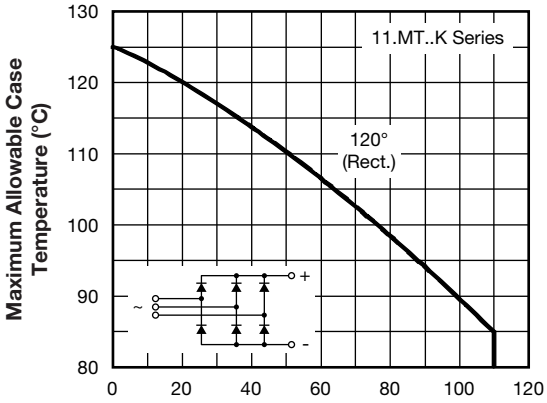


Fig. 11 - Current Ratings Characteristic

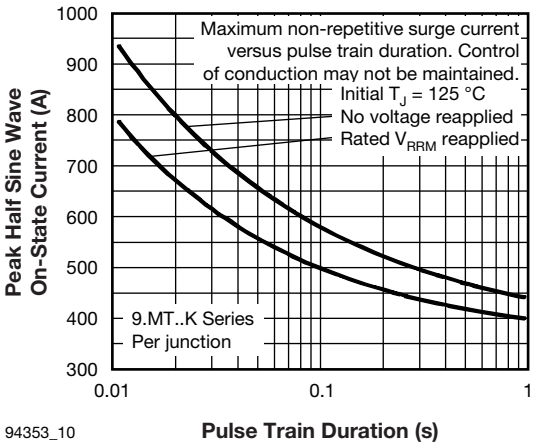


Fig. 10 - Maximum Non-Repetitive Surge Current

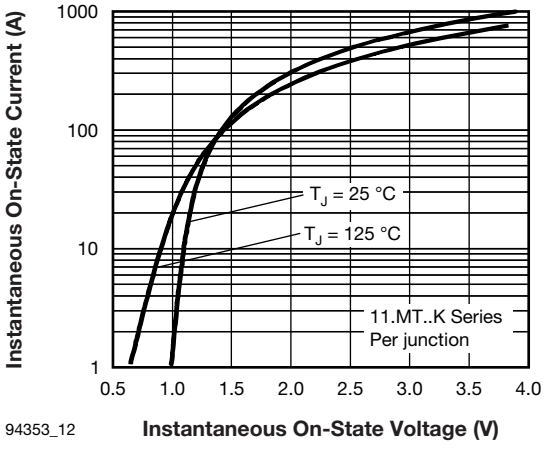
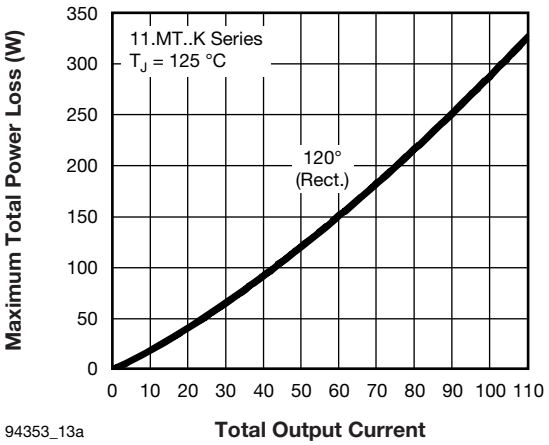


Fig. 12 - Forward Voltage Drop Characteristics



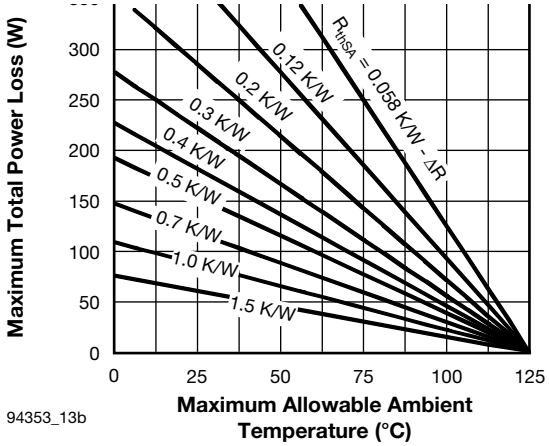


Fig. 13 - Total Power Loss Characteristics

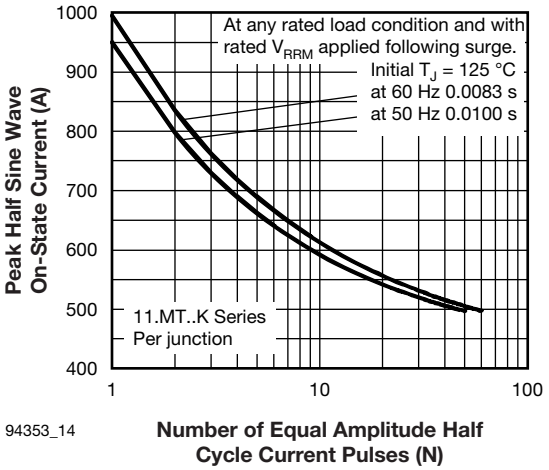


Fig. 14 - Maximum Non-Repetitive Surge Current

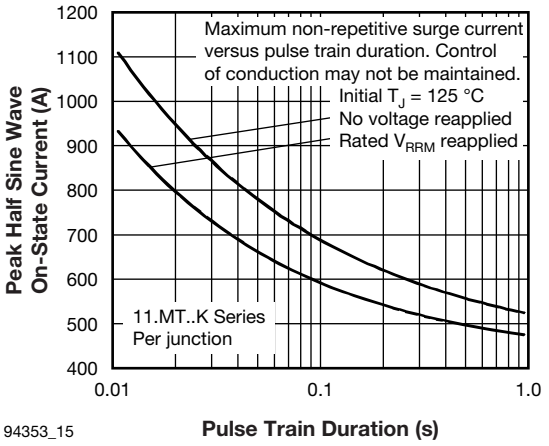


Fig. 15 - Maximum Non-Repetitive Surge Current

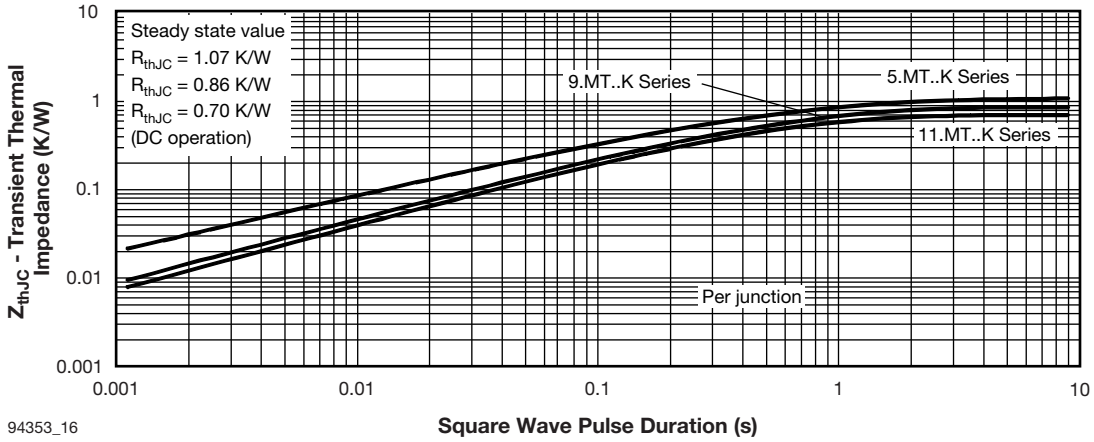


Fig. 16 - Thermal Impedance Z_{thJC} Characteristics

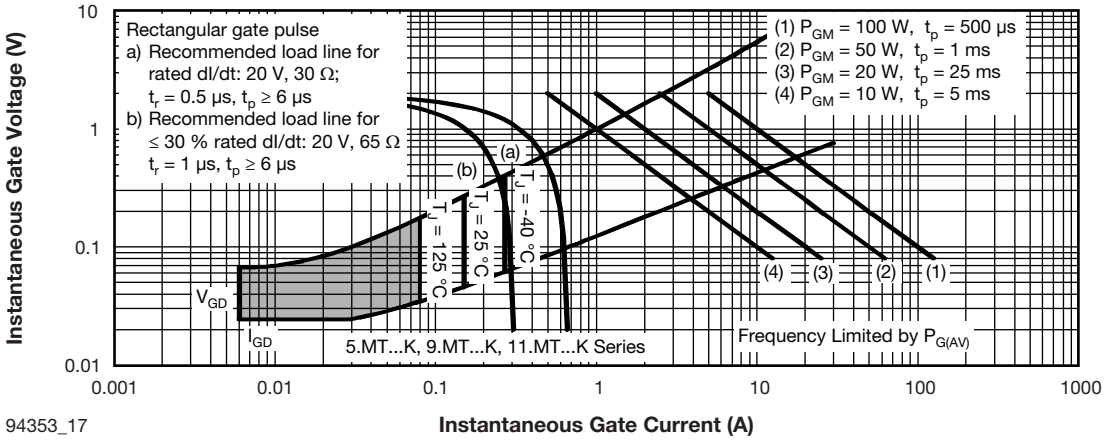


Fig. 17 - Gate Characteristics

ORDERING INFORMATION TABLE

Device code

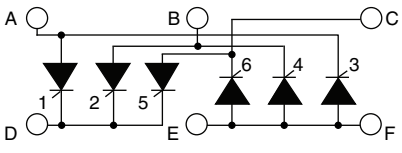
VS-	11	3	MT	160	K	S90	PbF
1	2	3	4	5		6	7

- **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/µs (standard value)
  - S90 = 1000 V/µs (special selection)
- **7** - PbF = Lead (Pb)-free

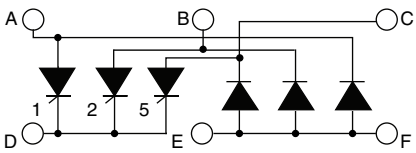
Note

- To order the optional hardware go to www.vishay.com/doc?95172

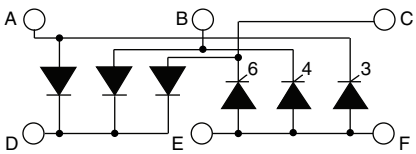
CIRCUIT CONFIGURATION



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)

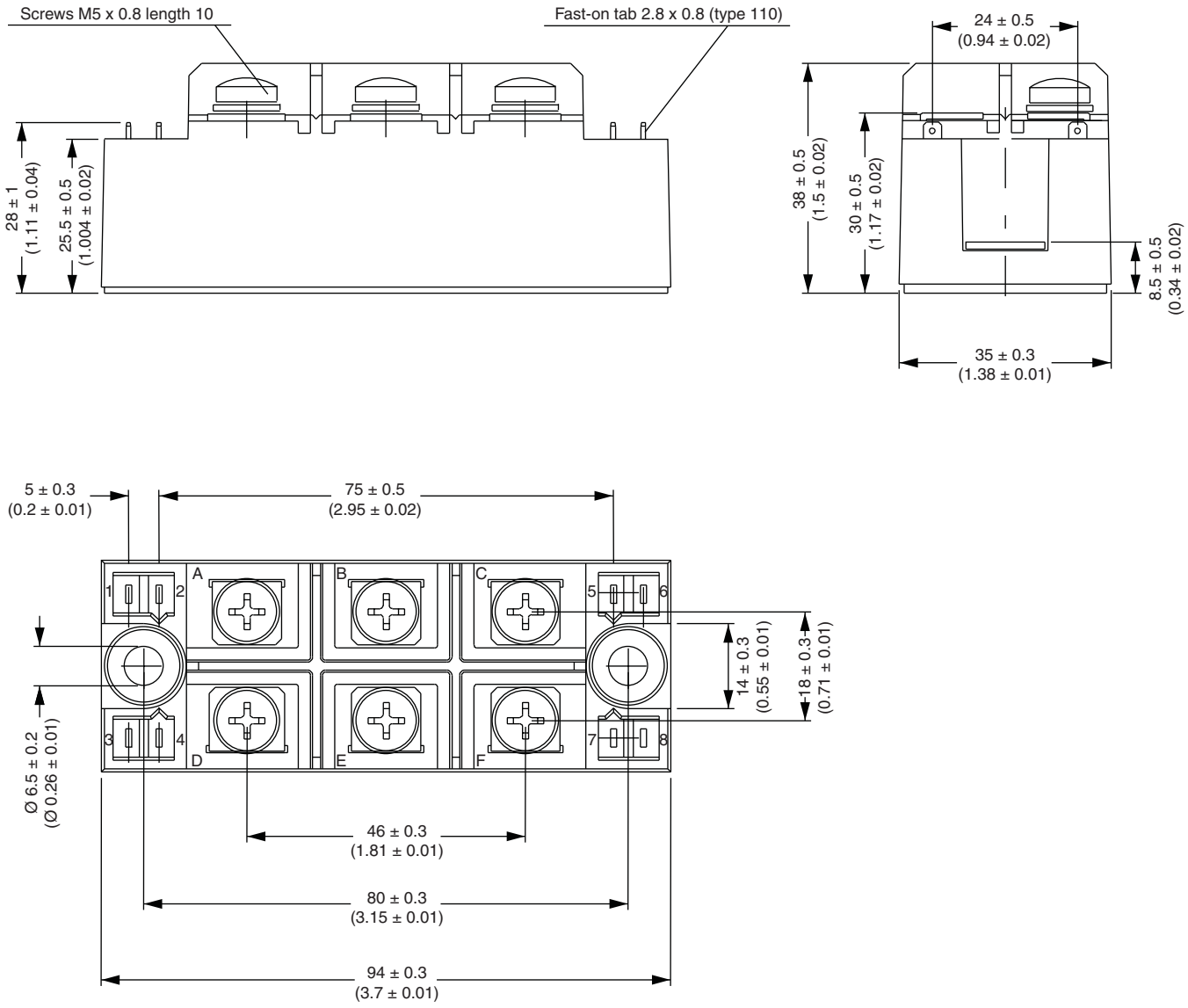


Negative half-controlled bridge
(5.MT...K, 9.MT...K, 11.MT..K)

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95004

MTK (with and without optional barrier)

DIMENSIONS WITH OPTIONAL BARRIERS in millimeters (inches)



DIMENSIONS WITHOUT OPTIONAL BARRIERS in millimeters (inches)