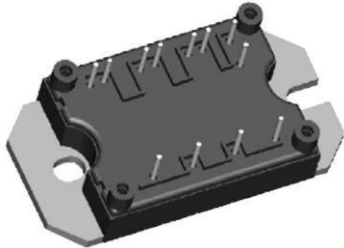


## "Half-Bridge" IGBT MTP (Ultrafast NPT IGBT), 80 A



MTP

### FEATURES

- Ultrafast Non Punch Through (NPT) technology
- Positive  $V_{CE(on)}$  temperature coefficient
- 10  $\mu$ s short circuit capability
- Square RBSOA
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery and low  $V_F$
- $Al_2O_3$  DBC
- Optional SMD thermistor (NTC)
- Very low stray inductance design for high speed operation
- UL approval pending
- Speed 8 to 60 kHz
- Totally lead (Pb)-free
- Designed and qualified for industrial level



**RoHS\***  
COMPLIANT

### PRODUCT SUMMARY

$V_{CES}$	1200 V
$V_{CE(on)}$ typical at $V_{GE} = 15$ V	3.36 V
$I_C$ at $T_C = 25$ °C	80 A

### BENEFITS

- Optimized for welding, UPS and SMPS applications
- Rugged with ultrafast performance
- Benchmark efficiency above 20 kHz
- Outstanding ZVS and hard switching operation
- Low EMI, requires less snubbing
- Excellent current sharing in parallel operation
- Direct mounting to heatsink
- PCB solderable terminals
- Very low junction to case thermal resistance

### ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{CES}$		1200	V
Continuous collector current	$I_C$	$T_C = 25$ °C	80	A
		$T_C = 104$ °C	40	
Pulsed collector current	$I_{CM}$		160	
Clamped inductive load current	$I_{LM}$		160	
Diode continuous forward current	$I_F$	$T_C = 105$ °C	21	
Diode maximum forward current	$I_{FM}$		160	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ min	2500	
Maximum power dissipation (only IGBT)	$P_D$	$T_C = 25$ °C	463	W
		$T_C = 100$ °C	185	

\* Pb containing terminations are not RoHS compliant, exemptions may apply

# 40MT120UHAPbF/40MT120UHTAPbF



Vishay High Power Products "Half-Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 80 A

ELECTRICAL SPECIFICATIONS (T <sub>J</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	V <sub>(BR)CES</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA	1200	-	-	V
Temperature coefficient of breakdown voltage	ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 3 mA (25 to 125 °C)	-	+ 1.1	-	V/°C
Collector to emitter saturation voltage	V <sub>CE(on)</sub>	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A	-	3.36	3.59	V
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 80 A	-	4.53	4.91	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A, T <sub>J</sub> = 150 °C	-	3.88	4.10	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 80 A, T <sub>J</sub> = 150 °C	-	5.35	5.68	
Gate threshold voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 500 μA	4	-	6	
Temperature coefficient of threshold voltage	V <sub>GE(th)</sub> /ΔT <sub>J</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 mA (25 to 125 °C)	-	- 12	-	mV/°C
Transconductance	g <sub>fe</sub>	V <sub>CE</sub> = 50 V, I <sub>C</sub> = 40 A, PW = 80 μs	-	35	-	S
Zero gate voltage collector current	I <sub>CES</sub>	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>J</sub> = 25 °C	-	-	250	μA
		V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>J</sub> = 125 °C	-	0.4	1.0	mA
		V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>J</sub> = 150 °C	-	0.2	10	
Gate to emitter leakage current	I <sub>GES</sub>	V <sub>GE</sub> = ± 20 V	-	-	± 250	nA

SWITCHING CHARACTERISTICS (T <sub>J</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q <sub>g</sub>	I <sub>C</sub> = 40 A V <sub>CC</sub> = 600 V V <sub>GE</sub> = 15 V	-	399	599	nC
Gate to emitter charge (turn-on)	Q <sub>ge</sub>		-	43	65	
Gate to collector charge (turn-on)	Q <sub>gc</sub>		-	187	281	
Turn-on switching loss	E <sub>on</sub>	V <sub>CC</sub> = 600 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, R <sub>g</sub> = 5 Ω, L = 200 μH, T <sub>J</sub> = 25 °C, energy losses include tail and diode reverse recovery	-	1.14	1.71	mJ
Turn-off switching loss	E <sub>off</sub>		-	1.35	2.02	
Total switching loss	E <sub>tot</sub>		-	2.49	3.73	
Turn-on switching loss	E <sub>on</sub>		V <sub>CC</sub> = 600 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, R <sub>g</sub> = 5 Ω, L = 200 μH, T <sub>J</sub> = 125 °C, energy losses include tail and diode reverse recovery	-	1.60	
Turn-off switching loss	E <sub>off</sub>	-		1.62	2.43	
Total switching loss	E <sub>tot</sub>	-		3.22	4.82	
Input capacitance	C <sub>ies</sub>	V <sub>GE</sub> = 0 V V <sub>CC</sub> = 30 V f = 1.0 MHz		-	5521	8282
Output capacitance	C <sub>oes</sub>		-	380	570	
Reverse transfer capacitance	C <sub>res</sub>		-	171	257	
Reverse bias safe operating area	RBSOA	T <sub>J</sub> = 150 °C, I <sub>C</sub> = 160 A V <sub>CC</sub> = 1000 V, V <sub>p</sub> = 1200 V R <sub>g</sub> = 5 Ω, V <sub>GE</sub> = + 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	T <sub>J</sub> = 150 °C, V <sub>CC</sub> = 900 V, V <sub>p</sub> = 1200 V R <sub>g</sub> = 5 Ω, V <sub>GE</sub> = + 15 V to 0 V	10	-	-	μs



# 40MT120UHAPbF/40MT120UHTAPbF

"Half-Bridge" IGBT MTP Vishay High Power Products  
(Ultrafast NPT IGBT), 80 A

DIODE SPECIFICATIONS (T <sub>J</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Diode forward voltage drop	V <sub>FM</sub>	I <sub>C</sub> = 40 A	-	2.98	3.38	V
		I <sub>C</sub> = 80 A	-	3.90	4.41	
		I <sub>C</sub> = 40 A, T <sub>J</sub> = 125 °C	-	3.08	3.39	
		I <sub>C</sub> = 80 A, T <sub>J</sub> = 125 °C	-	4.29	4.72	
		I <sub>C</sub> = 40 A, T <sub>J</sub> = 150 °C	-	3.12	3.42	
Reverse recovery energy of the diode	E <sub>rec</sub>	V <sub>GE</sub> = 15 V, R <sub>g</sub> = 5 Ω, L = 200 μH V <sub>CC</sub> = 600 V, I <sub>C</sub> = 40 A T <sub>J</sub> = 125 °C	-	574	861	μJ
Diode reverse recovery time	t <sub>rr</sub>		-	120	180	ns
Peak reverse recovery current	I <sub>rr</sub>		-	43	65	A

THERMISTOR SPECIFICATIONS (40MT120UHTAPbF only)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Resistance	R <sub>0</sub> <sup>(1)</sup>	T <sub>0</sub> = 25 °C	-	30	-	kΩ
Sensitivity index of the thermistor material	β <sup>(1)(2)</sup>	T <sub>0</sub> = 25 °C T <sub>1</sub> = 85 °C	-	4000	-	K

**Notes**

(1) T<sub>0</sub>, T<sub>1</sub> are thermistor's temperatures

(2)  $\frac{R_0}{R_1} = \exp\left[\beta\left(\frac{1}{T_0} - \frac{1}{T_1}\right)\right]$ , temperature in Kelvin

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range	T <sub>J</sub>		- 40	-	150	°C
Storage temperature range	T <sub>Stg</sub>		- 40	-	125	
Junction to case	IGBT	R <sub>thJC</sub>	-	-	0.29	°C/W
	Diode		-	-	0.61	
Case to sink per module	R <sub>thCS</sub>	Heatsink compound thermal conductivity = 1 W/mK	-	0.06	-	
Clearance <sup>(1)</sup>		External shortest distance in air between two terminals	5.5	-	-	mm
Creepage <sup>(2)</sup>		Shortest distance along external surface of the insulating material between 2 terminals	8	-	-	
Mounting torque to heatsink		A mounting compound is recommended and the torque should be checked after 3 hours to allow for the spread of the compound. Lubricated threads.	3 ± 10 %			Nm
Weight			66			g

# 40MT120UHAPbF/40MT120UHTAPbF



Vishay High Power Products "Half-Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 80 A

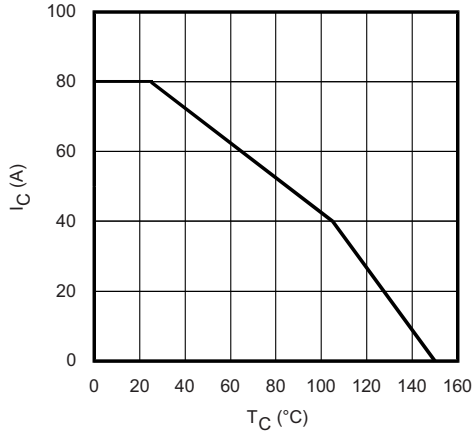


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

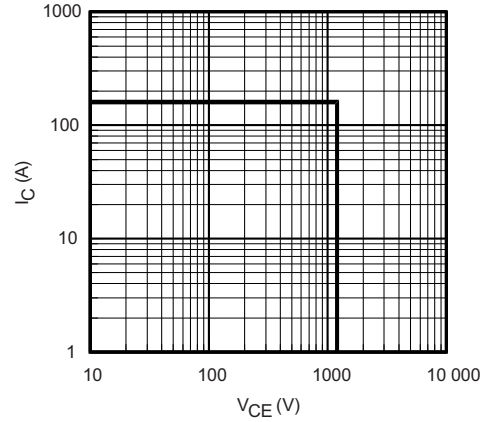


Fig. 4 - Reverse BIAS SOA  
 $T_J = 150\text{ }^\circ\text{C}$ ;  $V_{GE} = 15\text{ V}$

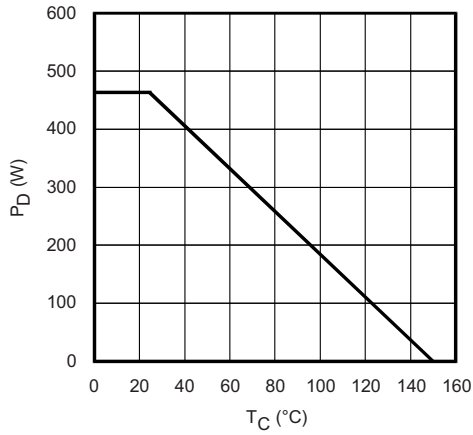


Fig. 2 - Power Dissipation vs. Case Temperature

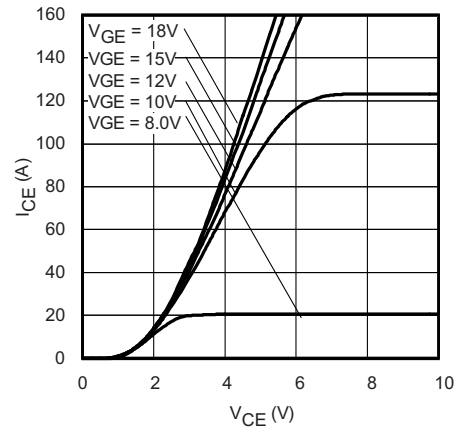


Fig. 5 - Typical IGBT Output Characteristics  
 $T_J = -40\text{ }^\circ\text{C}$ ;  $t_p = 80\text{ }\mu\text{s}$

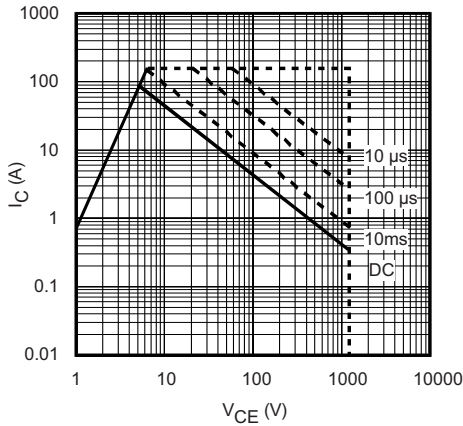


Fig. 3 - Forward SOA  
 $T_C = 25\text{ }^\circ\text{C}$ ;  $T_J \leq 150\text{ }^\circ\text{C}$

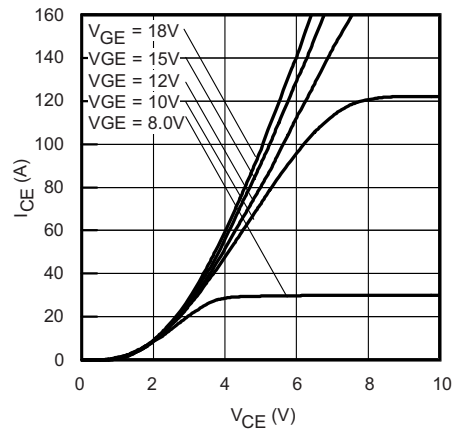


Fig. 6 - Typical IGBT Output Characteristics  
 $T_J = 25\text{ }^\circ\text{C}$ ;  $t_p = 80\text{ }\mu\text{s}$



# 40MT120UHAPbF/40MT120UHTAPbF

"Half-Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 80 A

Vishay High Power Products

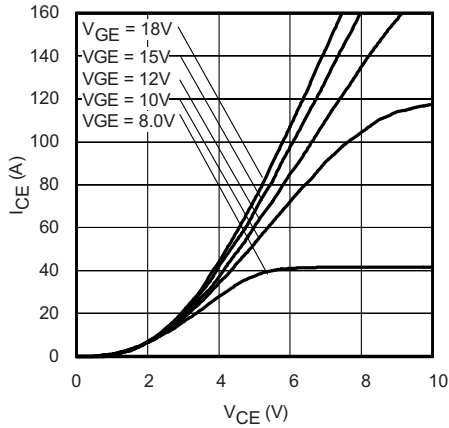


Fig. 7 - Typical IGBT Output Characteristics  
 $T_J = 125^\circ\text{C}$ ;  $t_p = 80 \mu\text{s}$

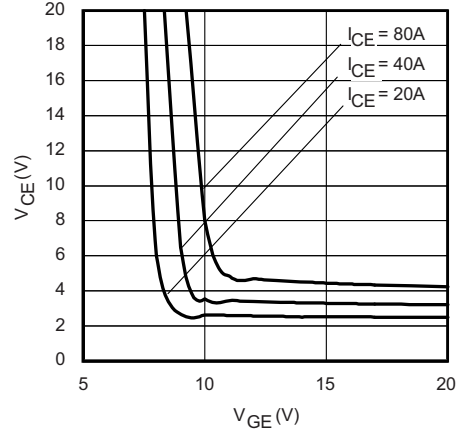


Fig. 10 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$

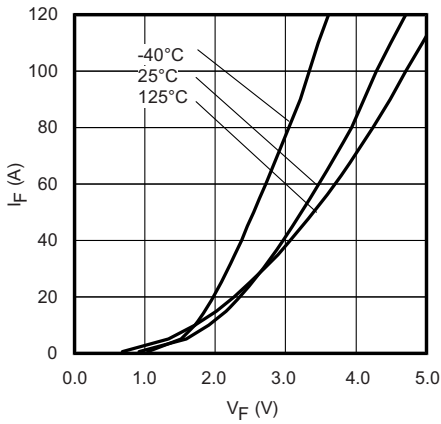


Fig. 8 - Typical Diode Forward Characteristics  
 $t_p = 80 \mu\text{s}$

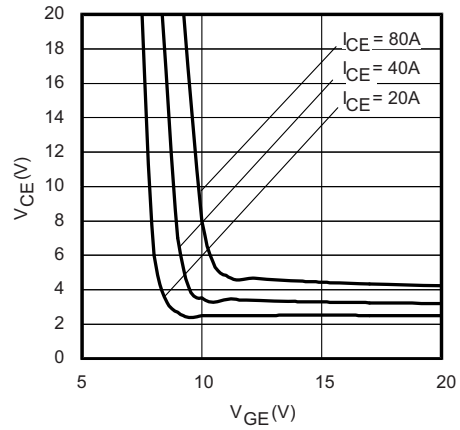


Fig. 11 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 125^\circ\text{C}$

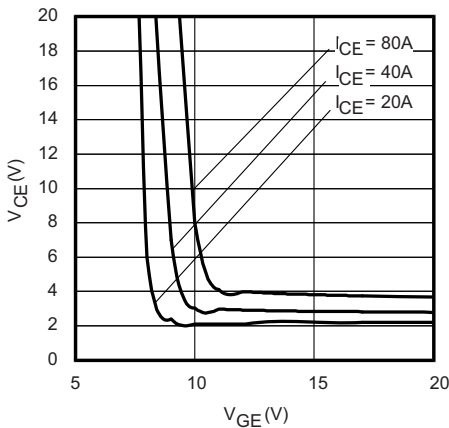


Fig. 9 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$

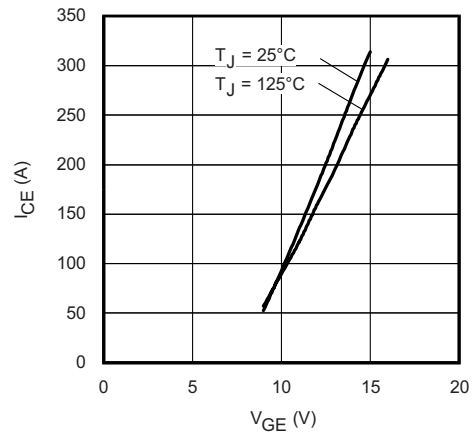


Fig. 12 - Typical Transfer Characteristics  
 $V_{CE} = 50 \text{ V}$ ;  $t_p = 10 \mu\text{s}$

# 40MT120UHAPbF/40MT120UHTAPbF



Vishay High Power Products "Half-Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 80 A

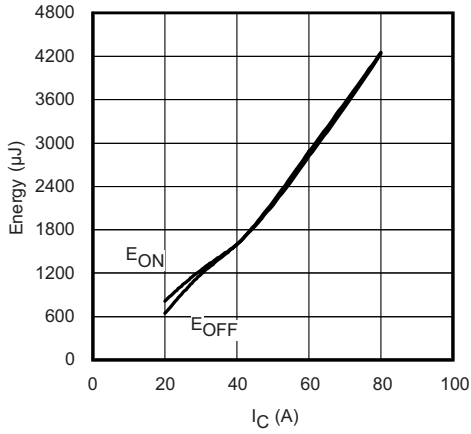


Fig. 13 - Typical Energy Loss vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 250\text{ }\mu\text{H}$ ;  $V_{CE} = 400\text{ V}$   
 $R_G = 5\text{ }\Omega$ ;  $V_{GE} = 15\text{ V}$

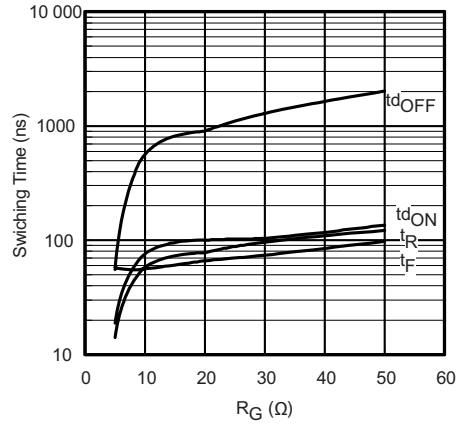


Fig. 16 - Typical Switching Time vs.  $R_G$   
 $T_J = 150\text{ }^\circ\text{C}$ ;  $L = 250\text{ }\mu\text{H}$ ;  $V_{CE} = 600\text{ V}$   
 $I_{CE} = 40\text{ A}$ ;  $V_{GE} = 15\text{ V}$

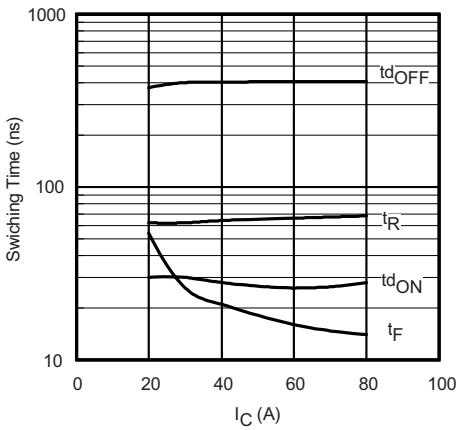


Fig. 14 - Typical Switching Time vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 250\text{ }\mu\text{H}$ ;  $V_{CE} = 400\text{ V}$   
 $R_G = 5\text{ }\Omega$ ;  $V_{GE} = 15\text{ V}$

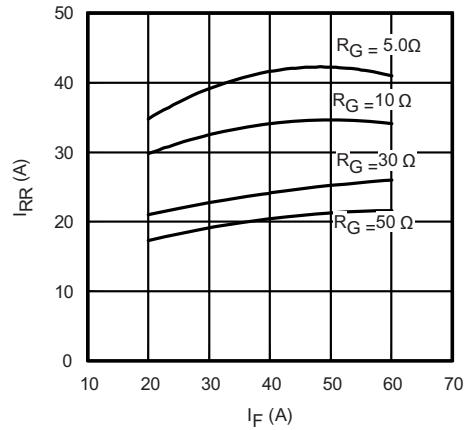


Fig. 17 - Typical Diode  $I_{RR}$  vs.  $I_F$   
 $T_J = 125\text{ }^\circ\text{C}$

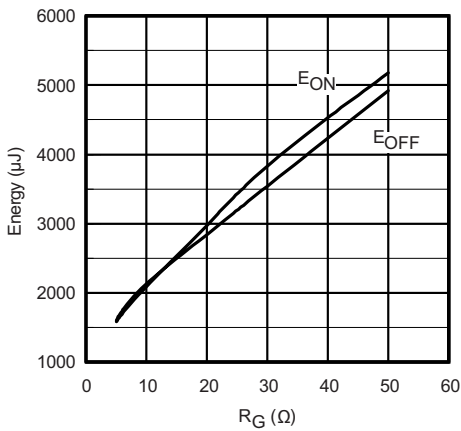


Fig. 15 - Typical Energy Loss vs.  $R_G$   
 $T_J = 150\text{ }^\circ\text{C}$ ;  $L = 250\text{ }\mu\text{H}$ ;  $V_{CE} = 600\text{ V}$   
 $I_{CE} = 40\text{ A}$ ;  $V_{GE} = 15\text{ V}$

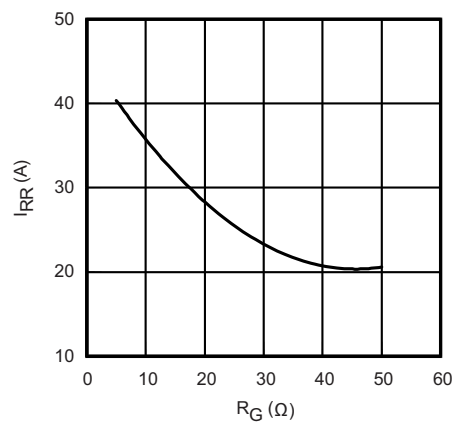


Fig. 18 - Typical Diode  $I_{RR}$  vs.  $R_G$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $I_F = 40\text{ A}$



# 40MT120UHAPbF/40MT120UHTAPbF

"Half-Bridge" IGBT MTP Vishay High Power Products  
(Ultrafast NPT IGBT), 80 A

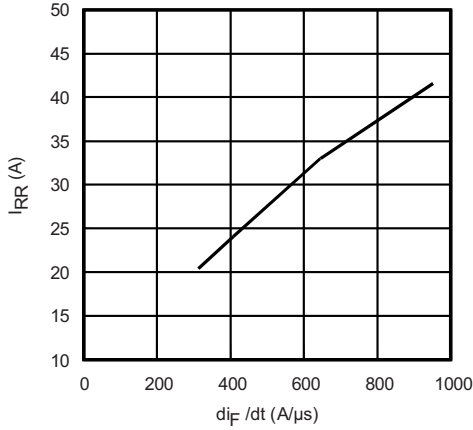


Fig. 19 - Typical Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 600\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  
 $I_{CE} = 40\text{ A}$ ;  $T_J = 125\text{ }^\circ\text{C}$

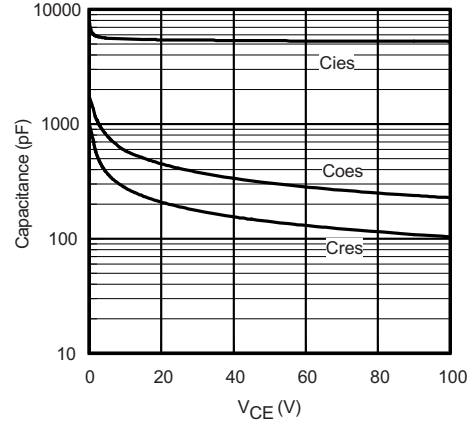


Fig. 21 - Typical Capacitance vs.  $V_{CE}$   
 $V_{GE} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

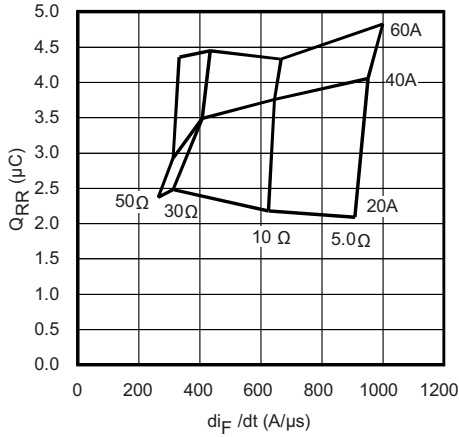


Fig. 20 - Typical Diode  $Q_{RR}$   
 $V_{CC} = 600\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $T_J = 125\text{ }^\circ\text{C}$

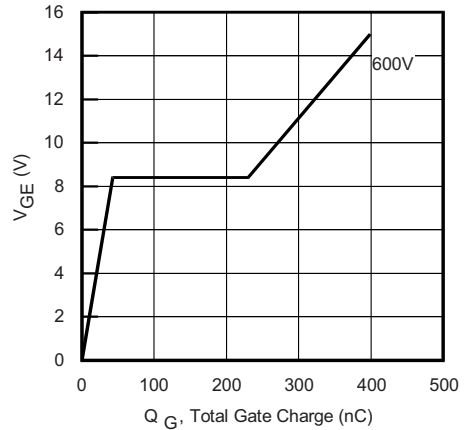


Fig. 22 - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 5.0\text{ A}$ ;  $L = 600\text{ } \mu\text{H}$

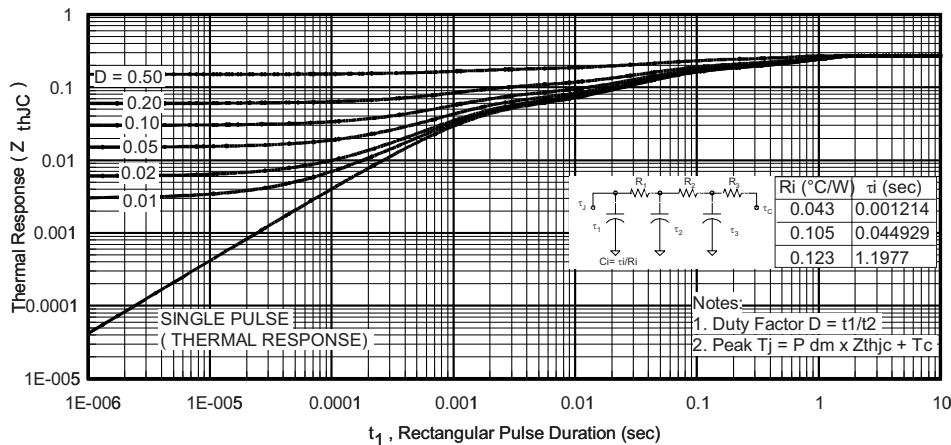


Fig. 23 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

# 40MT120UHAPbF/40MT120UHTAPbF

Vishay High Power Products "Half-Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 80 A

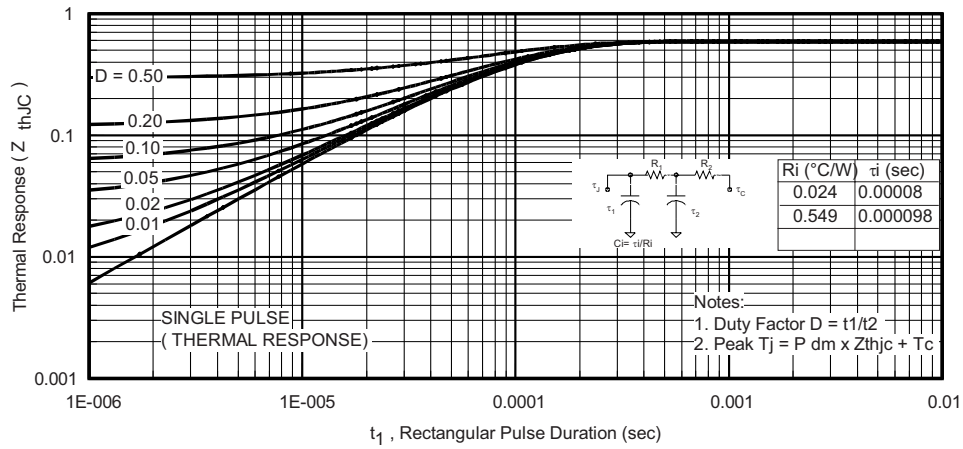


Fig. 24 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

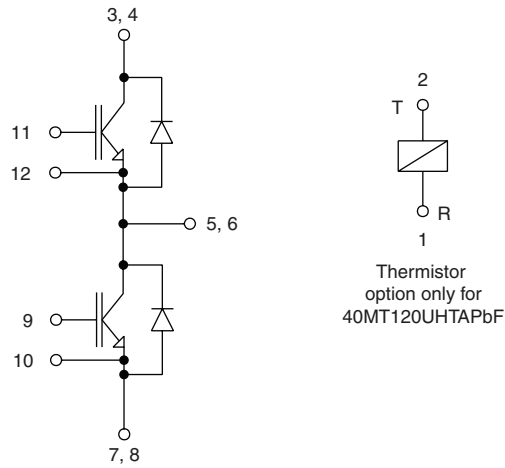


Fig. 25 - Electrical diagram

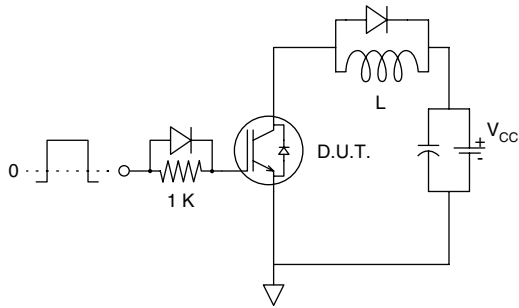


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

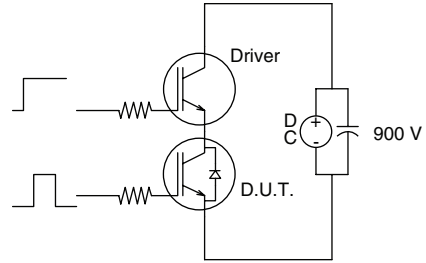


Fig. C.T.3 - S.C. SOA Circuit

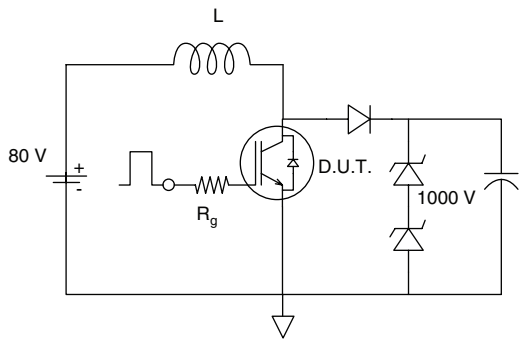


Fig. C.T.2 - RBSOA Circuit

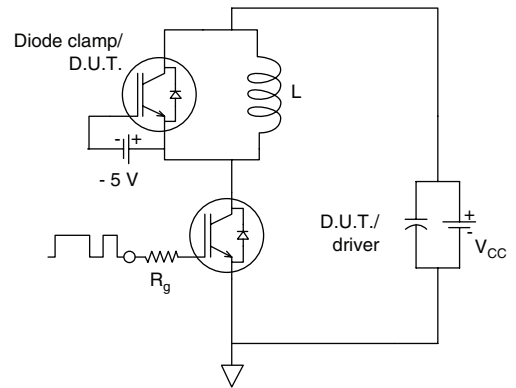


Fig. C.T.4 - Switching Loss Circuit

# 40MT120UHAPbF/40MT120UHTAPbF



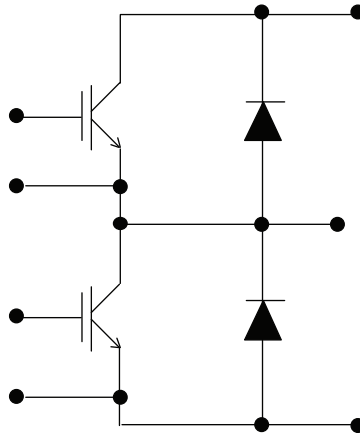
Vishay High Power Products "Half-Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 80 A

## ORDERING INFORMATION TABLE

Device code	<b>40</b>	<b>MT</b>	<b>120</b>	<b>U</b>	<b>H</b>	<b>T</b>	<b>A</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥	⑦	⑧

- 1** - Current rating (40 = 40 A)
- 2** - Essential part number
- 3** - Voltage code (120 = 1200 V)
- 4** - Speed/type (U = Ultrafast IGBT)
- 5** - Circuit configuration (H = Half bridge)
- 6** - Special option
  - None = No special option
  - T = Thermistor
- 7** - A = Al<sub>2</sub>O<sub>3</sub> DBC substrate
- 8** - PbF = Lead (Pb)-free

## CIRCUIT CONFIGURATION



### LINKS TO RELATED DOCUMENTS

Dimensions

<http://www.vishay.com/doc?95175>



## Disclaimer

All product specifications and data are subject to change without notice.

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