


## "Half-Bridge" IGBT INT-A-PAK (Ultrafast Speed IGBT), 200 A


**INT-A-PAK**

### FEATURES

- Generation 4 IGBT technology
- Ultrafast: Optimized for high speed 8 kHz to 40 kHz in hard switching, > 200 kHz in resonant mode
- Very low conduction and switching losses
- HEXFRED® antiparallel diodes with ultrasoft recovery
- Industry standard package
- UL approved file E78996 
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


**RoHS**  
COMPLIANT

### PRODUCT SUMMARY

$V_{CES}$	600 V
$I_C$ DC	265 A
$V_{CE(on)}$ at 200 A, 25 °C	1.74 V

### BENEFITS

- Increased operating efficiency
- Direct mounting to heatsink
- Performance optimized for power conversion: UPS, SMPS, welding
- Low EMI, requires less snubbing

### ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	$V_{CES}$		600	V
Continuous collector current	$I_C$	$T_C = 25\text{ °C}$	265	A
		$T_C = 67\text{ °C}$	200	
Pulsed collector current	$I_{CM}$		400	
Peak switching current	$I_{LM}$		400	
Peak diode forward current	$I_{FM}$		400	
Gate to emitter voltage	$V_{GE}$		± 20	V
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, t = 1 min	2500	
Maximum power dissipation	$P_D$	$T_C = 25\text{ °C}$	625	W
		$T_C = 85\text{ °C}$	325	

### ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ °C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}$ , $I_C = 1\text{ mA}$	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$ , $I_C = 200\text{ A}$	-	1.74	2.2	
		$V_{GE} = 15\text{ V}$ , $I_C = 200\text{ A}$ , $T_J = 125\text{ °C}$	-	1.79	2.25	
Gate threshold voltage	$V_{GE(th)}$	$I_C = 0.25\text{ mA}$	3	4.4	6	
Temperature coeff. of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$ , $I_C = 0.25\text{ mA}$	-	- 11	-	mV/°C
Forward transconductance	$g_{fe}$	$V_{CE} = 20\text{ V}$ , $I_C = 200\text{ A}$	-	220	-	S
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0\text{ V}$ , $V_{CE} = 600\text{ V}$	-	0.014	1	mA
		$V_{GE} = 0\text{ V}$ , $V_{CE} = 600\text{ V}$ , $T_J = 125\text{ °C}$	-	-	10	
Diode forward voltage drop	$V_{FM}$	$I_C = 200\text{ A}$ , $V_{GE} = 0\text{ V}$	-	4.2	6.0	V
		$I_C = 200\text{ A}$ , $V_{GE} = 0\text{ V}$ , $T_J = 125\text{ °C}$	-	4.4	6.2	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	± 250	nA

# Vishay High Power Products "Half-Bridge" IGBT INT-A-PAK (Ultrafast Speed IGBT), 200 A

SWITCHING CHARACTERISTICS ( $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge	$Q_g$	$I_C = 200\text{ A}$ $I_C = 270\text{ A}$ $V_{GE} = 15\text{ V}$	-	900	-	nC
Gate to emitter charge	$Q_{ge}$		-	125	-	
Gate to collector charge	$Q_{gc}$		-	306	-	
Turn-on delay time	$t_{d(on)}$	$I_C = 200\text{ A}$ $V_{CC} = 360\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $T_J = 25\text{ }^{\circ}\text{C}$	-	220	-	ns
Rise time	$t_r$		-	154	-	
Turn-off delay time	$t_{d(off)}$		-	300	-	
Fall time	$t_f$		-	180	-	
Turn-on switching energy	$E_{on}$	$R_{g1} = 15\text{ }\Omega$ $R_{g2} = 0\text{ }\Omega$	-	2.2	-	mJ
Turn-off switching energy	$E_{off}$		-	6.6	-	
Total switching energy	$E_{ts}$		-	8.8	-	
Turn-on delay time	$t_{d(on)}$	$I_C = 200\text{ A}$ $V_{CC} = 360\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $T_J = 125\text{ }^{\circ}\text{C}$	-	342	-	ns
Rise time	$t_r$		-	194	-	
Turn-off delay time	$t_{d(off)}$		-	366	-	
Fall time	$t_f$		-	213	-	
Turn-on switching energy	$E_{on}$	$R_{g1} = 15\text{ }\Omega$ $R_{g2} = 0\text{ }\Omega$	-	5	-	mJ
Turn-off switching energy	$E_{off}$		-	16	-	
Total switching energy	$E_{ts}$		-	21	-	
Input capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$	-	20 068	-	pF
Output capacitance	$C_{oes}$		-	1254	-	
Reverse transfer capacitance	$C_{res}$		-	261	-	
Diode reverse recovery time	$t_{rr}$	$I_C = 200\text{ A}$ $V_{CC} = 360\text{ V}$ $di/dt = 1300\text{ A}/\mu\text{s}$	-	179	-	ns
Diode peak reverse current	$I_{rr}$		-	120	-	A
Diode recovery charge	$Q_{rr}$		-	10 714	-	$\mu\text{C}$
Diode peak rate of fall of recovery during $t_b$	$di_{(rec)M}/dt$		-	1922	-	$\text{A}/\mu\text{s}$

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range	$T_J$	- 40	-	150	$^{\circ}\text{C}$
Storage temperature range	$T_{Stg}$	- 40	-	125	
Junction to case	$R_{thJC}$	-	-	0.2	$^{\circ}\text{C}/\text{W}$
Diode		-	-	0.4	
Case to sink per module	$R_{thCS}$	-	0.1	-	
Mounting torque	case to heatsink	-	-	4	Nm
	case to terminal 1, 2, 3	-	-	3	
Weight		-	200	-	g

# "Half-Bridge" IGBT INT-A-PAKVishay High Power Products (Ultrafast Speed IGBT), 200 A

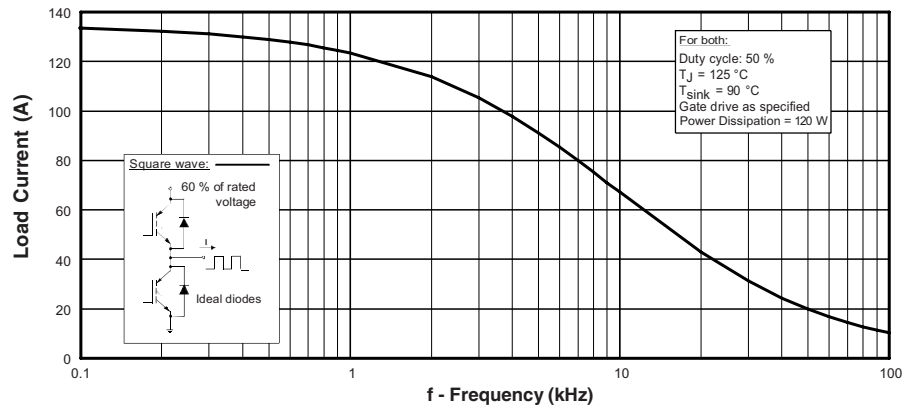


Fig. 1 - Typical Load Current vs. Frequency  
(Load Current =  $I_{RMS}$  of Fundamental)

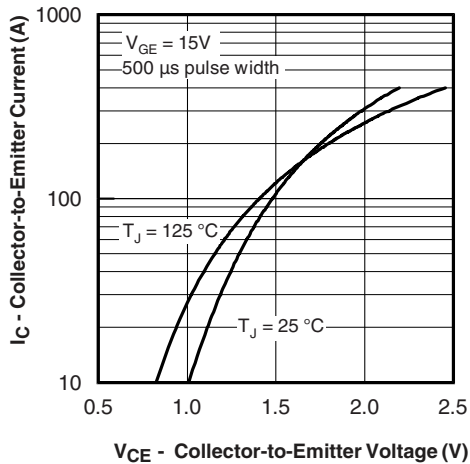


Fig. 2 - Typical Output Characteristics

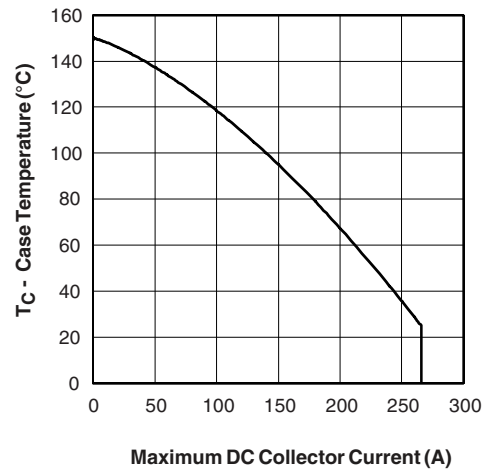


Fig. 4 - Case Temperature vs. Maximum Collector Current

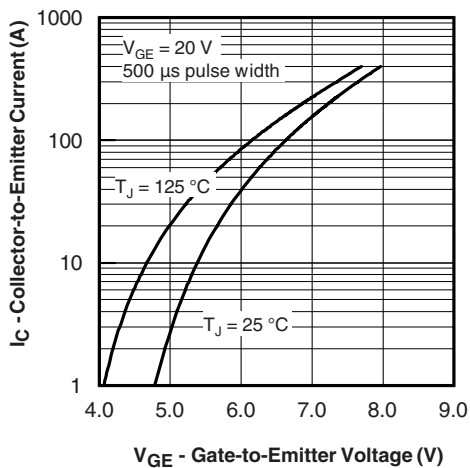


Fig. 3 - Typical Transfer Characteristics

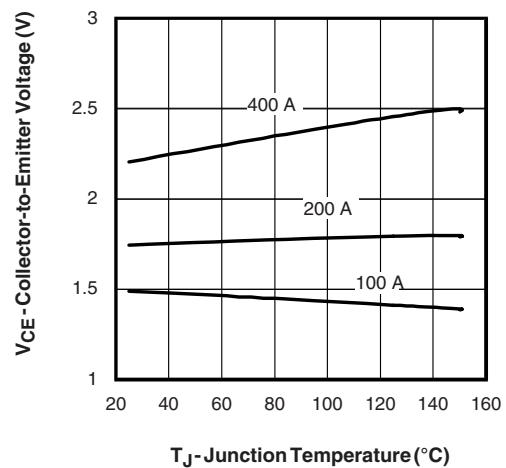


Fig. 5 - Typical Collector to Emitter Voltage vs.  
Junction Temperature

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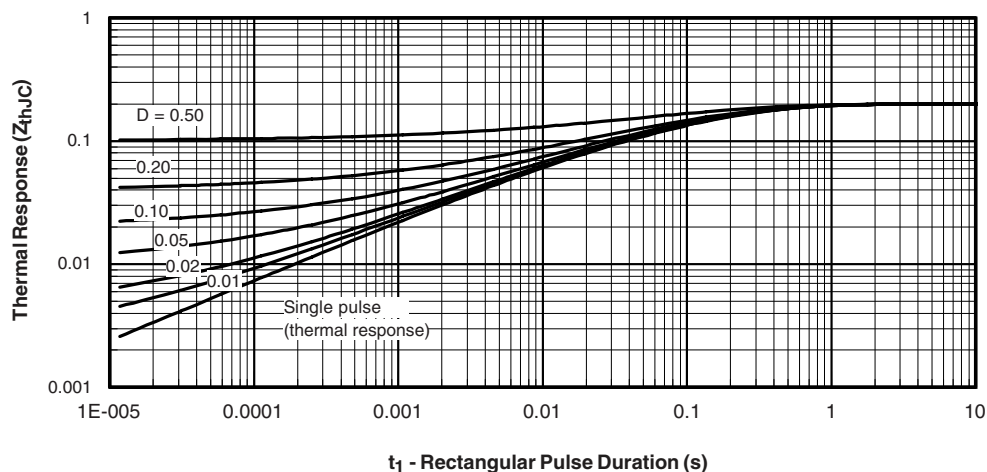


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

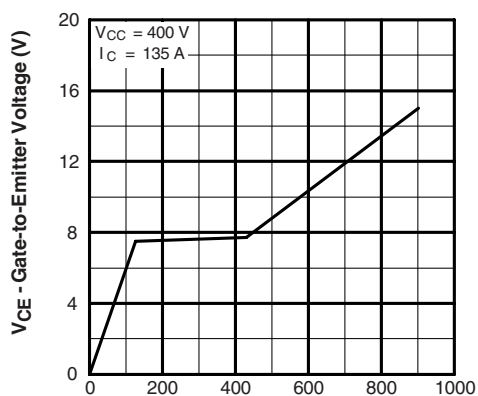


Fig. 7 - Typical Gate Charge vs. Gate to Emitter Voltage

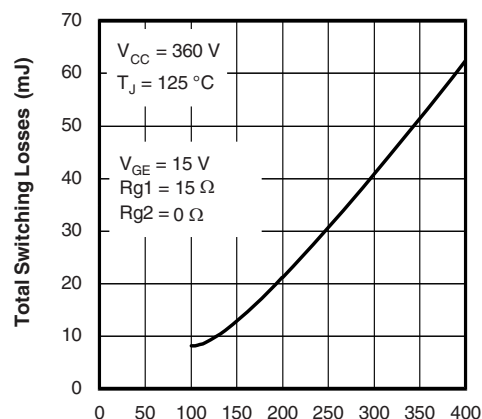


Fig. 9 - Typical Switching Losses vs. Collector to Emitter Current

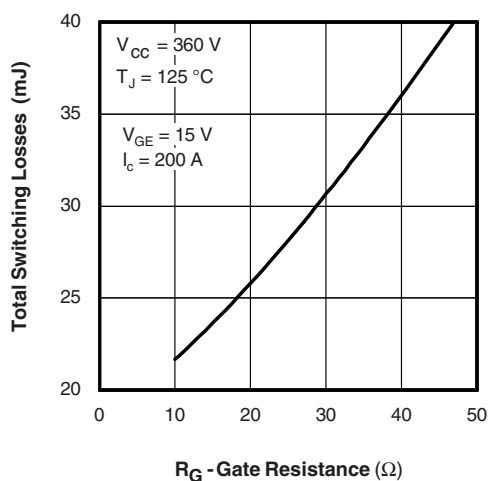


Fig. 8 - Typical Switching Losses vs. Gate Resistance

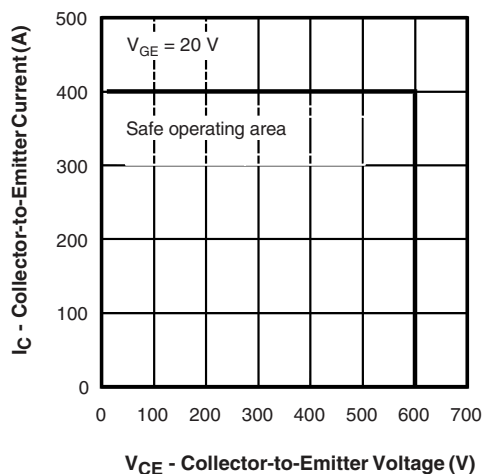
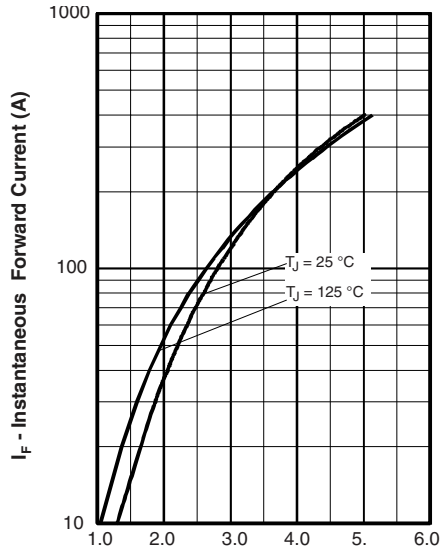


Fig. 10 - Reverse Bias SOA

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**V<sub>FM</sub> - Forward Voltage Drop (V)**  
Fig. 11 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

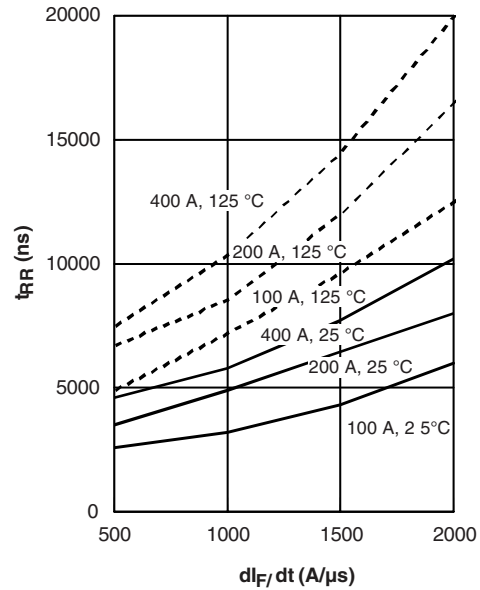


Fig. 13 - Typical Reverse Recovery Time vs.  $dI_F/dt$

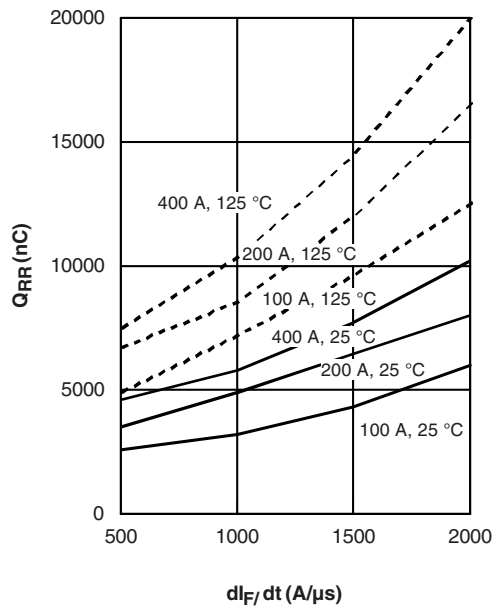


Fig. 12 - Typical Stored Charge vs.  $dI_F/dt$

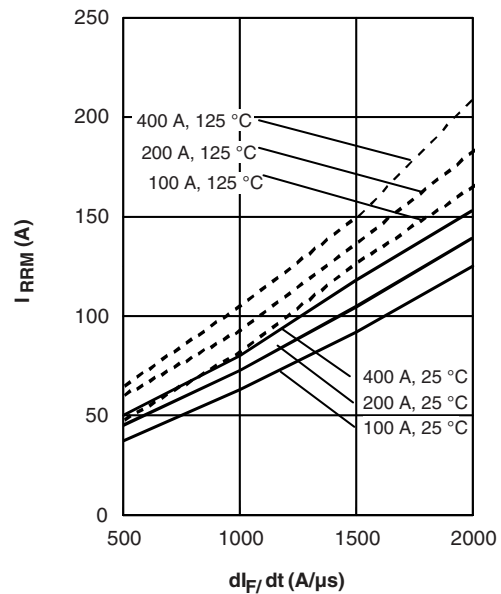


Fig. 14 - Typical Reverse Recovery vs.  $dI_F/dt$

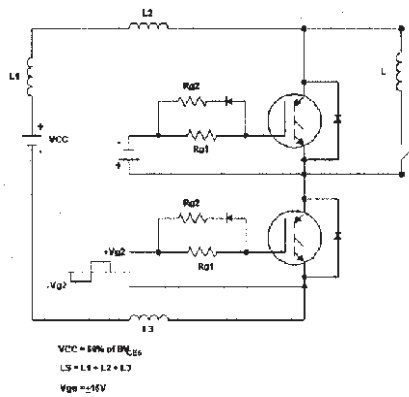


Fig. 15a - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$

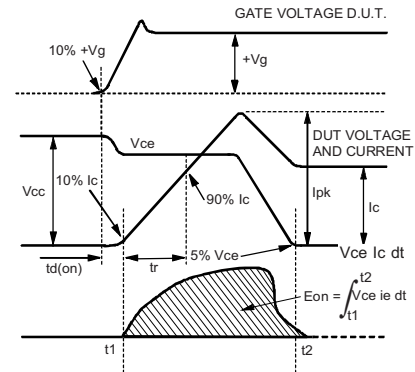


Fig. 15c - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{on}$ ,  $t_{d(on)}$ ,  $t_r$

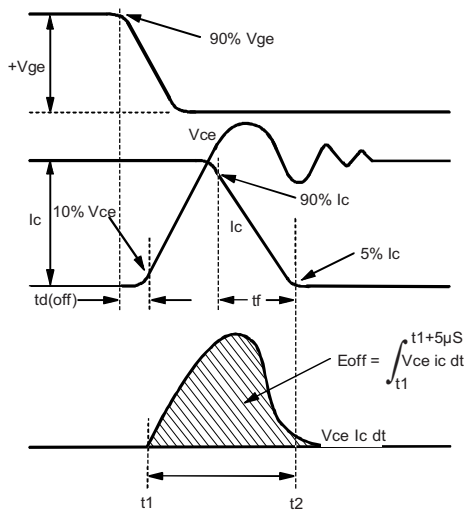


Fig. 15b - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{off}$ ,  $t_{d(off)}$ ,  $t_f$

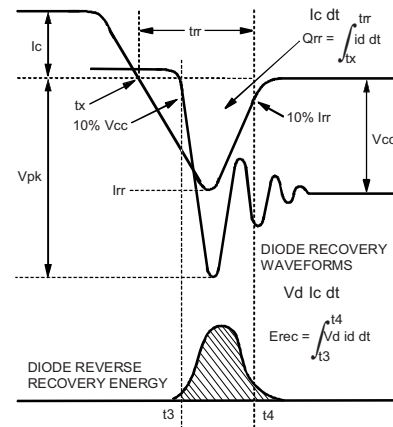


Fig. 15d - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$

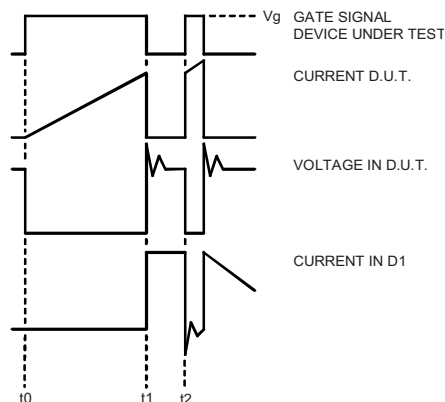


Fig. 15e - Macro Waveforms for Figure 18a's Test Circuit

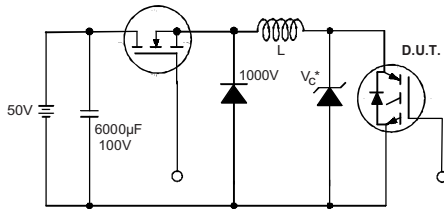


Fig. 16 - Clamped Inductive Load Test Circuit

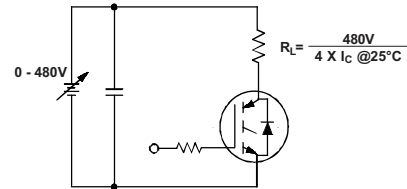


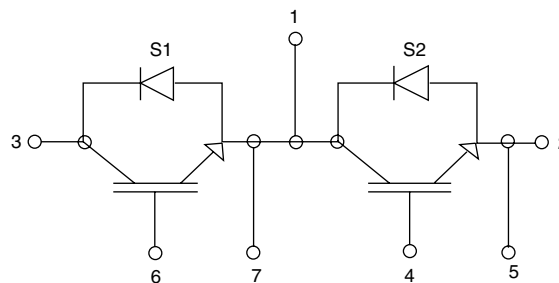
Fig. 17 - Pulsed Collector Current Test Circuit

## ORDERING INFORMATION TABLE

Device code	GA	200	T	S	60	U	PbF
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

- 1 - Essential part number IGBT modules
- 2 - Current rating (200 = 200 A)
- 3 - Circuit configuration (T = Half bridge)
- 4 - INT-A-PAK
- 5 - Voltage code (60 = 600 V)
- 6 - Speed/type (U = Ultrafast IGBT)
- 7 - PbF = Lead (Pb)-free

## CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95173">www.vishay.com/doc?95173</a>

**DIMENSIONS** in millimeters (inches)







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