

IGBT SIP Module (Fast IGBT)


IMS-2

FEATURES

- Fully isolated printed circuit board mount package
- Switching-loss rating includes all “tail” losses
- HEXFRED® soft ultrafast diodes
- Optimized for high speed over 5 kHz
See fig. 1 for current vs. frequency curve
- Totally lead (Pb)-free
- Designed and qualified for industrial level


RoHS
COMPLIANT

PRODUCT SUMMARY

OUTPUT CURRENT IN A TYPICAL 20 kHz MOTOR DRIVE

I_{RMS} per phase (3.1 kW total) with $T_C = 90\text{ }^{\circ}\text{C}$	4.6 A _{RMS}
T_J	125 $^{\circ}\text{C}$
Supply voltage	360 Vdc
Power factor	0.8
Modulation depth (see fig. 1)	115 %
$V_{CE(on)}$ (typical) at $I_C = 3.9\text{ A}$, 25 $^{\circ}\text{C}$	1.7 V

DESCRIPTION

The IGBT technology is the key to Vishay’s HPP advanced line of IMS (Insulated Metal Substrate) power modules. These modules are more efficient than comparable bipolar transistor modules, while at the same time having the simpler gate-drive requirements of the familiar power MOSFET. This superior technology has now been coupled to a state of the art materials system that maximizes power throughput with low thermal resistance. This package is highly suited to motor drive applications and where space is at a premium.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V _{CES}		600	V
Continuous collector current, each IGBT	I _C	T _C = 25 °C	7.2	A
		T _C = 100 °C	3.9	
Pulsed collector current	I _{CM} ⁽¹⁾		22	
Clamped inductive load current	I _{LM} ⁽²⁾			
Diode continuous forward current	I _F	T _C = 100 °C	3.4	
Diode maximum forward current	I _{FM}		22	
Gate to emitter voltage	V _{GE}		± 20	V
Isolation voltage	V _{ISOL}	1 minute, any terminal to case	2500	V _{RMS}
Maximum power dissipation, each IGBT	P _D	T _C = 25 °C	23	W
		T _C = 100 °C	9.1	
Operating junction and storage temperature range	T _J , T _{Stg}		- 40 to + 150	°C
Soldering temperature		10 s, (0.063" (1.6 mm) from case)	300	
Mounting torque		6-32 or M3 screw	5 to 7 (0.55 to 0.8)	lbf · in (N · m)

Notes

(1) Repetitive rating; $V_{GE} = 20\text{ V}$, pulse width limited by maximum junction temperature (see fig. 20)

(2) $V_{CC} = 80\text{ } \%$ (V_{GES}), $V_{GE} = 20\text{ V}$, $L = 10\text{ }\mu\text{H}$, $R_G = 50\text{ }\Omega$ (see fig.19)

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER	SYMBOL	TYP.	MAX.	UNITS
Junction to case, each IGBT, one IGBT in conduction	R_{thJC} (IGBT)	-	5.5	°C/W
Junction to case, each DIODE, one DIODE on conduction	R_{thJC} (DIODE)	-	9.0	
Case to sink, flat, greased surface	R_{thCS} (MODULE)	0.1	-	
Weight of module		20		g
		0.7		oz.

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(VB)CES}^{(1)}$	$V_{GE} = 0\text{ V}$, $I_C = 250\text{ }\mu\text{A}$	600	-	-	V
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	-	0.63	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	$I_C = 3.9\text{ A}$	-	1.70	2.2	V
		$I_C = 7.2\text{ A}$	-	1.95	-	
		$I_C = 3.9\text{ A}$, $T_J = 150\text{ °C}$	-	1.70	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.0	-	6.0	mV/°C
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$		-	- 11	-	
Forward transconductance	$g_{fe}^{(2)}$	$V_{CE} = 100\text{ V}$, $I_C = 6.5\text{ A}$	1.4	4.3	-	S
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	-	250	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 150\text{ °C}$	-	-	2500	
Diode forward voltage drop	V_{FM}	$I_C = 8.0\text{ A}$	-	1.4	1.7	V
		$I_C = 8.0\text{ A}$, $T_J = 150\text{ °C}$	-	1.3	1.6	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 100	nA

Notes(1) Pulse width $\leq 80\text{ }\mu\text{s}$; duty factor $\leq 0.1\%$ (2) Pulse width $5.0\text{ }\mu\text{s}$, single shot



SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX. UNITS
Total gate charge (turn-on)	Q_g	$I_C = 3.9\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$		-	31	47 nC
Gate to emitter charge (turn-on)	Q_{GE}			-	5.0	7.5
Gate to collector charge (turn-on)	Q_{gc}			-	13	20
Turn-on delay time	$t_{d(on)}$	$T_J = 25\text{ }^{\circ}\text{C}$ $I_C = 3.9\text{ A}$, $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$, $R_G = 50\text{ }\Omega$ Energy losses include "tail" and diode reverse recovery See fig. 9, 10, 11, 18		-	45	- ns
Rise time	t_r			-	22	-
Turn-off delay time	$t_{d(off)}$			-	100	160
Fall time	t_f			-	120	180
Turn-on switching loss	E_{on}			-	0.13	- mJ
Turn-off switching loss	E_{off}			-	0.07	-
Total switching loss	E_{ts}			-	0.20	0.3
Turn-on delay time	$t_{d(on)}$	$T_J = 150\text{ }^{\circ}\text{C}$ $I_C = 3.9\text{ A}$, $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$, $R_G = 50\text{ }\Omega$ Energy losses include "tail" and diode reverse recovery See fig. 9, 10, 11, 18		-	42	- ns
Rise time	t_r			-	22	-
Turn-off delay time	$t_{d(off)}$			-	120	-
Fall time	t_f			-	250	-
Total switching loss	E_{ts}			-	0.35	- mJ
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$	See fig. 7	-	530	- pF
Output capacitance	C_{oes}			-	39	-
Reverse transfer capacitance	C_{res}			-	7.4	-
Diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$	See fig. 14	-	37	55 ns
		$T_J = 125\text{ }^{\circ}\text{C}$		-	55	90
Diode peak reverse recovery current	I_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$	See fig. 15	-	3.5	5.0 A
		$T_J = 125\text{ }^{\circ}\text{C}$		-	4.5	8.0
Diode reverse recovery charge	Q_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$	See fig. 16	-	65	138 nC
		$T_J = 125\text{ }^{\circ}\text{C}$		-	124	360
Diode peak rate of fall of recovery during t_b	$dl_{(rec)M}/dt$	$T_J = 25\text{ }^{\circ}\text{C}$	See fig. 17	-	240	- A/ μs
		$T_J = 125\text{ }^{\circ}\text{C}$		-	210	-

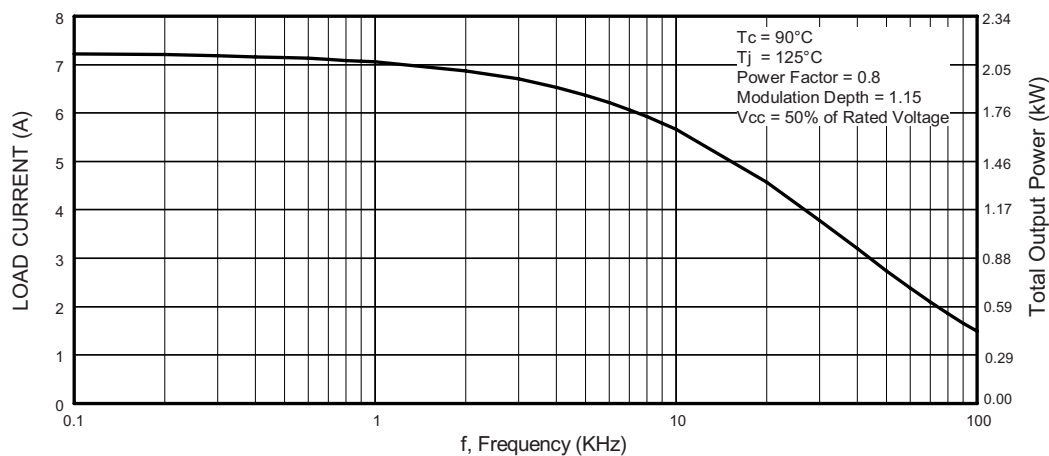


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of Fundamental)

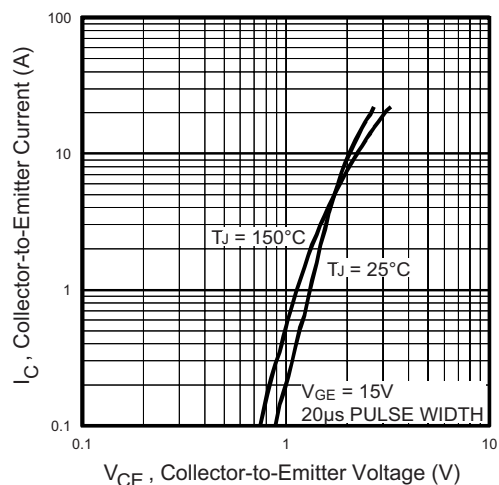


Fig. 2 - Typical Output Characteristics

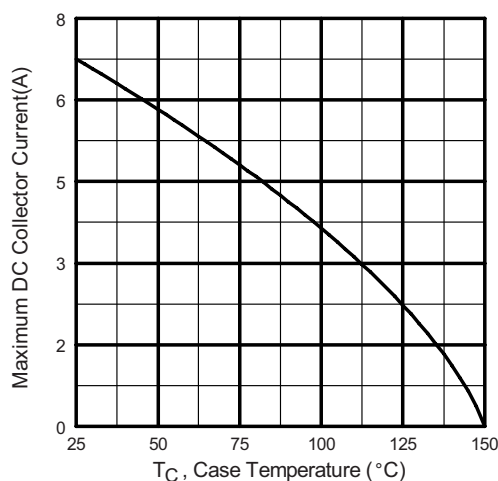


Fig. 4 - Maximum Collector Current vs. Case Temperature

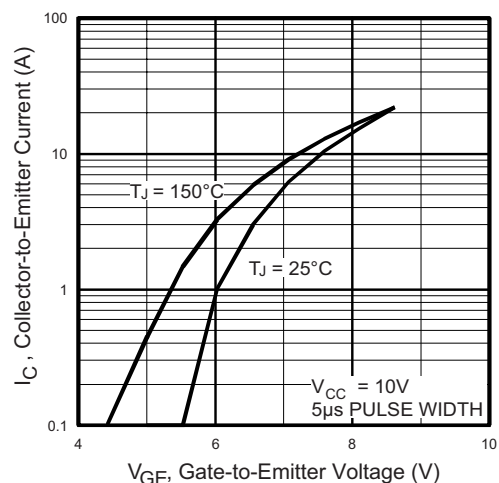


Fig. 3 - Typical Transfer Characteristics

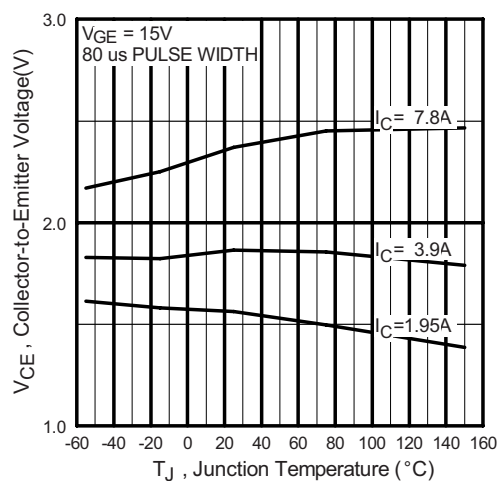


Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

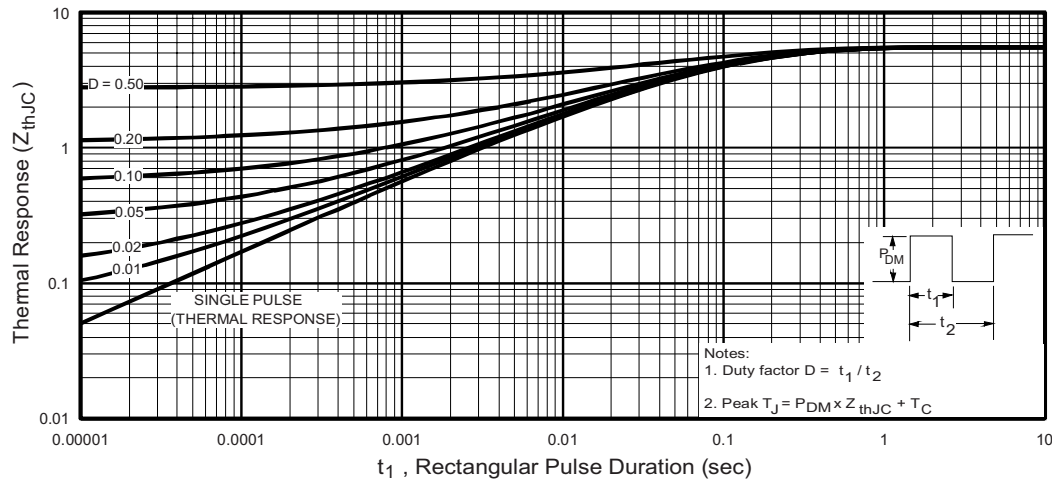


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

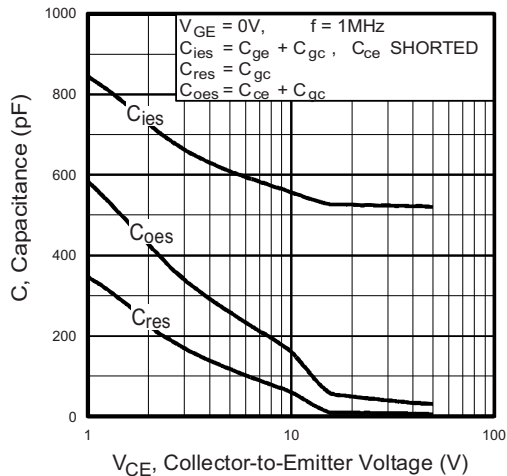


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

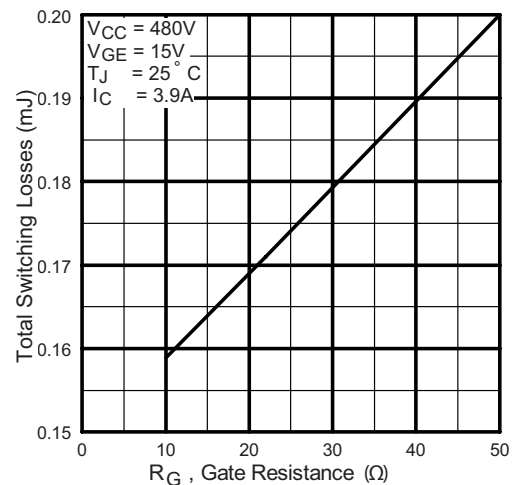


Fig. 9 - Typical Switching Losses vs. Gate Resistance

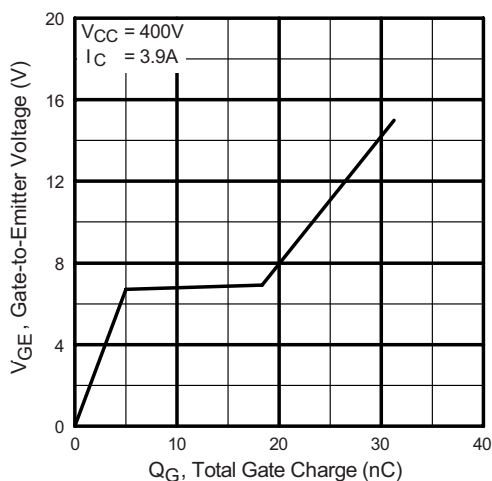


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

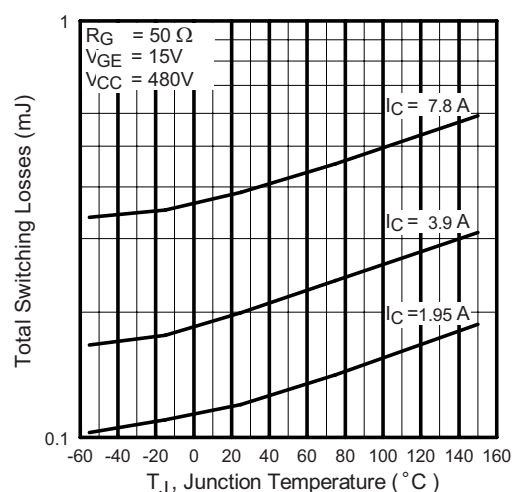
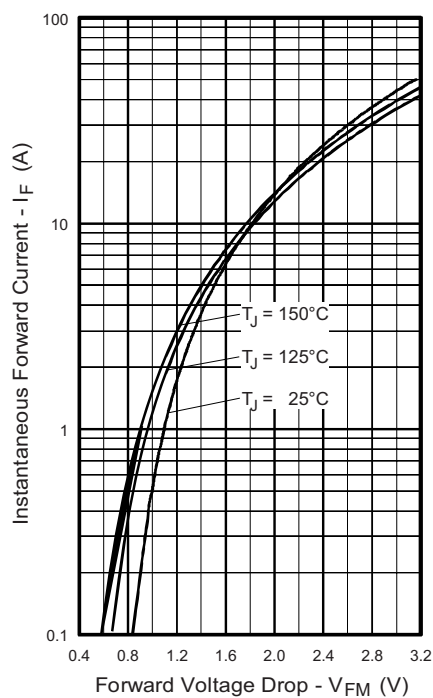
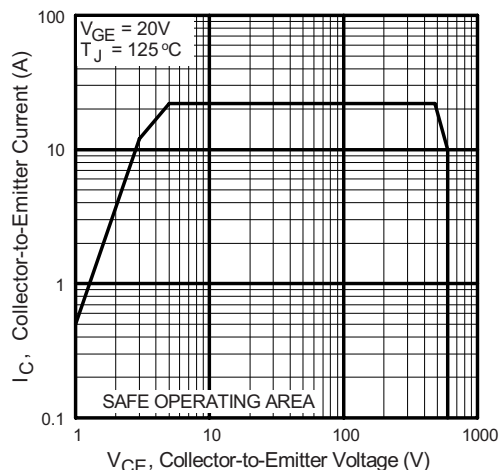
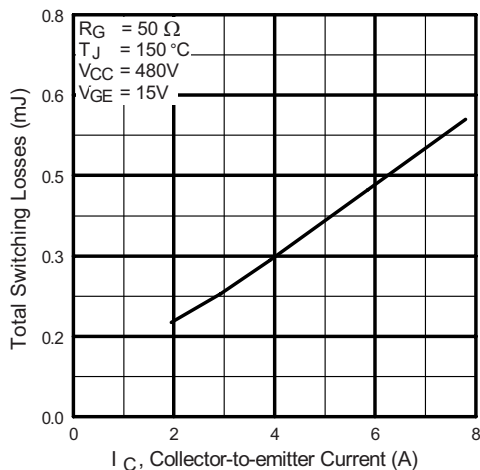


Fig. 10 - Typical Switching Losses vs. Junction Temperature



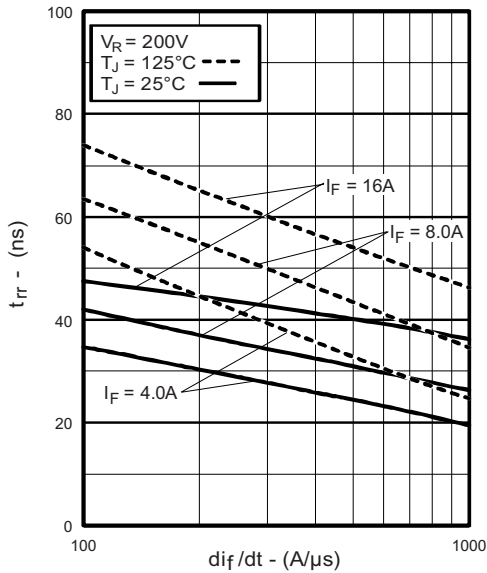


Fig. 14 - Typical Reverse Recovery Time vs. di_F/dt

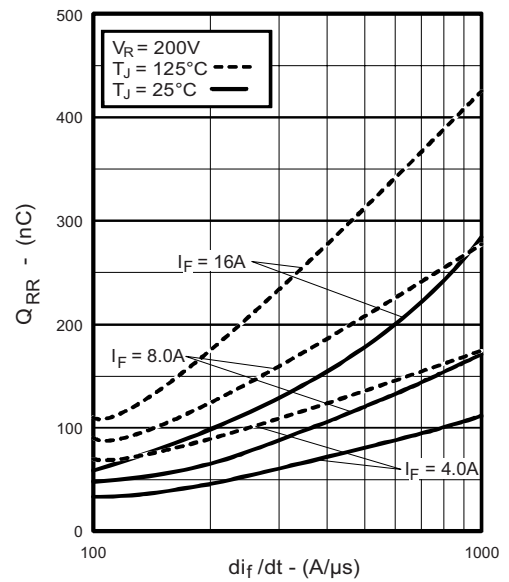


Fig. 16 - Typical Stored Charge vs. di_F/dt

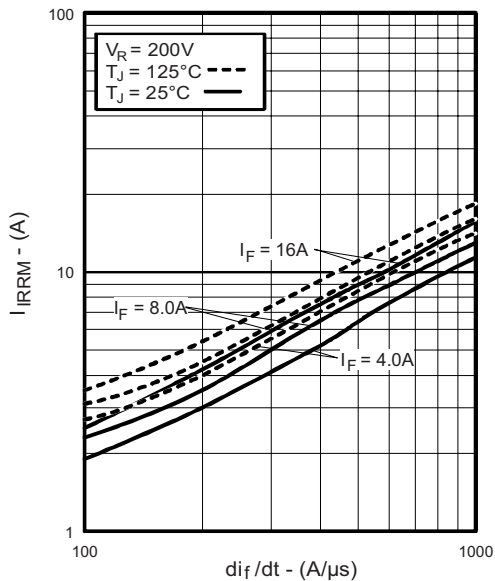


Fig. 15 - Typical Recovery Current vs. di_F/dt

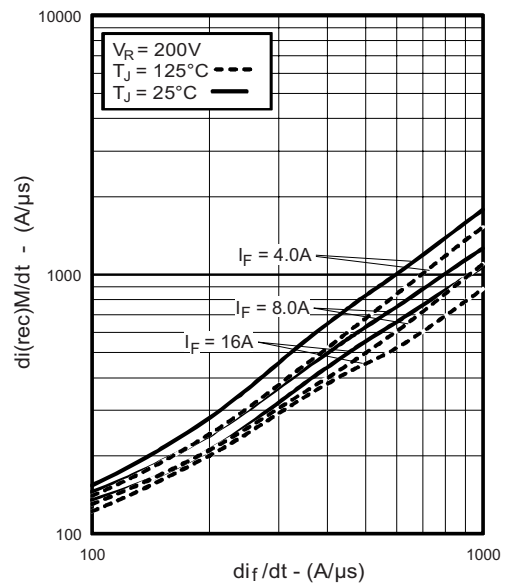


Fig. 17 - Typical $dI_{(rec)M}/dt$ vs. di_F/dt

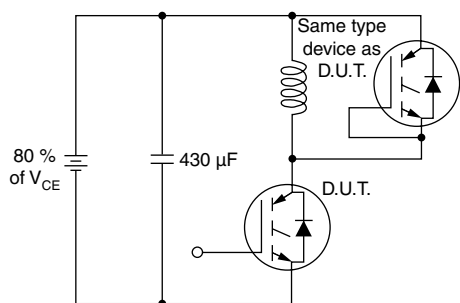


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

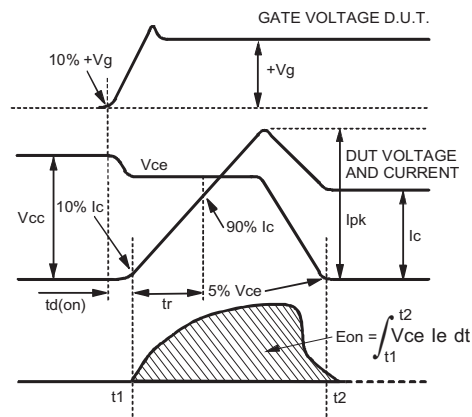


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

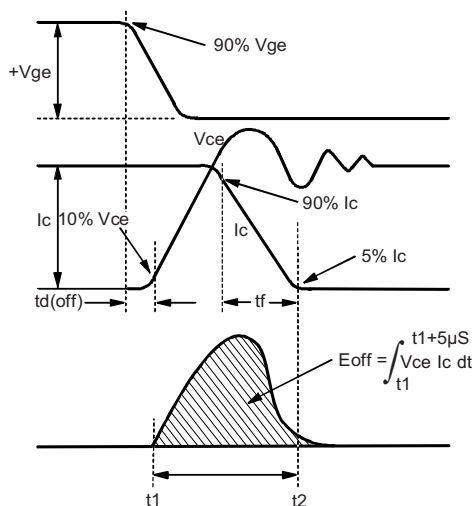


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

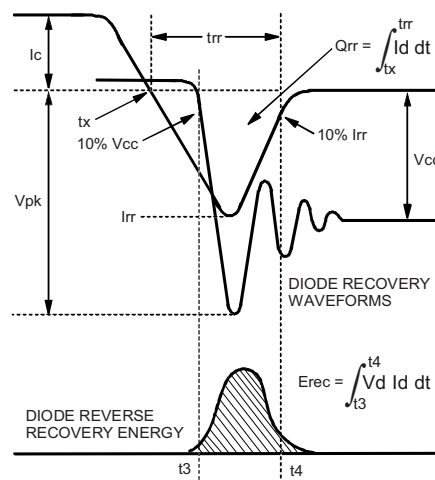


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

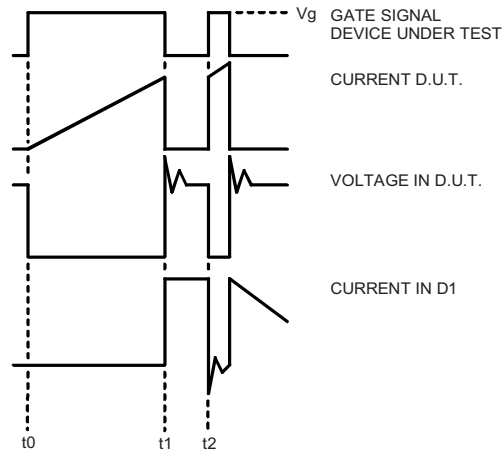


Fig. 18e - Macro Waveforms for Fig. 18a's Test Circuit

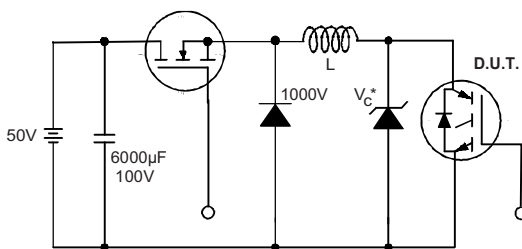


Fig. 19 - Clamped Inductive Load Test Circuit

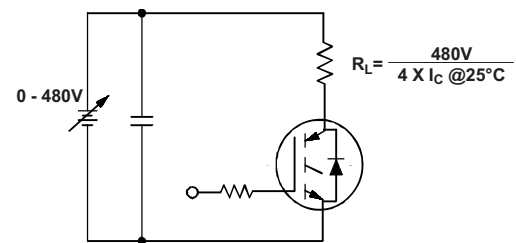
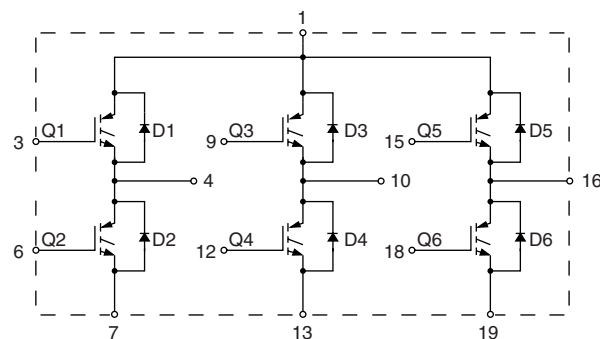


Fig. 20 - Pulsed Collector Current Test Circuit

CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	http://www.vishay.com/doc?95066

DIMENSIONS in millimeters (inches)



- (1) Tolerance unless otherwise specified ± 0.254 mm (0.010")
 (2) Controlling dimension: inch
 (3) Terminal numbers are shown for reference only



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