IGBT SIP Module (Fast IGBT)

IMS-2

PRODUCT SUMMARY	
OUTPUT CURRENT IN A TYPICAL 20 kHz MOTOR DRIVE	
I_{RMS} per phase (3.1 kW total) with T_C = 90 °C	4.6 A_{RMS}
T_J	125 °C
Supply voltage	360 Vdc
Power factor	0.8
Modulation depth (see fig. 1)	115 %
$V_{CE(on)}$ (typical) at I_C = 3.9 A, 25 °C	1.7 V
Package	SIP
Circuit	Three Phase Inverter

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
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb
Pb-free
RoHS
COMPLIANT

DESCRIPTION

The IGBT technology is the key to Vishay´s Semiconductors 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 V, pulse width limited by maximum junction temperature (see fig. 20)

(2) V_{CC} = 80 % (V_{GES}), V_{GE} = 20 V, L = 10 μH, R_G = 50 Ω (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 °C unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(VB)CES}$ (1)	V_{GE} = 0 V, I_C = 250 μA		600	-	-	V
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 1 mA		-	0.63	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	I_C = 3.9 A	V_{GE} = 15 V See fig. 2, 5	-	1.70	2.2	V
		I_C = 7.2 A		-	1.95	-	
		I_C = 3.9 A, T_J = 150 °C		-	1.70	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 μA		3.0	-	6.0	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$			-	- 11	-	mV/°C
Forward transconductance	g_{fe} (2)	V_{CE} = 100 V, I_C = 6.5 A		1.4	4.3	-	S
Zero gate voltage collector current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V		-	-	250	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 150 °C		-	-	2500	
Diode forward voltage drop	V_{FM}	I_C = 8.0 A	See fig. 13	-	1.4	1.7	V
		I_C = 8.0 A, T_J = 150 °C		-	1.3	1.6	
Gate to emittler leakage current	I_{GES}	V_{GE} = ± 20 V		-	-	± 100	nA

Notes

(3) Pulse width ≤ 80 μs; duty factor ≤ 0.1 %

(4) Pulse width 5.0 μs, single shot

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	O_g	I_C = 3.9 A V_{CC} = 400 V V_{GE} = 15 V		-	31	47	nC
Gate to emitter charge (turn-on)	O_{GE}			-	5.0	7.5	
Gate to collector charge (turn-on)	O_{gc}			-	13	20	
Turn-on delay time	$t_{d(on)}$	T_J = 25 °C I_C = 3.9 A, V_{CC} = 480 V V_{GE} = 15 V, R_G = 50 Ω 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 °C I_C = 3.9 A, V_{CC} = 480 V V_{GE} = 15 V, R_G = 50 Ω 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 V V_{CC} = 30 V f = 1.0 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 °C, See fig. 14	I_F = 8.0 A V_R = 200 V dI/dt = 200 A/μs	-	37	55	ns
		T_J = 125 °C, See fig. 14		-	55	90	
Diode peak reverse recovery current	I_{rr}	T_J = 25 °C, See fig. 15		-	3.5	5.0	A
		T_J = 125 °C, See fig. 15		-	4.5	8.0	
Diode reverse recovery charge	Q_{rr}	T_J = 25 °C, See fig. 16		-	65	138	nC
		T_J = 125 °C, See fig. 16		-	124	360	
Diode peak rate of fall of recovery during t_b	$dI_{(rec)M}/dt$	T_J = 25 °C, See fig. 17		-	240	-	A/μs
		T_J = 125 °C, See fig. 17		-	210	-	

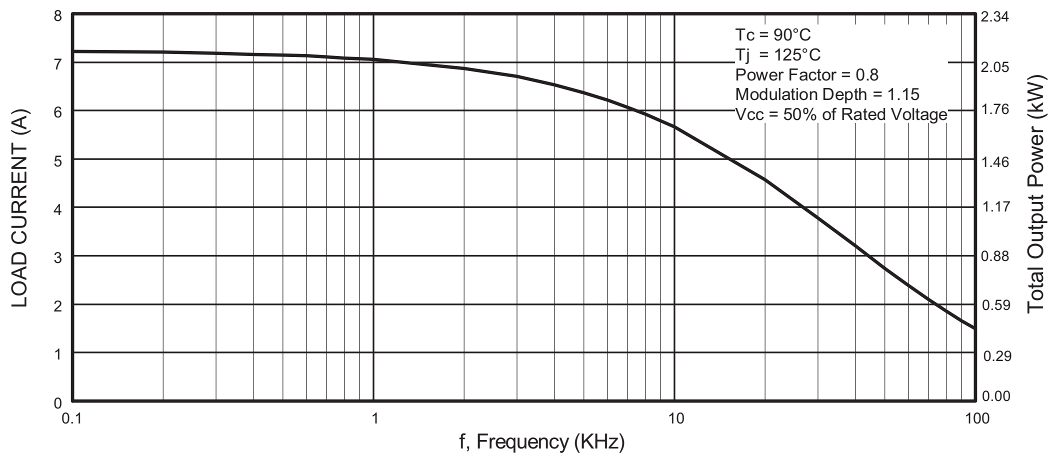


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of Fundamental)

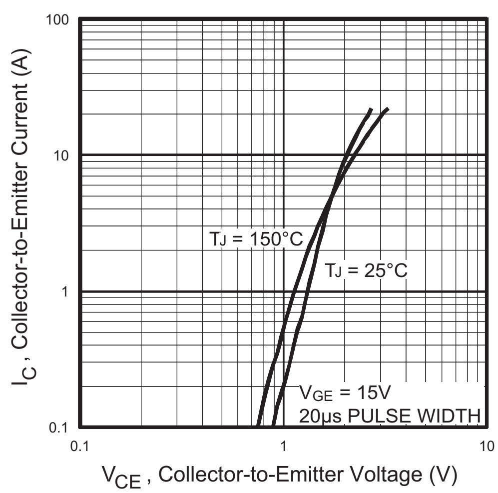


Fig. 2 - Typical Output Characteristics

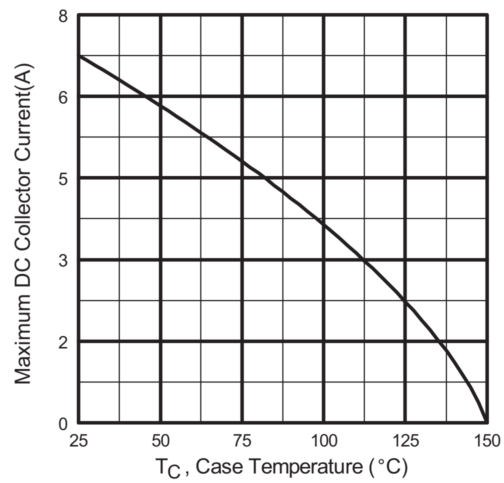


Fig. 4 - Maximum Collector Current vs. Case Temperature

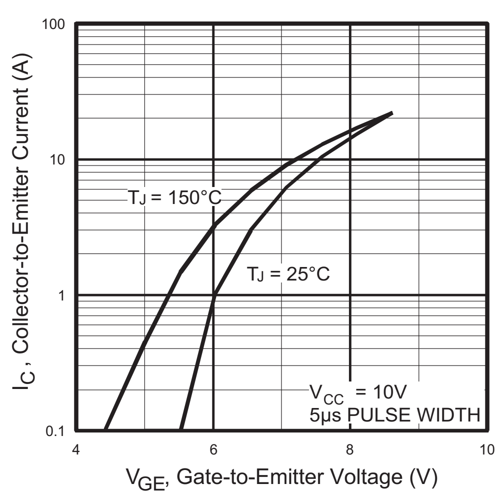


Fig. 3 - Typical Transfer Characteristics

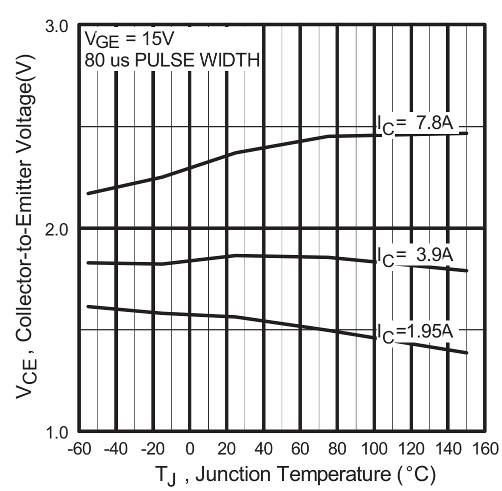


Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

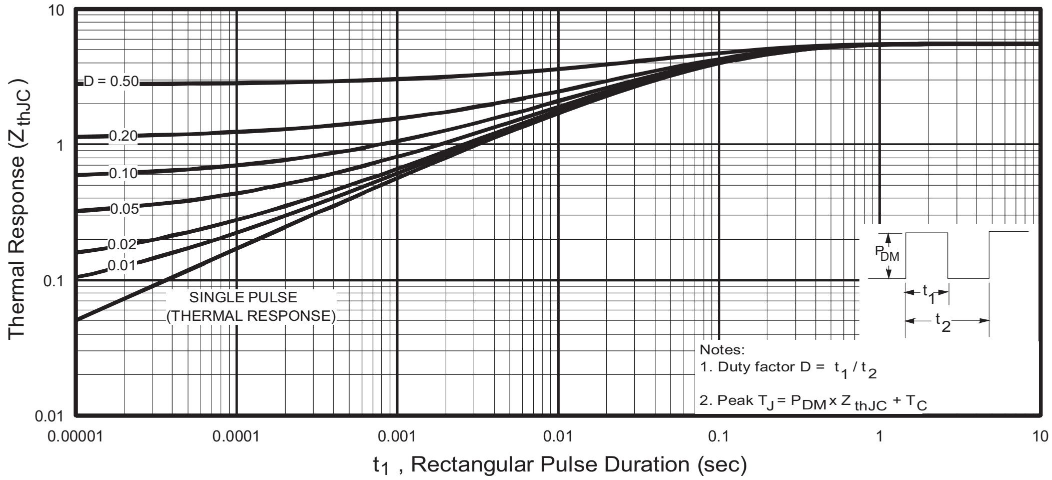


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

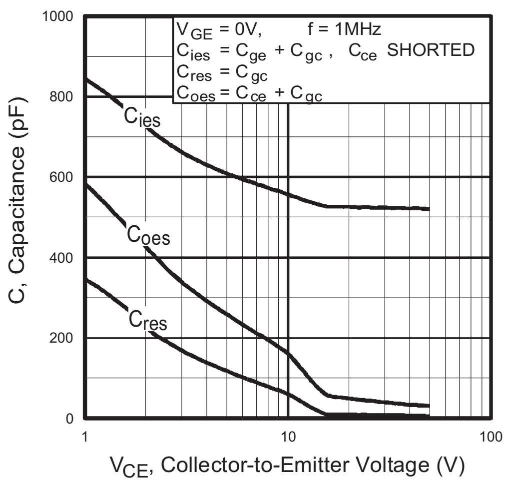


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

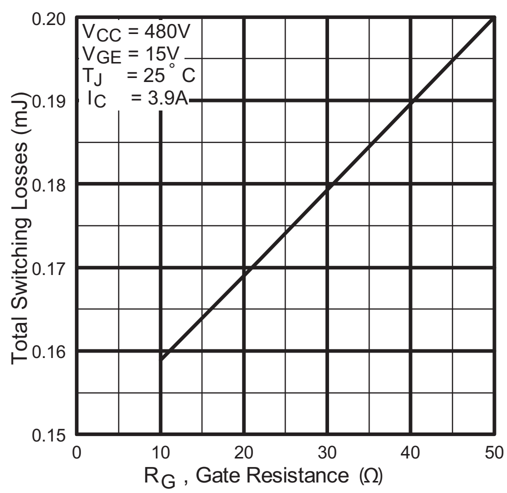


Fig. 9 - Typical Switching Losses vs. Gate Resistance

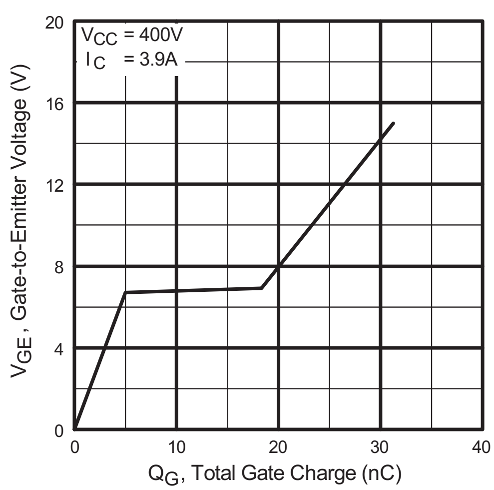


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

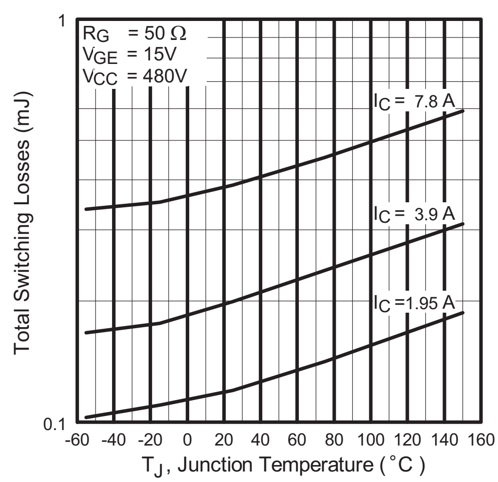


Fig. 10 - Typical Switching Losses vs. Junction Temperature

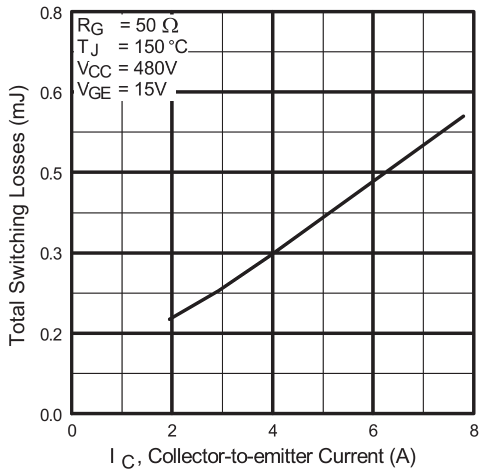


Fig. 11 - Typical Switching Losses vs. Collector to Emitter Current

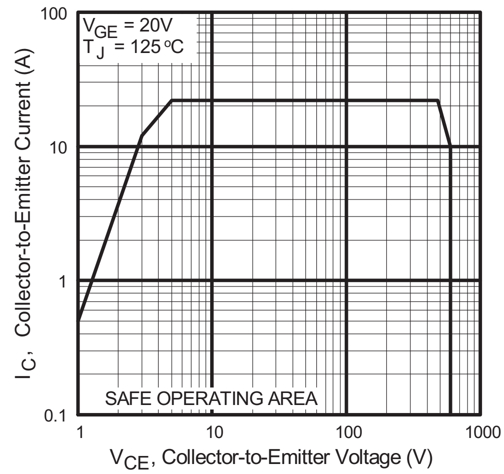


Fig. 12 - Turn-Off SOA

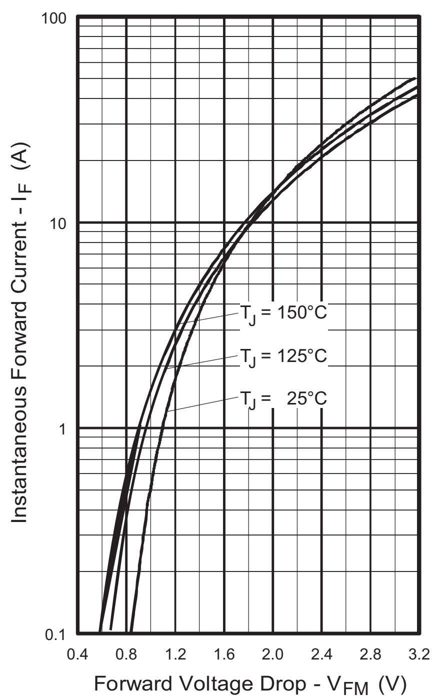


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

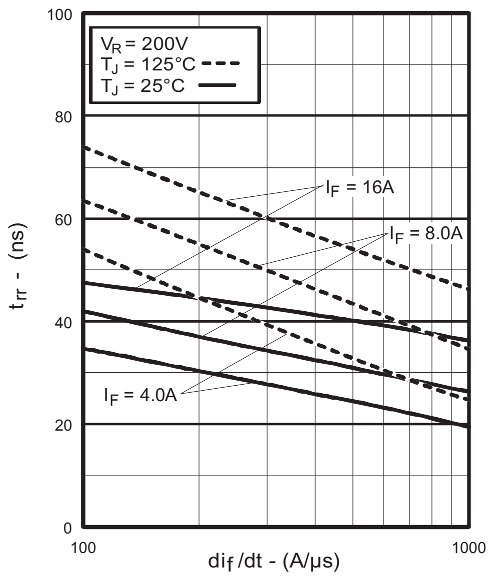


Fig. 14 - Typical Reverse Recovery Time vs. dI_F/dt

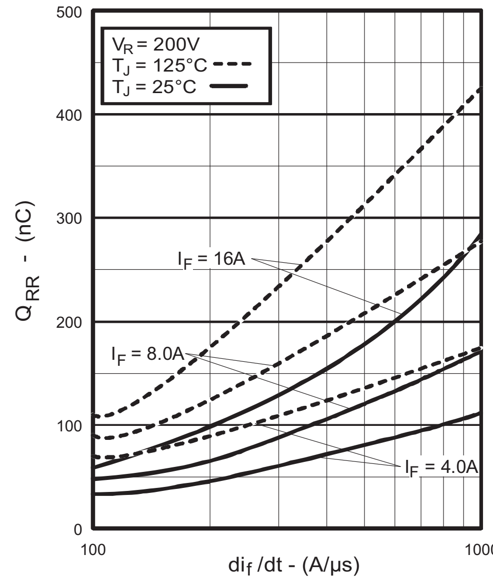


Fig. 16 - Typical Stored Charge vs. dI_F/dt

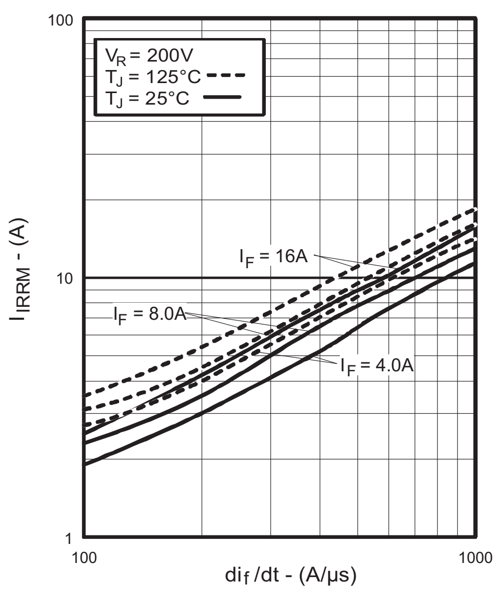


Fig. 15 - Typical Recovery Current vs. dI_F/dt

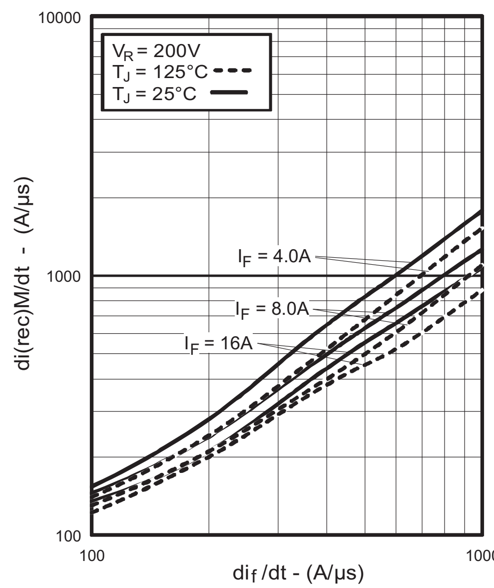


Fig. 17 - Typical $dI_{(rec)M}/dt$ vs. dI_F/dt

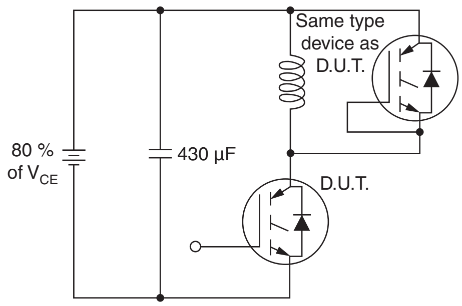


Fig. 18a - Test Circuit for Measurement of
I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

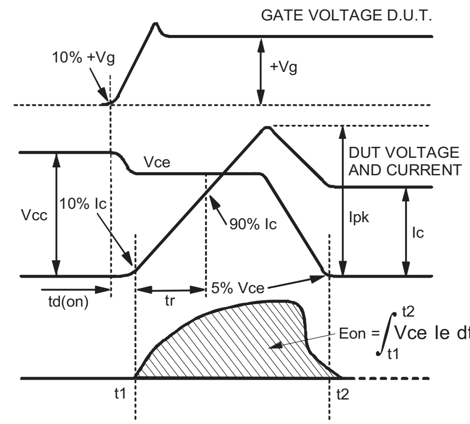


Fig. 18c - Test Waveforms for Circuit of Fig. 18a,
Defining E_{on}, $t_{d(on)}$, t_r

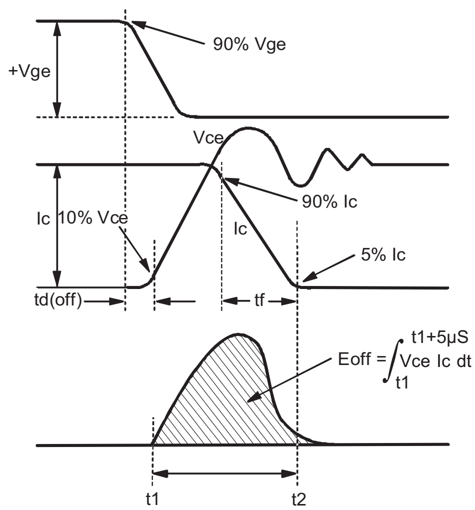


Fig. 18b - Test Waveforms for Circuit of Fig. 18a,
Defining E_{off}, $t_{d(off)}$, t_f

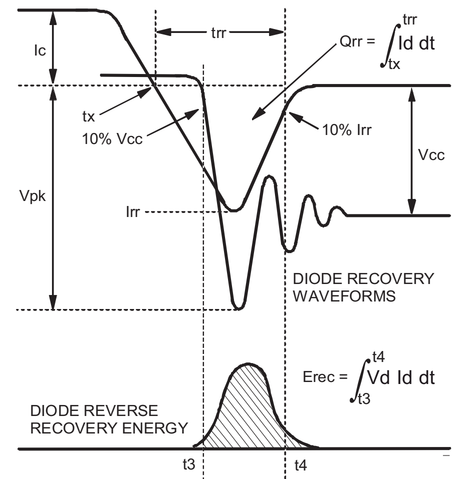


Fig. 18d - Test Waveforms for Circuit of Fig. 18a,
Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

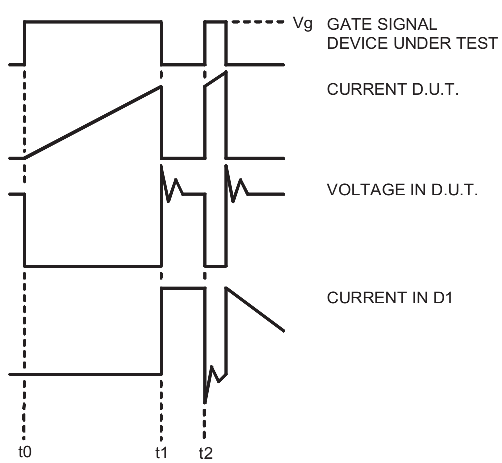


Fig. 18e - Macro Waveforms for Fig. 18a´s Test Circuit

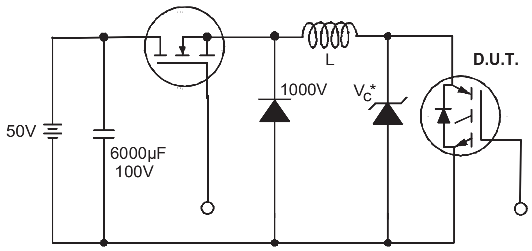


Fig. 19 - Clamped Inductive Load Test Circuit

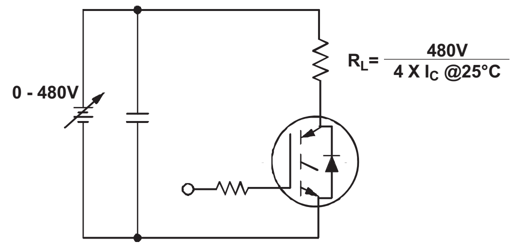
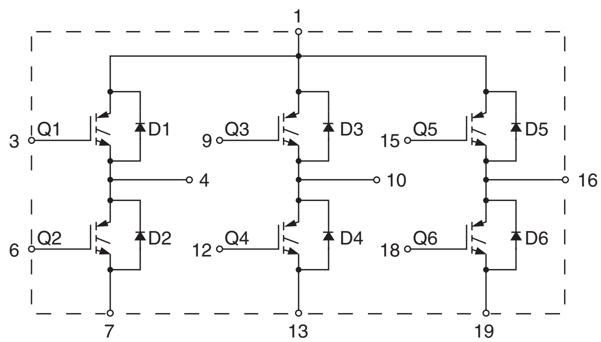


Fig. 20 - Pulsed Collector Current Test Circuit

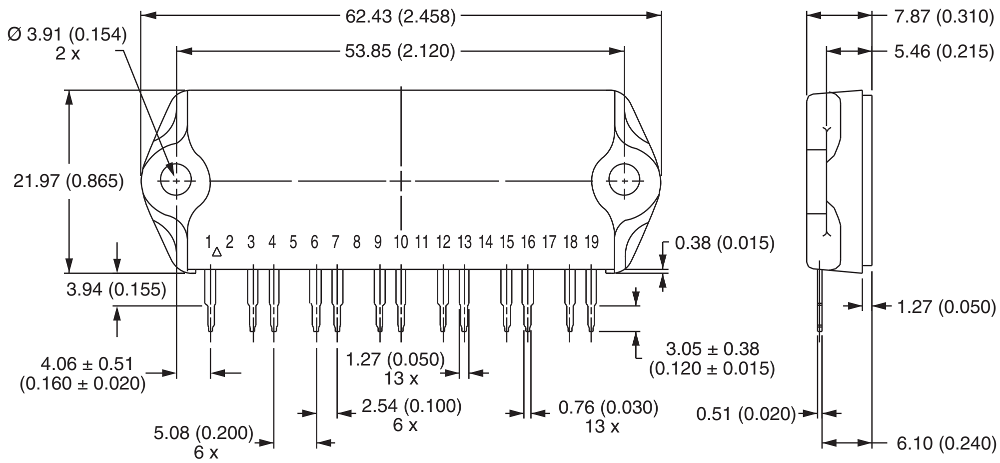
CIRCUIT CONFIGURATION



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

IMS-2 (SIP)

DIMENSIONS in millimeters (inches)



IMS-2 Package Outline (13 Pins)

Notes

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

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