IGBT SIP Module
(Short Circuit Rated Ultrafast 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	11 A_{RMS}
T_J	125 °C
Supply voltage	360 V_{DC}
Power factor	0.8
Modulation depth (see fig. 1)	115 %
$V_{CE(on)}$ (typical) at I_C = 13 A, 25 °C	1.8 V
Package	SIP
Circuit	Three Phase Inverter

FEATURES

Pb-free

RoHS COMPLIANT

- Short circuit rated ultrafast: Optimized for high speed > 5.0 kHz, and short circuit rated to 10 μs at 125 °C, V_{GE} = 15 V
- Fully isolated printed circuit board mount package
- Switching-loss rating includes all "tail" losses
- HEXFRED® soft ultrafast diodes
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

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	I_C	T_C = 25 °C	24	A
		T_C = 100 °C	13	
Pulsed collector current	I_{CM} (1)		48	
Clamped inductive load current	I_{LM} (2)		48	
Short circuit withstand time	t_{SC}	T_C = 100 °C	9.3	μs
Gate to emitter voltage	V_{GE}		± 20	V
Isolation voltage	V_{ISOL}	t = 1 min, any terminal to case	2500	V_{RMS}
Maximum power dissipation, each IGBT	P_D	T_C = 25 °C	63	W
		T_C = 100 °C	25	
Operating junction and storage temperature range	T_J, T_{Stg}		- 55 to + 150	°C
Soldering temperature		For 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_{CES}), V_{GE} = 20 V, L = 10 μH, R_G = 10 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)	-	2.2	°C/W
Junction to case, each DIODE, one DIODE in conduction	R_{thJC} (DIODE)	-	3.7	
Case to sink, flat, greased surface	R_{thCS} (MODULE)	0.10	-	
Weight of module		20	-	g
		0.7	-	oz.

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$V_{(BR)CES}$ (1)	V_{GE} = 0 V, I_C = 250 µA		600	-	-	V
Temperature coeff. of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 1.0 mA		-	0.63	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	I_C = 13 A	V_{GE} = 15 V See fig. 2, 5	-	1.80	2.3	V
		I_C = 24 A		-	1.80	-	
		I_C = 13 A, T_J = 150 °C		-	1.56	1.73	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, I_C = 250 µA		3.0	-	6.0	
Temperature coeff. of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$			-	- 13	-	mV/°C
Forward transconductance	g_{fe} (2)	V_{CE} = 100 V, I_C = 10 A		11	18	-	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		-	-	3500	
Diode forward voltage drop	V_{FM}	I_C = 15 A	See fig. 13	-	1.3	1.7	V
		I_C = 15 A, T_J = 150 °C		-	1.2	1.6	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V		-	-	± 100	nA

Notes
(1) Pulse width ≤ 80 µs, duty factor ≤ 0.1 %
(2) 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)	Q_g	I_C = 13 A V_{CC} = 400 V V_{GE} = 15 V See fig. 8	-	110	170	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	14	21	
Gate to collector charge (turn-on)	Q_{gc}		-	49	74	
Turn-on delay time	$t_{d(on)}$	T_J = 25 °C I_C = 13 A, V_{CC} = 480 V V_{GE} = 15 V, R_G = 10 Ω Energy losses include "tail" and diode reverse recovery See fig. 9, 10, 18	-	50	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	110	170	
Fall time	t_f		-	91	140	
Turn-on switching loss	E_{on}		-	0.56	-	mJ
Turn-off switching loss	E_{off}		-	0.28	-	
Total switching loss	E_{ts}		-	0.84	1.1	
Short circuit withstand time	t_{sc}	V_{CC} = 360 V, T_J = 125 °C V_{GE} = 15 V, R_G = 10 Ω, V_{CPK} < 500 V	10	-	-	µs
Turn-on delay time	$t_{d(on)}$	T_J = 150 °C, see fig. 9, 10, 11, 18 I_C = 13 A, V_{CC} = 480 V V_{GE} = 15 V, R_G = 10 Ω Energy losses include "tail" and diode reverse recovery	-	47	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	250	-	
Fall time	t_f		-	150	-	
Total switching loss	E_{ts}		-	1.28	-	mJ
Internal emitter inductance	L_E	Measured 5 mm from package	-	7.5	-	nH
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1.0 MHz See fig. 7	-	1600	-	pF
Output capacitance	C_{oes}		-	130	-	
Reverse transfer capacitance	C_{res}		-	55	-	
Diode reverse recovery time	t_{rr}	T_J = 25 °C, See fig. 14; I_F = 15 A, V_R = 200 V, dI/dt = 200 A/µs	-	42	60	ns
		T_J = 125 °C	-	74	120	
Diode peak reverse recovery charge	I_{rr}	T_J = 25 °C, See fig. 15	-	4.0	6.0	A
		T_J = 125 °C	-	6.5	10	
Diode reverse recovery charge	Q_{rr}	T_J = 25 °C, See fig. 16	-	80	180	nC
		T_J = 125 °C	-	220	600	
Diode peak rate of fall of recovery during t_b	$dI_{(rec)M}/dt$	T_J = 25 °C, See fig. 17	-	188	-	A/µs
		T_J = 125 °C	-	160	-	

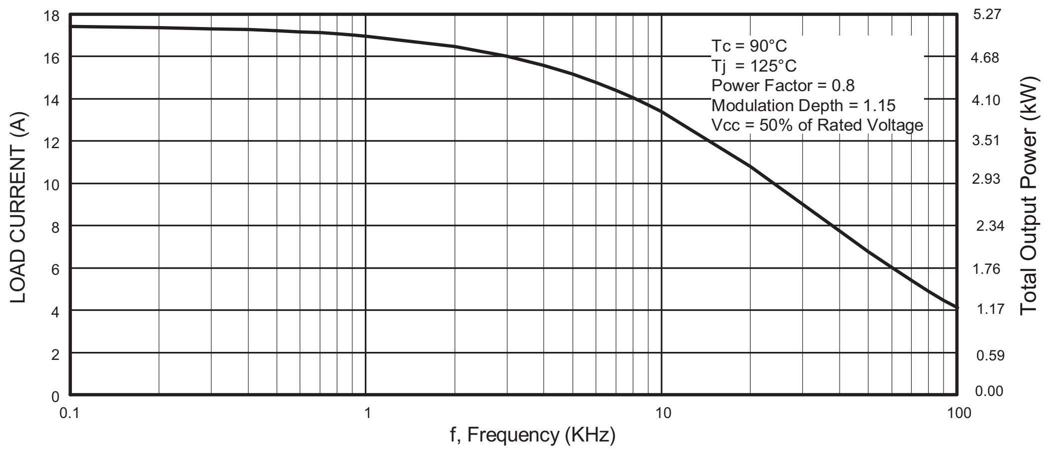


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of Fundamental)

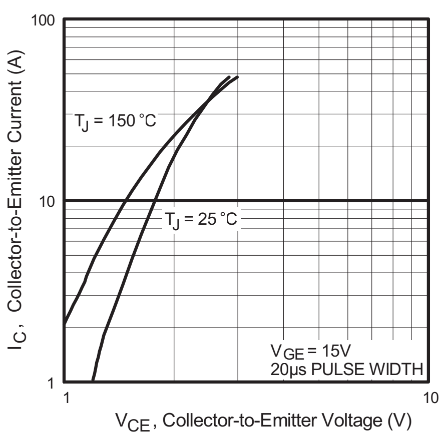


Fig. 2 - Typical Output Characteristics

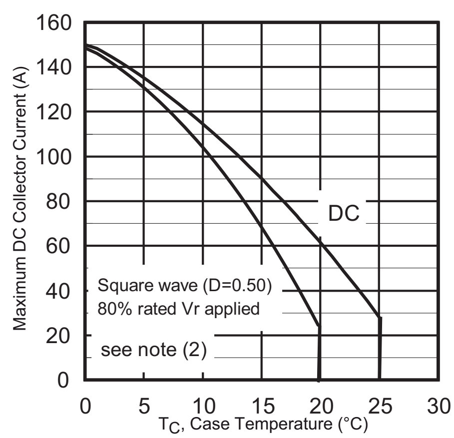


Fig. 4 - Maximum Collector Current vs. Case Temperature

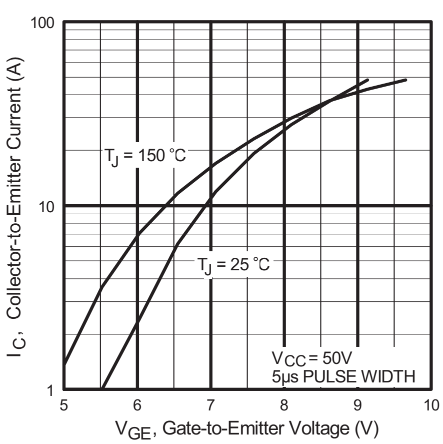


Fig. 3 - Typical Output Characteristics

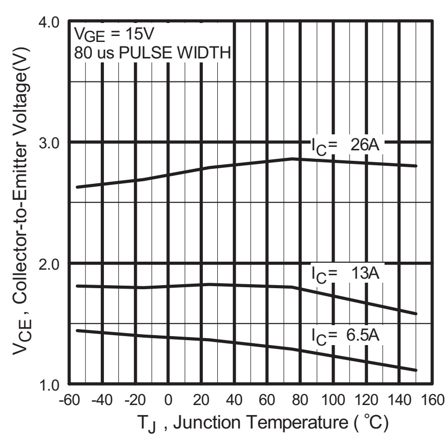


Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

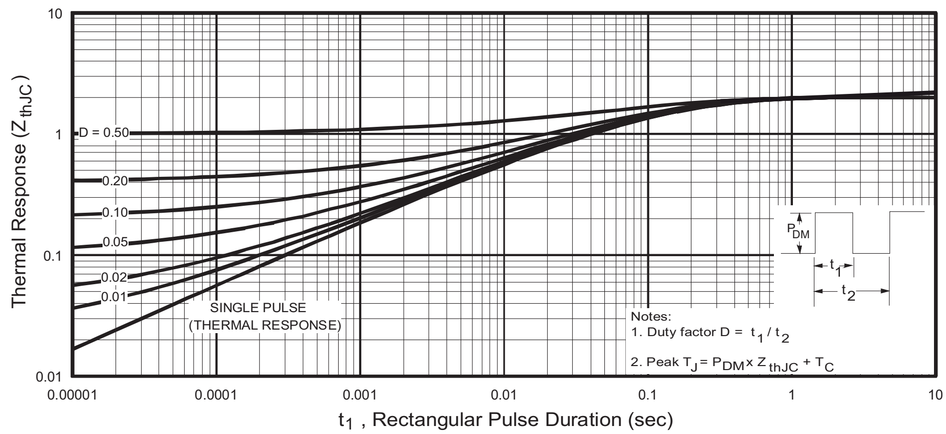


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction to Case

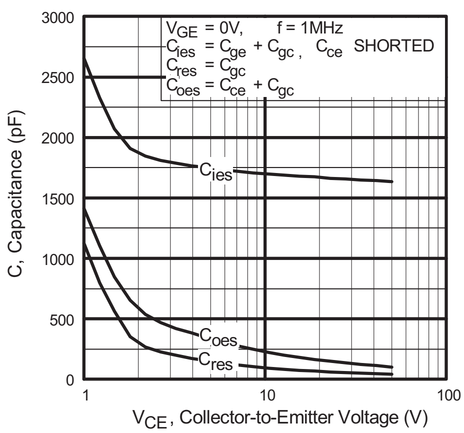


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

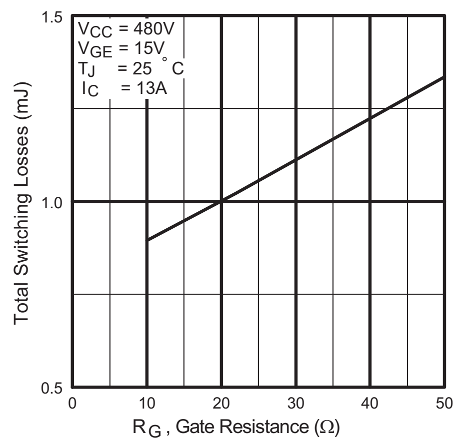


Fig. 9 - Typical Switching Losses vs. Gate Resistance

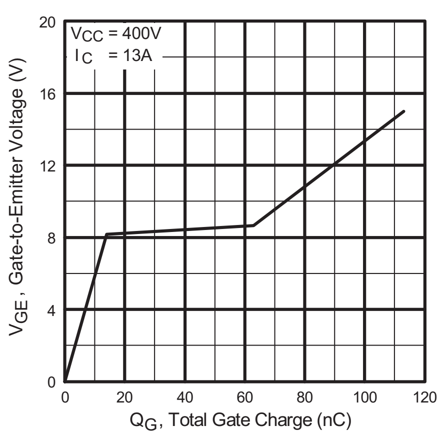


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

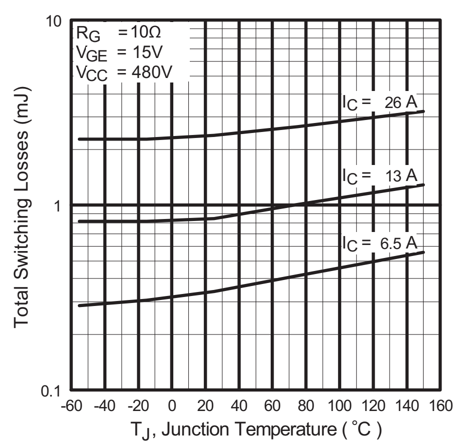


Fig. 10 - Typical Switching Losses vs. Junction Temperature

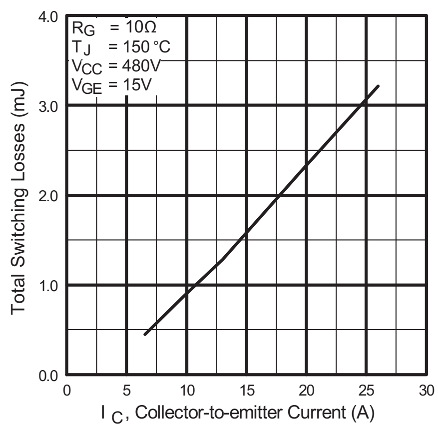


Fig. 11 - Typical Switching Losses vs. Collector to Emitter Current

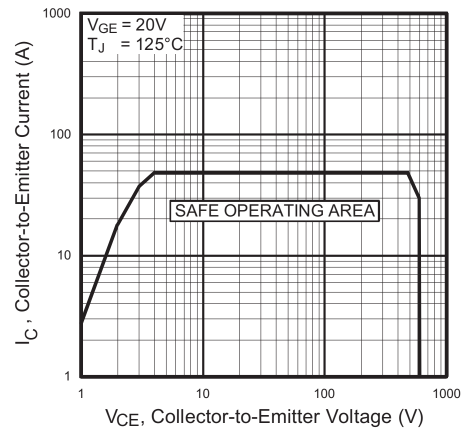


Fig. 12 - Turn-Off SOA

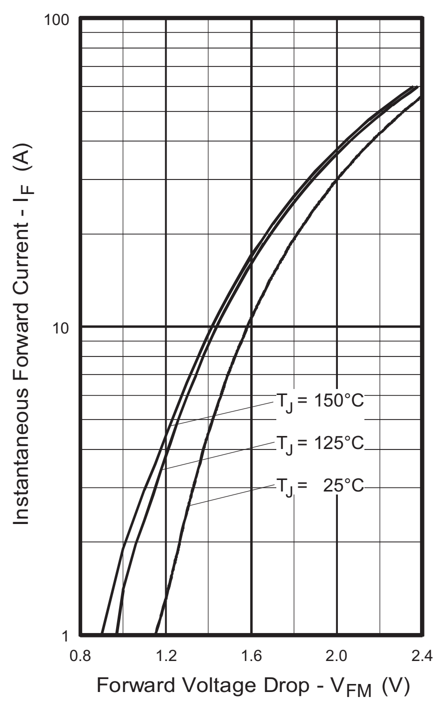


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

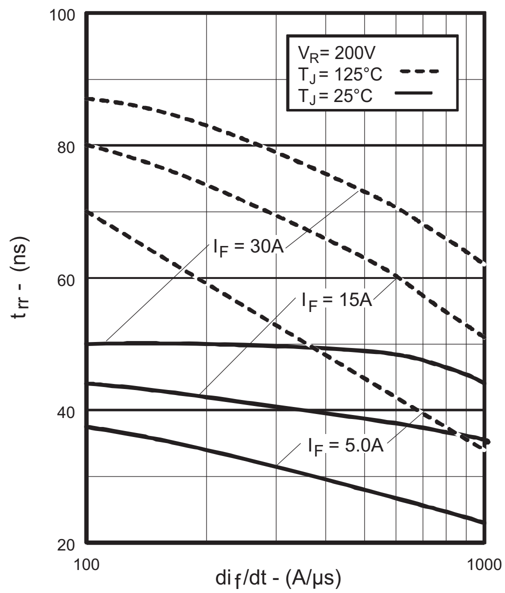


Fig. 14 - Typical Reverse Recovery Time vs. dI_F/dt

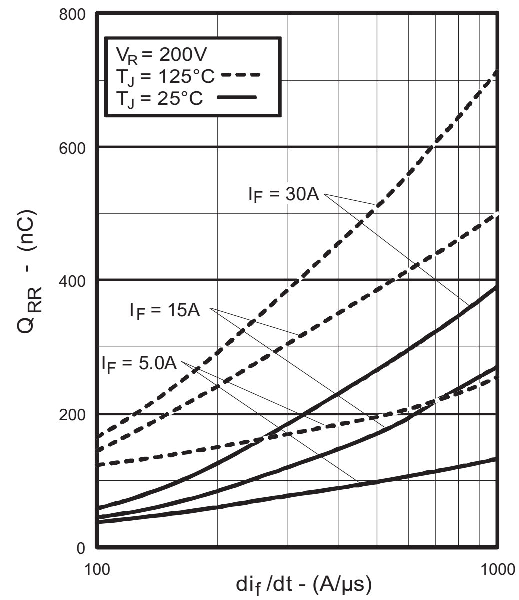


Fig. 16 - Typical Stored Charge vs. dI_F/dt

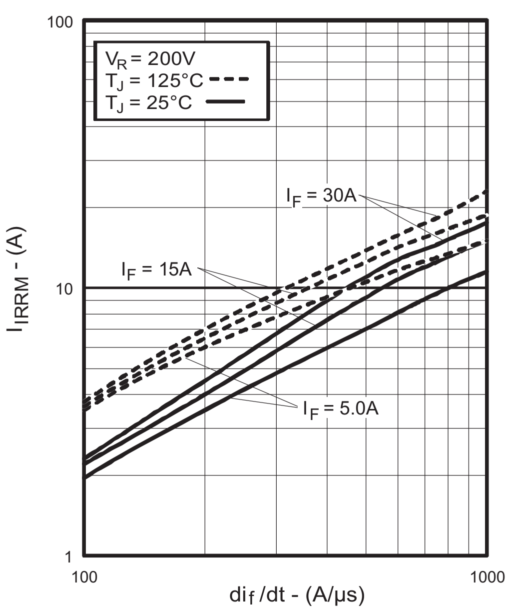


Fig. 15 - Typical Recovery Current vs. dI_F/dt

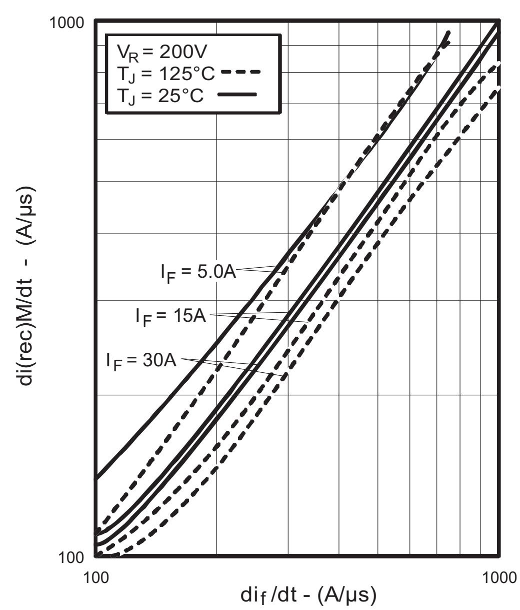


Fig. 17 - Typical $dI_{(rec)M}/dt$ vs dI_F/dt

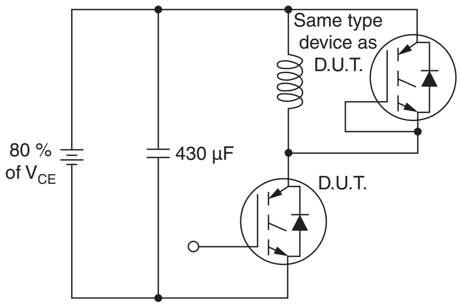


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

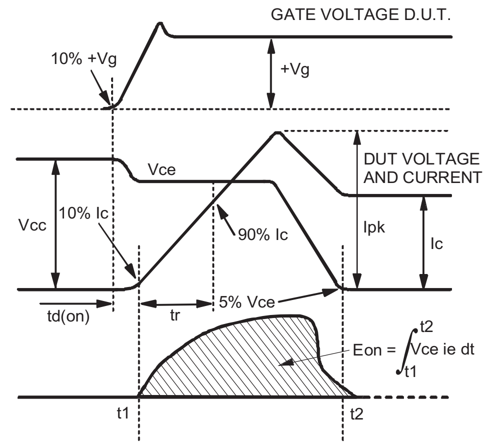


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

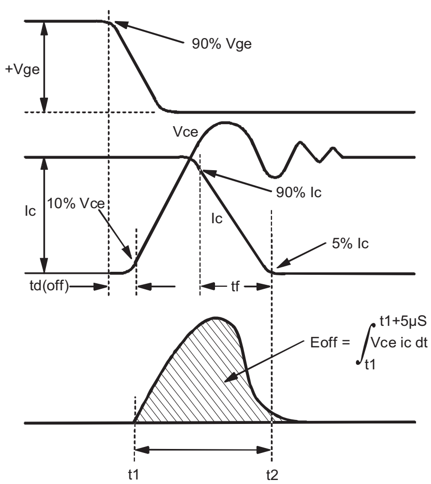


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

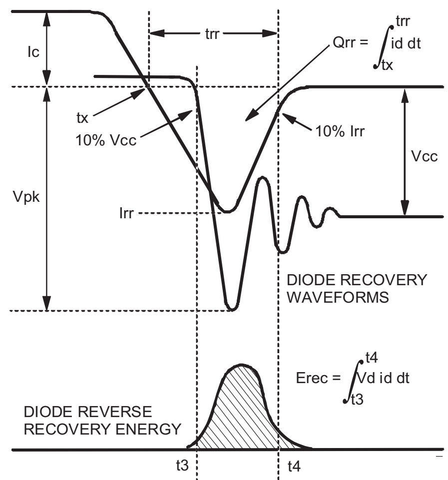


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

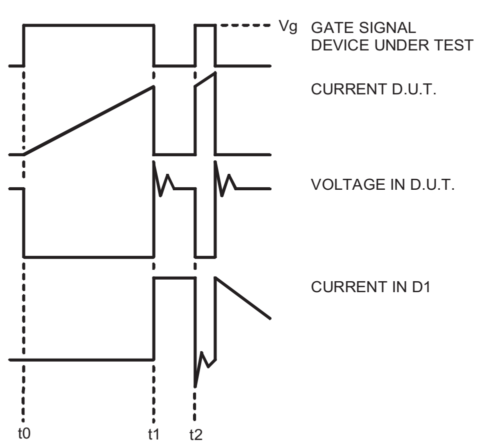


Fig. 18e - Macro Waveforms for Figure 18a's Test Circuit

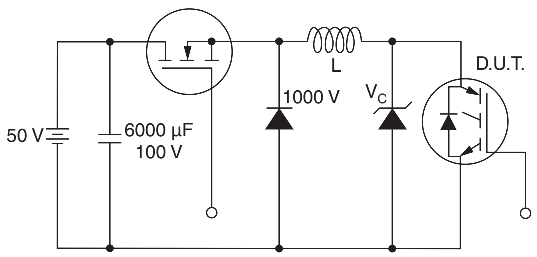


Fig. 19 - Clamped Inductive Load Test Circuit

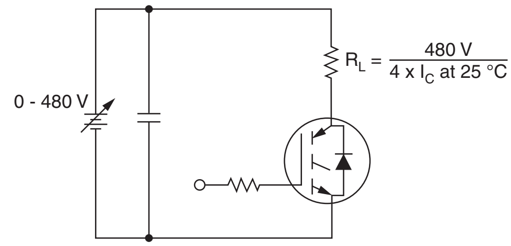
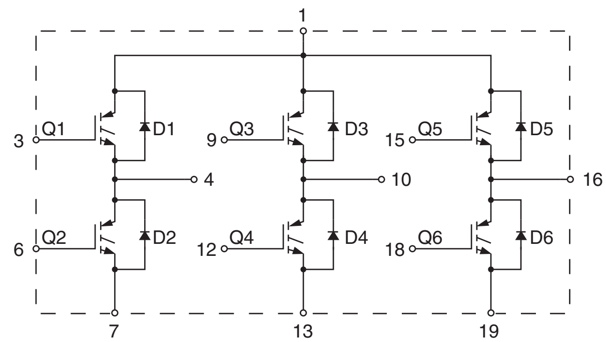


Fig. 20 - Pulsed Collector Current Test Circuit

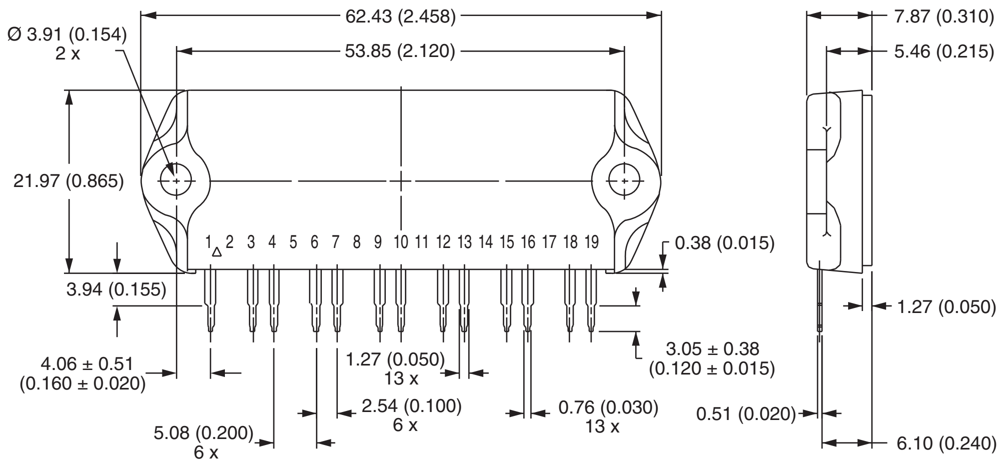
CIRCUIT CONFIGURATION



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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