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IGBT SIP Module (Fast IGBT)

SIP (IMS-2)

PRIMARY CHARACTERISTICS	
OUTPUT CURRENT IN A TYPICAL 5.0 kHz MOTOR DRIVE	
V_{CES}	600 V
I_{RMS} per phase (3.1 kW total) with T_C = 90 °C	11 A
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 = 4.8 A, 25 °C	1.41 V
Speed	1 kHz to 8 kHz
Package	SIP
Circuit configuration	Three phase inverter

FEATURES

- Fully isolated printed circuit board mount package
- Switching-loss rating includes all "tail" losses
- HEXFRED® soft ultrafast diodes
- Optimized for medium speed, see fig. 1 for current vs. frequency curve
- Designed and qualified for industrial level
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

DESCRIPTION

The IGBT technology is the key to the 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	8.8	A
		T_C = 100 °C	4.8	
Pulsed collector current	I_{CM}	Repetitive rating; V_{GE} = 20 V, pulse width limited by maximum junction temperature. See fig. 20	26	
Clamped inductive load current	I_{LM}	V_{CC} = 80 % (V_{CES}), V_{GE} = 20 V, L = 10 μH, R_G = 50 Ω See fig. 19	800	
Diode continuous forward current	I_F	T_C = 100 °C	3.4	
Diode maximum forward current	I_{FM}		26	
Gate to emitter voltage	V_{GE}		± 20	V
Isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	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		For 10 s	300 (0.063" (1.6 mm) from case)	
Mounting torque		6-32 or M3 screw	5 to 7 (0.55 to 0.8)	lbf · in (N · m)

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 in conduction	R_{thJC} (diode)	-	9.0	
Case to sink, flat, greased surface	R_{thCS} (module)	0.1	-	
Weight of module		20 (0.7)	-	g (oz.)

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 250 μA Pulse width ≤ 80 μs, duty factor ≤ 0.1 %	600	-	-	V
Temperature coeff. of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 1.0 mA	-	0.72	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	I_C = 4.8 A; V_{GE} = 15 V, See fig. 2, 5	-	1.41	1.7	V
		I_C = 8.8 A; V_{GE} = 15 V, See fig. 2, 5	-	1.66	-	
		I_C = 4.8 A, T_J = 150 °C; V_{GE} = 15 V, See fig. 2, 5	-	1.42	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 μA	3.0	-	6.0	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 100	nA
Temperature coeff. of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{GE} = 0 V, I_C = 1.0 mA	-	-11	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 100 V, I_C = 4.8 A Pulse width 5.0 μs; single shot	2.9	5.0	-	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	-	-	1700	
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; See fig. 13	-	1.3	1.6	

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 = 4.8 A V_{CC} = 400 V See fig. 8	-	30	45	nC
Gate to emitter charge (turn on)	Q_{ge}		-	4.0	6.0	
Gate to collector charge	Q_{gc}		-	13	20	
Turn-on delay time	$t_{d(on)}$	T_J = 25 °C I_C = 4.8 A, V_{CC} = 480 V V_{GE} = 15 V, R_G = 50 Ω Energy losses include "tail" and diode reversev recovery. See fig. 9, 10, 18	-	49	-	ns
Rise time	t_r		-	22	-	
Turn-off delay time	$t_{d(off)}$		-	200	300	
Fall time	t_f		-	214	320	
Turn-on switching loss	E_{on}		-	0.23	-	mJ
Turn-off switching loss	E_{off}		-	0.33	-	
Total switching loss	E_{ts}		-	0.45	0.70	
Turn-on delay time	$t_{d(on)}$	T_J = 150 °C, I_C = 4.8 A, V_{CC} = 480 V V_{GE} = 15 V, R_G = 50 Ω Energy losses include "tail" and diode reverse recovery See fig. 10, 11, 18	-	48	-	ns
Rise time	t_r		-	25	-	
Turn-off delay time	$t_{d(off)}$		-	435	-	
Fall time	t_f		-	364	-	
Total switching loss	E_{ts}		-	0.93	-	mJ
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V See fig. 7	-	340	-	pF
Output capacitance	C_{oes}		-	63	-	
Reverse transfer capacitance	C_{res}		-	5.9	-	
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	-	55	90	
Diode peak reverse recovery current	I_{rr}	T_J = 25 °C; See fig. 15	-	3.5	50	A
		T_J = 125 °C	-	4.5	8.0	
Diode reverse recovery charge	Q_{rr}	T_J = 25 °C; See fig. 16	-	65	138	nC
		T_J = 125 °C	-	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	-	210	-	

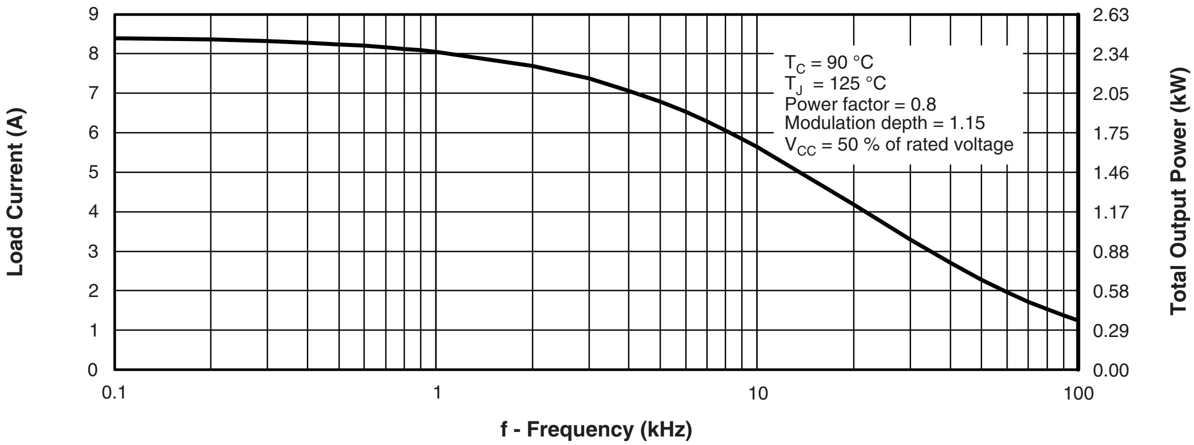


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of Fundamental)

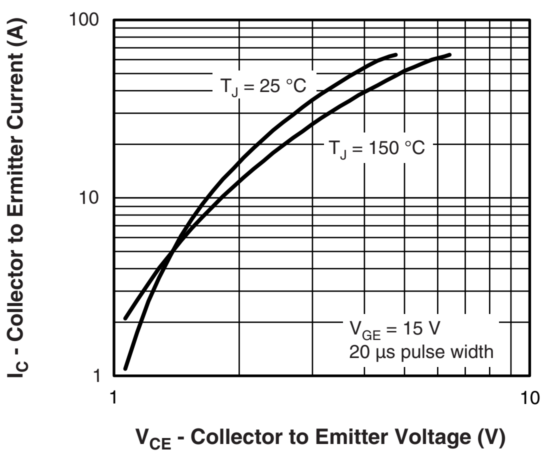


Fig. 2 - Typical Output Characteristics

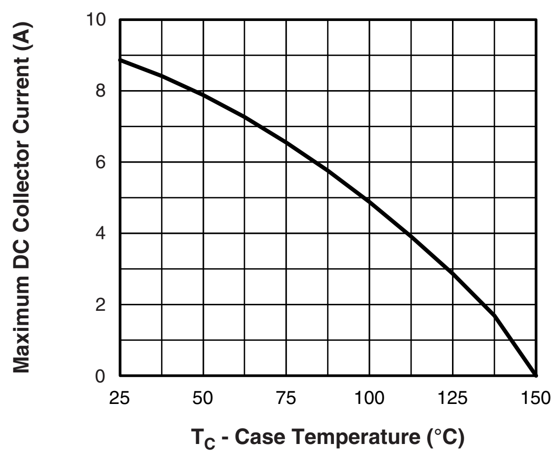


Fig. 4 - Maximum Collector Current vs.
Case Temperature

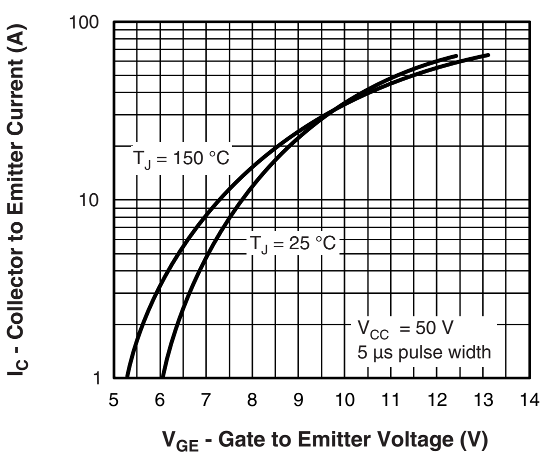


Fig. 3 - Typical Transfer Characteristics

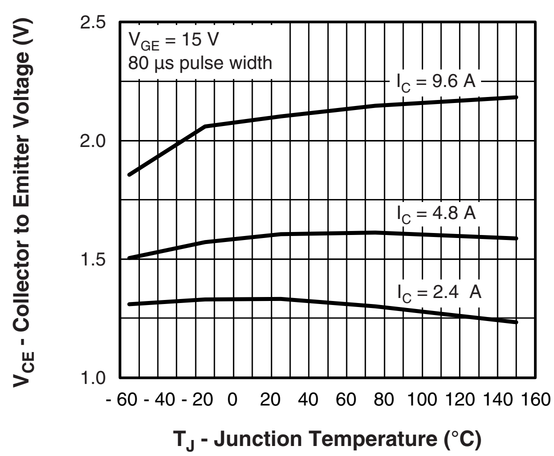


Fig. 5 - Typical Collector to Emitter Voltage vs.
Junction Temperature

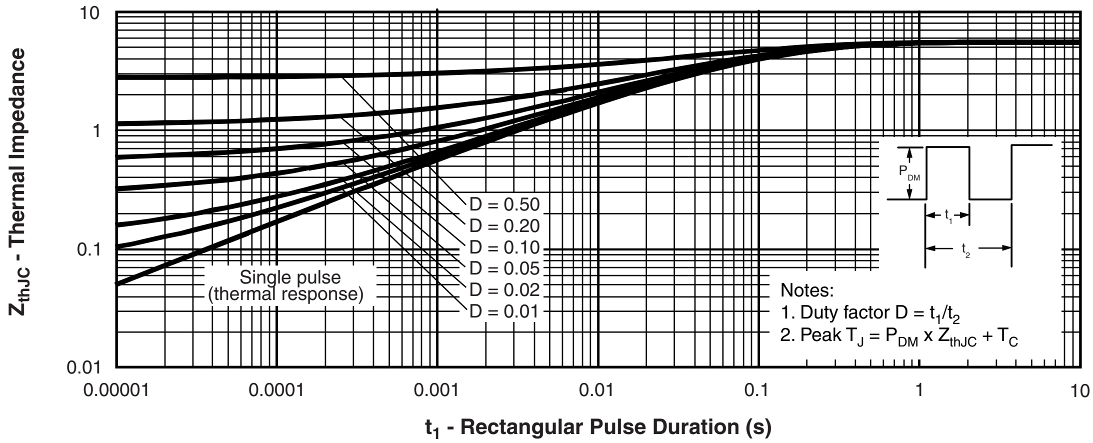


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

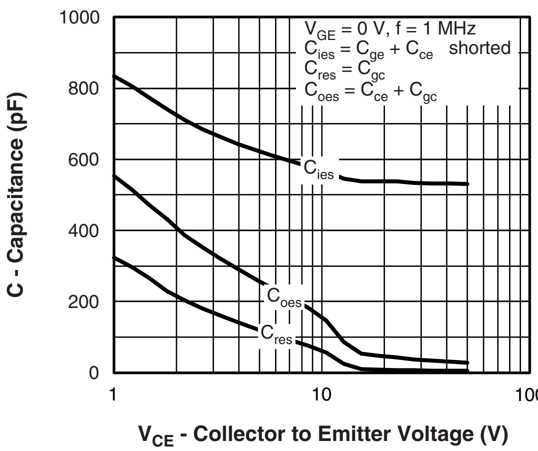


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

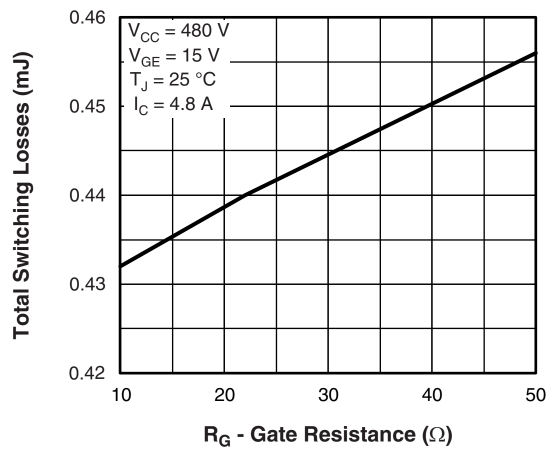


Fig. 9 - Typical Switching Losses vs. Gate Resistance

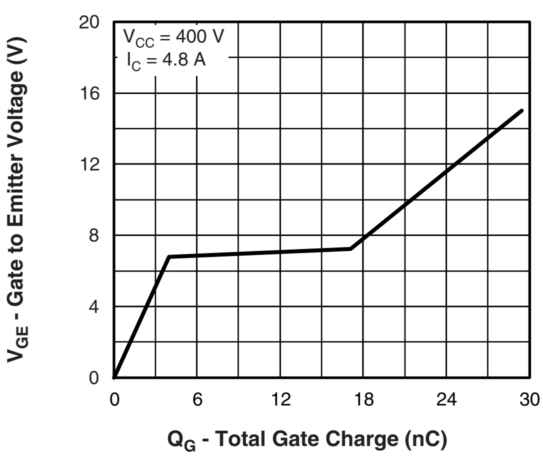


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

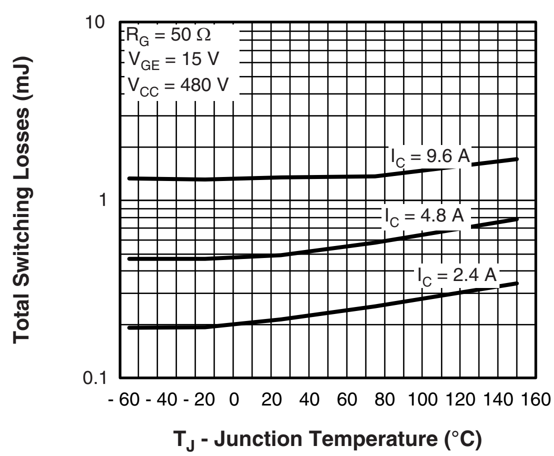


Fig. 10 - Typical Switching Losses vs. Junction Temperature

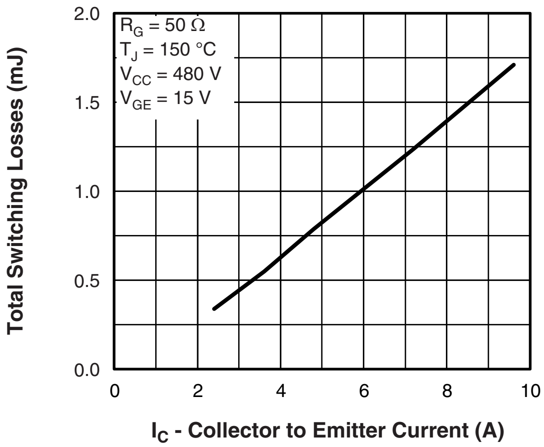


Fig. 11 - Typical Switching Losses vs. Collector to Emitter Current

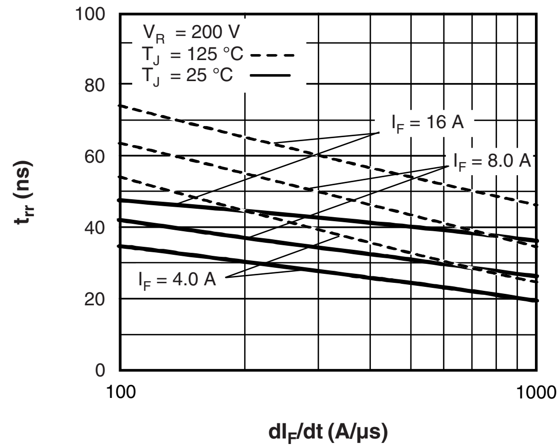


Fig. 14 - Typical Reverse Recovery Time vs. dI_F/dt

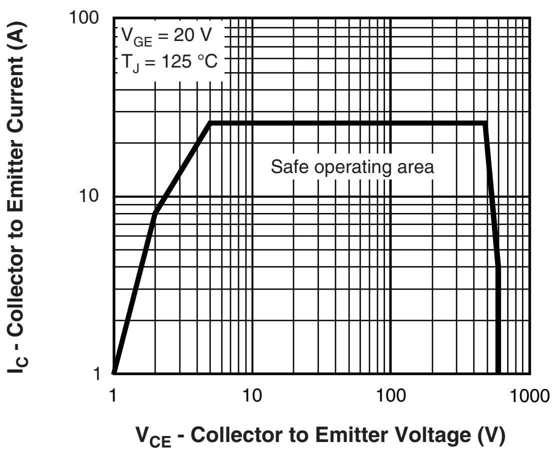


Fig. 12 - Turn-Off SOA

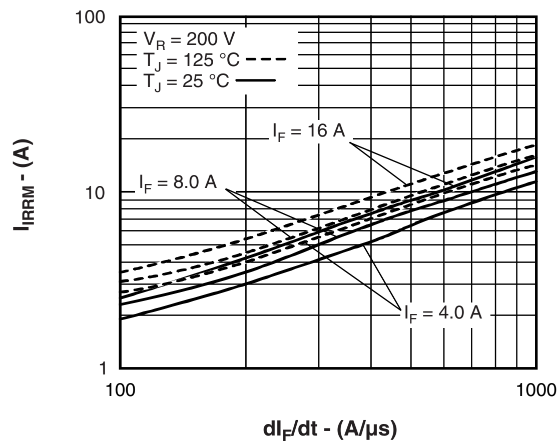


Fig. 15 - Typical Recovery Current vs. dI_F/dt

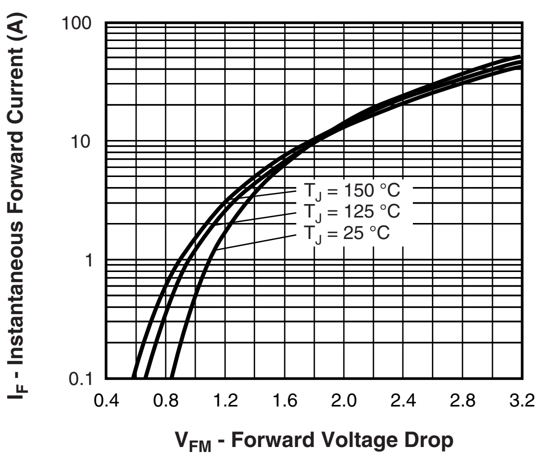


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

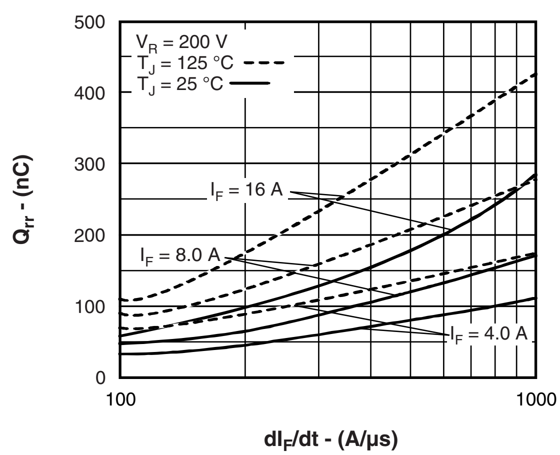


Fig. 16 - Typical Stored Charge vs. dI_F/dt

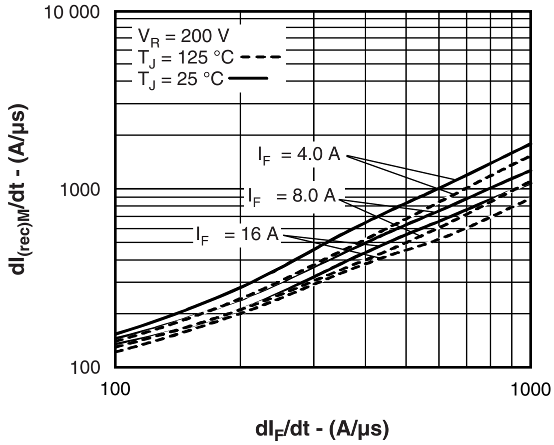


Fig. 17 - Typical $dI_{(REC)M}/dt$ vs dI_F/dt

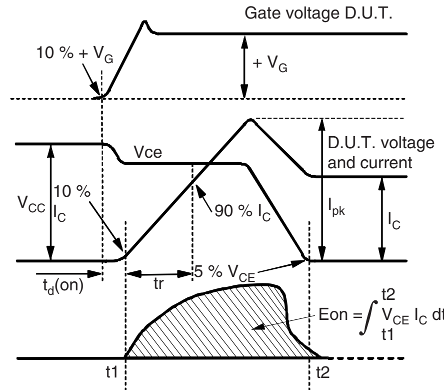


Fig. 18c - Test Waveforms of Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

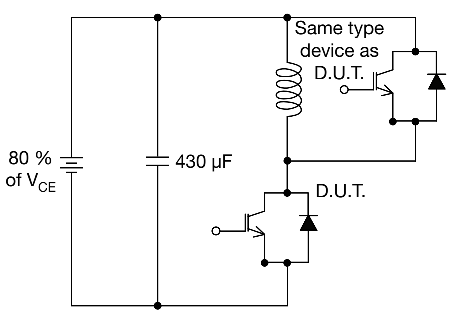


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

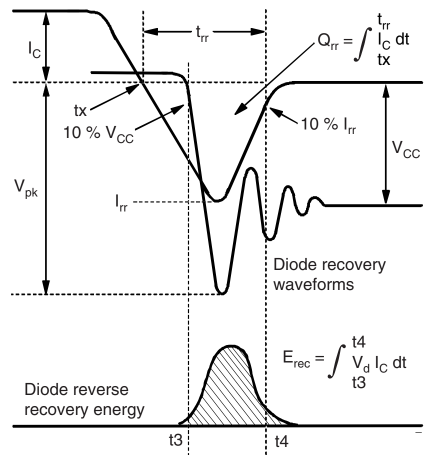


Fig. 18d - Test Waveforms of Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

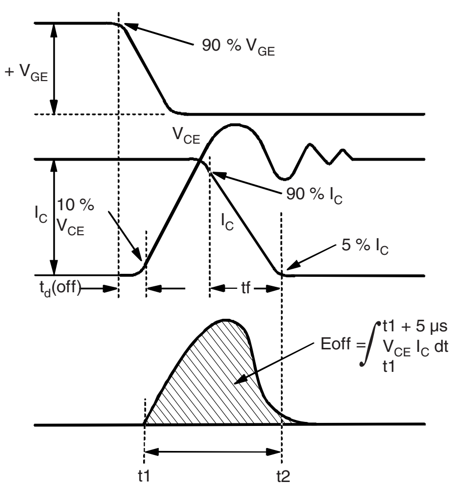


Fig. 18b - Test Waveforms of Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

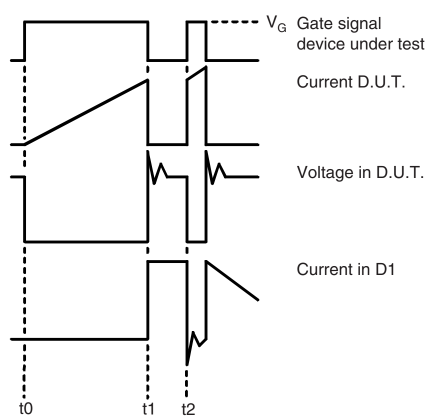


Fig. 18e - Macro Waveforms for Figure 18a's Test Circuit

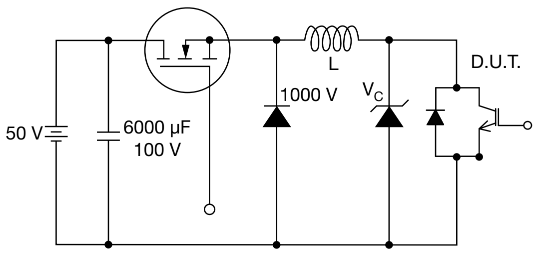


Fig. 19 - Clamped Inductive Load Test Circuit

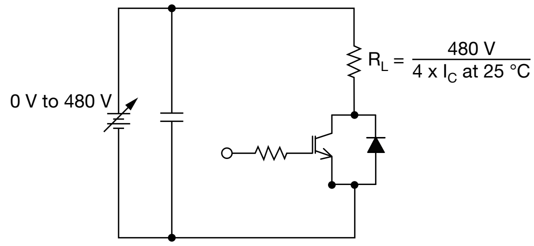
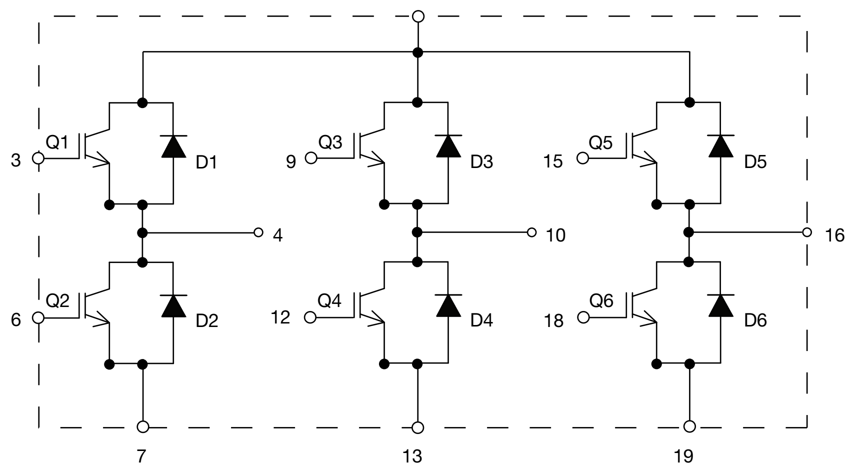


Fig. 20 - Pulsed Collector Current Test Circuit

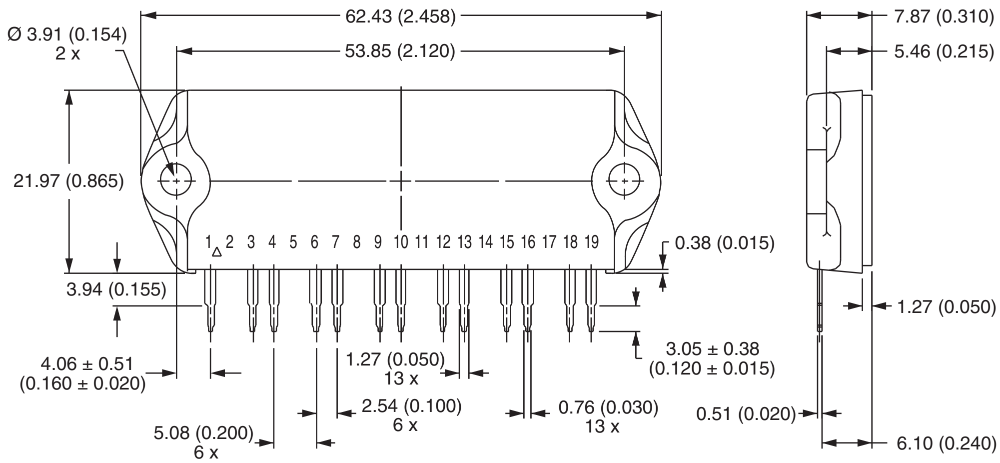
CIRCUIT CONFIGURATION



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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