International Rectifier

PD - 9.1134

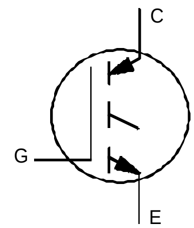
IRGBC40K-S

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
UltraFast Fast IGBT

Features

- Short circuit rated - 10µs @ 125°C, V_{GE} = 15V
- Switching-loss rating includes all "tail" losses
- Optimized for high operating frequency (over 5kHz) See Fig. 1 for Current vs. Frequency curve



n-channel

V_{CES} = 600V

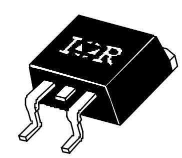
$V_{CE(sat)} \leq$ 3.2V

@V_{GE} = 15V, I_C = 25A

Description

Insulated Gate Bipolar Transistors (IGBTs) from International Rectifier have higher usable current densities than comparable bipolar transistors, while at the same time having simpler gate-drive requirements of the familiar power MOSFET. They provide substantial benefits to a host of high-voltage, high-current applications.

These new short circuit rated devices are especially suited for motor control and other applications requiring short circuit withstand capability.


SMD-220

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	42	A
I_C @ T_C = 100°C	Continuous Collector Current	25	
I_{CM}	Pulsed Collector Current ①	84	
I_{LM}	Clamped Inductive Load Current ②	84	
t_{sc}	Short Circuit Withstand Time	10	µs
V_{GE}	Gate-to-Emitter Voltage	±20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	15	mJ
P_D @ T_C = 25°C	Maximum Power Dissipation	160	W
P_D @ T_C = 100°C	Maximum Power Dissipation	65	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	------	------	0.77	°C/W
$R_{\theta JA}$	Junction-to-Ambient, (PCB mount)**	------	------	40	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	------	------	80	
Wt	Weight	------	2 (0.07)	------	g (oz)

** When mounted on 1" square PCB (FR-4 or G-10 Material)
For recommended footprint and soldering techniques refer to application note #AN-994.

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	----	----	V	V_{GE} = 0V, I_C = 250µA
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	20	----	----	V	V_{GE} = 0V, I_C = 1.0A
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.46	----	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	2.1	3.2	V	I_C = 25A; V_{GE} = 15V
		----	2.8	----		I_C = 42A; See Fig. 2, 5
		----	2.5	----		I_C = 25A, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	----	5.5		V_{CE} = V_{GE}, I_C = 250µA
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	----	-13	----	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance ⑤	7.0	14	----	S	V_{CE} = 100V, I_C = 25A
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	µA	V_{GE} = 0V, V_{CE} = 600V
		----	----	1000		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	----	----	±100	nA	V_{GE} = ±20V

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	----	61	92	nC	I_C = 25A
Q_{ge}	Gate - Emitter Charge (turn-on)	----	13	19		V_{CC} = 400V See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	22	33		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	----	35	----	ns	T_J = 25°C
t_r	Rise Time	----	27	----		I_C = 25A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	----	160	240		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	----	130	200		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	----	0.52	----	mJ	See Fig. 9, 10, 11, 14
E_{off}	Turn-Off Switching Loss	----	1.2	----		
E_{ts}	Total Switching Loss	----	1.7	2.6		
t_{sc}	Short Circuit Withstand Time	10	----	----	µs	V_{CC} = 360V, T_J = 125°C V_{GE} = 15V, R_G = 10Ω, V_{CPK} < 500V
$t_{d(on)}$	Turn-On Delay Time	----	34	----	ns	T_J = 150°C,
t_r	Rise Time	----	28	----		I_C = 25A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	----	300	----		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	----	310	----		Energy losses include "tail"
E_{ts}	Total Switching Loss	----	3.6	----	mJ	See Fig. 10, 14
L_E	Internal Emitter Inductance	----	7.5	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	1500	----	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	----	190	----		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	17	----		f = 1.0MHz

Notes:

① Repetitive rating; V_{GE}=20V, pulse width limited by max. junction temperature. (See fig. 13b)

② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G= 10Ω, (See fig. 13a)

③ Repetitive rating; pulse width limited by maximum junction temperature.

④ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

⑤ Pulse width 5.0µs, single shot.

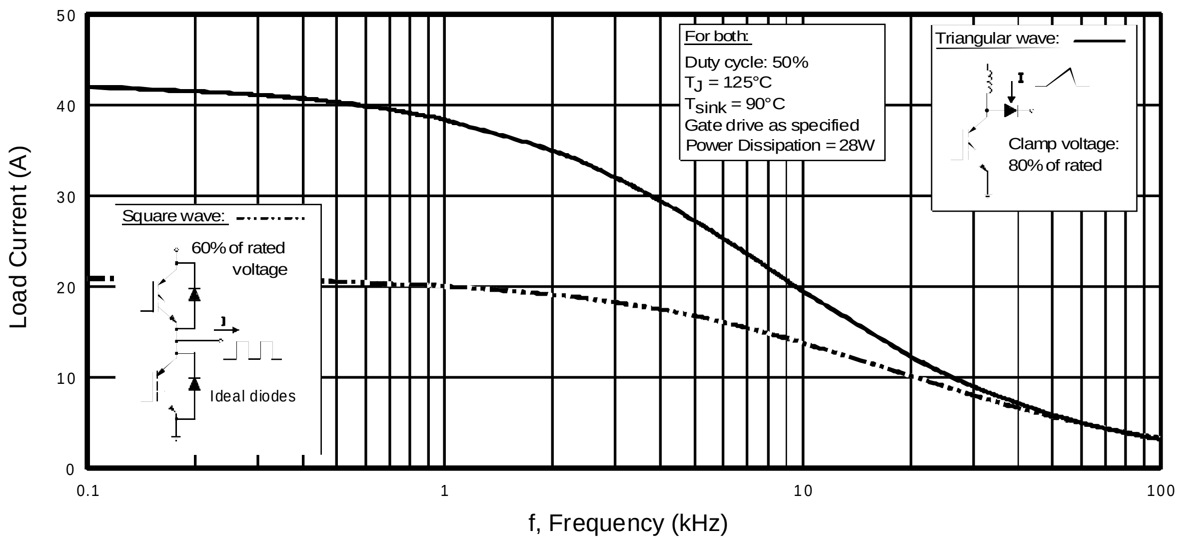


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

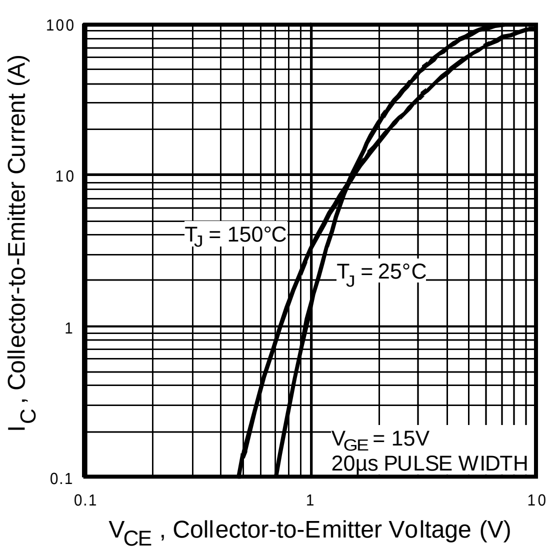


Fig. 2 - Typical Output Characteristics

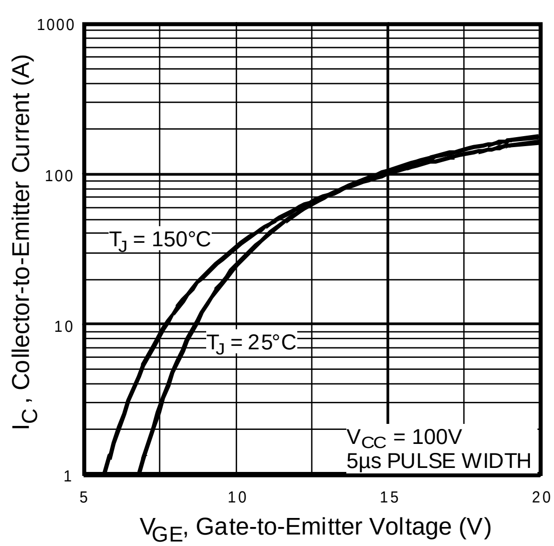


Fig. 3 - Typical Transfer Characteristics

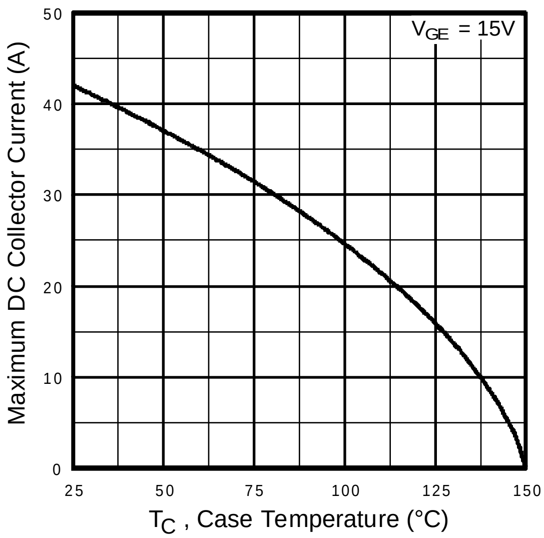


Fig. 4 - Maximum Collector Current vs. Case Temperature

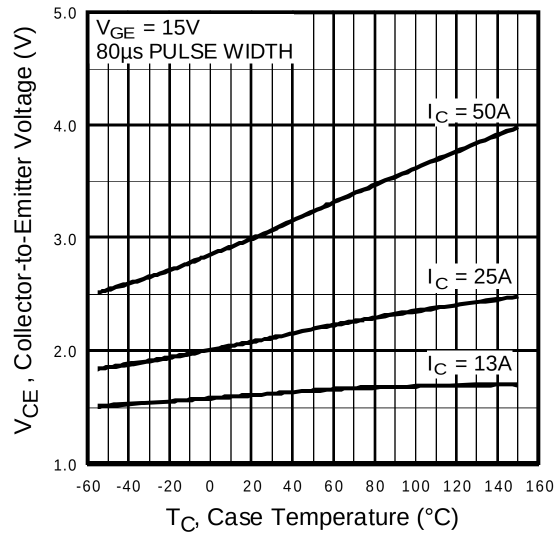


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

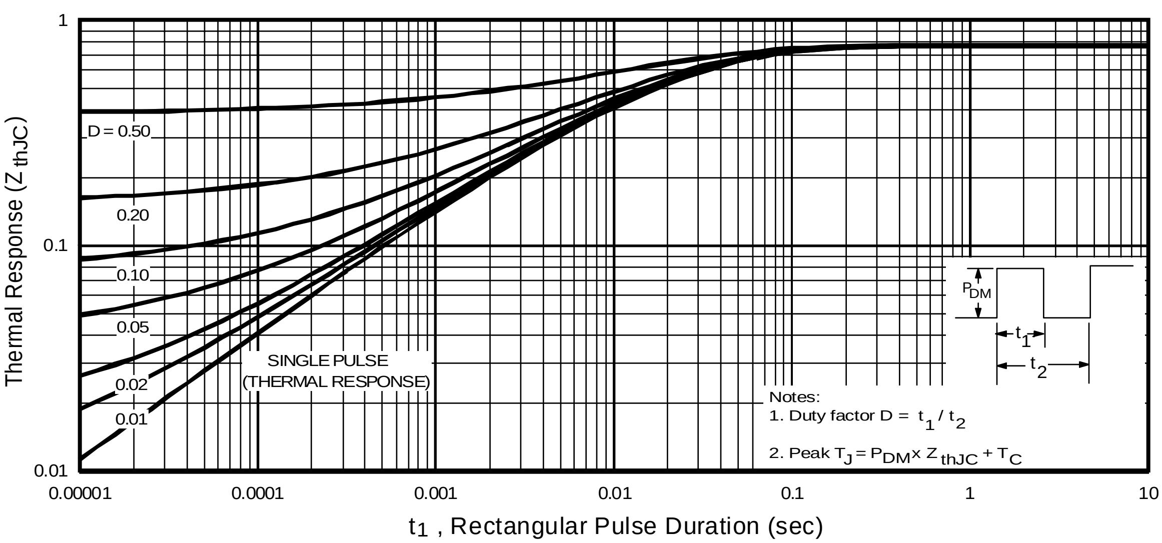


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

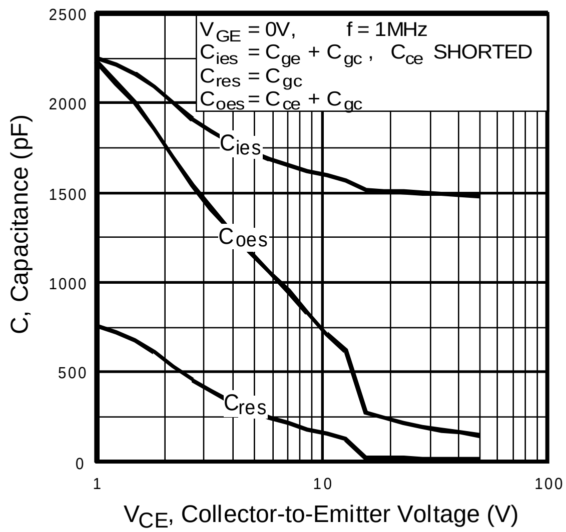


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

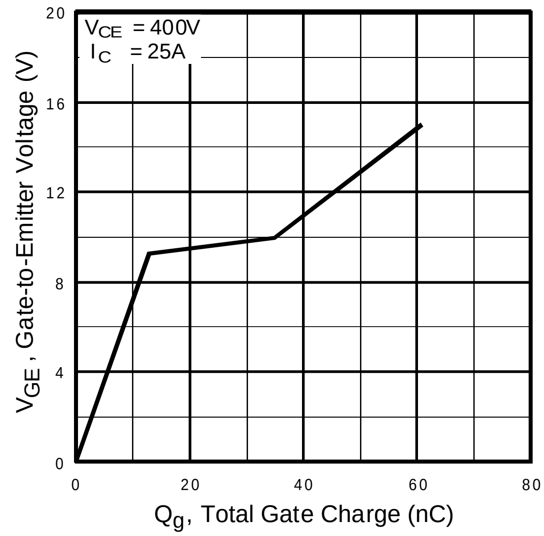


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

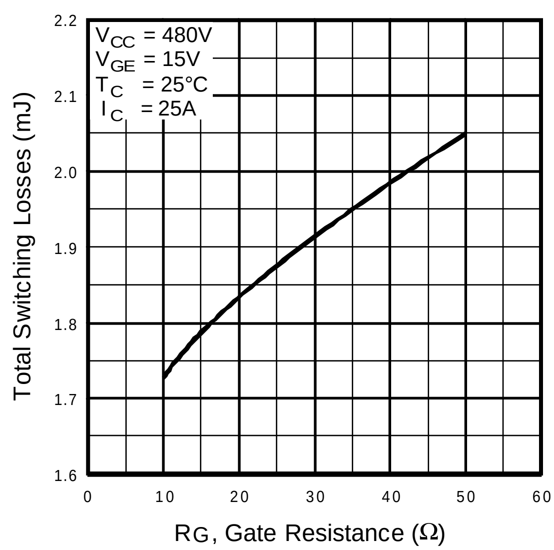


Fig. 9 - Typical Switching Losses vs. Gate Resistance

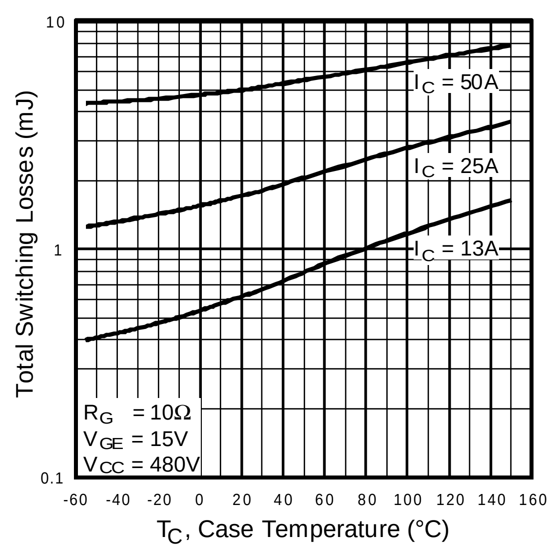


Fig. 10 - Typical Switching Losses vs. Case Temperature

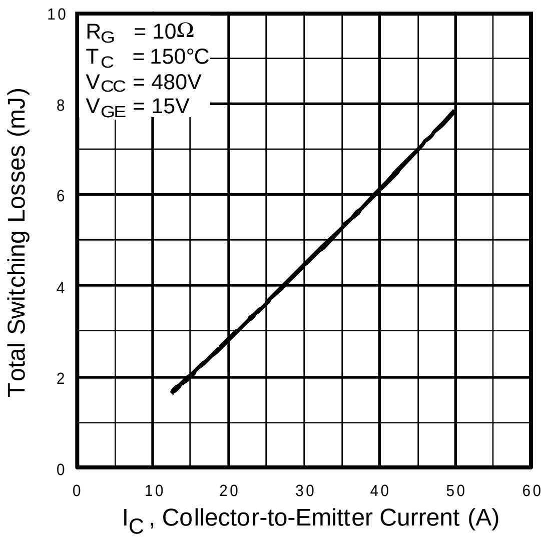


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

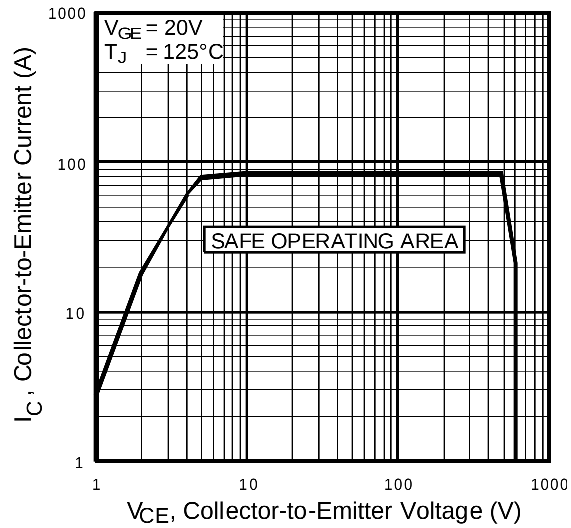
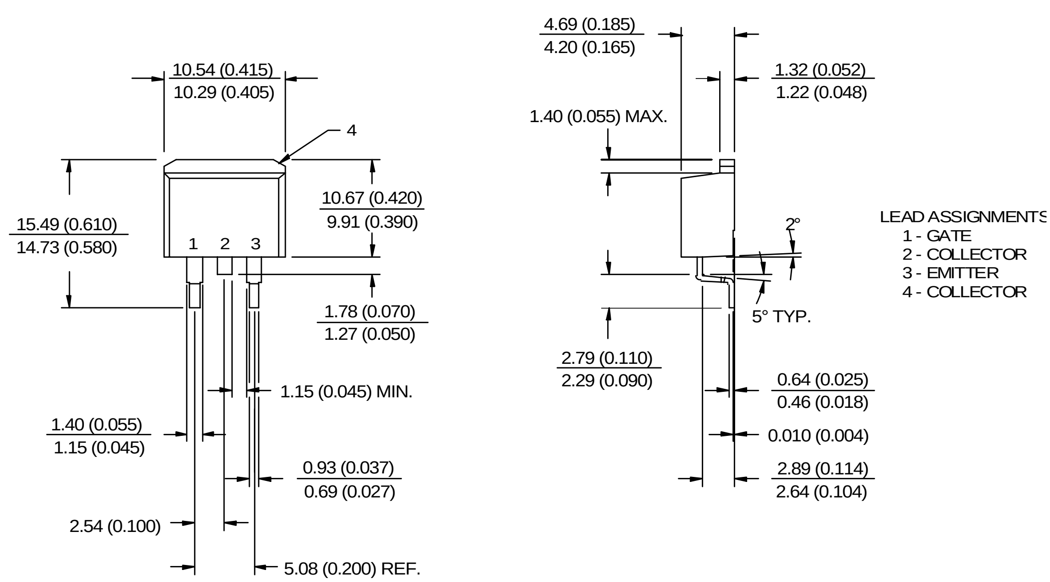
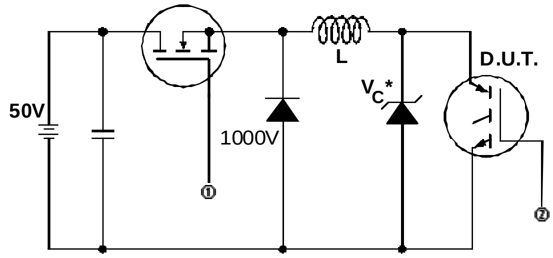


Fig. 12 - Turn-Off SOA



OUTLINE SMD-220

Dimensions in Millimeters and (Inches)



* Driver same type as D.U.T.; Vc = 80% of Vce(max)
* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated Id.

Fig. 13a - Clamped Inductive Load Test Circuit

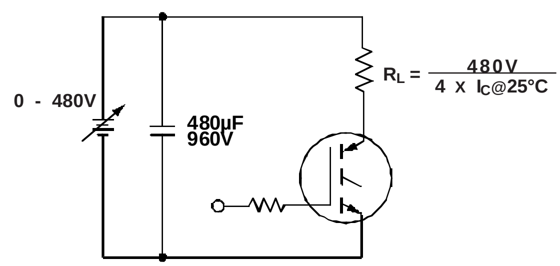


Fig. 13b - Pulsed Collector Current Test Circuit

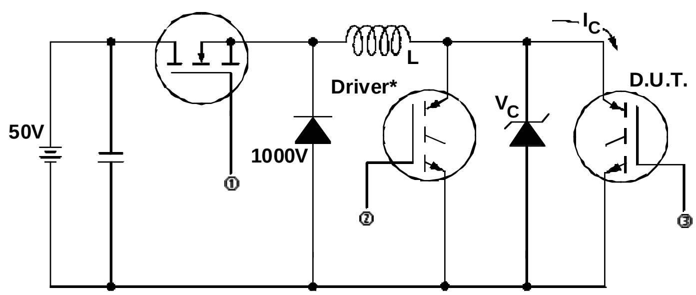


Fig. 14a - Switching Loss Test Circuit

*** Driver same type as D.U.T., VC = 480V**

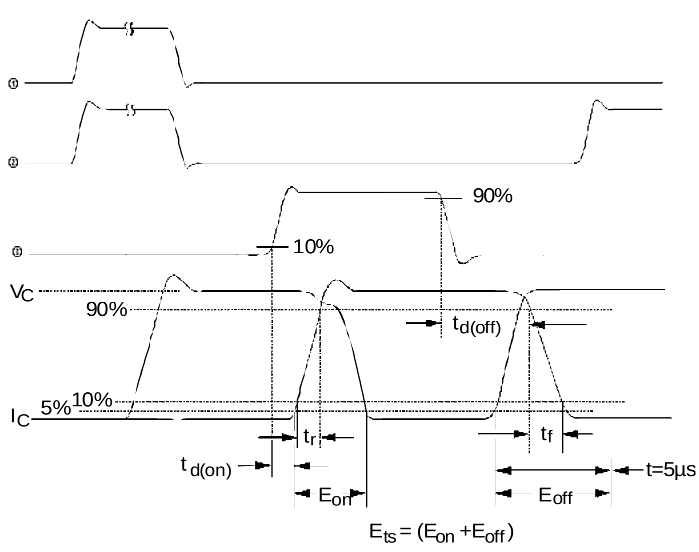


Fig. 14b - Switching Loss Waveforms