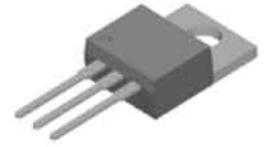
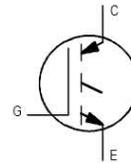


## Features

- High short circuit rating optimized for motor control
- Low conduction losses
- High switching speed
- Tighter parameter distribution

$V_{CES} = 1200\text{ V}$   
 $V_{CE(on) \text{ typ.}} = 4,0\text{ V}$   
 @  $V_{GE} = 15\text{ V}$ ,  $I_C = 10\text{ A}$



TO-220

N-channel

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Units	Max
Collector-to-Emitter Voltage	$V_{CES}$	V	1200
Continuous Collector Current	$I_C @ T_C = 25^\circ\text{C}$	A	10
Continuous Collector Current	$I_C @ T_C = 100^\circ\text{C}$		5
Pulsed Collector Current <sup>1</sup>	$I_{CM}$		22
Clamped Inductive Load Current <sup>2</sup>	$I_{LM}$		22
Short Circuit Withstand Time	tsc	$\mu\text{s}$	10
Maximum Power Dissipation	$P_D @ T_C = 25^\circ\text{C}$	W	60
Maximum Power Dissipation	$P_D @ T_C = 100^\circ\text{C}$		24
Gate-to-Emitter Voltage	$V_{GE}$	V	$\pm 20$
Operating Junction and Storage temperature Range	$T_J$ $T_{STG}$	$^\circ\text{C}$	-55 to +150
Soldering Temperature, for 10 seconds		$^\circ\text{C}$	300

## THERMAL RESISTANCE

Parameter	Symbol	Units	Min	Typ.	Max
Junction-to-Case	$R_{\theta JC}$	$^\circ\text{C/W}$	-	-	2,1
Case-to-Sink, Flat, Greased Surface	$R_{\theta CS}$		-	0,24	-
Junction-to-Ambient, typical socket mount	$R_{\theta JA}$		-	-	40

**ELECTRICAL CHARACTERISTICS (T<sub>j</sub> =25 °C)**

Parameter	Symbol	Units	Test Conditions	Min	Typ.	Max
Collector-to-Emitter Breakdown Voltage	V <sub>(BR)CES</sub>	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	1200	-	-
Emitter-to-Collector Breakdown Voltage	V <sub>(BR)ECS</sub>	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1A	18	-	-
Breakdown Voltage Temp.Coefficient	ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 2,5 mA	-	1,2	-
Collector-to-Emitter Saturation Voltage (See figure 2,5)	V <sub>CE(ON)</sub>	V	V <sub>GE</sub> = 15V, I <sub>C</sub> = 5A	-	3,0	4,3
			V <sub>GE</sub> = 15V, I <sub>C</sub> = 10A	-	4,0	-
			V <sub>GE</sub> = 15V, I <sub>C</sub> = 15A T <sub>J</sub> =150°C	-	2,9	-
Gate Threshold Voltage	V <sub>GE(th)</sub>	V	V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> =250 μA	3,5	-	6,5
Threshold Voltage Temp.Coefficient	ΔV <sub>(GE)th</sub> / ΔT <sub>J</sub>	mV/°C	V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> =1mA	-	-11	-
Forward Transconductance	g <sub>(fe)</sub>	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 5 A	2,3	3,8	-
Zero Gate Voltage Collector Current	I <sub>CES</sub>	μA	V <sub>CE</sub> = 1200V, V <sub>GE</sub> =0V	-	-	250
			V <sub>CE</sub> = 10V, V <sub>GE</sub> =0V T <sub>J</sub> =25°C	-	-	2,0
			V <sub>CE</sub> = 1200V, V <sub>GE</sub> =0V T <sub>J</sub> =150°C	-	-	1000
Gate-to-Emitter Leakage Current	I <sub>GES</sub>	nA	V <sub>GS</sub> = ±20V			±100

**SWITCHING CHARACTERISTICS (T<sub>j</sub> =25 °C)**

Parameter	Symbol	Units	Test Conditions	Min	Typ.	Max
Total Gate Charge (turn on)	Q <sub>g</sub>	nC	V <sub>GE</sub> = 15V, V <sub>CC</sub> = 400V, I <sub>C</sub> =15 A See Figure 8	-	34	43
Gate-to-Emitter Charge (turn on)	Q <sub>ge</sub>			-	5	6,6
Gate-to-Collector Charge (turn on)	Q <sub>gc</sub>			-	14	18
Turn-On Delay Time	t <sub>d(on)</sub>	ns	V <sub>CC</sub> =960V, I <sub>C</sub> =5A V <sub>GE</sub> = 15V R <sub>G</sub> =50 Ω	-	26	-
Rise Time	t <sub>r</sub>			-	29	-
Turn-Off Delay Time	t <sub>d(off)</sub>			-	120	140
Fall Time	t <sub>f</sub>			-	330	400
Turn-On Switching Loss	E <sub>on</sub>	mJ	Energy losses include «tail» See Figure 9,10,14	-	0,6	-
Turn-Off Switching Loss	E <sub>off</sub>			-	0,58	-
Total Switching Loss	E <sub>TS</sub>			-	0,96	1,2
Turn-On Delay Time	t <sub>d(on)</sub>	ns	T <sub>J</sub> =150°C V <sub>CC</sub> =960V, I <sub>C</sub> =5A V <sub>GE</sub> = 15V R <sub>G</sub> =50 Ω Energy losses include «tail» See Figure 10,11,14	-	26	-
Rise Time	t <sub>r</sub>			-	30	-
Turn-Off Delay Time	t <sub>d(off)</sub>			-	140	-
Fall Time	t <sub>f</sub>			-	650	-
Total Switching Loss	E <sub>TS</sub>	mJ		-	2,3	-
Input Capacitance	C <sub>ISS</sub>	pF	V <sub>GE</sub> = 0V, V <sub>CC</sub> = 30V, f = 1.0MHz See Figure 7	-	450	-
Output Capacitance	C <sub>OSS</sub>			-	50	-
Reverse Transfer Capacitance	C <sub>RSS</sub>			-	10	-

**NOTES:**

- <sup>1</sup> Repetitive rating; V<sub>GE</sub> =20V, pulse width limited by max junction temperature.(Fig.13b)
- <sup>2</sup> V<sub>CC</sub>=80%(V<sub>CES</sub>), L= 10 μH, V<sub>GE</sub> = 20V, R<sub>G</sub>=50 Ω,(Fig.13a)
- <sup>3</sup> Pulse width ≤80 μs, duty factor ≤0,1%.
- <sup>4</sup> Pulse width 5,0μs single short.

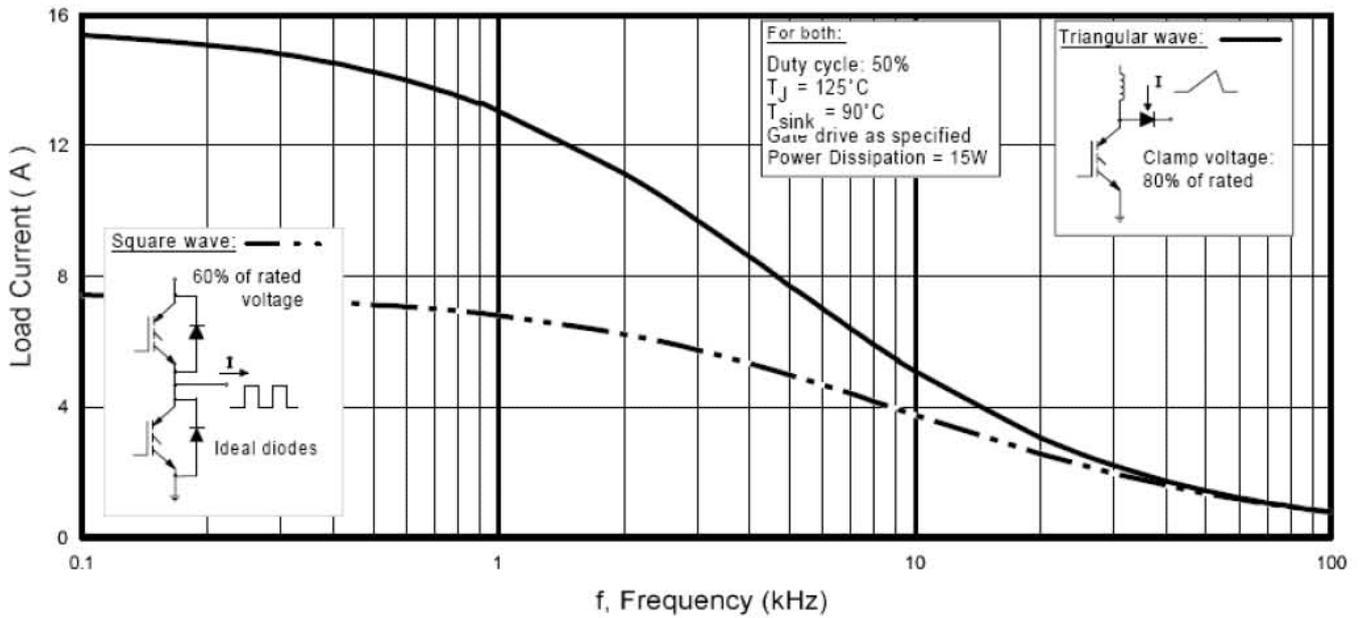


Fig.1- Typical Load Current vs. Frequency  
(Load Current= $I_{RMS}$  of fundamental)

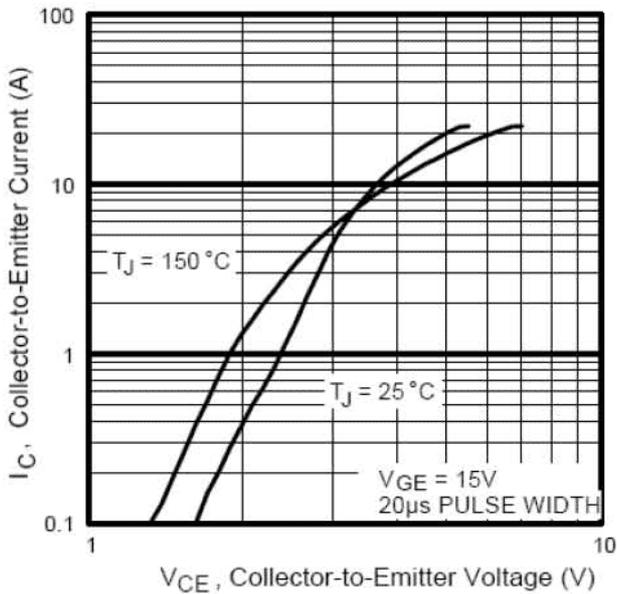


Fig.2-Typical Output Characteristics

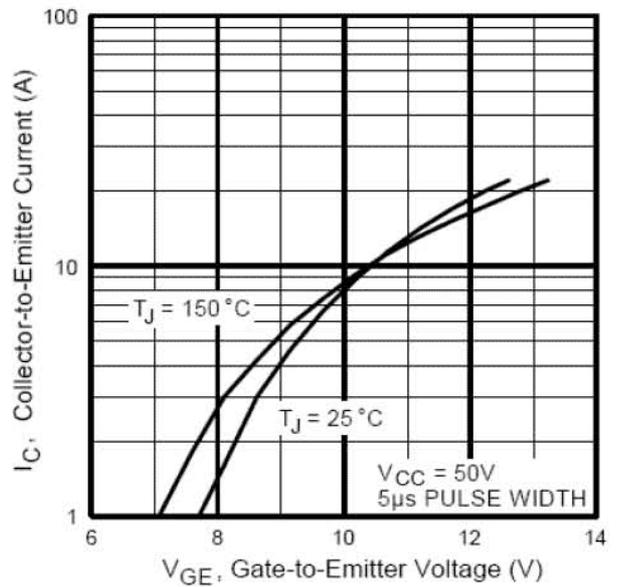


Fig.3 – Typical Transfer Characteristics

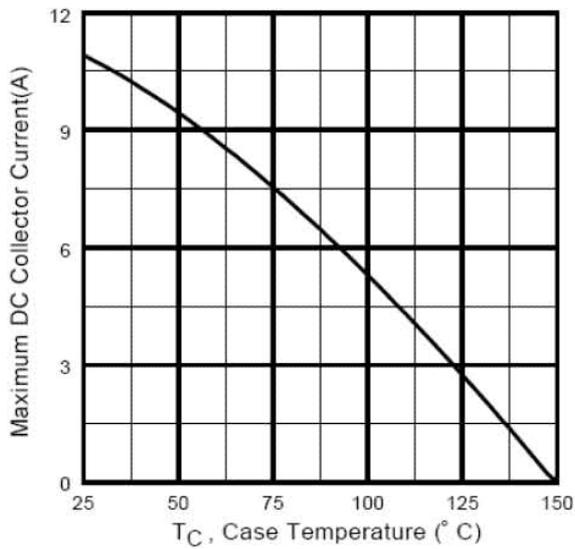


Fig.4 – Maximum Collector Current vs. Case Temperature

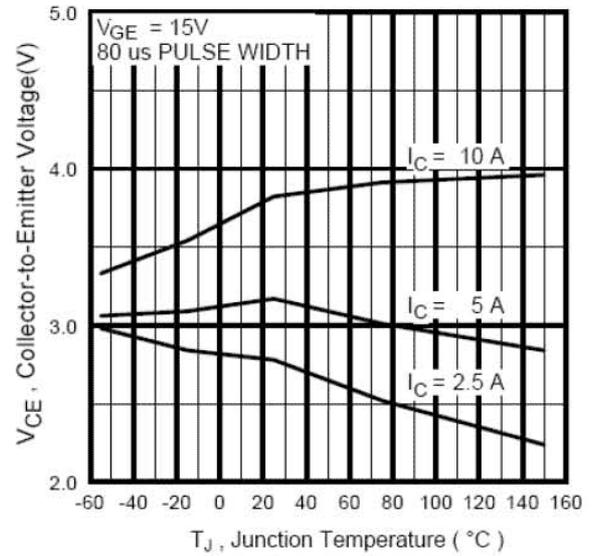


Fig.5 – Typical Collector- to – Emmitter Voltage Vs. Junction Temperature

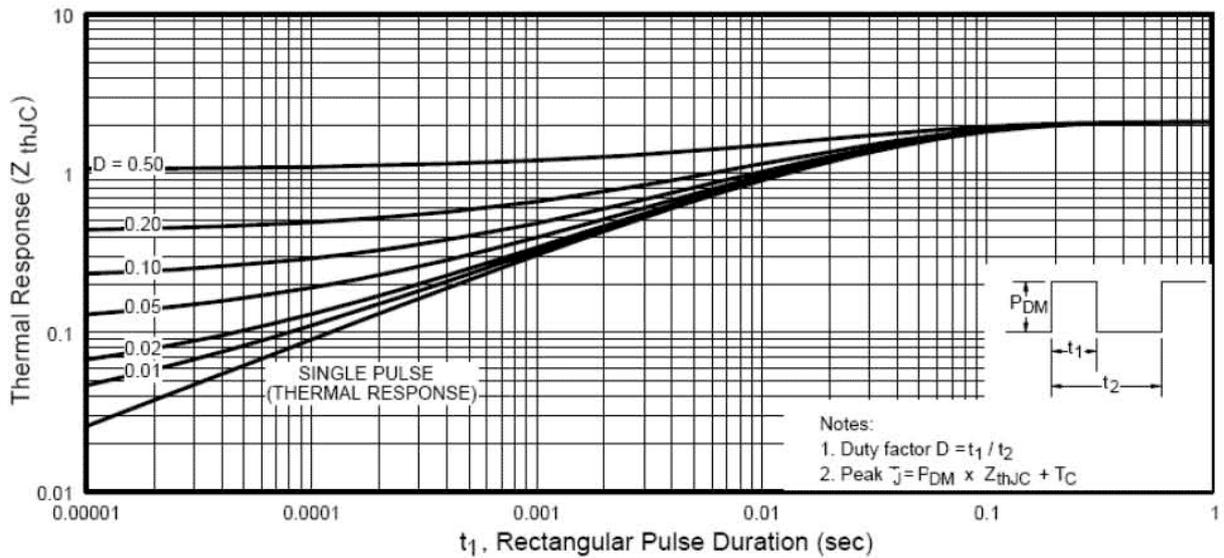


Fig.6 – Maximum Effective Transient Thermal Impedance, Junction-to-Case

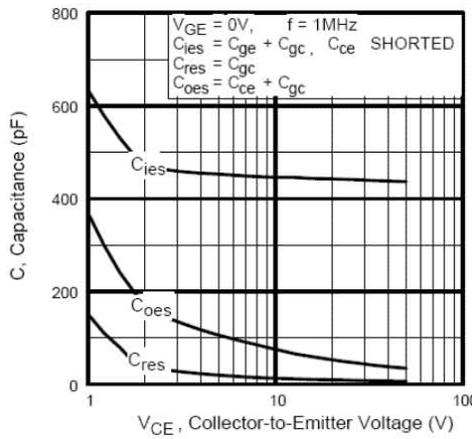


Fig.7 – Typical Capacitance vs. Collector-to-Emitter Voltage

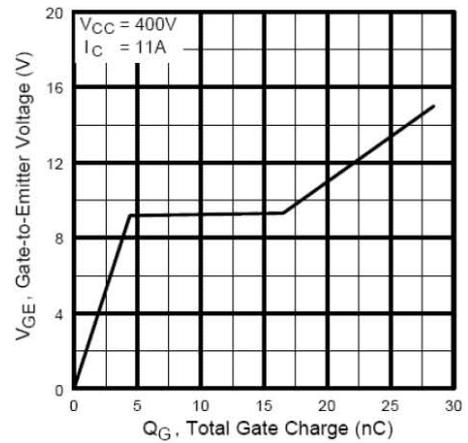


Fig.8 – Typical Gate Charge vs. Gate-to-Emitter Voltage

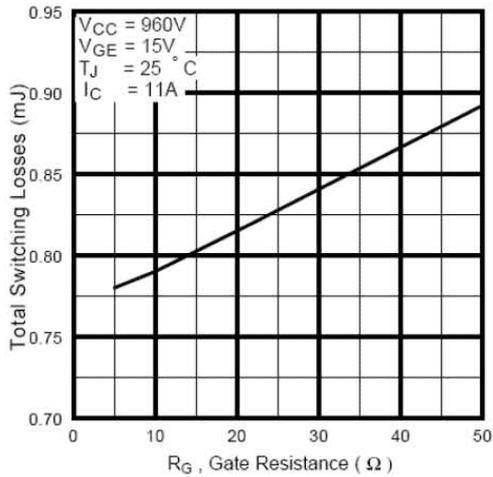


Fig.9-Typical Switching Losses vs. Gate Resistance

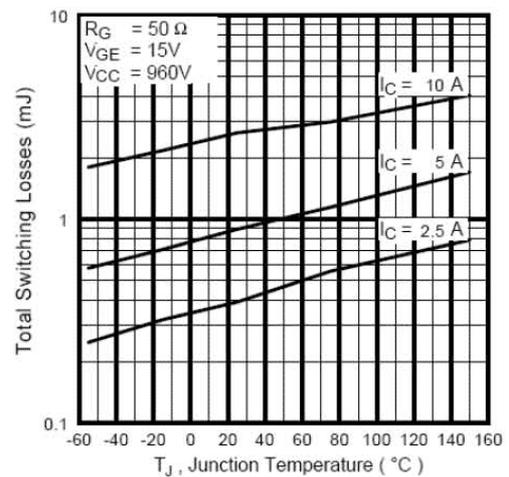


Fig.10 – Typical Switching Losses vs. Junction Temperature

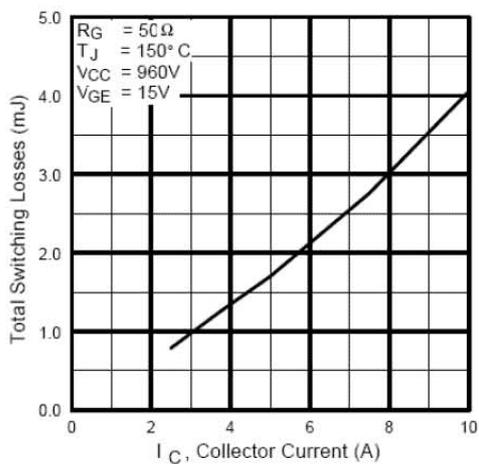


Fig.11 – Typical Switching Losses vs. Collector Current

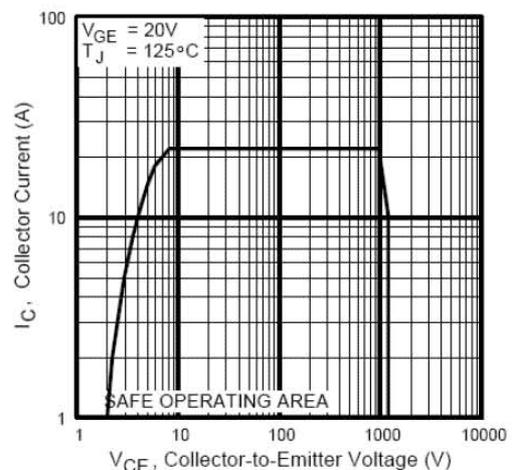
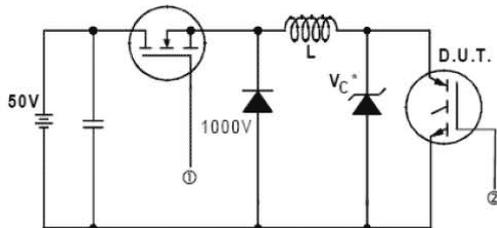


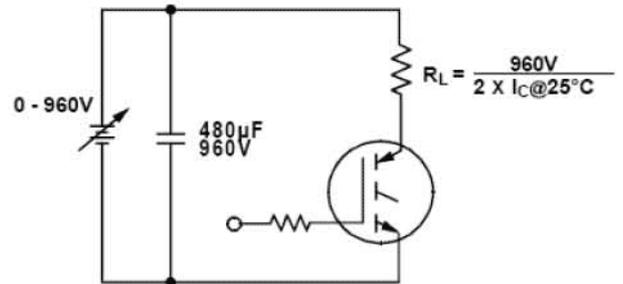
Fig.12-Turn-Off SOA

Collector-to-Emitter Current

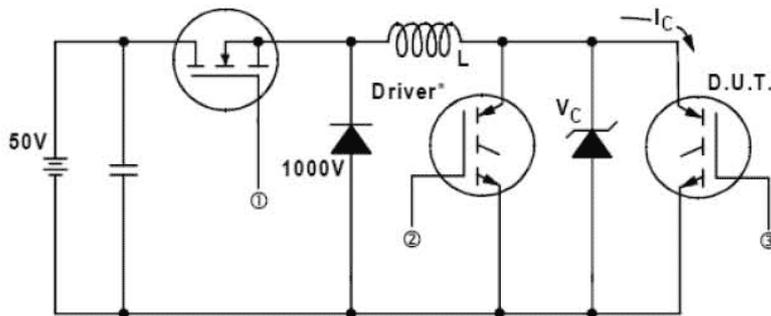


\* Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{CE(max)}$   
\* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

**Fig. 13a – Clamped Inductive Load Test Circuit**

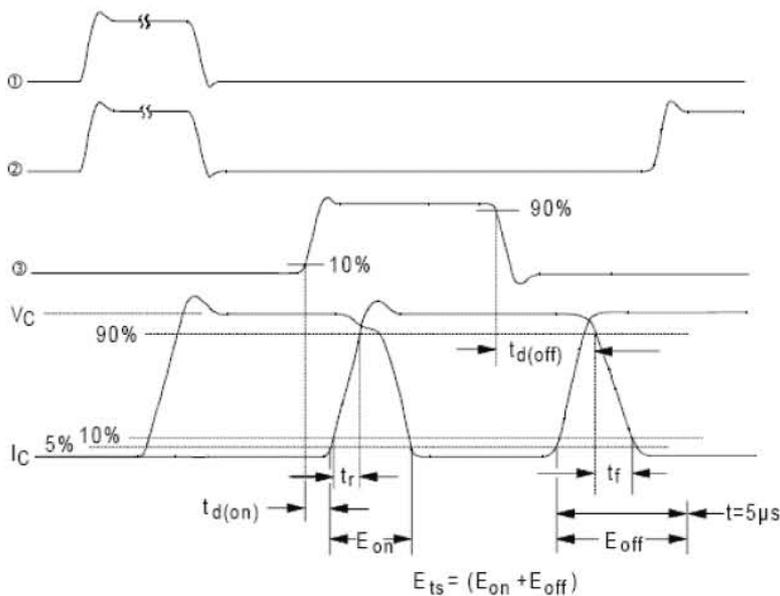


**Fig. 13b-Pulsed Collector Current Test Circuit**



**Fig. 14a - Switching Loss Test Circuit**

\* Driver same type as D.U.T.,  $V_C = 960V$



**Fig. 14b - Switching Loss Waveforms**