

V_{CES}	650V
I_C	74A
$V_{CE(sat)}$ (Typ.)	1.60V
P_D	333W

●Features

- 1) Qualified to AEC-Q101
- 2) Short Circuit Withstand Time 7 μ s
- 3) Low Collector - Emitter Saturation Voltage
- 4) Built in Very Fast & Soft Recovery FRD
- 5) Pb - free Lead Plating ; RoHS Compliant

●Application

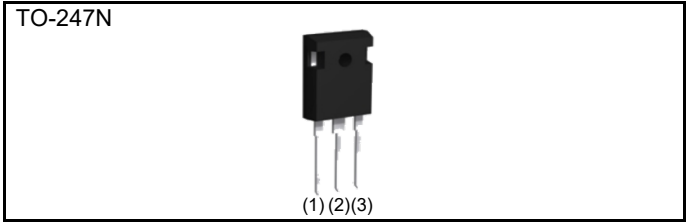
General Inverter

for Automotive and Industrial Use

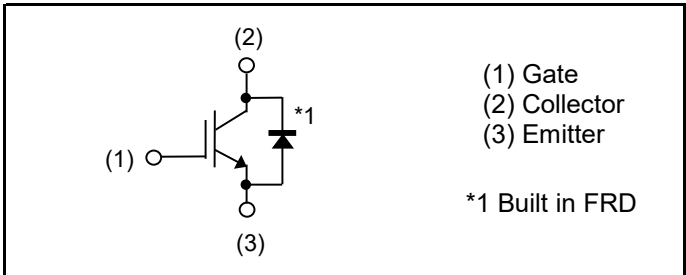
Heater for Automotive

Relay Circuit (ex. Pre Charge Relay)

●Outline



●Inner Circuit



●Packaging Specifications

Type	Parameter	Value
	Packaging	Tube
	Reel Size (mm)	-
	Tape Width (mm)	-
	Basic Ordering Unit (pcs)	450
	Packing Code	C11
	Marking	RGAX5TS65E

●Absolute Maximum Ratings (at $T_C = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Value	Unit
Collector - Emitter Voltage	V_{CES}	650	V
Gate - Emitter Voltage	V_{GES}^{*1}	± 30	V
Collector Current	$T_C = 25^\circ\text{C}$	I_C	115 A
	$T_C = 100^\circ\text{C}$	I_C	74 A
Pulsed Collector Current	I_{CP}^{*2}	225	A
Diode Forward Current	$T_C = 25^\circ\text{C}$	I_F	101 A
	$T_C = 100^\circ\text{C}$	I_F	61 A
Diode Pulsed Forward Current	I_{FP}^{*2}	225	A
Power Dissipation	$T_C = 25^\circ\text{C}$	P_D	333 W
	$T_C = 100^\circ\text{C}$	P_D	166 W
Operating Junction Temperature	T_j	-40 to +175	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +175	$^\circ\text{C}$

*1 Please be advised not to use IGBTs with VGE below 10V as doing so may cause thermal runaway.

*2 Pulse width limited by T_{jmax} .

●Thermal Resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal Resistance IGBT Junction - Case	$R_{\theta(j-c)}$	-	-	0.45	°C/W
Thermal Resistance Diode Junction - Case	$R_{\theta(j-c)}$	-	-	0.69	°C/W

●IGBT Electrical Characteristics (at $T_j = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Collector - Emitter Breakdown Voltage	BV_{CES}	$I_C = 1\mu\text{A}, V_{GE} = 0\text{V}$	650	-	-	V
Collector Cut - off Current	I_{CES}	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V},$ $T_j = 25^\circ\text{C}$	-	-	1	μA
		$T_j = 175^\circ\text{C}$	-	500	-	μA
Gate - Emitter Leakage Current	I_{GES}	$V_{GE} = \pm 30\text{V}, V_{CE} = 0\text{V}$	-	-	± 500	nA
Gate - Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 5\text{V}, I_C = 17.8\text{mA}$	5.2	6.0	6.8	V
Collector - Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 75\text{A}, V_{GE} = 15\text{V},$ $T_j = 25^\circ\text{C}$	-	1.60	1.90	V
		$T_j = 175^\circ\text{C}$	-	2.05	-	V

●IGBT Electrical Characteristics (at $T_j = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input Capacitance	C_{ies}	$V_{CE} = 30\text{V}$,	-	5753	-	pF
Output Capacitance	C_{oes}	$V_{GE} = 0\text{V}$,	-	206	-	
Reverse transfer Capacitance	C_{res}	$f = 1\text{MHz}$	-	47	-	
Total Gate Charge	Q_g	$V_{CE} = 400\text{V}$,	-	216	-	nC
Gate - Emitter Charge	Q_{ge}	$I_C = 75\text{A}$,	-	62	-	
Gate - Collector Charge	Q_{gc}	$V_{GE} = 15\text{V}$	-	91	-	
Turn - on Delay Time	$t_{d(on)}$	$I_C = 75\text{A}$, $V_{CC} = 400\text{V}$, $V_{GE} = 15\text{V}$, $R_G = 10\Omega$, $T_j = 25^\circ\text{C}$ Inductive Load * E_{on} does not include diode reverse recovery	-	72	-	ns
Rise Time	t_r		-	42	-	
Turn - off Delay Time	$t_{d(off)}$		-	238	-	
Fall Time	t_f		-	83	-	
Turn-on Switching Loss	E_{on}		-	2.90	-	
Turn-off Switching Loss	E_{off}	-	1.74	-		
Turn - on Delay Time	$t_{d(on)}$	$I_C = 75\text{A}$, $V_{CC} = 400\text{V}$, $V_{GE} = 15\text{V}$, $R_G = 10\Omega$, $T_j = 175^\circ\text{C}$ Inductive Load * E_{on} does not include diode reverse recovery	-	73	-	ns
Rise Time	t_r		-	49	-	
Turn - off Delay Time	$t_{d(off)}$		-	243	-	
Fall Time	t_f		-	129	-	
Turn-on Switching Loss	E_{on}		-	3.15	-	
Turn-off Switching Loss	E_{off}	-	2.21	-		
Reverse Bias Safe Operating Area	$RBSOA^{*2}$	$I_C = 225\text{A}$, $V_{CC} = 550\text{V}$, $V_p = 650\text{V}$, $V_{GE} = 15\text{V}$, $R_G = 50\Omega$, $T_j = 175^\circ\text{C}$	FULL SQUARE			-
Short Circuit Withstand Time	t_{sc}	$V_{GE} = 15\text{V}$, $T_j = 25^\circ\text{C}$,	7	-	-	μs
		$V_{CC} \leq 360\text{V}^{*2}$ $V_{CC} \leq 400\text{V}$	6.5	-	-	μs
Short Circuit Withstand Time	t_{sc}^{*2}	$V_{GE} = 15\text{V}$, $T_j = 150^\circ\text{C}$, $V_{CC} \leq 400\text{V}$	5	-	-	μs

*2 Design assurance without measurement

●FRD Electrical Characteristics (at $T_j = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Diode Forward Voltage	V_F	$I_F = 75\text{A}$, $T_j = 25^\circ\text{C}$ $T_j = 175^\circ\text{C}$	- -	1.55 1.65	1.90 -	V
Diode Reverse Recovery Time	t_{rr}	$I_F = 75\text{A}$, $V_{CC} = 400\text{V}$, $di_F/dt = 500\text{A}/\mu\text{s}$, $T_j = 25^\circ\text{C}$	-	134	-	ns
Diode Peak Reverse Recovery Current	I_{rr}		-	18.1	-	A
Diode Reverse Recovery Charge	Q_{rr}		-	1.2	-	μC
Diode Reverse Recovery Energy	E_{rr}		-	198	-	μJ
Diode Reverse Recovery Time	t_{rr}	$I_F = 75\text{A}$, $V_{CC} = 400\text{V}$, $di_F/dt = 500\text{A}/\mu\text{s}$, $T_j = 175^\circ\text{C}$	-	184	-	ns
Diode Peak Reverse Recovery Current	I_{rr}		-	21.5	-	A
Diode Reverse Recovery Charge	Q_{rr}		-	2.3	-	μC
Diode Reverse Recovery Energy	E_{rr}		-	454	-	μJ

●Electrical Characteristic Curves

Fig.1 Power Dissipation vs. Case Temperature

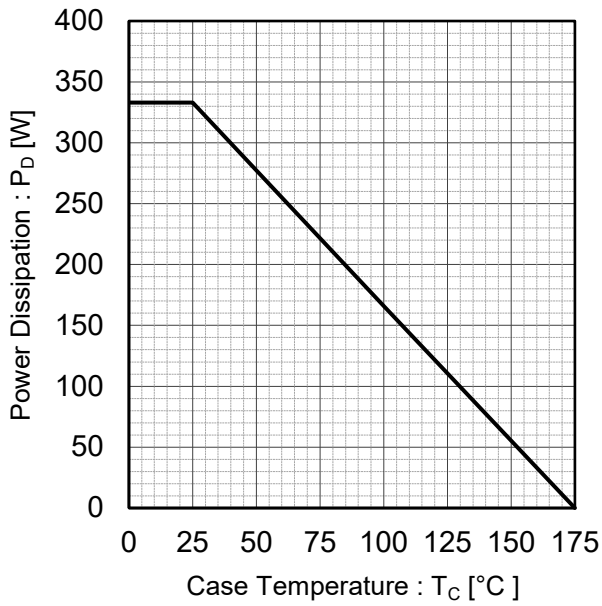


Fig.2 Collector Current vs. Case Temperature

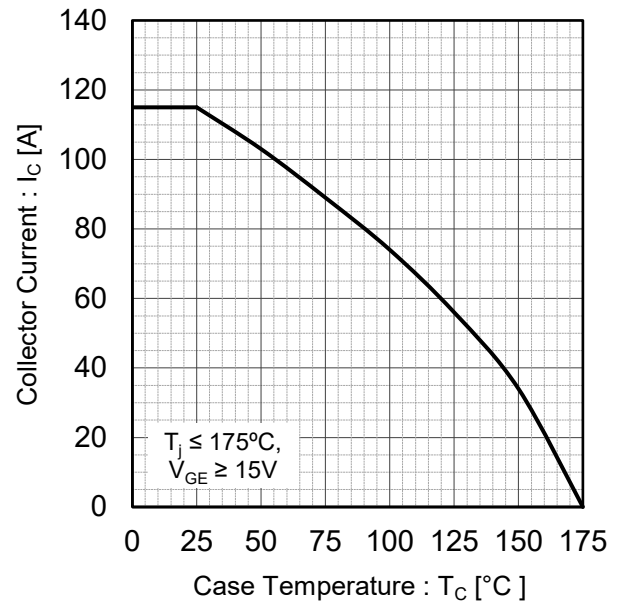


Fig.3 Forward Bias Safe Operating Area

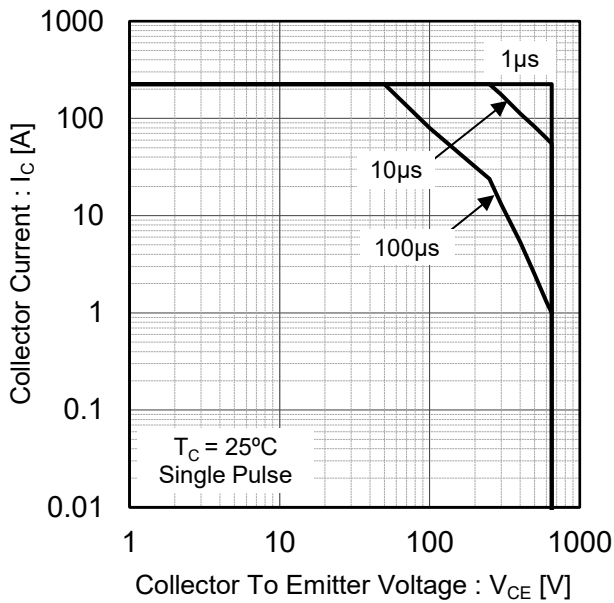
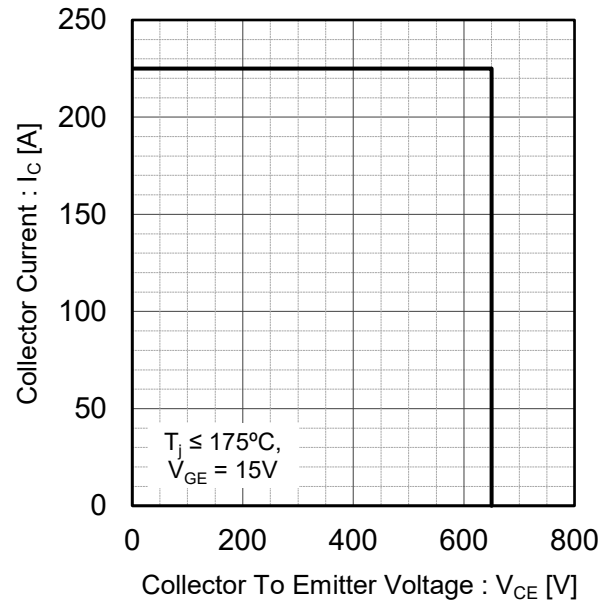


Fig.4 Reverse Bias Safe Operating Area



●Electrical Characteristic Curves

Fig.5 Typical Output Characteristics

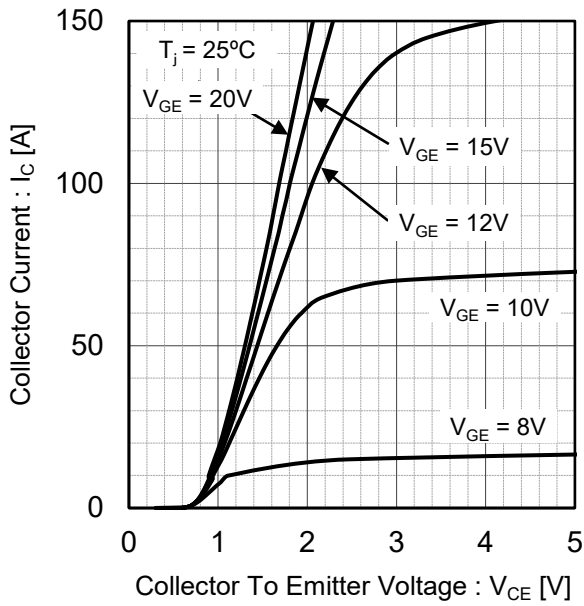


Fig.6 Typical Output Characteristics

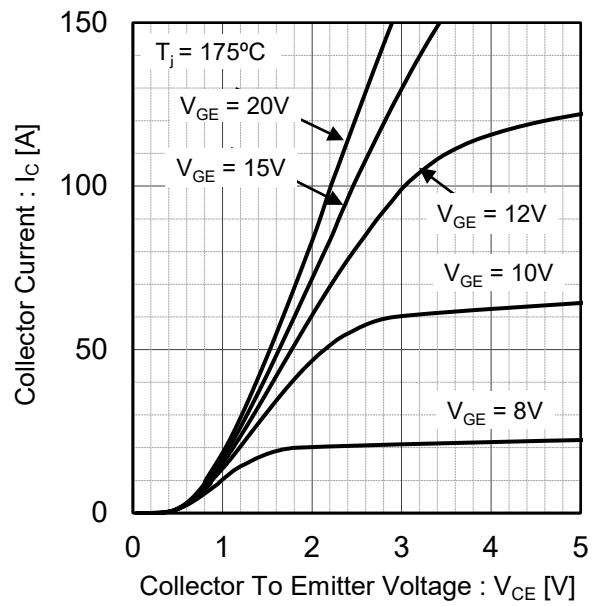


Fig.7 Typical Transfer Characteristics

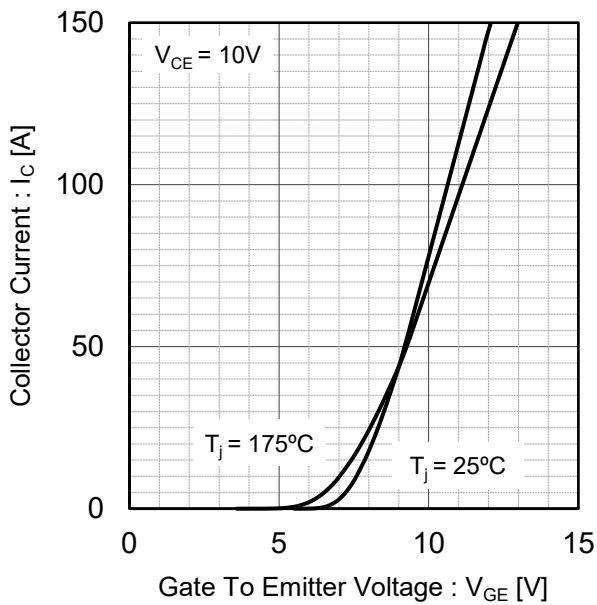
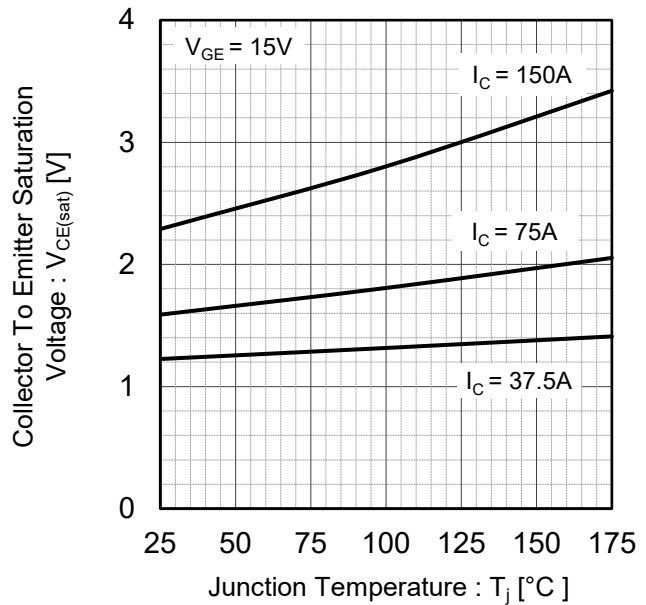


Fig.8 Typical Collector To Emitter Saturation Voltage vs. Junction Temperature



●Electrical Characteristic Curves

Fig.9 Typical Collector To Emitter Saturation Voltage vs. Gate To Emitter Voltage

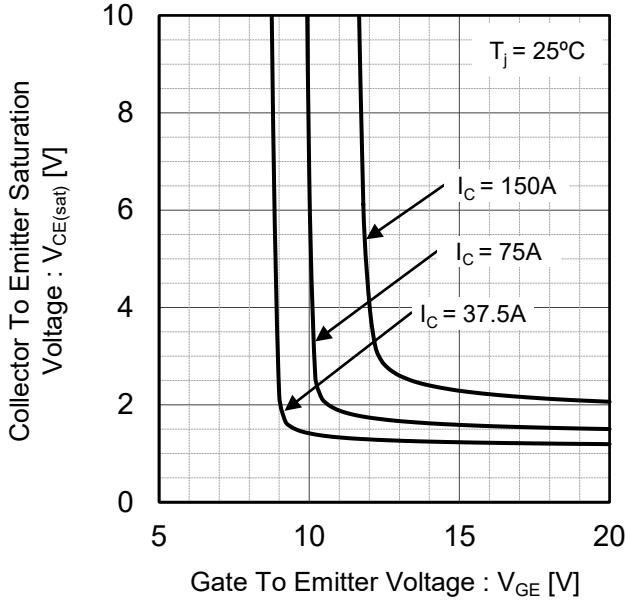


Fig.10 Typical Collector To Emitter Saturation Voltage vs. Gate To Emitter Voltage

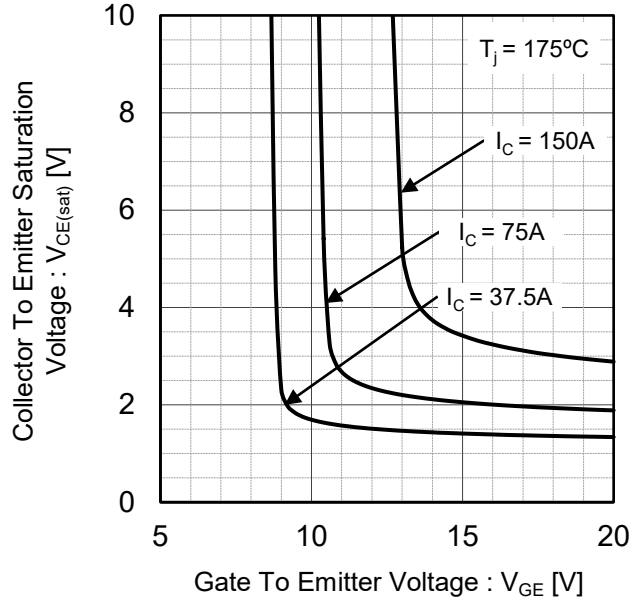


Fig.11 Typical Capacitance vs. Collector To Emitter Voltage

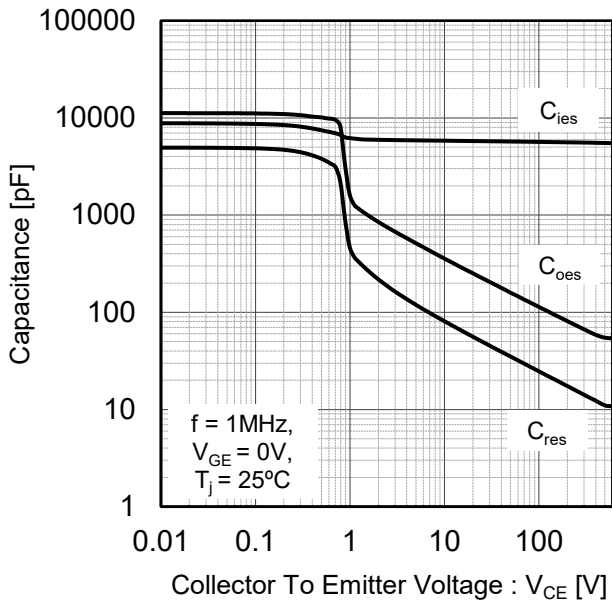
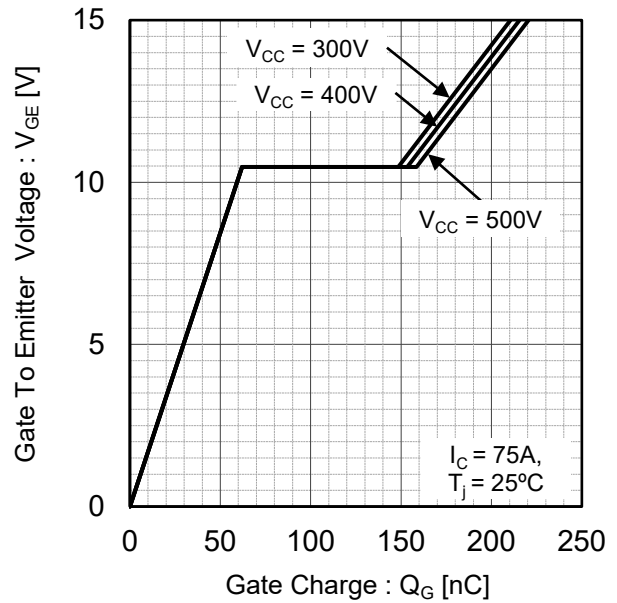


Fig.12 Typical Gate Charge



●Electrical Characteristic Curves

Fig.13 Typical Switching Time vs. Collector Current

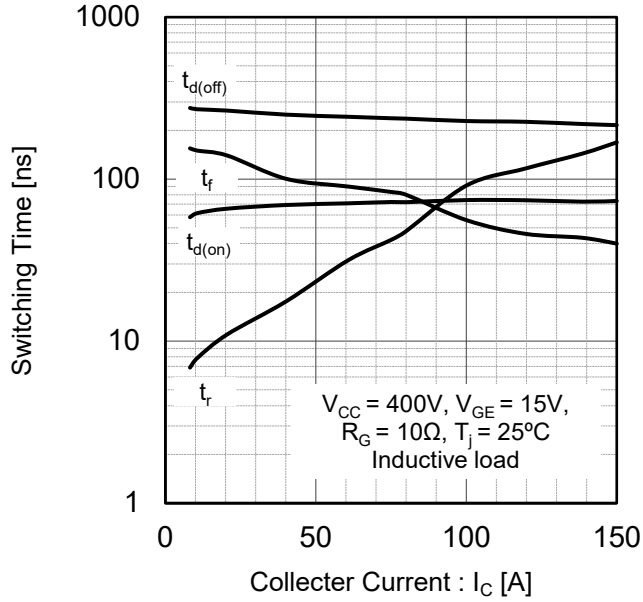


Fig.14 Typical Switching Time vs. Gate Resistance

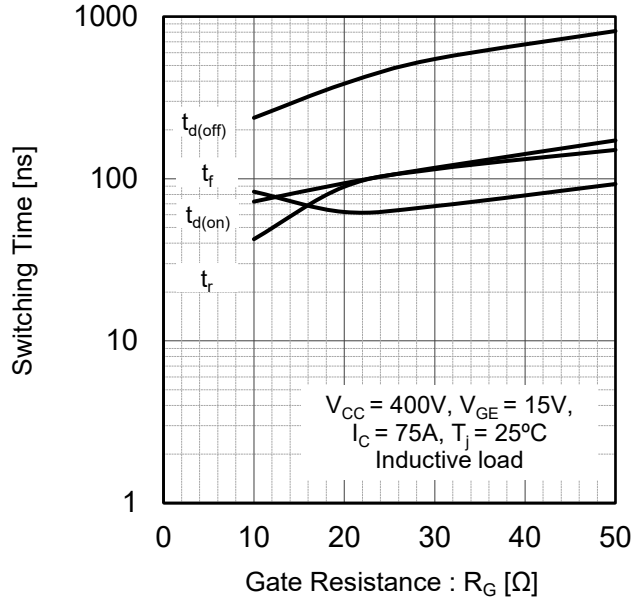


Fig.15 Typical Switching Energy Losses vs. Collector Current

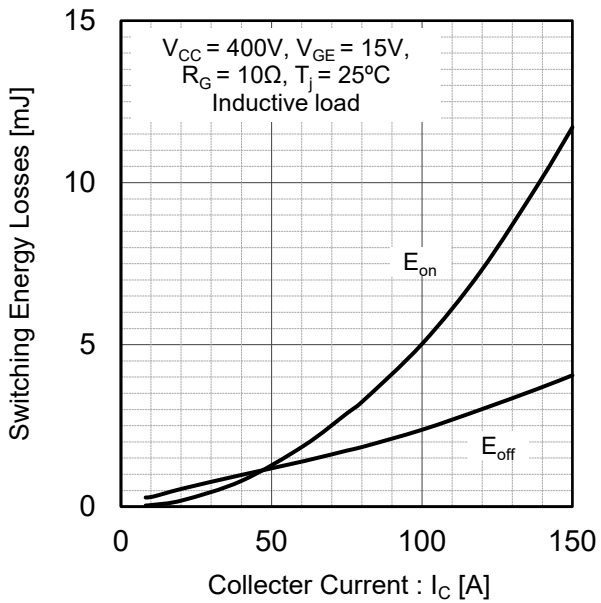
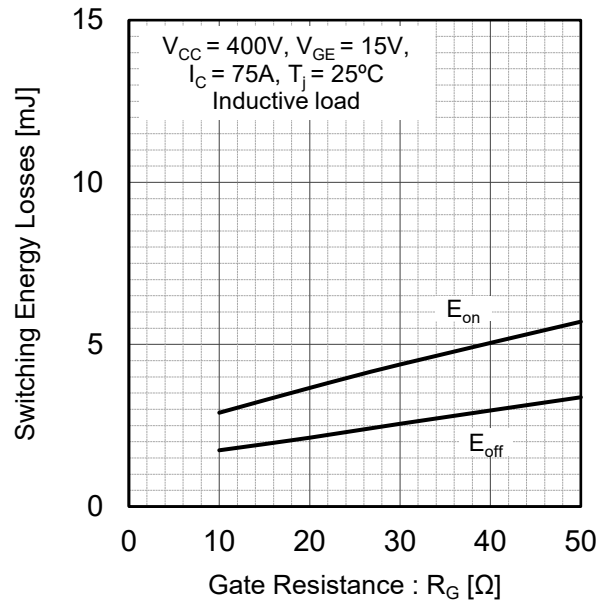


Fig.16 Typical Switching Energy Losses vs. Gate Resistance



●Electrical Characteristic Curves

Fig.17 Typical Switching Time vs. Collector Current

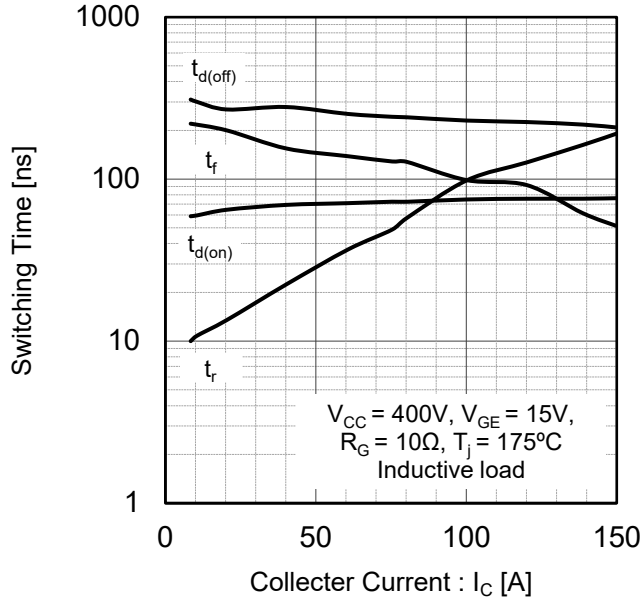


Fig.18 Typical Switching Time vs. Gate Resistance

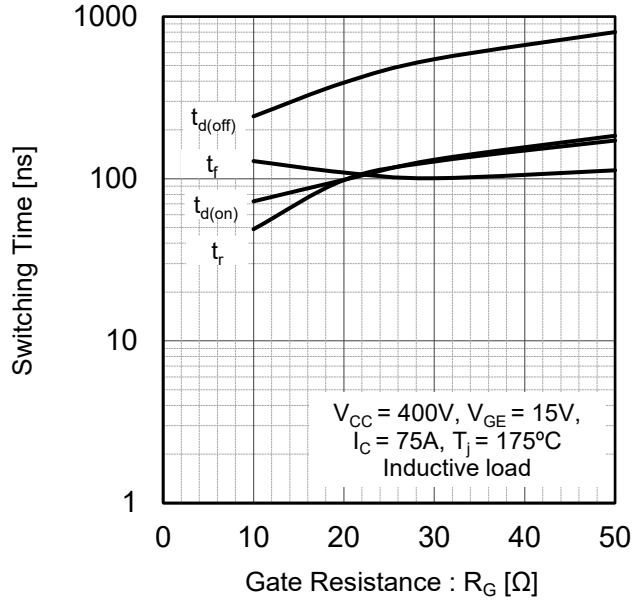


Fig.19 Typical Switching Energy Losses vs. Collector Current

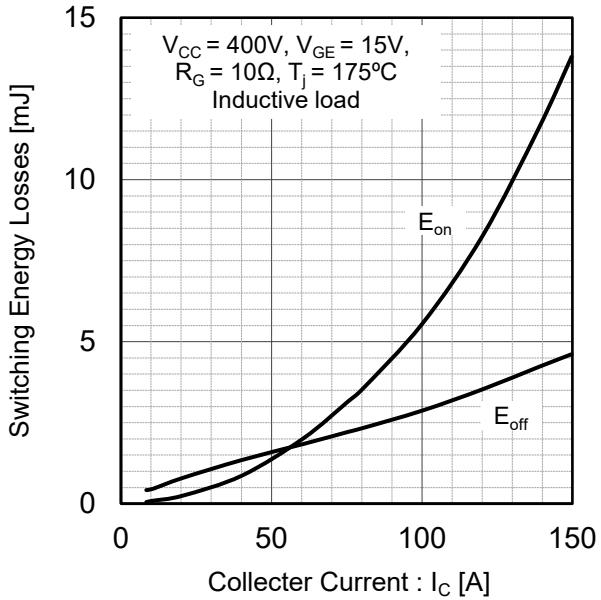
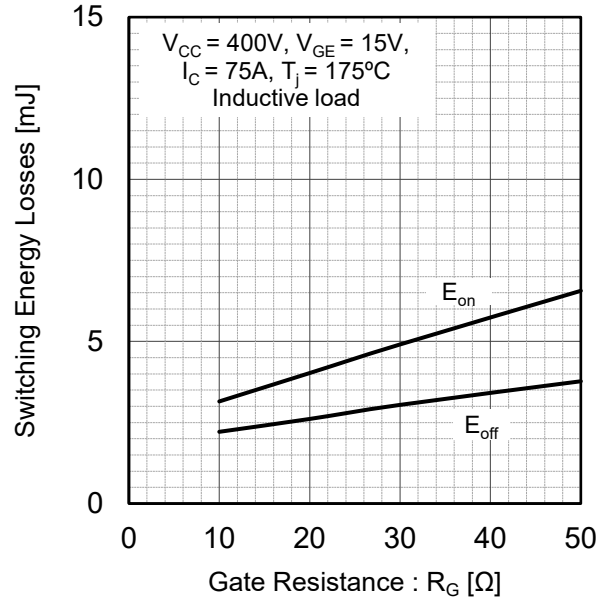


Fig.20 Typical Switching Energy Losses vs. Gate Resistance



●Electrical Characteristic Curves

Fig.21 Typical Diode Forward Current vs. Forward Voltage

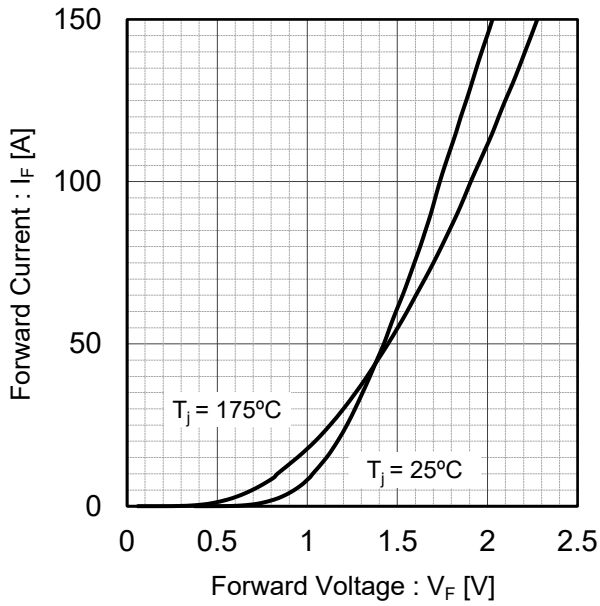


Fig.22 Typical Diode Reverse Recovery Time vs. Forward Current

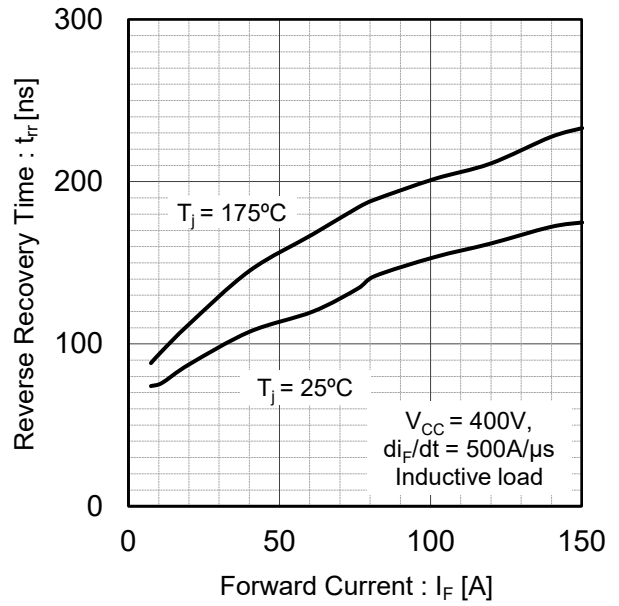


Fig.23 Typical Diode Reverse Recovery Current vs. Forward Current

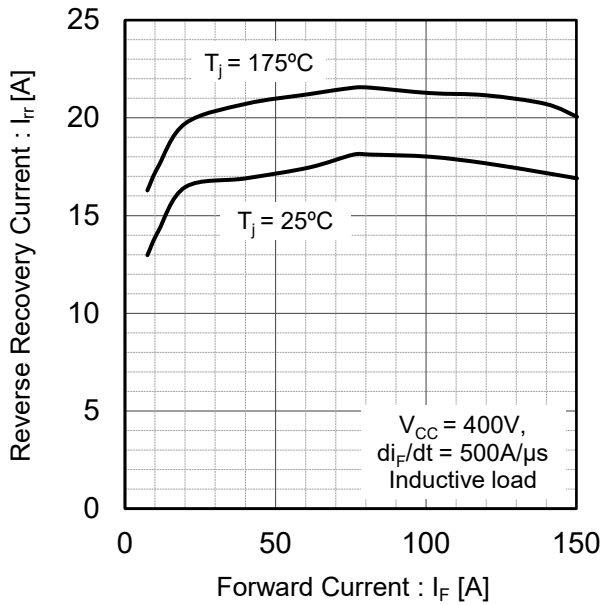
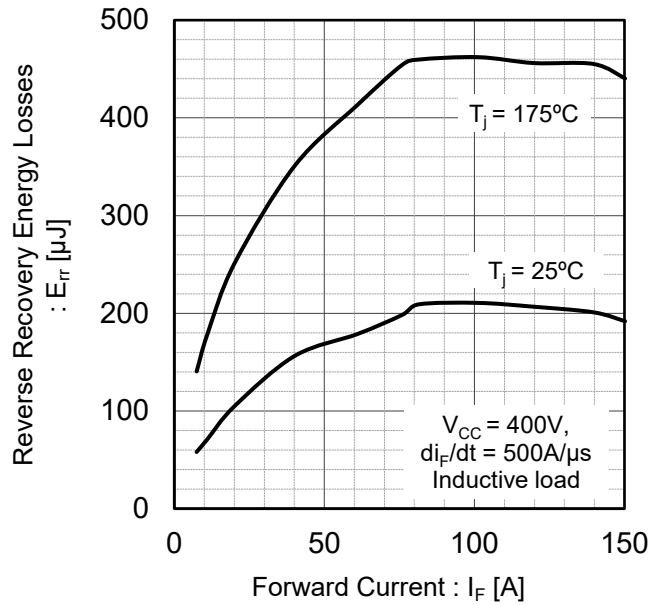


Fig.24 Typical Diode Reverse Recovery Energy Losses vs. Forward Current



●Electrical Characteristic Curves

Fig.25 Typical IGBT Transient Thermal Impedance

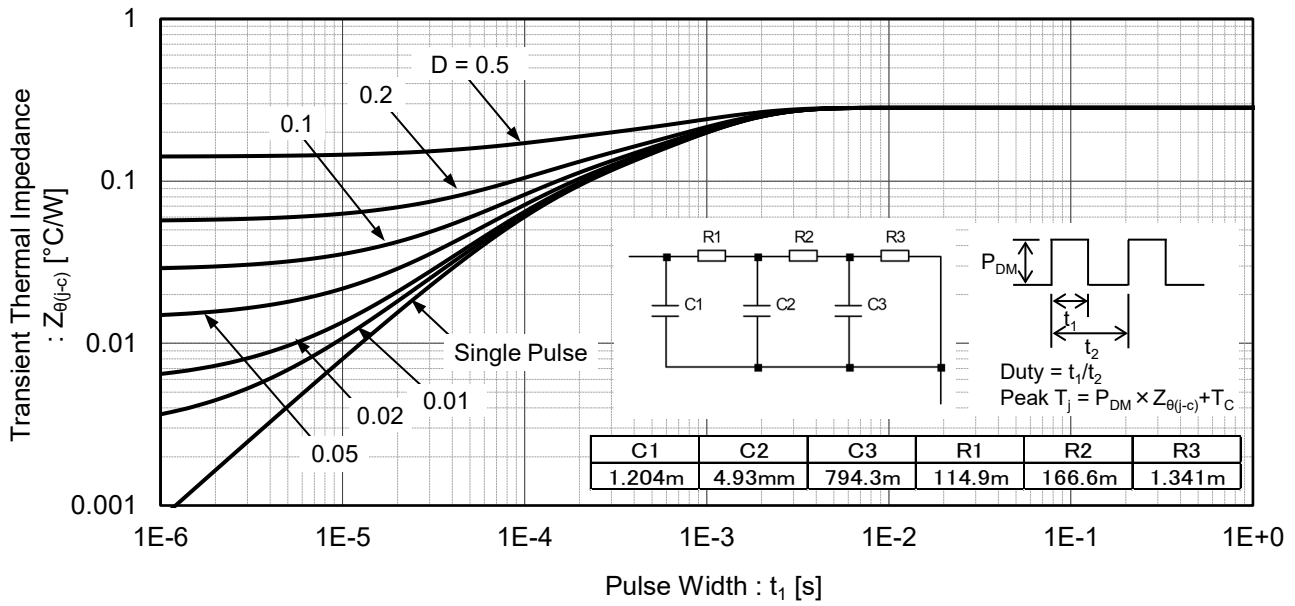
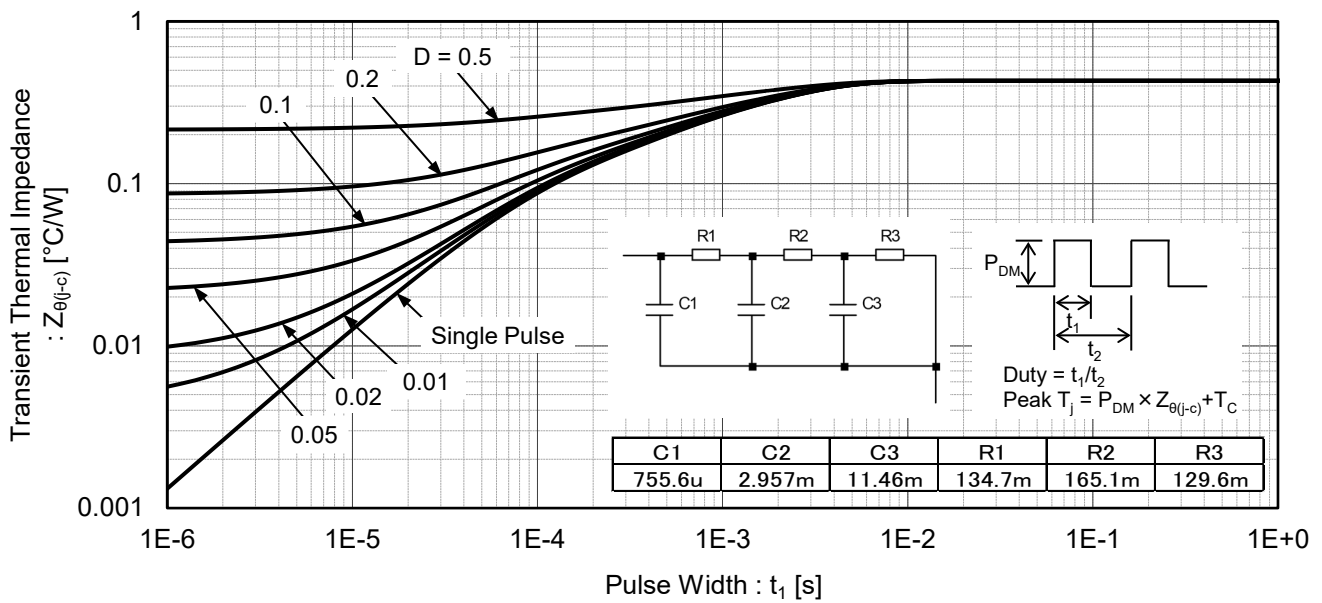


Fig.26 Typical Diode Transient Thermal Impedance



● Inductive Load Switching Circuit and Waveform and Short Circuit

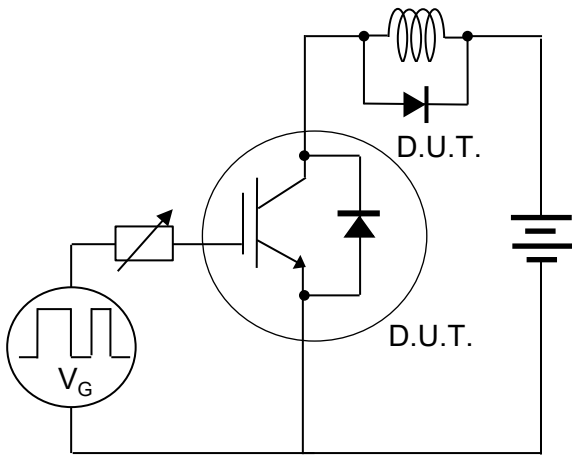


Fig.27 Inductive Load Circuit

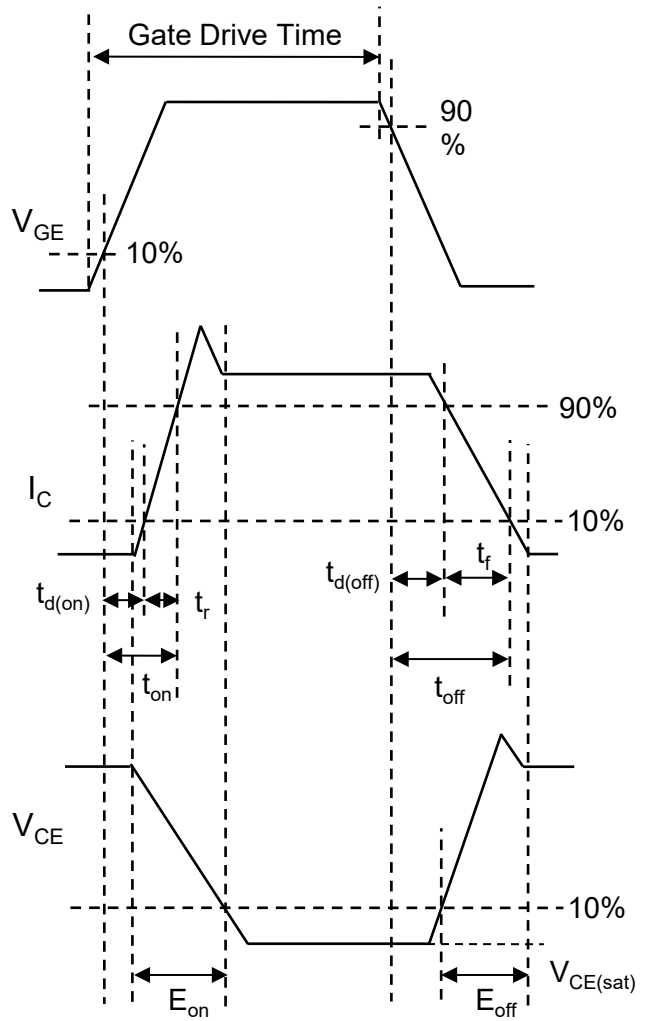


Fig.29 Inductive Load Waveform

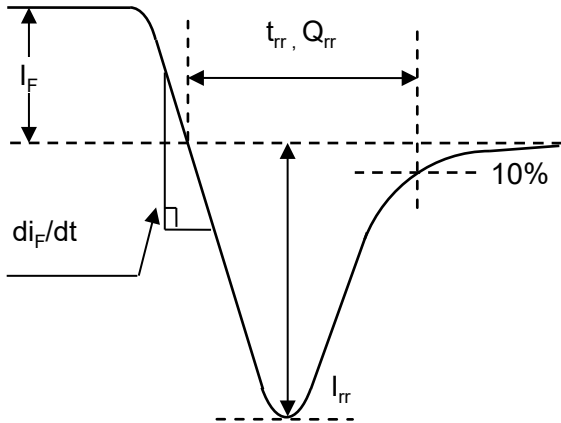


Fig.28 Diode Reverse Recovery Waveform

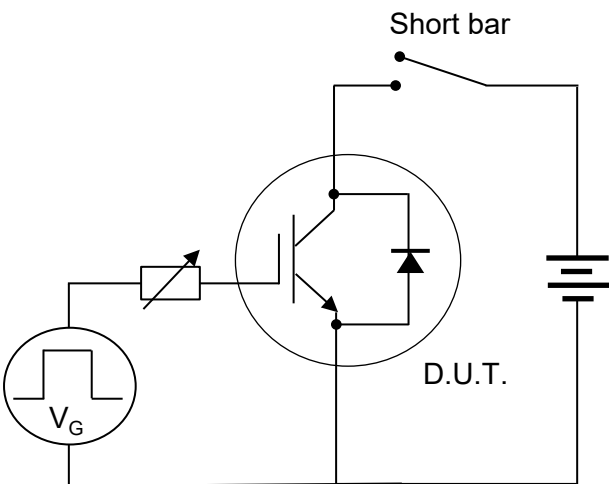


Fig.30 Short Circuit

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