

$V_{CES}$	650V
$I_C$ (100°C)	30A
$V_{CE(sat)}$ (Typ.)	1.6V
$P_D$	156W

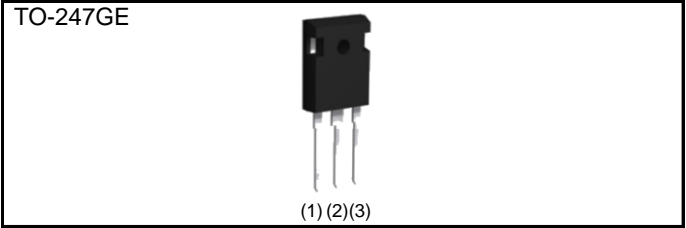
### ●Features

- 1) Low Collector - Emitter Saturation Voltage
- 2) High Speed Switching
- 3) Low Switching Loss & Soft Switching
- 4) Pb - free Lead Plating ; RoHS Compliant

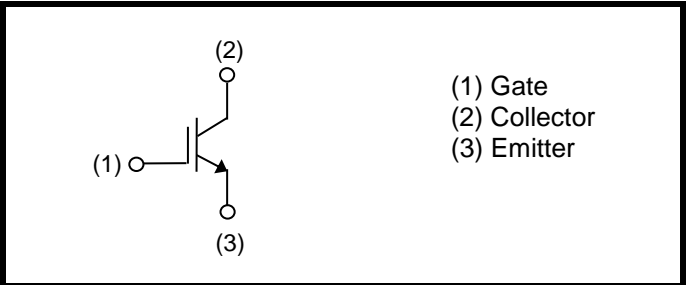
### ●Application

- PFC
- Solar converters
- Mid to high switching frequency converters

### ●Outline



### ●Inner Circuit



### ●Packaging Specifications

Type	Packaging	Tube
	Reel Size (mm)	-
	Tape Width (mm)	-
	Basic Ordering Unit (pcs)	600
	Packing Code	C13
	Marking	RGWS60TS65

### ●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	$V_{GES}$	$\pm 30$	V	
Collector Current	$T_C = 25^\circ\text{C}$	$I_C$	51	A
	$T_C = 100^\circ\text{C}$	$I_C$	32	A
Pulsed Collector Current	$I_{CP}^{*1}$	90	A	
Power Dissipation	$T_C = 25^\circ\text{C}$	$P_D$	156	W
	$T_C = 100^\circ\text{C}$	$P_D$	78	W
Operating Junction Temperature	$T_j$	-40 to +175	$^\circ\text{C}$	
Storage Temperature	$T_{stg}$	-55 to +175	$^\circ\text{C}$	

\*1 Pulse width limited by  $T_{jmax}$ .

### ● Thermal Resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal Resistance IGBT Junction - Case	$R_{\theta(j-c)}$	-	-	0.96	°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	$BV_{CES}$	$I_C = 10\mu\text{A}, V_{GE} = 0\text{V}$	650	-	-	V
Collector Cut - off Current	$I_{CES}$	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}$	-	-	10	$\mu\text{A}$
Gate - Emitter Leakage Current	$I_{GES}$	$V_{GE} = \pm 30\text{V}, V_{CE} = 0\text{V}$	-	-	$\pm 200$	nA
Gate - Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 5\text{V}, I_C = 13.3\text{mA}$	5.0	6.0	7.0	V
Collector - Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 30\text{A}, V_{GE} = 15\text{V},$ $T_j = 25^\circ\text{C}$	-	1.6	2.0	V
		$T_j = 175^\circ\text{C}$	-	2.0	-	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{V}$ ,	-	1680	-	pF
Output Capacitance	$C_{oes}$	$V_{GE} = 0\text{V}$ ,	-	47	-	
Reverse transfer Capacitance	$C_{res}$	$f = 1\text{MHz}$	-	31	-	
Total Gate Charge	$Q_g$	$V_{CE} = 400\text{V}$ ,	-	58	-	nC
Gate - Emitter Charge	$Q_{ge}$	$I_C = 30\text{A}$ ,	-	12	-	
Gate - Collector Charge	$Q_{gc}$	$V_{GE} = 15\text{V}$	-	24	-	
Turn - on Delay Time	$t_{d(on)}$	$I_C = 30\text{A}$ , $V_{CC} = 400\text{V}$ , $V_{GE} = 15\text{V}$ , $R_G = 10\Omega$ , $T_j = 25^\circ\text{C}$	-	32	-	ns
Rise Time	$t_r$		-	12	-	
Turn - off Delay Time	$t_{d(off)}$		-	91	-	
Fall Time	$t_f$		-	46	-	
Turn - on Switching Loss	$E_{on}$	Inductive Load * $E_{on}$ include diode reverse recovery	-	0.50	-	mJ
Turn - off Switching Loss	$E_{off}$		-	0.45	-	
Turn - on Delay Time	$t_{d(on)}$	$I_C = 30\text{A}$ , $V_{CC} = 400\text{V}$ , $V_{GE} = 15\text{V}$ , $R_G = 10\Omega$ , $T_j = 175^\circ\text{C}$	-	31	-	ns
Rise Time	$t_r$		-	13	-	
Turn - off Delay Time	$t_{d(off)}$		-	101	-	
Fall Time	$t_f$		-	74	-	
Turn - on Switching Loss	$E_{on}$	Inductive Load * $E_{on}$ include diode reverse recovery	-	0.51	-	mJ
Turn - off Switching Loss	$E_{off}$		-	0.56	-	
Reverse Bias Safe Operating Area	RBSOA	$I_C = 90\text{A}$ , $V_{CC} = 520\text{V}$ $V_P = 650\text{V}$ , $V_{GE} = 15\text{V}$ $R_G = 100\Omega$ , $T_j = 175^\circ\text{C}$	FULL SQUARE			-

●Electrical Characteristic Curves

Fig.1 Power Dissipation vs. Case Temperature

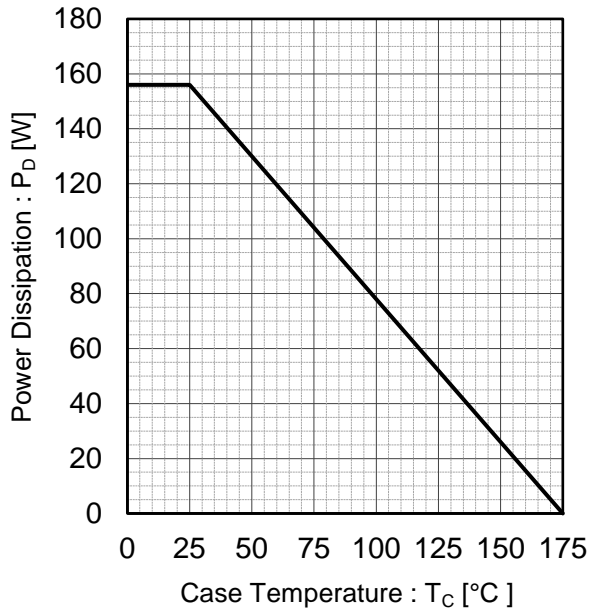


Fig.2 Collector Current vs. Case Temperature

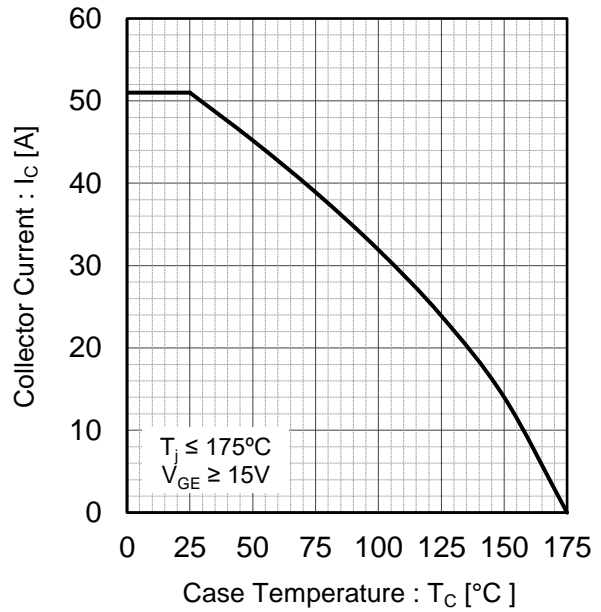


Fig.3 Forward Bias Safe Operating Area

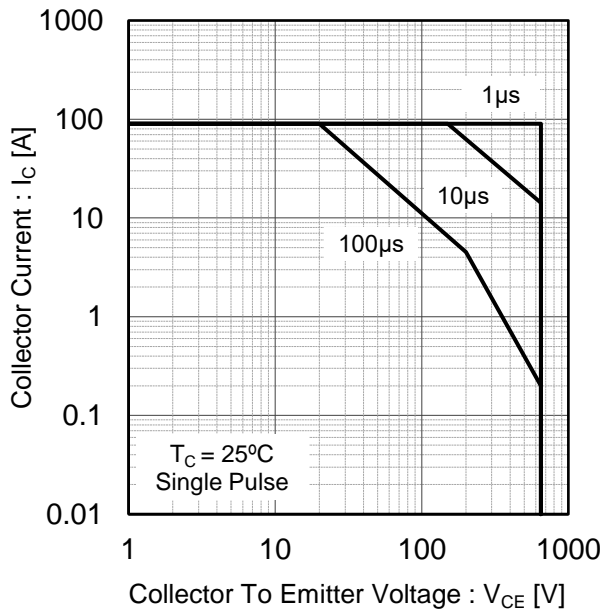
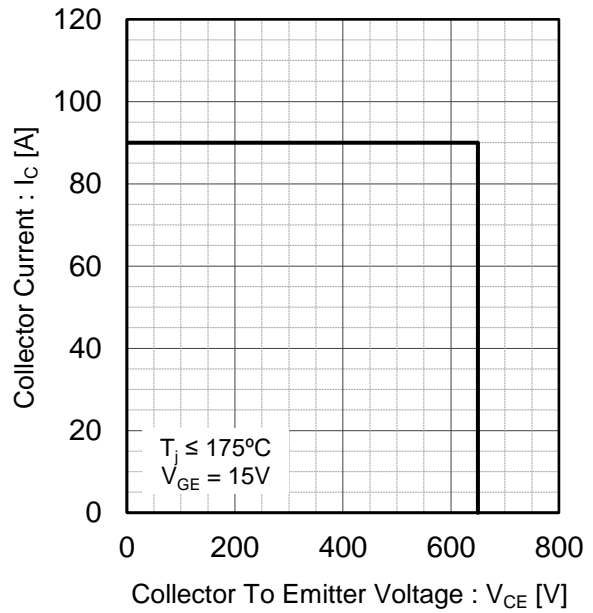


Fig.4 Reverse Bias Safe Operating Area



●Electrical Characteristic Curves

Fig.5 Typical Output Characteristics

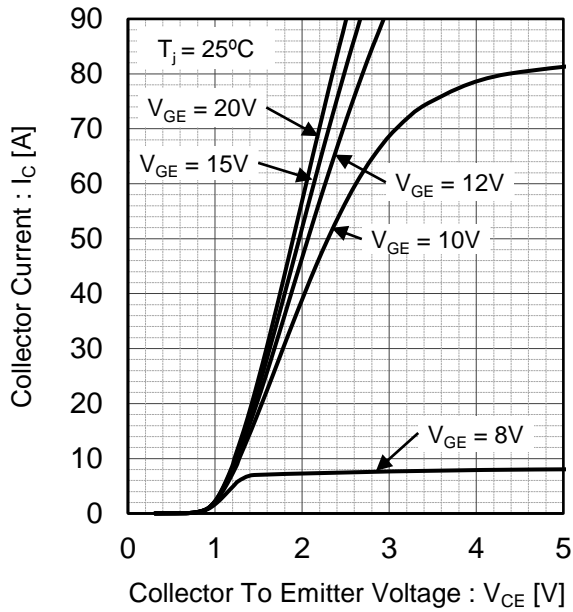


Fig.6 Typical Output Characteristics

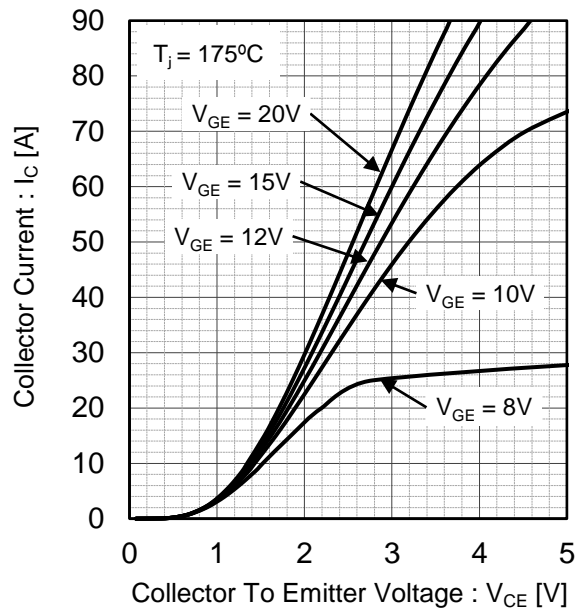


Fig.7 Typical Transfer Characteristics

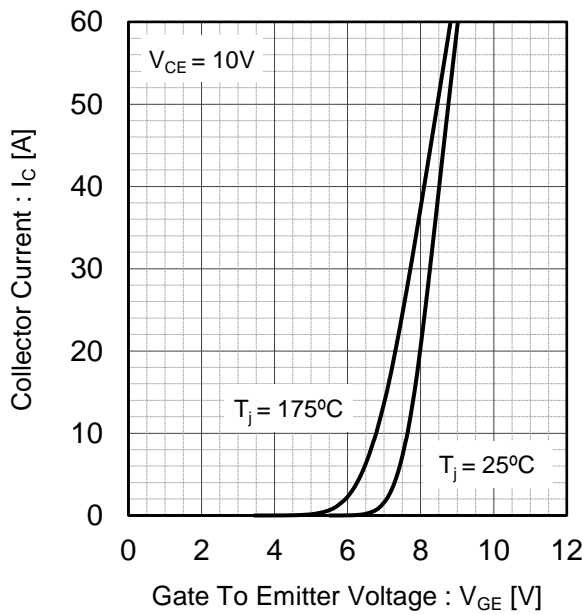
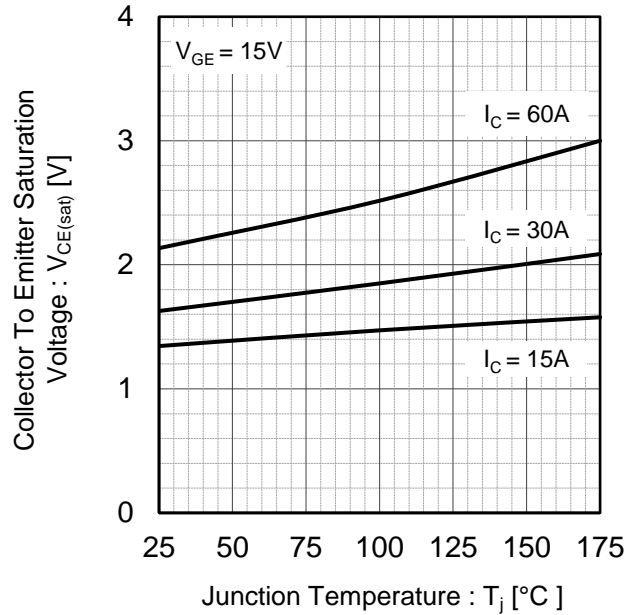


Fig.8 Typical Collector to Emitter Saturation Voltage vs. Junction Temperature



●Electrical Characteristic Curves

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

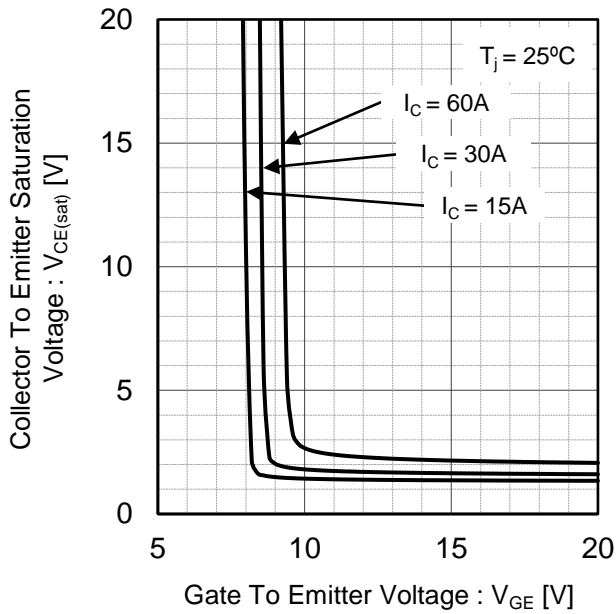


Fig.10 Typical Collector to Emitter Saturation Voltage vs. Gate to Emitter Voltage

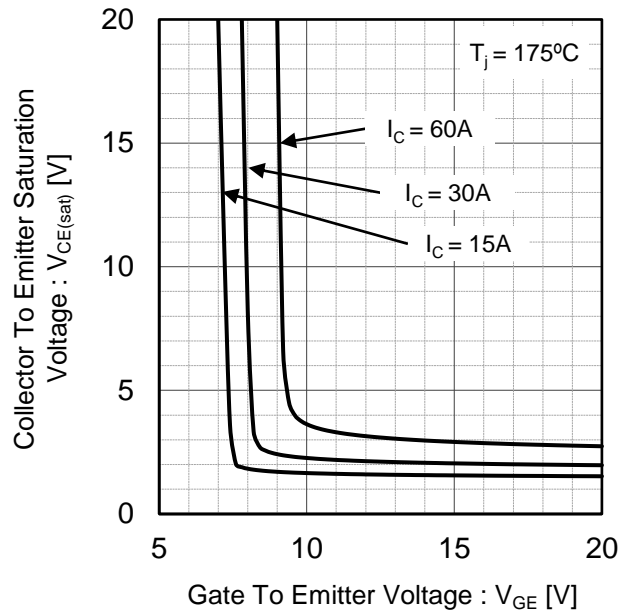


Fig.11 Typical Switching Time vs. Collector Current

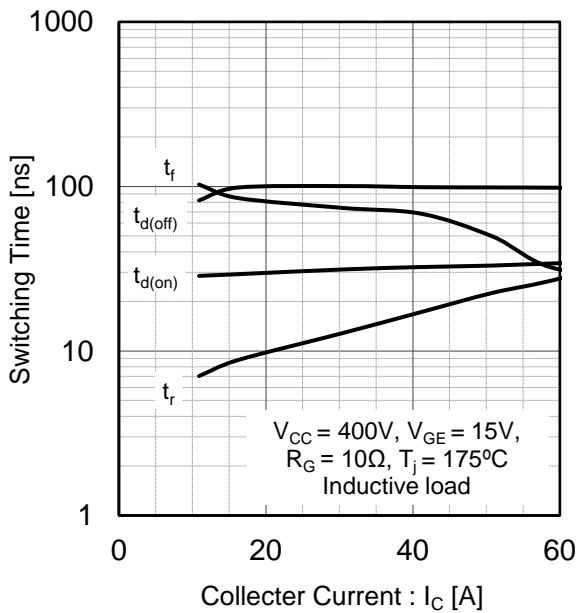
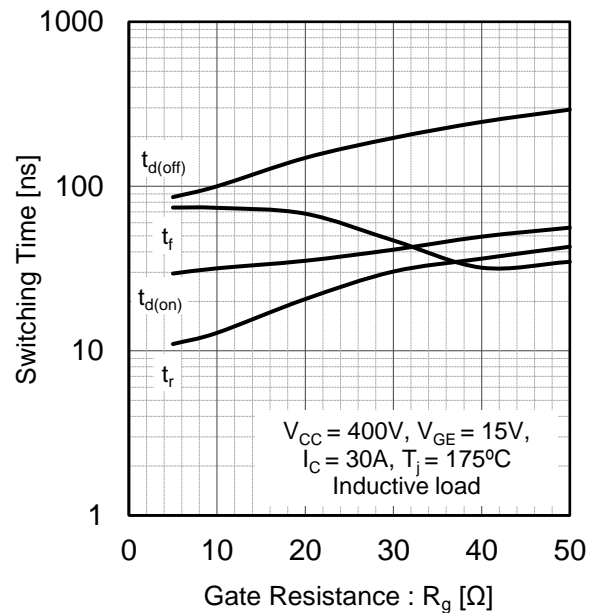


Fig.12 Typical Switching Time vs. Gate Resistance



●Electrical Characteristic Curves

Fig.13 Typical Switching Energy Losses vs. Collector Current

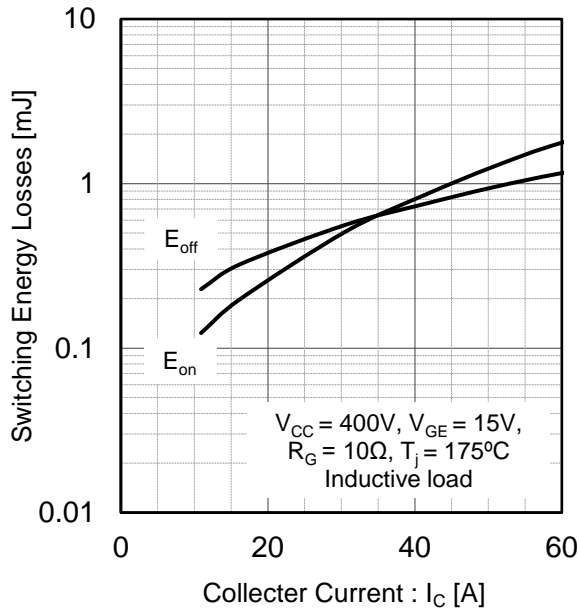


Fig.14 Typical Switching Energy Losses vs. Gate Resistance

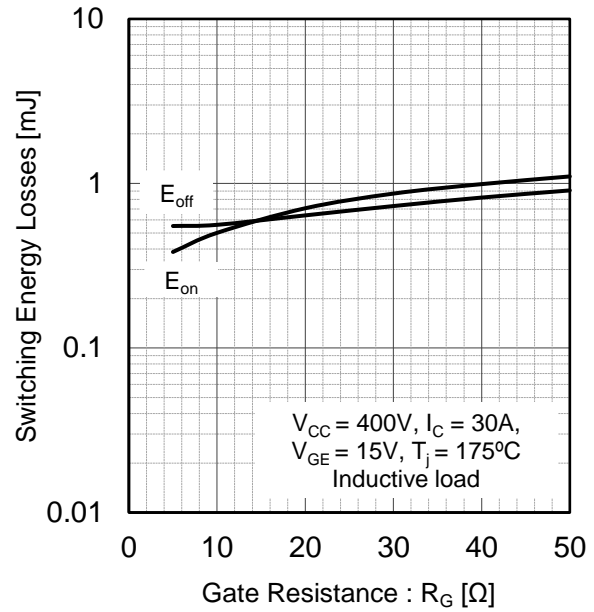


Fig.15 Typical Capacitance vs. Collector to Emitter Voltage

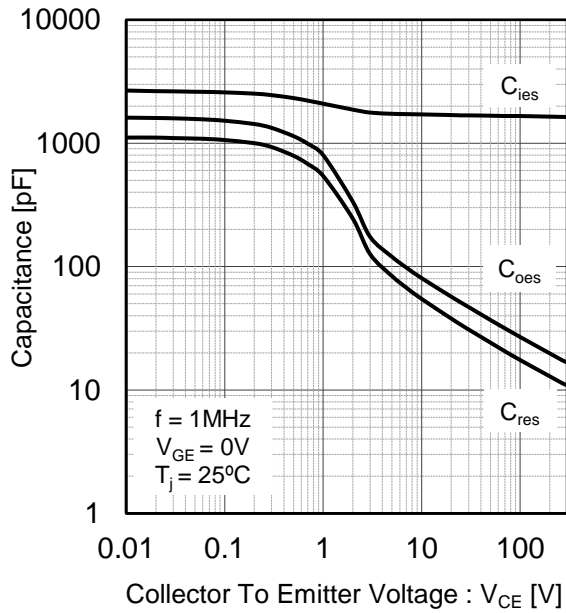
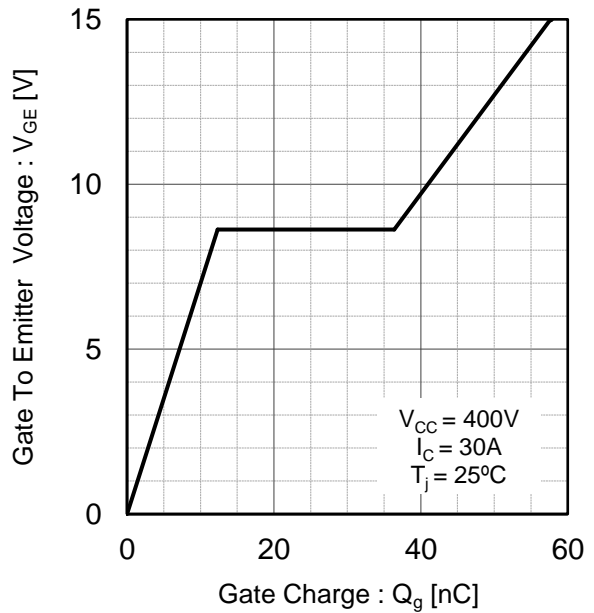
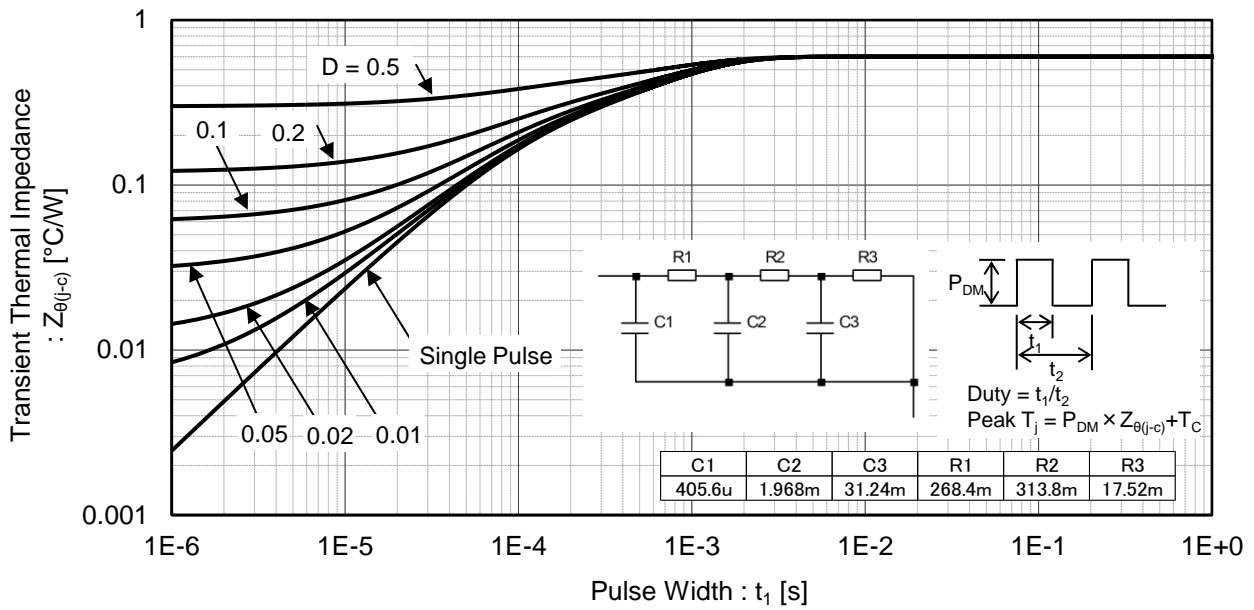


Fig.16 Typical Gate Charge



●Electrical Characteristic Curves

Fig.17 Typical IGBT Transient Thermal Impedance





● Inductive Load Switching Circuit and Waveform

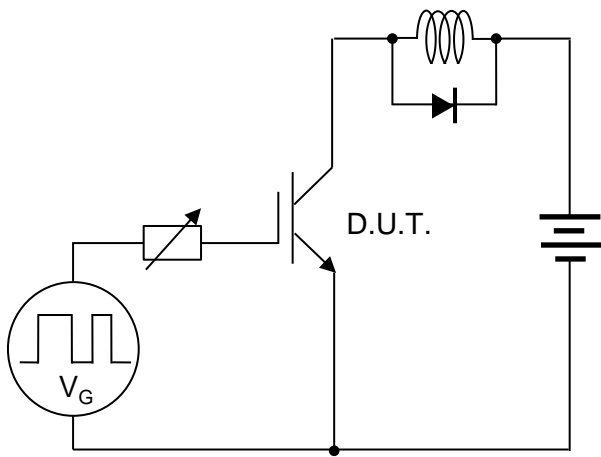


Fig.18 Inductive Load Circuit

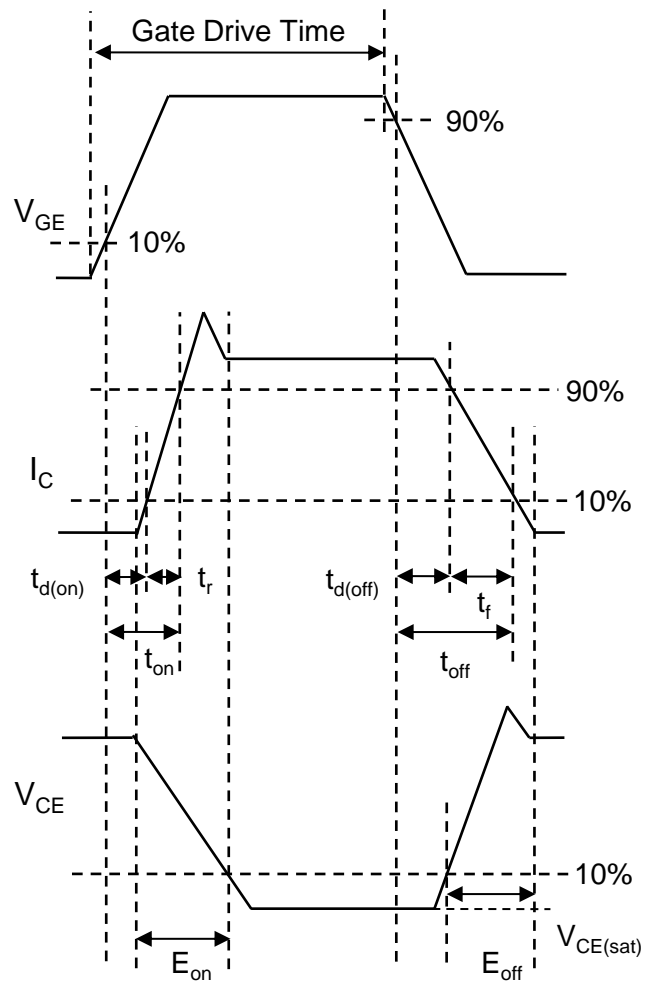


Fig.19 Inductive Load Waveform

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