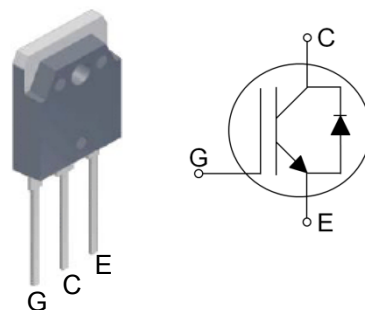


### Features:

- 600V Field Stop Trench Technology
- High Speed Switching
- Low Conduction Loss
- Positive Temperature Coefficient
- Easy Parallel Operation
- RoHS Compliant
- JEDEC Qualification



### Applications :

Induction Heating, Soft Switching Application, UPS, Welder, Inverter

Device	Package	Marking	Remark
TGAN60N60FD	TO-3PN	TGAN60N60FD	RoHS

### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	
Collector-Emitter Voltage	$V_{CES}$	600	V	
Gate-Emitter Voltage	$V_{GES}$	$\pm 20$	V	
Continuous Collector Current	$I_c$	$T_C = 25\text{ }^\circ\text{C}$	120	A
		$T_C = 100\text{ }^\circ\text{C}$	60	A
Pulsed Collector Current (Note 1)	$I_{CM}$	180	A	
Diode Continuous Forward Current	$I_F$	30	A	
Power Dissipation	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	347	W
		$T_C = 100\text{ }^\circ\text{C}$	139	W
Operating Junction Temperature	$T_J$	-55 ~ 150	$^\circ\text{C}$	
Storage Temperature Range	$T_{STG}$	-55 ~ 150	$^\circ\text{C}$	
Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	$T_L$	300	$^\circ\text{C}$	

Notes :

(1) Repetitive rating : Pulse width limited by maximum junction temperature

### Thermal Characteristics

Parameter	Symbol	Value	Unit
Maximum Thermal resistance, Junction-to-Case	$R_{\theta JC}$ (IGBT)	0.36	$^\circ\text{C/W}$
Maximum Thermal resistance, Junction-to-Case	$R_{\theta JC}$ (DIODE)	1.12	$^\circ\text{C/W}$
Maximum Thermal resistance, Junction-to-Ambient	$R_{\theta JA}$	40	$^\circ\text{C/W}$

### Electrical Characteristics of the IGBT $T_C=25^\circ\text{C}$ , unless otherwise noted

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Units
<b>OFF</b>						
Collector – Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0V, I_C = 1mA$	600	--	--	V
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 600V, V_{GE} = 0V$	--	--	1	mA
Gate – Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0V, V_{GE} = \pm 20V$	--	--	$\pm 250$	nA

### ON

Gate – Emitter Threshold Voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}, I_C = 60mA$	4.5	6.0	7.5	V
Collector – Emitter Saturation Voltage	$V_{CE(SAT)}$	$V_{GE} = 15V, I_C = 60A, T_C = 25^\circ\text{C}$	--	1.8	2.3	V
		$V_{GE} = 15V, I_C = 60A, T_C = 125^\circ\text{C}$	--	2.3	--	V

### DYNAMIC

Input Capacitance	$C_{IES}$	$V_{CE} = 30V,$ $V_{GE} = 0V$ $f = 1MHz$	--	3300	--	pF
Output Capacitance	$C_{OES}$		--	170	--	pF
Reverse Transfer Capacitance	$C_{RES}$		--	110	--	pF

### SWITCHING

Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400V, I_C = 60A$ $R_G = 10\Omega, V_{GE} = 15V$ Inductive Load, $T_C = 25^\circ\text{C}$	--	45	--	ns
Rise Time	$t_r$		--	125	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	150	--	ns
Fall Time	$t_f$		--	80	120	ns
Turn-On Switching Loss	$E_{ON}$		--	2.66	4	mJ
Turn-Off Switching Loss	$E_{OFF}$		--	1.53	2.3	mJ
Total Switching Loss	$E_{TS}$	--	4.19	6.3	mJ	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400V, I_C = 60A$ $R_G = 10\Omega, V_{GE} = 15V$ Inductive Load, $T_C = 125^\circ\text{C}$	--	45	--	ns
Rise Time	$t_r$		--	135	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	160	--	ns
Fall Time	$t_f$		--	90	--	ns
Turn-On Switching Loss	$E_{ON}$		--	2.65	4	mJ
Turn-Off Switching Loss	$E_{OFF}$		--	1.86	2.8	mJ
Total Switching Loss	$E_{TS}$	--	4.51	6.8	mJ	
Total Gate Charge	$Q_g$	$V_{CE} = 400V, I_C = 60A$ $V_{GE} = 15V$	--	150	225	nC
Gate-Emitter Charge	$Q_{ge}$		--	22	33	nC
Gate-Collector Charge	$Q_{gc}$		--	78	117	nC

**Electrical Characteristics of the DIODE**  $T_C=25^\circ\text{C}$ , unless otherwise noted

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Units	
Diode Forward Voltage	$V_{FM}$	$I_F = 30\text{A}$	$T_C = 25^\circ\text{C}$	--	1.9	--	V
			$T_C = 125^\circ\text{C}$	--	1.78	--	
Reverse Recovery Time	$t_{rr}$	$I_F = 30\text{A},$ $di/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	--	140	--	ns
			$T_C = 125^\circ\text{C}$	--	240	--	
Reverse Recovery Current	$I_{rr}$		$T_C = 25^\circ\text{C}$	--	5	--	A
			$T_C = 125^\circ\text{C}$	--	10	--	
Reverse Recovery Charge	$Q_{rr}$		$T_C = 25^\circ\text{C}$	--	340	--	nC
			$T_C = 125^\circ\text{C}$	--	1200	--	

### IGBT Characteristics

Fig. 1 Output characteristics

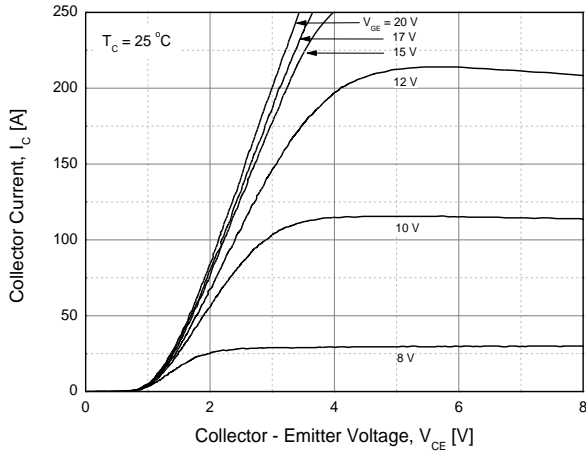


Fig. 2 Saturation voltage characteristics

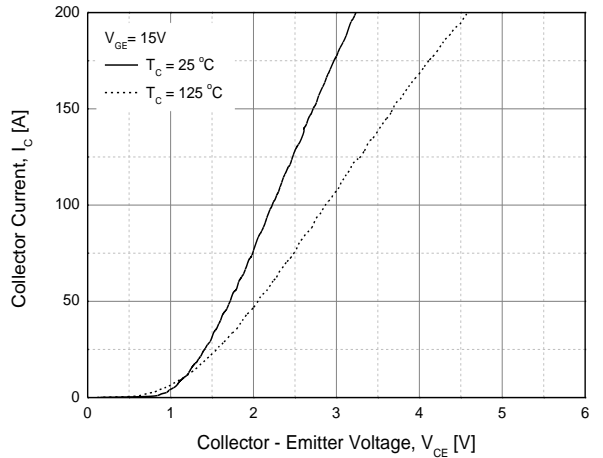


Fig. 3 Saturation voltage vs. collector current

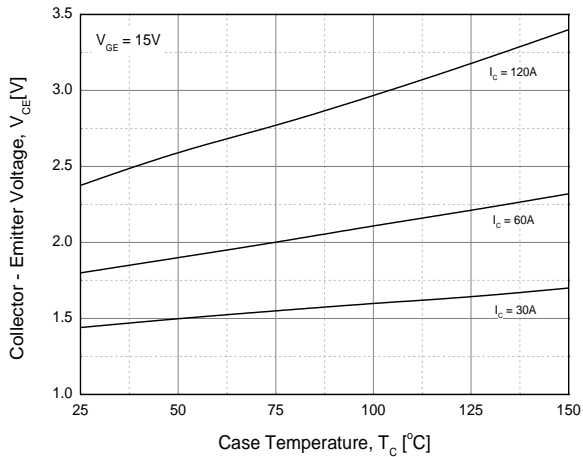


Fig. 4 Saturation voltage vs. gate bias

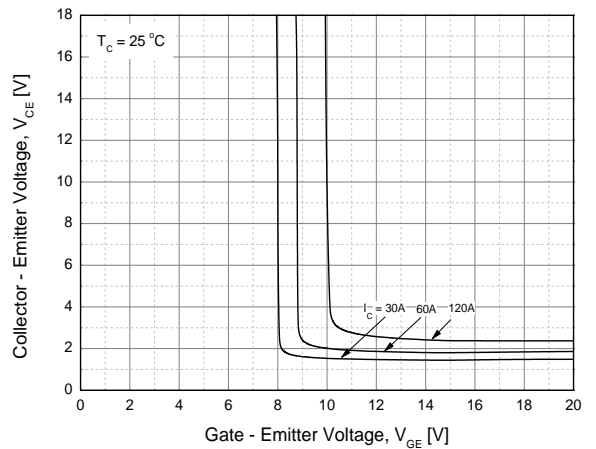


Fig. 5 Saturation voltage vs. gate bias

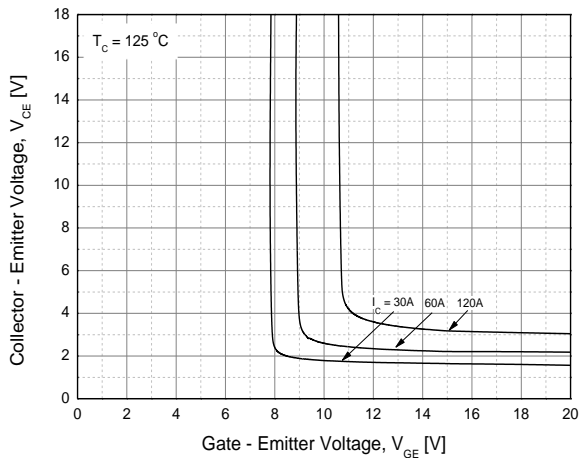
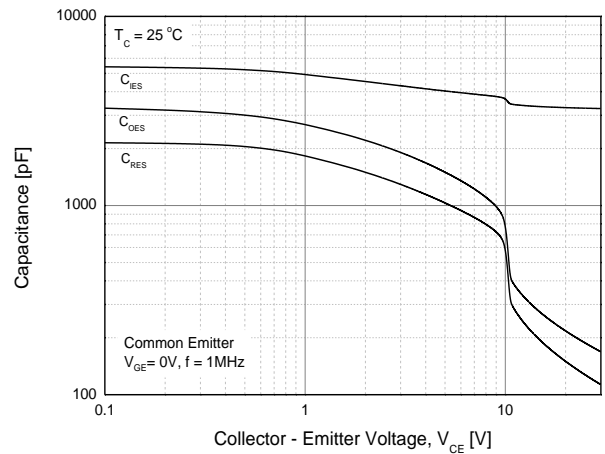


Fig. 6 Capacitance characteristics



# IGBT Characteristics

Fig. 7 Turn-on time vs. gate resistance

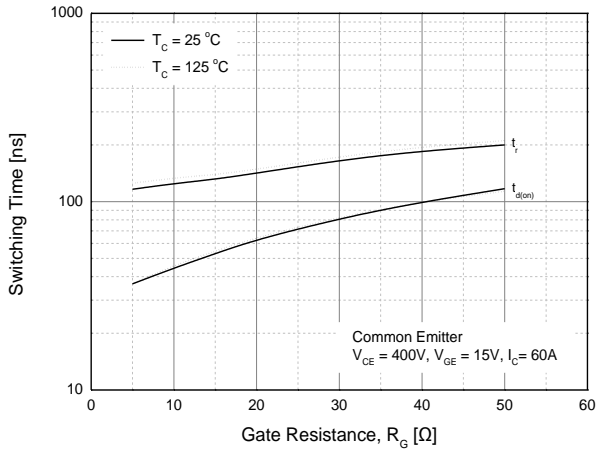


Fig. 8 Turn-off time vs. gate resistance

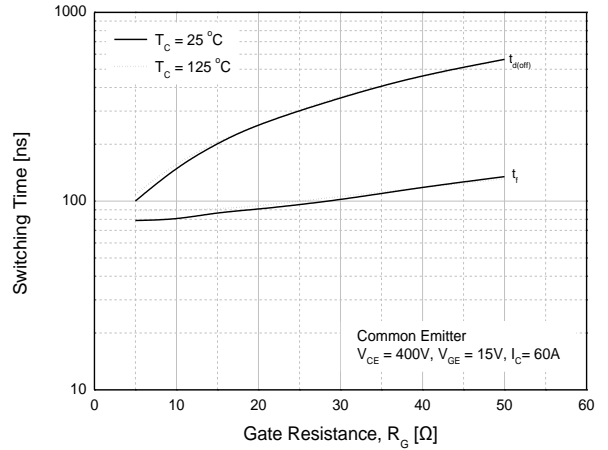


Fig. 9 Switching loss vs. gate resistance

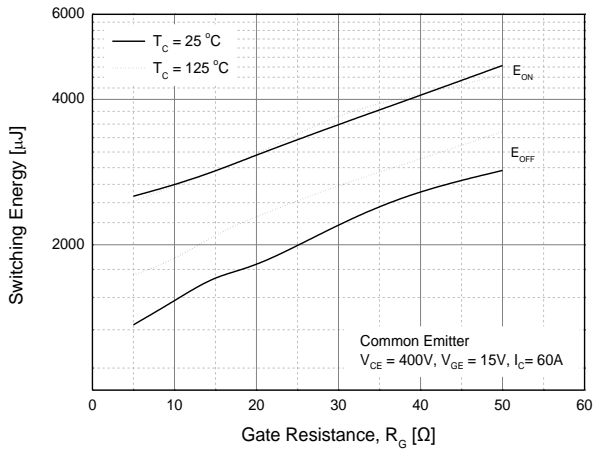


Fig. 10 Turn-on time vs. collector current

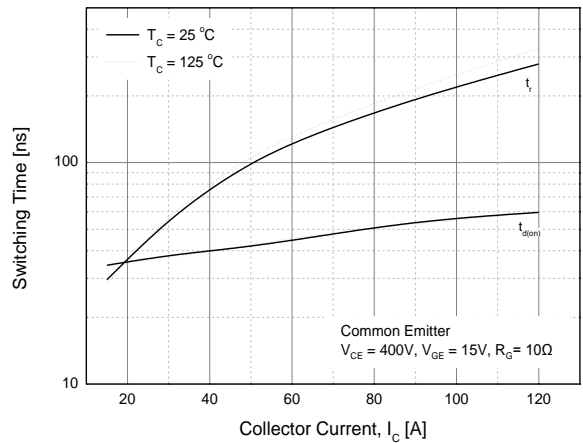


Fig. 11 Turn-off time vs. collector current

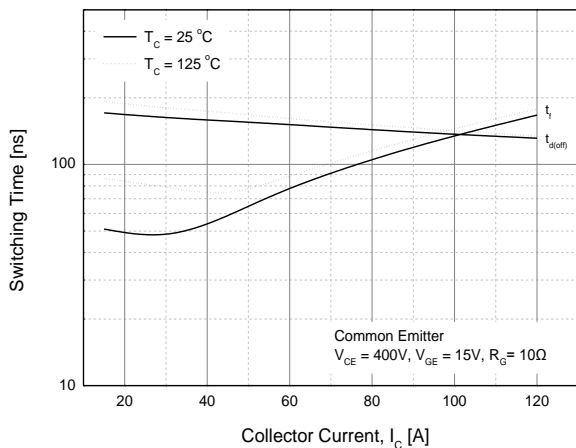
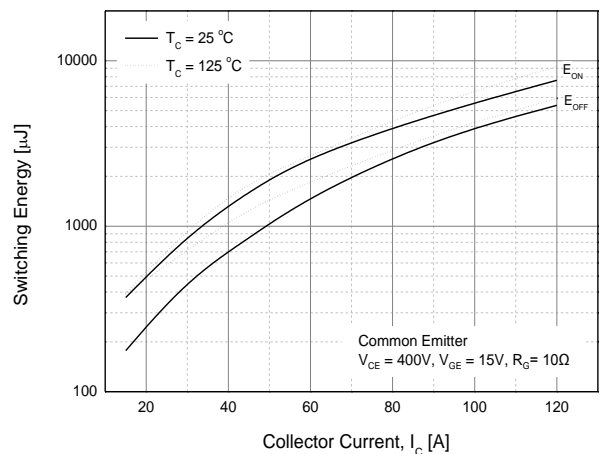


Fig. 12 Switching loss vs. collector current



**IGBT Characteristics**

Fig. 13 Gate charge characteristics

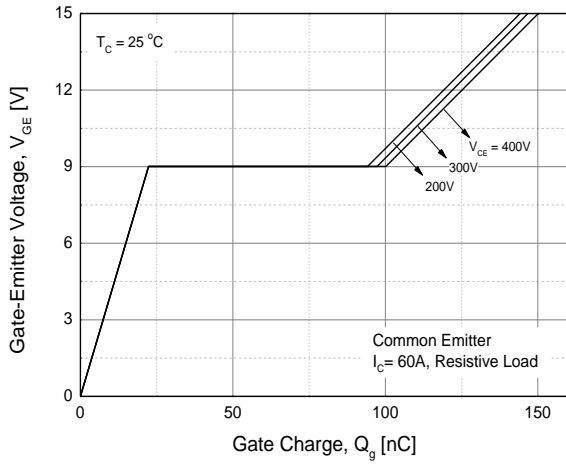


Fig. 14 SOA

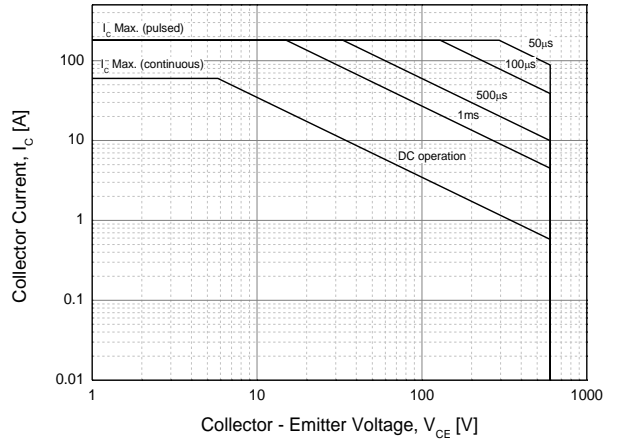


Fig. 15 RBSOA

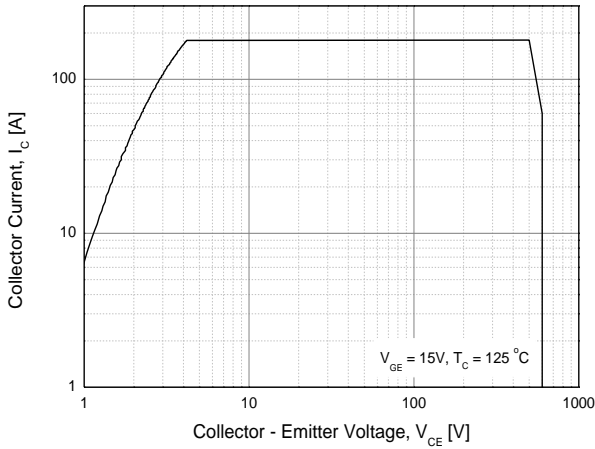


Fig. 16 Transient thermal impedance of IGBT

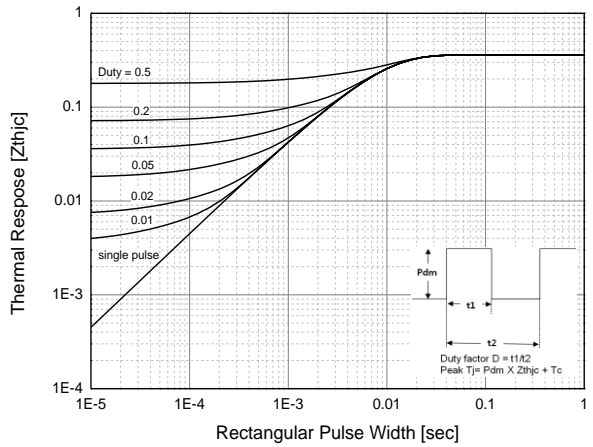
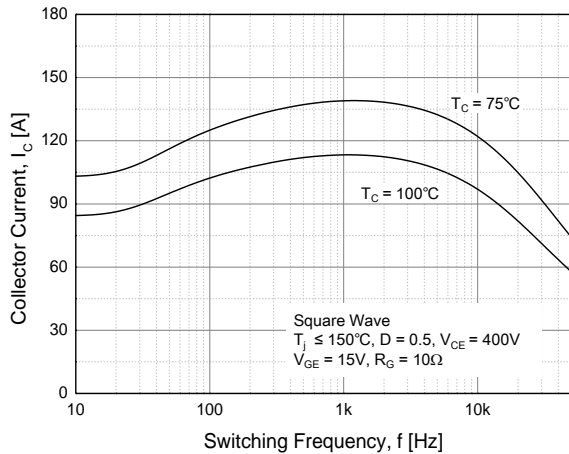


Fig. 17 Load Current vs. Frequency



## Diode Characteristics

Fig. 18 Conduction characteristics

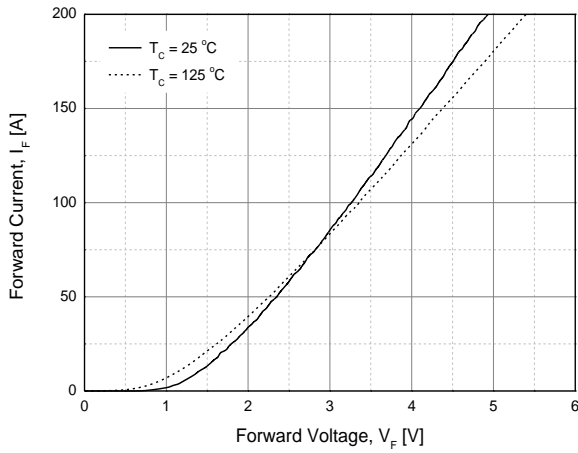


Fig. 19 Reverse recovery current vs. forward current

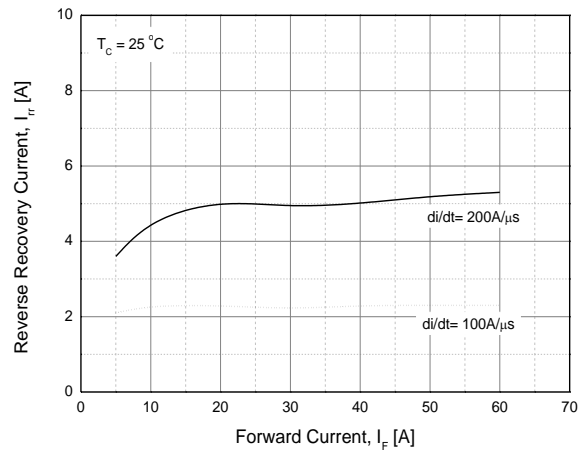


Fig. 20 Reverse recovery charge vs. forward current

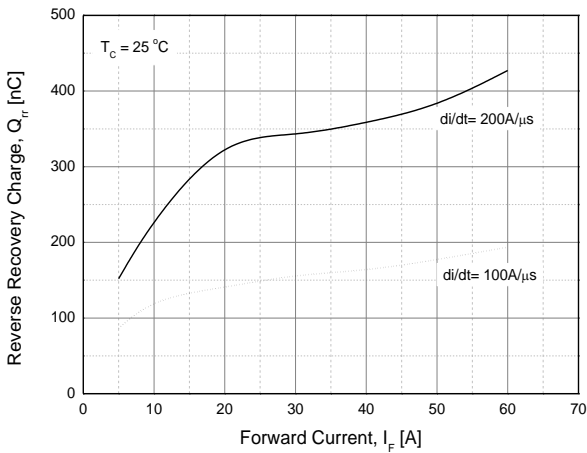
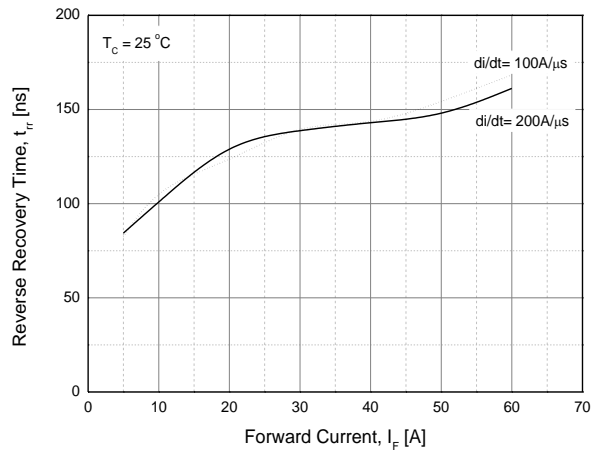
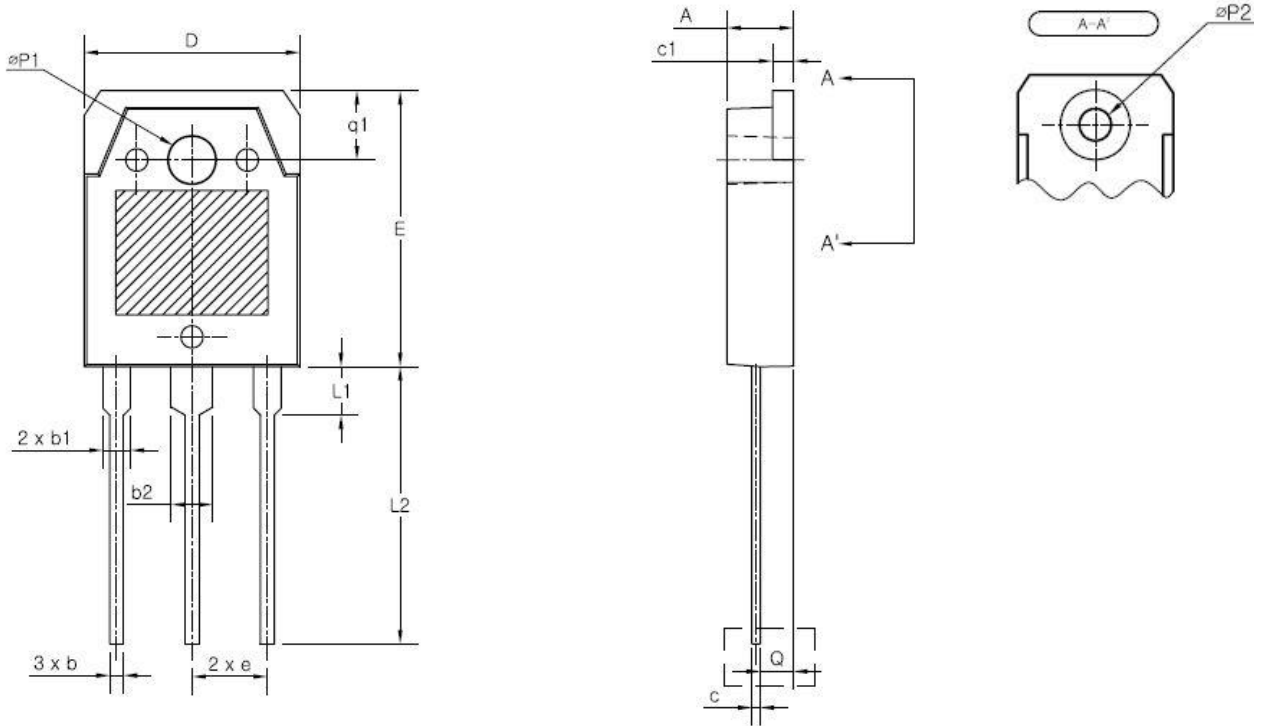


Fig. 21 Reverse recovery time vs. forward current



**TO-3PN MECHANICAL DATA**



SYMBOL	MIN	NOM	MAX
A	4.60	4.80	5.00
b	0.80	1.00	1.20
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.55	0.60	0.75
c1	1.45	1.50	1.65
D	15.40	15.60	15.80
E	19.70	19.90	20.10
e	5.15	5.45	5.75
L1	3.30	3.50	3.70
L2	19.80	20.00	20.20
øP1	3.30	3.40	3.50
øP2	(3.20)		
Q	2.20	2.40	2.60
q1	4.80	5.00	5.20