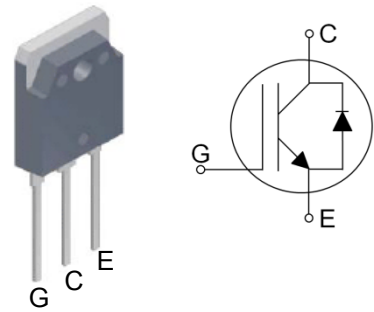


### Features

- 600V Fast Field Stop Trench Technology
- Low Switching Loss for a Wide Temperature Range
- Positive Temperature Coefficient
- Easy Parallel Operation
- RoHS Compliant
- JEDEC Qualification



### Applications

UPS, Welder, Inverter, Solar

Device	Package	Marking	Remark
TGAN60N60F2DS	TO-3PN	TGAN60N60F2DS	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
		$T_C = 100\text{ }^\circ\text{C}$	60
Pulsed Collector Current (Note 1)	$I_{CM}$	180	A
Diode Continuous Forward Current	$I_F$	30	A
Power Dissipation	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	357
		$T_C = 100\text{ }^\circ\text{C}$	143
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)	0.35	$^\circ\text{C}/\text{W}$
Maximum Thermal resistance, Junction-to-Case	$R_{\theta JC}$ (DIODE)	1.12	$^\circ\text{C}/\text{W}$
Maximum Thermal resistance, Junction-to-Ambient	$R_{\theta JA}$	40	$^\circ\text{C}/\text{W}$

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

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
<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
<b>ON</b>						
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	2.2	V
		$V_{GE} = 15V, I_C = 60A, T_C = 150^\circ\text{C}$	--	2.2	--	V
<b>DYNAMIC</b>						
Input Capacitance	$C_{IES}$	$V_{CE} = 30V,$ $V_{GE} = 0V$ $f = 1MHz$	--	3250	--	pF
Output Capacitance	$C_{OES}$		--	160	--	pF
Reverse Transfer Capacitance	$C_{RES}$		--	100	--	pF
<b>SWITCHING</b> (Note 2)						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400V, I_C = 60A$ $R_G = 10\Omega, V_{GE} = 15V$ Inductive Load, $T_C = 25^\circ\text{C}$	--	55	--	ns
Rise Time	$t_r$		--	130	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	160	--	ns
Fall Time	$t_f$		--	85	127	ns
Turn-On Switching Loss	$E_{ON}$		--	2.90	4.35	mJ
Turn-Off Switching Loss	$E_{OFF}$		--	1.52	2.28	mJ
Total Switching Loss	$E_{TS}$		--	4.42	6.63	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400V, I_C = 60A$ $R_G = 10\Omega, V_{GE} = 15V$ Inductive Load, $T_C = 150^\circ\text{C}$	--	55	--	ns
Rise Time	$t_r$		--	130	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	170	--	ns
Fall Time	$t_f$		--	80	--	ns
Turn-On Switching Loss	$E_{ON}$		--	3.18	4.77	mJ
Turn-Off Switching Loss	$E_{OFF}$		--	1.65	2.47	mJ
Total Switching Loss	$E_{TS}$		--	4.83	7.24	mJ
Total Gate Charge	$Q_g$	$V_{CC} = 400V, I_C = 60A$ $V_{GE} = 15V$	--	150	225	nC
Gate-Emitter Charge	$Q_{ge}$		--	20	30	nC
Gate-Collector Charge	$Q_{gc}$		--	80	120	nC

Notes :

(2) Not subject to production test – verified by design/characterization

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

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit	
Diode Forward Voltage	$V_{FM}$	$I_F = 30\text{A}$	$T_C = 25^\circ\text{C}$	--	1.9	--	V
			$T_C = 150^\circ\text{C}$	--	1.7	--	
Reverse Recovery Time	$t_{rr}$		$T_C = 25^\circ\text{C}$	--	55	--	ns
			$T_C = 150^\circ\text{C}$	--	170	--	
Reverse Recovery Current	$I_{rr}$	$I_F = 30\text{A},$ $di/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	--	4.5	--	A
			$T_C = 150^\circ\text{C}$	--	9.5	--	
Reverse Recovery Charge	$Q_{rr}$		$T_C = 25^\circ\text{C}$	--	145	--	nC
			$T_C = 150^\circ\text{C}$	--	1020	--	

### IGBT Characteristics

Fig. 1 Output characteristics

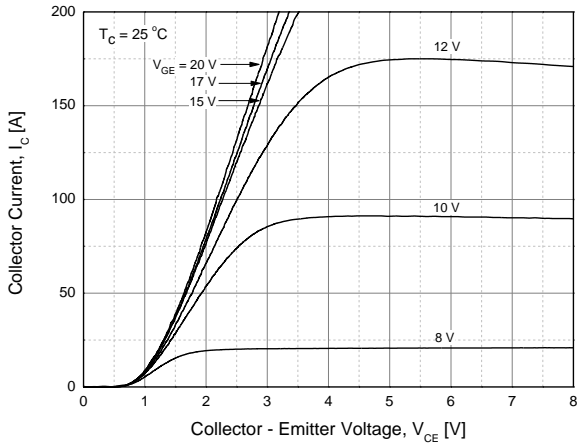


Fig. 2 Saturation voltage characteristics

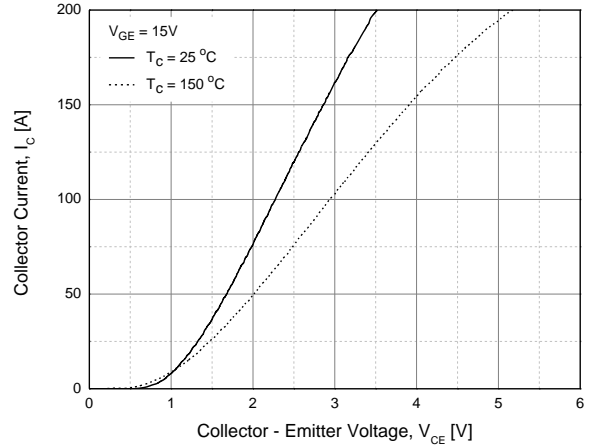


Fig. 3 Saturation voltage vs. collector current

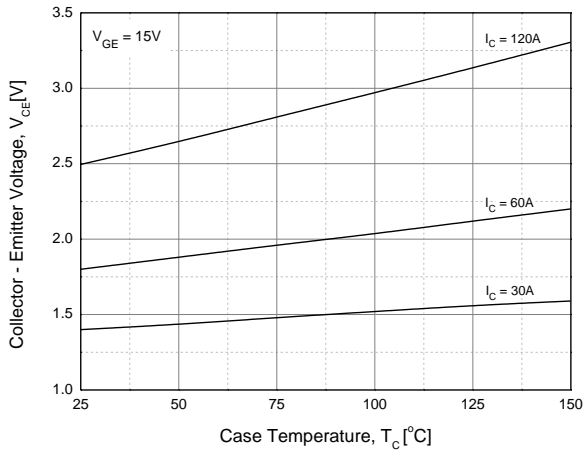


Fig. 4 Saturation voltage vs. gate bias

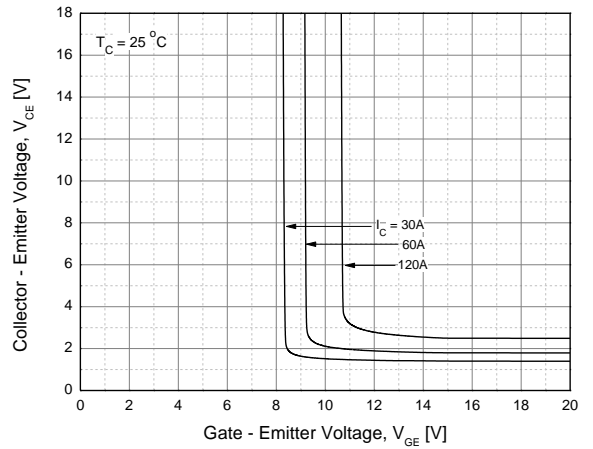


Fig. 5 Saturation voltage vs. gate bias

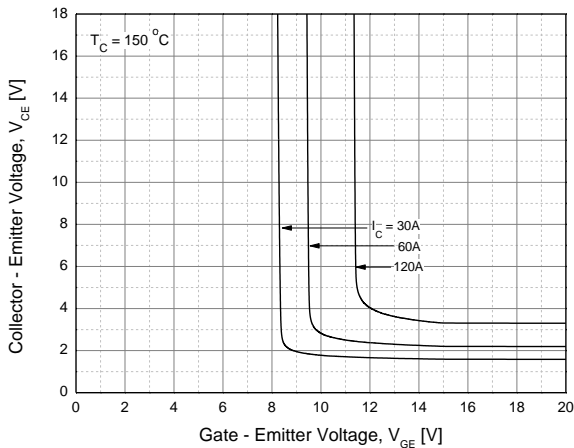
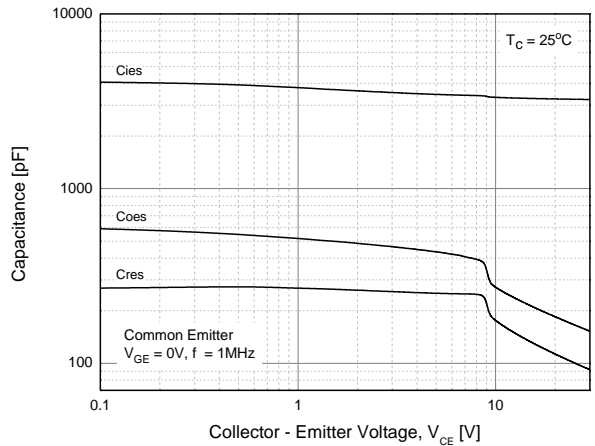


Fig. 6 Capacitance characteristics



# IGBT Characteristics

Fig. 7 Turn-on time vs. gate resistor

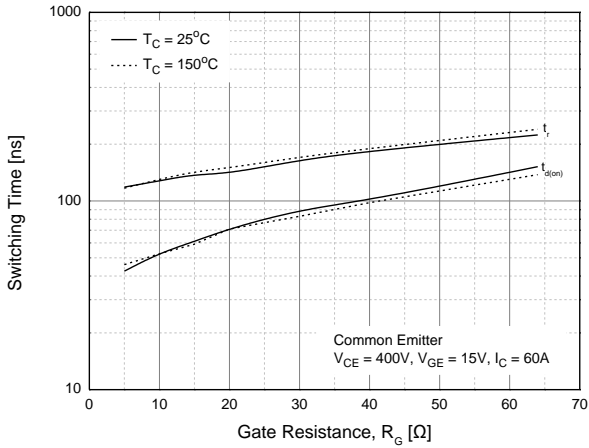


Fig. 8 Turn-off time vs. gate resistor

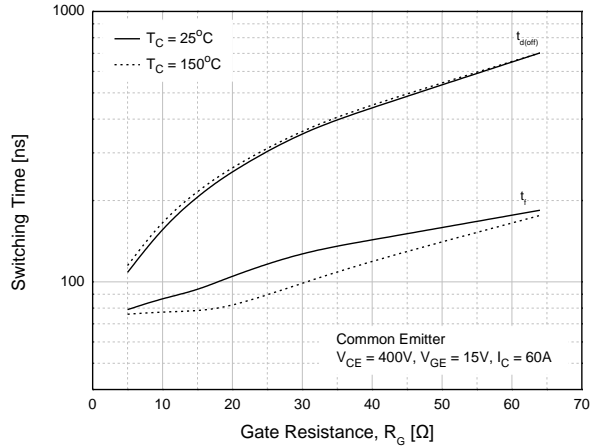


Fig. 9 Switching loss vs. gate resistor

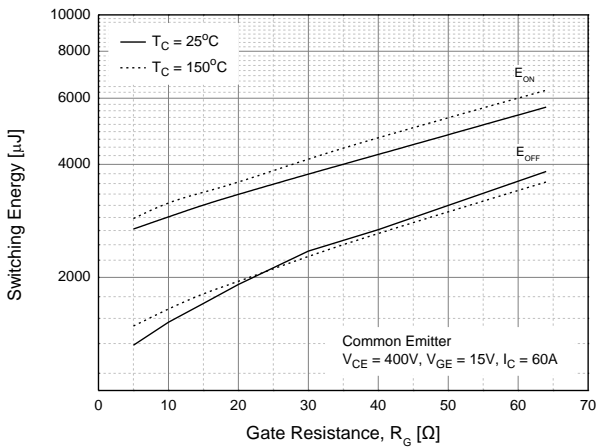


Fig. 10 Turn-on time vs. collector current

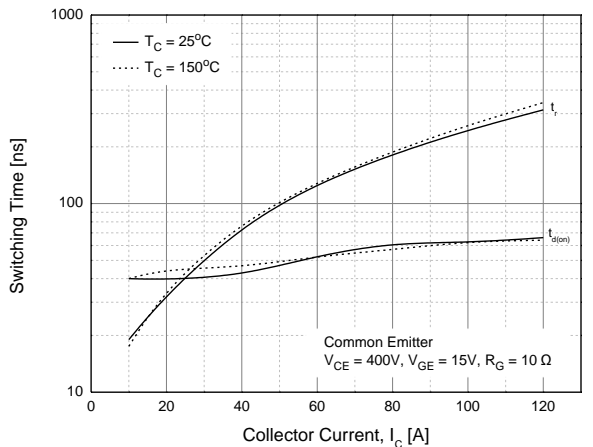


Fig. 11 Turn-off time vs. collector current

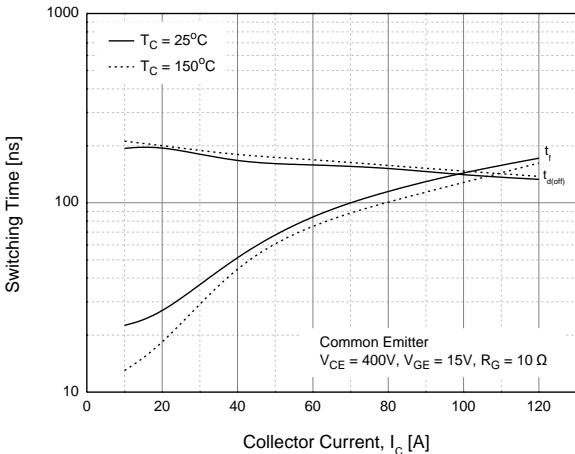
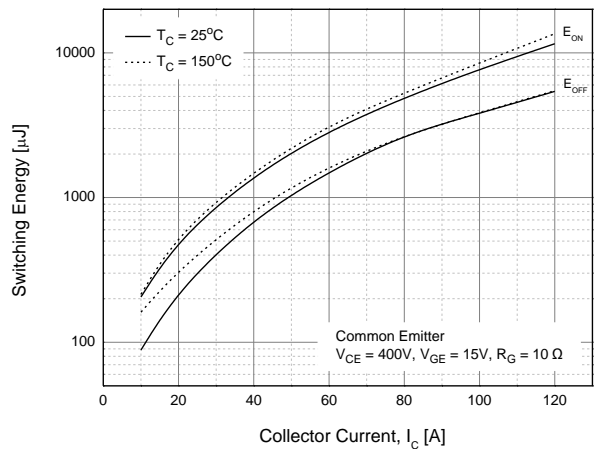


Fig. 12 Switching loss vs. collector current



# IGBT Characteristics

Fig. 13 Gate charge characteristics

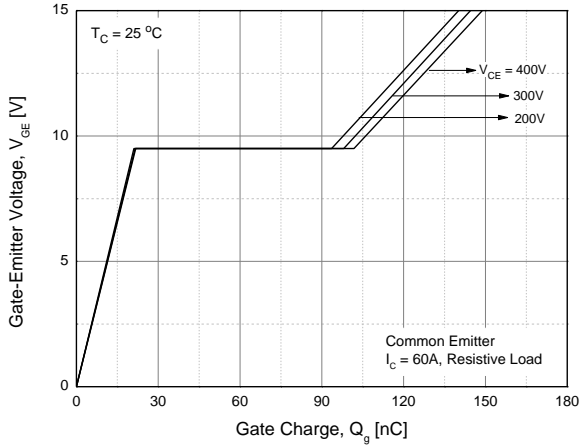


Fig. 14 SOA

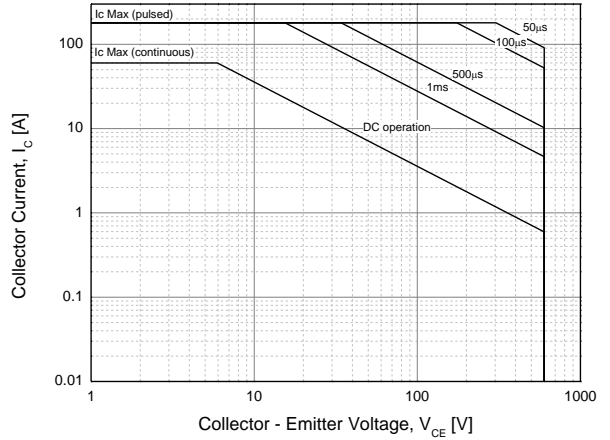


Fig. 15 RBSOA

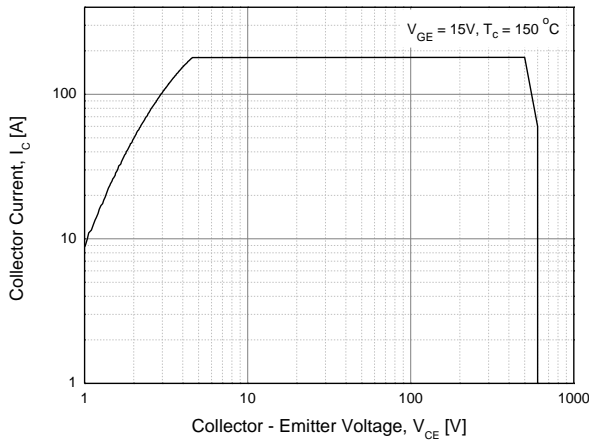


Fig. 16 Transient thermal impedance of IGBT

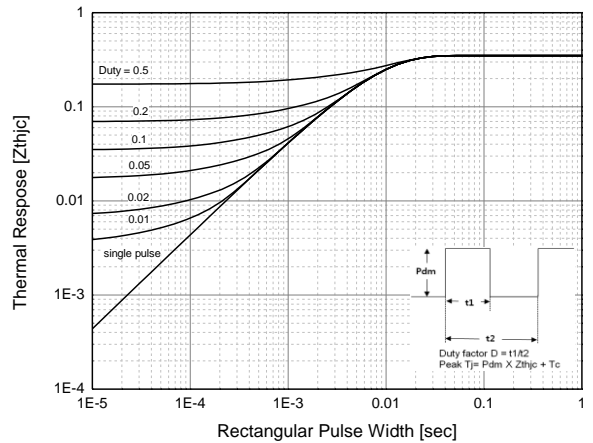
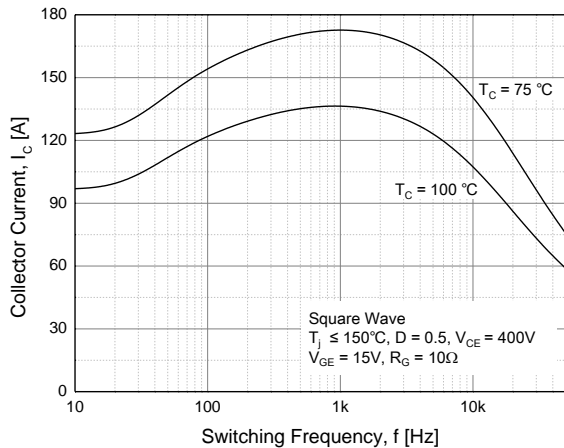


Fig. 17 Load Current vs. Frequency



## Diode Characteristics

Fig. 18 Conduction characteristics

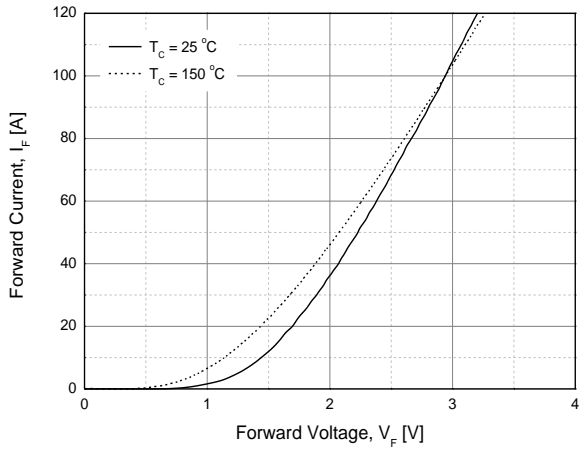


Fig. 19 Reverse recovery current vs. forward current

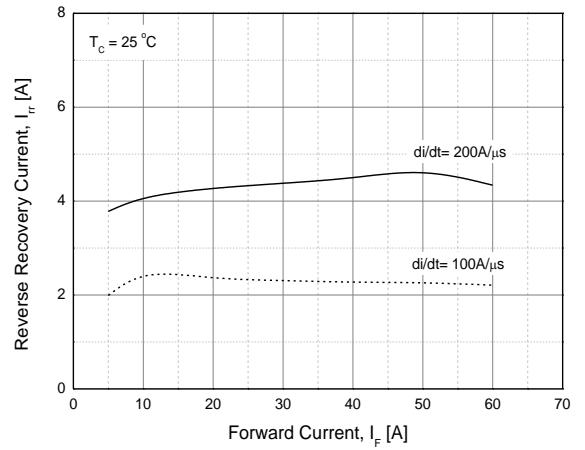


Fig. 20 Reverse recovery charge vs. forward current

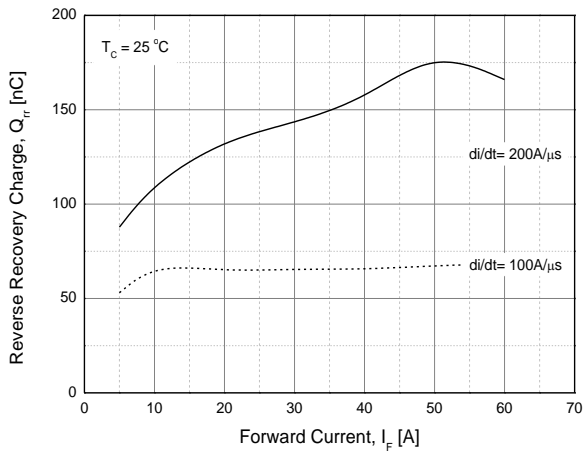
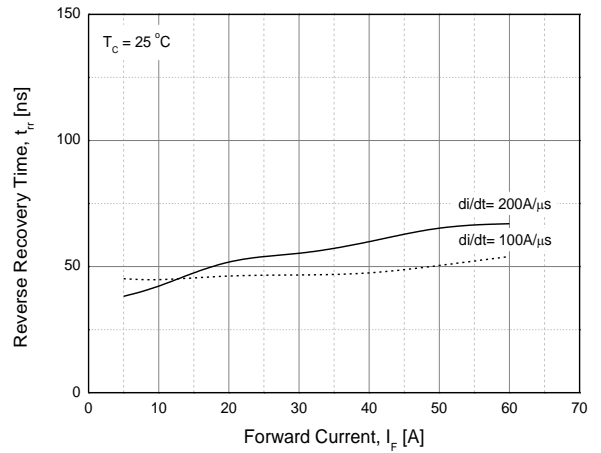
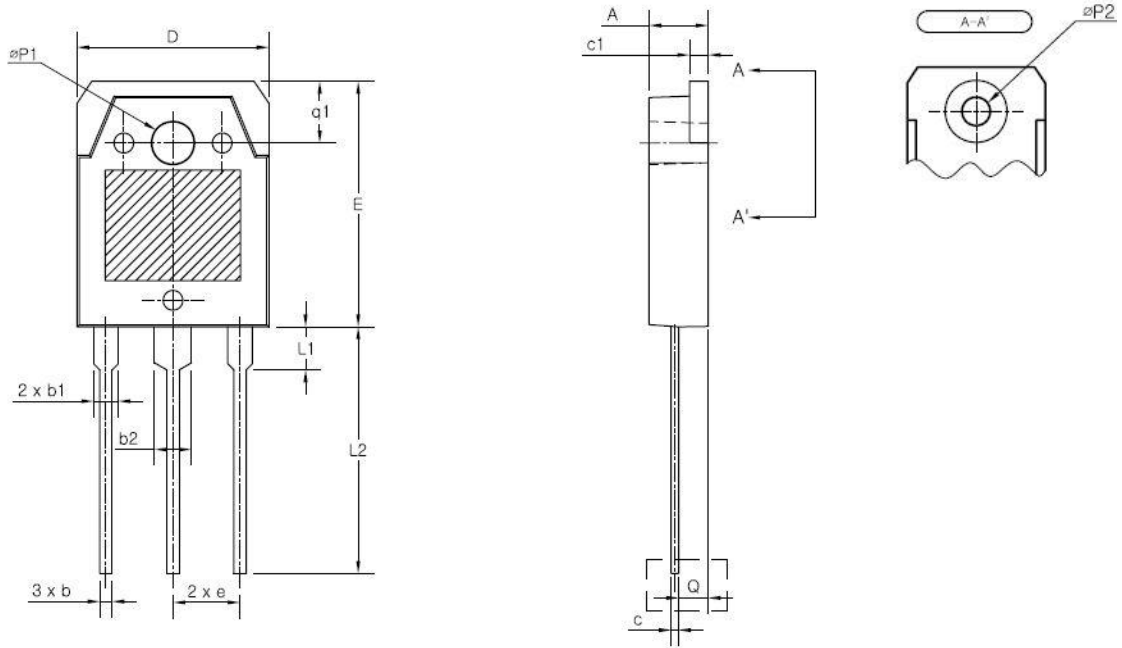


Fig. 21 Reverse recovery time vs. forward current



**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

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