

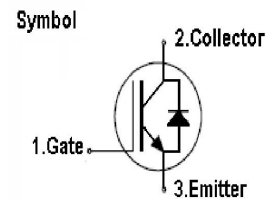
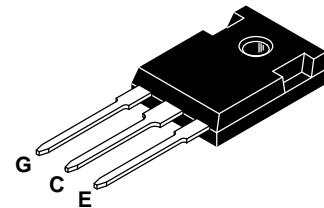
**PIN Connection TO-3P/TO-247**

## Features

- 1200V,20A,V<sub>ce(on)</sub>(typ)=2.3V@V<sub>ge</sub>=15V
- High speed switching
- Higher system efficiency
- Soft current turn-off waveforms
- Square RBSOA using NPT technology

## General Description

First semi NPT IGBTs offer lower losses and higher energy efficiency for application such as IH (induction heating), UPS,General inverter and other soft switching applications.



### Marking Diagram



- Y = Year
- A = Assembly Location
- WW = Work Week
- FIR20N120TD= Specific Device Code

## Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V <sub>CES</sub>	Collector-Emitter Voltage	1200	V
V <sub>GES</sub>	Gate-Emitter Voltage	± 30	V
I <sub>C</sub>	Continuous Collector Current ( T <sub>C</sub> =25 °C )	40	A
	Continuous Collector Current ( T <sub>C</sub> =100 °C )	20	A
I <sub>CM</sub>	Pulsed Collector Current (Note 1)	80	A
I <sub>F</sub>	Diode Continuous Forward Current ( T <sub>C</sub> =100 °C )	15	A
I <sub>FM</sub>	Diode Maximum Forward Current (Note 1)	80	A
t <sub>sc</sub>	Short Circuit Withstand Time	10	us
P <sub>D</sub>	Maximum Power Dissipation ( T <sub>C</sub> =25 °C )	192	W
	Maximum Power Dissipation ( T <sub>C</sub> =100 °C )	76	W
T <sub>J</sub>	Operating Junction Temperature Range	-55 to +150	°C
T <sub>STG</sub>	Storage Temperature Range	-55 to +150	°C

## Thermal Characteristics

Symbol	Parameter	Max.	Units
R <sub>th j-c</sub>	Thermal Resistance, Junction to case for IGBT	0.45	°C / W
R <sub>th j-c</sub>	Thermal Resistance, Junction to case for Diode	0.85	°C / W
R <sub>th j-a</sub>	Thermal Resistance, Junction to Ambient	40	°C / W

**Electrical Characteristics** ( $T_C=25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0V, I_C=250\mu A$	1200	-	-	V
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE}=1200V, V_{GE}=0V$	-	-	25	$\mu A$
$I_{GES}$	Gate Leakage Current, Forward	$V_{GE}=30V, V_{CE}=0V$	-	-	100	nA
	Gate Leakage Current, Reverse	$V_{GE}=-30V, V_{CE}=0V$	-	-	-100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=250\mu A$	4.5	5.0	5.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=20A$	-	2.3	2.7	V
$Q_g$	Total Gate Charge	$V_{CC}=600V$ $V_{GE}=15V$ $I_C=20A$	-	100	120	nC
$Q_{ge}$	Gate-Emitter Charge		-	22	25	nC
$Q_{gc}$	Gate-Collector Charge		-	45	50	nC
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V$ $V_{GE}=15V$ $I_C=20A$ $R_G=28\Omega$ Inductive Load $T_C=25^\circ\text{C}$	-	45	-	ns
$t_r$	Turn-on Rise Time		-	55	-	ns
$t_{d(off)}$	Turn-off Delay Time		-	350	-	ns
$t_f$	Turn-off Fall Time		-	80	-	ns
Eon	Turn-on Switching Loss		-	2.7	-	mJ
Eoff	Turn-off Switching Loss		-	0.95	-	mJ
Ets	Total Switching Loss		-	3.65	-	mJ
$C_{ies}$	Input Capacitance	$V_{CE}=25V$ $V_{GE}=0V$ $f=100\text{kHz}$	-	619	-	pF
$C_{oes}$	Output Capacitance		-	109	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	46	-	pF
$R_{Gint}$	Integrated gate resistor		2.0	2.5	3.0	$\Omega$

**Electrical Characteristics of Diode** ( $T_C=25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=15A$	-	1.35	1.5	V
$t_{rr}$	Diode Reverse Recovery Time	$V_{CE}=600V$ $I_F=15A$ $di_F/dt=500A/\mu s$	-	210	245	ns
$I_{rr}$	Diode peak Reverse Recovery Current		-	27	30	A
$Q_{rr}$	Diode Reverse Recovery Charge		-	3300	3700	nC

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature

## Typical Performance Characteristics

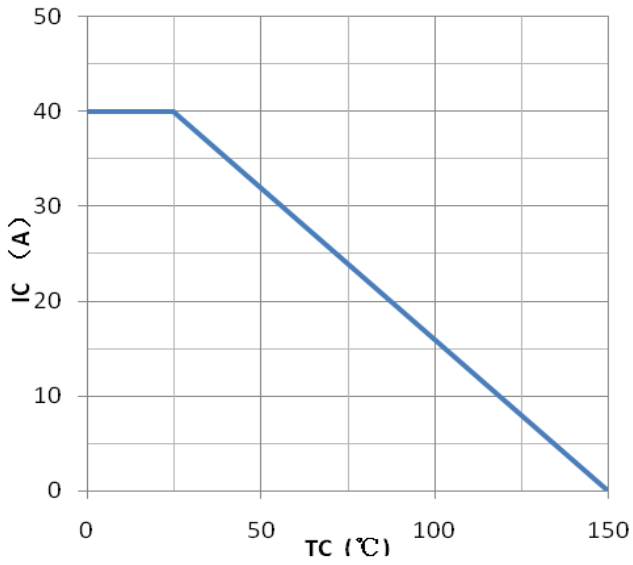


Figure1:maximum DC collector current VS. case temprature

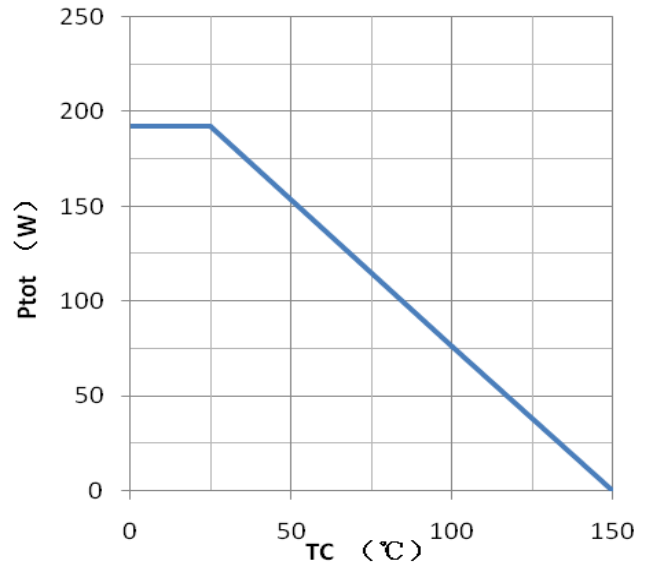


Figure2:power dissipation VS. case temprature

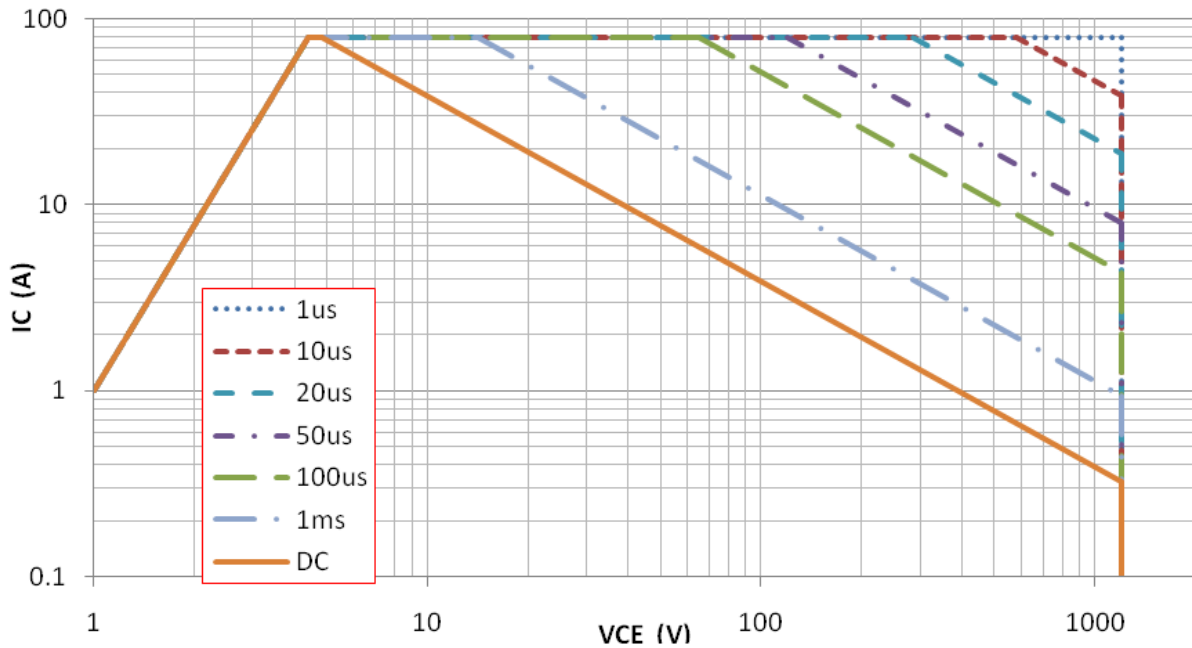


Figure3:forward SOA,TC=25°C,TJ≤150°C

## Typical Performance Characteristics

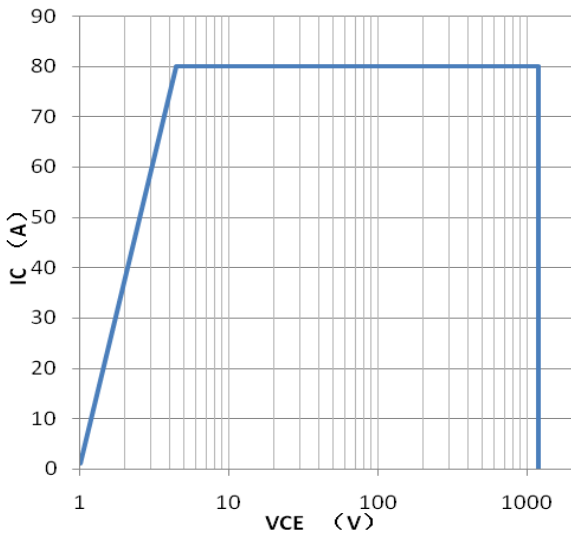


Figure4:reverse bias SOA,  $T_J=150^{\circ}\text{C}$ ,  $V_{GE}=15\text{V}$

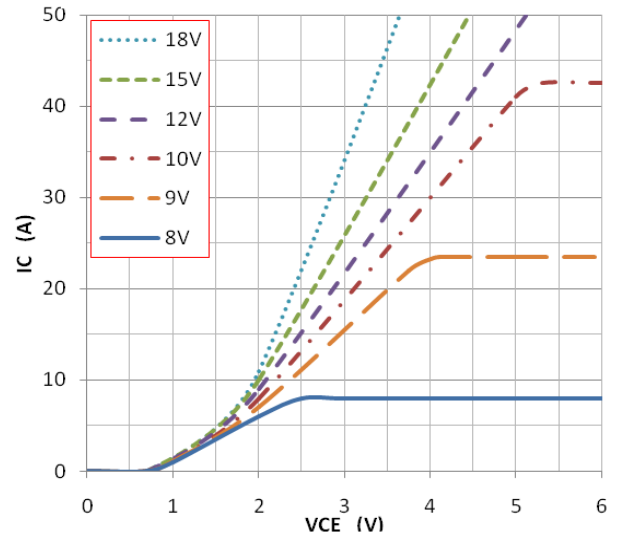


Figure5:typical IGBT output characteristics,  $T_J=25^{\circ}\text{C}$ ;  $t_p=300\mu\text{s}$

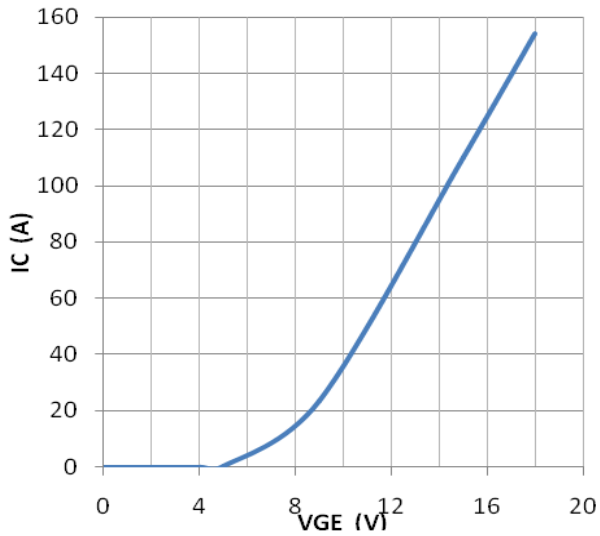


Figure6:typical trans characteristics,  $V_{CE}=20\text{V}$ ,  $t_p=20\mu\text{s}$

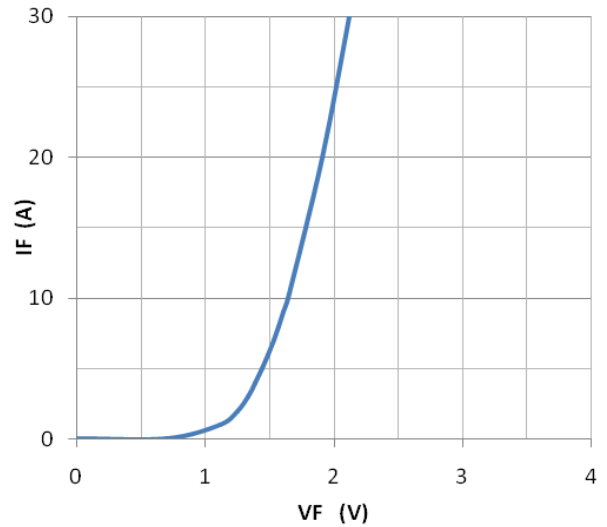


Figure7:typical diode forward characteristic,  $t_p=300\mu\text{s}$

## Typical Performance Characteristics

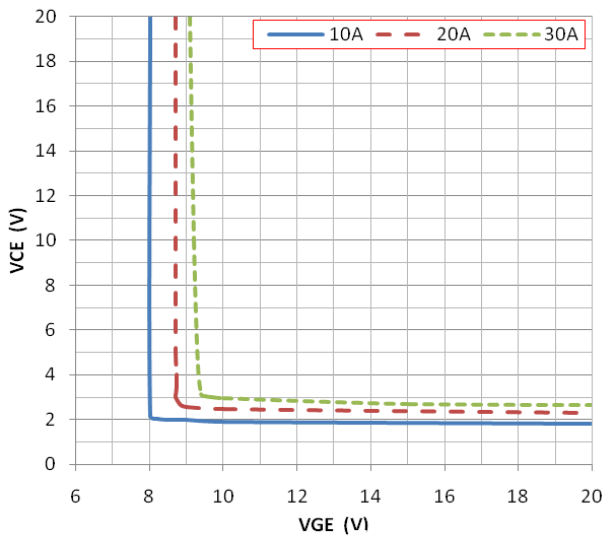


Figure8: typical VCE VS. VGE,  $T_J=25^{\circ}\text{C}$

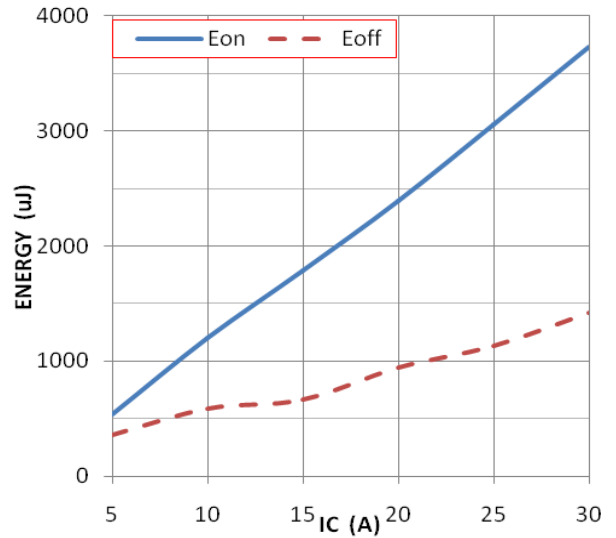


Figure9: typical energy loss VS.  $I_C$ ,  $T_C=25^{\circ}\text{C}$ ,  $L=500\mu\text{H}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $R_g=28\Omega$

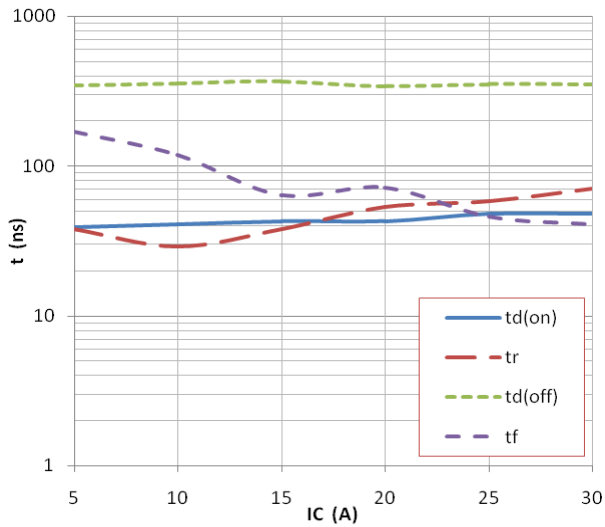


Figure10: typical switching time VS.  $I_C$ ,  $T_C=25^{\circ}\text{C}$ ,  $L=500\mu\text{H}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $R_g=28\Omega$

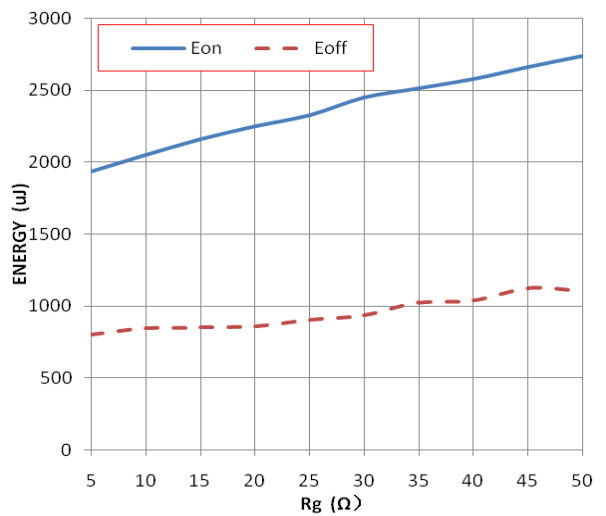


Figure11: typical energy loss VS.  $R_g$ ,  $T_C=25^{\circ}\text{C}$ ,  $L=500\mu\text{H}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $I_C=20\text{A}$

## Typical Performance Characteristics

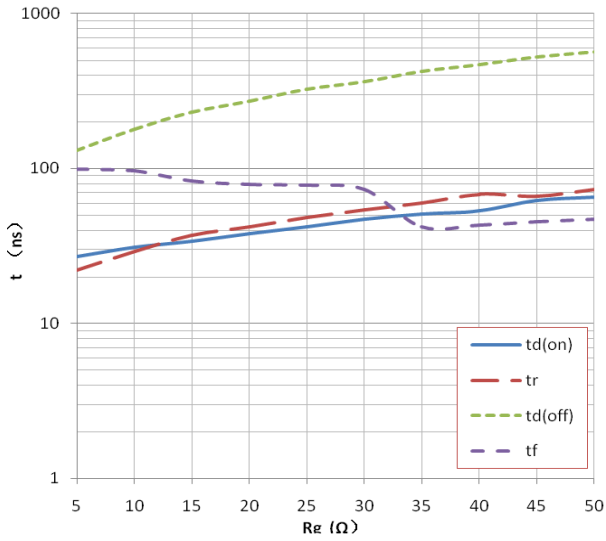


Figure 11: typical switching time VS. Rg, TC=25°C  
L=500uH, VCE=600V, VGE=15V, IC=20A

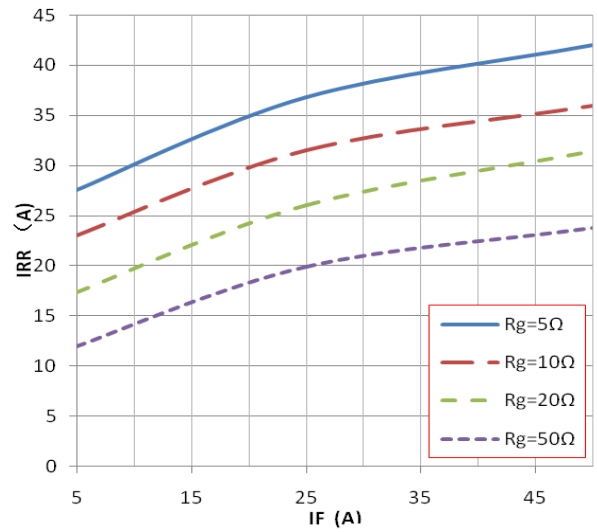


Figure 12: typical diode IRR VS. IF, TC=25°C  
VCC=600V, VGE=15V

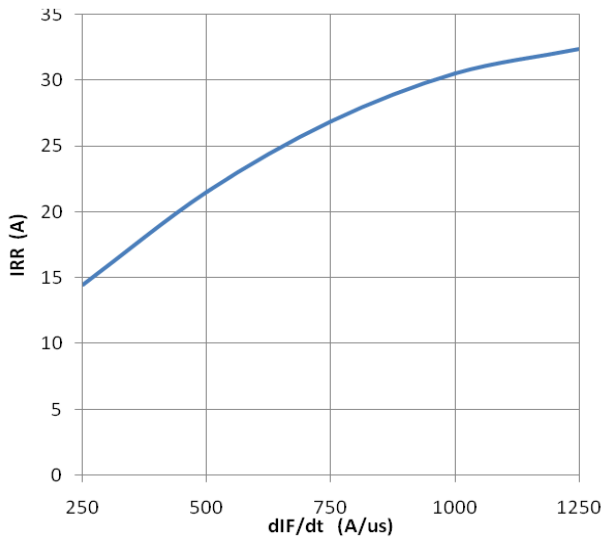


Figure 13: typical diode IRR VS. dIF/dt  
VCC=600V, VGE=15V, IF=20A

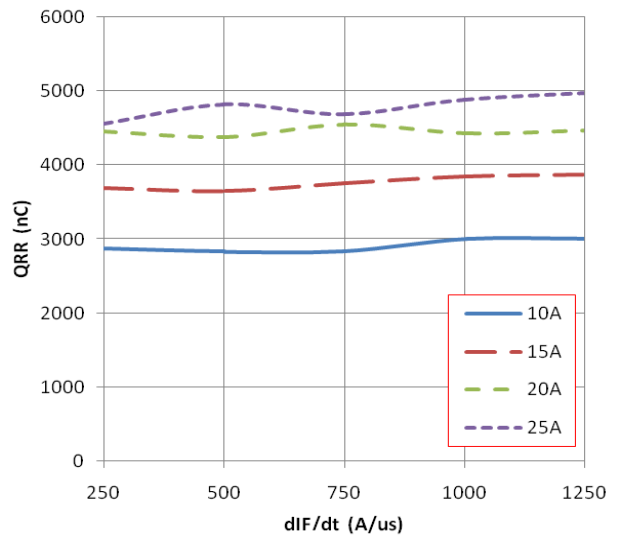


Figure 14: typical diode QRR VS. dIF/dt  
VCC=600V, VGE=15V

Typical Performance Characteristics

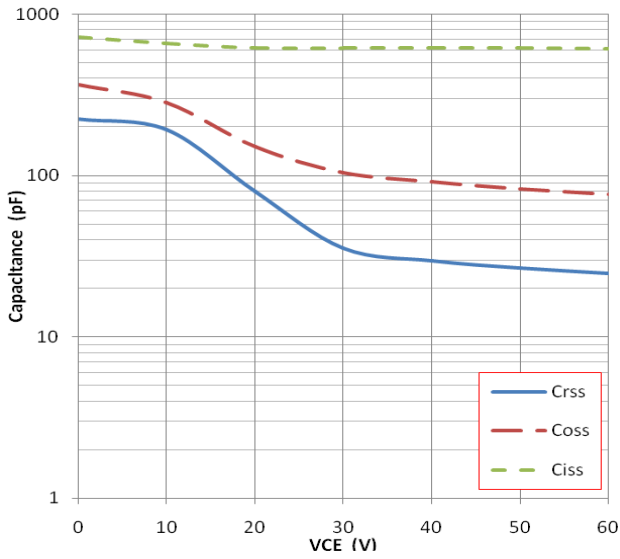


Figure15:typical capacitance VS. VCE,VGE=0V,f=100kHz

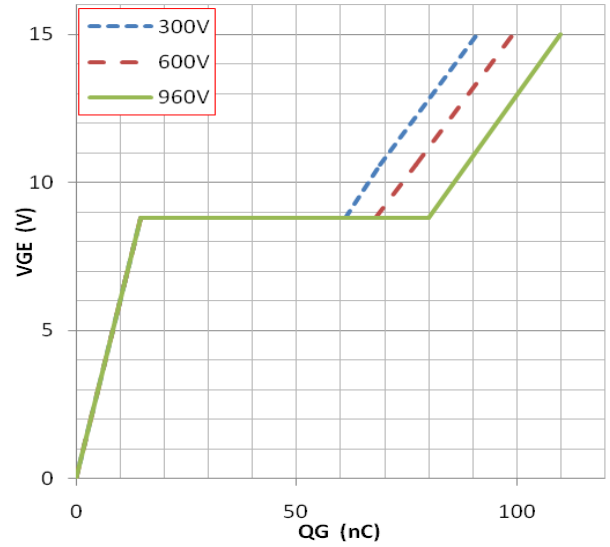


Figure16:typical gate charge VS. VGE,IC=20A

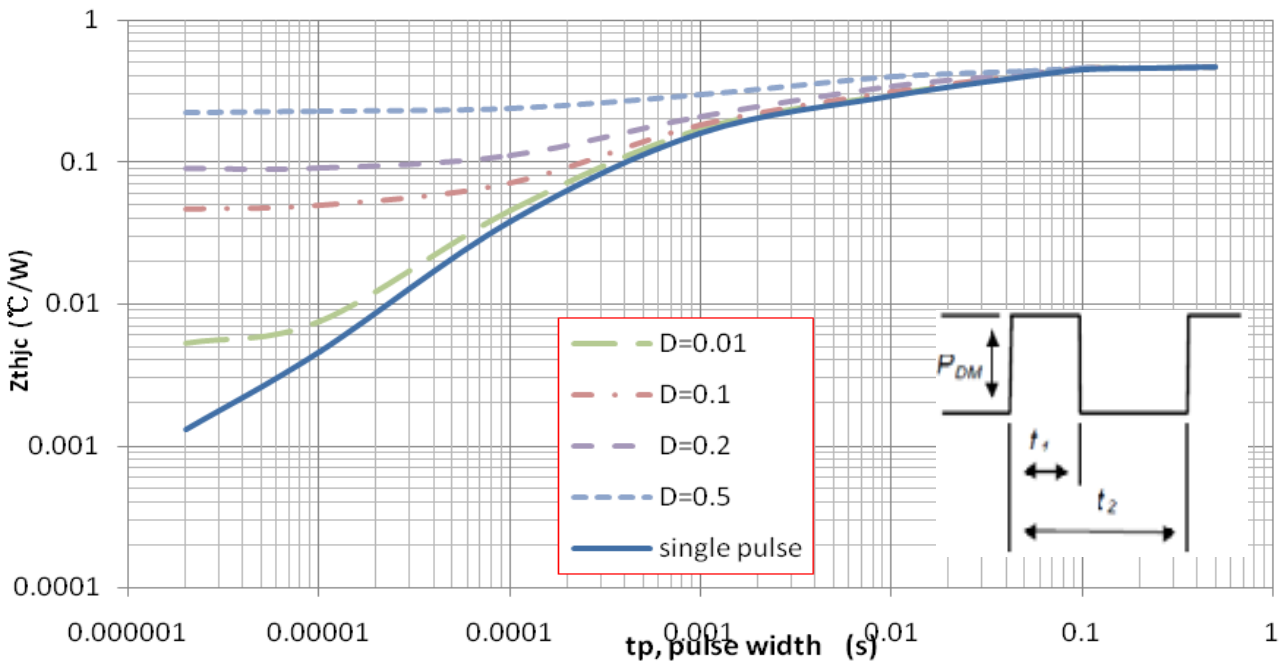
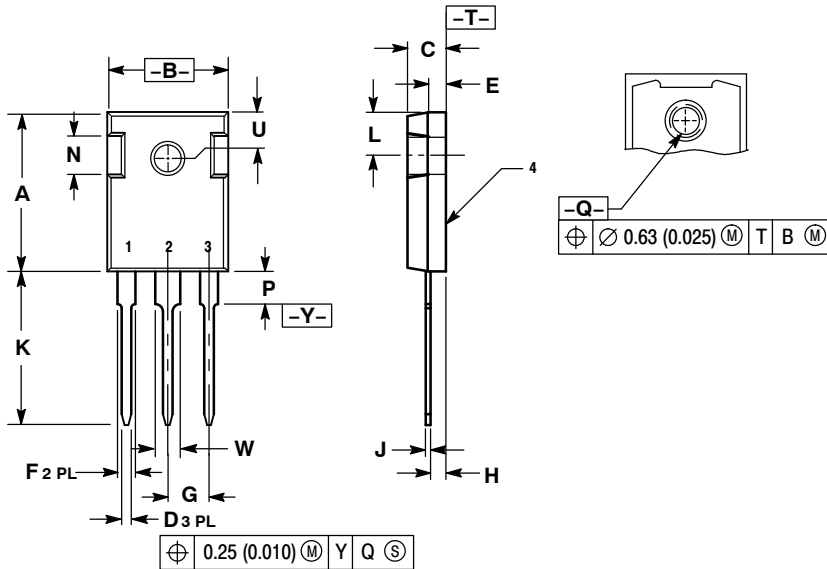


Figure19:normalised transient thermal impedance,junction-to-case

Note1.Duty factor  $D=t_1/t_2$ ; Note2:peak  $T_J=P_{DM} \times Z_{thjc}+T_C$

## Package Dimensions

### TO-3P/TO-247



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	20.32	21.08	0.800	0.830
B	15.75	16.26	0.620	0.640
C	4.70	5.30	0.185	0.209
D	1.00	1.40	0.040	0.055
E	1.90	2.60	0.075	0.102
F	1.65	2.13	0.065	0.084
G	5.45 BSC		0.215 BSC	
H	1.50	2.49	0.059	0.098
J	0.40	0.80	0.016	0.031
K	19.81	20.83	0.780	0.820
L	5.40	6.20	0.212	0.244
N	4.32	5.49	0.170	0.216
P	---	4.50	---	0.177
Q	3.55	3.65	0.140	0.144
U	6.15 BSC		0.242 BSC	
W	2.87	3.12	0.113	0.123

**STYLE 2:**

- PIN 1. ANODE
- 2. CATHODE (S)
- 3. ANODE 2
- 4. CATHODES (S)