Ordering number : ENA2283A

# NGTB10N60FG

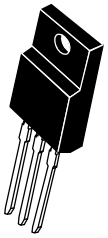
## N-Channel IGBT
## 600V, 10A, $V_{CE}$(sat);1.5V, TO-220F-3FS

ON Semiconductor®

http://onsemi.com

### Features

- IGBT $V_{CE}$ (sat)=1.5V typ. ($I_C$=10A, $V_{GE}$=15V)
- IGBT $I_C$=20A (Tc=25°C)
- Adaption of full isolation type package
- 5μs short circuit capability
- Diode $V_F$=1.3V typ.($I_F$=10A)
- Diode $t_{rr}$=70ns typ.
- Enhansment type



TO-220F-3FS

### Applications

- Power factor correction of white goods appliance
- General purpose inverter

### Specifications

**Absolute Maximum Ratings** at Ta = 25°C, Unless otherwise specified

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| Collector to Emitter Voltage | $V_{CES}$ | | | 600 | V |
| Gate to Emitter Voltage | $V_{GES}$ | | | ±20 | V |
| Collector Current (DC) | $I_C$*1 | Limited by Tjmax | @ Tc=25°C *2 | 20 | A |
| | | | @ Tc=100°C *2 | 10 | A |
| Collector Current (Pulse) | $I_{CP}$ | Pulse width Limited by Tjmax | | 72 | A |
| Diode Average Output Current | $I_O$ | | | 10 | A |
| Allowable Power Dissipation | $P_D$ | Tc=25°C (Our ideal heat dissipation condition) *2 | | 40 | W |
| Junction Temperature | Tj | | | 150 | °C |
| Storage Temperature | Tstg | | | - 55 to +150 | °C |

Note : *1 Collector Current is calculated from the following formula.

$$I_C(Tc)= \frac{Tjmax - Tc}{R_{th}(j\text{-}c)\times V_{CE}(sat)\ (I_C(Tc))}$$

*2 Our condition is radiation from backside.
The method is applying silicone grease to the backside of the device and attaching the device to water-cooled radiator made of aluminium.

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**Electrical Characteristics** at Ta = 25°C, Unless otherwise specified

| Parameter | Symbol | Conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | min | typ | max | |
| Collector to Emitter Breakdown Voltage | $V_{(BR)CES}$ | $I_C$=500μA, $V_{GE}$=0V | | 600 | | | V |
| Collector to Emitter Cut off Current | $I_{CES}$ | $V_{CE}$=600V, $V_{GE}$=0V | Tc=25°C | | | 10 | μA |
| | | | Tc=125°C | | | 1 | mA |
| Gate to Emitter Leakage Current | $I_{GES}$ | $V_{GE}$=±20V, $V_{CE}$ =0V | | | | ±100 | nA |
| Gate to Emitter Threshold Voltage | $V_{GE}$(off) | $V_{CE}$ =20V, $I_C$=250μA | | 4.5 | | 6.5 | V |
| Collector to Emitter Saturation Voltage | $V_{CE}$(sat) | $V_{GE}$=15V, $I_C$=10A | Tc=25°C | | 1.5 | 1.7 | V |
| | | | Tc=125°C | | 1.7 | | V |
| Diode Forward Voltage | $V_F$ | $I_F$=10A | | | 1.3 | | V |
| Input Capacitance | Cies | $V_{CE}$ =20V,f=1MHz | | | 1440 | | pF |
| Output Capacitance | Coes | | | | 60 | | pF |
| Reverse Transfer Capacitance | Cres | | | | 30 | | pF |

Continued on next page.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

Continued from preceding page.

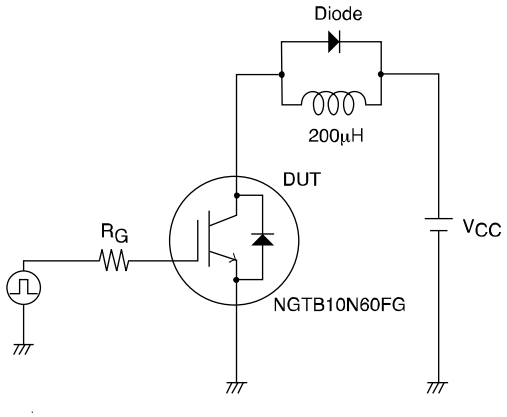
| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Turn-ON Delay Time | $t_{d}$(on) | $V_{CC}$=300V,$I_C$=10A<br>$R_G$=30Ω,L=200μH<br>$V_{GE}$=0V/15V<br>Vclamp=400V<br>See Fig.1, See Fig.2 | | 40 | | ns |
| Rise Time | $t_r$ | | | 23 | | ns |
| Turn-ON Time | ton | | | 110 | | ns |
| Turn-OFF Delay Time | $t_{d}$(off) | | | 145 | | ns |
| Fall Time | $t_f$ | | | 90 | | ns |
| Turn-OFF Time | toff | | | 240 | | ns |
| Total Gate Charge | Qg | $V_{CE}$ =300V, $V_{GE}$=15V, $I_C$=10A | | 55 | | nC |
| Gate to Emitter Charge | Qge | | | 20 | | nC |
| Gate to Collector “Miller” Charge | Qgc | | | 10 | | nC |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_F$=10A, di/dt=100A/μs, $V_{CC}$=50V, See Fig.3 | | 70 | | ns |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

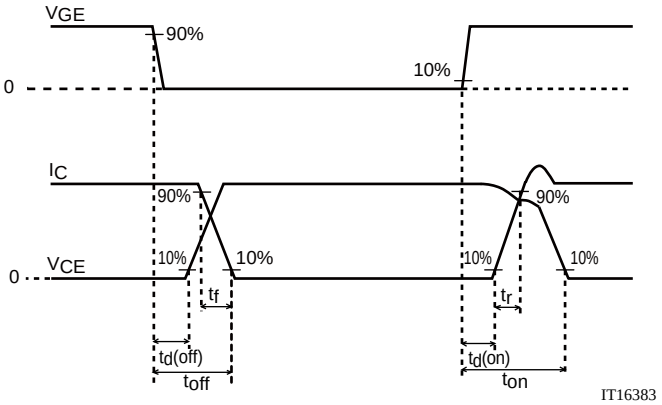
**Thermal Characteristics** at Ta = 25°C, Unless otherwise specified

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Thermal Resistance IGBT (junction- Case) | Rth(j-c) (IGBT) | Tc=25°C (Our ideal heat dissipation condition)*2 | 3.09 | °C /W |
| Thermal Resistance Diode (junction- Case) | Rth(j-c) (Diode) | Tc=25°C (Our ideal heat dissipation condition)*2 | 4 | °C /W |
| Thermal Resistance (junction- ambient) | Rth(j-a) | | 59.5 | °C /W |

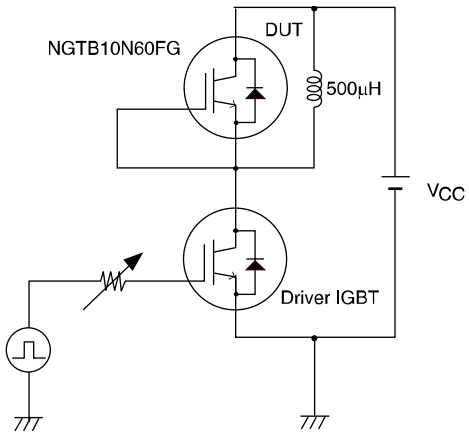
## Fig.1 Switching Time Test Circuit

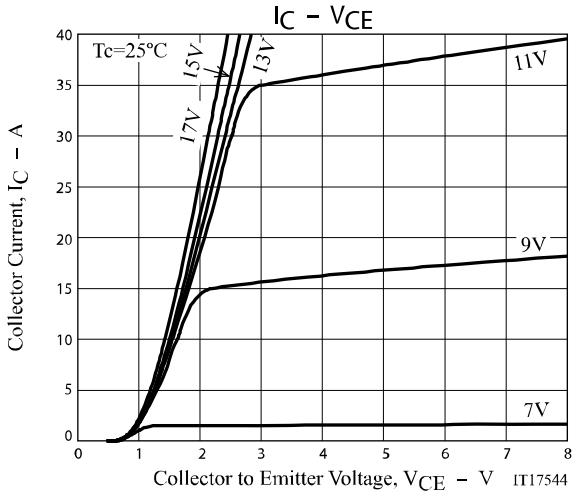


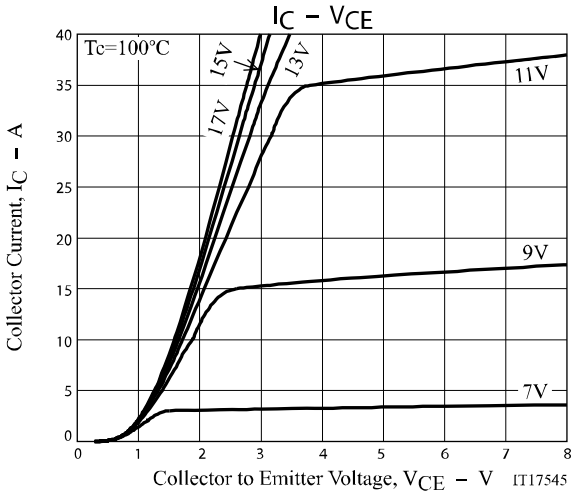

## Fig.2 Timing Chart

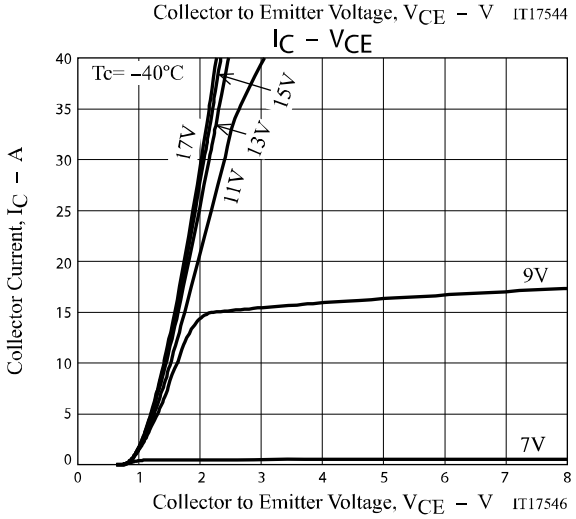


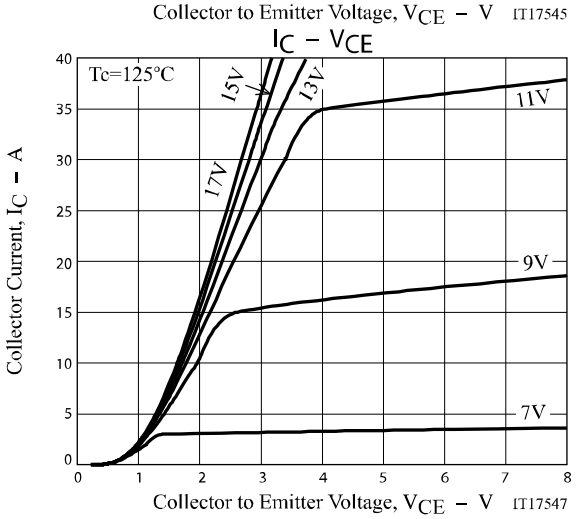

## Fig.3 Reverse Recovery Time Test Circuit

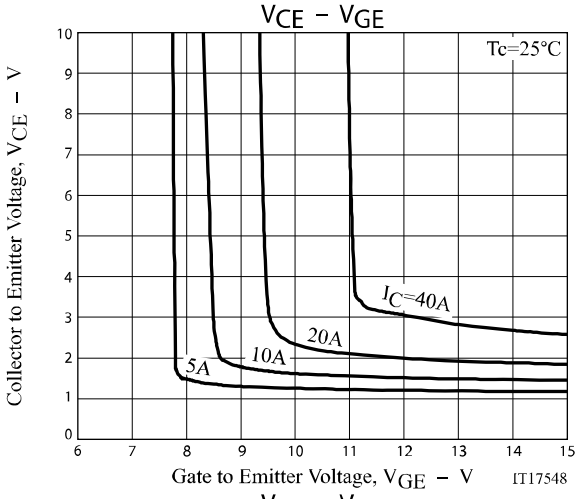


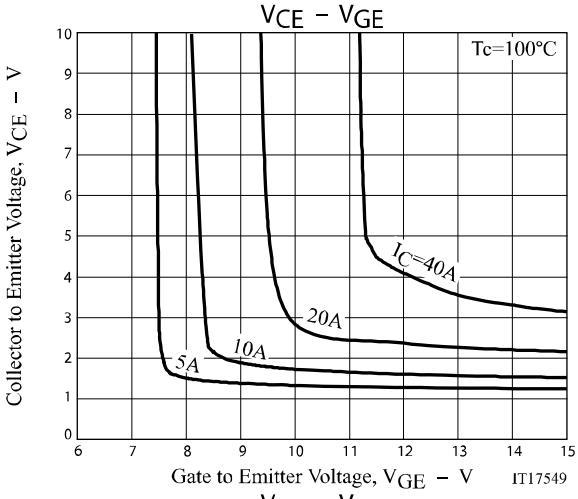

IC – VCE
Tc=25°C
15V
13V
17V
11V
9V
7V
Collector Current, IC – A
Collector to Emitter Voltage, VCE – V
IT17544

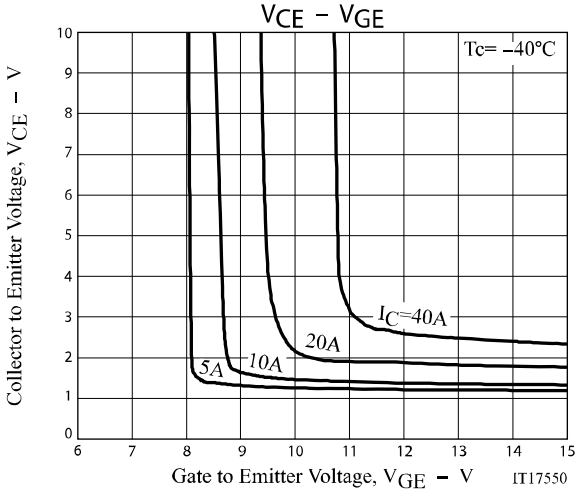

IC – VCE
Tc=100°C
15V
13V
17V
11V
9V
7V
Collector Current, IC – A
Collector to Emitter Voltage, VCE – V
IT17545

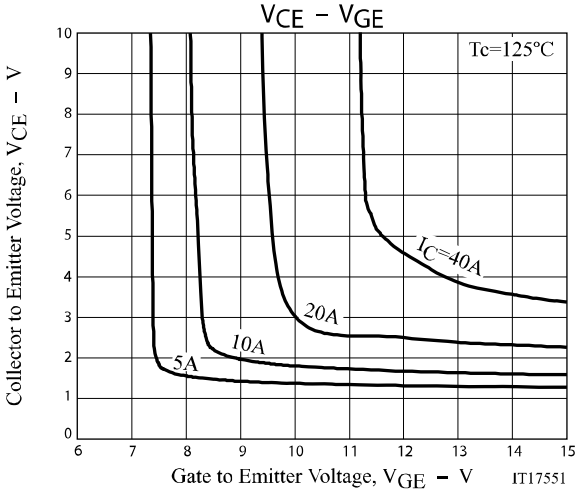

IC – VCE
Tc= –40°C
15V
13V
17V
11V
9V
7V
Collector Current, IC – A
Collector to Emitter Voltage, VCE – V
IT17546

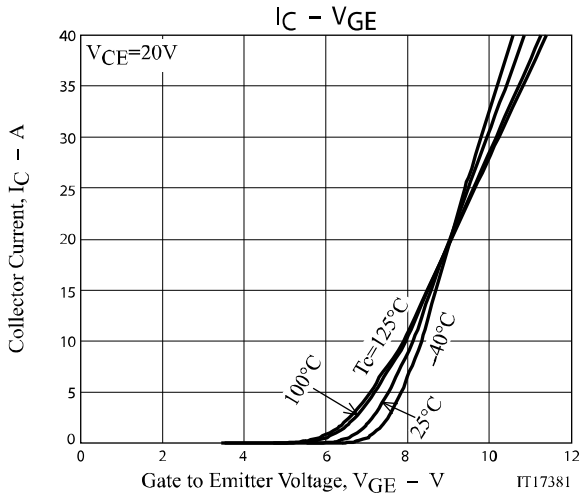

IC – VCE
Tc=125°C
15V
13V
17V
11V
9V
7V
Collector Current, IC – A
Collector to Emitter Voltage, VCE – V
IT17547

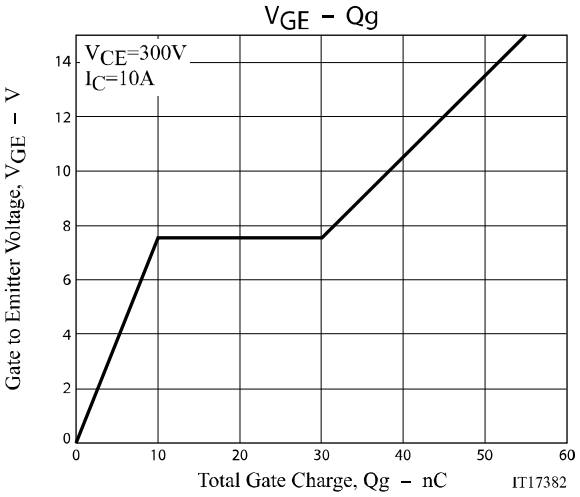

VCE – VGE
Tc=25°C
IC=40A
20A
10A
5A
Collector to Emitter Voltage, VCE – V
Gate to Emitter Voltage, VGE – V
IT17548

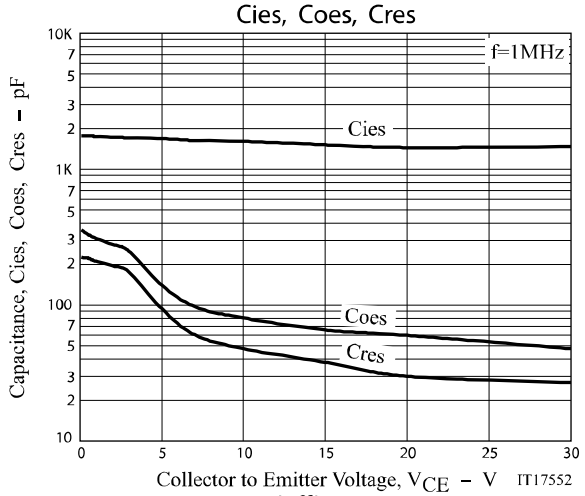

VCE – VGE
Tc=100°C
IC=40A
20A
10A
5A
Collector to Emitter Voltage, VCE – V
Gate to Emitter Voltage, VGE – V
IT17549

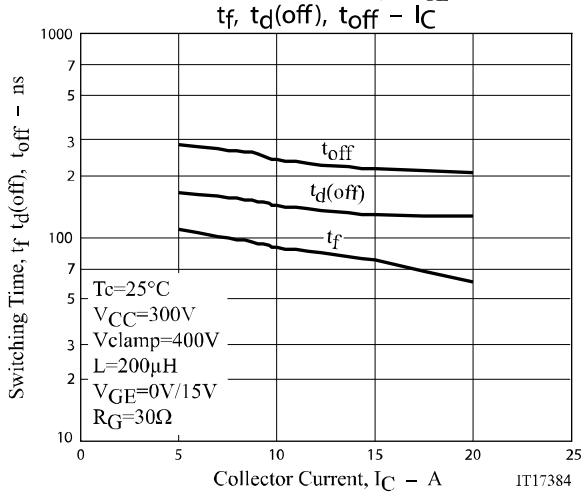

VCE – VGE
Tc= –40°C
IC=40A
20A
10A
5A
Collector to Emitter Voltage, VCE – V
Gate to Emitter Voltage, VGE – V
IT17550

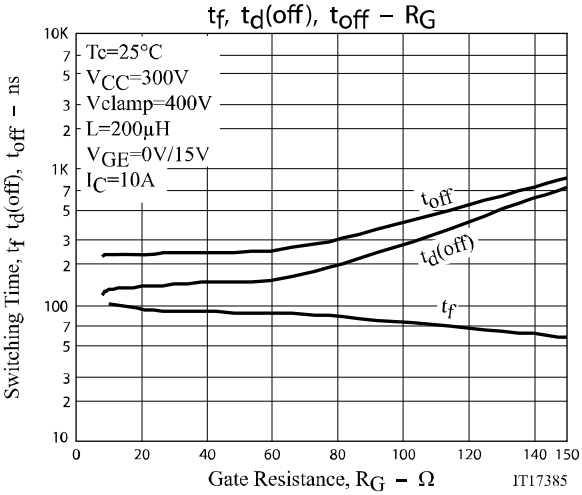

VCE – VGE
Tc=125°C
IC=40A
20A
10A
5A
Collector to Emitter Voltage, VCE – V
Gate to Emitter Voltage, VGE – V
IT17551

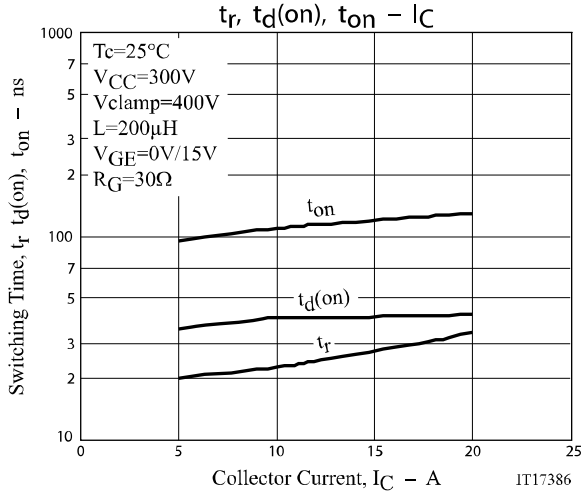

IC – VGE
VCE=20V
Collector Current, IC – A
Gate to Emitter Voltage, VGE – V
100°C
Tc=125°C
–40°C
25°C
IT17381

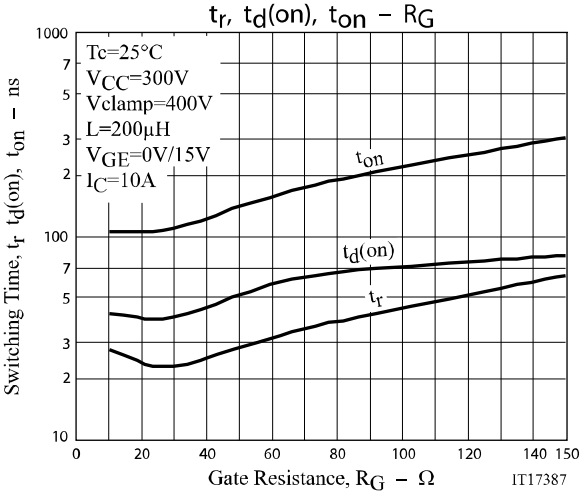

VGE – Qg
VCE=300V
IC=10A
Gate to Emitter Voltage, VGE – V
Total Gate Charge, Qg – nC
IT17382


Cies, Coes, Cres
f=1MHz
Cies
Coes
Cres
Capacitance, Cies, Coes, Cres – pF
Collector to Emitter Voltage, VCE – V
IT17552

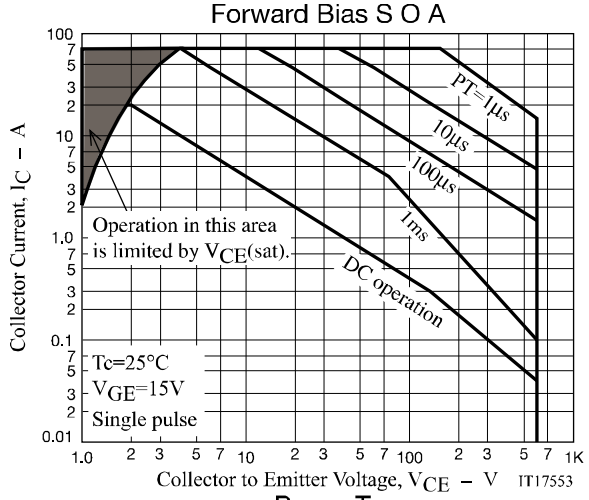

tf, td(off), toff – IC
toff
td(off)
tf
Tc=25°C
VCC=300V
Vclamp=400V
L=200µH
VGE=0V/15V
RG=30Ω
Switching Time, tf, td(off), toff – ns
Collector Current, IC – A
IT17384


tf, td(off), toff – RG
Tc=25°C
VCC=300V
Vclamp=400V
L=200µH
VGE=0V/15V
IC=10A
toff
td(off)
tf
Switching Time, tf, td(off), toff – ns
Gate Resistance, RG – Ω
IT17385

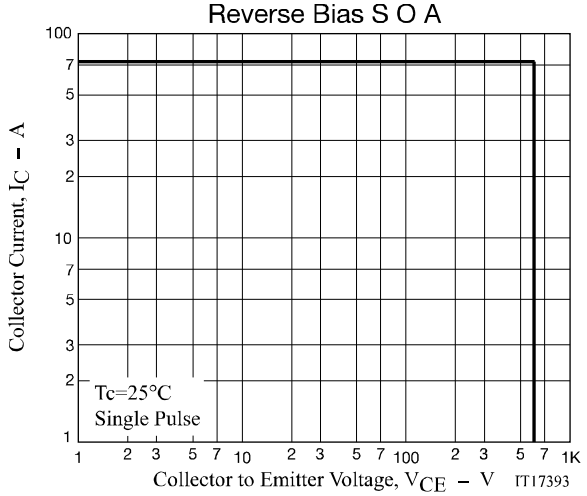

tr, td(on), ton – IC
Tc=25°C
VCC=300V
Vclamp=400V
L=200µH
VGE=0V/15V
RG=30Ω
ton
td(on)
tr
Switching Time, tr, td(on), ton – ns
Collector Current, IC – A
IT17386


tr, td(on), ton – RG
Tc=25°C
VCC=300V
Vclamp=400V
L=200µH
VGE=0V/15V
IC=10A
ton
td(on)
tr
Switching Time, tr, td(on), ton – ns
Gate Resistance, RG – Ω
IT17387

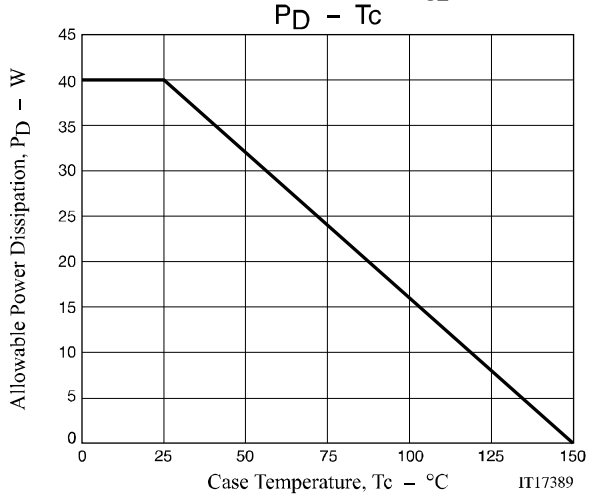
Forward Bias S O A



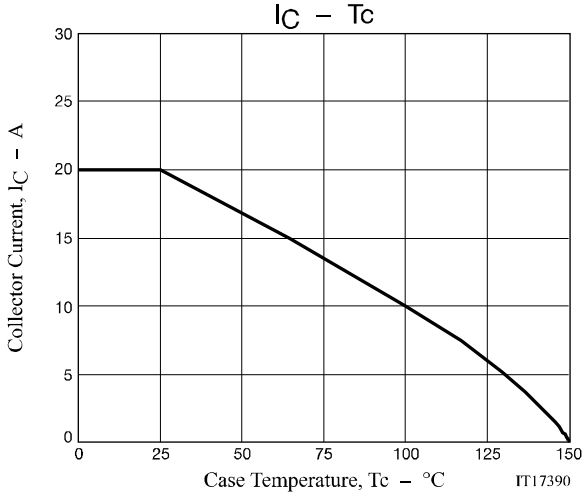

Reverse Bias S O A



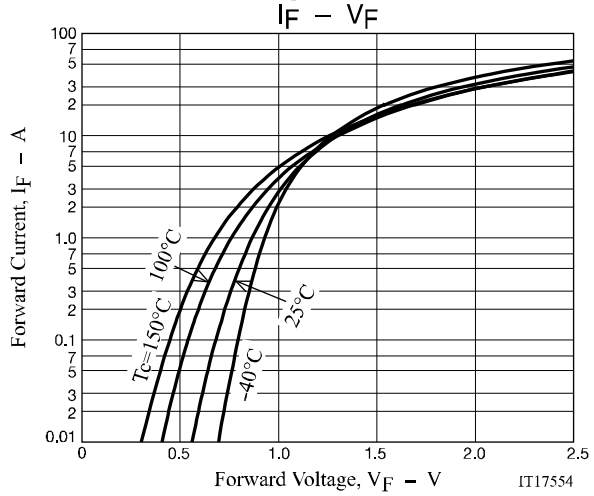

$P_D$ – Tc



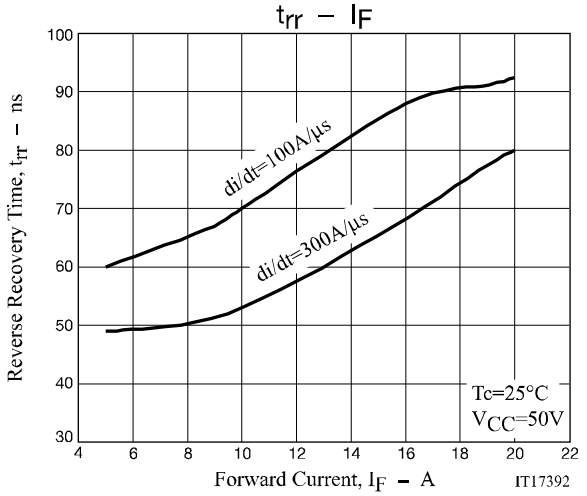

$I_C$ – Tc




$I_F$ – $V_F$




$t_{rr}$ – $I_F$



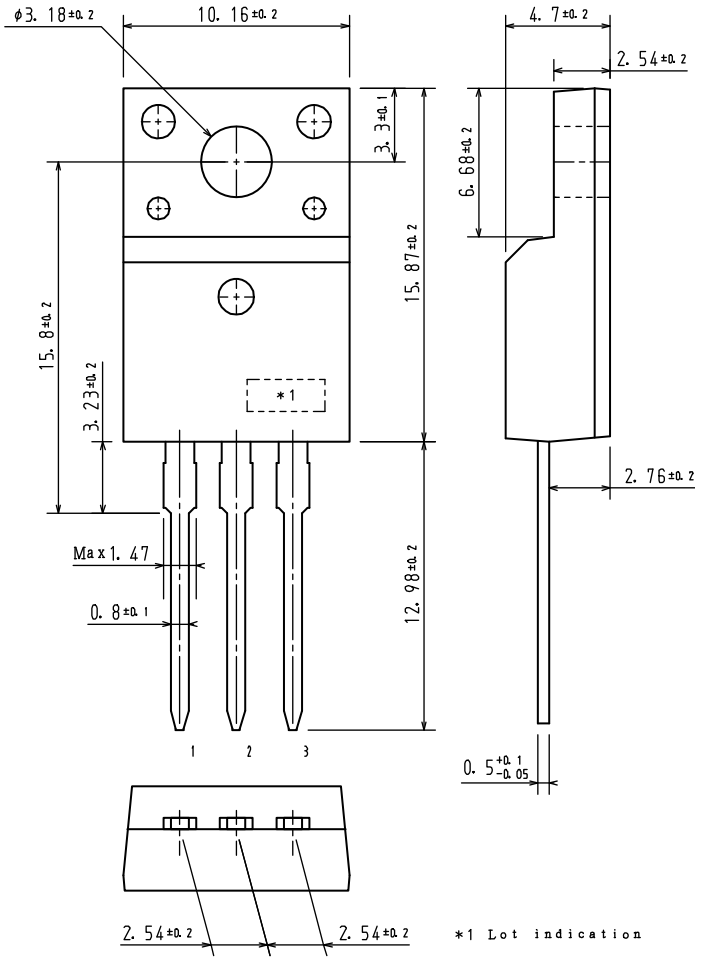
## Package Dimensions

NGTB10N60FG

### TO-220F-3FS

CASE 221AM
ISSUE O
Unit : mm

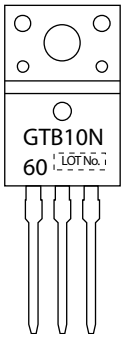
1: Gate
2: Collector
3: Emitter



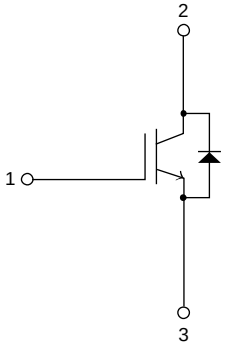

## Ordering & Package Information

| Device | Package | Shipping | note |
|---|---|---|---|
| NGTB10N60FG | TO-220F-3FS<br>SC-67 | 50<br>pcs. / tube | Pb-Free |

## Marking




## Electrical Connection




ON Semiconductor and the ON logo are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.