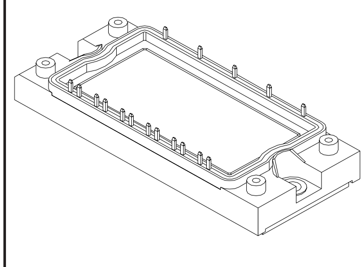
Bulletin I27155 06/03

International IOR Rectifier

# GB15XF120K

## IGBT SIXPACK MODULE



ECONO2 6PACK

$V_{CES}$ = 1200V

$I_C$ =18A @ $T_C$=80°C

$t_{sc}$ > 10µs @ $T_J$=150°C

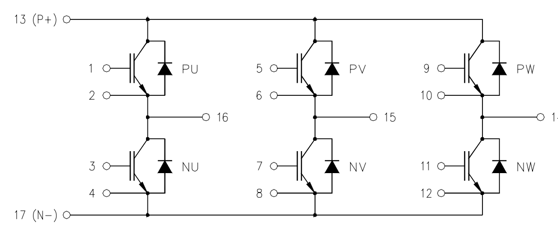
$V_{CE(on)}$ typ. = 2.51V

### Features

- Low $V_{CE}$ (on) Non Punch Through IGBT Technology
- Low Diode $V_F$
- 10µs Short Circuit Capability
- Square RBSOA
- HEXFRED Antiparallel Diode with Ultrasoft Reverse Recovery Characteristics
- Positive $V_{CE}$ (on) Temperature Coefficient
- Ceramic DBC Substrate
- Low Stray Inductance Design

### Benefits

- Benchmark Efficiency for Motor Control
- Rugged Transient Performance
- Low EMI, Requires Less Snubbing
- Direct Mounting to Heatsink
- PCB Solderable Terminals
- Low Junction to Case Thermal Resistance
- UL Approved E78996




### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 1200 | V |
| $I_C$ @ Tc=25°C | Continuous Collector Current | 25 | A |
| $I_C$ @ Tc=80°C | Continuous Collector Current | 18 | |
| $I_{CM}$ | Pulsed Collector Current (Ref. Fig. C.T.5) | 50 | |
| $I_{LM}$ | Clamped Inductive Load Current | 50 | |
| $I_F$ @ Tc=25°C | Diode Continuous Forward Current | 25 | |
| $I_F$ @ Tc=80°C | Diode Continuous Forward Current | 17 | |
| $I_{FM}$ | Diode Maximum Forward Current | 50 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ±20 | V |
| $P_D$ @ Tc=25°C | Maximum Power Dissipation (IGBT and Diode) | 200 | W |
| $P_D$ @ Tc=80°C | Maximum Power Dissipation (IGBT and Diode) | 114 | |
| $T_J$ | Maximum Operating Junction Temperature | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | -40 to +125 | |
| $V_{ISOL}$ | Isolation Voltage | AC 2500 (MIN) | V |

### Thermal and Mechanical Characteristics

| | Parameter | Min | Typical | Maximum | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ (IGBT) | Junction-to-Case IGBT | - | - | 1.0 | °C/W |
| $R_{\theta JC}$ (Diode) | Junction-to-Case Diode | - | - | 1.6 | |
| $R_{\theta CS}$ (Module) | Case-to-Sink, flat, greased surface | - | 0.05 | - | |
| | Mounting Torque (M5) | 2.7 | - | 3.3 | N*m |
| | Weight | - | 170 | - | g |

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $BV_{(CES)}$ | Collector-to-Emitter Breakdown Voltage | 1200 | - | - | V | $V_{GE}$ = 0 $I_C$ = 500µA |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temp. Coefficient of Breakdown Voltage | - | 1.1 | - | V/°C | $V_{GE}$ = 0 $I_C$ = 1mA (25°C - 125°C) |
| $V_{CE(ON)}$ | Collector-to-Emitter Voltage | - | 2.51 | 2.88 | V | $I_C$ = 15A $V_{GE}$ = 15V |
| | | - | 3.11 | 3.76 | | $I_C$ = 25A $V_{GE}$ = 15V |
| | | - | 2.96 | 3.14 | | $I_C$ = 15A $V_{GE}$ = 15V $T_J$ = 125°C |
| | | - | 3.78 | 4.05 | | $I_C$ =25A $V_{GE}$ = 15V $T_J$ = 125°C |
| $V_{GE}(th)$ | Gate Threshold Voltage | 4 | - | 6 | | $V_{CE}$ = $V_{GE}$ $I_C$ = 250µA |
| $\Delta V_{GE}(th)/\Delta T_J$ | Thresold Voltage temp. coefficient | - | -11 | - | mV/°C | $V_{CE}$ = $V_{GE}$ $I_C$ = 1mA (25°C-125°C) |
| $I_{CES}$ | Zero Gate Voltage Collector Current | - | - | 100 | µA | $V_{GE}$ = 0 $V_{CE}$ = 1200V |
| | | - | 370 | - | | $V_{GE}$ = 0 $V_{CE}$ = 1200V Tj = 125°C |
| $V_{FM}$ | Diode Forward Voltage Drop | - | 2.04 | 2.72 | V | $I_F$ = 15A |
| | | - | 2.40 | 3.38 | | $I_F$ = 25A |
| | | - | 2.16 | 2.74 | | $I_F$ = 15A Tj = 125°C |
| | | - | 2.68 | 3.46 | | $I_F$ = 25A Tj = 125°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | - | - | ±200 | nA | $V_{GE}$ = ±20V |

## Switching Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_G$ | Total Gate Charge (turn-on) | - | 95 | 145 | nC | $I_C$ = 15A |
| $Q_{GE}$ | Gate-to-Emitter Charge (turn-on) | - | 10 | 15 | | $V_{CC}$ = 400V |
| $Q_{GC}$ | Gate-to-Collector Charge (turn-on) | - | 45 | 70 | | $V_{GE}$ = 15V |
| $E_{ON}$ | Turn-On Switching Loss | - | 1.1 | 1.65 | mJ | $I_C$ = 15A $V_{CC}$ = 600V |
| $E_{OFF}$ | Turn-Off Switching Loss | - | 0.67 | 1.00 | | $V_{GE}$ = 15V $R_G$ = 22Ω L = 500µH |
| $E_{TOT}$ | Total Switching Loss | - | 1.77 | 2.66 | | Tj = 25°C ① |
| $E_{ON}$ | Turn-On Switching Loss | - | 1.40 | 2.10 | mJ | $I_C$ = 15A $V_{CC}$ = 600V |
| $E_{OFF}$ | Turn-Off Switching Loss | - | 1.10 | 1.65 | | $V_{GE}$ = 15V $R_G$ = 22Ω L = 500µH |
| $E_{TOT}$ | Total Switching Loss | - | 2.50 | 3.75 | | Tj = 125°C ① |
| $t_{d(on)}$ | Turn-On delay time | - | 125 | 190 | ns | $I_C$ = 15A $V_{CC}$ = 600V |
| $t_r$ | Rise time | - | 24 | 36 | | $V_{GE}$ = 15V $R_G$ = 22Ω L = 500µH |
| $t_{d(off)}$ | Turn-Off delay time | - | 150 | 225 | | Tj = 125°C |
| $t_f$ | Fall time | - | 241 | 360 | | |
| $C_{ies}$ | Input Capacitance | - | 1320 | 1980 | pF | $V_{GE}$ = 0 |
| $C_{oes}$ | Output Capacitance | - | 280 | 420 | | $V_{CC}$ = 30V |
| $C_{res}$ | Reverse Transfer Capacitance | - | 35 | 53 | | f = 1Mhz |
| RBSOA | Reverse Bias Safe Operating Area | FULL SQUARE | | | | Tj = 150°C $I_C$ = 50A<br>$R_G$ = 22Ω $V_{GE}$ = 15V to 0 |
| SCSOA | Short Circuit Safe Operating Area | 10 | - | - | µs | Tj = 150°C<br>$V_{CC}$ = 900V $V_P$ = 1200V<br>$R_G$ = 22Ω $V_{GE}$ = 15V to 0 |
| $I_{rr}$ | Diode Peak Rev. Recovery Current | - | 29 | - | A | Tj = 125°C<br>$V_{CC}$ = 600V $I_F$ = 15A L = 500µH<br>$V_{GE}$ = 15V $R_G$ = 22Ω |

① Energy losses include "tail" and diode reverse recovery.

## Inverter

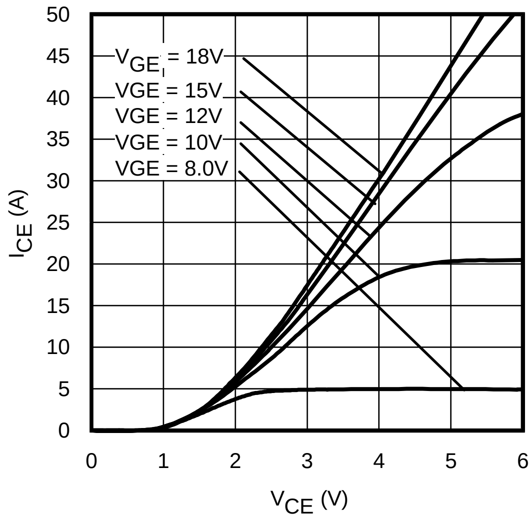



**Fig. 1** - Typ. IGBT Output Characteristics
$T_J$ = 25°C; tp = 80µs

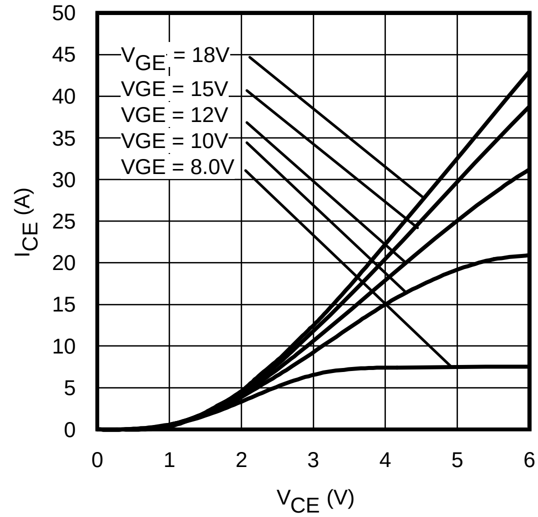



**Fig. 2** - Typ. IGBT Output Characteristics
$T_J$ = 125°C; tp = 80µs

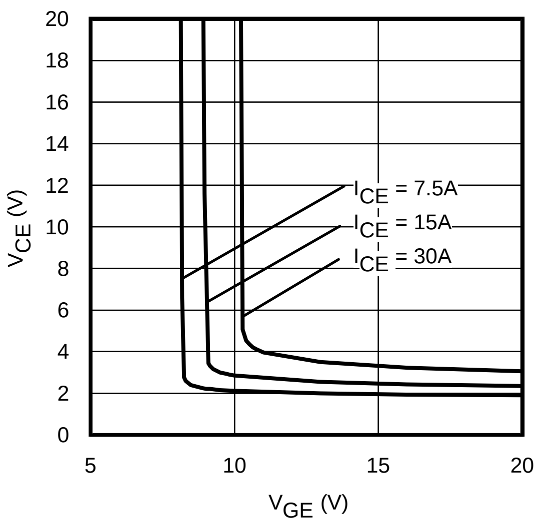



**Fig. 3** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 25°C

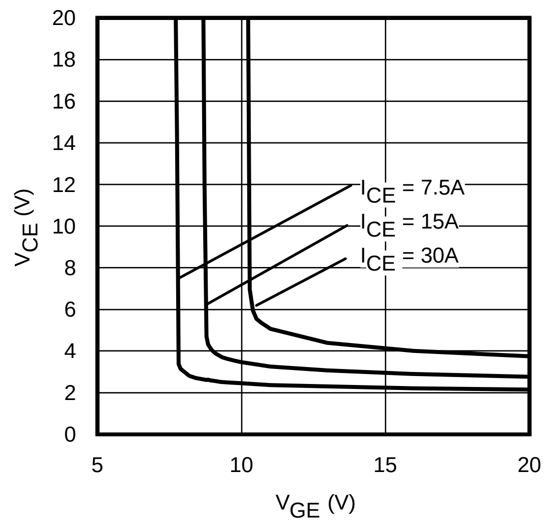



**Fig. 4** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 125°C

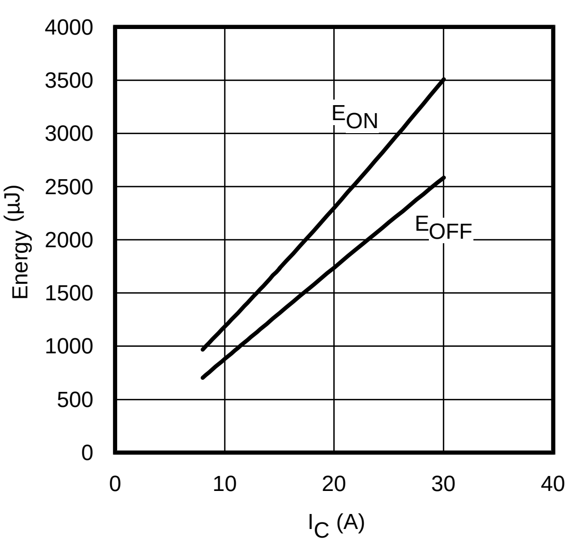



**Fig. 5** - Typ. Energy Loss vs. $I_C$
$T_J$ = 125°C; L=500µH; $V_{CE}$= 600V
$R_G$= 22Ω; $V_{GE}$= 15V

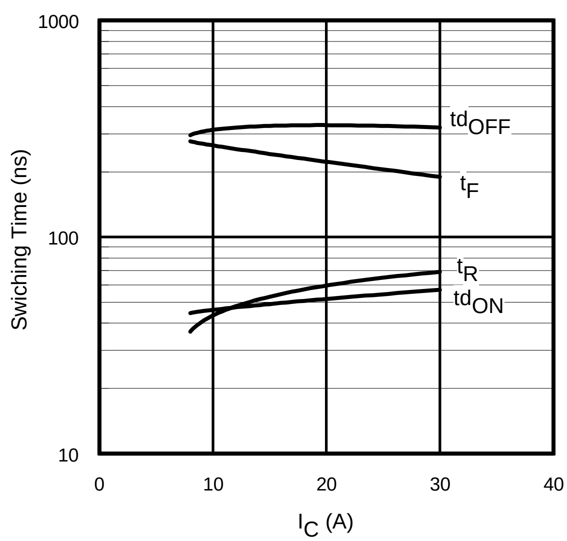



**Fig. 6** - Typ. Switching Time vs. $I_C$
$T_J$ = 125°C; L=500µH; $V_{CE}$= 600V
$R_G$= 22Ω; $V_{GE}$= 15V

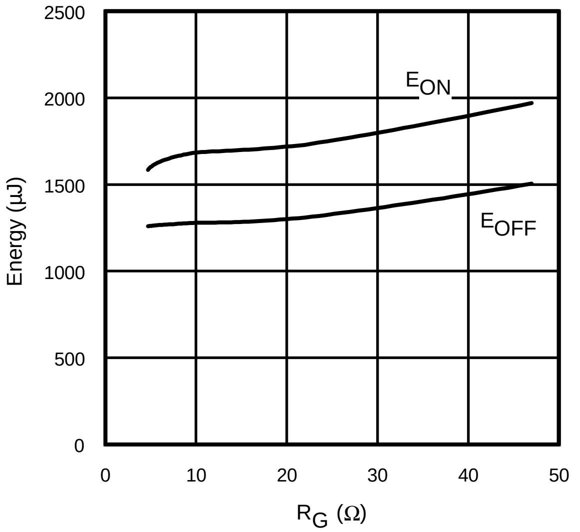



**Fig. 7** - Typ. Energy Loss vs. $R_G$
$T_J$ = 125°C; L=500µH; $V_{CE}$= 600V
$I_{CE}$= 15A; $V_{GE}$= 15V

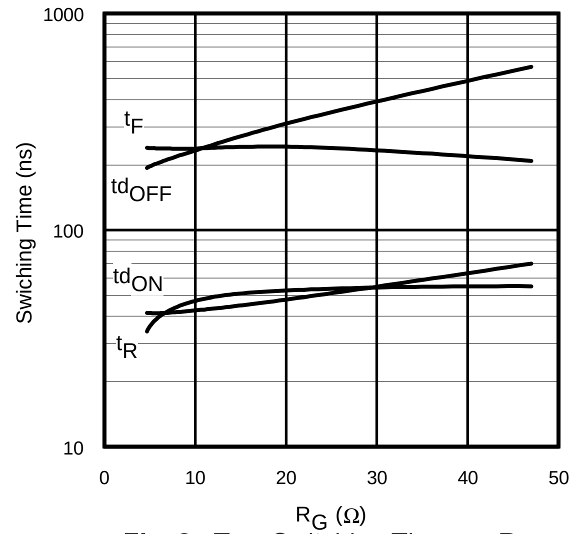



**Fig. 8** - Typ. Switching Time vs. $R_G$
$T_J$ = 125°C; L=500µH; $V_{CE}$= 600V;
$I_{CE}$= 15A; $V_{GE}$= 15V

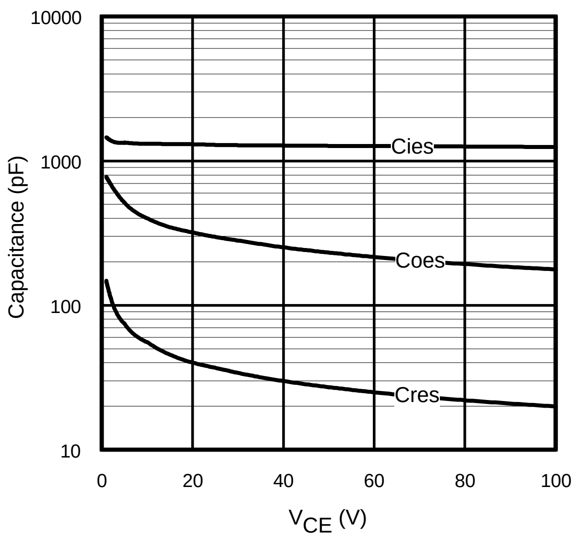



**Fig. 9**- Typ. Capacitance vs. $V_{CE}$
$V_{GE}$= 0; f = 1MHz

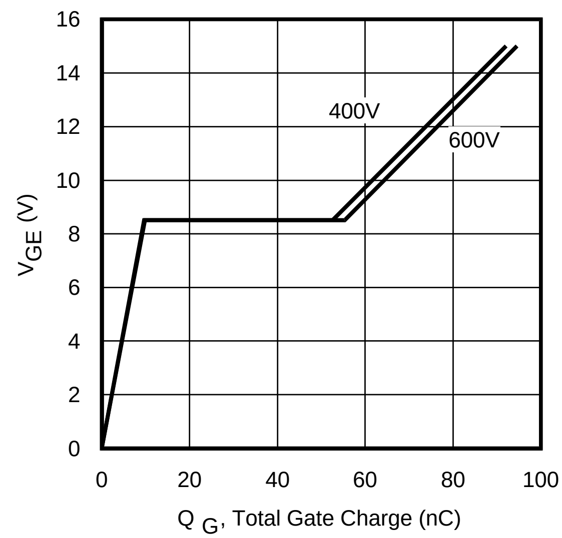



**Fig. 10** - Typical Gate Charge vs. $V_{GE}$
$I_{CE}$ = 15A; L = 600µH

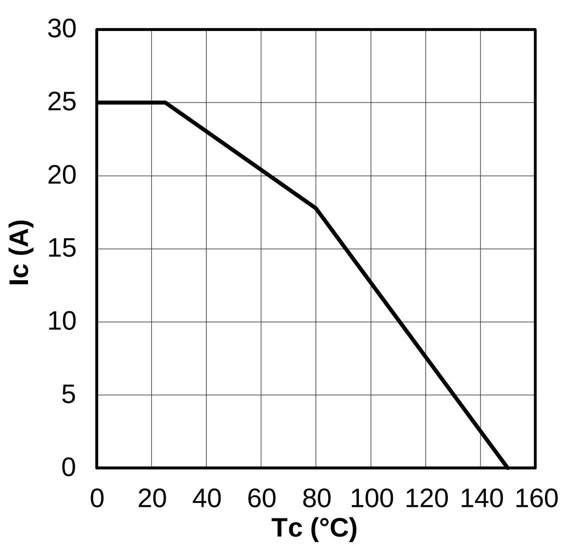



**Fig. 11** - Maximum DC Collector Current vs.
Case Temperature

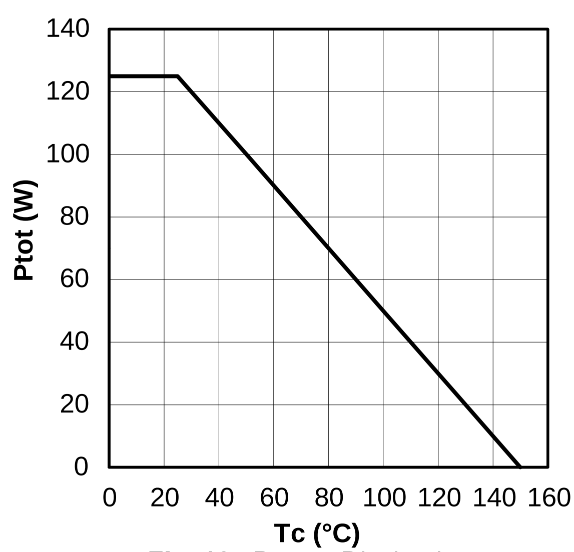



**Fig. 12** - Power Dissipation vs.
Case Temperature

**Inverter**

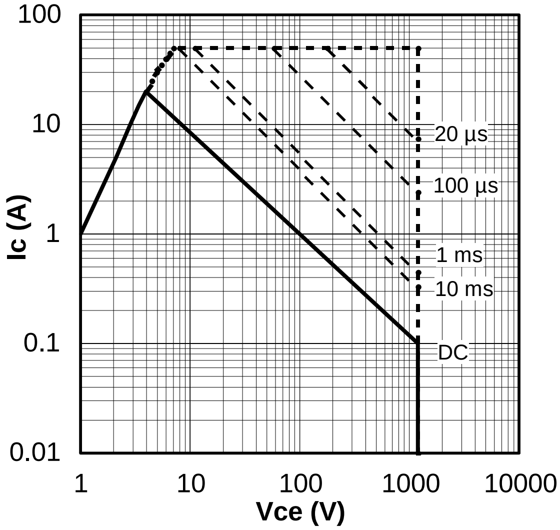



**Fig. 13** - Forward SOA
$T_C = 25°C$; $T_J \leq 150°C$

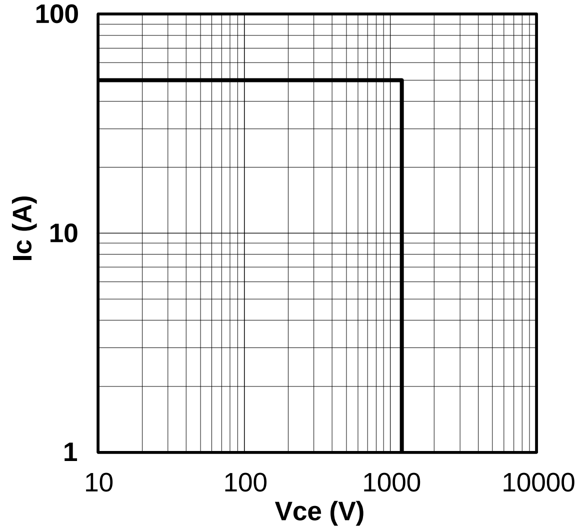



**Fig. 14** - Reverse Bias SOA
$T_J = 150°C$; $V_{GE} = 15V$

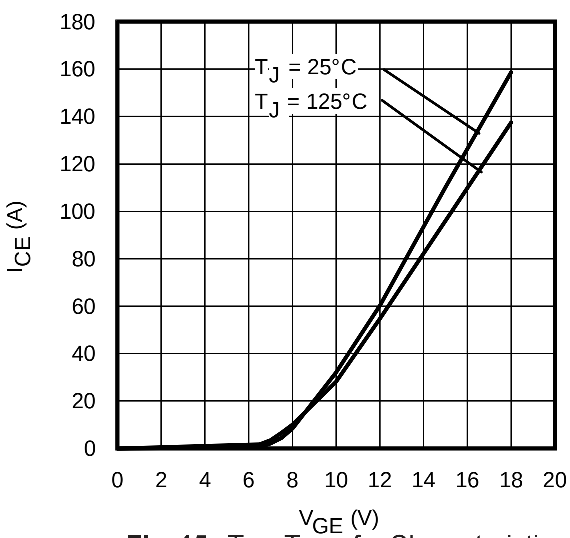



**Fig. 15** - Typ. Transfer Characteristics
$V_{CE}$=50V; tp=10µs

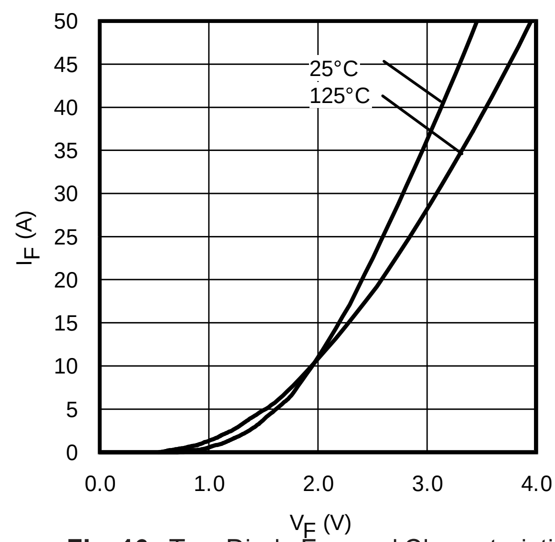



**Fig. 16** - Typ. Diode Forward Characteristics
tp = 80µs

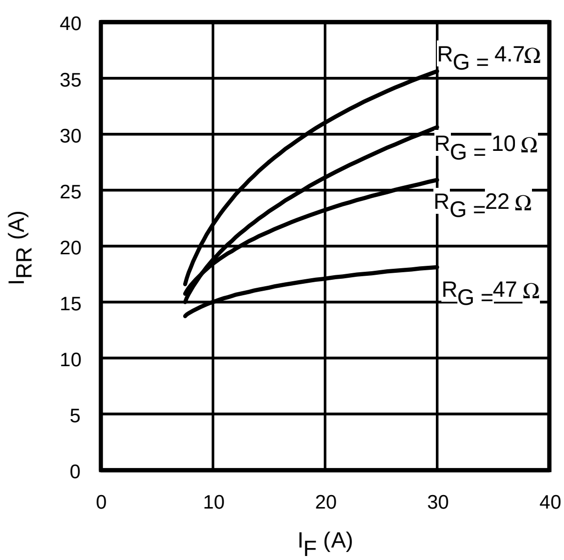



**Fig. 17** - Typical Diode $I_{RR}$ vs. $I_F$
$T_J = 125°C$

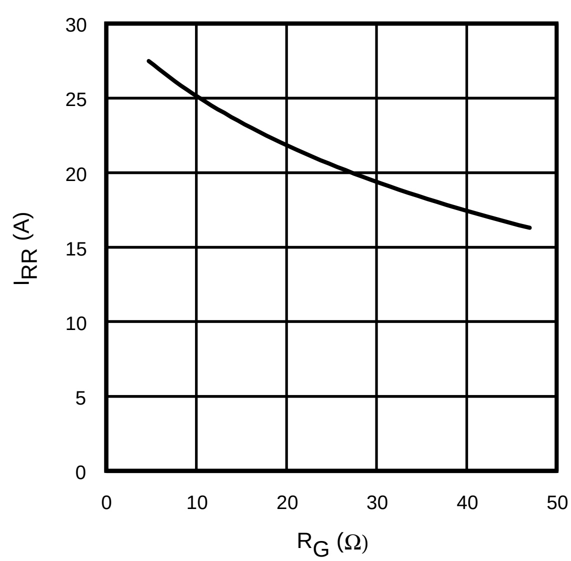



**Fig. 18** - Typical Diode $I_{RR}$ vs. $R_G$
$T_J = 125°C$; $I_F = 10A$

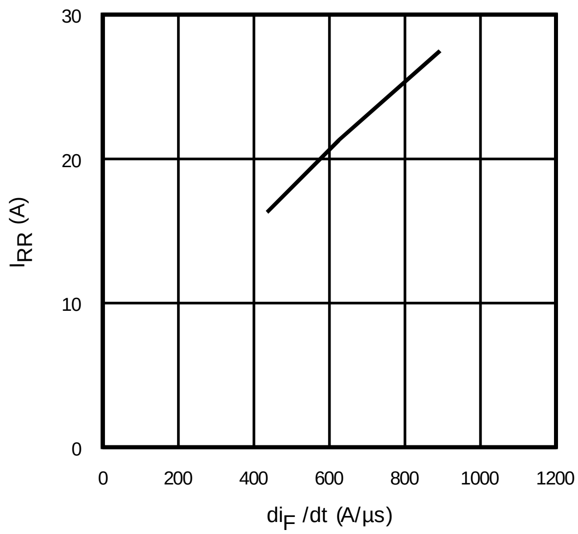



**Fig. 19**- Typical Diode $I_{RR}$ vs. $di_F/dt$; $V_{CC}$= 600V; $V_{GE}$= 15V; $I_{CE}$= 15A; $T_J$ = 125°C

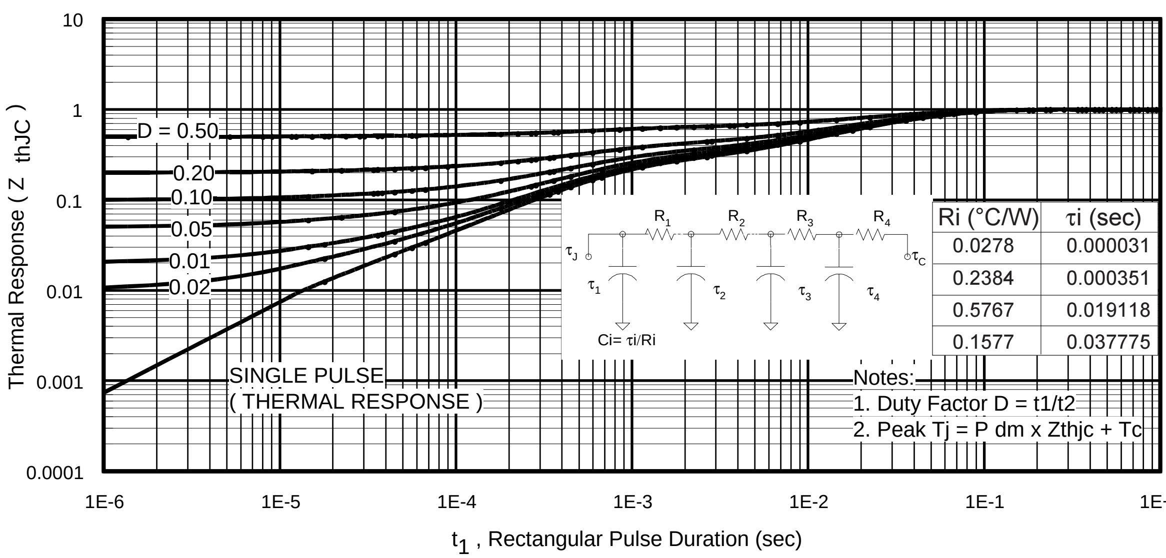



**Fig 20.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

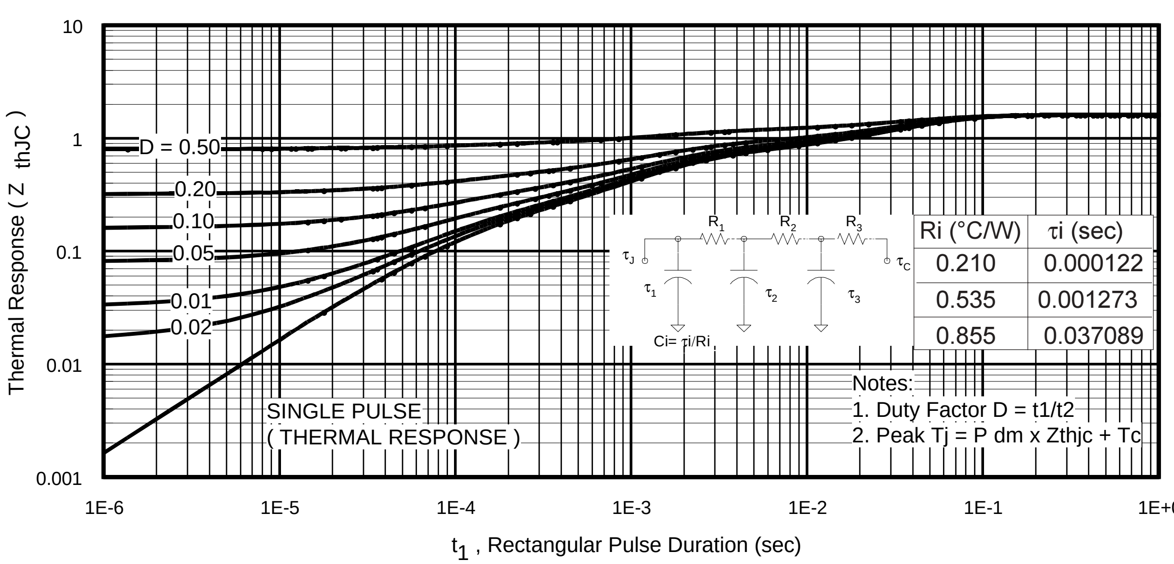



**Fig 21.** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

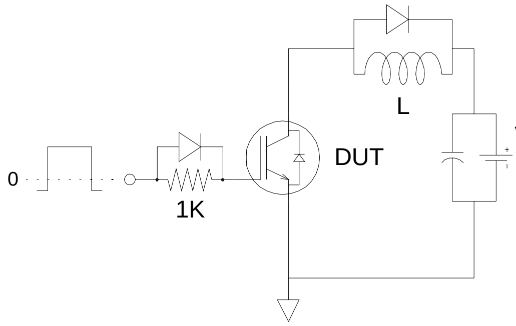



**Fig.C.T.1** - Gate Charge Circuit (turn-off)

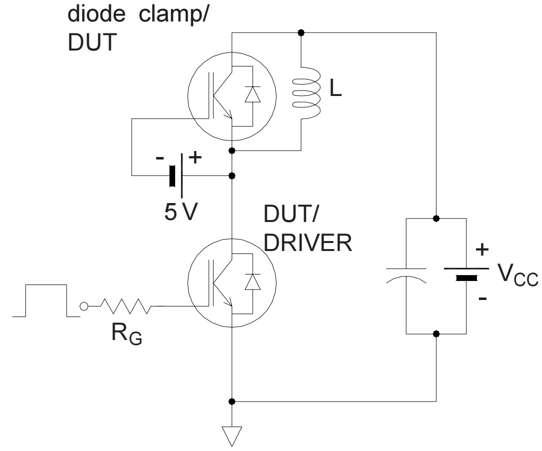



**Fig.C.T.2** - RBSOA Circuit

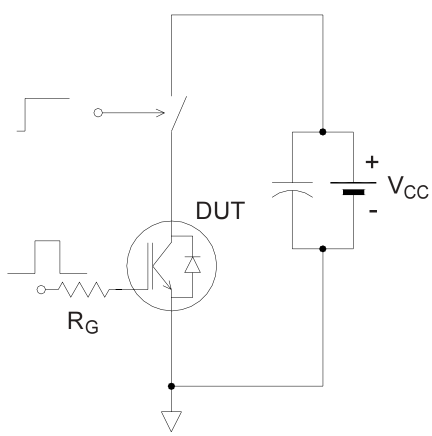



**Fig.C.T.3** - S.C. SOA Circuit

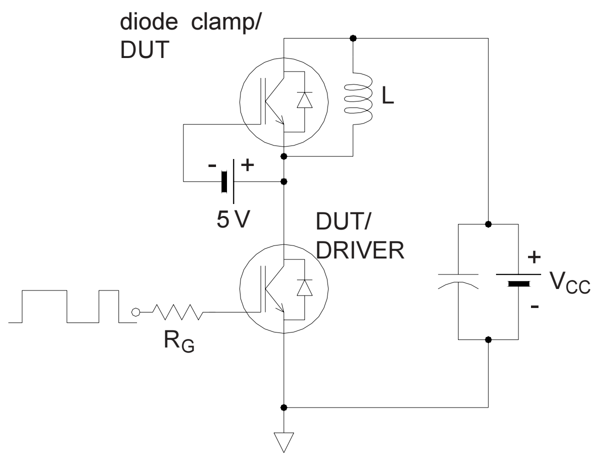



**Fig.C.T.4** - Switching Loss Circuit

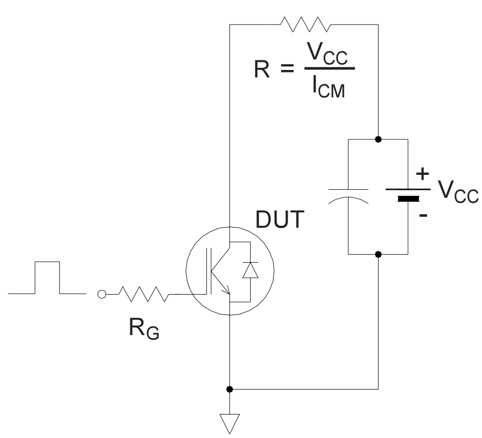



**Fig.C.T.5** - Resistive Load Circuit

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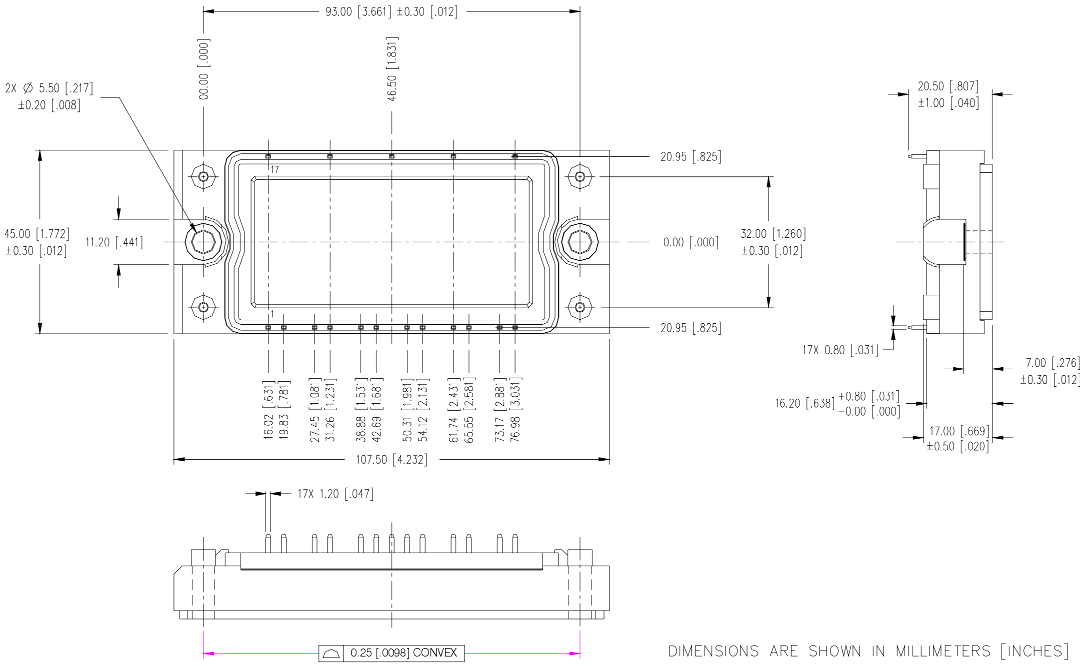
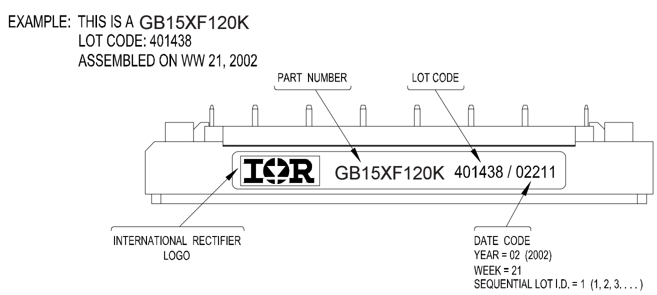
## Econo2 6Pak Package Outline

Dimensions are shown in millimeters (inches)




## Econo2 6Pak Part Marking Information




Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial market.
Qualification Standards can be found on IR's Web site.

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**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
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