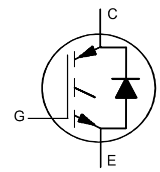
## *INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE*

### Features

- Low $V_{CE\ (on)}$ Trench IGBT Technology
- Low Switching Losses
- 6µs SCSOA
- Square RBSOA
- 100% of the parts tested for $I_{LM}$ ①
- Positive $V_{CE\ (on)}$ Temperature Coefficient
- Soft Recovery Co-pak Diode
- Lead-Free, RoHS Compliant
- Automotive Qualified *




n-channel

$V_{CES}$ = 600V

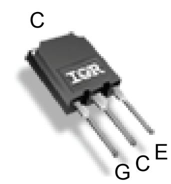
$I_C$ = 160A, $T_C$ = 100°C

tsc ≥ 6µs, $T_{J(MAX)}$ = 175°C

$V_{CE(on)\ typ.}$ = 1.70V

### Benefits

- High Efficiency in a Wide Range of Applications
- Suitable for Applications in the Low to Mid-Range Frequencies
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation
- Low EMI




PG-TO274-3-903

| G | C | E |
|---|---|---|
| Gate | Collector | Emitter |

| Base Part Number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRGPS4067D1 | PG-TO274-3-903 | Tube | 25 | AUIRGPS4067D1 |

### Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ($T_A$) is 25°C, unless otherwise specified.

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 240⑤ | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 160 | |
| $I_{NOMINAL}$ | Nominal Current | 120 | |
| $I_{CM}$ | Pulse Collector Current, $V_{GE}$ = 15V | 360 | |
| $I_{LM}$ | Clamped Inductive Load Current, $V_{GE}$ = 20V ① | 480 | |
| $I_{F\ NOMINAL}$ | Diode Nominal Current ② | 120⑤ | |
| $I_{FM}$ | Diode Maximum Forward Current ② | 480 | |
| $V_{GE}$ | Continuous Gate-to-Emitter Voltage | ±20 | V |
| | Transient Gate-to-Emitter Voltage | ±30 | |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 750 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 375 | |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to +175 | °C |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |

### Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ (IGBT) | Thermal Resistance Junction-to-Case (each IGBT) ④ | —— | 0.20 | °C/W |
| $R_{\theta JC}$ (Diode) | Thermal Resistance Junction-to-Case (each Diode) ④ | —— | 0.44 | |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink (flat, greased surface) | 0.24 | —— | |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (typical socket mount) | —— | 40 | |

* Qualification standards can be found at www.infineon.com

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 500µA ③ |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | — | 0.27 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 15mA (25°C-175°C) |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 1.7 | 2.05 | V | $I_C$ = 120A, $V_{GE}$ = 15V, $T_J$ = 25°C |
| | | — | 2.15 | — | | $I_C$ = 120A, $V_{GE}$ = 15V, $T_J$ = 150°C |
| | | — | 2.20 | — | | $I_C$ = 120A, $V_{GE}$ = 15V, $T_J$ = 175°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 4.0 | — | 6.5 | V | $V_{CE}$ = $V_{GE}$, $I_C$ = 5.6mA |
| $\Delta V_{GE(th)}/\Delta TJ$ | Threshold Voltage temp. coefficient | — | -17 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 20mA (25°C-175°C) |
| gfe | Forward Transconductance | — | 85 | — | S | $V_{CE}$ = 50V, $I_C$ = 120A |
| $I_{CES}$ | Collector-to-Emitter Leakage Current | — | 2.3 | 200 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | — | 9.4 | — | mA | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 175°C |
| $V_{FM}$ | Diode Forward Voltage Drop | — | 1.9 | 2.2 | V | $I_F$ = 120A |
| | | — | 2.0 | — | | $I_F$ = 120A, $T_J$ = 175°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | — | — | ±100 | 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) | — | 240 | 360 | nC | $I_C$ = 120A |
| $Q_{ge}$ | Gate-to-Emitter Charge (turn-on) | — | 69 | 104 | | $V_{GE}$ = 15V |
| $Q_{gc}$ | Gate-to-Collector Charge (turn-on) | — | 90 | 135 | | $V_{CC}$ = 400V |
| $E_{on}$ | Turn-On Switching Loss | — | 8.2 | 10 | mJ | $I_C$ = 120A, $V_{CC}$ = 400V, $V_{GE}$ = 15V |
| $E_{off}$ | Turn-Off Switching Loss | — | 2.9 | 3.2 | | $R_G$ = 4.7Ω, L = 87µH, $T_J$ = 25°C |
| $E_{total}$ | Total Switching Loss | — | 11.1 | 13.2 | | Energy losses include tail & diode reverse recovery |
| $t_{d(on)}$ | Turn-On delay time | — | 69 | 82 | ns | |
| $t_r$ | Rise time | — | 65 | 82 | | |
| $t_{d(off)}$ | Turn-Off delay time | — | 198 | 230 | | |
| $t_f$ | Fall time | — | 38 | 48 | | |
| $E_{on}$ | Turn-On Switching Loss | — | 10 | — | mJ | $I_C$ = 120A, $V_{CC}$ = 400V, $V_{GE}$ = 15V |
| $E_{off}$ | Turn-Off Switching Loss | — | 3.8 | — | | $R_G$ = 4.7Ω, L = 87µH, $T_J$ = 175°C |
| $E_{total}$ | Total Switching Loss | — | 13.8 | — | | Energy losses include tail & diode reverse recovery |
| $t_{d(on)}$ | Turn-On delay time | — | 63 | — | ns | |
| $t_r$ | Rise time | — | 64 | — | | |
| $t_{d(off)}$ | Turn-Off delay time | — | 230 | — | | |
| $t_f$ | Fall time | — | 51 | — | | |
| $C_{ies}$ | Input Capacitance | — | 7780 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 505 | — | | $V_{CC}$ = 30V |
| $C_{res}$ | Reverse Transfer Capacitance | — | 245 | — | | f = 1.0Mhz |
| RBSOA | Reverse Bias Safe Operating Area | FULL SQUARE | | | | $T_J$ = 175°C, $I_C$ = 480A<br>$V_{CC}$ = 480V, Vp ≤ 600V<br>Rg = 4.7Ω, $V_{GE}$ = +20V to 0V |
| SCSOA | Short Circuit Safe Operating Area | 6 | — | — | µs | $V_{CC}$ = 400V, Vp ≤ 600V<br>Rg = 1.0Ω, $V_{GE}$ = +15V to 0V |
| Erec | Reverse Recovery Energy of the Diode | — | 2440 | — | µJ | $T_J$ = 175°C |
| $t_{rr}$ | Diode Reverse Recovery Time | — | 360 | — | ns | $V_{CC}$ = 400V, $I_F$ = 120A |
| $I_{rr}$ | Peak Reverse Recovery Current | — | 53 | — | A | $V_{GE}$ = 15V, Rg = 4.7Ω, L = 87µH |

**Notes:**

① $V_{CC}$ = 80% ($V_{CES}$), $V_{GE}$ = 20V, L = 0.87µH, $R_G$ = 50Ω tested in production ILM ≤ 400A.
② Pulse width limited by max. junction temperature.
③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
④ $R_\theta$ is measured at $T_J$ approximately 90°C.
⑤ Calculated continuous current based on maximum allowable junction temperature. Package IGBT current limit is 195A. Package diode current limit is120A. Note that current limitations arising from heating of the device leads may occur.

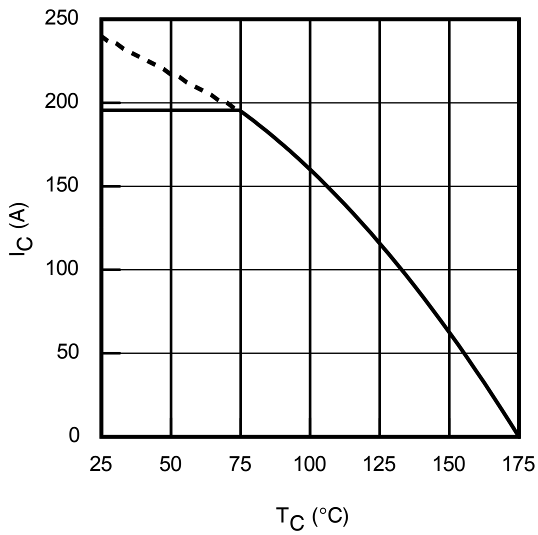



**Fig. 1** - Maximum DC Collector Current vs. Case Temperature

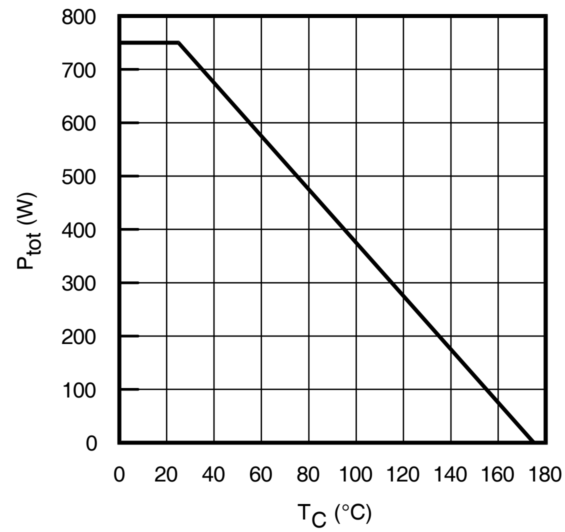



**Fig. 2** - Power Dissipation vs. Case Temperature

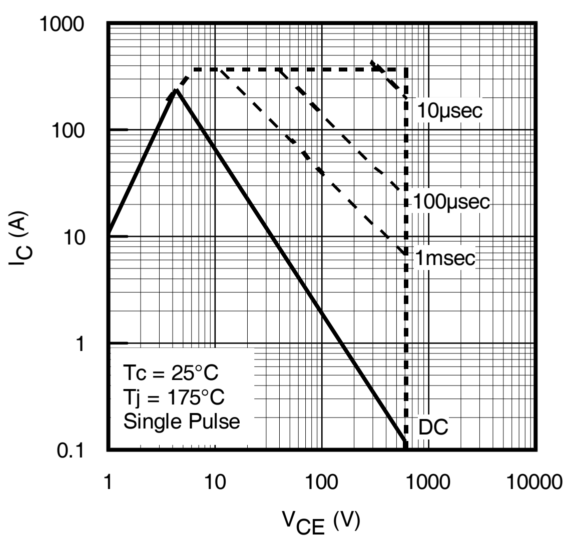



**Fig. 3** - Forward SOA
$T_C$ = 25°C, $T_J \leq$ 175°C; $V_{GE}$ =15V

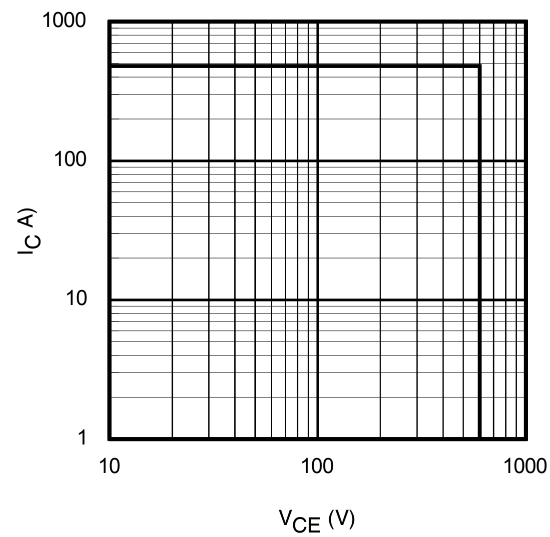



**Fig. 4** - Reverse Bias SOA
$T_J$ = 175°C; $V_{GE}$ = 20V

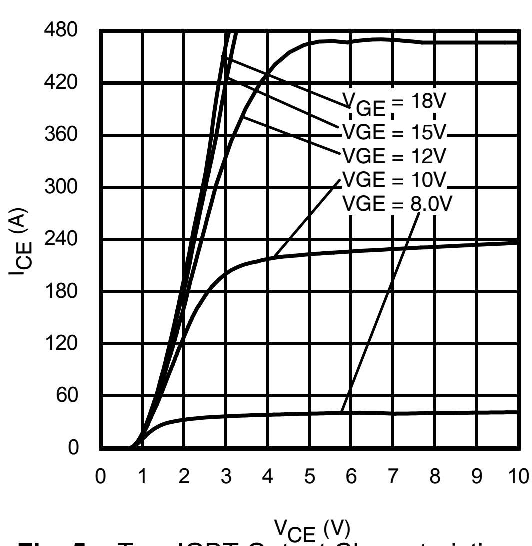



**Fig. 5** - Typ. IGBT Output Characteristics
$T_J$ = -40°C; tp = 30µs

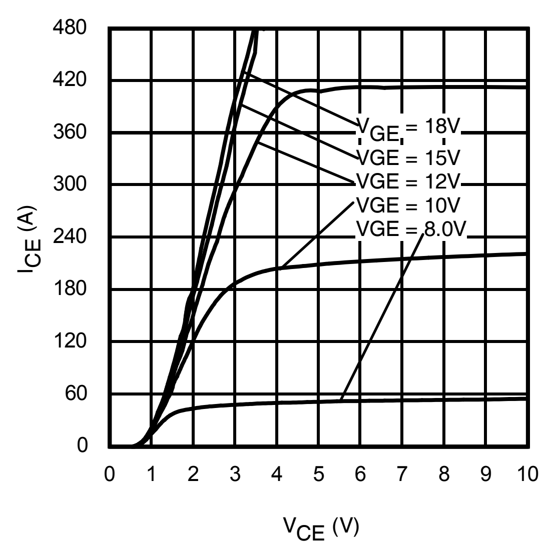



**Fig. 6** - Typ. IGBT Output Characteristics
$T_J$ = 25°C; tp = 30µs

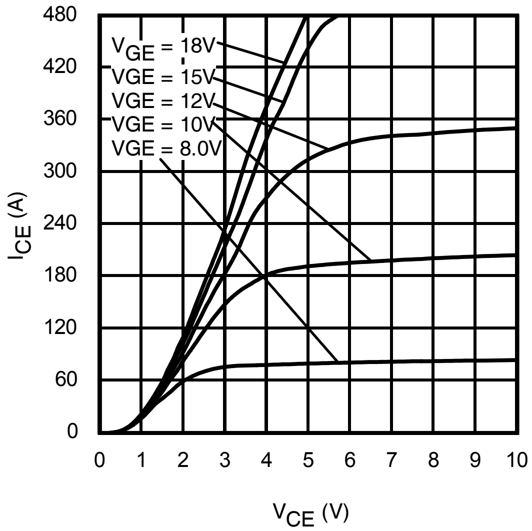



**Fig. 7** - Typ. IGBT Output Characteristics
$T_J$ = 175°C; tp = 30µs

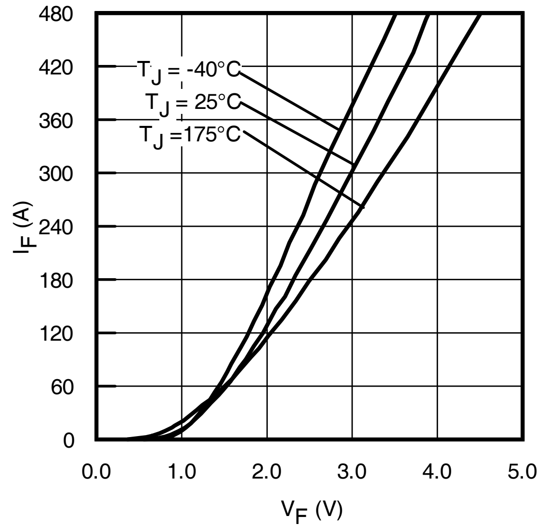



**Fig. 8** - Typ. Diode Forward Characteristics
tp = 30µs

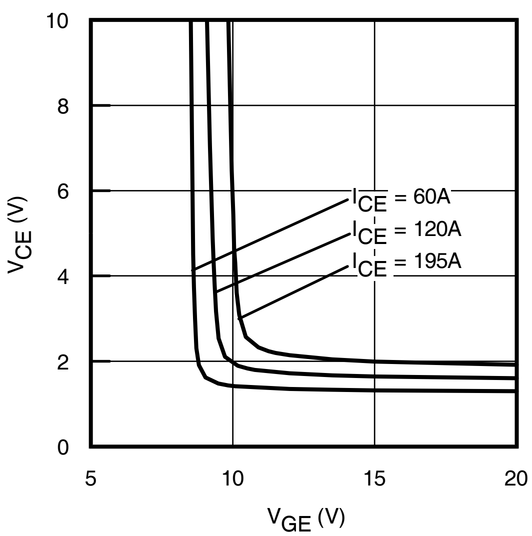



**Fig. 9** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = -40°C

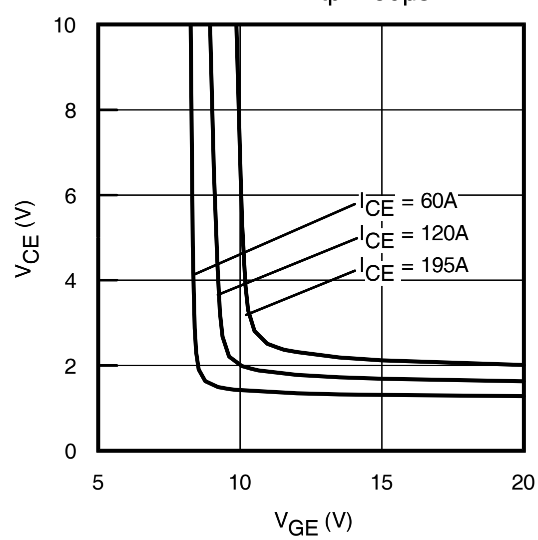



**Fig. 10** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 25°C

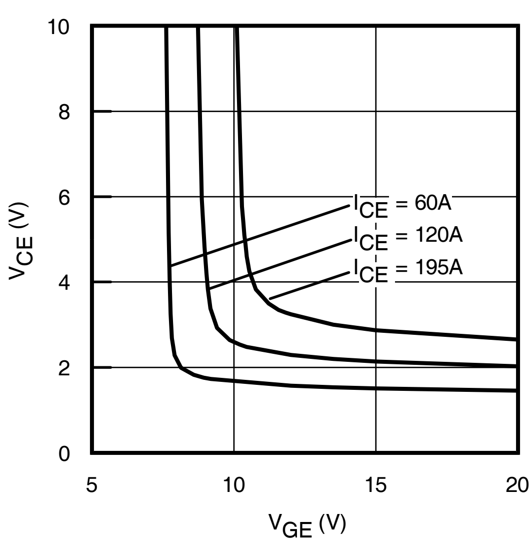



**Fig. 11** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 175°C

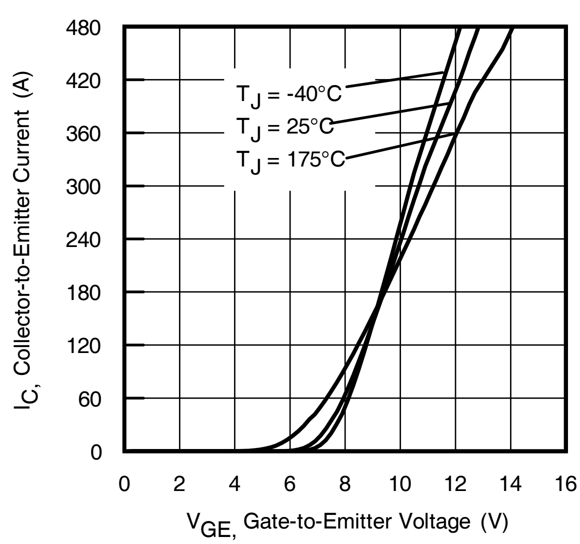



**Fig. 12** - Typ. Transfer Characteristics
$V_{CE}$ = 50V; tp = 10µs

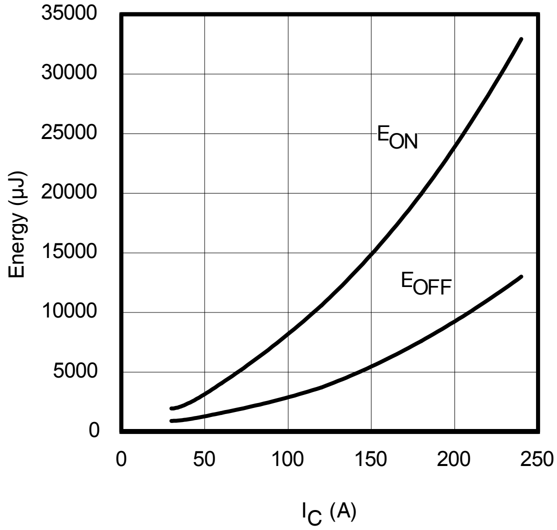



**Fig. 13** - Typ. Energy Loss vs. $I_C$
$T_J$ = 175°C; L = 0.087mH; $V_{CE}$ = 400V, $R_G$ = 5.0Ω; $V_{GE}$ = 15V

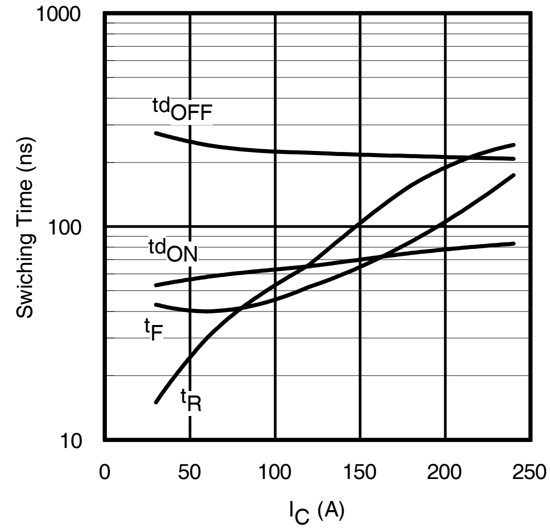



**Fig. 14** - Typ. Switching Loss vs. $I_C$
$T_J$ = 175°C; L = 0.087mH; $V_{CE}$ = 400V, $R_G$ = 5.0Ω; $V_{GE}$ = 15V

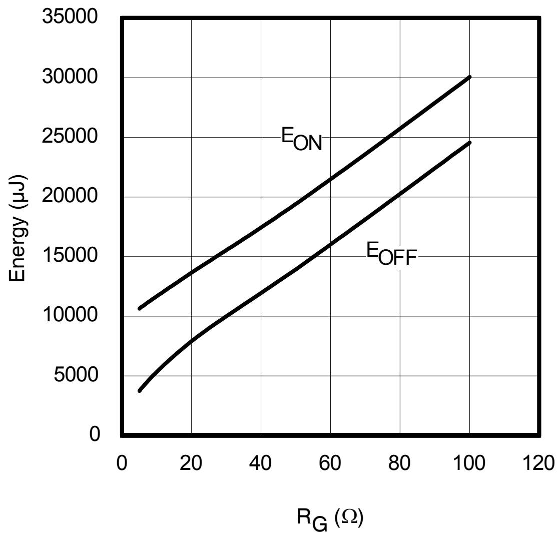



**Fig. 15** - Typ. Energy Loss vs. $R_G$
$T_J$ = 175°C; L = 0.087mH; $V_{CE}$ = 400V, $I_{CE}$ = 120A; $V_{GE}$ = 15V

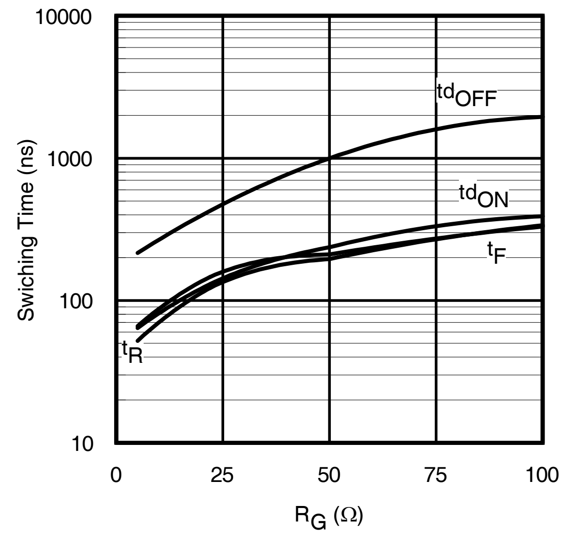



**Fig. 16** - Typ. Switching Time vs. $R_G$
$T_J$ = 175°C; L = 0.087mH; $V_{CE}$ = 400V, $I_{CE}$ = 120A; $V_{GE}$ = 15V

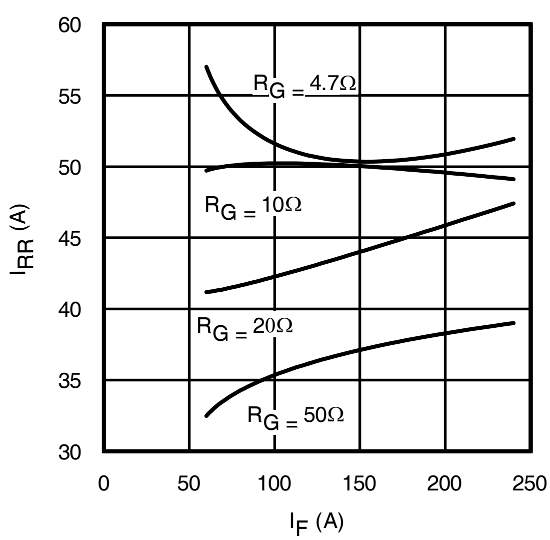



**Fig. 17** - Typ. Diode $I_{RR}$ vs. $I_F$
$T_J$ = 175°C

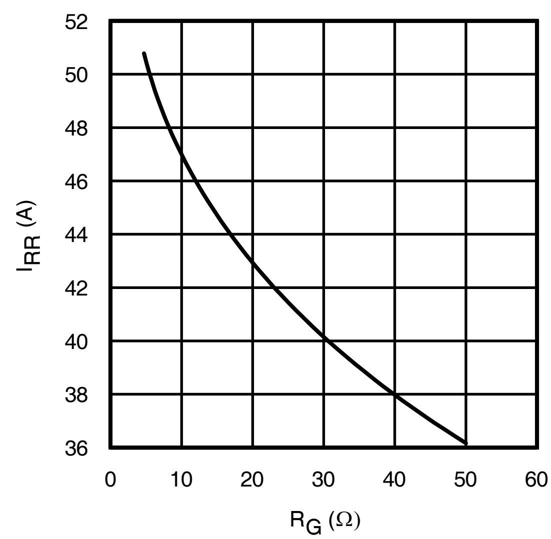



**Fig. 18** - Typ. Diode $I_{RR}$ vs. $R_G$
$T_J$ = 175°C

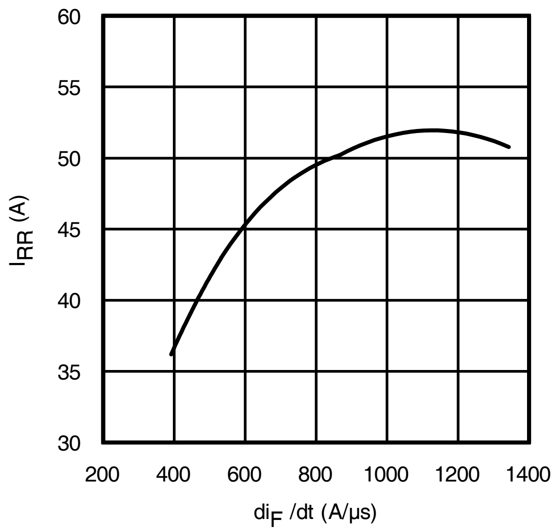



**Fig. 19** - Typ. Diode $I_{RR}$ vs. diF/dt
$V_{CC}$ = 400V; $V_{GE}$ = 15V; $I_F$ = 120A; $T_J$ = 175°C

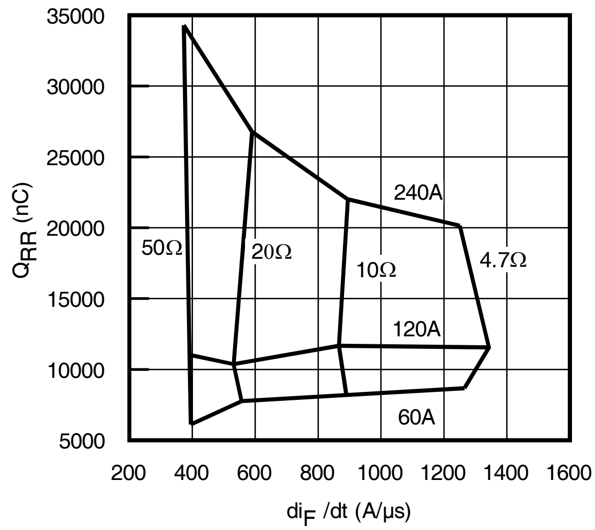



**Fig. 20** - Typ. Diode $Q_{RR}$ vs. diF/dt
$V_{CC}$ = 400V; $V_{GE}$ = 15V; $T_J$ = 175°C

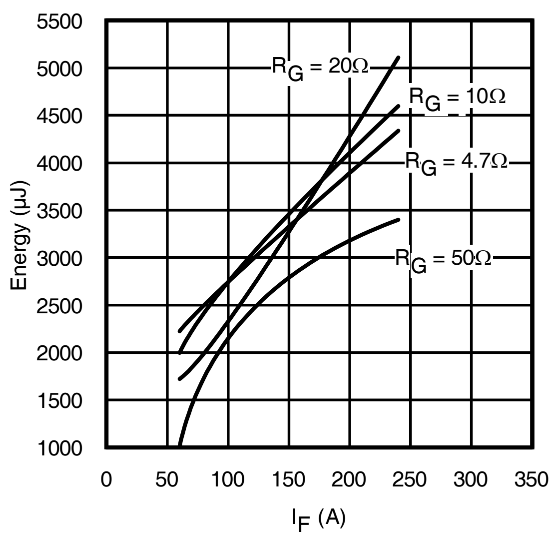



**Fig. 21** - Typ. Diode $E_{RR}$ vs. $I_F$
$T_J$ = 175°C

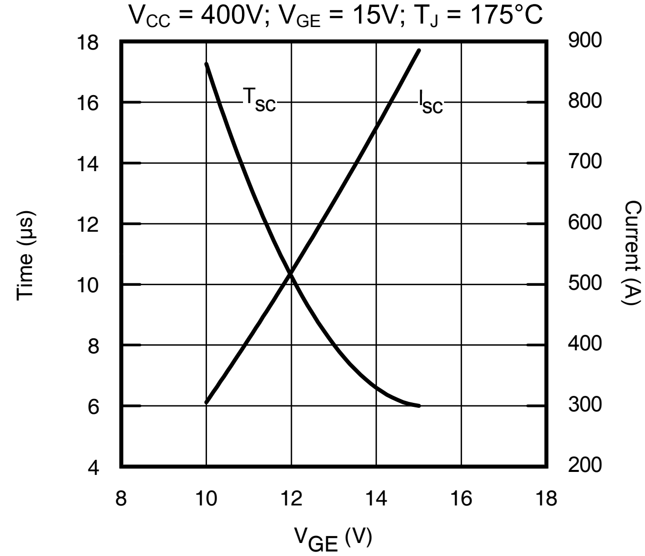



**Fig. 22** - $V_{GE}$ vs. Short Circuit Time
$V_{CC}$ = 400V; $T_C$ = 25°C

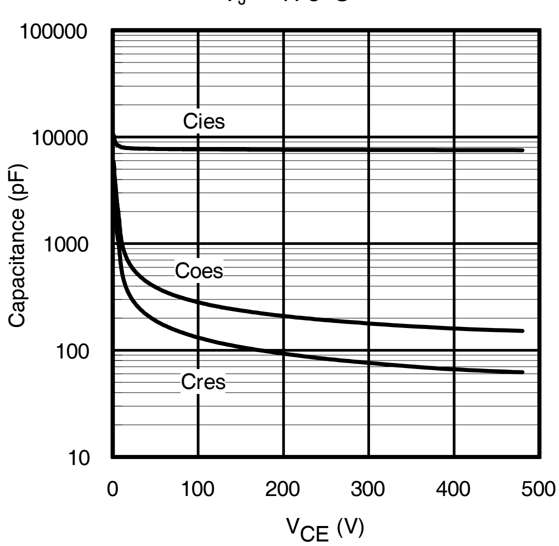



**Fig. 23** - Typ. Capacitance vs. $V_{CE}$
$V_{GE}$= 0V; f = 1MHz

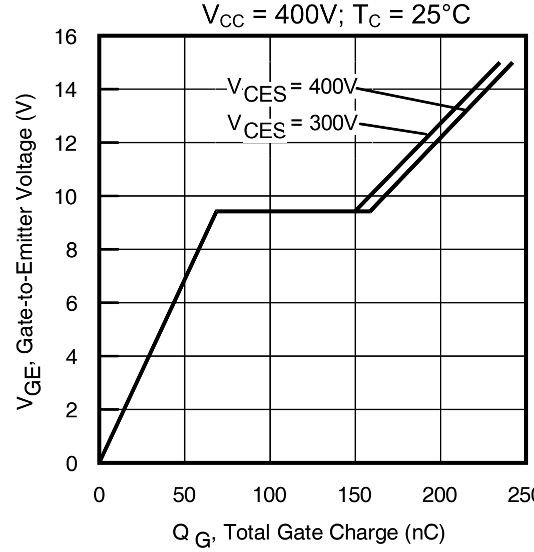



**Fig. 24** - Typical Gate Charge vs. $V_{GE}$
$I_{CE}$ = 120A

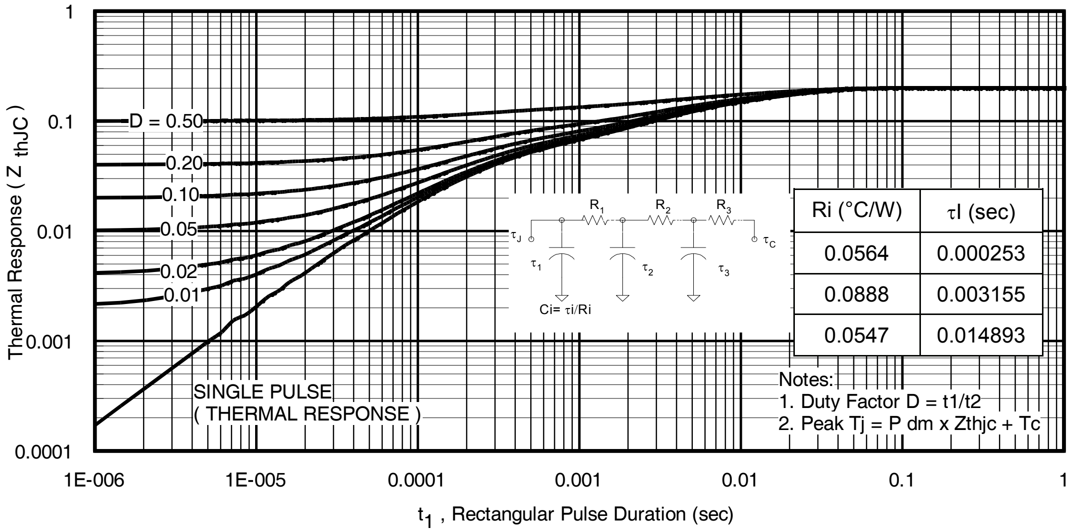



**Fig 25.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

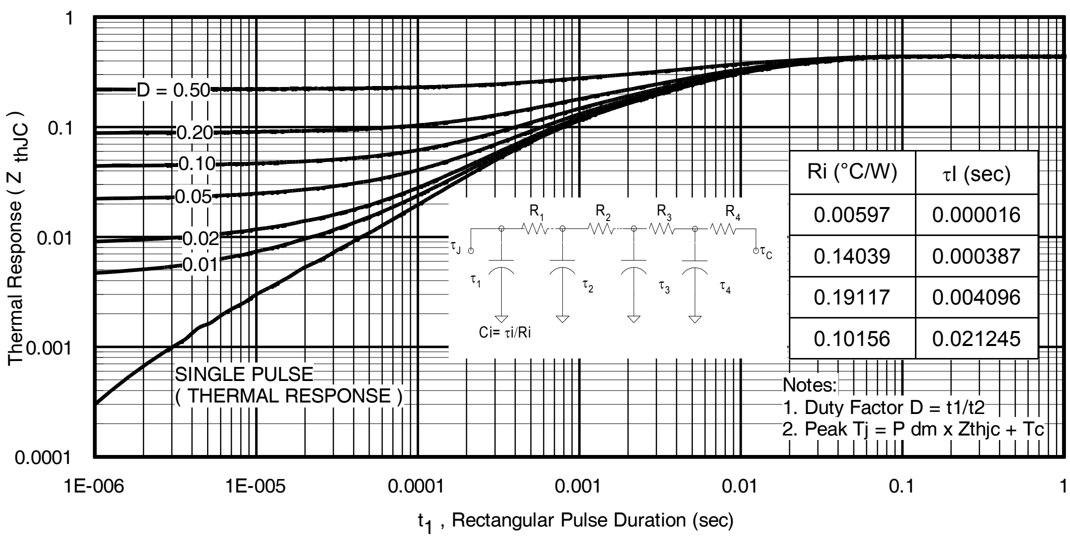



**Fig 26.** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

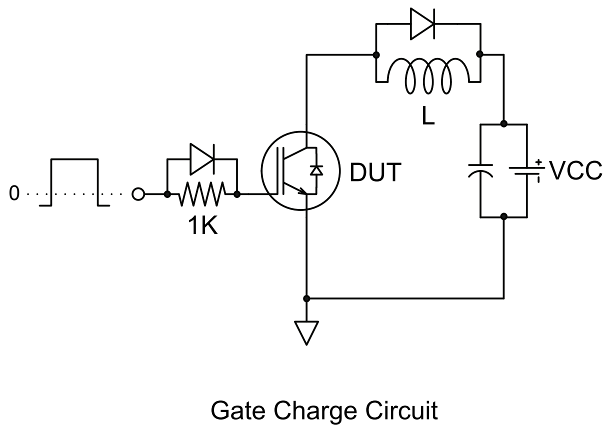



**Fig.C.T.1** - Gate Charge Circuit (turn-off)

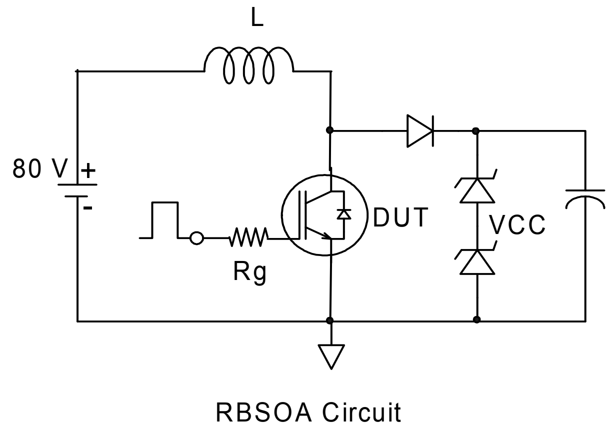



**Fig.C.T.2** - RBSOA Circuit

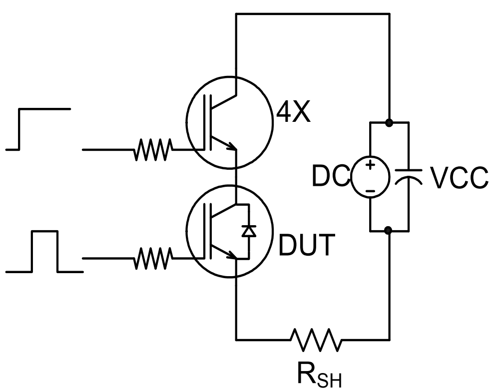



**Fig.C.T.3** - S.C. SOA Circuit

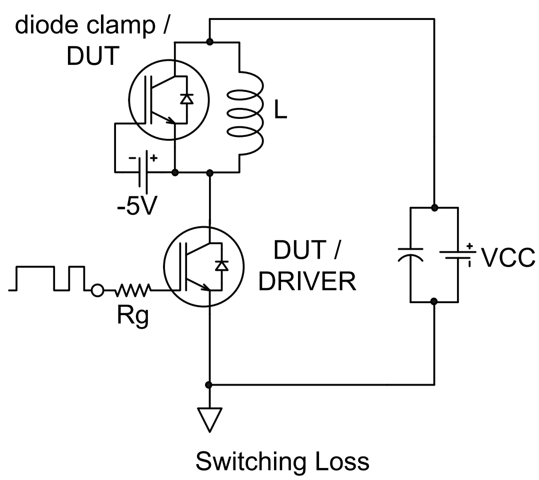



**Fig.C.T.4** - Switching Loss Circuit

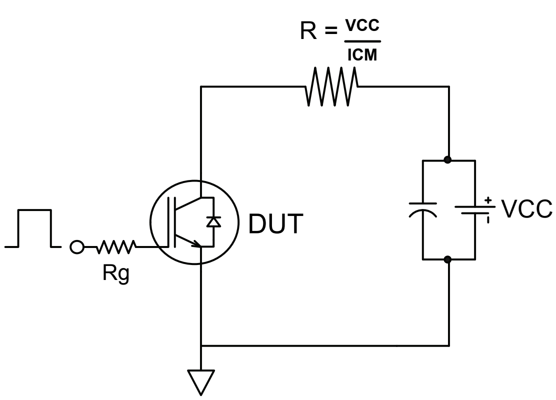



**Fig.C.T.5** - Resistive Load Circuit

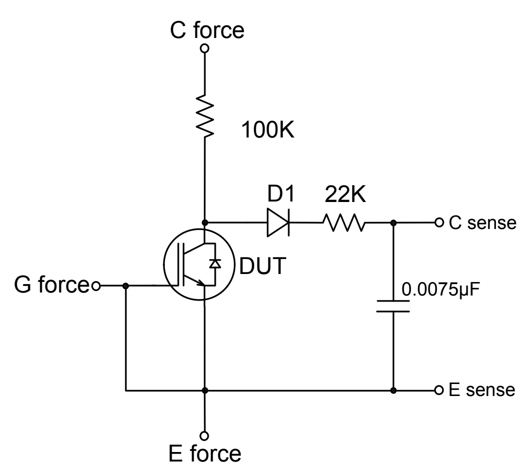



**Fig.C.T.6** - BVCES Filter Circuit

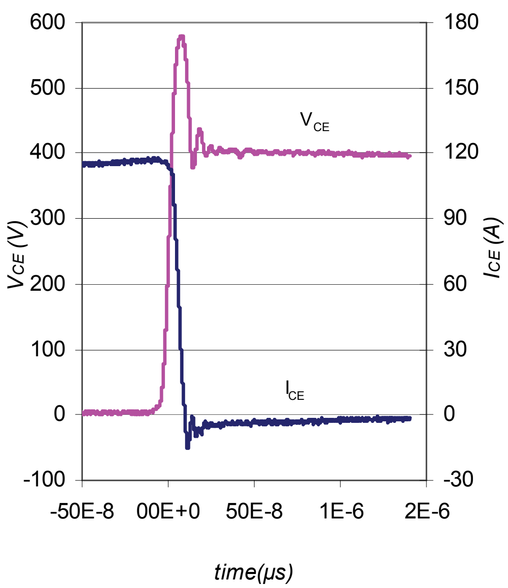



**Fig. WF1** - Typ. Turn-off Loss Waveform
@ $T_J$ = 175°C using Fig. CT.4

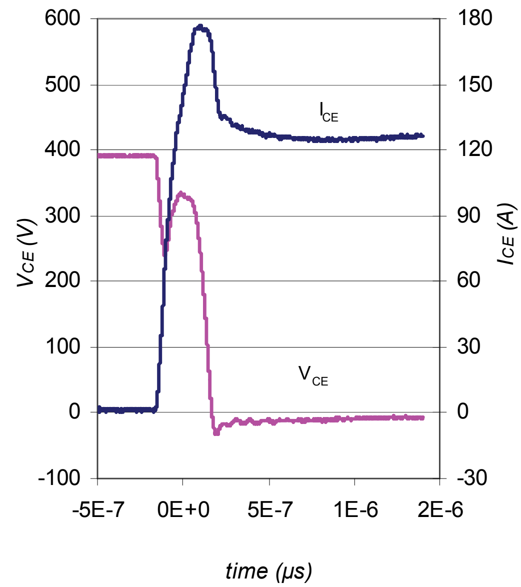



**Fig. WF2** - Typ. Turn-on Loss Waveform
@ $T_J$ = 175°C using Fig. CT.4

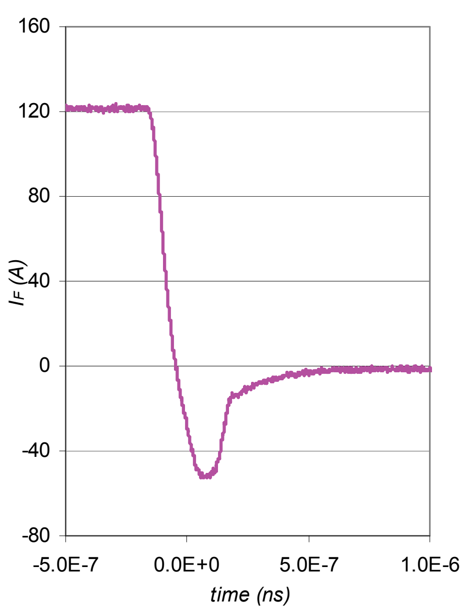



**Fig. WF3** - Typ. Diode Recovery Waveform
@ $T_J$ = 175°C using Fig. CT.4

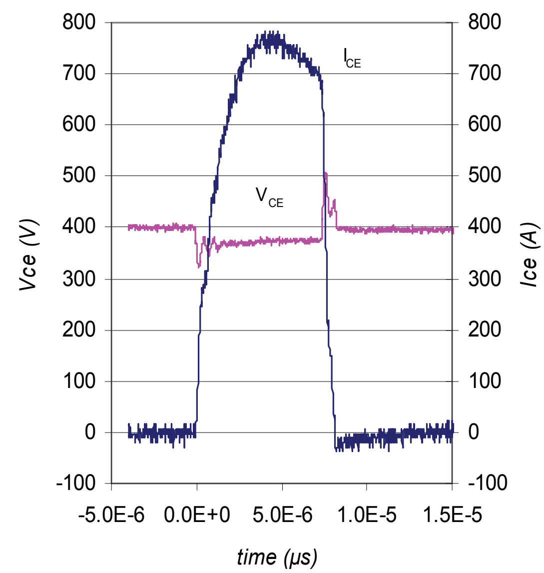
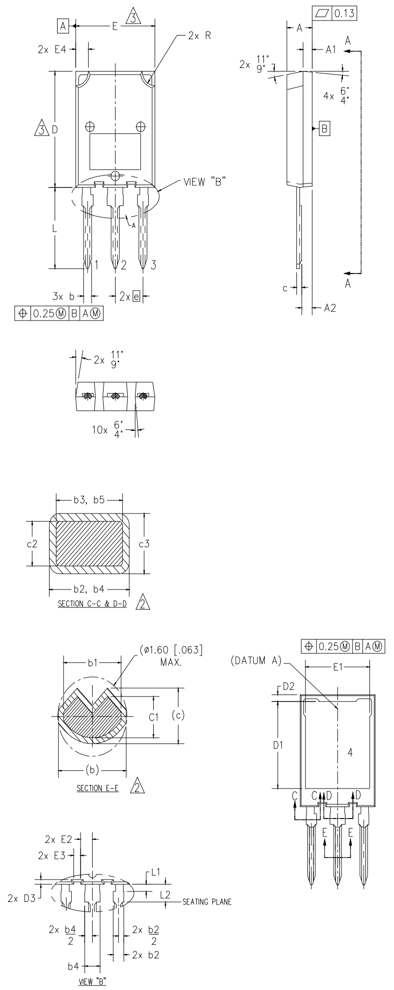



**Fig. WF4** - Typ. S.C. Waveform
@ $T_J$ = 25°C using Fig. CT.3

## Case Outline and Dimensions-PG-TO274-3-903 Dimensions are shown in millimeters (inches))



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M–1994
2. DIMENSIONS b1, b3, b5, c1 & c3 APPLY TO BASE METAL ONLY.
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER EXTREMES OF THE PLASTIC BODY.
4. – ALL DIMENSIONS SHOWN IN MILLIMETERS.
5. – CONTROLLING DIMENSION: MILLIMETER.
6. – OUTLINE CONFORMS TO JEDEC OUTLINE TO-274AA

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.50 | 5.50 | .177 | .217 | |
| A1 | 1.45 | 2.15 | .057 | .085 | |
| A2 | 1.65 | 2.35 | .065 | .093 | |
| b | 1.45 | 1.60 | .054 | .063 | |
| b1 | 1.40 | 1.50 | .055 | .059 | 2 |
| b2 | 2.00 | 2.40 | .079 | .094 | |
| b3 | 1.95 | 2.35 | .077 | .093 | 2 |
| b4 | 3.00 | 3.15 | .118 | .124 | |
| b5 | 2.95 | 3.35 | .116 | .132 | 2 |
| c | 1.10 | 1.30 | .043 | .051 | |
| c1 | 0.90 | 1.10 | .035 | .043 | 2 |
| c2 | 0.65 | 0.85 | .026 | .033 | |
| c3 | 0.50 | 0.70 | .020 | .028 | 2 |
| D | 19.80 | 20.80 | .780 | .819 | 3 |
| D1 | 15.50 | 16.10 | .610 | .634 | |
| D2 | 0.70 | 1.30 | .028 | .051 | |
| D3 | 0.75 | 1.25 | .030 | .049 | |
| E | 15.10 | 16.10 | .594 | .634 | 3 |
| E1 | 13.30 | 13.90 | .524 | .547 | |
| E2 | 2.25 | 2.70 | .089 | .109 | |
| E3 | 1.20 | 1.70 | .047 | .067 | |
| E4 | 2.00 | 3.00 | .079 | .118 | |
| e | 5.45 BSC | | .215 BSC | | |
| L | 13.80 | 14.80 | .535 | .583 | |
| L1 | 1.00 | 1.60 | .039 | .063 | |
| L2 | 3.85 | 4.25 | .152 | .167 | |
| R | 2.00 | 3.00 | .079 | .118 | |

LEAD ASSIGNMENTS

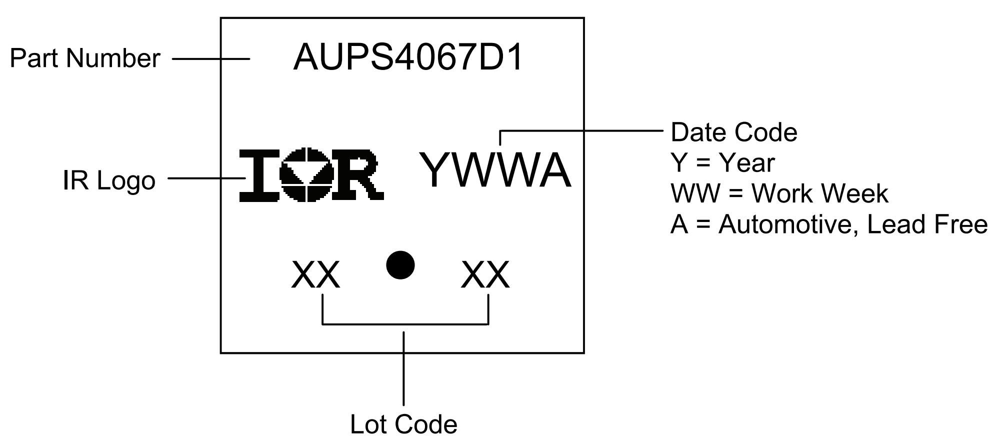
MOSFET

1. – GATE
2. – DRAIN
3. – SOURCE
4. – DRAIN

IGBT

1. – GATE
2. – COLLECTOR
3. – EMITTER
4. – COLLECTOR

## PG-TO274-3-903 -Part Marking Information



**Qualification Information**

| | | | |
|---|---|---|---|
| **Qualification Level** | | Automotive (per AEC-Q101) | |
| | | This part number(s) passed Automotive qualification. Infineon's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. | |
| **Moisture Sensitivity Level** | | PG-TO274-3-903 | N/A |
| **ESD** | Machine Model | Class M4(+/- 400)† AEC-Q101-002 | |
| | Human Body Model | Class H3B(+/- 8000)† AEC-Q101-001 | |
| | Charged Device Model | Class C5 (+/- 1000)† AEC-Q101-005 | |
| **RoHS Compliant** | | Yes | |

† Highest passing voltage.

**Revision History**

| Date | Comments |
|---|---|
| 07/19/2018 | • Updated datasheet with corporate template.<br>• Corrected the reference of "SUPER–247" to "PG-TO274-3-903" to align with IFX nomenclature on pages 1,10,11. |

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