

## Features

- High Speed Smooth Switching Device for Hard and Soft Switching
- $V_{ce(sat)}$  with Positive Temperature Coefficient
- High Ruggedness, Good Thermal Stability
- Very Tight Parameter Distribution
- Halogen Free. "Green" Device (Note 1)
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant ("P" Suffix Designates RoHS Compliant. See Ordering Information)

## Maximum Ratings

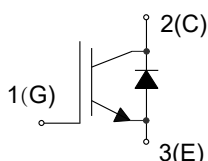
- Operating Junction Temperature Range :  $-40^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$
- Storage Temperature Range:  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$
- IGBT Thermal Resistance:  $0.35^{\circ}\text{C/W}$  Junction to Case
- Diode Thermal Resistance:  $0.65^{\circ}\text{C/W}$  Junction to Case
- Thermal Resistance:  $40^{\circ}\text{C/W}$  Junction to Ambient

| Parameter                                                                                                            | Symbol        | Rating                           | Unit          |
|----------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|---------------|
| Collector-Emitter Voltage                                                                                            | $V_{CE}$      | 1200                             | V             |
| DC Collector Current <sup>(2)</sup>                                                                                  | $I_C$         | $T_C=25^{\circ}\text{C}$<br>80   | A             |
|                                                                                                                      |               | $T_C=100^{\circ}\text{C}$<br>40  |               |
| Pulsed Collector Current <sup>(3)</sup>                                                                              | $I_{C,pluse}$ | 160                              | A             |
| Diode Forward Current <sup>(2)</sup>                                                                                 | $I_F$         | $T_C=25^{\circ}\text{C}$<br>80   | A             |
|                                                                                                                      |               | $T_C=100^{\circ}\text{C}$<br>40  |               |
| Diode Pulsed Current <sup>(3)</sup>                                                                                  | $I_{F,pluse}$ | 160                              | A             |
| Gate-Emitter Voltage                                                                                                 | $V_{GE}$      | $\pm 20$                         | V             |
| Transient Gate-Emitter Voltage <sup>(4)</sup>                                                                        |               | $\pm 30$                         |               |
| Short Circuit Withstand Time <sup>(5)</sup><br>$V_{GE}=15\text{V}, V_{CC}=600\text{V}, T_J \leq 150^{\circ}\text{C}$ | $t_{SC}$      | 10                               | $\mu\text{s}$ |
| Power Dissipation                                                                                                    | $P_D$         | $T_C=25^{\circ}\text{C}$<br>428  | W             |
|                                                                                                                      |               | $T_C=100^{\circ}\text{C}$<br>214 |               |

Note:

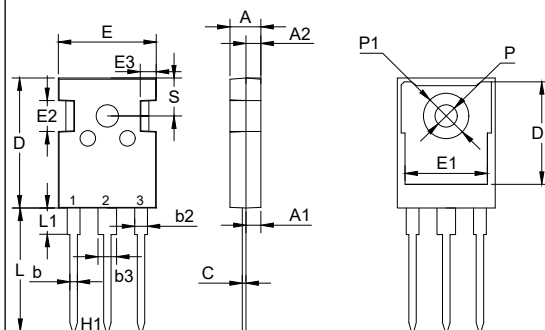
1. Halogen free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
2. Limited by  $T_{Jmax}$ .
3.  $T_p$  limited by  $T_{Jmax}$ .
4.  $T_p \leq 10\mu\text{s}$ , Duty Cycle < 1%
5. Allowed number of short circuits: <1000; time between short circuits: >1s.

## Internal Structure



# Trench and Field Stop IGBT 1200V 40A

## TO-247AB



### DIMENSIONS

| DIM | INCHES |       | MM    |       | NOTE |
|-----|--------|-------|-------|-------|------|
|     | MIN    | MAX   | MIN   | MAX   |      |
| A   | 0.189  | 0.205 | 4.80  | 5.20  |      |
| A1  | 0.087  | 0.103 | 2.21  | 2.61  |      |
| A2  | 0.073  | 0.085 | 1.85  | 2.15  |      |
| b   | 0.039  | 0.055 | 1.00  | 1.40  |      |
| b2  | 0.075  | 0.087 | 1.91  | 2.21  |      |
| C   | 0.020  | 0.028 | 0.50  | 0.70  |      |
| D   | 0.815  | 0.839 | 20.70 | 21.30 |      |
| D1  | 0.640  | 0.663 | 16.25 | 16.85 |      |
| E   | 0.610  | 0.634 | 15.50 | 16.10 |      |
| E1  | 0.512  | 0.535 | 13.00 | 13.60 |      |
| E2  | 0.189  | 0.205 | 4.80  | 5.20  |      |
| E3  | 0.091  | 0.106 | 2.30  | 2.70  |      |
| L   | 0.772  | 0.796 | 19.62 | 20.22 |      |
| L1  | -      | 0.169 | -     | 4.30  |      |
| P   | 0.134  | 0.150 | 3.40  | 3.80  | Φ    |
| P1  | -      | 0.287 | -     | 7.30  | Φ    |
| S   | 0.242  |       | 6.15  |       | TYP  |
| H1  | 0.214  |       | 5.44  |       | TYP  |
| b3  | 0.110  | 0.126 | 2.80  | 3.20  |      |

**Electrical Characteristics @ 25°C (Unless Otherwise Specified)**

| Parameter                             | Symbol        | Test Conditions                                                            | Min  | Typ  | Max  | Unit |
|---------------------------------------|---------------|----------------------------------------------------------------------------|------|------|------|------|
| <b>Static Characteristics</b>         |               |                                                                            |      |      |      |      |
| Collector-Emitter Breakdown Voltage   | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=250\mu A$                                                  | 1200 |      |      | V    |
| Collector-Emitter Saturation Voltage  | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=40A, T_J=25^\circ C$                                      |      | 1.85 | 2.30 | V    |
|                                       |               | $V_{GE}=15V, I_C=40A, T_J=125^\circ C$                                     |      | 2.20 |      |      |
|                                       |               | $V_{GE}=15V, I_C=40A, T_J=150^\circ C$                                     |      | 2.30 |      |      |
| G-E Threshold Voltage                 | $V_{GE(th)}$  | $I_C=250\mu A, V_{CE}=V_{GE}$                                              | 5.1  | 5.8  | 6.4  | V    |
| C-E Leakage Current                   | $I_{CES}$     | $V_{CE}=1200V, V_{GE}=0V, T_J=25^\circ C$                                  |      |      | 0.25 | mA   |
|                                       |               | $V_{CE}=1200V, V_{GE}=0V, T_J=150^\circ C$                                 |      |      | 5    |      |
| G-E Leakage Current                   | $I_{GES}$     | $V_{CE}=0V, V_{GE}=\pm 20V$                                                |      |      | 100  | nA   |
| <b>Dynamic Characteristics</b>        |               |                                                                            |      |      |      |      |
| Input Capacitance                     | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz$                                            |      | 4.2  |      | nF   |
| Reverse Transfer Capacitance          | $C_{res}$     |                                                                            |      | 0.18 |      |      |
| Gate Charge                           | $Q_g$         | $V_{CC}=960V, I_C=40A, V_{GE}=15V$                                         |      | 0.33 |      | uC   |
| <b>IGBT Switching Characteristics</b> |               |                                                                            |      |      |      |      |
| Turn-On Delay Time                    | $t_{d(on)}$   | $V_{CC}=600V, I_C=40A,$<br>$V_{GE}=-15/15V, R_G=12\Omega, T_J=25^\circ C$  |      | 45   |      | ns   |
| Rise Time                             | $t_r$         |                                                                            |      | 56   |      |      |
| Turn-Off Delay Time                   | $t_{d(off)}$  |                                                                            |      | 180  |      |      |
| Fall Time                             | $t_f$         |                                                                            |      | 80   |      |      |
| Turn-On Energy                        | $E_{on}$      |                                                                            |      | 3.8  |      | mJ   |
| Turn-Off Energy                       | $E_{off}$     |                                                                            |      | 1.7  |      |      |
| Turn-On Delay Time                    | $t_{d(on)}$   | $V_{CC}=600V, I_C=40A,$<br>$V_{GE}=-15/15V, R_G=12\Omega, T_J=125^\circ C$ |      | 50   |      | ns   |
| Rise Time                             | $t_r$         |                                                                            |      | 58   |      |      |
| Turn-Off Delay Time                   | $t_{d(off)}$  |                                                                            |      | 240  |      |      |
| Fall Time                             | $t_f$         |                                                                            |      | 85   |      |      |
| Turn-On Energy                        | $E_{on}$      |                                                                            |      | 5.4  |      | mJ   |
| Turn-Off Energy                       | $E_{off}$     |                                                                            |      | 2.7  |      |      |
| Turn-On Delay Time                    | $t_{d(on)}$   | $V_{CC}=600V, I_C=40A,$<br>$V_{GE}=-15/15V, R_G=12\Omega, T_J=150^\circ C$ |      | 53   |      | ns   |
| Rise Time                             | $t_r$         |                                                                            |      | 60   |      |      |
| Turn-Off Delay Time                   | $t_{d(off)}$  |                                                                            |      | 260  |      |      |
| Fall Time                             | $t_f$         |                                                                            |      | 90   |      |      |
| Turn-On Energy                        | $E_{on}$      |                                                                            |      | 5.8  |      | mJ   |
| Turn-Off Energy                       | $E_{off}$     |                                                                            |      | 3.0  |      |      |

**Electrical Characteristics @ 25°C (Unless Otherwise Specified)**

| Parameter                    | Symbol    | Test Conditions                                                 | Min | Typ  | Max | Unit    |
|------------------------------|-----------|-----------------------------------------------------------------|-----|------|-----|---------|
| <b>Diode Characteristics</b> |           |                                                                 |     |      |     |         |
| Diode Forward Voltage        | $V_F$     | $V_{GE}=0V, I_F=40A, T_J=25^{\circ}C$                           |     | 2.0  |     | V       |
|                              |           | $V_{GE}=0V, I_F=40A, T_J=125^{\circ}C$                          |     | 1.8  |     |         |
|                              |           | $V_{GE}=0V, I_F=40A, T_J=150^{\circ}C$                          |     | 1.7  |     |         |
| Reverse Recovery Current     | $I_{rr}$  | $V_R=600V, I_F=40A,$<br>$di_F/dt=-450A/\mu s, T_J=25^{\circ}C$  |     | 21   |     | A       |
| Reverse Recovery Charge      | $Q_{rr}$  |                                                                 |     | 2.4  |     | $\mu C$ |
| Reverse Recovery Energy      | $E_{rec}$ |                                                                 |     | 1.0  |     | mJ      |
| Reverse Recovery Current     | $I_{rr}$  | $V_R=600V, I_F=40A,$<br>$di_F/dt=-450A/\mu s, T_J=125^{\circ}C$ |     | 25   |     | A       |
| Reverse Recovery Charge      | $Q_{rr}$  |                                                                 |     | 4.8  |     | $\mu C$ |
| Reverse Recovery Energy      | $E_{rec}$ |                                                                 |     | 1.95 |     | mJ      |
| Reverse Recovery Current     | $I_{rr}$  | $V_R=600V, I_F=40A,$<br>$di_F/dt=-450A/\mu s, T_J=150^{\circ}C$ |     | 28   |     | A       |
| Reverse Recovery Charge      | $Q_{rr}$  |                                                                 |     | 5.4  |     | $\mu C$ |
| Reverse Recovery Energy      | $E_{rec}$ |                                                                 |     | 2.25 |     | mJ      |

## Curve Characteristics

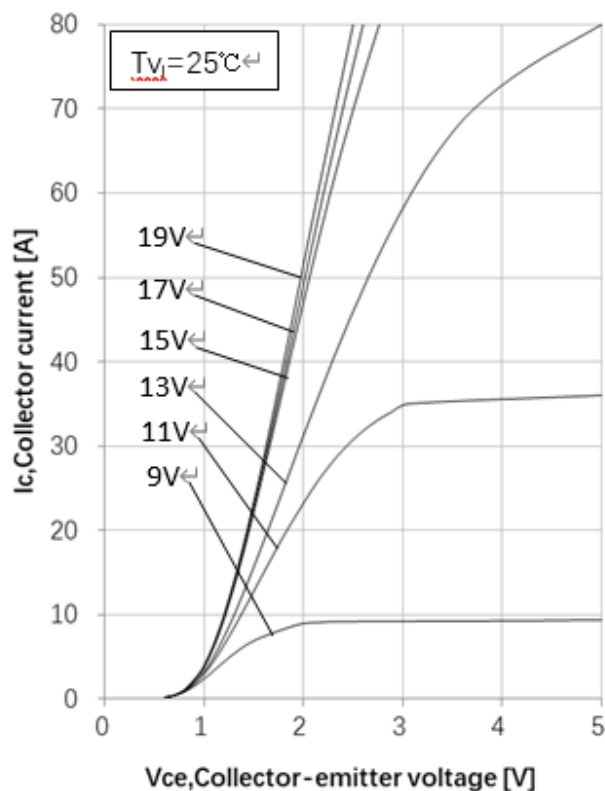


Fig1. Typical output characteristic

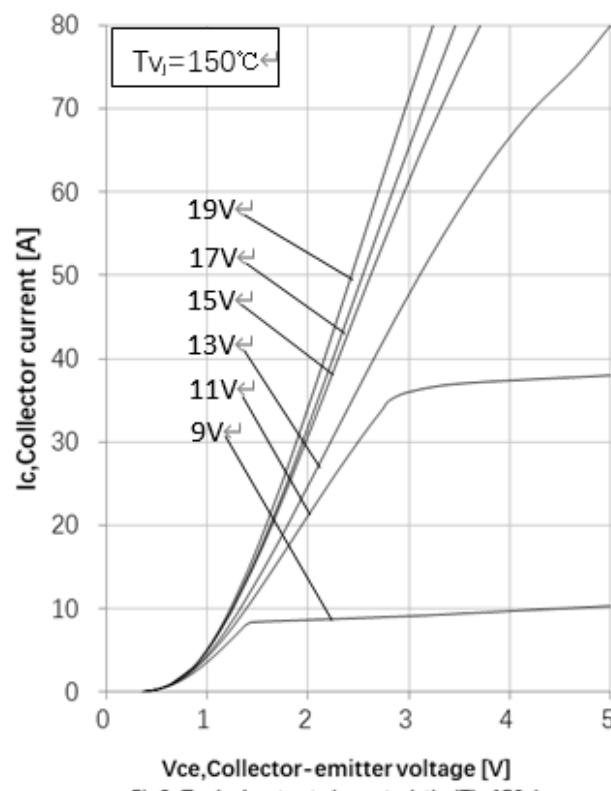


Fig2. Typical output characteristic ( $T_j=150^{\circ}\text{C}$ )

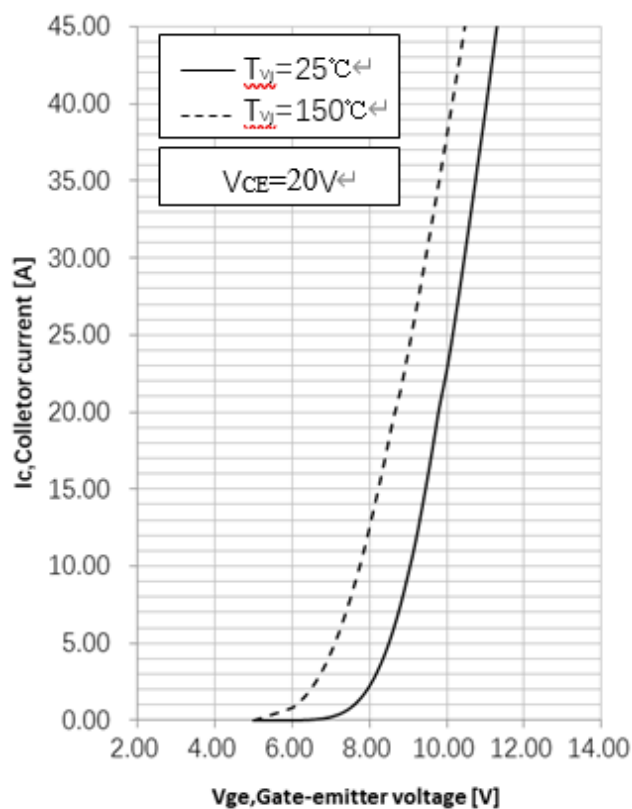


Fig3. Typical transfer characteristic

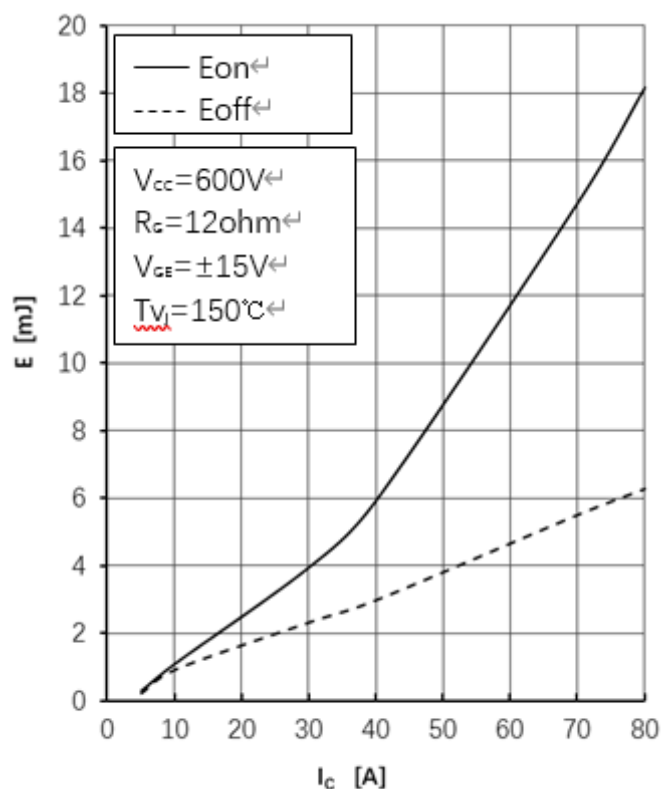
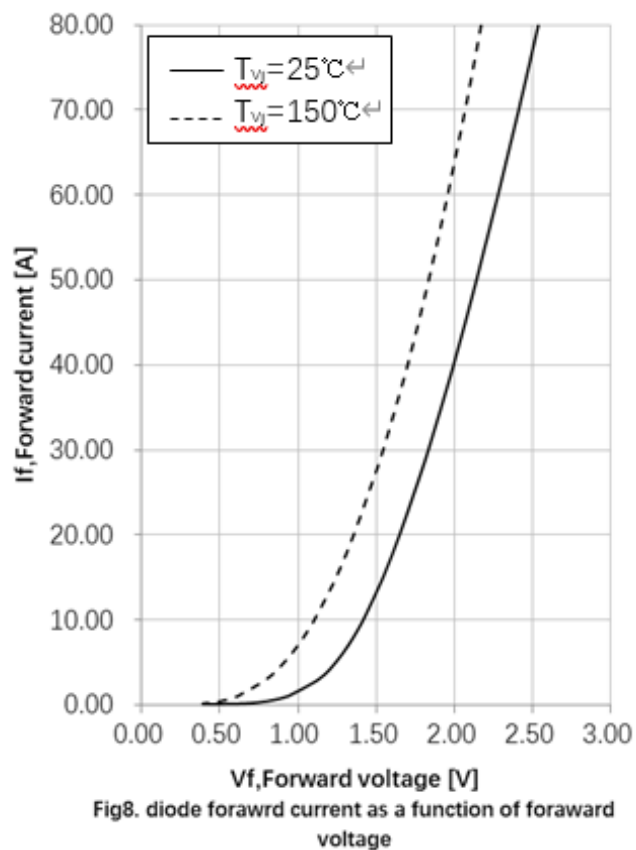
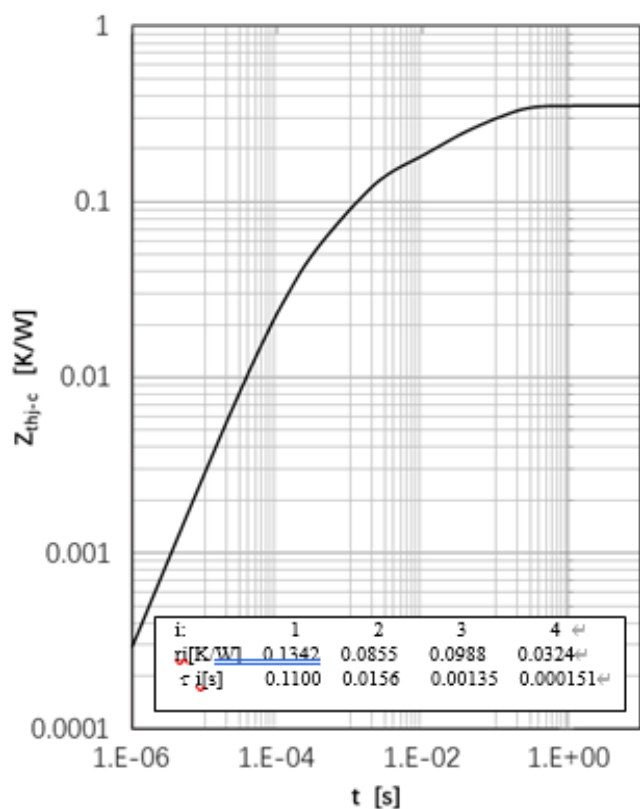
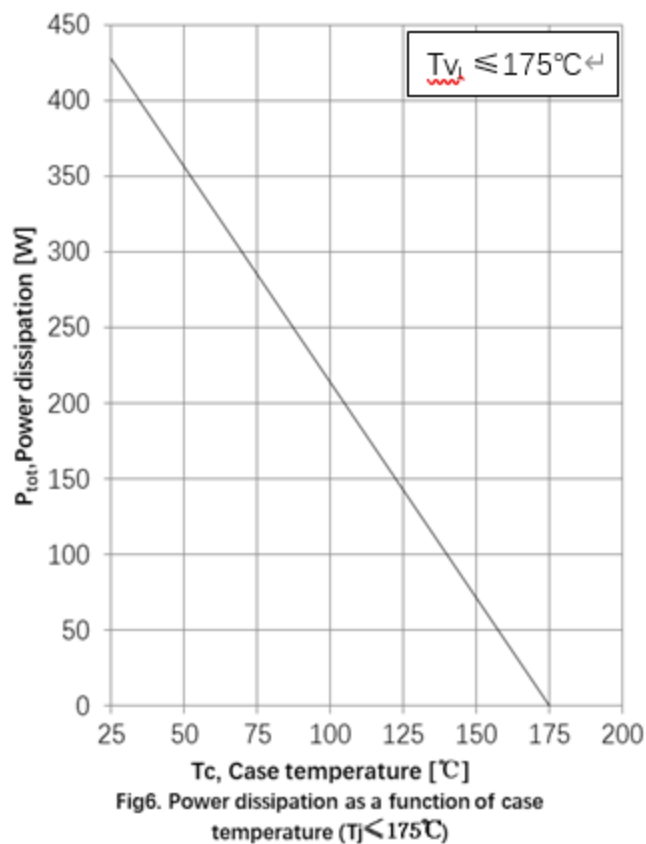
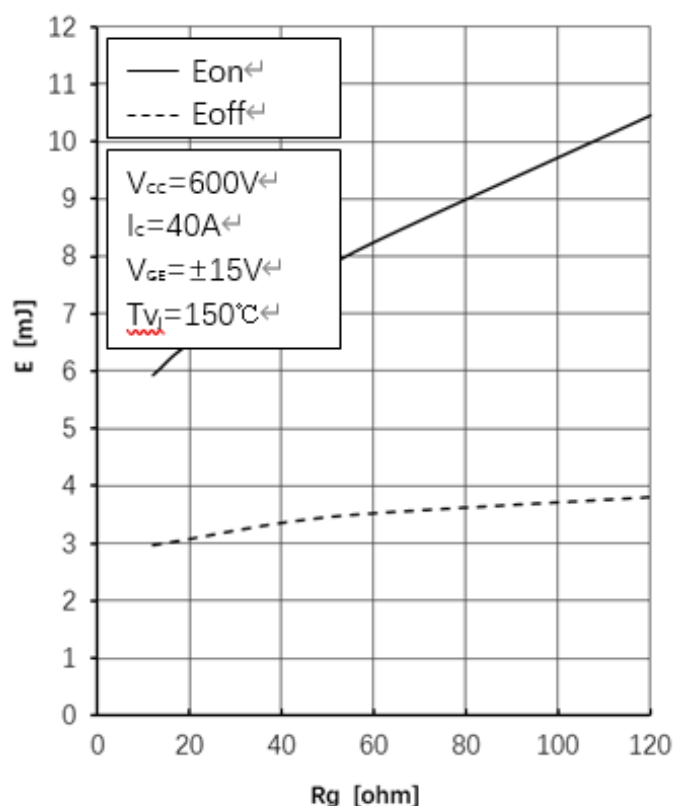
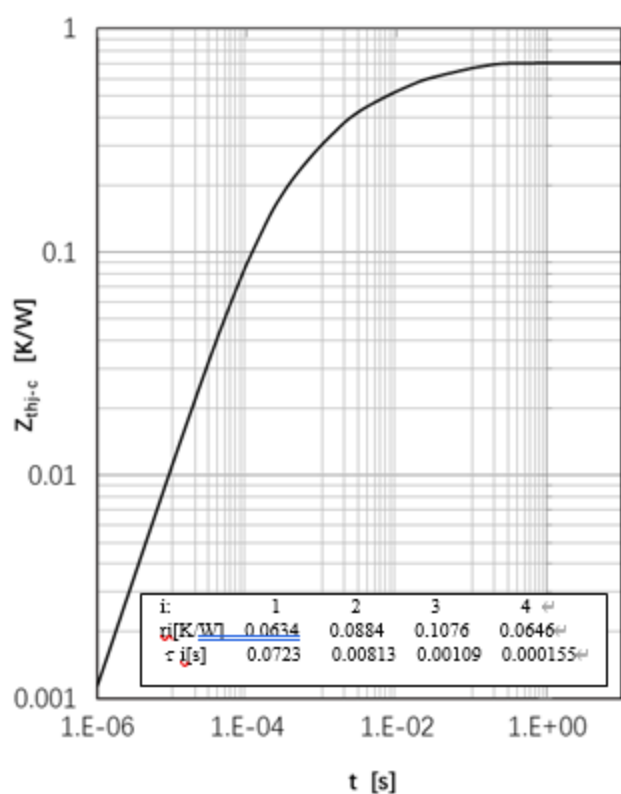
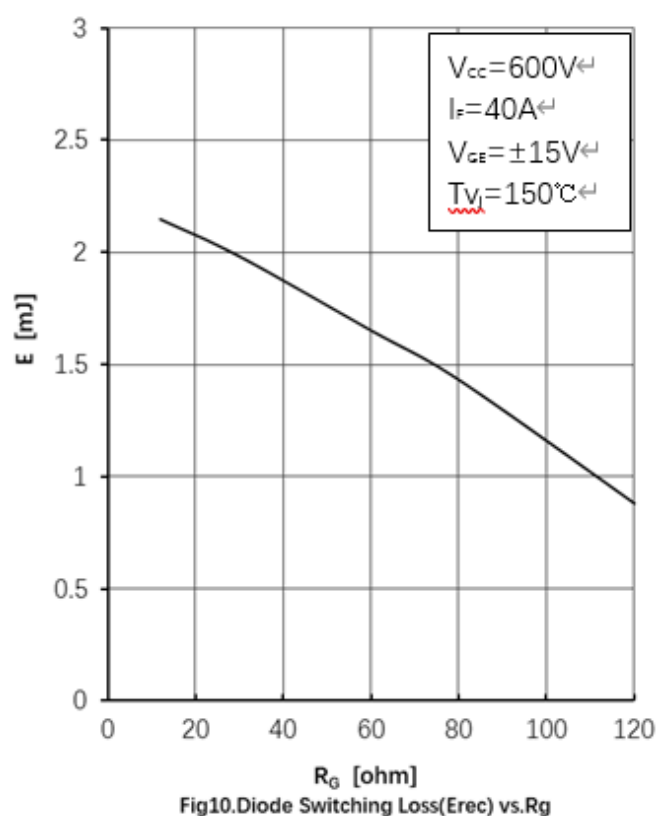
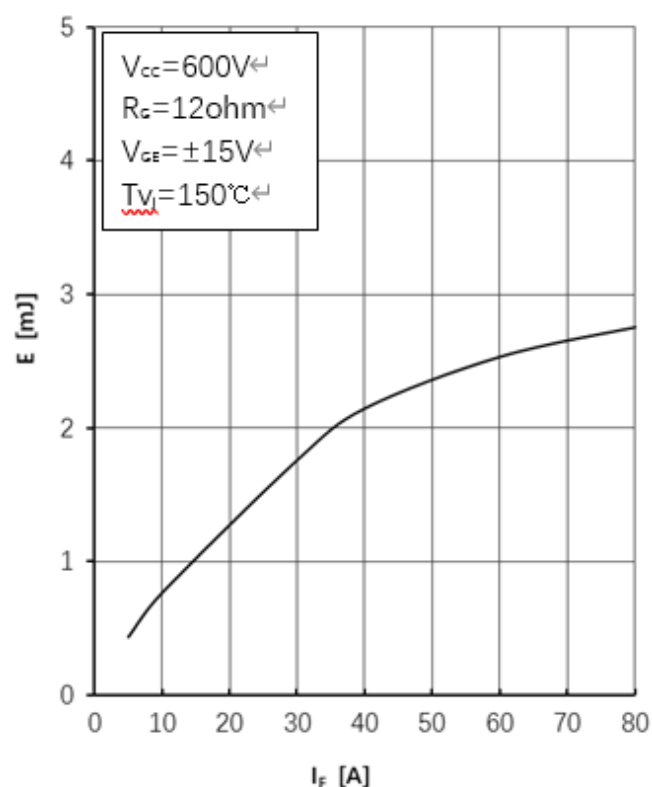


Fig4. IGBT Switching Loss vs.  $I_c$

## Curve Characteristics



## Curve Characteristics



## Ordering Information

| Device         | Packing                       |
|----------------|-------------------------------|
| Part Number-BP | Tube: 30pcs/Tube, 1800pcs/Ctn |

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