

# PTDCQ40120BY

1200V 40A Si IGBT Discrete

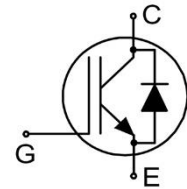
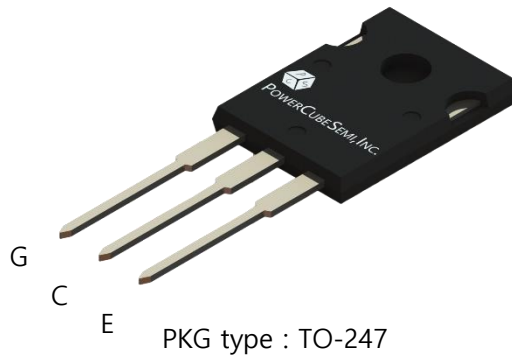
## Features

### Si IGBT Discrete

- Rated to 1200V at 40Amps @ $T_C = 100^\circ\text{C}$
- $V_{CE(sat)} = 1.85\text{V}$  @  $I_C = 40\text{A}$
- Low Collector-Emitter saturation voltage
- Maximum Junction Temperature  $175^\circ\text{C}$
- Qualified to AEC-Q101
- Including fast & soft recovery anti-parallel FWD
- High short circuit capability (10 $\mu\text{s}$ )

## Application

- Inverter for Automotive and Industrial
- AC and DC servo drive amplifier
- Uninterruptible power supply



## Absolute Maximum Ratings

| Symbol         | Parameter                            | Value                     | Unit             |   |
|----------------|--------------------------------------|---------------------------|------------------|---|
| $BV_{CES}$     | Collector-Emitter Breakdown Voltage  | 1200                      | V                |   |
| $I_C$          | DC Collector Current                 | $T_C = 25^\circ\text{C}$  | 80               | A |
|                |                                      | $T_C = 100^\circ\text{C}$ | 40               |   |
| $I_{C, Pulse}$ | Pulsed Collector Current             | 160                       | A                |   |
| $I_F$          | Diode Forward Current                | $T_C = 25^\circ\text{C}$  | 80               | A |
|                |                                      | $T_C = 100^\circ\text{C}$ | 40               |   |
| $I_{F, Pulse}$ | Diode Pulsed Current                 | 160                       | A                |   |
| $V_{GE}$       | Continuous Gate-Emitter Voltage      | $\pm 20$                  | V                |   |
| $V_{GE}$       | Transient Gate-Emitter Voltage       | $\pm 30$                  |                  |   |
| $P_D$          | Power Dissipation                    | $T_C = 25^\circ\text{C}$  | 428              | W |
| $t_{SC}$       | Short circuit withstand time         | 10                        | $\mu\text{s}$    |   |
| $T_{vj}$       | Operating Junction Temperature Range | -40 to 175                | $^\circ\text{C}$ |   |
| $T_{stg}$      | Storage Temperature Range            | -55 to 150                |                  |   |

## Package Marking and Ordering Information

| Device Marking | Device     | Package | Packing Method | Tape width | Quantity |
|----------------|------------|---------|----------------|------------|----------|
| PTDCQ40120BY   | PTDCQ40120 | TO-247  | TUBE           | -          | 30       |

## Electrical Characteristics $T_j=25^\circ\text{C}$ Unless Otherwise Specified

### Static Characteristics

| Symbol        | Parameter                            | Test Condition                                | Numerical               |     |      | Unit |    |
|---------------|--------------------------------------|---|-------------------------|-----|------|------|----|
|               |                                      |   | Min                     | Typ | Max  |      |    |
| $BV_{CES}$    | Collector-Emitter Breakdown Voltage  | $I_C=250\mu\text{A}$ , $V_{GE}=0\text{V}$     | 1200                    | -   | -    | V    |    |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C=40\text{A}$ ,<br>$V_{GE}=15\text{V}$     | $T_j=25^\circ\text{C}$  | -   | 1.85 | 2.40 | V  |
|               |                                      |   | $T_j=125^\circ\text{C}$ | -   | 2.20 | -    |    |
|               |                                      |   | $T_j=150^\circ\text{C}$ | -   | 2.30 | -    |    |
| $V_{GE(TH)}$  | Gate-Emitter Threshold Voltage       | $V_{CE}=V_{GE}$ , $I_C=1.4\text{mA}$          | 4.8                     | 5.6 | 6.5  | V    |    |
| $I_{CES}$     | Zero Gate Voltage Collector Current  | $V_{CE}=1200\text{V}$ ,<br>$V_{GE}=0\text{V}$ | $T_j=25^\circ\text{C}$  | -   | -    | 0.25 | mA |
|               |                                      |   | $T_j=150^\circ\text{C}$ | -   | -    | 5.00 |    |
| $I_{GES}$     | Gate-Emitter Leakage Current         | $V_{GE}=\pm 30\text{V}$ , $V_{CE}=0\text{V}$  | -                       | -   | 200  | nA   |    |

### Dynamic Characteristics

| Symbol      | Parameter                       | Test Condition   | Numerical               |      |      | Unit          |   |
|-------------|---------------------------------|--|-------------------------|------|------|---------------|---|
|             |                                 |  | Min                     | Typ  | Max  |               |   |
| $Q_G$       | Total Gate Charge               | $V_{CC}=960\text{V}$ , $I_C=40\text{A}$ ,<br>$V_{GE}=15\text{V}$   | -                       | 0.33 | -    | $\mu\text{C}$ |   |
| $V_F$       | Diode Forward Voltage           | $I_F=40\text{A}$   | $T_j=25^\circ\text{C}$  | 1.60 | 2.00 | 2.60          | V |
|             |                                 |  | $T_j=125^\circ\text{C}$ | -    | 1.80 | -             |   |
|             |                                 |  | $T_j=150^\circ\text{C}$ | -    | 1.70 | -             |   |
| $C_{IES}$   | Input Capacitance               | $V_{CE}=25\text{V}$ , $V_{GE}=0\text{V}$ ,<br>$f=1\text{MHz}$  | -                       | 2.50 | -    | nF            |   |
| $C_{RES}$   | Reverse Transfer Capacitance    |  | -                       | 0.09 | -    |               |   |
| $I_{C(SC)}$ | Short circuit collector current | $V_{GE}=15\text{V}$ , $t_{SC}\leq 10\mu\text{s}$ ,<br>$V_{CC}=600\text{V}$ , $T_j\leq 150^\circ\text{C}$ | -                       | 150  | -    | A             |   |



## Electrical Characteristics

$T_j=25^{\circ}\text{C}$  Unless Otherwise Specified

### Switching Characteristics

| Symbol       | Parameter                 | Test Condition   | Numerical  |     |      | Unit |    |
|--------------|---------------------------|--|--|-----|------|------|----|
|              |                           |  | Min  | Typ | Max  |      |    |
| $t_{d(on)}$  | Turn-On Delay Time        | $V_{GE}=-15\sim 15\text{V}$ ,<br>$V_{CC}=600\text{V}$ ,<br>$I_C=40\text{A}$ , $R_G=12\Omega$ | $T_j=25^{\circ}\text{C}$<br>$T_j=125^{\circ}\text{C}$<br>$T_j=150^{\circ}\text{C}$ | -   | 45   | -    | ns |
|              |                           |  |  | -   | 50   | -    |    |
|              |                           |  |  | -   | 53   | -    |    |
| $t_r$        | Turn-On Rise Time         |  |  | -   | 56   | -    |    |
|              |                           |  |  | -   | 58   | -    |    |
|              |                           |  |  | -   | 60   | -    |    |
| $t_{d(off)}$ | Turn-Off Delay Time       |  |  | -   | 180  | -    | mJ |
|              |                           |  |  | -   | 240  | -    |    |
|              |                           |  |  | -   | 260  | -    |    |
| $t_f$        | Turn-Off Fall Time        | -  | 80   | -   | mJ   |      |    |
|              |                           | -  | 85   | -   |      |      |    |
|              |                           | -  | 90   | -   |      |      |    |
| $E_{on}$     | Turn-On Switching Energy  | -  | 3.8  | -   | mJ   |      |    |
|              |                           | -  | 5.4  | -   |      |      |    |
|              |                           | -  | 5.8  | -   |      |      |    |
| $E_{off}$    | Turn-Off Switching Energy | -  | 1.7  | -   | mJ   |      |    |
|              |                           | -  | 2.7  | -   |      |      |    |
|              |                           | -  | 3.0  | -   |      |      |    |
| $E_{rec}$    | Reverse Recovery Energy   | $I_F=40\text{A}$ , $V_R=600\text{V}$ ,<br>$di/dt=-520\text{A}/\mu\text{s}$                   | $T_j=25^{\circ}\text{C}$<br>$T_j=125^{\circ}\text{C}$<br>$T_j=150^{\circ}\text{C}$ | -   | 0.92 | -    | mJ |
|              |                           |  |  | -   | 2.05 | -    |    |
|              |                           |  |  | -   | 2.25 | -    |    |
| $I_{rr}$     | Reverse Recovery Current  |  |  | -   | 14   | -    | A  |
|              |                           |  |  | -   | 18   | -    |    |
|              |                           |  |  | -   | 20   | -    |    |
| $Q_{rr}$     | Reverse Recovery Charge   |  |  | -   | 2.55 | -    | uC |
|              |                           |  |  | -   | 6.33 | -    |    |
|              |                           |  |  | -   | 7.05 | -    |    |
| $T_{rr}$     | Reverse Recovery Time     | -  | 439  | -   | ns   |      |    |
|              |                           | -  | 628  | -   |      |      |    |
|              |                           | -  | 773  | -   |      |      |    |

### Thermal Characteristics

| Symbol            | Parameter                                     | Numerical | Unit |
|-------------------|---|-----------|------|
| $R_{\theta(J-A)}$ | Thermal Resistance Junction-to-Ambient        | 40        | K/W  |
| $R_{\theta(J-C)}$ | Thermal Resistance Junction-to-Case for IGBT  | 0.35      |      |
| $R_{\theta(J-C)}$ | Thermal Resistance Junction-to-Case for Diode | 0.65      |      |

# Typical Characteristics

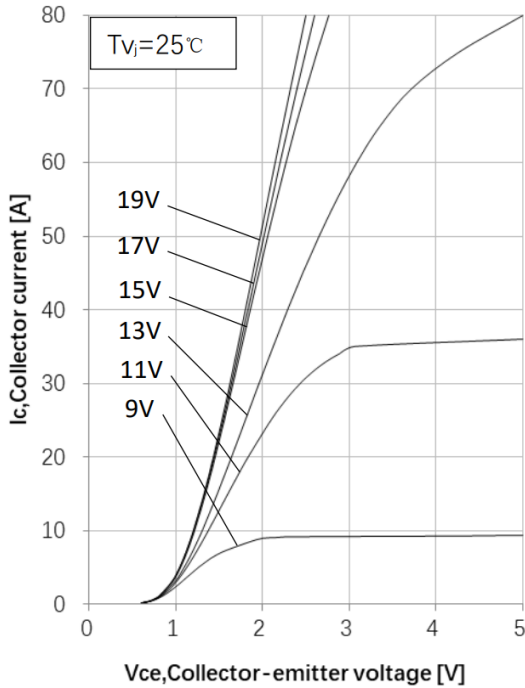


Figure 1. Output Characteristics ( $T_J=25^\circ\text{C}$ )

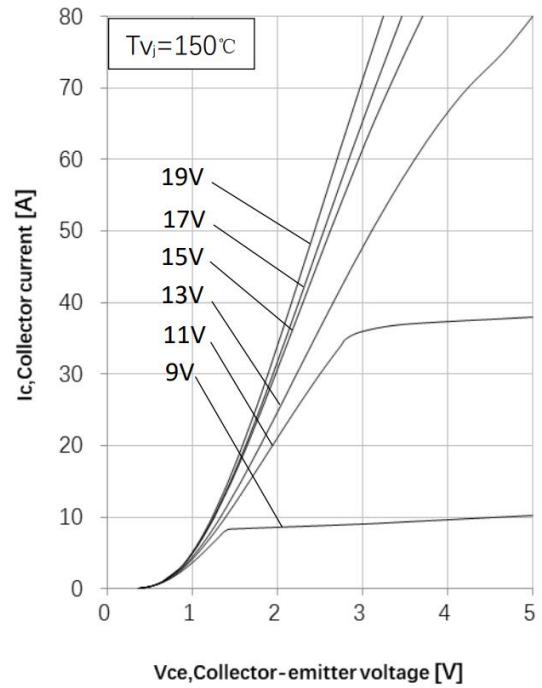


Figure 2. Output Characteristics ( $T_J=150^\circ\text{C}$ )

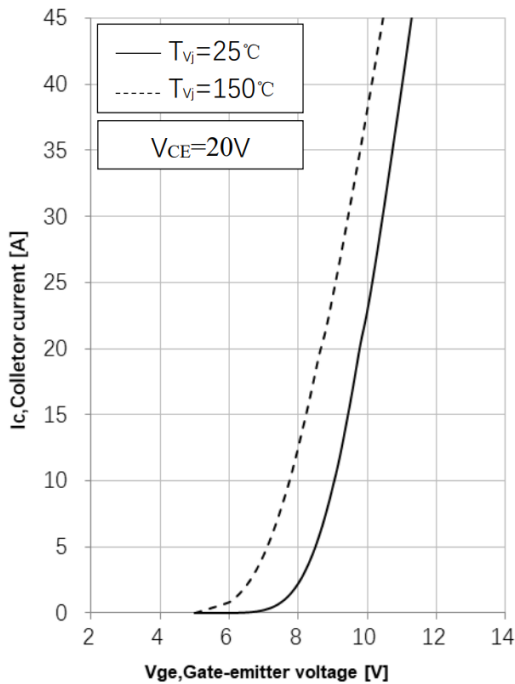


Figure 3. Typical transfer Characteristic ( $V_{CE}=20\text{V}$ )

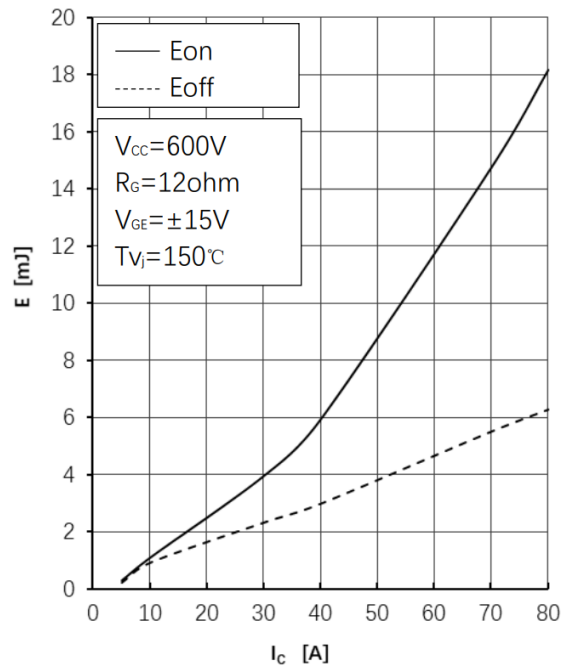


Figure 4. IGBT Switching Loss vs.  $I_C$

# Typical Characteristics

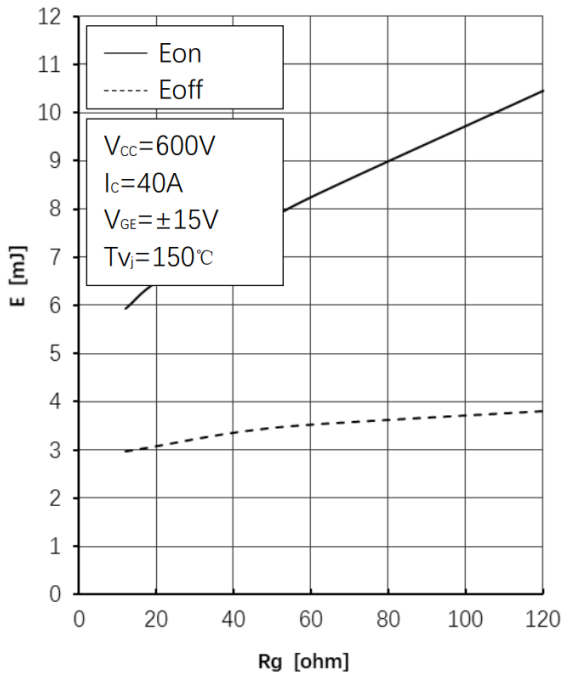


Figure 5. IGBT Switching Loss vs.  $R_G$  ( $150^\circ\text{C}$ )

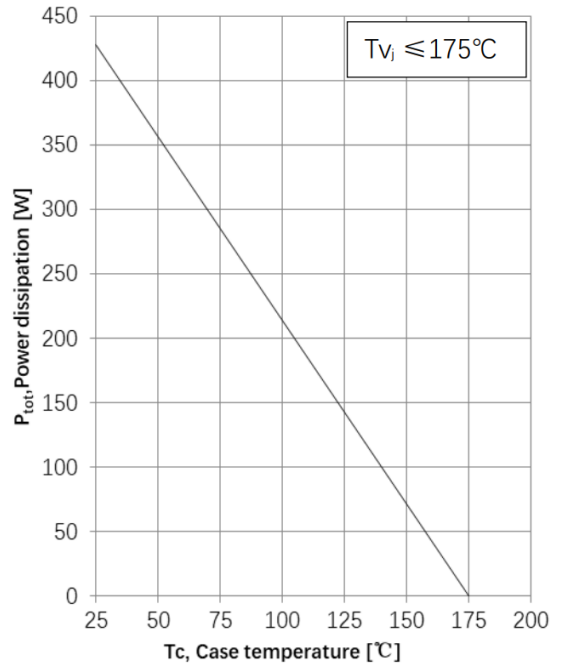


Figure 6. Power dissipation as a function of case temperature ( $T_{vj} \leq 175^\circ\text{C}$ )

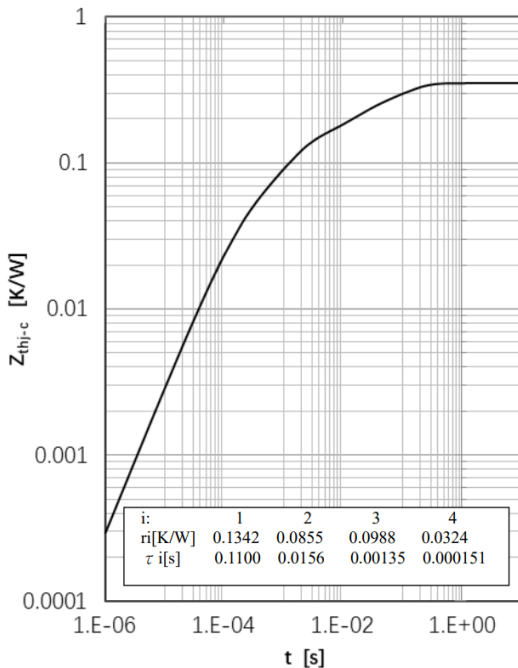


Figure 7. IGBT Transient Thermal Impedance

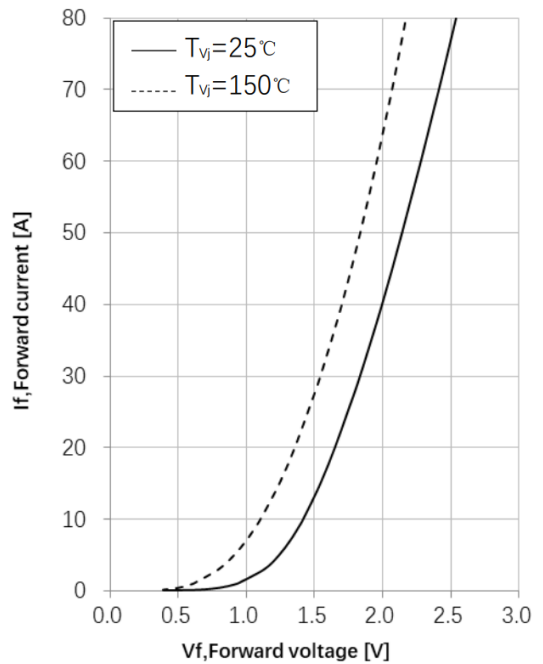


Figure 8. Diode forward current as a function of forward voltage

# Typical Characteristics

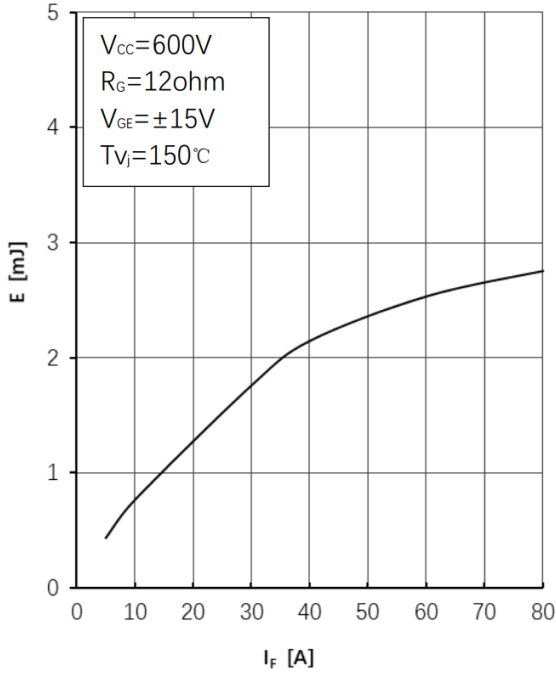


Figure 9. Diode Switching Loss(Erec) vs.  $I_F$

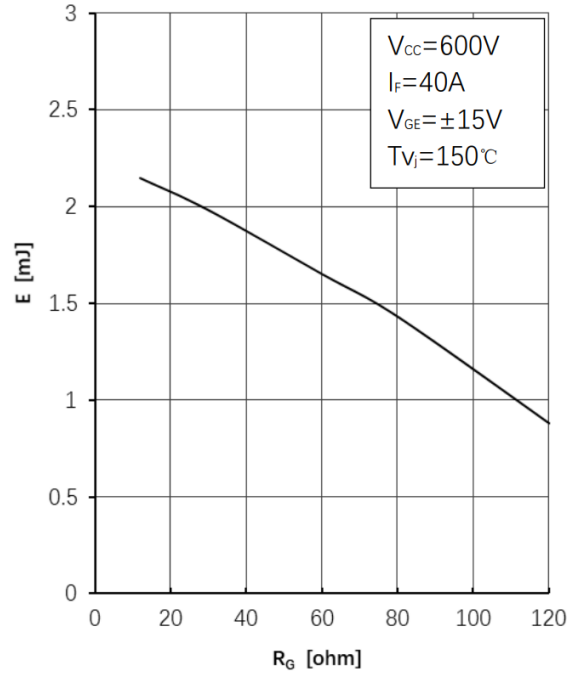


Figure 10. Diode Switching Loss(Erec) vs.  $R_G$

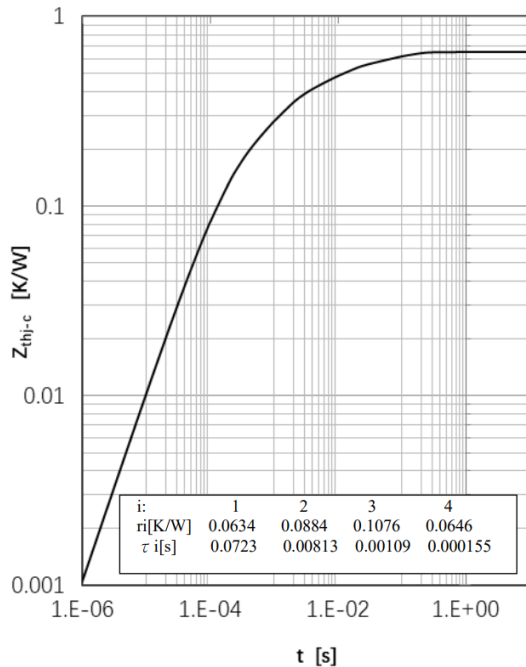
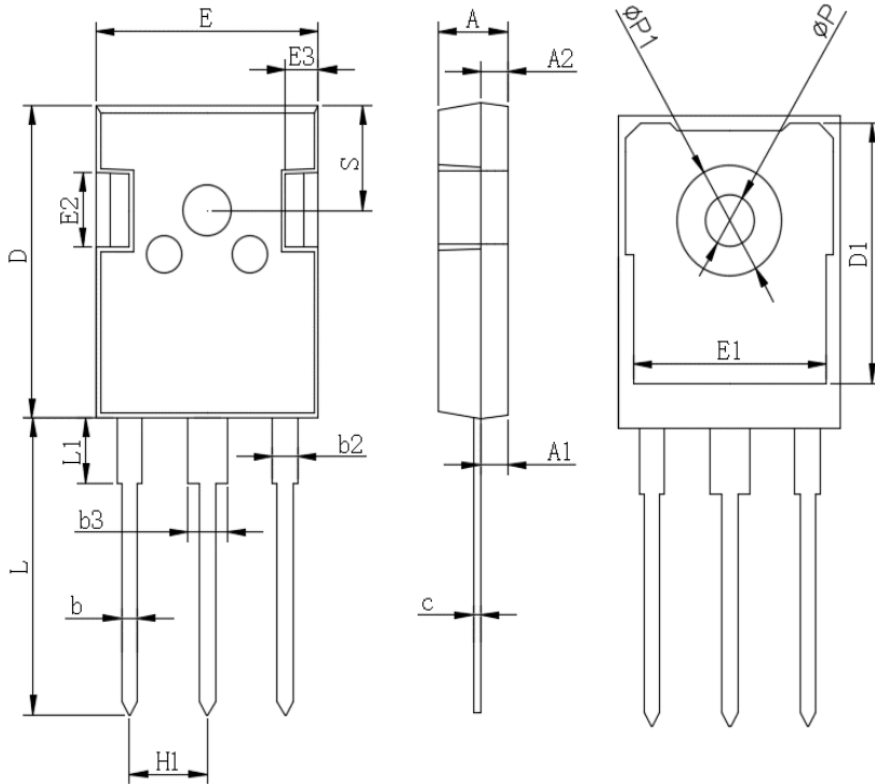


Figure 11. Diode Transient Thermal Impedance

## Package Outline

Unit : mm



| SYMBOL                      | DIMENSIONS |       |
|-----------------------------|------------|-------|
|                             | MIN        | MAX   |
| <b>A</b>                    | 4.80       | 5.20  |
| <b>A1</b>                   | 2.21       | 2.61  |
| <b>A2</b>                   | 1.85       | 2.15  |
| <b>b</b>                    | 1.0        | 1.4   |
| <b>b2</b>                   | 1.91       | 2.21  |
| <b>C</b>                    | 0.5        | 0.7   |
| <b>D</b>                    | 20.70      | 21.30 |
| <b>D1</b>                   | 16.25      | 16.85 |
| <b>E</b>                    | 15.50      | 16.10 |
| <b>E1</b>                   | 13.0       | 13.6  |
| <b>E2</b>                   | 4.80       | 5.20  |
| <b>E3</b>                   | 2.30       | 2.70  |
| <b>L</b>                    | 19.62      | 20.22 |
| <b>L1</b>                   | -          | 4.30  |
| <b><math>\Phi P</math></b>  | 3.40       | 3.80  |
| <b><math>\Phi P1</math></b> | -          | 7.30  |
| <b>S</b>                    | 6.15 Typ   |       |
| <b>H1</b>                   | 5.44 Typ   |       |
| <b>b3</b>                   | 2.80       | 3.20  |