

### Product Summary

| $V_{(BR)CES}$ | $V_{CE(SAT)TYP}$ | $I_C(100^{\circ}C)$ |
|---------------|------------------|---------------------|
| 1200V         | 1.65V@15V        | 40A                 |

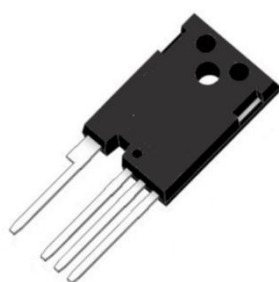
### Feature

- High breakdown voltage to 1200V for improved reliability
- Maximum junction temperature 175°C
- Positive temperature coefficient
- Including SiC FWD

### Application

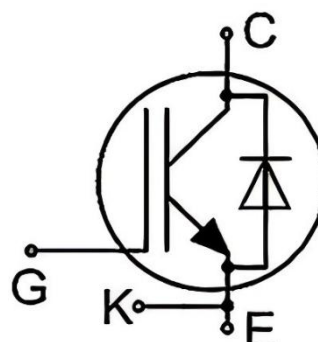
- EV-Charging
- String inverter
- Uninterruptible power supply
- Welding converters

### Package

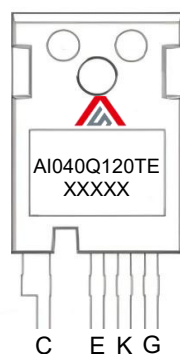


TO-247-4L

### Circuit diagram



### Marking



### Absolute maximum ratings ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

| Parameter                                                                                 | Symbol                     | Value           | Unit                        |
|-------------------------------------------------------------------------------------------|----------------------------|-----------------|-----------------------------|
| Collector-Emitter Voltage                                                                 | $V_{CES}$                  | 1200            | V                           |
| Continuous Gate- Emitter Voltage                                                          | $V_{GE}$                   | $\pm 20$        | V                           |
| Transient Gate-Emitter Voltage ( $t_p \leq 10\mu\text{s}, D < 0.01$ )                     | $V_{GE}$                   | $\pm 30$        | V                           |
| Collector Current, limited by $T_{jmax}$                                                  | $I_C$                      | 80              | A                           |
| Collector Current, limited by $T_{jmax}$ ( $T_C = 100^{\circ}\text{C}$ )                  | $I_C(100^{\circ}\text{C})$ | 40              | A                           |
| Pulsed Collector Current, $t_p$ limited by $T_{jmax}$ ( $V_{GE} = 15\text{V}$ )           | $I_{CM}$                   | 120             | A                           |
| Diode Continuous Forward Current, limited by $T_{jmax}$                                   | $I_F$                      | 80              | A                           |
| Diode Continuous Forward Current, limited by $T_{jmax}$ ( $T_C = 100^{\circ}\text{C}$ )   | $I_F(100^{\circ}\text{C})$ | 40              | A                           |
| Diode Pulsed Current, $t_p$ limited by $T_{jmax}$                                         | $I_{Fpuls}$                | 120             | A                           |
| Turn off Safe Operating Area ( $V_{CE} \leq 1200\text{V}, T_J \leq 150^{\circ}\text{C}$ ) | -                          | 120             | A                           |
| Power Dissipation ( $T_J = 175^{\circ}\text{C}$ )                                         | $P_D$                      | 288             | W                           |
| Thermal Resistance, Junction to case for Diode                                            | $R_{\theta JC}$            | 0.47            | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance, Junction to case for IGBT                                             | $R_{\theta JC}$            | 0.52            | $^{\circ}\text{C}/\text{W}$ |
| Operating junction temperature range                                                      | $T_J$                      | $-40 \sim +175$ | $^{\circ}\text{C}$          |
| Storage Temperature Range                                                                 | $T_{STG}$                  | $-55 \sim +150$ | $^{\circ}\text{C}$          |

### Electrical characteristics of the IGBT ( $T_J=25^{\circ}\text{C}$ unless otherwise noted)

| Parameter                            | Symbol        | Test Condition                                               | Min. | Typ. | Max. | Unit    |
|--------------------------------------|---------------|--------------------------------------------------------------|------|------|------|---------|
| Static Characteristics               |               |                                                              |      |      |      |         |
| Collector-Emitter Breakdown Voltage  | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=250\mu A$                                    | 1200 |      |      | V       |
| Collector-Emitter Leakage Current    | $I_{CES}$     | $V_{GE}=0V, V_{CE}=1200V$                                    |      |      | 0.25 | mA      |
|                                      |               | $V_{GE}=0V, V_{CE}=1200V, T_J=150^{\circ}C$                  |      |      | 4    |         |
| Gate to Emitter Leakage Current      | $I_{GES}$     | $V_{GE}=20V, V_{CE}=0V$                                      |      |      | 100  | nA      |
| Gate Threshold Voltage               | $V_{GE(th)}$  | $V_{GE}=V_{CE}, I_C=1mA$                                     | 5    | 5.8  | 6.6  | V       |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=40A$                                        |      | 1.65 | 1.95 | V       |
|                                      |               | $V_{GE}=15V, I_C=40A, T_J=125^{\circ}C$                      |      | 1.95 |      |         |
|                                      |               | $V_{GE}=15V, I_C=40A, T_J=150^{\circ}C$                      |      | 2.05 |      |         |
| Dynamic characteristics              |               |                                                              |      |      |      |         |
| Input Capacitance                    | $C_{ies}$     | $V_{CE}=25V, V_{GE}=0V, f=1MHz$                              |      | 5.06 |      | nF      |
| Reverse Transfer Capacitance         | $C_{res}$     |                                                              |      | 0.04 |      |         |
| Total Gate Charge                    | $Q_g$         | $V_{CC}=960V, V_{GE}=15V, I_C=40A$                           |      | 0.12 |      | $\mu C$ |
| Turn-on delay time                   | $t_{d(on)}$   | $V_{CC}=600V, V_{GE}=-5V\sim 15V$<br>$I_C=40A, R_G=10\Omega$ |      | 56   |      | nS      |
| Turn-on rise time                    | $t_r$         |                                                              |      | 22   |      |         |
| Turn-off delay time                  | $t_{d(off)}$  |                                                              |      | 192  |      |         |
| Turn-off fall time                   | $t_f$         |                                                              |      | 62   |      |         |
| Turn-On Switching Loss               | $E_{on}$      |                                                              |      | 1.28 |      | mJ      |
| Turn-Off Switching Loss              | $E_{off}$     |                                                              |      | 1.01 |      |         |

| Parameter                      | Symbol       | Test Condition                                                                               | Min. | Typ. | Max. | Unit |
|--------------------------------|--------------|----------------------------------------------------------------------------------------------|------|------|------|------|
| <b>Dynamic characteristics</b> |              |                                                                                              |      |      |      |      |
| Turn-on delay time             | $t_{d(on)}$  | $V_{CC} = 600V, V_{GE} = -5V \sim 15V$<br>$I_C = 40A, R_G = 10\Omega$<br>$T_J = 125^\circ C$ |      | 58   |      | nS   |
| Turn-on rise time              | $t_r$        |                                                                                              |      | 22   |      |      |
| Turn-off delay time            | $t_{d(off)}$ |                                                                                              |      | 201  |      |      |
| Turn-off fall time             | $t_f$        |                                                                                              |      | 69   |      |      |
| Turn-On Switching Loss         | $E_{on}$     |                                                                                              |      | 1.29 |      | mJ   |
| Turn-Off Switching Loss        | $E_{off}$    |                                                                                              |      | 1.1  |      |      |
| Turn-on delay time             | $t_{d(on)}$  | $V_{CC} = 600V, V_{GE} = -5V \sim 15V$<br>$I_C = 40A, R_G = 10\Omega$<br>$T_J = 150^\circ C$ |      | 59   |      | nS   |
| Turn-on rise time              | $t_r$        |                                                                                              |      | 23   |      |      |
| Turn-off delay time            | $t_{d(off)}$ |                                                                                              |      | 206  |      |      |
| Turn-off fall time             | $t_f$        |                                                                                              |      | 75   |      |      |
| Turn-On Switching Loss         | $E_{on}$     |                                                                                              |      | 1.3  |      | mJ   |
| Turn-Off Switching Loss        | $E_{off}$    |                                                                                              |      | 1.13 |      |      |

### Electrical characteristics of the Diode ( $T_J = 25^\circ C$ unless otherwise noted)

| Parameter               | Symbol | Test Condition                 | Min. | Typ. | Max. | Unit |
|-------------------------|--------|--------------------------------|------|------|------|------|
| Diode Forward Voltage   | $V_F$  | $I_F = 40A$                    |      | 1.8  | 2.2  | V    |
|                         |        | $I_F = 40A, T_J = 175^\circ C$ |      | 2.7  |      |      |
| Diode Capacitive Charge | $Q_C$  | $V_R = 800V$                   |      | 114  |      | nC   |
| Diode Capacitance       | C      | $V_R = 0V, f = 1MHz$           |      | 1552 |      | pF   |
|                         |        | $V_R = 400V, f = 1MHz$         |      | 107  |      |      |
|                         |        | $V_R = 800V, f = 1MHz$         |      | 79   |      |      |

### Typical Characteristics

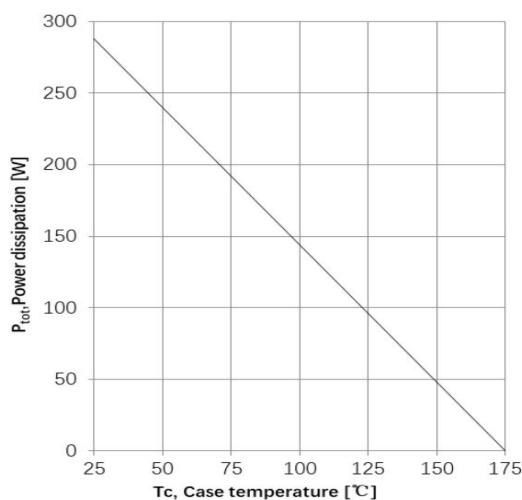


Fig1. Power dissipation as a function of case temperature ( $T_j < 175^\circ\text{C}$ )

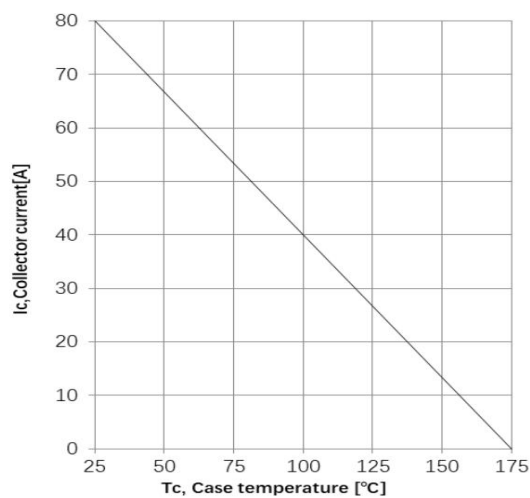


Fig2. Collector current as a function of case temperature ( $V_{ge} > 15\text{V}$ ,  $T_j < 175^\circ\text{C}$ )

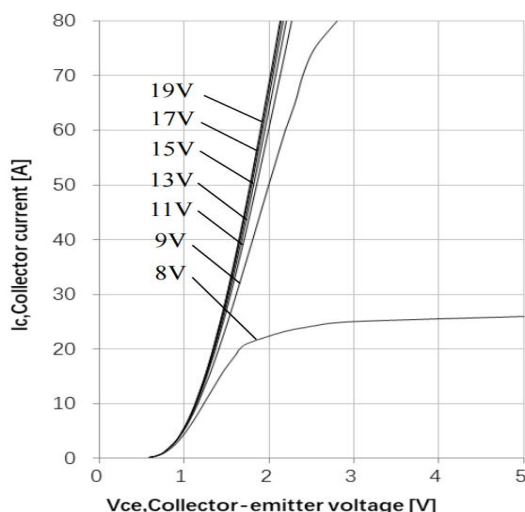


Fig3. Typical output characteristic ( $T_j = 25^\circ\text{C}$ )

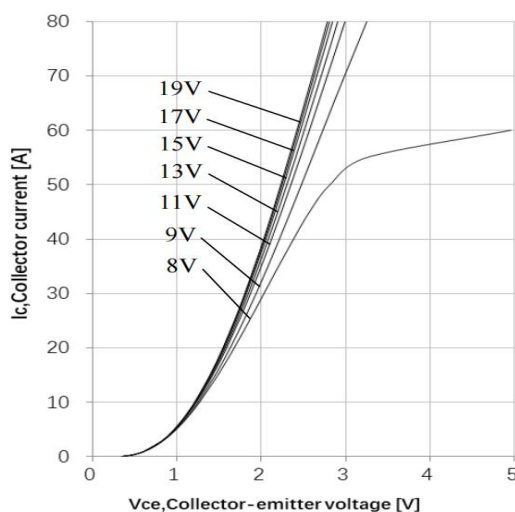


Fig4. Typical output characteristic ( $T_j = 150^\circ\text{C}$ )

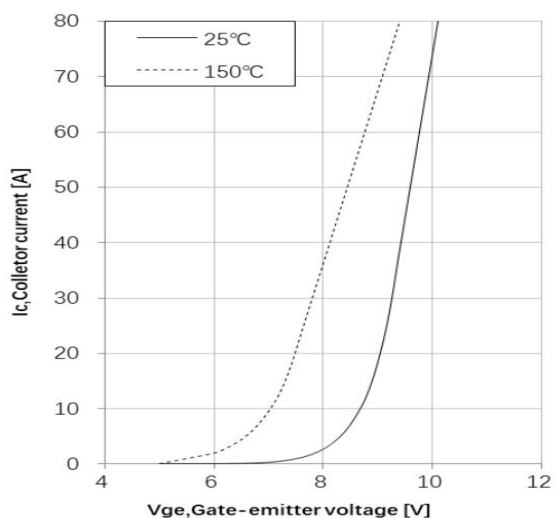


Fig5. Typical transfer characteristic ( $V_{ce} = 20\text{V}$ )

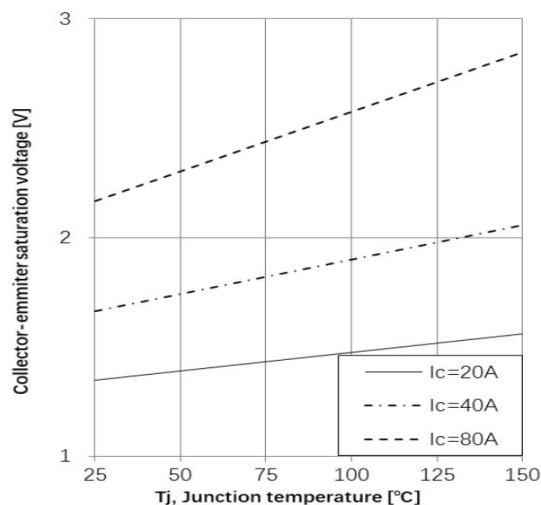
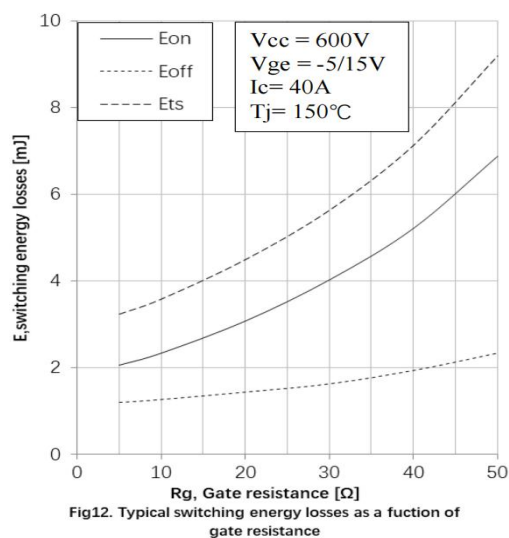
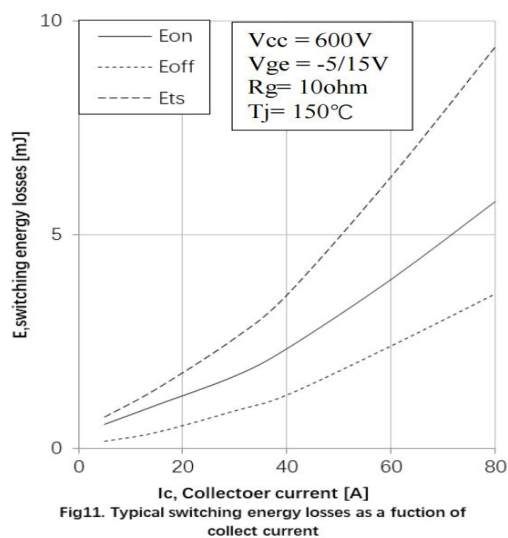
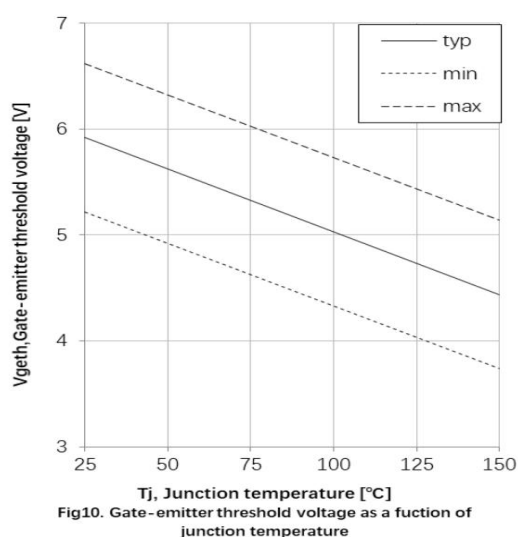
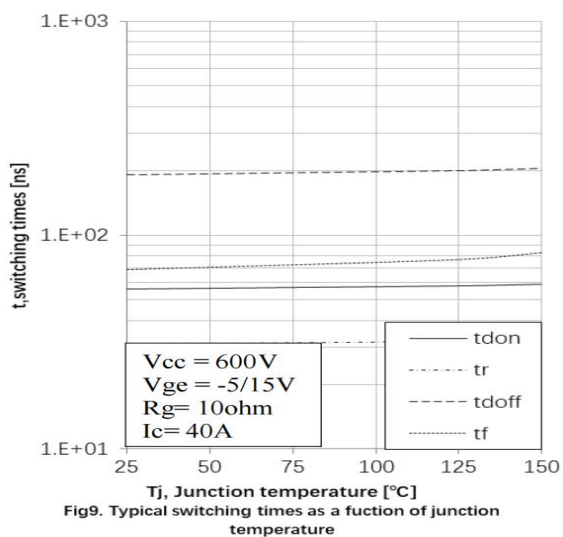
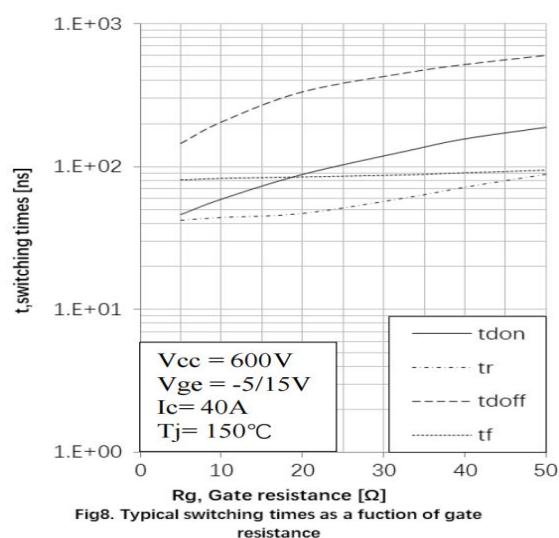
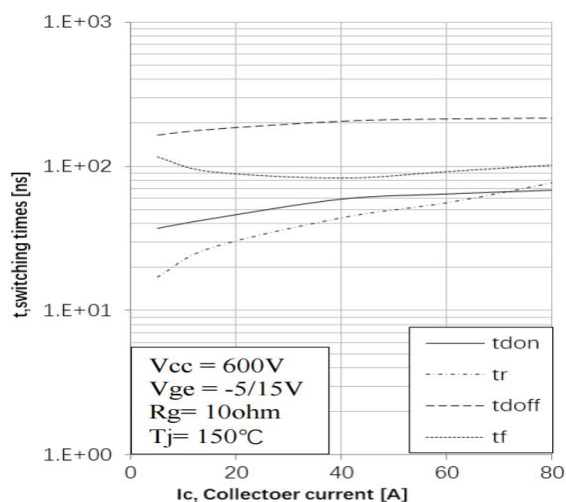


Fig6. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{ge} = 15\text{V}$ )

### Typical Characteristics



### Typical Characteristics

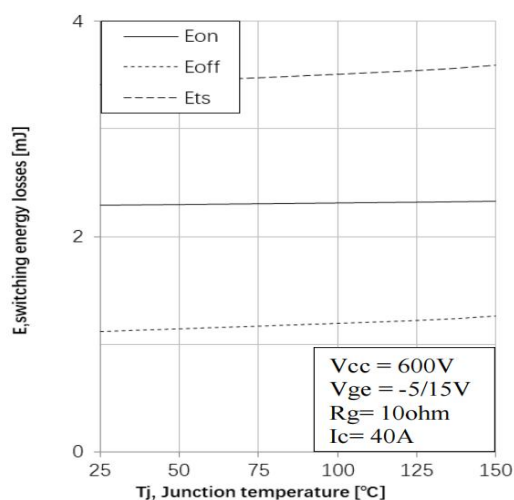


Fig13. Typical switching energy losses as a function of junction temperature

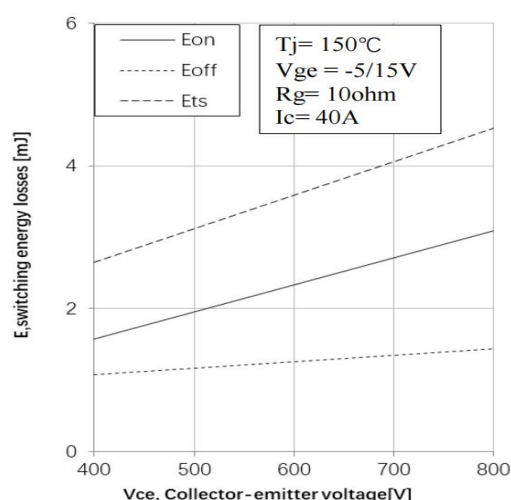


Fig14. Typical switching energy losses as a function of collector-emitter voltage

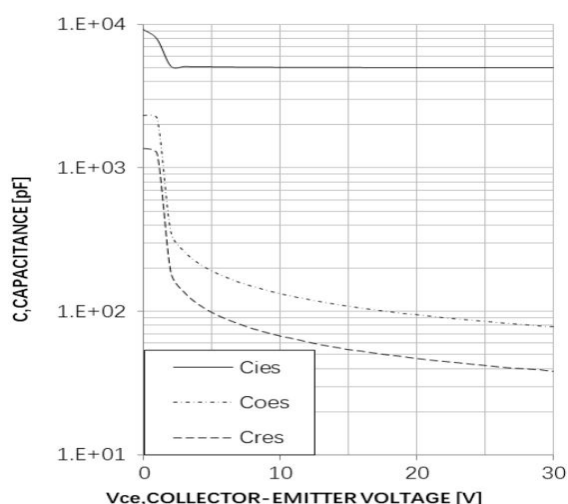


Fig15. Typical capacitance as a function of collector-emitter voltage

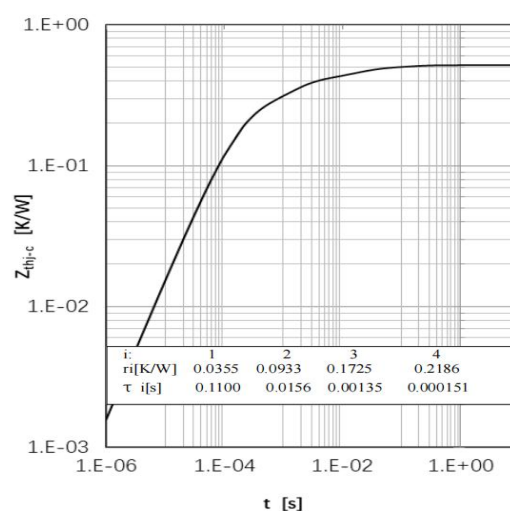


Fig16. IGBT Transient Thermal Impedance

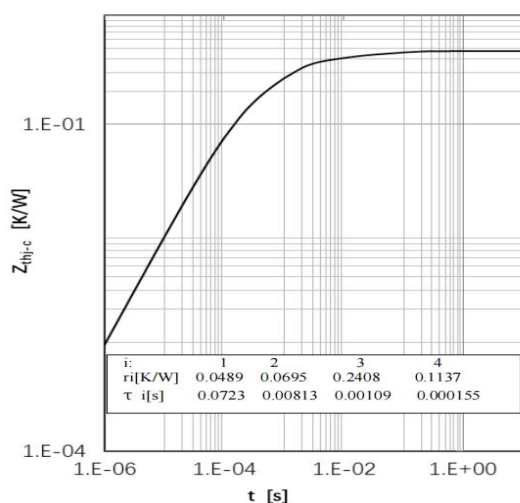


Fig17. Diode Transient Thermal Impedance

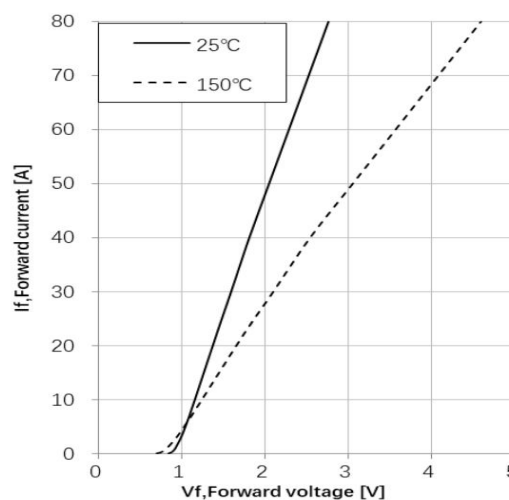
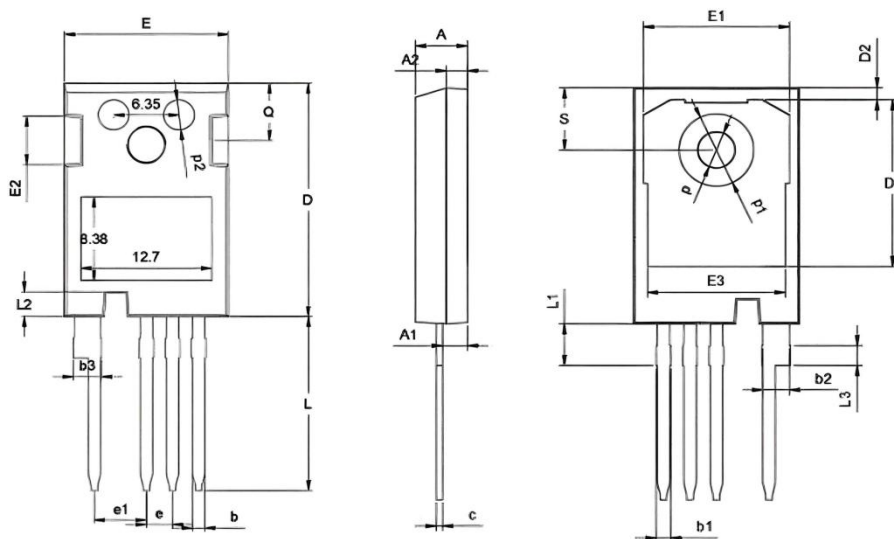


Fig18. Diode forward current as a function of forward voltage

### TO-247-4L Package Information



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 4.800                     | 5.200  | 0.189                | 0.205 |
| A1     | 2.300                     | 2.500  | 0.091                | 0.098 |
| A2     | 1.880                     | 2.080  | 0.074                | 0.082 |
| b      | 1.100                     | 1.300  | 0.043                | 0.051 |
| b1     | 1.200                     | 1.500  | 0.047                | 0.059 |
| b2     | 2.350                     | 2.750  | 0.093                | 0.108 |
| b3     | 2.450                     | 2.850  | 0.096                | 0.112 |
| c      | 0.550                     | 0.650  | 0.022                | 0.026 |
| D      | 23.300                    | 23.600 | 0.917                | 0.929 |
| D1     | 16.250                    | 16.850 | 0.640                | 0.663 |
| D2     | 1.000                     | 1.300  | 0.039                | 0.051 |
| e      | 2.540 TYP.                |        | 0.100 TYP.           |       |
| e1     | 5.060 TYP.                |        | 0.199 TYP.           |       |
| E      | 15.750                    | 16.050 | 0.620                | 0.632 |
| E1     | 13.800                    | 14.200 | 0.543                | 0.559 |
| E2     | 4.400                     | 5.100  | 0.173                | 0.201 |
| E3     | 13.000                    | 13.450 | 0.512                | 0.530 |
| L      | 17.340                    | 17.640 | 0.683                | 0.694 |
| L1     | 4.000                     | 4.300  | 0.157                | 0.169 |
| L2     | 2.350                     | 2.650  | 0.093                | 0.104 |
| L3     | 1.980 TYP.                |        | 0.078 TYP.           |       |
| Q      | 5.600                     | 6.000  | 0.220                | 0.236 |
| S      | 6.050                     | 6.300  | 0.238                | 0.248 |
| p      | 3.580 TYP.                |        | 0.141 TYP.           |       |
| p1     | 7.180 TYP.                |        | 0.283 TYP.           |       |
| p2     | 3.000 TYP.                |        | 0.118 TYP.           |       |