

## MOSFET Silicon N-Channel MOS

### 1. Applications

Boost PFC switch, Half bridge or Asymmetric half bridge or Series resonance half bridge and full bridge topologies.  
Server power, Telecom power, EV charging, Solar inverter, UPS Application.



### 2. Features

Low drain-source on-resistance:  $R_{DS(ON)} = 0.105\Omega$  (typ.)  
Easy to control Gate switching  
Enhancement mode:  $V_{th} = 3$  to  $5$  V



**Table 1 Key Performance Parameters**

| Parameter            | Value | Unit       |
|----------------------|-------|------------|
| $V_{DS} @ T_{j,max}$ | 700   | V          |
| $R_{DS(on),max}$     | 120   | m $\Omega$ |
| $Q_{g,typ}$          | 55.4  | nC         |
| $I_{D,pulse}$        | 90    | A          |
| Body diode dv/dt     | 50    | V/ns       |

### 3. Packaging and Internal Circuit

| Part Name    | Package | Marking      |
|--------------|---------|--------------|
| ASW65R120EFD | TO247   | ASW65R120EFD |
| ASA65R120EFD | TO220F  | ASA65R120EFD |
| ASR65R120EFD | TOLL-8L | ASR65R120EFD |
| ASB65R120EFD | TO263   | ASB65R120EFD |

| TO220F | TO263 | TO247 |  |
|--------|-------|-------|--|
|        |       |       |  |

| TOLL |  |
|------|--|
|      |  |

**1 Maximum ratings**  
at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter  | Symbol        | Values |      |       | Unit             | Note / Test Condition  |
|--|---------------|--------|------|-------|------------------|--|
|  |               | Min.   | Typ. | Max.  |                  |  |
| Continuous drain current <sup>1)</sup>                       | $I_D$         |        | -    | 30    | A                | $T_C=25^\circ\text{C}$   |
| Pulsed drain current <sup>2)</sup>                           | $I_{D,pulse}$ | -      | -    | 90    | A                | $T_C=25^\circ\text{C}$   |
| Avalanche energy, single pulse                               | $E_{AS}$      | -      | -    | 1216  | mJ               | $T_C=25^\circ\text{C}, V_{DD}=50\text{V}, L=10\text{mH}, R_G=25\Omega$     |
| Avalanche current, single pulse                              | $I_{AR}$      | -      | -    | 10.9  | A                | $T_C=25^\circ\text{C}, V_{DD}=50\text{V}, L=10\text{mH}, R_G=25\Omega$     |
| MOSFET dv/dt ruggedness                                      | dv/dt         | -      | -    | 36.2  | V/ns             | $V_{DS}=0\dots 400\text{V}$  |
| Gate source voltage (static)                                 | $V_{GS}$      | -20    | -    | 20    | V                | static;  |
| Gate source voltage (dynamic)                                | $V_{GS}$      | -30    | -    | 30    | V                | AC ( $f > 1\text{ Hz}$ )   |
| Power dissipation(TO247)                                     | $P_{tot}$     | -      | -    | 277.8 | W                | $T_C=25^\circ\text{C}$   |
| Power dissipation (TO220F)                                   | $P_{tot}$     | -      | -    | 36.5  | W                | $T_C=25^\circ\text{C}$   |
| Storage temperature  | $T_{stg}$     | -55    | -    | 150   | $^\circ\text{C}$ |  |
| Operating junction temperature                               | $T_j$         | -55    | -    | 150   | $^\circ\text{C}$ |  |
| Soldering Temperature<br>Distance of 1.6mm from case for 10s | $T_L$         |        |      | 260   | $^\circ\text{C}$ |  |
| Reverse diode dv/dt <sup>3)</sup>                            | dv/dt         | -      | -    | 50    | V/ns             | $V_{DS}=400\text{V}, I_{SD} \leq I_D, T_j=25^\circ\text{C}$<br>see table 8 |

<sup>1)</sup>Limited by  $T_{j,max}$ . Maximum Duty Cycle  $D = 0.50$

<sup>2)</sup>Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup>Identical low side and high side switch with identical  $R_G$

## 2 Thermal characteristics

**Table 3 Thermal characteristics (TO220F)**

| Parameter                    |           | Symbol     | Values |      |      | Unit | Note / Test Condition            |
|------------------------------|-----------|------------|--------|------|------|------|----------------------------------|
|                              |           |            | Min.   | Typ. | Max. |      |                                  |
| Thermal resistance, junction | - case    | $R_{thJC}$ | -      | -    | 3.4  | °C/W | -                                |
| Thermal resistance, junction | - ambient | $R_{thJA}$ | -      | -    | 62   | °C/W | device on PCB, minimal footprint |

**Thermal characteristics (TO247,TOLL,TO263)**

| Parameter                    |           | Symbol     | Values |      |      | Unit | Note / Test Condition            |
|------------------------------|-----------|------------|--------|------|------|------|----------------------------------|
|                              |           |            | Min.   | Typ. | Max. |      |                                  |
| Thermal resistance, junction | - case    | $R_{thJC}$ | -      | -    | 0.45 | °C/W | -                                |
| Thermal resistance, junction | - ambient | $R_{thJA}$ | -      | -    | 57   | °C/W | device on PCB, minimal footprint |

### 3 Electrical characteristics

at  $T_j=25^{\circ}\text{C}$ , unless otherwise specified

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |       |        | Unit          | Note / Test Condition  |
|----------------------------------|---------------|--------|-------|--------|---------------|--|
|                                  |               | Min.   | Typ.  | Max.   |               |  |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 655    | -     | -      | V             | $V_{GS}=0\text{V}$ , $I_D=250\mu\text{A}$                            |
| Gate threshold voltage           | $V_{(GS)th}$  | 3      |       | 5      | V             | $V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$                               |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -     | 2      | $\mu\text{A}$ | $V_{DS}=650\text{V}$ , $V_{GS}=0\text{V}$ , $T_j=25^{\circ}\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -     | +/-100 | nA            | $V_{GS}=\pm 30\text{V}$ , $V_{DS}=0\text{V}$                         |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.105 | 0.120  | $\Omega$      | $V_{GS}=10\text{V}$ , $I_D=14\text{A}$ , $T_j=25^{\circ}\text{C}$    |
| Gate resistance (Intrinsic)      | $R_G$         | -      | 12.6  | -      | $\Omega$      | $f=1\text{MHz}$ , open drain   |
| Transconductance                 | $G_{fs}$      |        | 29.2  |        | S             | $V_{DS}=20\text{V}$ , $I_D=15\text{A}$                               |

**Table 5 Dynamic characteristics**

| Parameter                    | Symbol       | Values |      |      | Unit | Note / Test Condition   |
|------------------------------|--------------|--------|------|------|------|---|
|                              |              | Min.   | Typ. | Max. |      |   |
| Input capacitance            | $C_{iss}$    | -      | 2657 | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=100\text{V}$ , $f=1\text{MHz}$                                 |
| Output capacitance           | $C_{oss}$    | -      | 89   | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=100\text{V}$ , $f=1\text{MHz}$                                 |
| Reverse transfer capacitance | $C_{riss}$   | -      | 2    | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=100\text{V}$ , $f=1\text{MHz}$                                 |
| Turn-on delay time           | $t_{d(on)}$  | -      | 29.6 | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=19\text{A}$ , $R_G=2\Omega$ ; see table 9 |
| Rise time                    | $t_r$        | -      | 31.3 | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=19\text{A}$ , $R_G=2\Omega$ ; see table 9 |
| Turn-off delay time          | $t_{d(off)}$ | -      | 94.6 | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=19\text{A}$ , $R_G=2\Omega$ ; see table 9 |
| Fall time                    | $t_f$        | -      | 9.1  | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=19\text{A}$ , $R_G=2\Omega$ ; see table 9 |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|-----------------------|---------------|--------|------|------|------|--|
|                       |               | Min.   | Typ. | Max. |      |  |
| Gate to source charge | $Q_{gs}$      | -      | 15   | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=19\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 20.2 | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=19\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate charge total     | $Q_g$         | -      | 55.4 | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=19\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 5.9  | -    | V    | $V_{DD}=400\text{V}$ , $I_D=19\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |

**Table 7 Reverse diode characteristic**

| Parameter                     | Symbol    | Values |       |      | Unit    | Note / Test Condition                                 |
|-------------------------------|-----------|--------|-------|------|---------|---|
|                               |           | Min.   | Typ.  | Max. |         |   |
| Diode forward voltage         | $V_{SD}$  | -      | 0.67  | -    | V       | $V_{GS}=0V, I_F=1A, T_j=25^{\circ}C$                  |
| Reverse recovery time         | $t_{rr}$  | -      | 136.7 | -    | ns      | $V_R=400V, I_F=17A, di_F/dt=100A/\mu s$ ; see table 8 |
| Reverse recovery charge       | $Q_{rr}$  | -      | 0.741 | -    | $\mu C$ | $V_R=400V, I_F=17A, di_F/dt=100A/\mu s$ ; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | -      | 10.28 | -    | A       | $V_R=400V, I_F=17A, di_F/dt=100A/\mu s$ ; see table 8 |

## 4 Electrical characteristics diagram

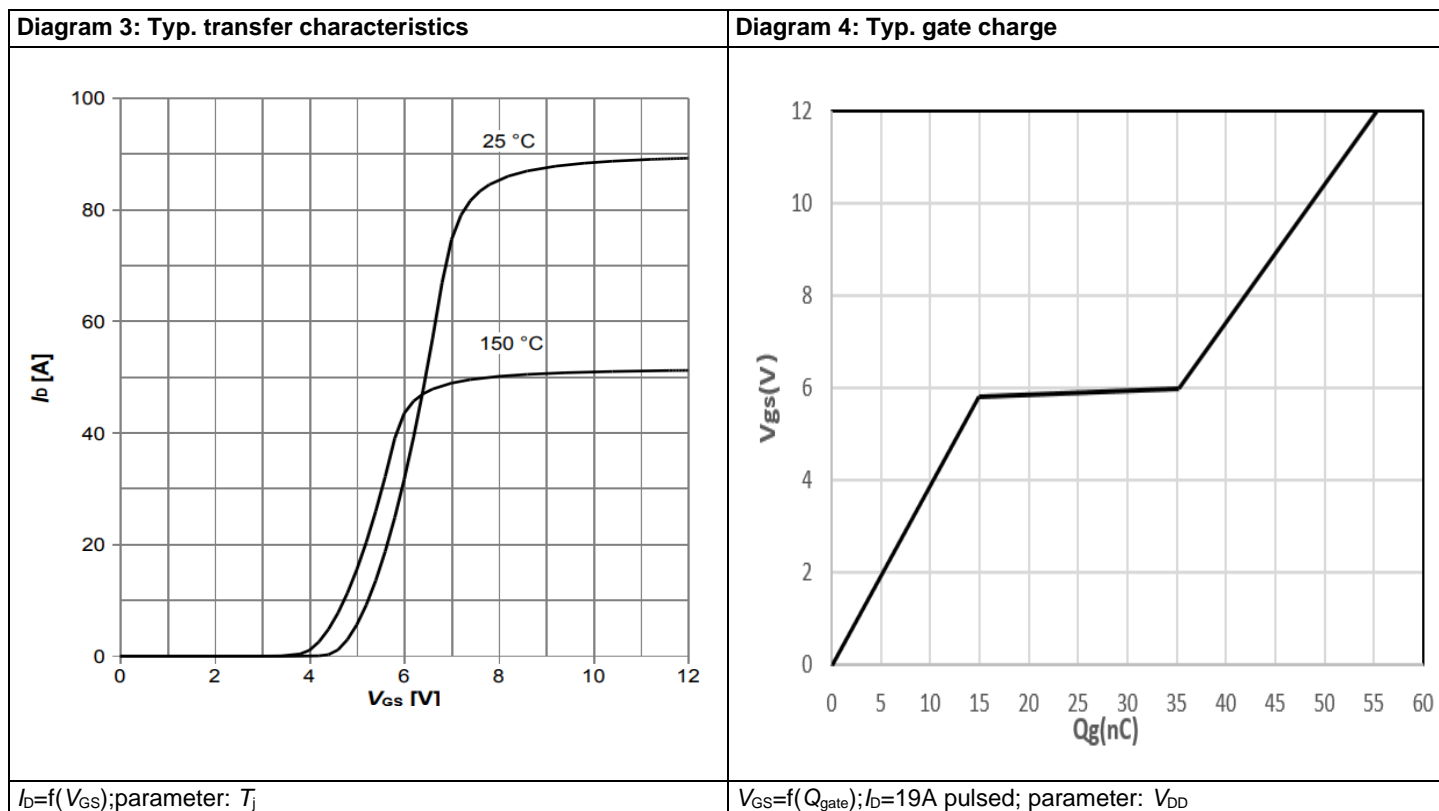
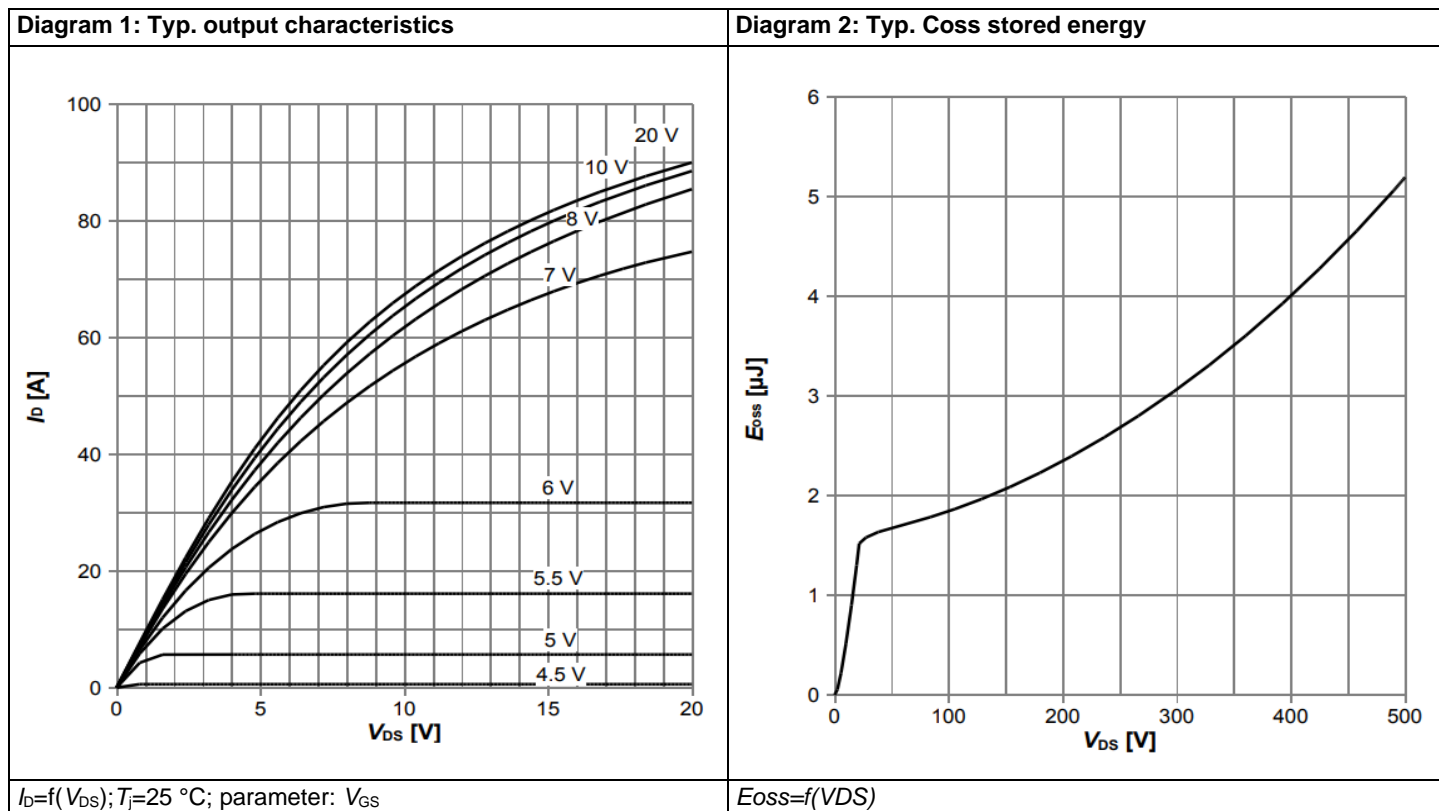
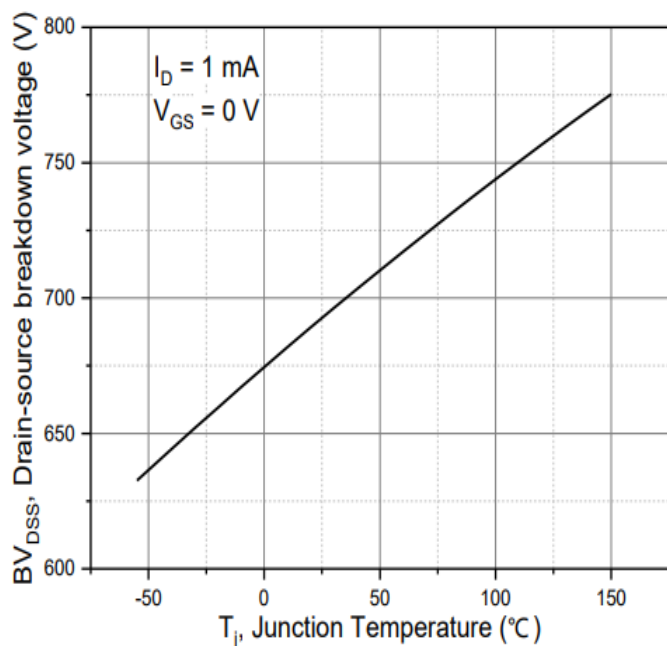
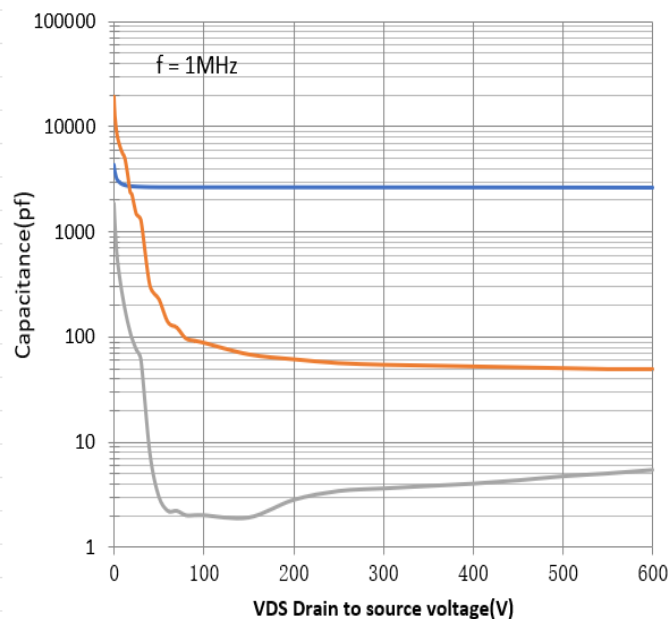


Diagram 5: Drain-source breakdown voltage



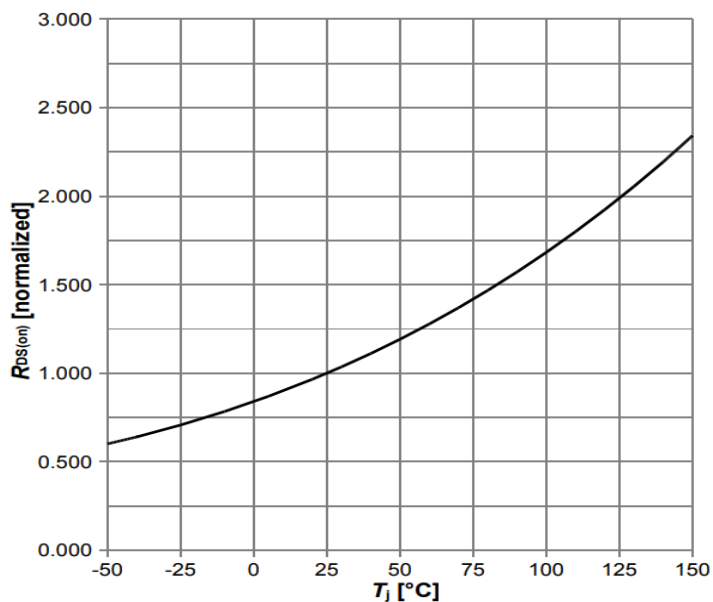
$V_{BR(DSS)}=f(T_j); I_D=1\text{mA}$

Diagram 6: Typ. capacitances



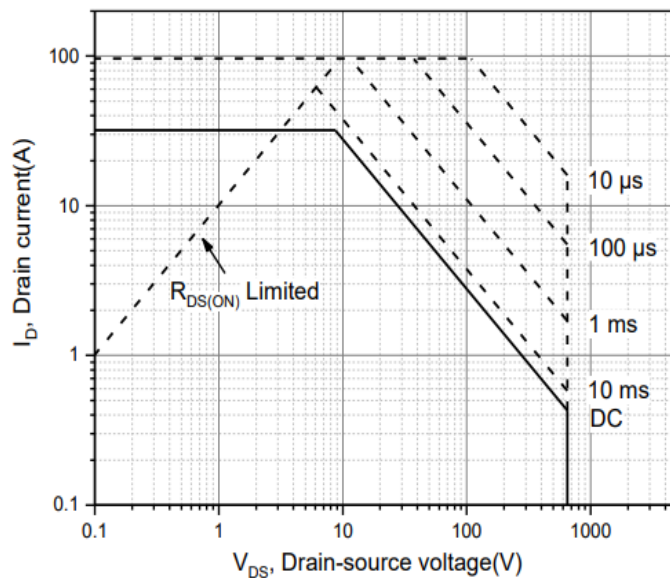
$C=f(V_{DS}); V_{GS}=0\text{V}; f=1\text{MHz}$

Diagram 7: Typ. On-Resistance vs. Junction Temperature



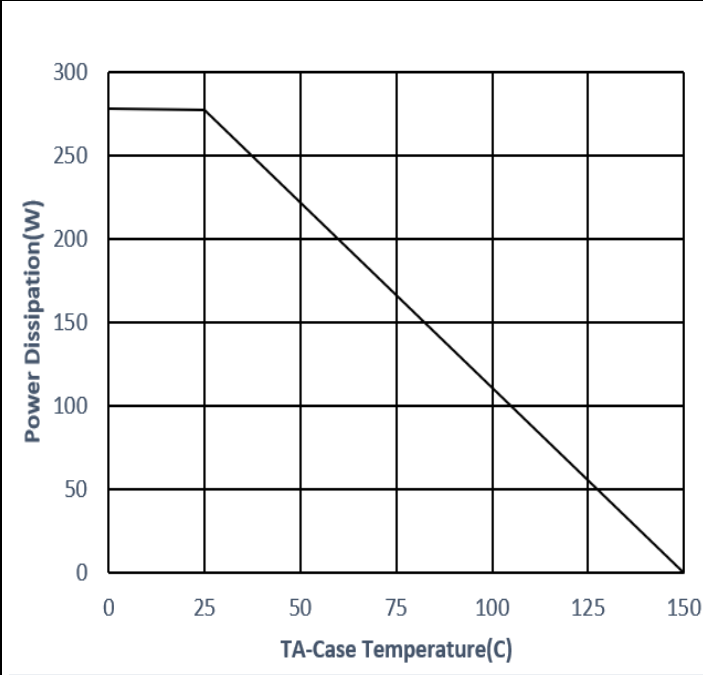
$R_{ds(on)}=f(T_j); V_{GS}=10\text{V}/I_D=14\text{A}$

Diagram 8: Safe operating area  $T_C=25^\circ\text{C}$ ,



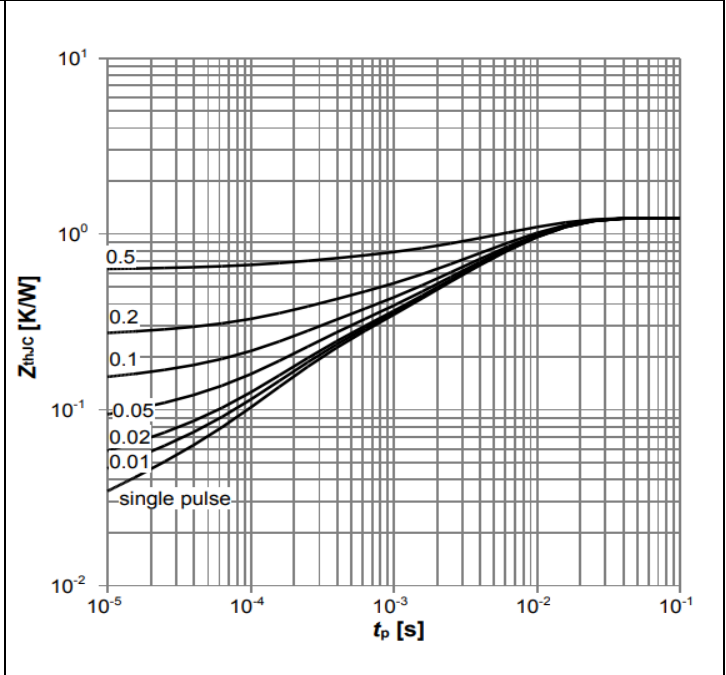
$I_D=f(V_{DS}); T_C=25^\circ\text{C}; V_{GS}>7\text{V}; D=0; \text{parameter } t_p$

Diagram 9: Typ. Power Dissipation



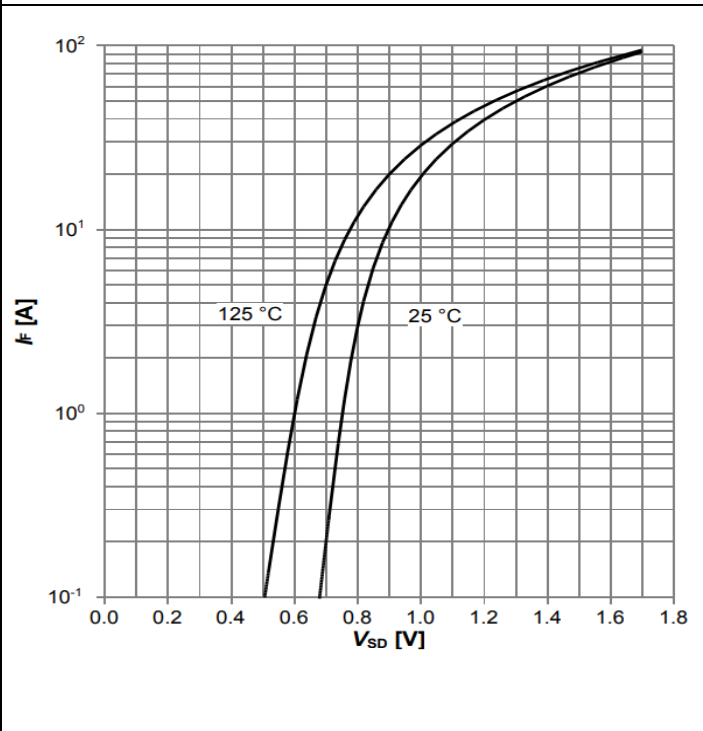
$P_{tot}=f(T_C)$

Diagram 10: Max. transient thermal impedance



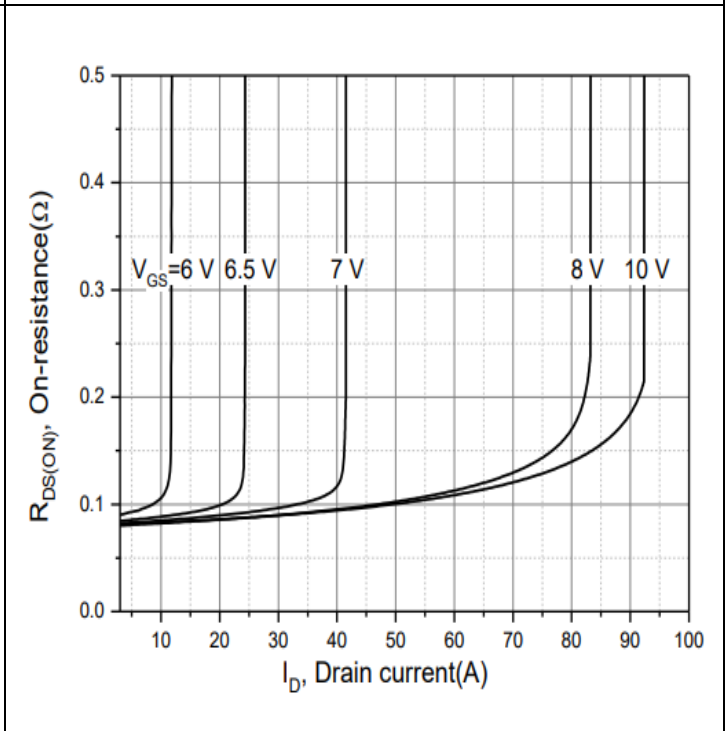
$Z_{thJC}=f(t_p)$ ; parameter:  $D=t_p/T$

Diagram 11: Forward characteristics of reverse diode



$I_f=f(V_{DS});$ parameter:  $T_j$

Diagram 12: Typ. Drain-source on-state resistance

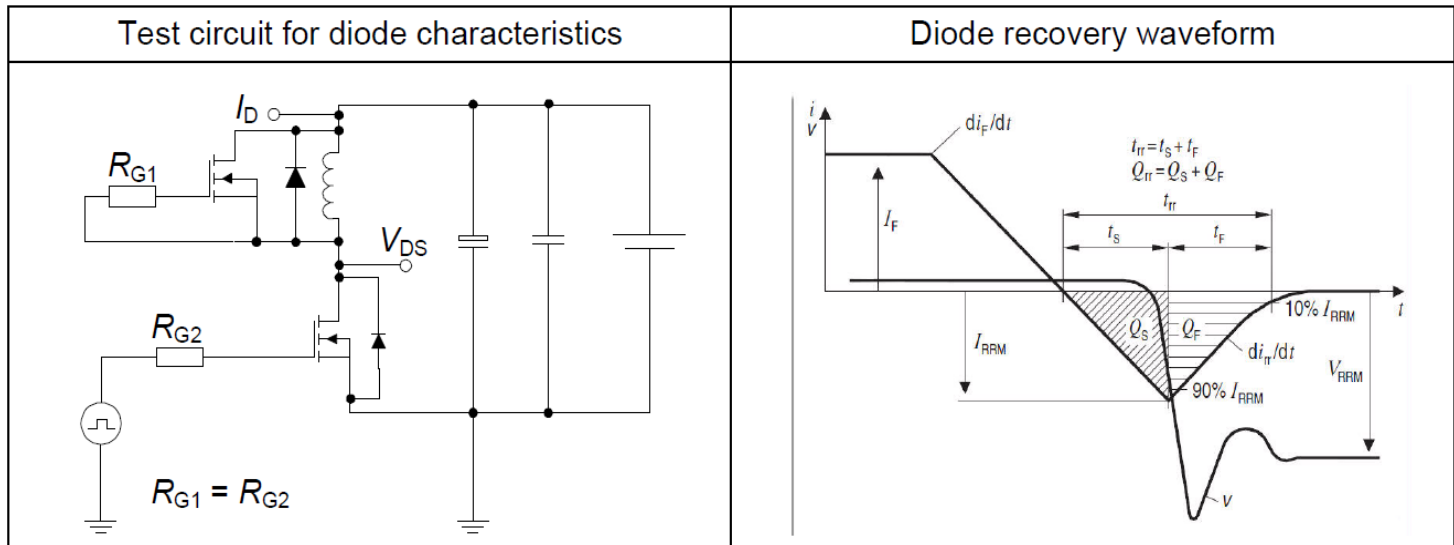


$R_{ds(on)}=f(T_j); T_j=25C,$  Parameter :  $V_{gs}$

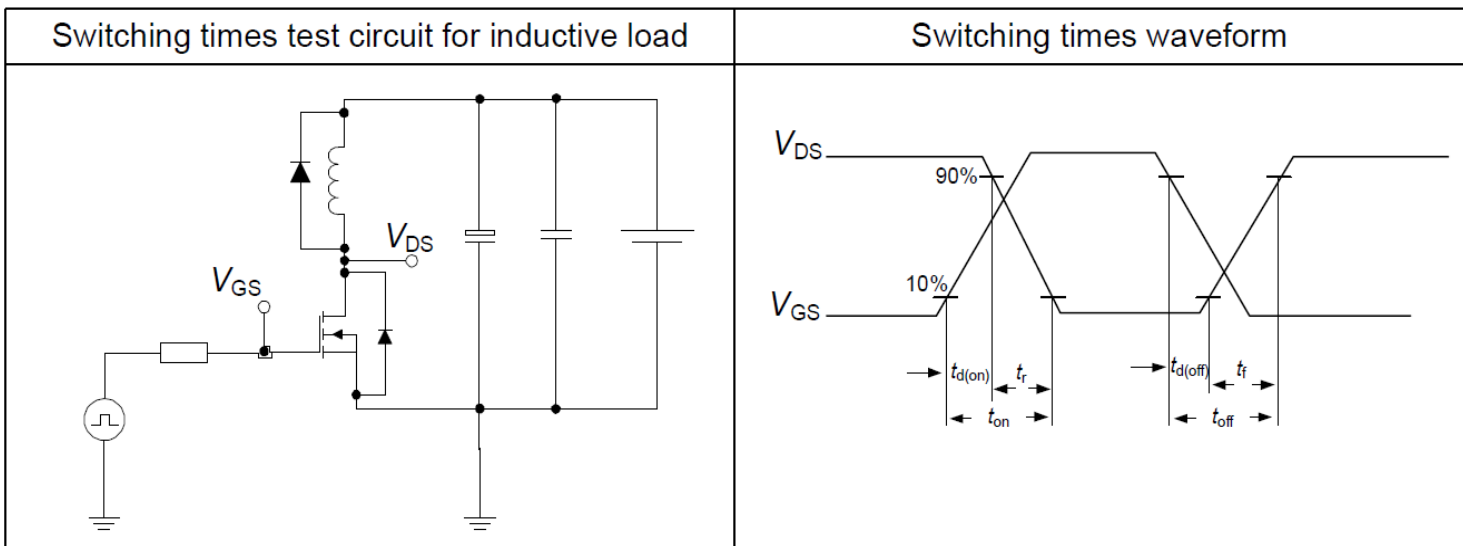


## 5 Test Circuits

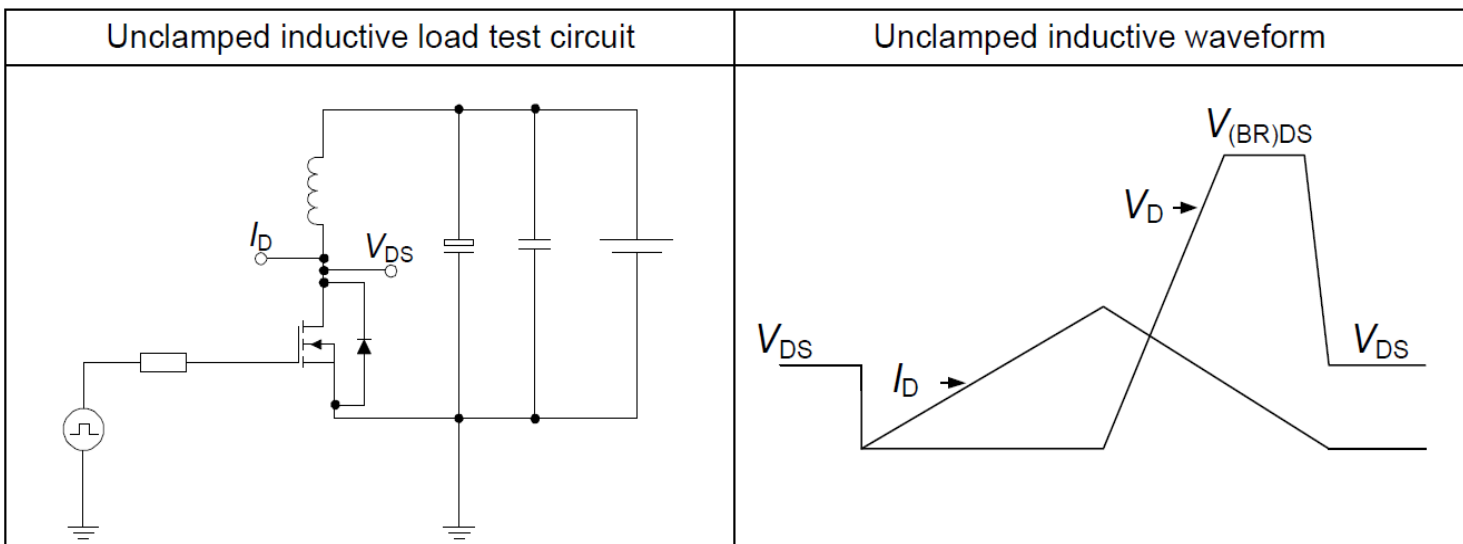
**Table 8 Diode characteristics**



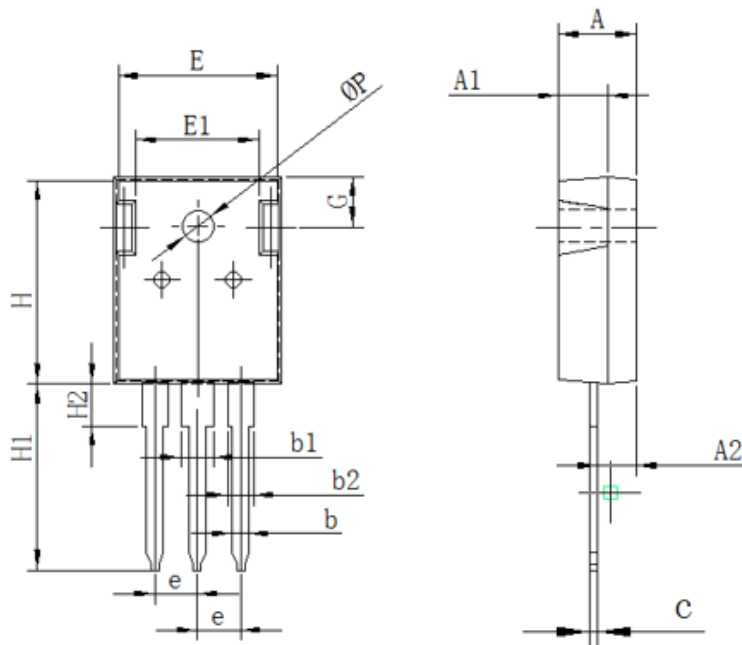
**Table 9 Switching times**



**Table 10 Unclamped inductive load**

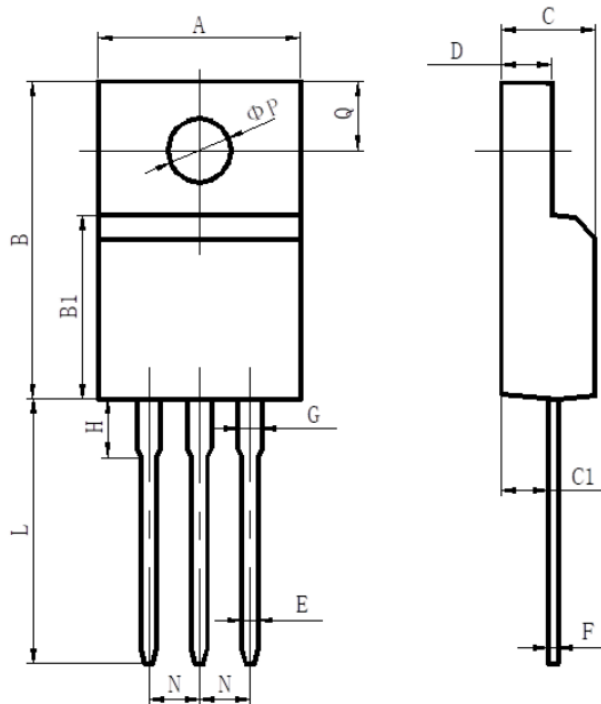


## 6 Package Outlines



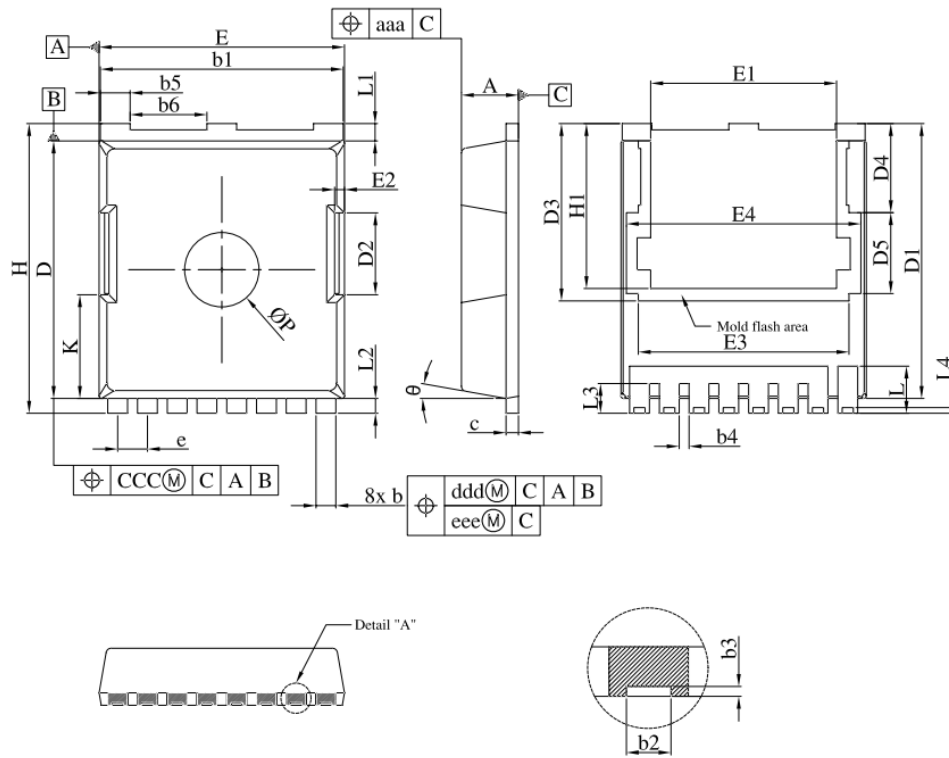
| Symbol | 单位 mm |      |      |
|--------|-------|------|------|
|        | Min   | Nom  | Max  |
| A      | 4.8   | 5.00 | 5.20 |
| A1     | 3.3   | 3.5  | 3.7  |
| A2     | 2.20  | 2.40 | 2.60 |
| b      | 1.00  | 1.2  | 1.40 |
| b1     | 2.90  | 3.10 | 3.30 |
| b2     | 1.90  | 2.10 | 2.30 |
| c      | 0.50  | 0.60 | 0.70 |
| e      | 5.25  | 5.45 | 5.65 |
| E      | 15.2  | 15.7 | 16.2 |
| E1     | 10.2  | 10.7 | 11.2 |
| H      | 20.8  | 21   | 21.2 |
| H1     | 19.5  | 20.0 | 20.5 |
| H2     | 4.00  | 4.20 | 4.40 |
| G      | 5.60  | 5.80 | 600  |
| ΦP     | 3.50  | 3.70 | 3.90 |

Figure1: Outline PG-T0247(CD&HT)



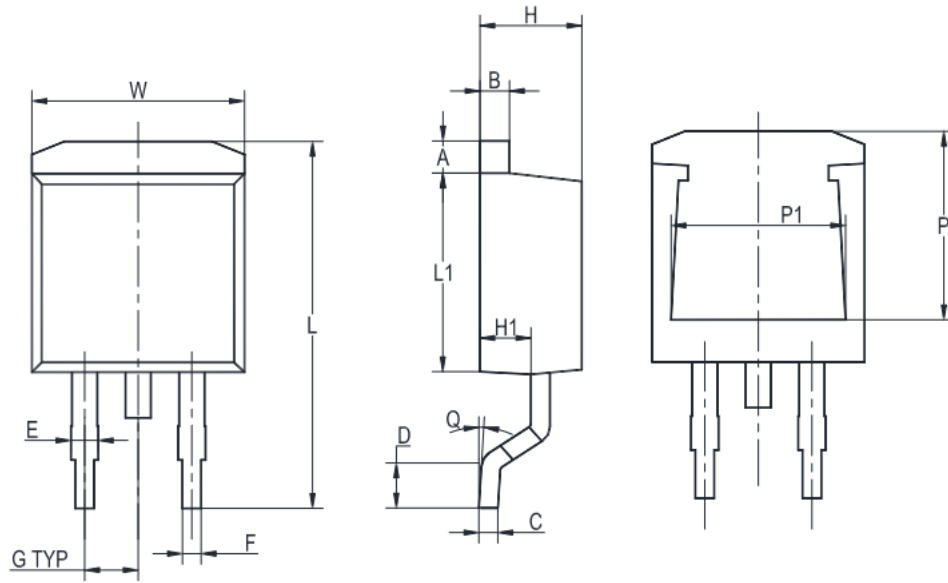
| 项目       | 规范(mm) |       |
|----------|--------|-------|
|          | MIN    | MAX   |
| A        | 9.70   | 10.30 |
| B        | 15.50  | 16.10 |
| B1       | 8.99   | 9.39  |
| C        | 4.40   | 4.80  |
| C1       | 2.15   | 2.55  |
| D        | 2.50   | 2.90  |
| E        | 0.70   | 0.90  |
| F        | 0.40   | 0.60  |
| G        | 1.12   | 1.42  |
| H        | 3.40   | 3.80  |
| L        | 12.6   | 13.6  |
| N        | 2.34   | 2.74  |
| Q        | 3.15   | 3.55  |
| $\phi P$ | 3.00   | 3.30  |

Figure2: Outline PG-T0220F(HT)



| SYMBOL   | COMMON     |         |       |
|----------|------------|---------|-------|
|          | MILLIMETER |         |       |
|          | MIN.       | NOMINAL | MAX.  |
| A        | 2.20       | 2.30    | 2.40  |
| b        | 0.70       | 0.80    | 0.90  |
| b1       | 9.70       | 9.80    | 9.90  |
| b2       | 0.36       | 0.45    | 0.55  |
| b3       | 0.05       | 0.100   | ?     |
| b4       | 0.30       | 0.40    | 0.50  |
| b5       | 1.10       | 1.20    | 1.30  |
| b6       | 3.00       | 3.10    | 3.20  |
| c        | 0.40       | 0.50    | 0.60  |
| D        | 10.28      | 10.38   | 10.55 |
| D1       | 10.98      | 11.08   | 11.18 |
| D2       | 3.20       | 3.30    | 3.40  |
| D3       | 7.15       |         |       |
| D4       | 3.59       |         |       |
| D5       | 3.26       |         |       |
| e        | 1.10       | 1.20    | 1.30  |
| E        | 9.80       | 9.90    | 10.00 |
| E1       | 7.40       | 7.50    | 7.60  |
| E2       | 0.30       | 0.40    | 0.50  |
| E3       | 8.50       |         |       |
| E4       | 9.46       |         |       |
| H        | 11.50      | 11.68   | 11.85 |
| H1       | 6.55       | 6.65    | 6.75  |
| K        | 4.08       | 4.18    | 4.28  |
| L        | 1.60       | 1.90    | 2.10  |
| L1       | 0.50       | 0.70    | 0.90  |
| L2       | 0.50       | 0.60    | 0.70  |
| L3       | 1.00       | 1.20    | 1.30  |
| L4       | 0.13       | 0.23    | 0.33  |
| P        | 2.85       | 3.00    | 3.15  |
| $\theta$ | 10° REF    |         |       |
| aaa      | 0.20       |         |       |
| ccc      | 0.20       |         |       |
| ddd      | 0.25       |         |       |
| eee      | 0.20       |         |       |

Figure3: Outline PG-TOLL(JQ)



| UNIT | A   | B   | C   | D    | E   | F    | G    | W    | H   | H1  | L    | L1  | Q   | P   | P1  |
|------|-----|-----|-----|------|-----|------|------|------|-----|-----|------|-----|-----|-----|-----|
| mm   | 1.5 | 1.5 | 0.5 | 2.60 | 1.6 | 0.94 | 2.54 | 10.5 | 4.8 | 2.9 | 16.5 | 8.7 | 8°  | 7.6 | 8.2 |
|      | 1.1 | 1.1 | 0.3 | 2.15 | 1.1 | 0.68 | TYP  | 9.6  | 4.4 | 2.5 | 14.5 | 8.2 | MAX | 7.1 | 7.4 |

Figure4: Outline PG-TO263(HC)

## Revision History

| Revision | Date       | Subjects (major changes since last revision)                                      |
|----------|------------|---|
| 1.0      | 2020-09-15 | Release version   |
| 1.1      | 2022-06-18 | Updated TO247 POD to CD   |
| 1.2      | 2022-12-23 | Updated Ciss/Coss/Crss&Trr/Qrr/Irrm, and added electrical characteristics diagram |
| 1.3      | 2023-04-26 | Added TO220F package  |
| 1.4      | 2023-08-22 | Added TOLL-8L package   |
| 1.5      | 2023-08-31 | Added Gfs   |
| 1.6      | 2023-10-18 | Added TO263 package   |

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