# FMW60N105F7

## N-Channel *e*MOS F7 Power MOSFET

600 V, 31.5 A, 105 mΩ

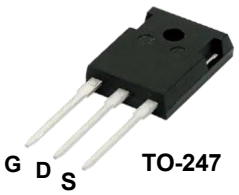
## Description

The 600V *e*MOS F7 is a fast recovery type MOSFET using E7 technology. *e*MOS F7 is an advanced Faster Semiconductor's Super Junction MOSFET family by utilizing charge balance technology for excellent low on-resistance and gate charge. It combines the benefits of a fast switching performance with ease of usage and robustness. Additionally, we offer low reverse recovery time($t_{rr}$) and reverse recovery charge($Q_{rr}$). Thus, 600V *e*MOS F7 is very suitable for the bridge structure topology, especially for resonant converters (LLC, PSFB, etc.).

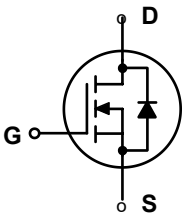
## Features

| $BV_{DSS}$ @ $T_{J,max}$ | $I_D$ | $R_{DS(on),max}$ | $Q_{g,typ}$ |
|---|---|---|---|
| 650 V | 31.5 A | 105 mΩ | 57.7 nC |

- Reduced Switching & Conduction Losses
- Fast Recovery Body-Diode
- Lower Gate Resistance
- 100% Avalanche Tested
- Pb-free and RoHS Compliant




TO-247




## Applications

- Soft Switching Topologies
- Telecom and Sever Power Supplies
- EV Charger and Industrial Power Supplies

## Absolute Maximum Ratings ($T_C$ = 25℃ unless otherwise noted)

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 600 | V |
| $V_{GSS}$ | Gate to Source Voltage | | ±30 | V |
| $I_D$ | Drain Current | Continuous ($T_C$ = 25℃) | 31.5 | A |
| | | Continuous ($T_C$ = 100℃) | 19.9 | |
| $I_{DM}$ | Drain Current | Pulsed (Note1) | 94.5 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note2) | 187 | mJ |
| $I_{AS}$ | Avalanche Current | (Note2) | 5.4 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | (Note1) | 2.6 | mJ |
| dv/dt | MOSFET dv/dt | | 100 | V/ns |
| | Peak Diode Recovery dv/dt | (Note3) | 50 | |
| $P_D$ | Power Dissipation | ($T_C$ = 25℃) | 260 | W |
| | | Derate Above 25℃ | 2.08 | W/℃ |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to 150 | ℃ |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds | | 260 | ℃ |

## Thermal Characteristics

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.48 | ℃/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5 | |

## Package Marking and Ordering Information

| Part Number | Top Marking | Package | Packing Method | Quantity |
|---|---|---|---|---|
| FMW60N105F7 | FMW60N105F7 | TO-247 | Tube | 50 units |

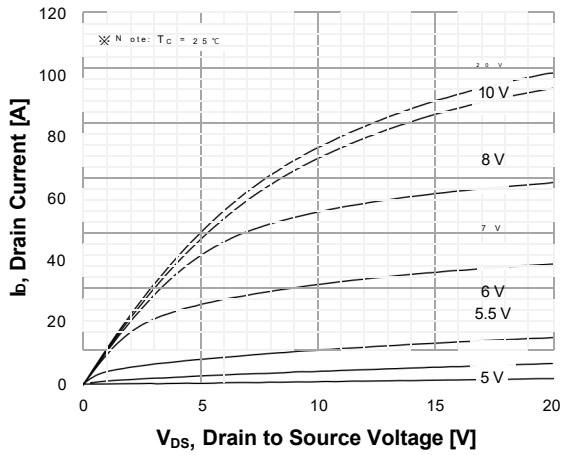
## Electrical Characteristics ($T_C$ = 25℃ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 600 | | | V |
| | | $V_{GS}$ = 0 V, $I_D$ = 1 mA, $T_J$ = 150℃ | 650 | | | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | | | 10 | μA |
| | | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, $T_J$ = 125℃ | | 60 | | |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 2.1 mA | 3.0 | | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 15.3 A | | 89 | 105 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 400 V, $V_{GS}$ = 0V, f = 250 kHz | | 2160 | | pF |
| $C_{oss}$ | Output Capacitance | | | 55 | | pF |
| $C_{o(tr)}$ | Time Related Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | | 630 | | pF |
| $C_{o(er)}$ | Energy Related Output Capacitance | | | 92.3 | | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10 V | $V_{DS}$ = 400 V, $I_D$ = 15.3 A, $V_{GS}$ = 10 V | | 57.7 | | nC |
| $Q_{gs}$ | Gate to Source Charge | | | 14 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 29.3 | | nC |
| $R_G$ | Gate Resistance | f = 1 MHz | | 1.1 | | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DS}$ = 400 V, $I_D$ = 15.3 A, $V_{GS}$ = 10 V, $R_G$ = 10 Ω See Figure 13 | | 23 | | ns |
| $t_r$ | Turn-On Rise Time | | | 12 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 80 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 9 | | ns |
| **Source-Drain Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Diode Forward Current | | | | 31.5 | A |
| $I_{SM}$ | Maximum Pulsed Diode Forward Current | | | | 94.5 | A |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 15.3 A | | | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{DD}$ = 400 V, $I_{SD}$ = 15.3 A, $dI_F/dt$ = 100 A/μs | | 139 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 0.91 | | μC |

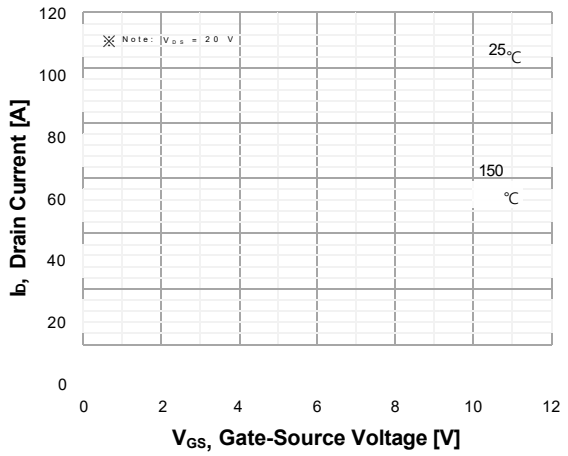
※Notes:
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $I_{AS}$ = 5.4 A, $R_G$ = 25 Ω,starting $T_J$ = 25℃.
3. $I_{SD}$ ≤ 15.3 A, di/dt ≤ 100 A/μs, $V_{DD}$ ≤ 400 V,starting $T_J$ = 25℃.

## Typical Performance Characteristics

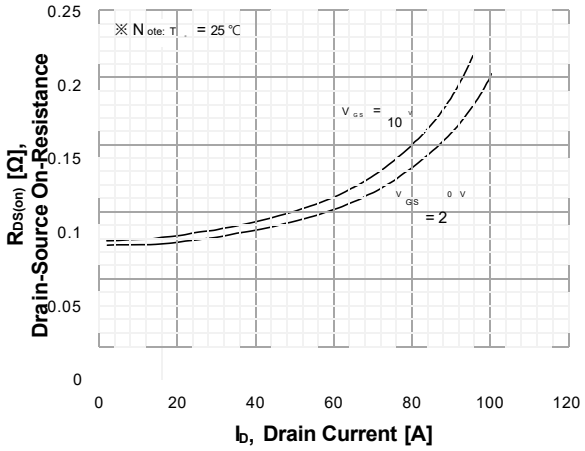
### Figure 1. On-Region Characteristics



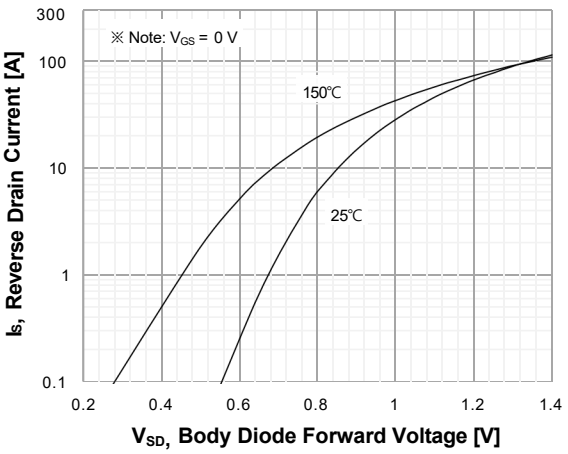

### Figure 2. Transfer Characteristics



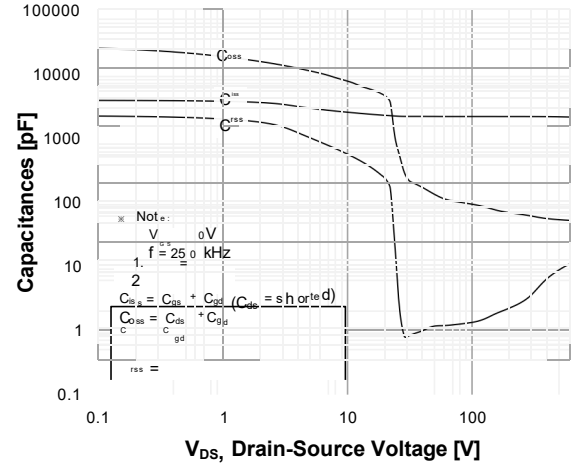

### Figure 3. On-Resistance Characteristics vs. Drain Current and Gate Voltage



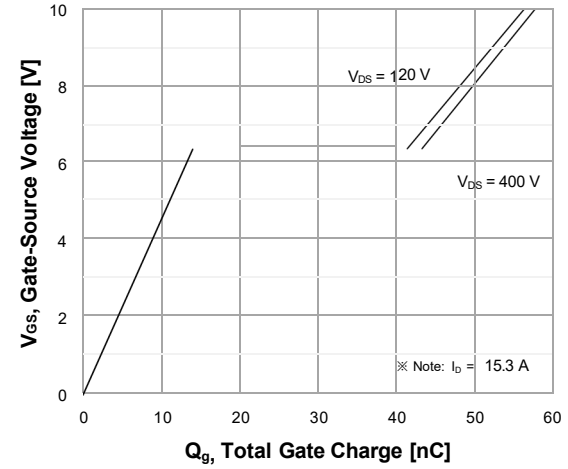

### Figure 4. Diode Forward Voltage Characteristics vs. Source-Drain Current and Temperature




### Figure 5. Capacitance Characteristics




### Figure 6. Gate Charge Characteristics



## Typical Performance Characteristics

**Figure 7. Breakdown Voltage Characteristics vs. Temperature**

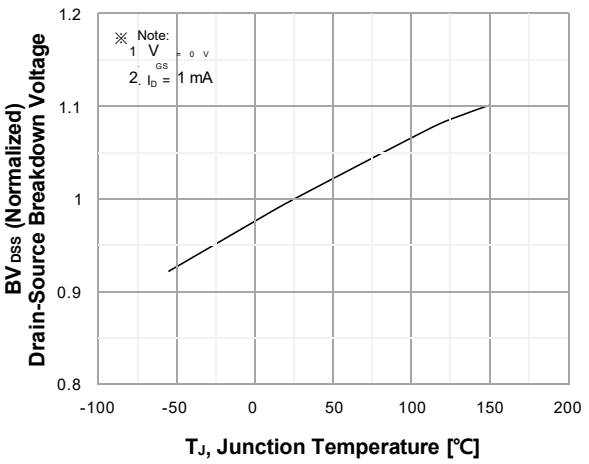



**Figure 8. On-Resistance Characteristics vs. Temperature**

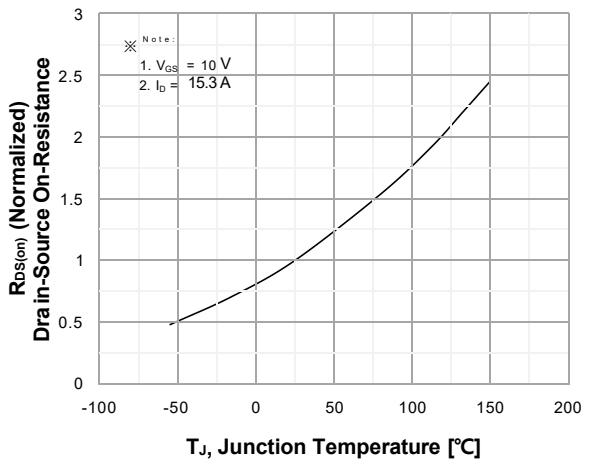



**Figure 9. Maximum Safe Operating Area**

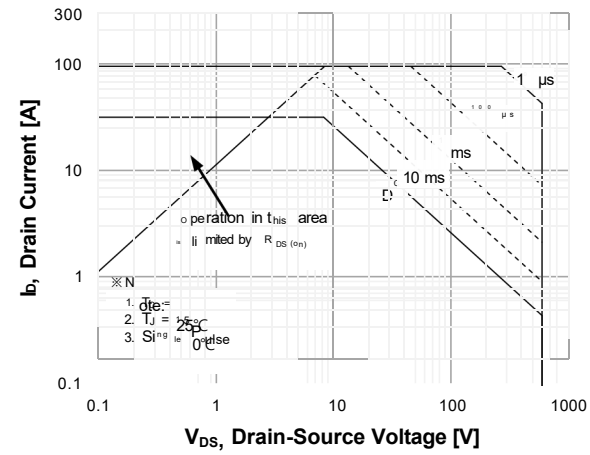



**Figure 10. Maximum Drain Current vs. Case Temperature**

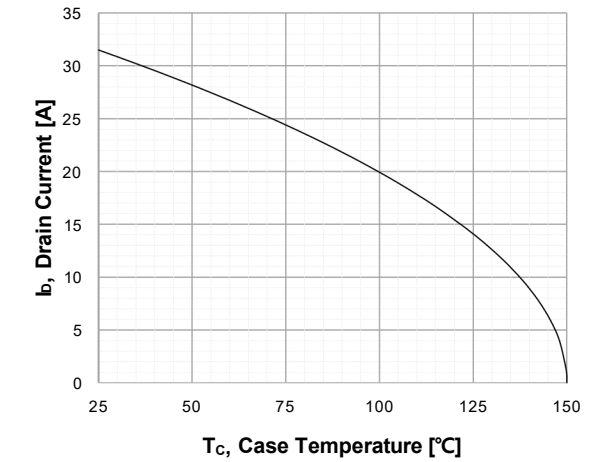



**Figure 11. $E_{oss}$ vs. Drain to Source Voltage**

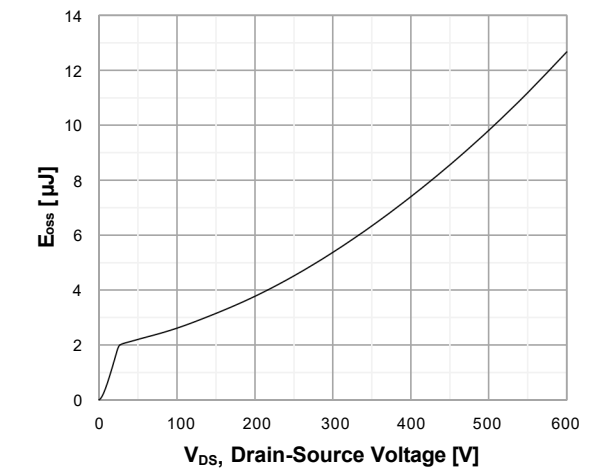
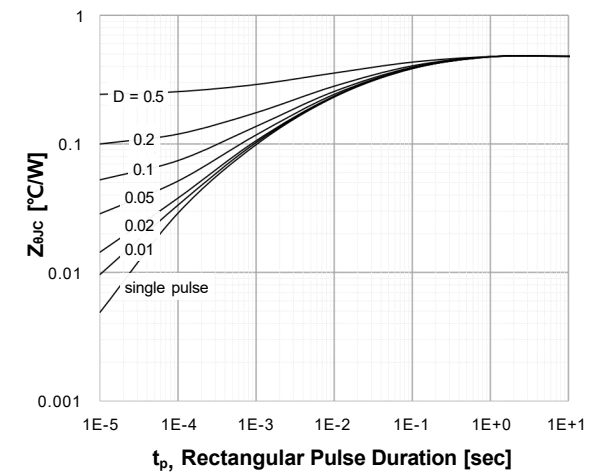



**Figure 12. Transient Thermal Response Curve**



## Test Circuits

**Figure 13. Inductive Load Switching Test Circuit and Waveforms**

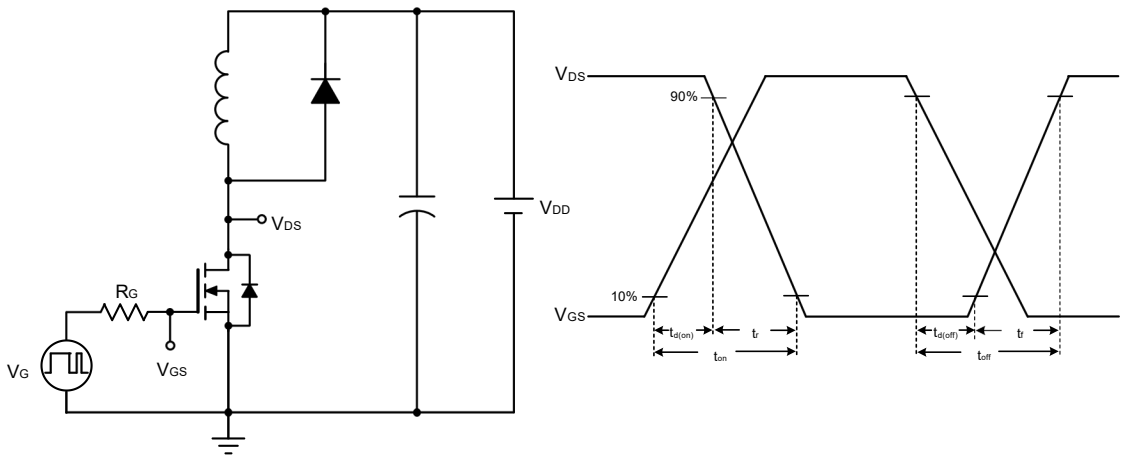



**Figure 14. Unclamped Inductive Switching Test Circuit and Waveforms**

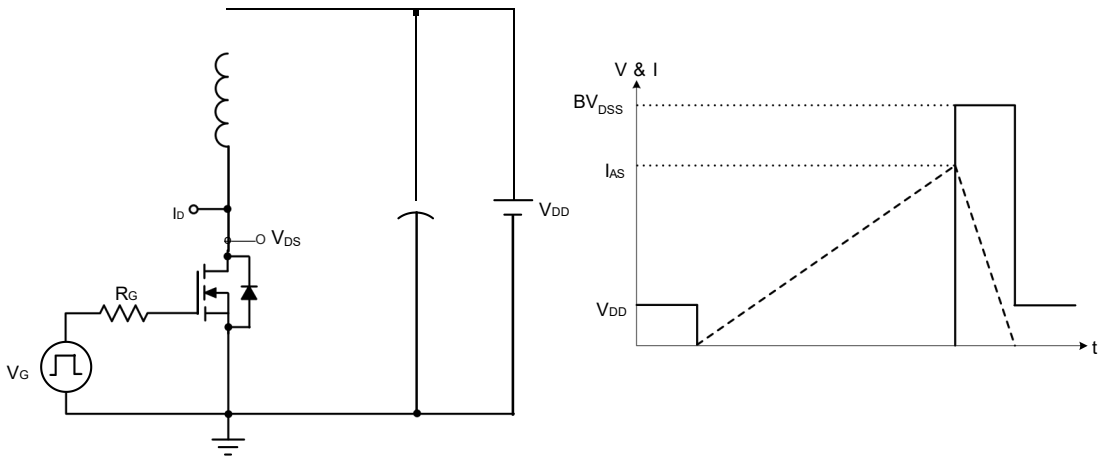
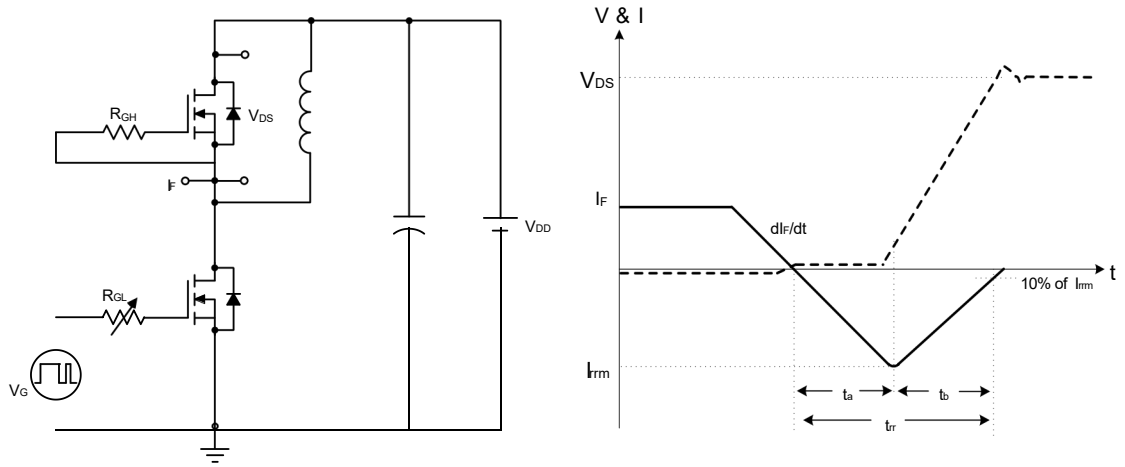



**Figure 15. Peak Diode Recovery dv/dt Test Circuit and Waveforms**



## Package Outlines

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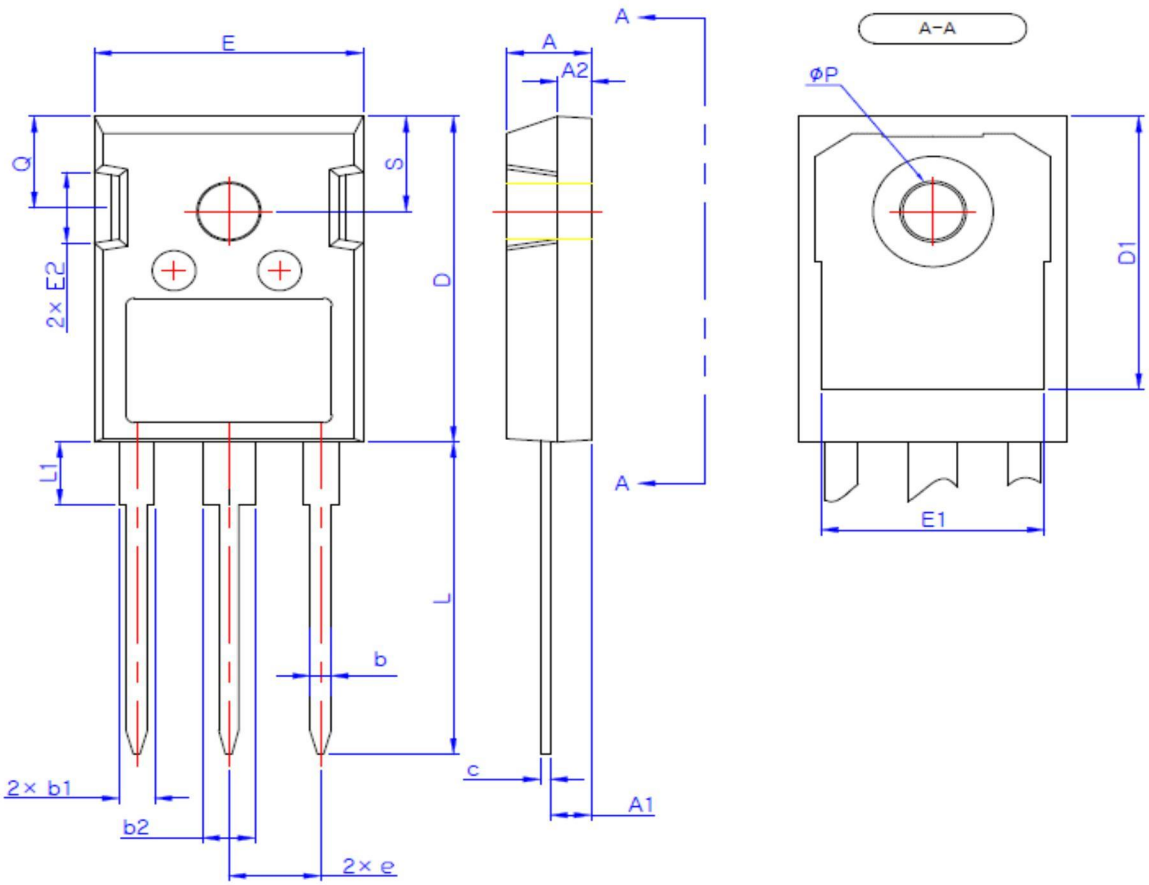


| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 4.80 | 5.00 | 5.20 |
| A1 | 2.29 | 2.42 | 2.54 |
| A2 | 1.90 | 2.00 | 2.10 |
| b | 1.10 | 1.20 | 1.30 |
| b1 | 1.91 | 2.06 | 2.20 |
| b2 | 2.92 | 3.06 | 3.20 |
| c | 0.50 | 0.60 | 0.70 |
| D | 20.80 | 21.07 | 21.34 |
| D1 | 17.43 | 17.63 | 17.83 |
| E | 15.75 | 15.94 | 16.13 |
| E1 | 13.06 | 13.26 | 13.46 |
| E2 | 4.32 | 4.58 | 4.83 |
| e | 5.45 BSC | | |
| L | 19.85 | 20.05 | 20.25 |
| L1 | 4.05 | 4.27 | 4.49 |
| ΦP | 3.55 | 3.60 | 3.65 |
| Q | 5.59 | 5.89 | 6.19 |
| S | 6.15 BSC | | |

* Dimensions in millimeters