

# BMx65N190UC1

## N-Channel Planar MOSFET

650 V, 20 A, 190 mΩ

### Description

BMx65N190UC1 is power MOSFET using bestirpower's advanced super junction technology that can realize very low on-resistance and gate charge. It will provide much high efficiency by using optimized charge coupling technology. These user friendly devices give an advantage of Low EMI to designers as well as low switching loss.

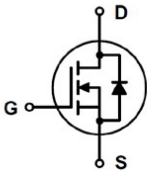
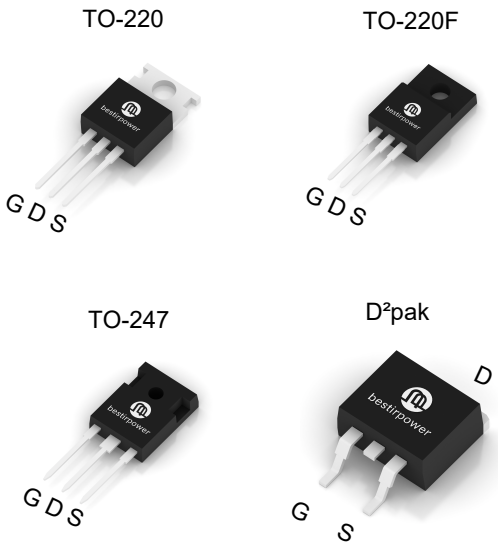
### Features

| $BV_{DSS}, T_c=25^{\circ}C$ | $I_D, T_c=25^{\circ}C$ | $R_{DS(on)}, max. T_c=25^{\circ}C$ | $Q_{g,typ}$ |
|-----------------------------|------------------------|------------------------------------|-------------|
| 650 V                       | 20 A                   | 190 mΩ                             | 40 nC       |

- Ultra-fast body diode.
- Extremely low losses due to very low FOM  $R_{dson} \cdot Q_g$  and  $E_{oss}$ .
- Very high commutation ruggedness.

### Applications

- PC power.
- AC/DC power supply.
- Telecom/Server.
- Solar inverter.



### Package Marking and Ordering Information

| Part Number  | Top Marking  | Package | Packing Method |
|--------------|--------------|---------|----------------|
| BMP65N190UC1 | BMP65N190UC1 | TO220   | Tube           |
| BMF65N190UC1 | BMF65N190UC1 | TO220F  | Tube           |
| BMB65N190UC1 | BMB65N190UC1 | TO263   | Tape & Reel    |
| BMW65N190UC1 | BMW65N190UC1 | TO247   | Tube           |

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

| Symbol        | Parameter                                                     |                                          | Value      | Unit             |
|---------------|---------------------------------------------------------------|------------------------------------------|------------|------------------|
| $V_{DSS}$     | Drain to Source Voltage <sup>1)</sup>                         |                                          | 650        | V                |
| $V_{GSS}$     | Gate to Source Voltage                                        |                                          | $\pm 30$   | V                |
| $I_D$         | Drain Current <sup>2)</sup>                                   | Continuous ( $T_C = 25^\circ\text{C}$ )  | 20         | A                |
|               |                                                               | Continuous ( $T_C = 125^\circ\text{C}$ ) | 10         |                  |
| $I_{DM}$      | Drain Current                                                 | Pulsed ( $T_C = 25^\circ\text{C}$ )      | 58         | A                |
| $P_D$         | Power Dissipation For TO-220F                                 |                                          | 34         | W                |
|               | Power Dissipation For TO-220, TO-247, TO-263                  |                                          | 152        |                  |
| $E_{AS}$      | Single Pulsed Avalanche Energy <sup>3)</sup>                  |                                          | 306        | mJ               |
| $dv/dt$       | Diode Recovery $dv/dt$ <sup>4)</sup>                          |                                          | 50         | V/ns             |
| $I_S$         | Continuous diode forward current $T_C = 25^\circ\text{C}$     |                                          | 20         | A                |
| $I_{S,pulse}$ | Diode pulse current <sup>2)</sup>                             |                                          | 58         | A                |
| $T_{STG}$     | Storage Temperature Range                                     |                                          | -55 to 150 | $^\circ\text{C}$ |
| $T_J$         | Maximum Operating Junction Temperature                        |                                          | 150        | $^\circ\text{C}$ |
| $T_L$         | Maximum Lead Temperature for Soldering, 1/8" from Case for 10 |                                          | 260        | $^\circ\text{C}$ |

1) Limited by  $T_J$  max. Maximum duty cycle  $D=0.75$ .

2) Pulse width  $t_p$  limited by  $T_J$ , max.

3)  $V_{DD}=50\text{V}$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$ .

4)  $V_{DClink}=400\text{V}$ ;  $V_{DS,peak} < V_{(BR)DSS}$ ; identical low side and high side switch with identical  $R_G$ .

## Thermal Characteristics (FullPAK) TO220F

| Symbol          | Parameter                               | Value | Unit               |
|-----------------|-----------------------------------------|-------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 3.67  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 62.5  |                    |

## Thermal Characteristics (Non FullPAK) TO220, TO247, TO263

| Symbol          | Parameter                               | Value | Unit               |
|-----------------|-----------------------------------------|-------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 0.82  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 62    |                    |

## Electrical Characteristics (T<sub>J</sub> = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

### Off Characteristics

|                   |                                   |                                                                     |     |   |      |    |
|-------------------|-----------------------------------|---------------------------------------------------------------------|-----|---|------|----|
| BV <sub>DSS</sub> | Drain to Source Breakdown Voltage | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1mA                         | 800 | - | -    | V  |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current   | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V T <sub>J</sub> =25°C | -   | - | 10   | μA |
| I <sub>GSS</sub>  | Gate-Source Leakage Current       | V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V                      | -   | - | ±100 | nA |

### On Characteristics

|                     |                                      |                                                            |     |     |     |    |
|---------------------|--------------------------------------|------------------------------------------------------------|-----|-----|-----|----|
| V <sub>GS(th)</sub> | Gate Threshold Voltage               | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250μA | 3.0 | 4.0 | 5.0 | V  |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 7A                | -   | 170 | 190 | mΩ |
| R <sub>G</sub>      | Gate Resistance                      | V <sub>DD</sub> = 0V, V <sub>GS</sub> = 0V, f = 1.0MHz     | -   | 4   | -   | Ω  |

### Dynamic Characteristics

|                      |                                                            |                                                                          |   |      |   |    |
|----------------------|------------------------------------------------------------|--------------------------------------------------------------------------|---|------|---|----|
| C <sub>iss</sub>     | Input Capacitance                                          | V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=250kHz                      | - | 1690 | - | pF |
| C <sub>oss</sub>     | Output Capacitance                                         |                                                                          | - | 78   | - | pF |
| C <sub>rss</sub>     | Reverse Transfer Capacitance                               |                                                                          | - | 3.3  | - | pF |
| C <sub>o(er)</sub>   | Effective output capacitance, energy related <sup>1)</sup> | V <sub>GS</sub> =0V, V <sub>DS</sub> = 0 to 400V                         | - | 50   | - | pF |
| C <sub>o(tr)</sub>   | Effective output capacitance, time related <sup>2)</sup>   |                                                                          | - | 245  | - | pF |
| Q <sub>g</sub>       | Total Gate Charge                                          | V <sub>GS</sub> = 0 to 10V,<br>V <sub>DD</sub> =400V, I <sub>D</sub> =7A | - | 40   | - | nC |
| Q <sub>gs</sub>      | Gate to Source Charge                                      |                                                                          | - | 9    | - | nC |
| Q <sub>gd</sub>      | Gate to Drain "Miller" Charge                              |                                                                          | - | 17   | - | nC |
| V <sub>plateau</sub> | Gate plateau voltage                                       |                                                                          | - | 6    | - | V  |

### Switching Characteristics

|                     |                     |                                                                       |   |    |   |    |
|---------------------|---------------------|-----------------------------------------------------------------------|---|----|---|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 400V,<br>I <sub>D</sub> = 7A, V <sub>GS</sub> = 10V | - | 10 | - | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                       | - | 16 | - | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                       | - | 55 | - | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |                                                                       | - | 14 | - | ns |

### Reverse Diode Characteristics

|                 |                               |                                                                            |   |      |   |    |
|-----------------|-------------------------------|----------------------------------------------------------------------------|---|------|---|----|
| V <sub>SD</sub> | Diode Forward Voltage         | I <sub>F</sub> =7A, V <sub>GS</sub> = 0V T <sub>F</sub> =25°C              | - | 0.85 | - | V  |
| t <sub>rr</sub> | Reverse Recovery Time         | V <sub>R</sub> = 400V, I <sub>F</sub> =7A<br>di <sub>F</sub> /dt = 100A/μs | - | 120  | - | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge       |                                                                            | - | 0.6  | - | μC |
| I <sub>rm</sub> | Peak Reverse Recovery Current |                                                                            | - | 10   | - | A  |

1) C<sub>o(er)</sub> is a fixed capacitance that gives the same stored energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 400V.

2) C<sub>o(tr)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 400V.

Typical Performance Characteristics

Figure 1: Transient Thermal Impedance For TO-220F

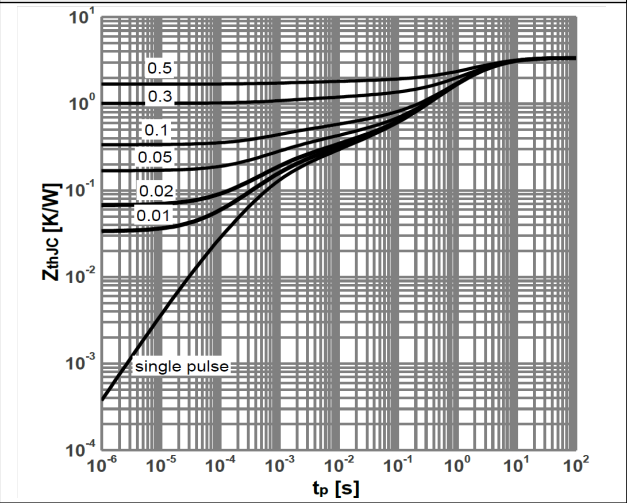


Figure 2: Power dissipation For TO-220F

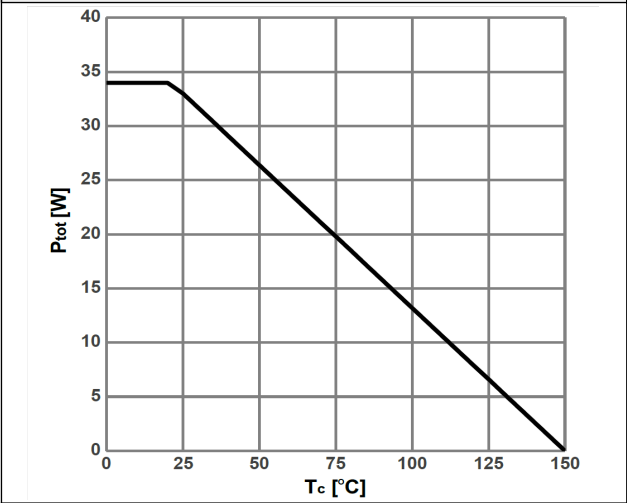


Figure 3: Transient Thermal Impedance For TO-220、TO-247、TO-263

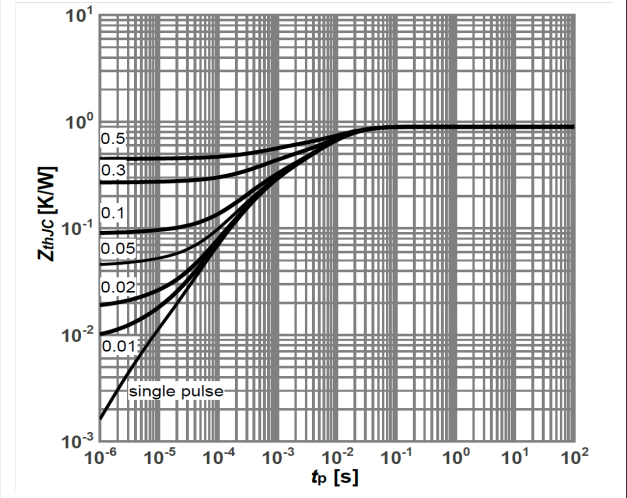


Figure 4: Power dissipation For TO-220、TO-247、TO-263

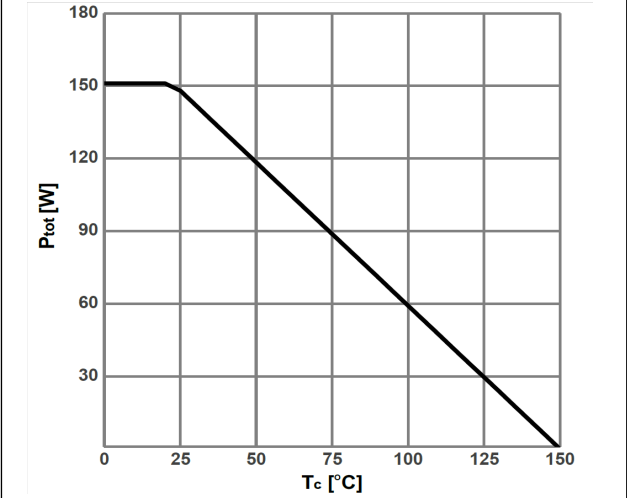


Figure 5: Safe operating area For TO-220、TO-247、TO-263

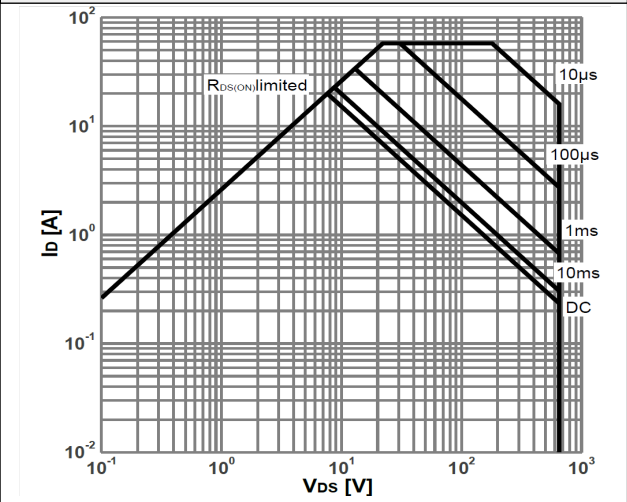
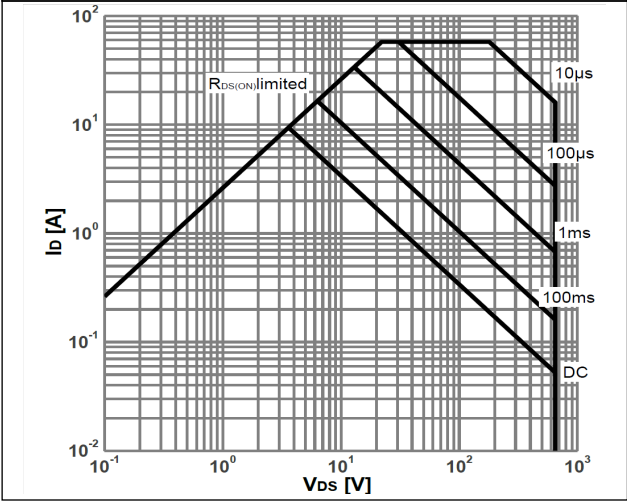


Figure 6: Safe operating area For TO-220F



Typical Performance Characteristics

Figure 7: Typ. output characteristics @  $T_j=25^{\circ}\text{C}$

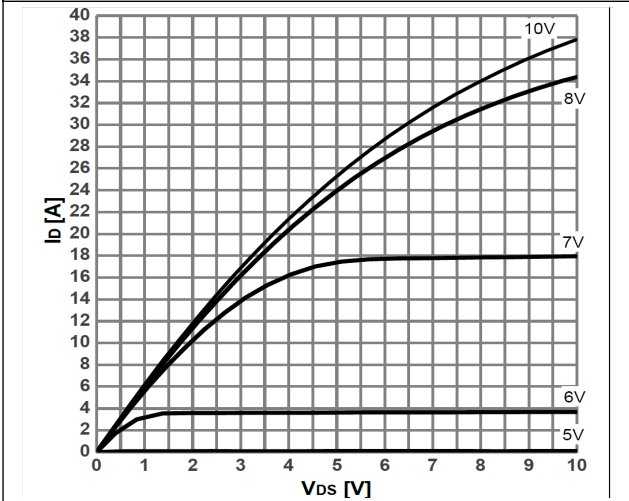


Figure 8: Typ. output characteristics @  $T_j=125^{\circ}\text{C}$

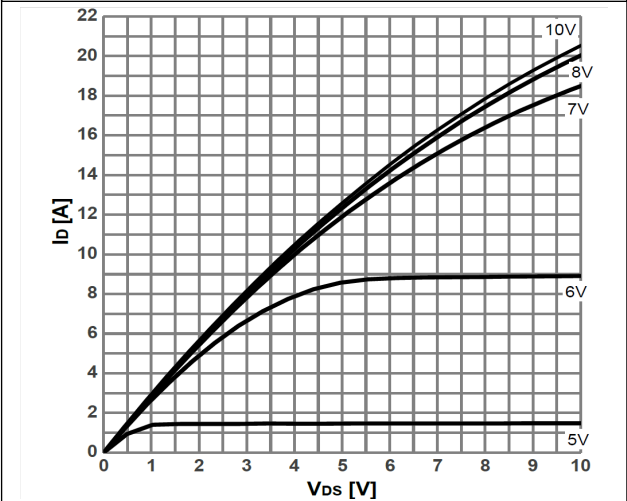


Figure 9: Typ. drain-source on-state resistance

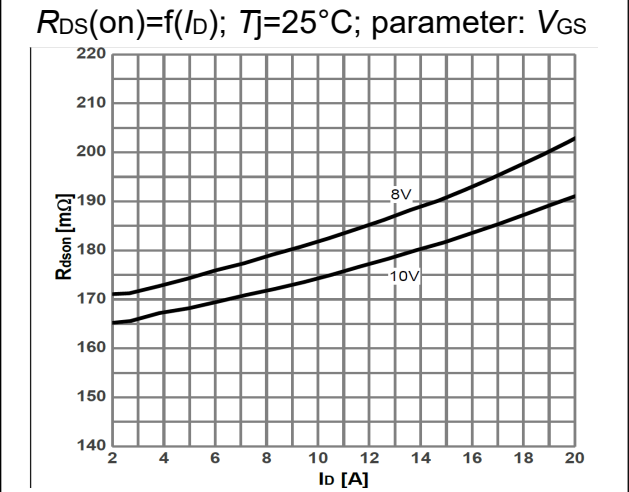


Figure 10: Drain-source on-state resistance

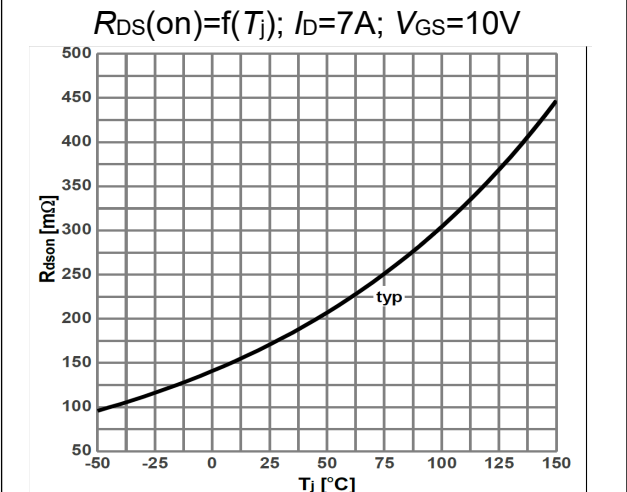


Figure 11: Breakdown Voltage vs Junction Temperature

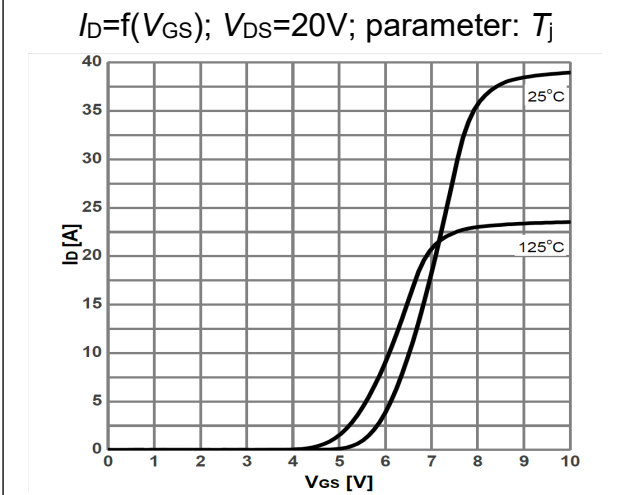
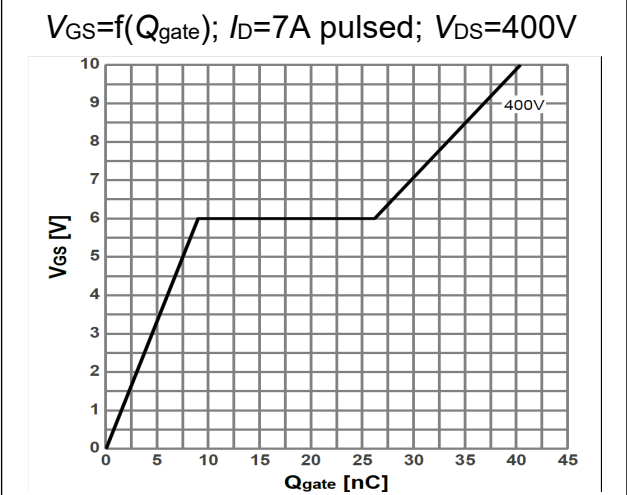


Figure 12: On-Resistance vs Temperature



Typical Performance Characteristics

Figure 13: Forward characteristics of reverse diode

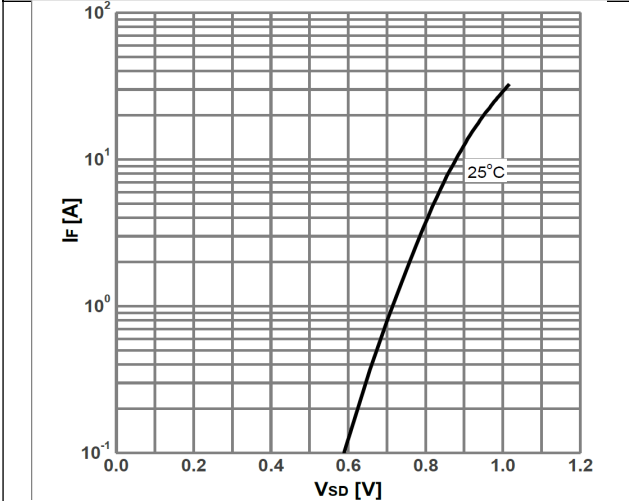


Figure 14: Drain-source breakdown voltage

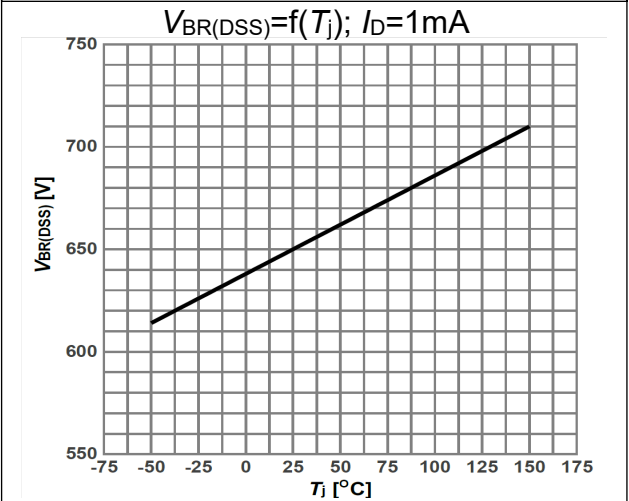


Figure 15: Typ. Coss stored energy

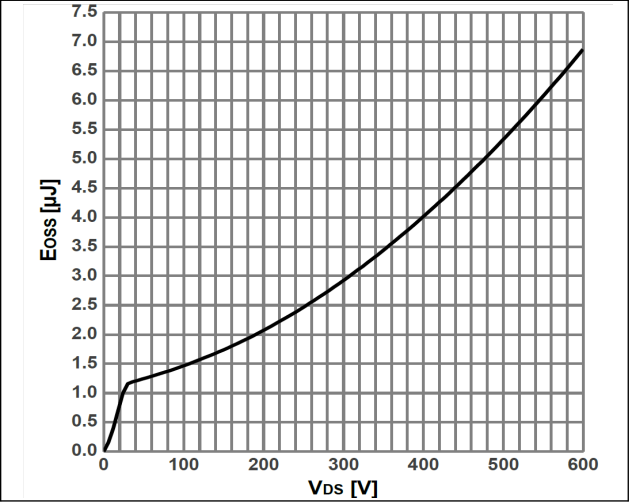
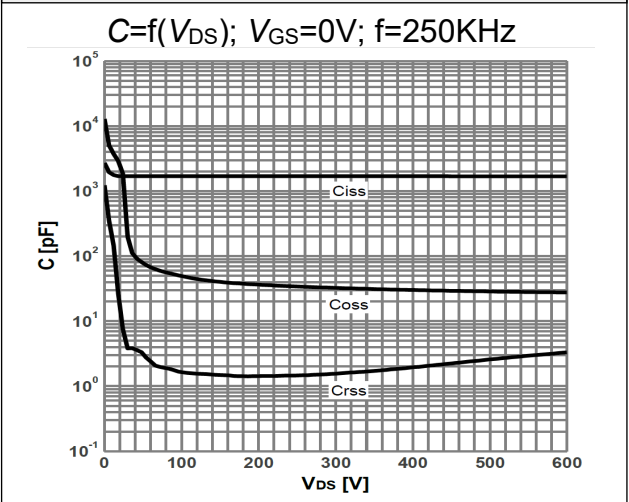


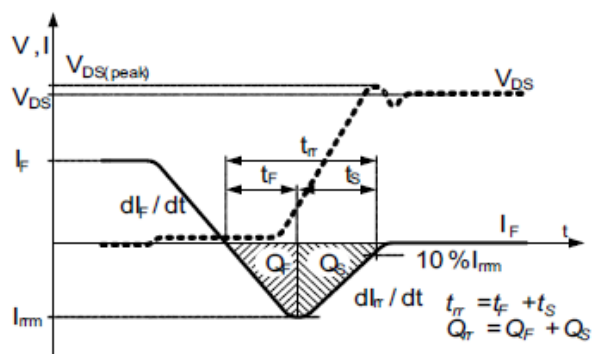
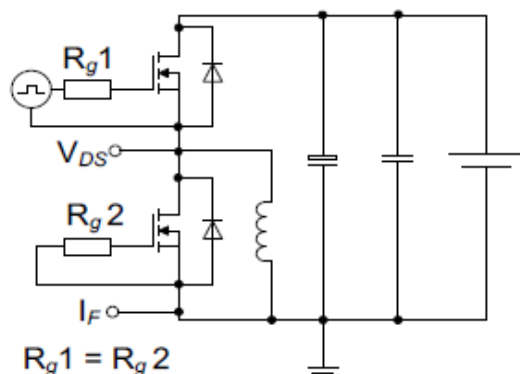
Figure 16: Typ. capacitances



## Test Circuits

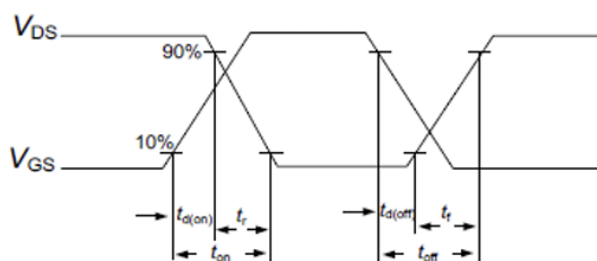
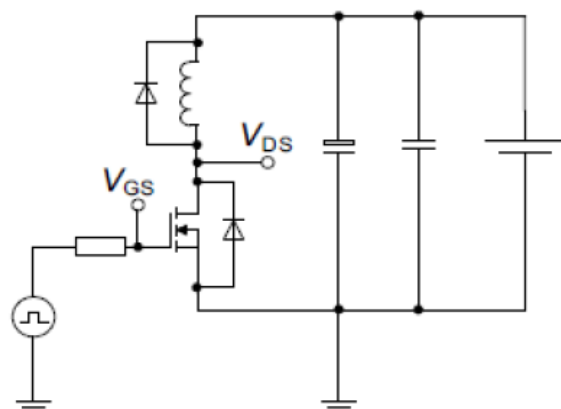
**Figure 17. Diode Characteristics**

**Test circuit for diode characteristics and Diode recovery waveform**



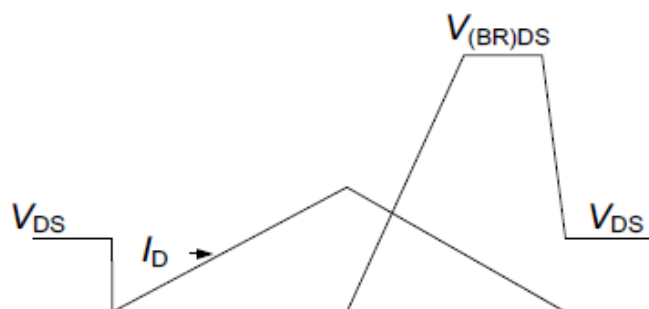
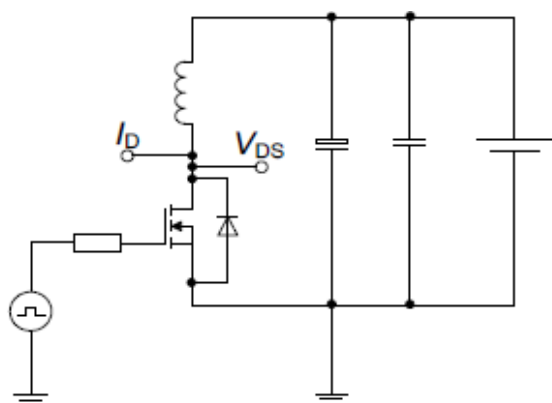
**Figure 18. Switching Times**

**Switching times test circuit for inductive load and Switching times waveform**



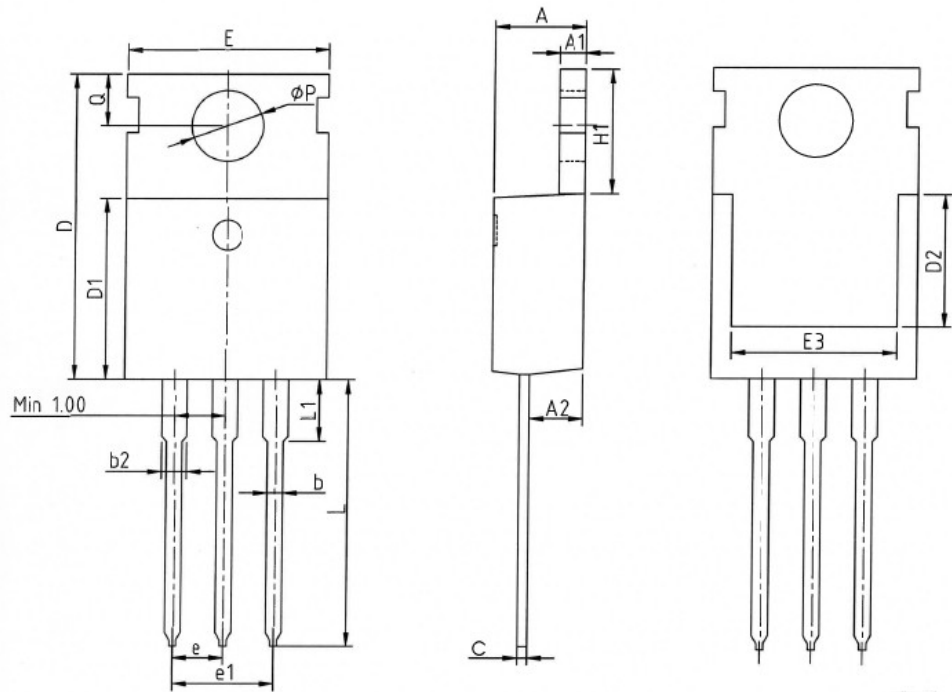
**Figure 19. Unclamped Inductive Load**

**Unclamped inductive load test circuit and Unclamped inductive waveform**



Package Outlines

TO-220



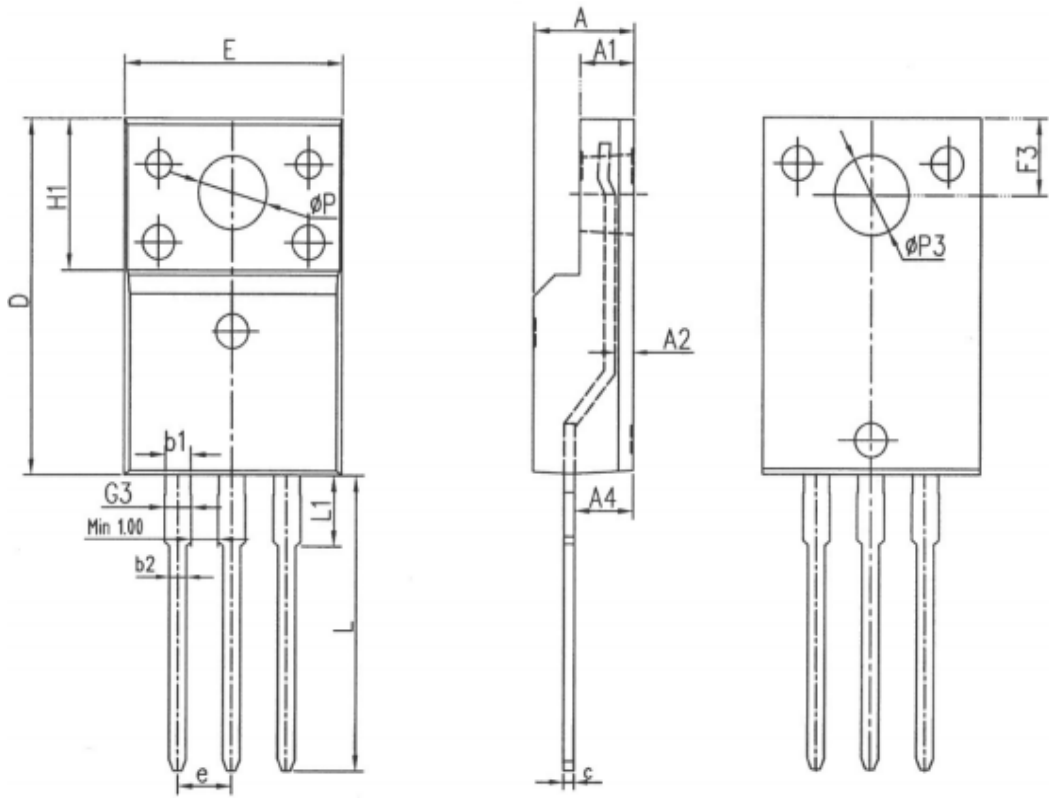
| SYMBOL   | MIN      | NOM   | MAX   |
|----------|----------|-------|-------|
| A        | 4.37     | 4.57  | 4.70  |
| A1       | 1.25     | 1.30  | 1.40  |
| A2       | 2.20     | 2.40  | 2.60  |
| b        | 0.70     | 0.80  | 0.95  |
| b2       | 1.17     | 1.27  | 1.47  |
| c        | 0.45     | 0.50  | 0.60  |
| D        | 15.10    | 15.60 | 16.10 |
| D1       | 8.80     | 9.10  | 9.40  |
| D2       | 5.50     | 6.30  | 7.10  |
| E        | 9.70     | 10.00 | 10.30 |
| E3       | 7.00     | 7.80  | 8.60  |
| e        | 2.54 BSC |       |       |
| e1       | 5.08 BSC |       |       |
| H1       | 6.25     | 6.50  | 6.85  |
| L        | 12.75    | 13.50 | 13.80 |
| L1       | -        | 3.10  | 3.40  |
| $\Phi P$ | 3.40     | 3.60  | 3.80  |
| Q        | 2.60     | 2.80  | 3.00  |

\* Dimensions in millimeters



Package Outlines

TO-220F



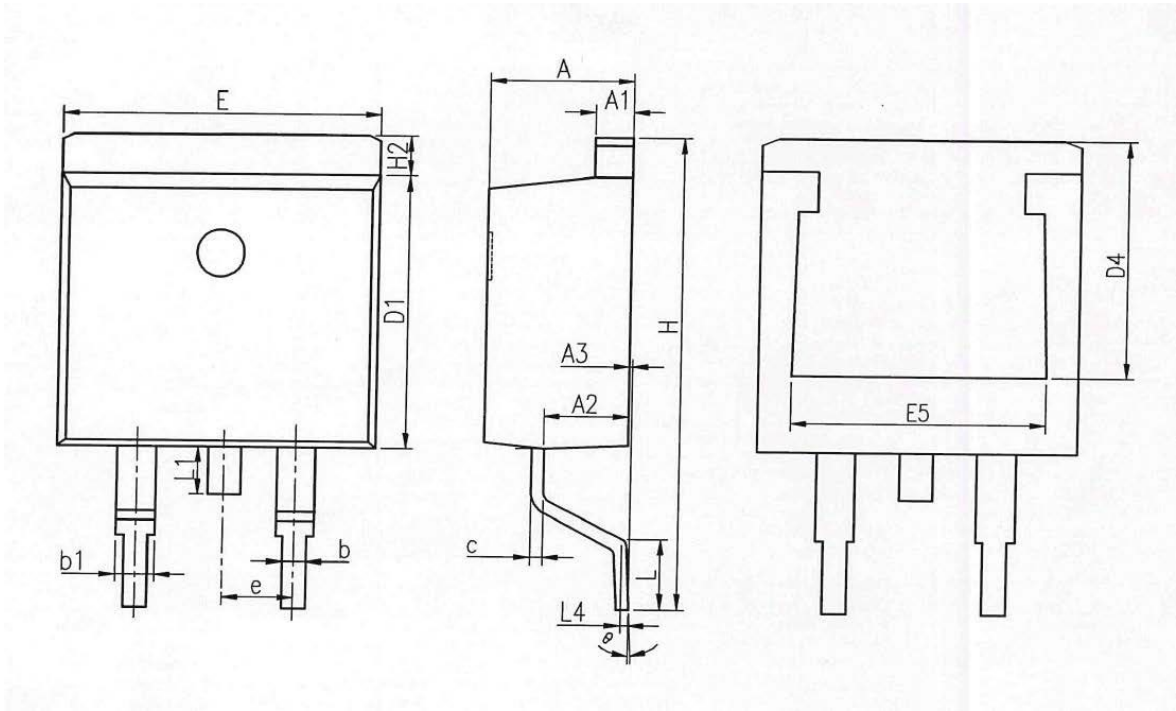
COMMON DIMENSIONS

| SYMBOL | MM       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| E      | 10.00    | 10.20 | 10.40 |
| A      | 4.50     | 4.70  | 4.90  |
| A1     | 2.34     | 2.54  | 2.74  |
| A2     | 0.65     | 0.85  | 1.30  |
| A4     | 2.55     | 2.75  | 2.95  |
| c      | 0.40     | 0.50  | 0.65  |
| D      | 15.57    | 15.87 | 16.17 |
| H1     | 6.70REF  |       |       |
| e      | 2.54BSC  |       |       |
| Φ P    | 3.183REF |       |       |
| L      | 12.68    | 12.98 | 13.28 |
| L1     | 3.25     | 3.45  | 3.65  |
| Φ P3   | 3.45REF  |       |       |
| F3     | 3.10     | 3.30  | 3.50  |
| G3     | 1.10     | 1.30  | 1.50  |
| b1     | 1.05     | 1.20  | 1.35  |
| b2     | 0.70     | 0.80  | 0.92  |

\* Dimensions in millimeters

Package Outlines

TO-263

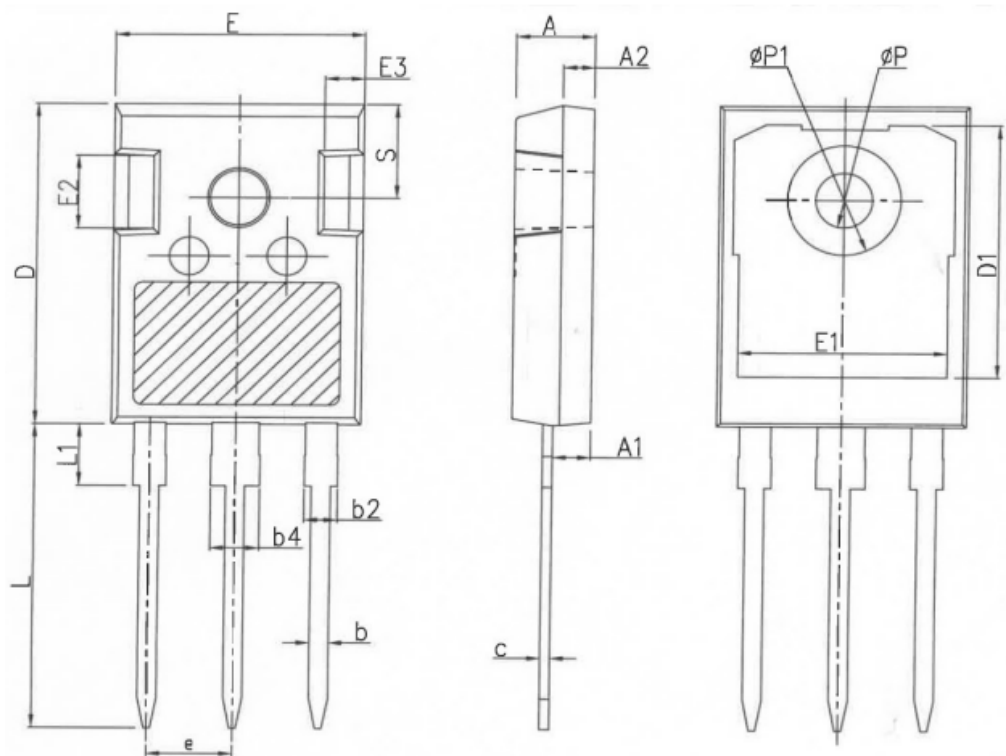


COMMON DIMENSIONS

| SYMBOL | MM       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| A      | 4.37     | 4.57  | 4.77  |
| A1     | 1.22     | 1.27  | 1.42  |
| A2     | 2.49     | 2.69  | 2.89  |
| A3     | 0.00     | 0.13  | 0.25  |
| b      | 0.70     | 0.81  | 0.96  |
| b1     | 1.17     | 1.27  | 1.47  |
| c      | 0.30     | 0.38  | 0.53  |
| D1     | 8.50     | 8.70  | 8.90  |
| D4     | 6.60     | -     | -     |
| E      | 9.86     | 10.16 | 10.36 |
| E5     | 7.06     | -     | -     |
| e      | 2.54 BSC |       |       |
| H      | 14.70    | 15.10 | 15.50 |
| H2     | 1.07     | 1.27  | 1.47  |
| L      | 2.00     | 2.30  | 2.60  |
| L1     | 1.40     | 1.55  | 1.70  |
| L4     | 0.25 BSC |       |       |
| θ      | 0°       | 5°    | 9°    |

\* Dimensions in millimeters

Package Outlines  
TO-247-3L



| 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  |
| ØP     | 3.55     | 3.60  | 3.65  |
| Q      | 5.59     | 5.89  | 6.19  |
| S      | 6.15 BSC |       |       |

\* Dimensions in millimeters

## Disclaimer

Bestirpower reserve the right to make changes, corrections, enhancements, modifications, and improvements to Bestirpower products and/or to this document at any time without notice.

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. Bestirpower does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Products or technical information described in this document.

This document is the property of Bestirpower Co., LTD., and not allowed to copy or transformed to other format if not under the authority approval.

© 2024 bestirpower – All rights reserved