

## 1. Description

BL10N60, the silicon N-channel Enhanced MOSFETs, is obtained by advanced MOSFET technology which reduce the conduction loss, improve switching performance and enhance the avalanche energy. The transistor is suitable device for SMPS, high speed switching and general purpose applications.

### KEY CHARACTERISTICS

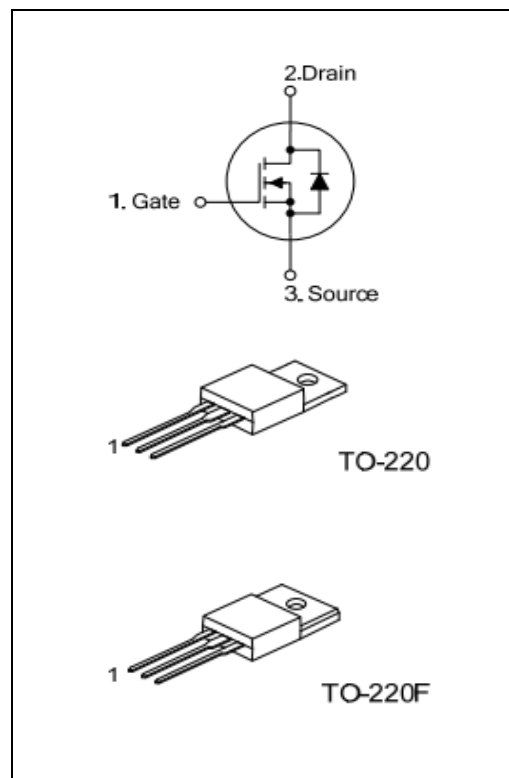
| Parameter        | Value | Unit     |
|------------------|-------|----------|
| $V_{DS@Tj.max}$  | 650   | V        |
| $I_D$            | 10    | A        |
| $R_{DS(ON).Typ}$ | 0.47  | $\Omega$ |

### FEATURES

- Fast Switching
- Low  $C_{rss}$
- 100% avalanche tested
- Improved dv/dt capability
- RoHS product

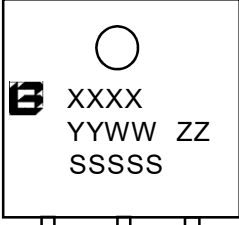
### APPLICATIONS

- High frequency switching mode power supply
- Electronic ballast



## ORDERING INFORMATION

| Ordering Codes | Package | Product Code | Packing |
|----------------|---------|--------------|---------|
| BL10N60-P      | TO-220  | BL10N60      | Tube    |
| BL10N60-A      | TO-220F |              | Tube    |

|                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>BL10N60-A</b></p> <div style="border: 1px solid black; padding: 5px; margin-left: 20px;"> <p>(2) Package type</p> <p>(1) Chip name</p> </div> <p>(1) BL10N60:600V 10A<br/>                 (2) A:TO-220F P:TO-220</p> | <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>XXXX: Product Code<br/>                 YYWW: Year&amp;Week<br/>                 ZZ: Assembly Code<br/>                 SSSSS: Lot Code</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 2. ABSOLUTE RATINGS

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

| Symbol         | Parameter                                            | Rating              | Units                 |
|----------------|------------------------------------------------------|---------------------|-----------------------|
| $V_{DS}$       | Drain-to-Source Voltage                              | 600                 | V                     |
| $I_D$          | Continuous Drain Current                             | 10                  | A                     |
|                | Continuous Drain Current $T_C = 100^{\circ}\text{C}$ | 6.3                 | A                     |
| $I_{DM}$       | Pulsed Drain Current(Note1)                          | 40                  | A                     |
| $V_{GS}$       | Gate-to-Source Voltage                               | $\pm 30$            | V                     |
| $E_{AS}$       | Single Pulse Avalanche Energy(Note2)                 | 600                 | mJ                    |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ (Note3)                  | 5.0                 | V/ns                  |
| $P_D$          | Power Dissipation<br>TO-220                          | 180                 | W                     |
|                | Derating Factor above $25^{\circ}\text{C}$           | 1.45                | W/ $^{\circ}\text{C}$ |
| $P_D$          | Power Dissipation<br>TO-220F                         | 45                  | W                     |
|                | Derating Factor above $25^{\circ}\text{C}$           | 0.36                | W/ $^{\circ}\text{C}$ |
| $T_J, T_{stg}$ | Operating Junction and Storage Temperature Range     | 150, $-55$ to $150$ | $^{\circ}\text{C}$    |
| $T_L$          | Maximum Temperature for Soldering                    | 300                 | $^{\circ}\text{C}$    |

## 3. Thermal characteristics

### Thermal characteristics TO-220

| Symbol          | Parameter           | RATINGS | Units                       |
|-----------------|---------------------|---------|-----------------------------|
| $R_{\theta JC}$ | Junction-to-Case    | 0.69    | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient | 62.5    | $^{\circ}\text{C}/\text{W}$ |

### Thermal characteristics TO-220F

| Symbol          | Parameter           | RATINGS | Units                       |
|-----------------|---------------------|---------|-----------------------------|
| $R_{\theta JC}$ | Junction-to-Case    | 2.78    | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient | 62.5    | $^{\circ}\text{C}/\text{W}$ |

## 4. Electrical Characteristics

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

| OFF Characteristics          |                                   |                                                             |        |      |      |                     |
|------------------------------|-----------------------------------|-------------------------------------------------------------|--------|------|------|---------------------|
| Symbol                       | Parameter                         | Test Conditions                                             | Values |      |      | Units               |
|                              |                                   |                                                             | Min.   | Typ. | Max. |                     |
| $V_{DSS}$                    | Drain to Source Breakdown Voltage | $V_{GS}=0V$ ,<br>$I_D=250\mu A$                             | 600    | --   | --   | V                   |
| $\Delta BV_{DSS}/\Delta T_J$ | Bvdss Temperature Coefficient     | $I_D=250\mu A$ ,<br>Reference $25^\circ\text{C}$            | --     | 0.6  | --   | V/ $^\circ\text{C}$ |
| $I_{DSS}$                    | Drain to Source Leakage Current   | $V_{DS}=600V$ ,<br>$V_{GS}=0V$ ,<br>$T_J=25^\circ\text{C}$  | --     | --   | 1    | $\mu A$             |
|                              |                                   | $V_{DS}=480V$ ,<br>$V_{GS}=0V$ ,<br>$T_J=125^\circ\text{C}$ | --     | --   | 100  | $\mu A$             |
| $I_{GSS(F)}$                 | Gate to Source Forward Leakage    | $V_{GS}=+30V$                                               | --     | --   | 100  | nA                  |
| $I_{GSS(R)}$                 | Gate to Source Reverse Leakage    | $V_{GS}=-30V$                                               | --     | --   | -100 | nA                  |

| ON Characteristics |                               |                                                   |        |      |      |          |
|--------------------|-------------------------------|---------------------------------------------------|--------|------|------|----------|
| Symbol             | Parameter                     | Test Conditions                                   | Values |      |      | Units    |
|                    |                               |                                                   | Min.   | Typ. | Max. |          |
| $R_{DS(ON)}$       | Drain-to-Source On-Resistance | $V_{GS}=10V$ ,<br>$I_D=5A(\text{Note4})$          | --     | 0.47 | 0.6  | $\Omega$ |
| $V_{GS(TH)}$       | Gate Threshold Voltage        | $V_{DS}=V_{GS}$ ,<br>$I_D=250\mu A(\text{Note4})$ | 2.0    | --   | 4.0  | V        |
| $g_{fs}$           | Forward Transconductance      | $V_{DS}=20V$ ,<br>$I_D=5A(\text{Note4})$          | --     | 10   | --   | S        |

| Dynamic Characteristics |                              |                                                  |        |      |      |          |
|-------------------------|------------------------------|--------------------------------------------------|--------|------|------|----------|
| Symbol                  | Parameter                    | Test Conditions                                  | Values |      |      | Units    |
|                         |                              |                                                  | Min.   | Typ. | Max. |          |
| $R_g$                   | Gate resistance              | $f=1.0\text{MHz}$                                | --     | 1.5  | --   | $\Omega$ |
| $C_{iss}$               | Input Capacitance            | $V_{GS}=0V$<br>$V_{DS}=25V$<br>$f=1.0\text{MHz}$ | --     | 2200 | --   | PF       |
| $C_{oss}$               | Output Capacitance           |                                                  | --     | 150  | --   |          |
| $C_{rss}$               | Reverse Transfer Capacitance |                                                  | --     | 3.8  | --   |          |

## Switching Characteristics

| Symbol       | Parameter                       | Test Conditions                                 | Values |      |      | Units |
|--------------|---------------------------------|-------------------------------------------------|--------|------|------|-------|
|              |                                 |                                                 | Min.   | Typ. | Max. |       |
| $t_{d(ON)}$  | Turn-on Delay Time              | ID = 10A<br>VDD = 300V<br>VGS = 10V<br>RG = 20Ω | --     | 30   | --   | ns    |
| $t_r$        | Rise Time                       |                                                 | --     | 28   | --   |       |
| $t_{d(OFF)}$ | Turn-Off Delay Time             |                                                 | --     | 80   | --   |       |
| $t_f$        | Fall Time                       |                                                 | --     | 33   | --   |       |
| $Q_g$        | Total Gate Charge               | ID = 10A<br>VDD = 480V<br>VGS = 10V             | --     | 40.3 | --   | nC    |
| $Q_{gs}$     | Gate to Source Charge           |                                                 | --     | 11.5 | --   |       |
| $Q_{gd}$     | Gate to Drain ("Miller") Charge |                                                 | --     | 11.3 | --   |       |

## Source-Drain Diode Characteristics

| Symbol    | Parameter                              | Test Conditions                                   | Values |      |      | Units |
|-----------|----------------------------------------|---------------------------------------------------|--------|------|------|-------|
|           |                                        |                                                   | Min.   | Typ. | Max. |       |
| $I_S$     | Continuous Source Current (Body Diode) | TC=25 °C                                          | --     | --   | 13   | A     |
| $I_{SM}$  | Maximum Pulsed Current (Body Diode)    |                                                   | --     | --   | 52   | A     |
| $V_{SD}$  | Diode Forward Voltage                  | IS=10A,<br>VGS=0V(Note4)                          | --     | --   | 1.0  | V     |
| $T_{rr}$  | Reverse Recovery Time                  | IS=10A,<br>Tj = 25°C<br>dIF/dt=100A/us,<br>VGS=0V | --     | 495  | --   | ns    |
| $Q_{rr}$  | Reverse Recovery Charge                |                                                   | --     | 3267 | --   | nC    |
| $I_{rrm}$ | Reverse Recovery Current               |                                                   | --     | 13.2 | --   | A     |

Note1: Pulse width limited by maximum junction temperature

Note2: L=10mH, VD=50V, Start TJ=25°C

Note3: ISD = 10A, di/dt ≤ 100A/us, VDD ≤ BVDS, Start TJ=25°C

Note4: Pulse width tp ≤ 300μs, δ ≤ 2%

## 5. Characteristics Curves

Figure 1a Safe Operating Area (No FullPAK)

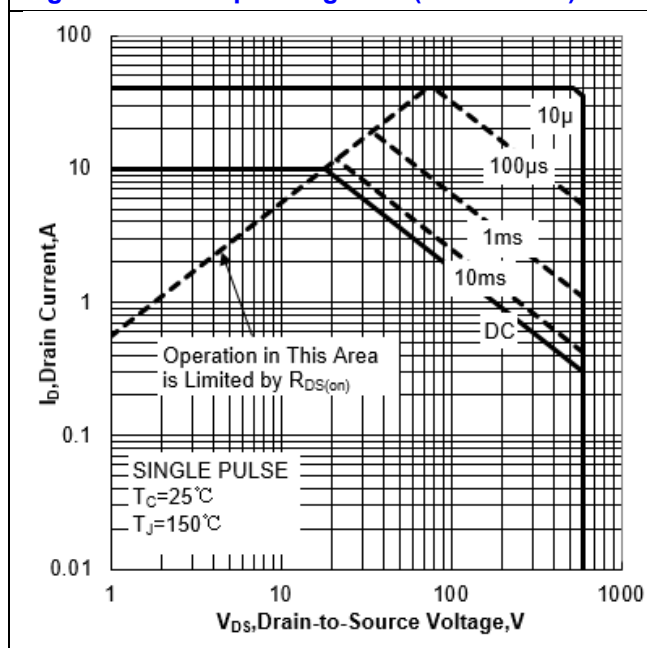


Figure 1b Safe Operating Area (FullPAK)

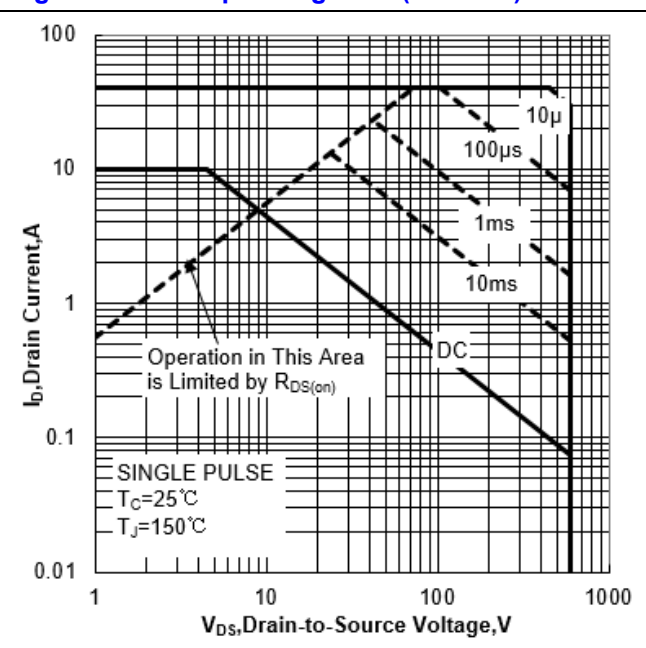


Figure 2a Power Dissipation (No FullPAK)

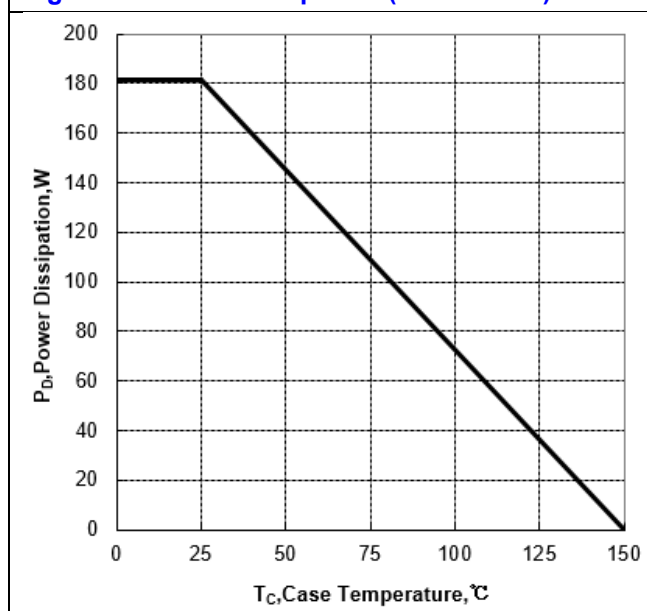
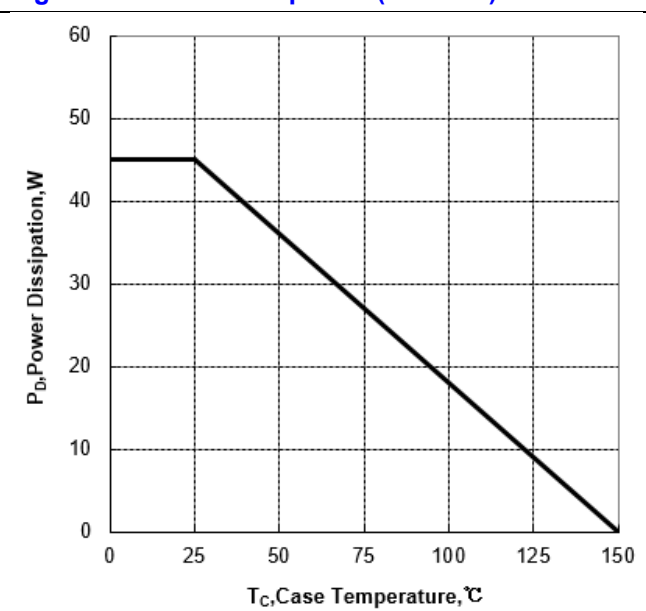
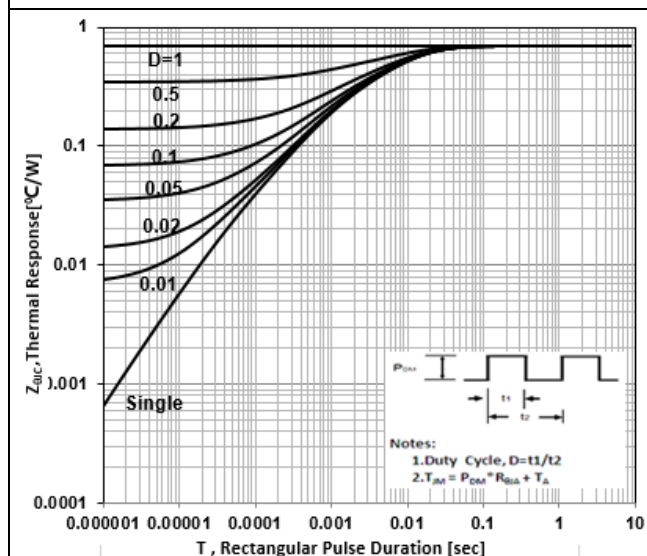


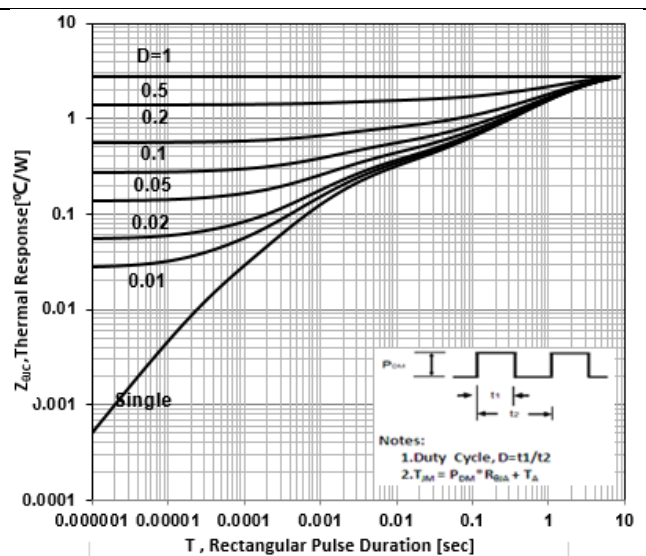
Figure 2b Power Dissipation (FullPAK)



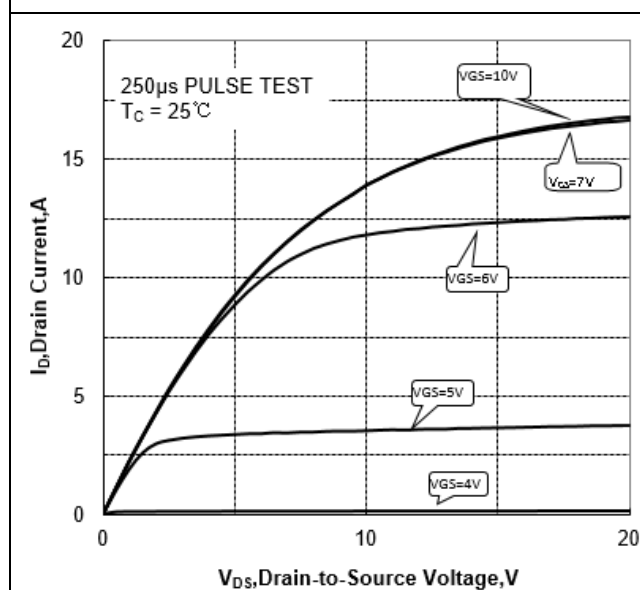
**Figure 3a Max Thermal Impedance (No FullPAK)**



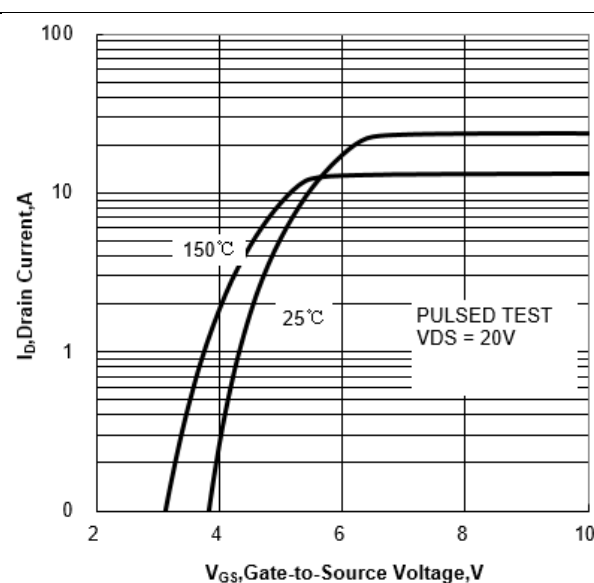
**Figure 3b Max Thermal Impedance (FullPAK)**



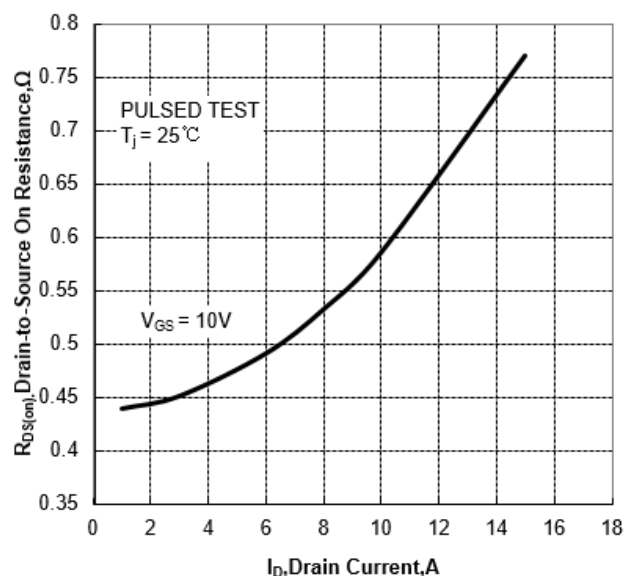
**Figure 4 Typical Output Characteristics**



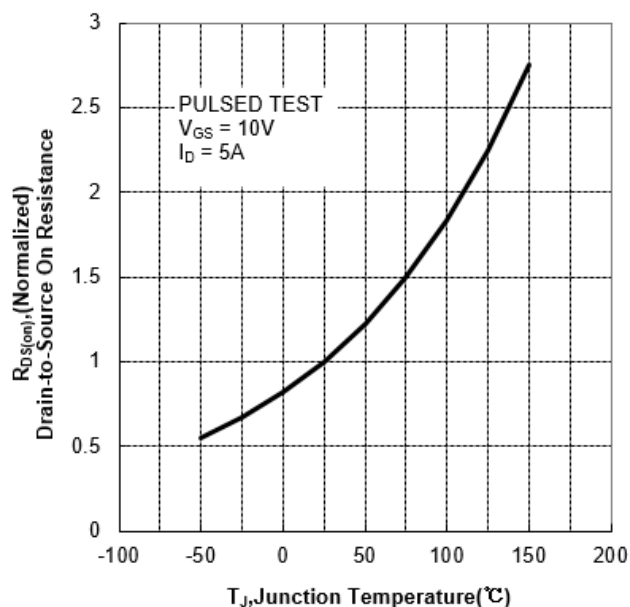
**Figure 5 Typical Transfer Characteristics**



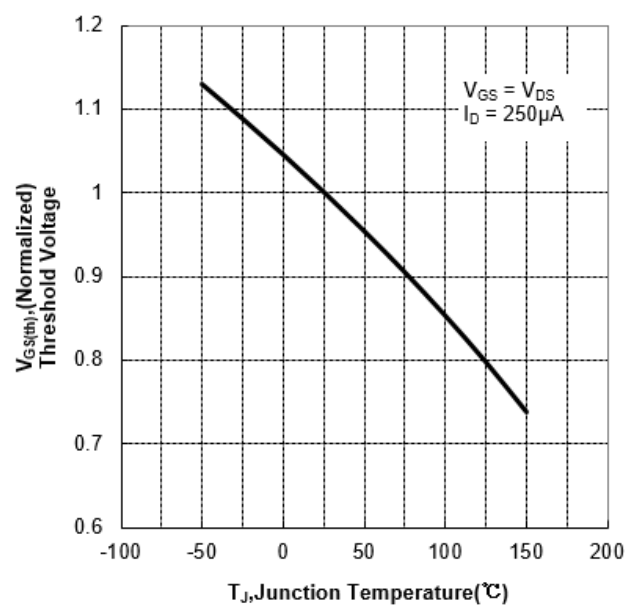
**Figure 6 Typical Drain to Source ON Resistance vs Drain Current**



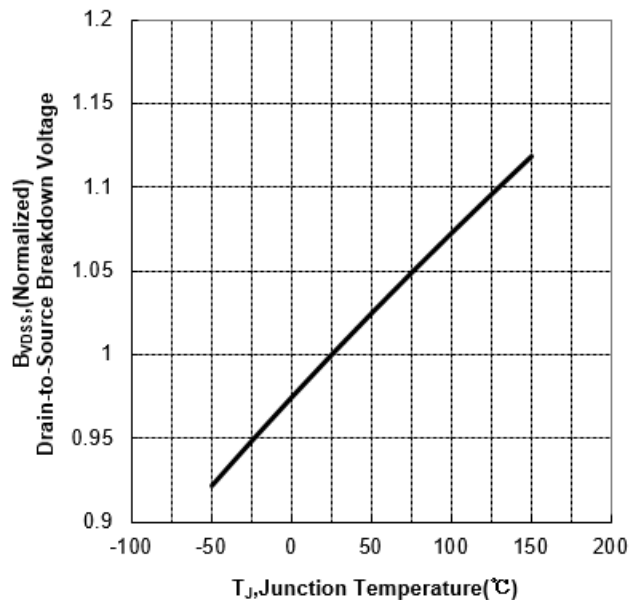
**Figure 7 Typical Drain to Source on Resistance vs Junction Temperature**



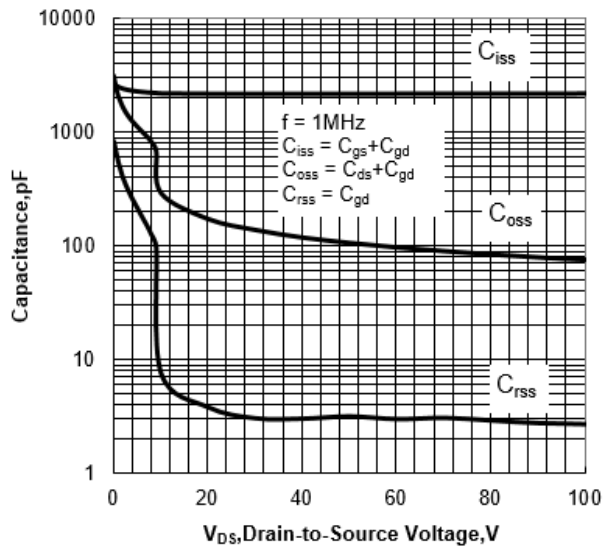
**Figure 8 Typical Threshold Voltage vs Junction Temperature**



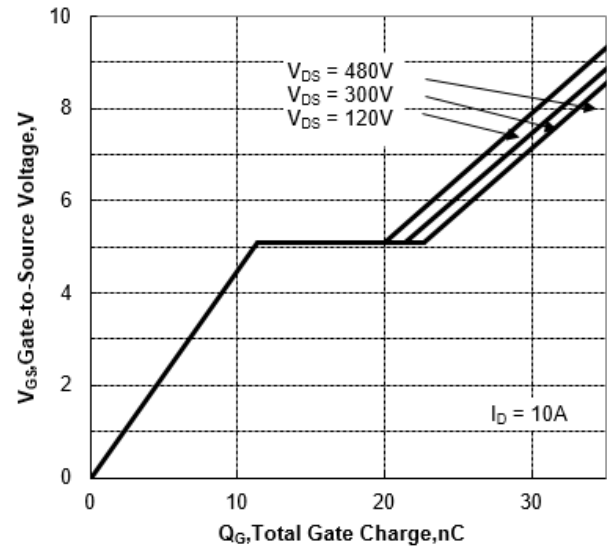
**Figure 9 Typical Breakdown Voltage vs Junction Temperature**



**Figure 10 Typical Capacitance vs Drain to Source Voltage**



**Figure 11 Typical Gate Charge vs Gate to Source Voltage**





## 6. Test Circuit and Waveform

Figure 12 Gate Charge Test Circuit

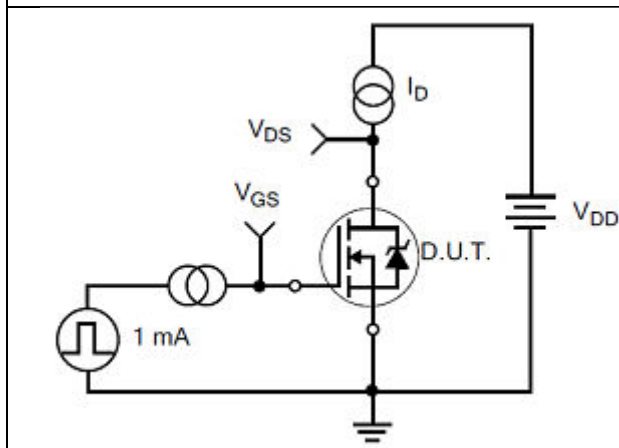


Figure 13 Gate Charge Waveforms

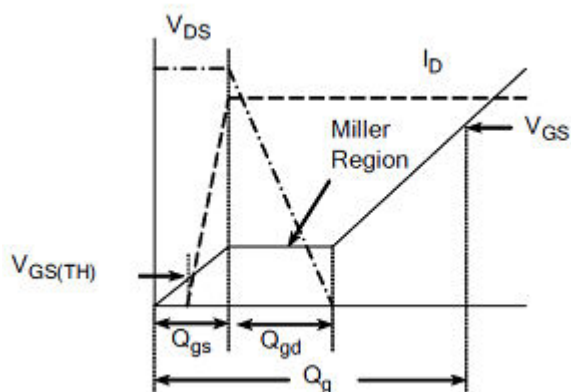


Figure 14 Resistive Switching Test Circuit

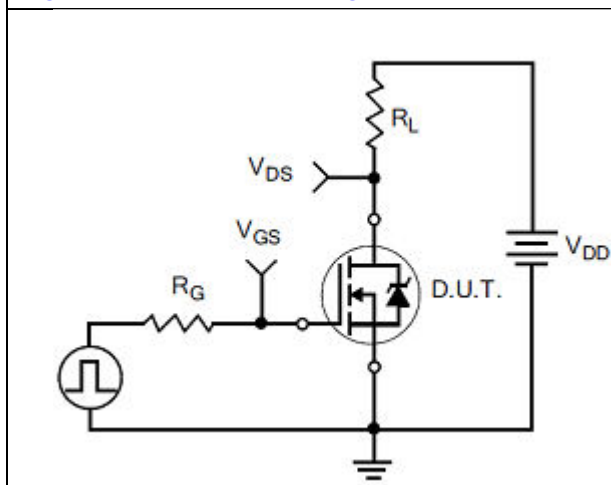


Figure 15 Resistive Switching Waveforms

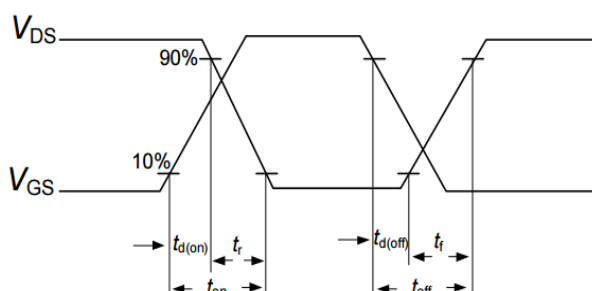


Figure 16 Diode Reverse Recovery Test Circuit

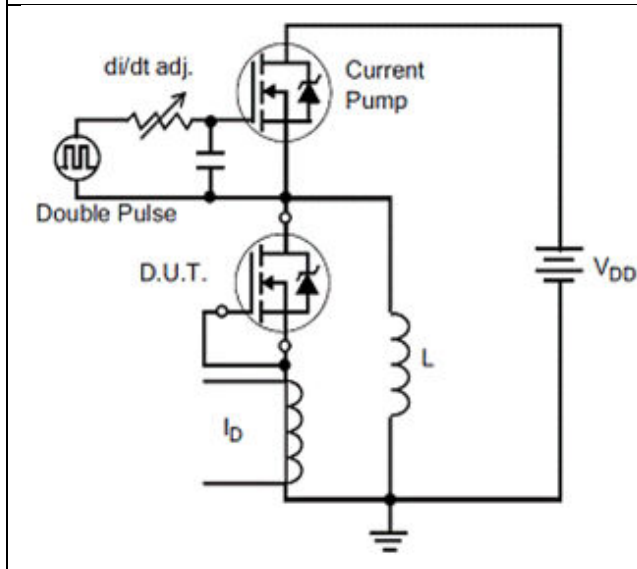


Figure 17 Diode Reverse Recovery Waveform

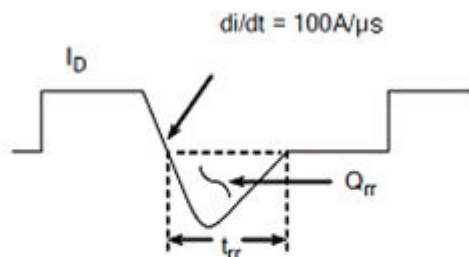


Figure 18 Unclamped Inductive Switching Test Circuit

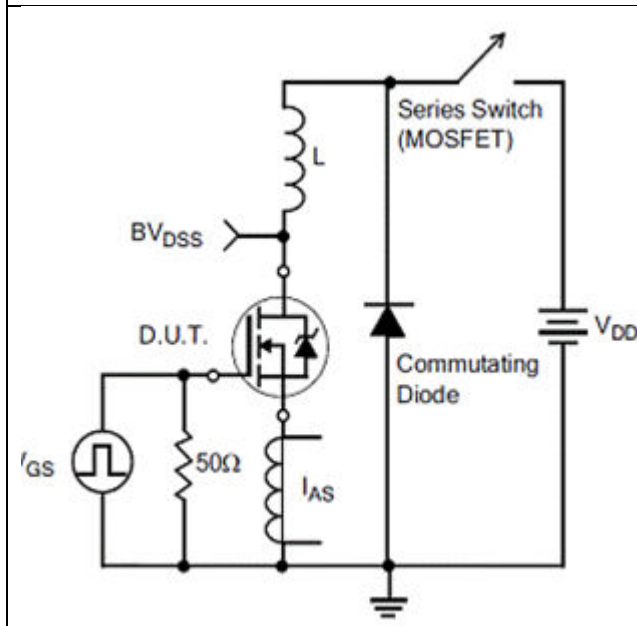
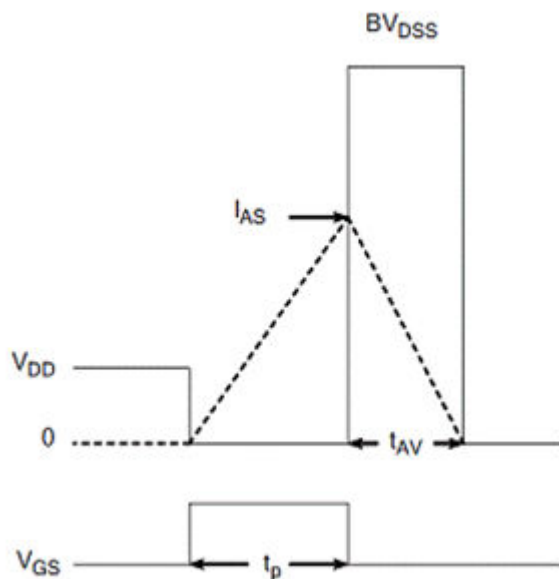
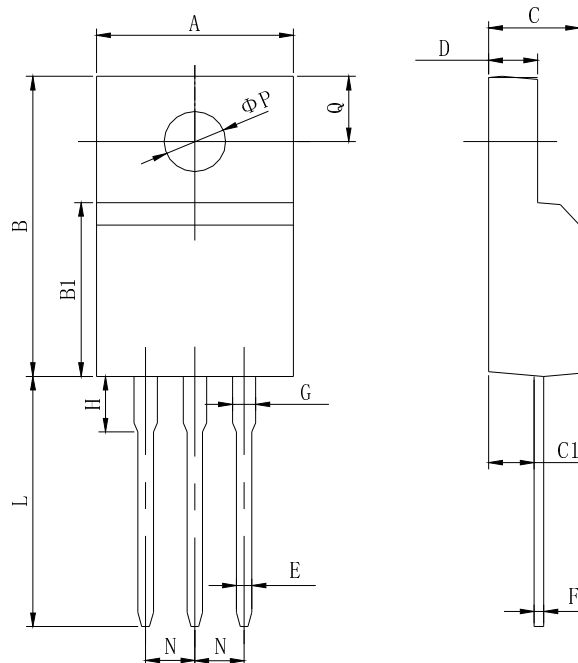


Figure 19 Unclamped Inductive Switching Waveform

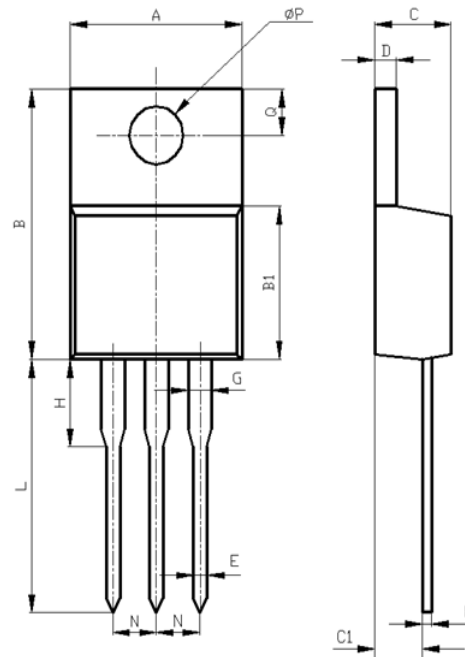


## 7. Package Description



| Items | Values(mm) |      |
|-------|------------|------|
|       | MIN        | MAX  |
| A     | 9.60       | 10.4 |
| B     | 15.4       | 16.2 |
| B1    | 8.90       | 9.50 |
| C     | 4.30       | 4.90 |
| C1    | 2.10       | 3.00 |
| D     | 2.40       | 3.00 |
| E     | 0.60       | 1.00 |
| F     | 0.30       | 0.60 |
| G     | 1.12       | 1.42 |
| H     | 3.40       | 3.80 |
|       | 1.60       | 2.90 |
| L     | 12.0       | 14.0 |
| N     | 2.34       | 2.74 |
| Q     | 3.15       | 3.55 |
| ϕ P   | 2.90       | 3.30 |

TO-220F Package



| Items | Values(mm) |      |
|-------|------------|------|
|       | MIN        | MAX  |
| A     | 9.60       | 10.6 |
| B     | 15.0       | 16.0 |
| B1    | 8.90       | 9.50 |
| C     | 4.30       | 4.80 |
| C1    | 2.30       | 3.10 |
| D     | 1.20       | 1.40 |
| E     | 0.70       | 0.90 |
| F     | 0.30       | 0.60 |
| G     | 1.17       | 1.37 |
| H     | 2.70       | 3.80 |
| L     | 12.6       | 14.8 |
| N     | 2.34       | 2.74 |
| Q     | 2.40       | 3.00 |
| Φ P   | 3.50       | 3.90 |

TO-220 Package

**NOTE:**

1. Exceeding the maximum ratings of the device in performance may cause damage to the device, even the permanent failure, which may affect the dependability of the machine. Please do not exceed the absolute maximum ratings of the device when circuit designing.
2. When installing the heat sink, please pay attention to the torsional moment and the smoothness of the heat sink.
3. MOSFETs is the device which is sensitive to the static electricity, it is necessary to protect the device from being damaged by the static electricity when using it.
4. Shanghai Belling reserves the right to make changes in this specification sheet and is subject to change without prior notice.

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