

# BCW120N32W1

## N-Channel Silicon Carbide PowerMOSFET

1200 V, 69 A, 32 mΩ



### Features

- High switching speed with a low gate charge
- Low On-Resistance with High Blocking Voltage
- Low Capacitances with High-Speed switching
- Low reverse recovery (Qrr)
- Halogen Free, and RoHS Compliant

| $BV_{DSS}, T_c=25^{\circ}C$ | $I_D, T_c=25^{\circ}C$ | $R_{DS(on),typ}$ | $Q_{g,typ}$ |
|-----------------------------|------------------------|------------------|-------------|
| 1200 V                      | 69 A                   | 32 mΩ            | 121nC       |

### Benefits

- Reduce switching losses
- Increased system Switching
- Frequency Increased power density
- Reduction of heat sink requirements



### Applications

- Switch mode power supplies
- Renewable energy
- Motor drives
- High voltage DC/DC converters



### Absolute Maximum Ratings (T<sub>J</sub> = 25°C unless otherwise noted)

| Symbol                            | Parameter                               |                                                                  | Value      | Unit |
|-----------------------------------|-----------------------------------------|------------------------------------------------------------------|------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage                 |                                                                  | 1200       | V    |
| V <sub>GS</sub>                   | Gate to Source Voltage (DC)             |                                                                  | -10 / +25  | V    |
| V <sub>GSop</sub>                 | Recommended Operation Value             |                                                                  | -4 / +20   | V    |
| I <sub>D</sub>                    | Drain Current                           | Continuous (V <sub>GS</sub> =18V, T <sub>C</sub> = 25°C)         | 69         | A    |
|                                   |                                         | Continuous (V <sub>GS</sub> =18V, T <sub>C</sub> = 100°C)        | 49         |      |
| I <sub>DM</sub>                   | Drain Current                           | Pulse with t <sub>p</sub> limited by T <sub>Jmax</sub> at 1 ms   | 140        | A    |
|                                   |                                         | Pulse with t <sub>p</sub> limited by T <sub>Jmax</sub> at 100 μs | 331        |      |
| P <sub>D</sub>                    | Power Dissipation                       |                                                                  | 348        | W    |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range |                                                                  | -55 to 175 | °C   |

### Thermal Characteristics

| Symbol            | Parameter                                                   | Value | Unit |
|-------------------|-------------------------------------------------------------|-------|------|
| R <sub>θJC</sub>  | Thermal Resistance, Junction to Case, Max.                  | 0.43  | °C/W |
| R <sub>θJA</sub>  | Thermal Resistance, Junction to Ambient, Max.               | 40    |      |
| T <sub>sold</sub> | Soldering temperature, wave soldering only allowed at leads | 260   | °C   |

**Electrical Characteristics** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

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

**Off Characteristics**

|            |                                   |                                                     |      |   |     |               |
|------------|-----------------------------------|-----------------------------------------------------|------|---|-----|---------------|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$ | 1200 | - | -   | V             |
| $I_{DSS}$  | Zero Gate Voltage Drain Current   | $V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$       | -    | 1 | 50  | $\mu\text{A}$ |
| $I_{GSS}$  | Gate-Source Leakage Current       | $V_{GS} = 18\text{ V}, V_{DS} = 0\text{ V}$         | -    | - | 250 | nA            |

**On Characteristics**

|              |                                      |                                                                     |   |     |    |    |
|--------------|--------------------------------------|---------------------------------------------------------------------|---|-----|----|----|
| $V_{GS(th)}$ | Gate Threshold Voltage               | $V_{GS} = V_{DS}, I_{DS} = 11.5\text{ mA}$                          | - | 2.9 | -  | V  |
|              |                                      | $V_{GS} = V_{DS}, I_{DS} = 11.5\text{ mA}, T_J = 175^\circ\text{C}$ | - | 2.0 | -  |    |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 18\text{ V}, I_D = 40\text{ A}$                           | - | 32  | 48 | mΩ |
|              |                                      | $V_{GS} = 20\text{ V}, I_D = 40\text{ A}$                           | - | 30  | -  |    |
|              |                                      | $V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 175^\circ\text{C}$  | - | 58  | -  |    |
|              |                                      | $V_{GS} = 20\text{ V}, I_D = 40\text{ A}, T_J = 175^\circ\text{C}$  | - | 52  | -  |    |
| $g_{fs}$     | Transconductance                     | $V_{GS} = 18\text{ V}, I_D = 40\text{ A}$                           | - | 26  | -  | S  |
|              |                                      | $V_{GS} = 20\text{ V}, I_D = 40\text{ A}, T_J = 175^\circ\text{C}$  | - | 22  | -  |    |

**Dynamic Characteristics**

|              |                               |                                                                                             |   |      |   |    |
|--------------|-------------------------------|---------------------------------------------------------------------------------------------|---|------|---|----|
| $C_{iss}$    | Input Capacitance             | $V_{DS} = 1000\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$ | - | 2812 | - | pF |
| $C_{oss}$    | Output Capacitance            |                                                                                             | - | 111  | - |    |
| $C_{rss}$    | Reverse Capacitance           |                                                                                             | - | 7    | - |    |
| $Q_{g(tot)}$ | Total Gate Charge             | $V_{DD} = 800\text{ V}, V_{GS} = -4/18\text{ V}, I_D = 40\text{ A}$                         | - | 121  | - | nC |
| $Q_{gs}$     | Gate to Source Charge         |                                                                                             | - | 20.9 | - |    |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |                                                                                             | - | 23.2 | - |    |
| $R_G$        | Internal Gate Resistance      | $f = 1\text{ MHz}, V_{AC} = 25\text{ mV open drain}$                                        | - | 1    | - | Ω  |

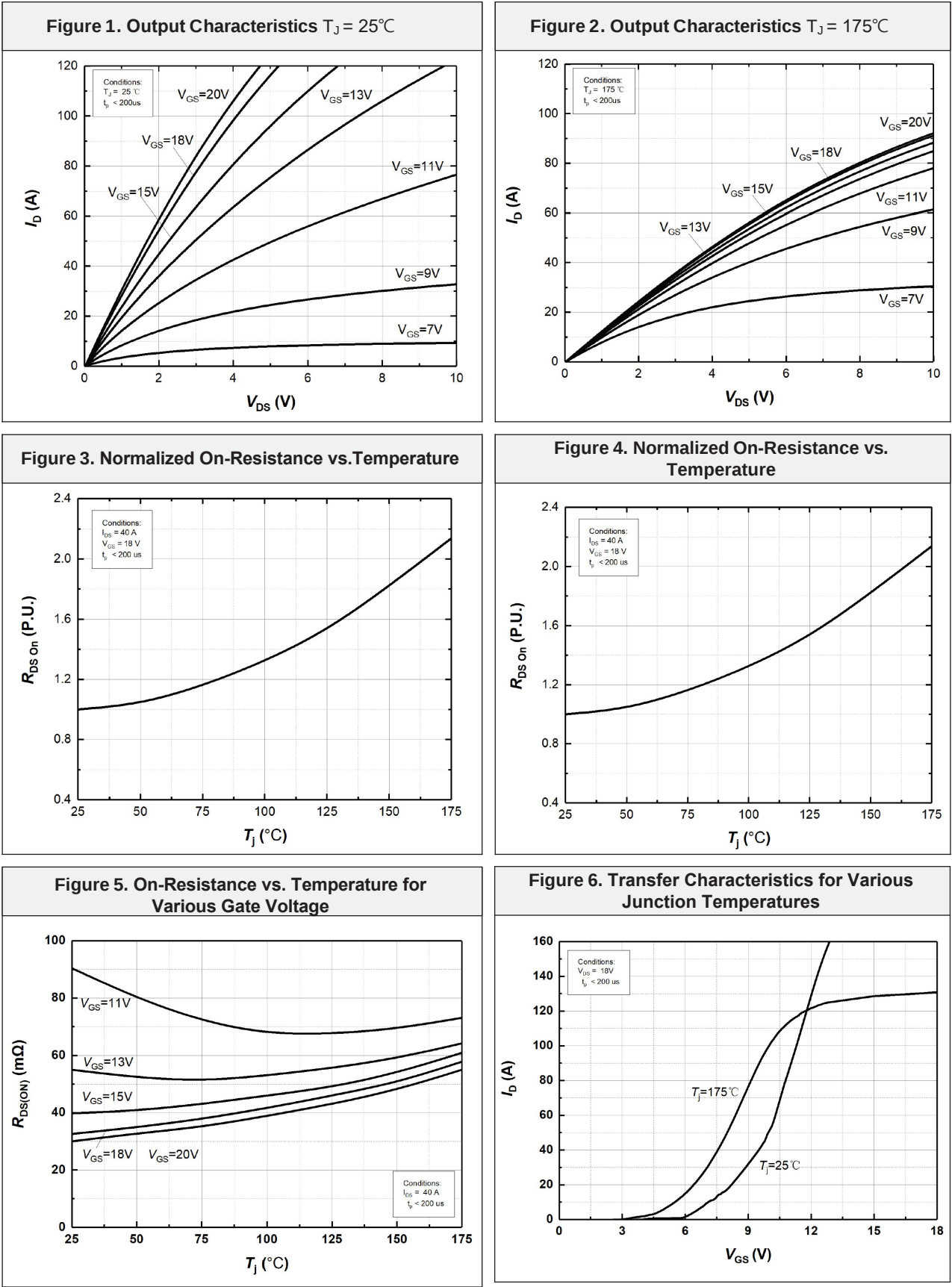
**Switching Characteristics**

|              |                           |                                                                                                                                         |   |     |   |               |
|--------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---|-----|---|---------------|
| $t_{d(on)}$  | Turn-On Delay Time        | $V_{DD} = 800\text{ V}, V_{GS} = -4/18\text{ V},$<br>$I_D = 40\text{ A}, R_{G(ext)} = 5\text{ }\Omega,$<br>$L = 276\text{ }\mu\text{H}$ | - | 23  | - | ns            |
| $t_r$        | Turn-On Rise Time         |                                                                                                                                         | - | 9   | - |               |
| $t_{d(off)}$ | Turn-Off Delay Time       |                                                                                                                                         | - | 27  | - |               |
| $t_f$        | Turn-Off Fall Time        |                                                                                                                                         | - | 11  | - |               |
| $E_{on}$     | Turn-on Switching Energy  |                                                                                                                                         | - | 352 | - | $\mu\text{J}$ |
| $E_{off}$    | Turn-off Switching Energy |                                                                                                                                         | - | 170 | - |               |

**Source-Drain Diode Characteristics**

|           |                               |                                                                                                           |   |     |   |    |
|-----------|-------------------------------|-----------------------------------------------------------------------------------------------------------|---|-----|---|----|
| $I_S$     | Diode Forward Current         | $V_{GS} = -4\text{ V}$                                                                                    | - | 72  | - | A  |
| $V_{SD}$  | Diode Forward Voltage         | $V_{GS} = -4\text{ V}, I_{SD} = 20\text{ A}$                                                              | - | 3.9 | - | V  |
|           |                               | $V_{GS} = -4\text{ V}, I_{SD} = 20\text{ A}, T_J = 175^\circ\text{C}$                                     | - | 3.3 | - |    |
| $t_{rr}$  | Reverse Recovery Time         | $V_R = 800\text{ V}, V_{GS} = -4\text{ V}, I_{SD} = 40\text{ A},$<br>$dif/dt = 3800\text{ A}/\mu\text{s}$ | - | 31  | - | ns |
| $Q_{rr}$  | Reverse Recovery Charge       |                                                                                                           | - | 281 | - | nC |
| $I_{rrm}$ | Peak Reverse Recovery Current |                                                                                                           | - | 18  | - | A  |

Typical Performance Characteristics



## Typical Performance Characteristics

Figure 7. Body Diode Characteristics at  $T_J = 25^\circ\text{C}$

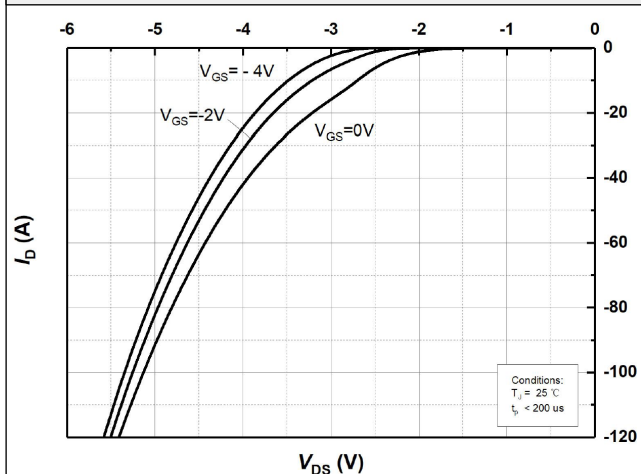


Figure 8. Body Diode Characteristics at  $T_J = 175^\circ\text{C}$

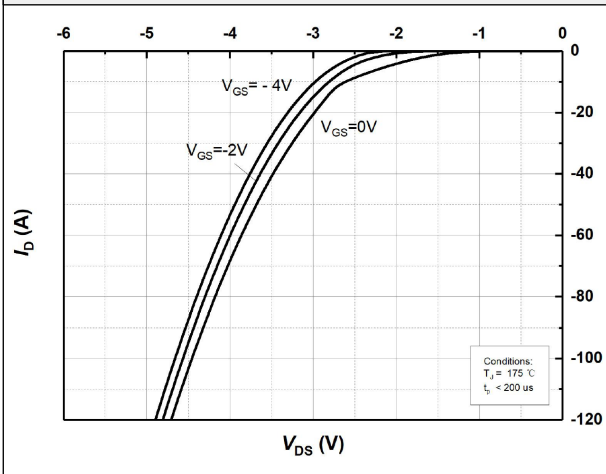


Figure 9. Threshold Voltage vs. Temperature

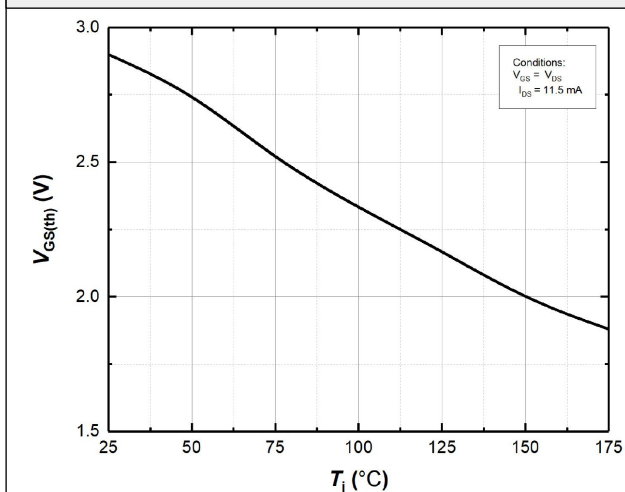


Figure 10. Gate Charge Characteristics

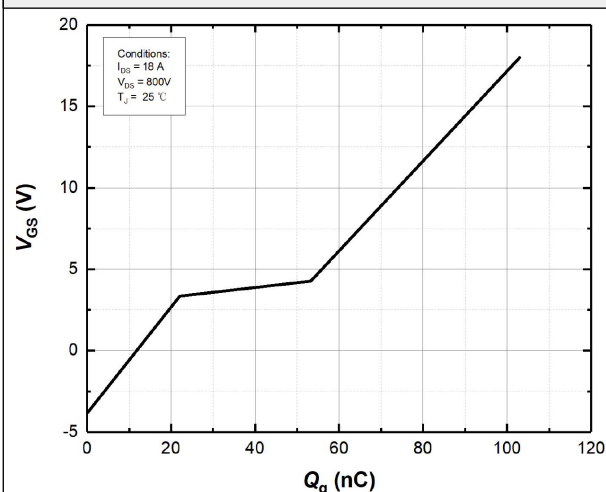


Figure 11. 3rd Quadrant Characteristic at  $T_J = 25^\circ\text{C}$

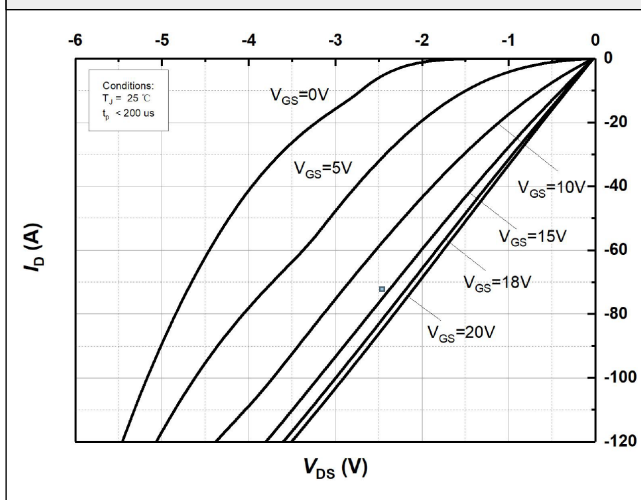
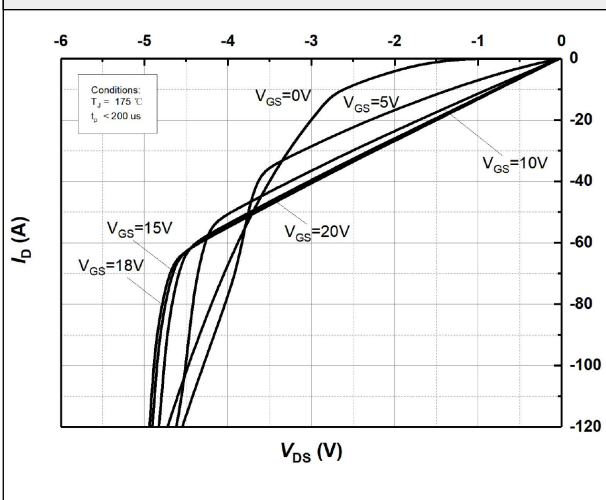


Figure 12. 3rd Quadrant Characteristic at  $T_J = 175^\circ\text{C}$



Typical Performance Characteristics

Figure 13. Capacitances vs. Drain-Source Voltage

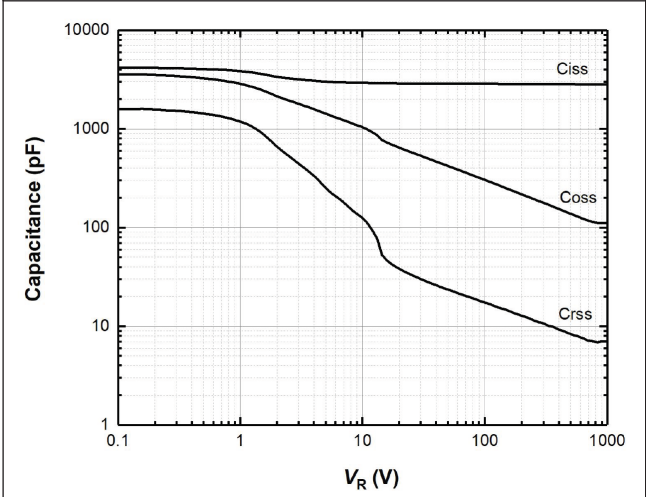


Figure 14. Continuous Drain Current Derating vs. Case Temperature

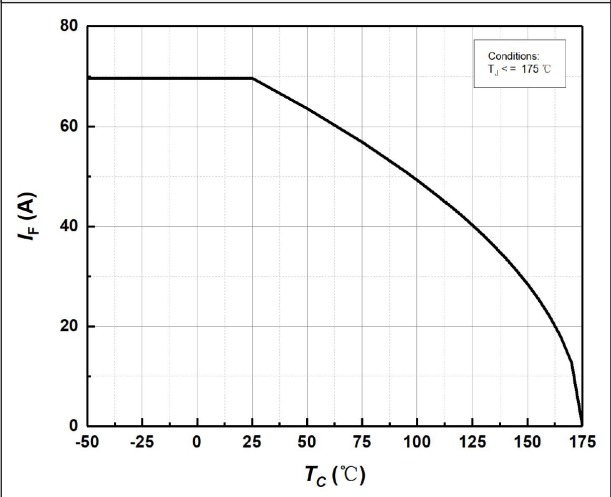


Figure 15. Transient Thermal Impedance

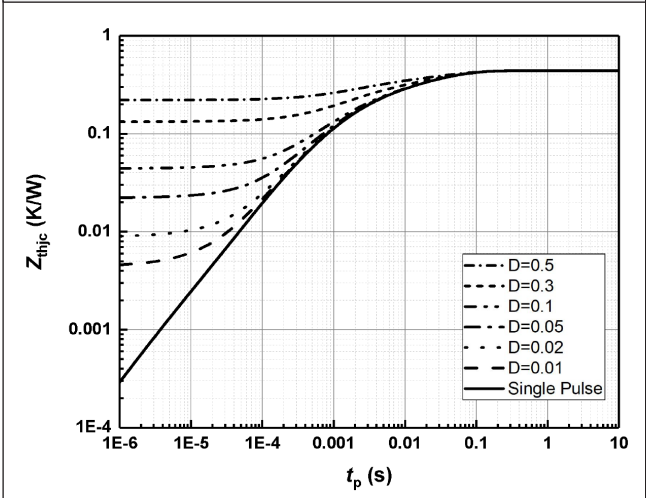


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

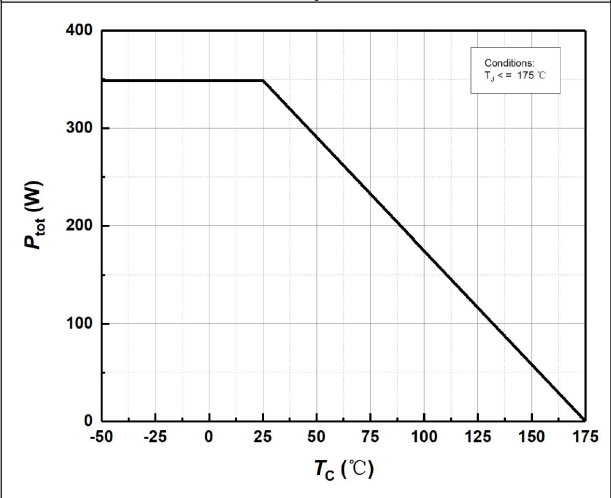


Figure 17. Output Capacitor Stored Energy

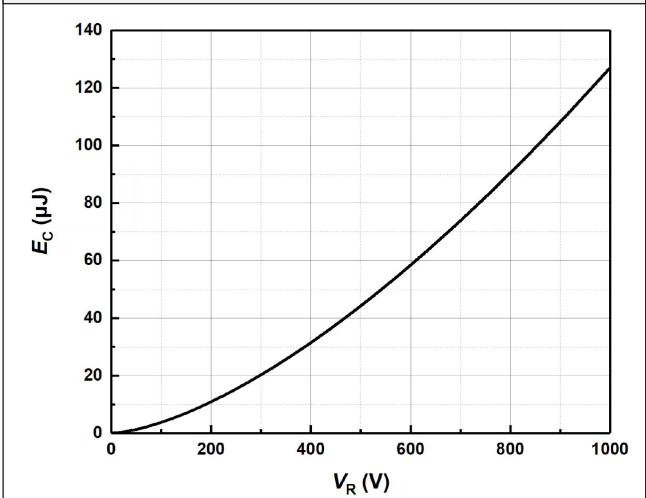
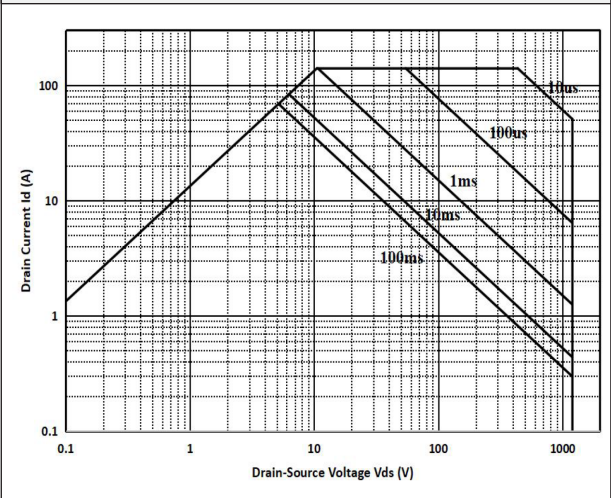
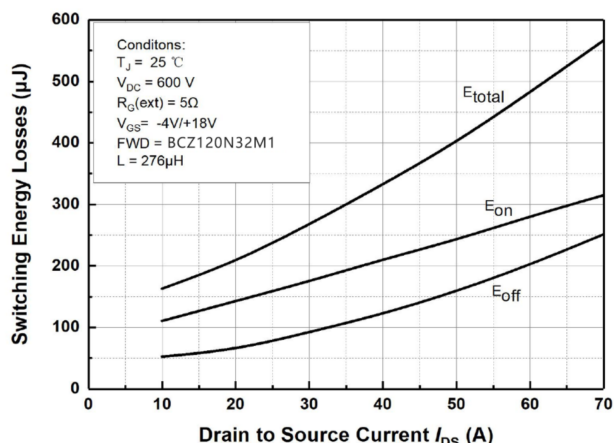


Figure 18. Safe Operating Area

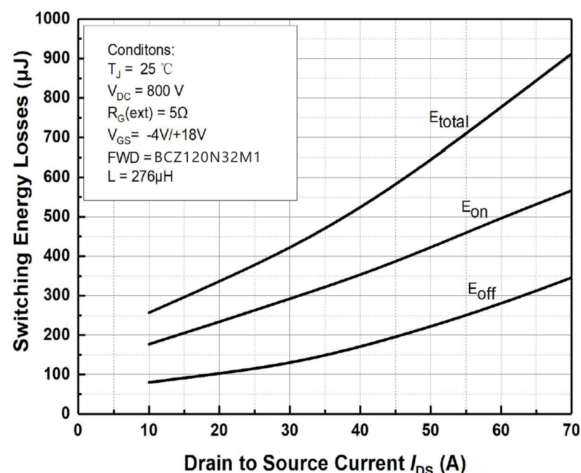


## Typical Performance Characteristics

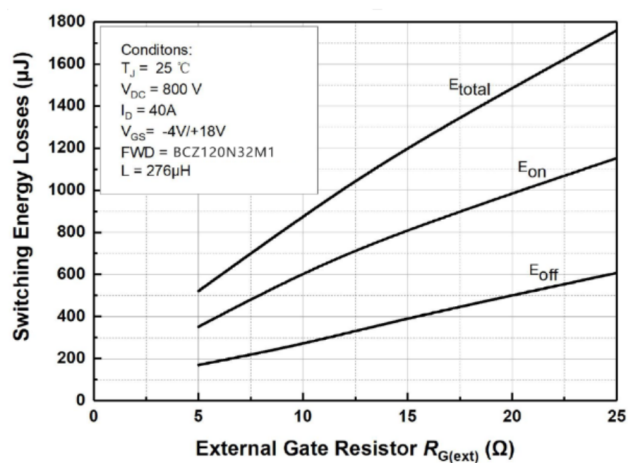
**Figure 19. Clamped Inductive Switching Energy vs. Drain Current( $V_{DD} = 600V$ )**



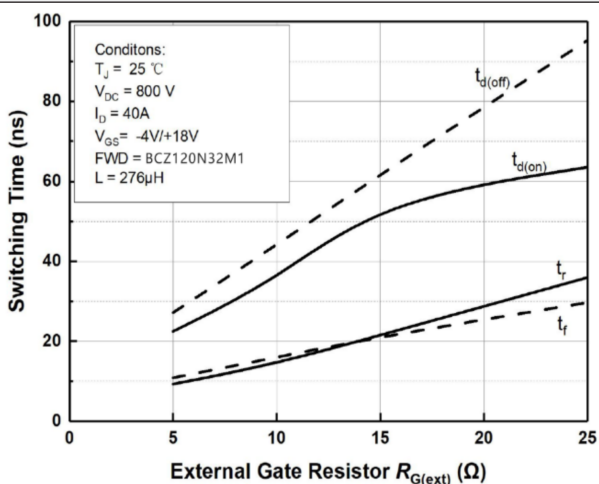
**Figure 20. Clamped Inductive Switching Energy vs. Drain Current( $V_{DD} = 800V$ )**



**Figure 21. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$**

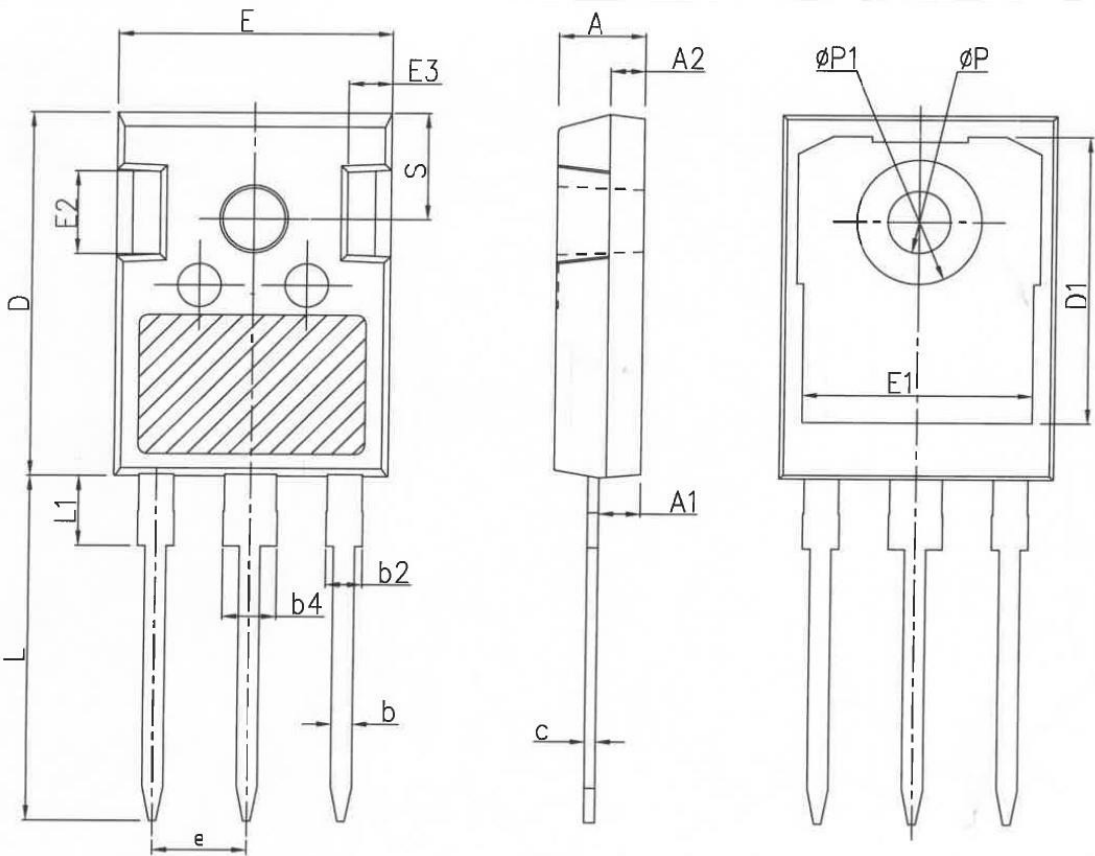


**Figure 22. On-Resistance vs. Temperature For**



Package Outlines

TO247-3



COMMON DIMENSIONS

| SYMBOL | mm      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| A      | 4.80    | 5.00  | 5.20  |
| A1     | 2.21    | 2.41  | 2.59  |
| A2     | 1.85    | 2.00  | 2.15  |
| b      | 1.11    | 1.21  | 1.36  |
| b2     | 1.91    | 2.01  | 2.21  |
| b4     | 2.91    | 3.01  | 3.21  |
| c      | 0.51    | 0.61  | 0.75  |
| D      | 20.70   | 21.00 | 21.30 |
| D1     | 16.25   | 16.55 | 16.85 |
| E      | 15.50   | 15.80 | 16.10 |
| E1     | 13.00   | 13.30 | 13.60 |
| E2     | 4.80    | 5.00  | 5.20  |
| E3     | 2.30    | 2.50  | 2.70  |
| e      | 5.44BSC |       |       |
| L      | 19.62   | 19.92 | 20.22 |
| L1     | -       | -     | 4.30  |
| ΦP     | 3.40    | 3.60  | 3.80  |
| ΦP1    | -       | -     | 7.30  |
| S      | 6.15BSC |       |       |

\*Dimensions in millimeters

Package Marking and Ordering Information

| Part Number | Top Marking | Package  | Packing Method | Quantity |
|-------------|-------------|----------|----------------|----------|
| BCW120N32W1 | BCW120N32W1 | TO247-3L | Tube           | 30 units |

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