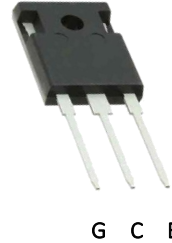


650V 50A CoolFAST™ 7 Technology IGBT

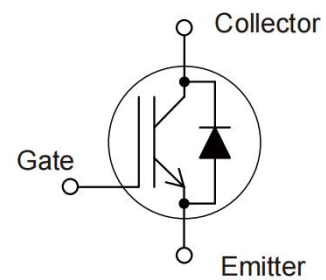
Features:

- Low Switching Power Loss
- Low Switching Surge and Noise
- Advanced Field Stop Technology
- Low EMI
- Maximum Junction Temperature 175°C
- Qualified According to JEDEC For Target Applications
- Pb-free Lead Plating, Halogen-free Mold Compound, RoHS Compliant



Applications:

- Industrial UPS
- Welding Machine
- Solar Converters
- Energy Storage
- EV Charger



Key Performance and Package Parameters

| Type | V _{CE} | I _C | V _{CEsat} , T _{vj} =25°C | T _{vjmax} | Marking | Package |
|-------------|-----------------|----------------|--|--------------------|-------------|---------|
| DKW50N65DF7 | 650V | 50A | 1.6V | 175°C | DKW50N65DF7 | TO247-3 |

Maximum Ratings and Characteristics

Absolute Maximum Ratings at T_{vj}= 25°C (unless otherwise specified)

| Items | Symbols | Value | Units |
|--|---------------------|------------|-------|
| Collector-emitter voltage | V _{CES} | 650 | V |
| Gate-emitter voltage | V _{GES} | ±20 | V |
| Transient gate-emitter voltage (t _p ≤ 10μs, D < 0.010) | | ±30 | |
| DC collector current, limited by T _{vjmax} | I _C | 90 | A |
| T _C = 25°C | | | |
| T _C = 100°C | | | |
| Pulsed collector current, t _p limited by T _{vjmax} | I _{CP} | 200 | A |
| Diode forward current, limited by T _{vjmax} | I _F | 110 | A |
| T _C = 25°C | | | |
| T _C = 100°C | | | |
| Diode Pulsed collector current, t _p limited by T _{vjmax} | I _{FP} | 200 | A |
| IGBT max. power dissipation | P _{D_IGBT} | 307 | W |
| FWD max. power dissipation | P _{D_FWD} | 274 | W |
| Operating junction temperature | T _{vj} | -40 ~ +175 | °C |
| Storage temperature | T _{stg} | -55 ~ +175 | °C |

Electrical Characteristics at $T_{vj}= 25^{\circ}\text{C}$ (unless otherwise specified)

| Description | Symbols | Conditions | Characteristics | | | Unit |
|--------------------------------------|---------------|---|-----------------|------|-----------|---------------|
| | | | Min | Typ | Max | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}= 0\text{V}, I_C= 0.25\text{mA}$ | 650 | - | - | V |
| Zero gate voltage collector current | I_{CES} | $V_{CE}= 650\text{V}, V_{GE}= 0\text{V}$ | - | - | 250 | μA |
| Gate-emitter leakage current | I_{GES} | $V_{CE}= 0\text{V}, V_{GE}= \pm 20\text{V}$ | - | - | ± 200 | nA |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{CE}= V_{GE}, I_C= 250\mu\text{A}$ | 5.0 | 5.8 | 6.6 | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}= 15\text{V}, I_C= 50\text{A}$ | - | 1.6 | 2.0 | V |
| | | $T_{vj}= 25^{\circ}\text{C}$ $T_{vj}= 175^{\circ}\text{C}$ | - | 2.2 | - | |
| Input capacitance | C_{ies} | $V_{CE}= 25\text{V}, V_{GE}= 0\text{V}$ $f= 1\text{MHz}$ | - | 6800 | - | pF |
| Output capacitance | C_{oes} | | - | 200 | - | pF |
| Reverse transfer capacitance | C_{res} | | - | 72 | - | pF |
| Gate charge | Q_G | $V_{CC}= 520\text{V}, I_C= 50\text{A}, V_{GE}= 15\text{V}$ | - | 215 | - | nC |
| Forward voltage drop | V_F | $I_F= 50\text{A}$ | - | 2.1 | 3.0 | V |
| | | $T_{vj}= 25^{\circ}\text{C}$ $T_{vj}= 175^{\circ}\text{C}$ | - | 1.5 | - | |

Switching Characteristics at $T_{vj}= 25^{\circ}\text{C}$

| Description | Symbols | Conditions | Characteristics | | | Unit |
|-------------------------------------|--------------|---|-----------------|------|-----|---------------|
| | | | Min | Typ | Max | |
| IGBT Characteristics | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}= 400\text{V}$ $I_C= 50\text{A}$ $V_{GE}= 15\text{V}$ $R_G= 10\Omega$ Inductive load | - | 50 | - | ns |
| Rise time | t_r | | - | 133 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 195 | - | ns |
| Fall time | t_f | | - | 78 | - | ns |
| Turn-on energy | E_{on} | | - | 2.6 | - | mJ |
| Turn-off energy | E_{off} | | - | 1.1 | - | mJ |
| Total switching energy | E_{ts} | | - | 3.7 | - | mJ |
| Diode Characteristics | | | | | | |
| Diode reverse recovery time | t_{rr} | $V_{CC}= 400\text{V}$ | - | 80 | - | ns |
| Diode reverse recovery charge | Q_{rr} | $I_F= 50\text{A}$ | - | 0.32 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | $di_F/dt= 500\text{A}/\mu\text{s}$ | - | 7.7 | - | A |

Switching Characteristics at $T_{vj}= 175^{\circ}\text{C}$

| Description | Symbols | Conditions | Characteristics | | | Unit |
|-------------------------------------|--------------|---|-----------------|------|-----|---------------|
| | | | Min | Typ | Max | |
| IGBT Characteristics | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}= 400\text{V}$ $I_C= 50\text{A}$ $V_{GE}= 15\text{V}$ $R_G= 10\Omega$ Inductive load | - | 45 | - | ns |
| Rise time | t_r | | - | 137 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 218 | - | ns |
| Fall time | t_f | | - | 95 | - | ns |
| Turn-on energy | E_{on} | | - | 2.7 | - | mJ |
| Turn-off energy | E_{off} | | - | 1.2 | - | mJ |
| Total switching energy | E_{ts} | | - | 3.9 | - | mJ |
| Diode Characteristics | | | | | | |
| Diode reverse recovery time | t_{rr} | $V_{CC}= 400\text{V}$ | - | 124 | - | ns |
| Diode reverse recovery charge | Q_{rr} | $I_F= 50\text{A}$ | - | 1.92 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | $di_F/dt= 500\text{A}/\mu\text{s}$ | - | 27.3 | - | A |

Thermal Resistance

| Items | Symbols | Characteristics | | | Unit |
|---|---------------|-----------------|-----|------|-------|
| | | Min | Typ | Max | |
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | - | - | 50 | °C /W |
| Thermal resistance, IGBT junction to case | $R_{th(j-c)}$ | - | - | 0.49 | |
| Thermal resistance, diodes junction to case | $R_{th(j-c)}$ | - | - | 0.55 | |

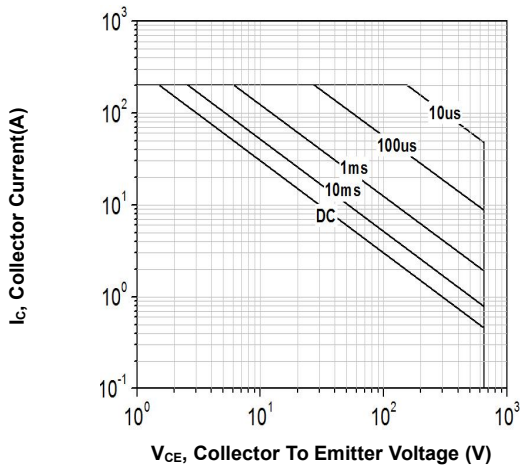


Figure 1. Forward bias safe operating area
($D = 0$, $T_C = 25^\circ\text{C}$, $T_{vj} \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$)

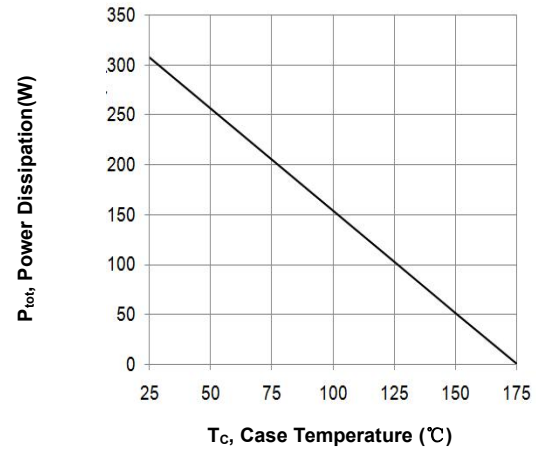


Figure 2. Power dissipation vs. case temperature
($T_{vj} \leq 175^\circ\text{C}$)

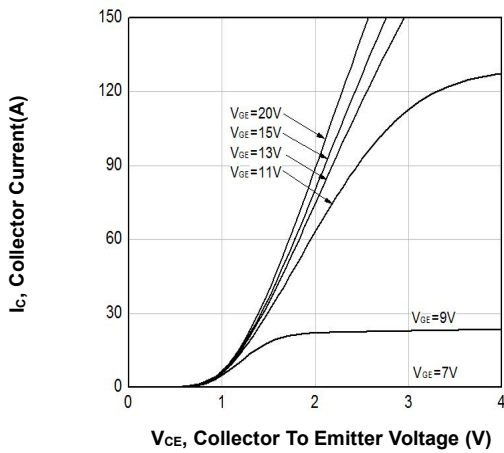


Figure 3. Typical output characteristic
($T_{vj} = 25^\circ\text{C}$)

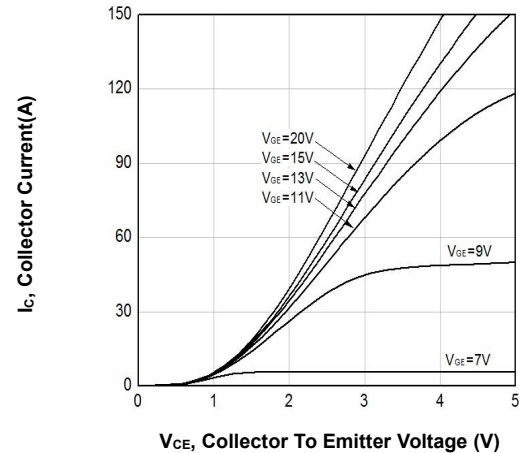


Figure 4. Typical output characteristic
($T_{vj} = 175^\circ\text{C}$)

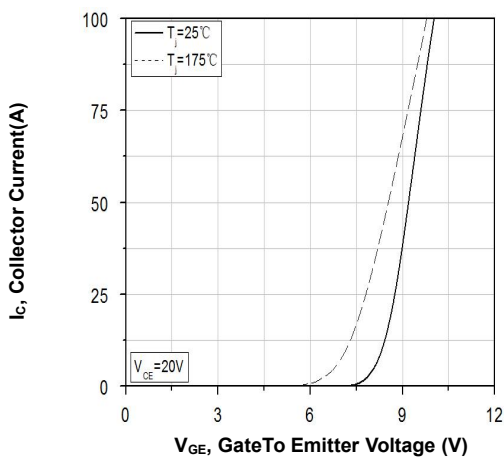


Figure 5. Typical transfer characteristic
($V_{CE} = 20\text{V}$)

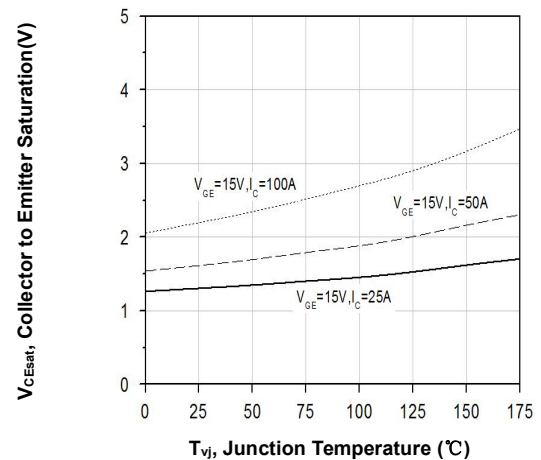


Figure 6. Typical collector-emitter saturation voltage vs. T_{vj} ($V_{GE} = 20\text{V}$)

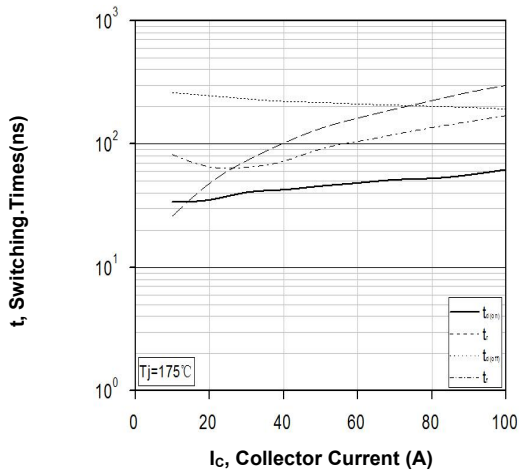


Figure 7. Typical switching times vs. collector current (Ind. load, $T_{vj} = 175^{\circ}\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $R_G = 10\Omega$)

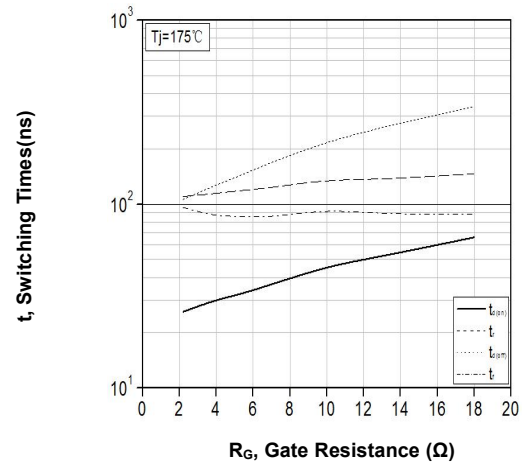


Figure 8. Typical switching times vs. gate resistor (Ind. Load, $T_{vj} = 175^{\circ}\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $I_C = 50\text{A}$)

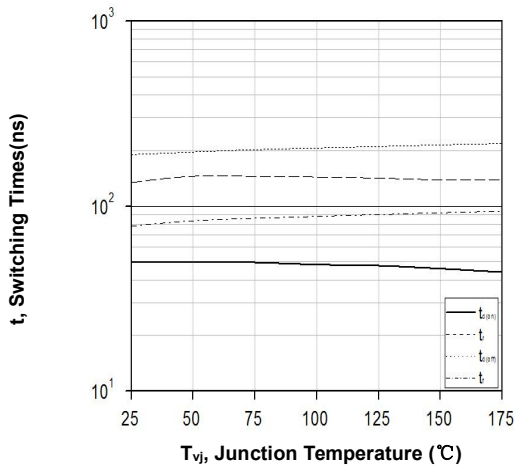


Figure 9. Typical switching times vs. T_{vj} (Ind. Load, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $I_C = 50\text{A}$, $R_G = 10\Omega$)

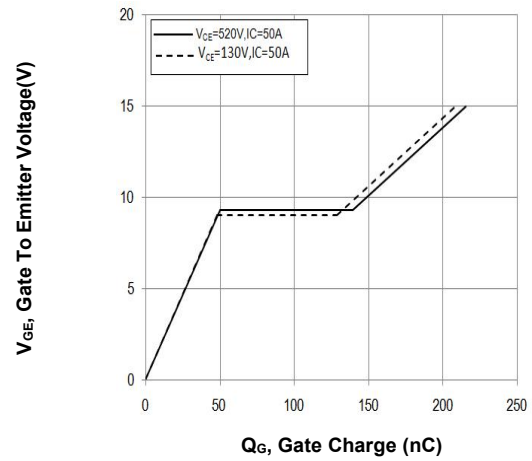


Figure 10. Typical gate charge ($I_C = 50\text{A}$)

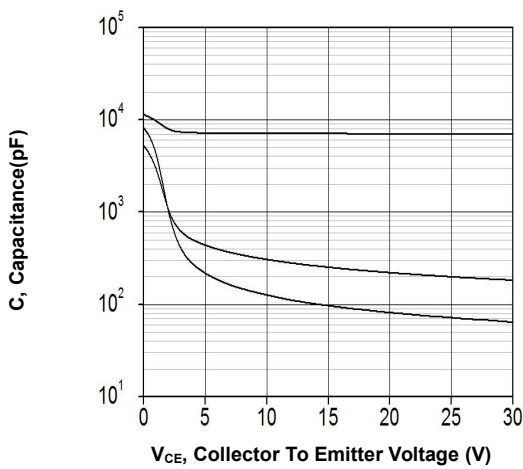


Figure 11. Typical capacitance vs. collector-emitter voltage ($V_{GE} = 0\text{V}$, $f = 1\text{MHz}$)

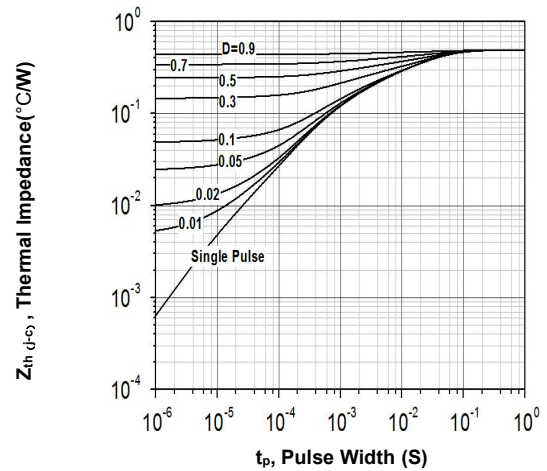


Figure 12. IGBT transient thermal impedance ($D = t_p/T$)

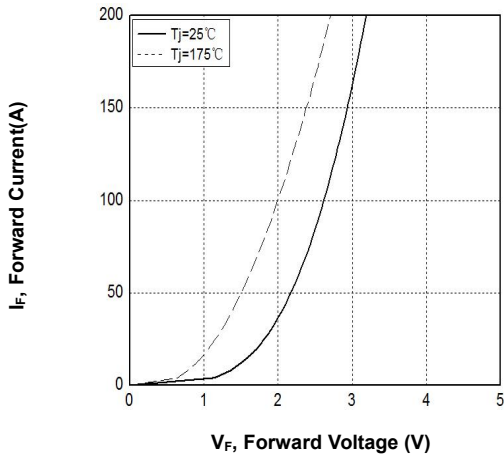


Figure 13. Typical diode forward current vs. forward voltage

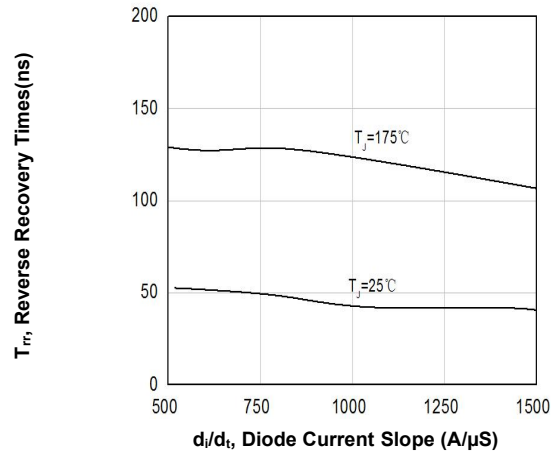


Figure 14. Typical reverse recovery time vs. diode current slope ($V_R = 400V$)

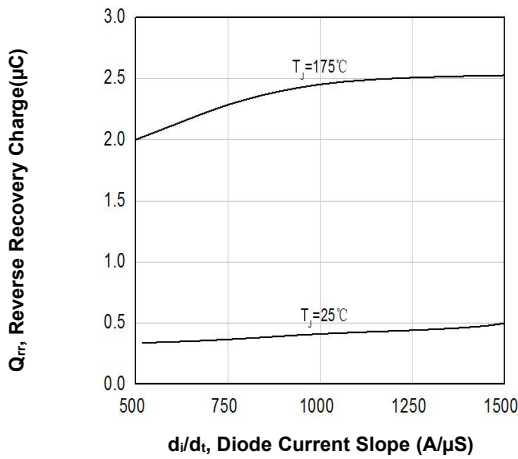


Figure 15. Typical reverse recovery charge vs. diode current slope ($V_R = 400V$)

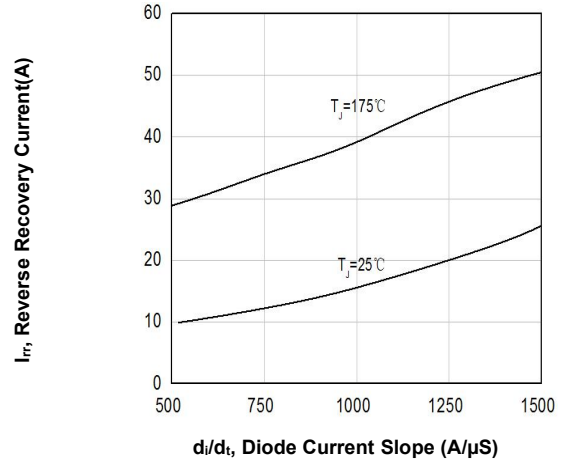
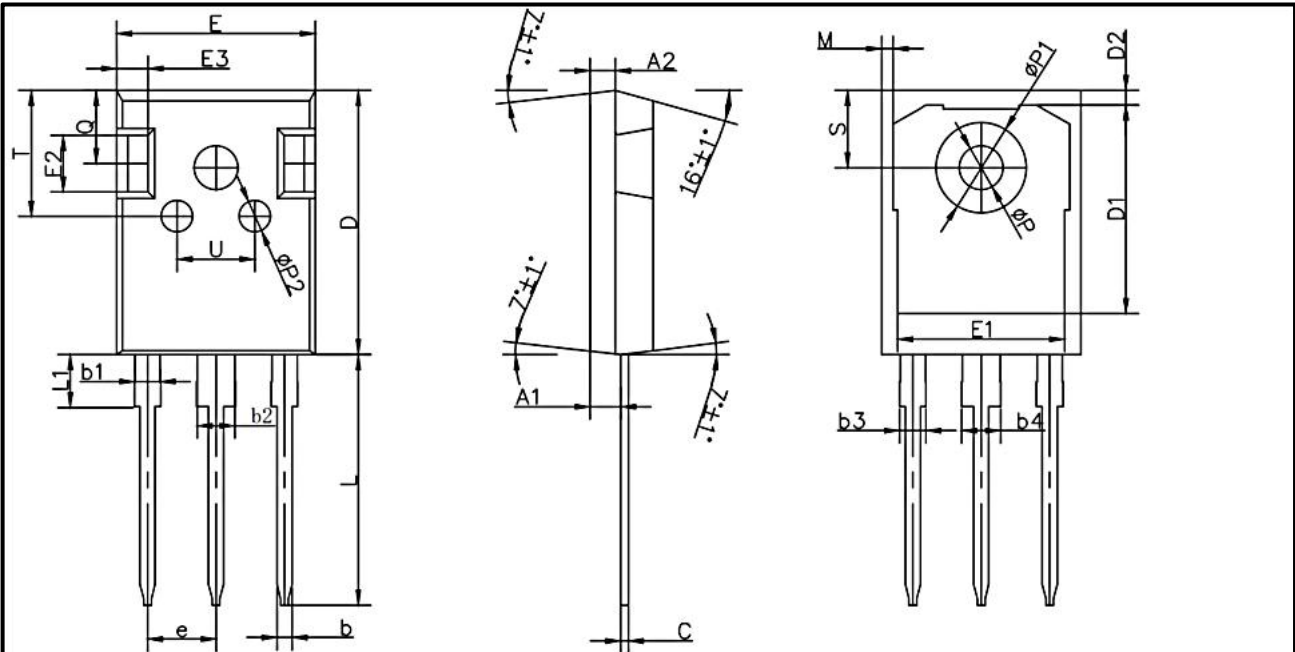


Figure 16. Typical reverse recovery current vs. diode current slope ($V_R = 400V$)

TO247-3 Package Outline



| TO247-3L | | | |
|----------|----------|-------|-------|
| DIM. | MIN. | NOM. | MAX. |
| A | 4.90 | 5.00 | 5.10 |
| A1 | 2.25 | 2.36 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| b | 1.16 | 1.20 | 1.26 |
| b1 | 1.96 | 2.00 | 2.06 |
| b2 | 2.96 | 3.00 | 3.06 |
| b3 | - | - | 2.25 |
| b4 | - | - | 3.25 |
| c | 0.59 | 0.60 | 0.66 |
| D | 20.90 | 21.00 | 21.10 |
| D1 | 16.25 | 16.55 | 16.85 |
| D2 | 1.05 | 1.17 | 1.35 |
| E | 15.70 | 15.80 | 15.90 |
| E1 | 13.10 | 13.26 | 13.50 |
| E2 | 4.40 | 4.50 | 4.60 |
| E3 | 2.40 | 2.50 | 2.60 |
| e | 5.436BSC | | |
| L | 19.80 | 19.90 | 20.10 |
| L1 | - | - | 4.30 |
| M | 0.35 | 0.89 | 0.95 |
| P | 3.40 | 3.50 | 3.60 |
| P1 | 7.00 | 7.20 | 7.40 |
| P2 | 2.40 | 2.50 | 2.60 |
| Q | 5.60 | 5.80 | 6.00 |
| S | 6.05 | 6.15 | 6.25 |
| T | 9.80 | 10.00 | 10.20 |
| U | 6.00 | 6.20 | 6.40 |

All dimensions in millimeters



DKW50N65DF7

CoolFAST™ Series Seventh Generation

Revision History

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 0.1 | 2023-07-20 | Target version |
| 1.1 | 2023-08-15 | Preliminary version |
| 1.2 | 2023-09-08 | MP version |

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