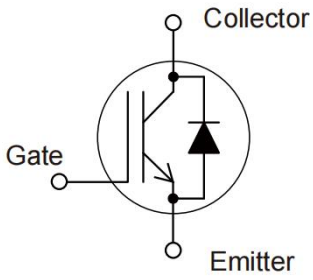
## 650V 50A CoolFAST™ 7 Technology IGBT

### 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 | Packing |
|---|---|---|---|---|---|---|---|
| DKF50N65IF7 | 650V | 50A | 1.6V | 175°C | DKF50N65IF7 | TO-220F-3 | Tube |

### 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<br>Transient gate-emitter voltage ($t_p$≤ 10μs, D< 0.010) | $V_{GES}$ | ±20<br>±30 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_C$= 25°C<br>$T_C$= 100°C | $I_C$ | <br>90<br>50 | A |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{CP}$ | 300 | A |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C$= 25°C<br>$T_C$= 100°C | $I_F$ | <br>110<br>50 | A |
| 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°C (unless otherwise specified)

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

## Switching Characteristics at $T_{vj}$= 25°C

| Description | Symbols | Conditions | Characteristics | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| **IGBT Characteristics** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$= 400V<br>$I_C$= 50A<br>$V_{GE}$= 15V<br>$R_G$= 10Ω<br>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 | $t_{rr}$ | $V_{CC}$= 400V<br>$I_F$= 50A<br>$di_F/dt$= 500A/μs | - | 60 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 0.24 | - | μC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 0.6 | - | A |

## Switching Characteristics at $T_{vj}$= 175°C

| Description | Symbols | Conditions | Characteristics | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| **IGBT Characteristics** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$= 400V<br>$I_C$= 50A<br>$V_{GE}$= 15V<br>$R_G$= 10Ω<br>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 | $t_{rr}$ | $V_{CC}$= 400V<br>$I_F$= 50A<br>$di_F/dt$= 500A/μs | - | 93 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.44 | - | μC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 20.48 | - | A |

## Thermal Resistance

| Items | Symbols | Characteristics | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | - | - | 62 | °C /W |
| Thermal resistance, IGBT junction to case | $R_{th(j-c)}$ | - | - | 1.5 | |
| Thermal resistance, diodes junction to case | $R_{th(j-c)}$ | - | - | 3.2 | |

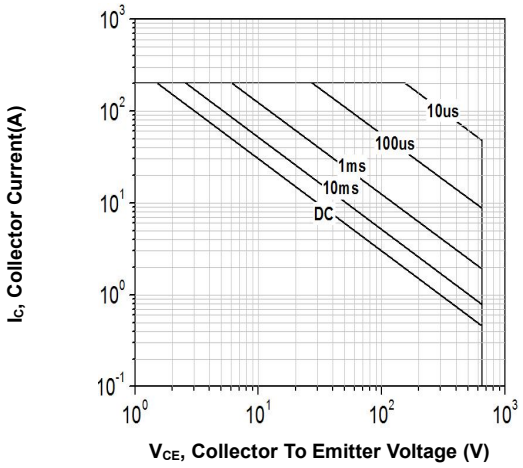



**Figure 1. Forward bias safe operating area**
(D= 0, $T_C$= 25°C, $T_{vj}$≤ 175°C; $V_{GE}$= 15V)

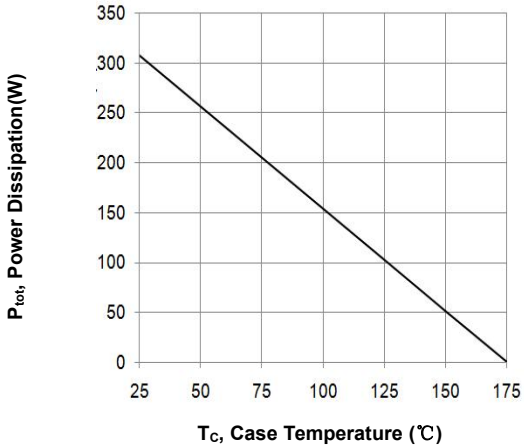



**Figure 2. Power dissipation vs. case temperature**
($T_{vj}$≤ 175°C)

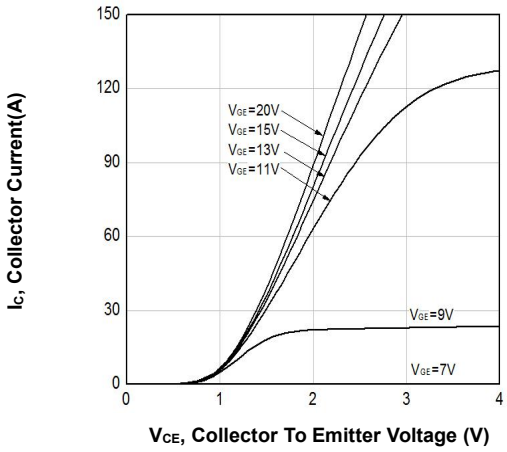



**Figure 3. Typical output characteristic**
($T_{vj}$= 25°C)

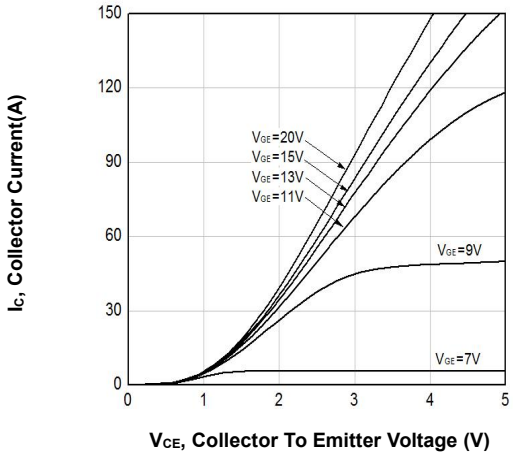



**Figure 4. Typical output characteristic**
($T_{vj}$= 175°C)

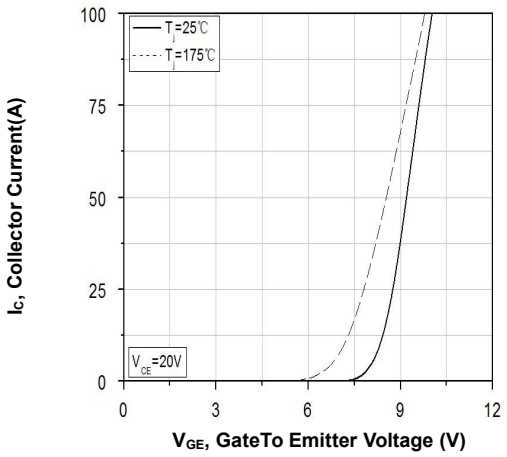



**Figure 5. Typical transfer characteristic**
($V_{CE}$= 20V)

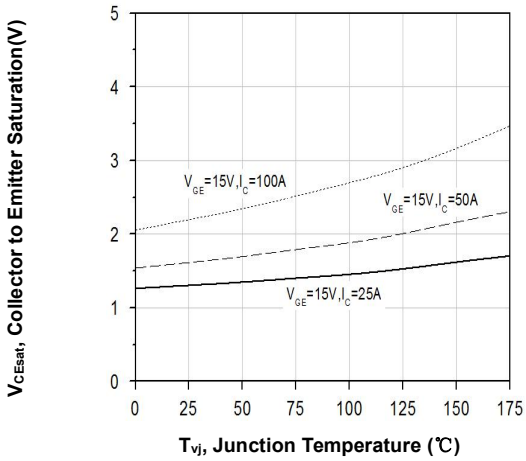



**Figure 6. Typical collector-emitter saturation voltage vs. $T_{vj}$** ($V_{GE}$= 20V)

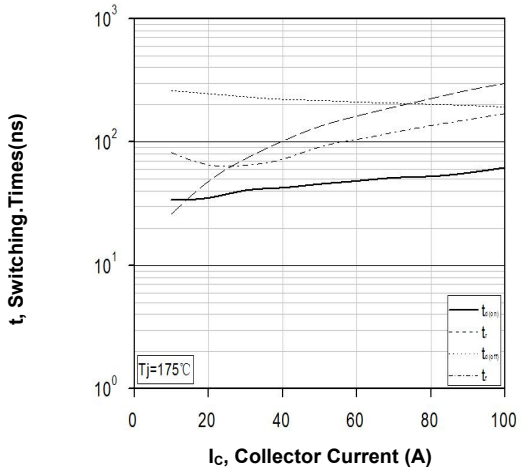



**Figure 7. Typical switching times vs. collector current** (Ind. load, $T_{vj}$= 175°C, $V_{CE}$= 400V, $V_{GE}$= 15/0V, $R_G$=10Ω)

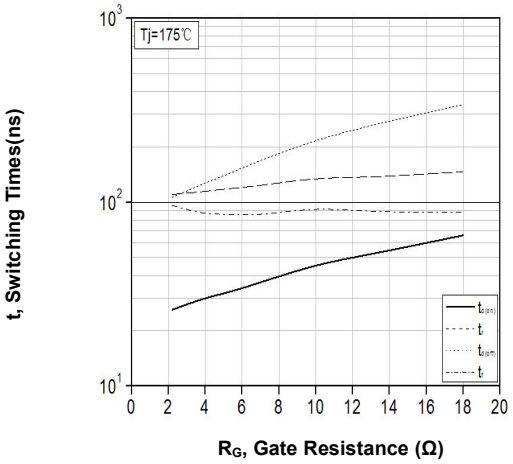



**Figure 8. Typical switching times vs. gate resistor**
(Ind. Load, $T_{vj}$= 175°C, $V_{CE}$= 400V, $V_{GE}$= 15/0V, $I_C$= 50A)

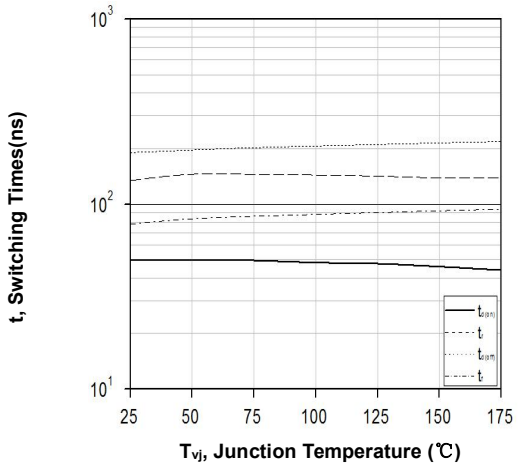



**Figure 9. Typical switching times vs. $T_{vj}$**
(Ind. Load, $V_{CE}$= 400V, $V_{GE}$= 15/0V, $I_C$= 50A, $R_G$= 10Ω)

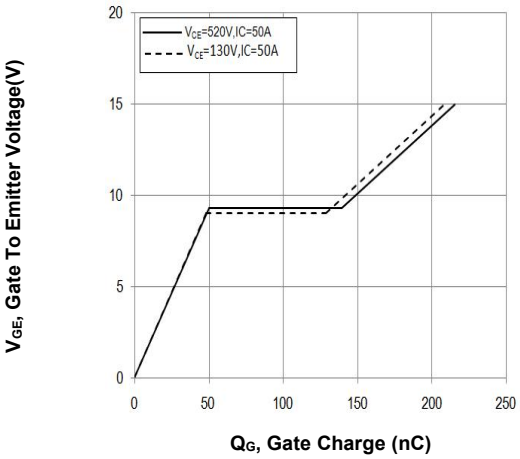



**Figure 10. Typical gate charge**
($I_C$= 50A)

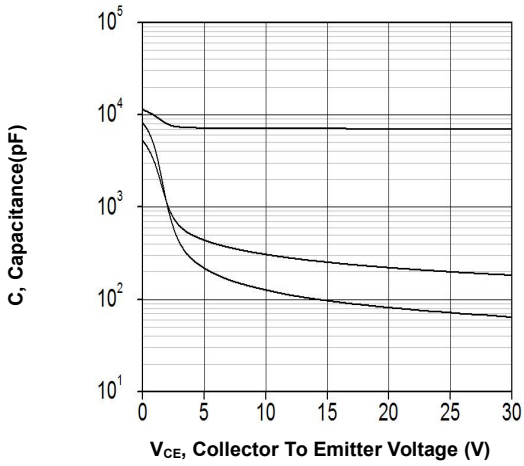



**Figure 11. Typical capacitance vs. collector-emitter voltage** ($V_{GE}$= 0V, f= 1MHz)

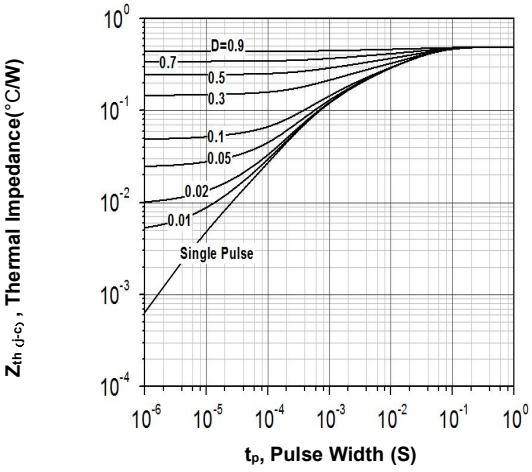
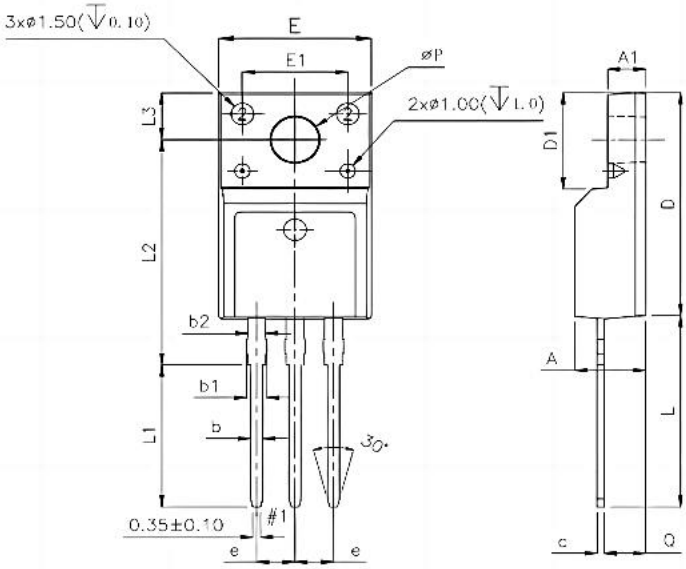



**Figure 12. IGBT transient thermal impedance**
(D= $t_p$/T)

## TO220F Package Outline

Unit: mm

| Symbol | Min | Nom | Max | Symbol | Min | Nom | Max |
|---|---|---|---|---|---|---|---|
| A | 4.5 | | 4.9 | E1 | 6.5 | 7 | 7.5 |
| A1 | 2.3 | | 2.9 | e | 2.44 | 2.54 | 2.64 |
| b | 0.65 | | 0.9 | L | 12.5 | | 14.3 |
| b1 | 1.1 | | 1.7 | L1 | 9.45 | | 10.05 |
| b2 | 1.2 | | 1.4 | L2 | 15 | | 16 |
| c | 0.35 | | 0.65 | L3 | 3.2 | | 4.4 |
| D | 14.5 | | 16.5 | ΦP | 3 | | 3.3 |
| D1 | 6.1 | | 6.9 | Q | 2.5 | | 2.9 |
| E | 9.6 | | 10.3 | | | | |



## Revision History

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1,0 | 2023-3-5 | Target version |
| 1.1 | 2024-3-25 | MP version |

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