

# CMF10B65D

650V, 10A Field Stop Trench IGBT

## General Description

Cmos's Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The device is designed for Motor applications where ruggedness is a required feature.

## Features

- High speed switching
- High input impedance
- RoHS Compliant

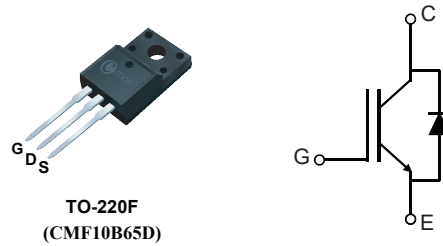
## Product Summary

| V <sub>CES</sub> | I <sub>C</sub> |
|------------------|----------------|
| 650V             | 10A            |

## Applications

- Motor drives
- Uninterruptible Power Supply

## TO-220F Pin Configuration



## Absolute Maximum Ratings

| Symbol                                | Parameter                            | Rating     | Units |
|---------------------------------------|--------------------------------------|------------|-------|
| V <sub>CES</sub>                      | Collector-Emitter Voltage            | 650        | V     |
| V <sub>GES</sub>                      | Gate-Emitter Voltage                 | ±20        | V     |
| I <sub>C</sub> @T <sub>C</sub> =25°C  | Collector Current                    | 20         | A     |
| I <sub>C</sub> @T <sub>C</sub> =100°C |                                      | 10         | A     |
| I <sub>CM</sub>                       | Pulsed Collector Current *           | 30         | A     |
| I <sub>F</sub> @T <sub>C</sub> =100°C | Diode Continuous Forward Current     | 5          | A     |
| I <sub>FM</sub>                       | Diode Maximum Forward Current        | 15         | A     |
| P <sub>D</sub> @T <sub>C</sub> =25°C  | Maximum Power Dissipation            | 30         | W     |
| P <sub>D</sub> @T <sub>C</sub> =100°C | Maximum Junction Temperature         | 12         | W     |
| T <sub>VJ</sub>                       | Operating Junction temperature range | -55 to 150 | °C    |
| T <sub>stg</sub>                      | Storage temperature range            | -55 to 150 | °C    |

\* Repetitive rating : Pulse width limited by max. junction temperature

## Thermal Data

| Symbol            | Parameter                               | Typ. | Max. | Units |
|-------------------|-----------------------------------------|------|------|-------|
| R <sub>thJA</sub> | Thermal Resistance, Junction-Ambient    | ---  | 62   | °C/W  |
| R <sub>thJC</sub> | Thermal Resistance, IGBT Junction-Case  | ---  | 4.2  | °C/W  |
| R <sub>thJC</sub> | Thermal Resistance, Diode Junction-Case | ---  | 7.0  | °C/W  |

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

| Symbol               | Characteristic                       | Test Condition                                                                                                                   | Min. | Typ. | Max. | Unit |
|----------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Static               |                                      |                                                                                                                                  |      |      |      |      |
| BV <sub>CES</sub>    | Collector-Emitter Breakdown Voltage  | V <sub>CE</sub> =0V , I <sub>C</sub> =2mA                                                                                        | 650  | ---  | ---  | V    |
| I <sub>CES</sub>     | Collector Cut-off Current            | V <sub>GE</sub> =0V , V <sub>CE</sub> =650V, T <sub>Vj</sub> = 25℃                                                               | ---  | ---  | 10   | μA   |
| I <sub>GES</sub>     | Gate Leakage Current                 | V <sub>CE</sub> =0V , V <sub>GE</sub> =±20V                                                                                      | ---  | ---  | ±100 | nA   |
| V <sub>GE(th)</sub>  | Gate-Emitter Threshold Voltage       | V <sub>CE</sub> = 5V , I <sub>C</sub> =250μA                                                                                     | 3.5  | 5.2  | 6.5  | V    |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | V <sub>GE</sub> =15V, I <sub>C</sub> =10A, T <sub>Vj</sub> = 25℃                                                                 | ---  | 1.7  | 2.0  | V    |
|                      |                                      | V <sub>GE</sub> =15V, I <sub>C</sub> =10A, T <sub>Vj</sub> = 150℃                                                                | ---  | 2.0  | ---  | V    |
| Dynamic              |                                      |                                                                                                                                  |      |      |      |      |
| Q <sub>g</sub>       | Total Gate Charge                    | V <sub>CC</sub> =520V, V <sub>GE</sub> =15V, I <sub>C</sub> = 10A                                                                | ---  | 24   | ---  | nC   |
| Q <sub>ge</sub>      | Gate-Emitter Charge                  |                                                                                                                                  | ---  | 5.5  | ---  |      |
| Q <sub>gc</sub>      | Gate-Collector Charge                |                                                                                                                                  | ---  | 12   | ---  |      |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CC</sub> =400V, I <sub>C</sub> =10A, V <sub>GE</sub> =15V, R <sub>G</sub> =30Ω<br>Inductive Load , T <sub>Vj</sub> = 25℃  | ---  | 12   | ---  | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                                  | ---  | 16   | ---  |      |
| t <sub>d(off)</sub>  | Turn-Off Delay Time                  |                                                                                                                                  | ---  | 91   | ---  |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                                  | ---  | 14   | ---  |      |
| E <sub>on</sub>      | Turn-On Switching Loss               |                                                                                                                                  | ---  | 0.18 | ---  | mJ   |
| E <sub>off</sub>     | Turn-Off Switching Loss              |                                                                                                                                  | ---  | 0.13 | ---  |      |
| E <sub>total</sub>   | Total Switching Energy               |                                                                                                                                  | ---  | 0.31 | ---  |      |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CC</sub> =400V, I <sub>C</sub> =10A, V <sub>GE</sub> =15V, R <sub>G</sub> =30Ω<br>Inductive Load , T <sub>Vj</sub> = 150℃ | ---  | 11   | ---  | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                                  | ---  | 17   | ---  | ns   |
| t <sub>d(off)</sub>  | Turn-Off Delay Time                  |                                                                                                                                  | ---  | 108  | ---  | ns   |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                                  | ---  | 23   | ---  | ns   |
| E <sub>on</sub>      | Turn-On Switching Loss               |                                                                                                                                  | ---  | 0.2  | ---  | mJ   |
| E <sub>off</sub>     | Turn-Off Switching Loss              |                                                                                                                                  | ---  | 0.21 | ---  | mJ   |
| E <sub>total</sub>   | Total Switching Energy               |                                                                                                                                  | ---  | 0.41 | ---  | mJ   |
| C <sub>ies</sub>     | Input Capacitance                    | V <sub>CE</sub> =25V , V <sub>GE</sub> =0V , f=1MHz                                                                              | ---  | 1400 | ---  | pF   |
| C <sub>oes</sub>     | Output Capacitance                   |                                                                                                                                  | ---  | 45   | ---  |      |
| C <sub>res</sub>     | Reverse Transfer Capacitance         |                                                                                                                                  | ---  | 25   | ---  |      |

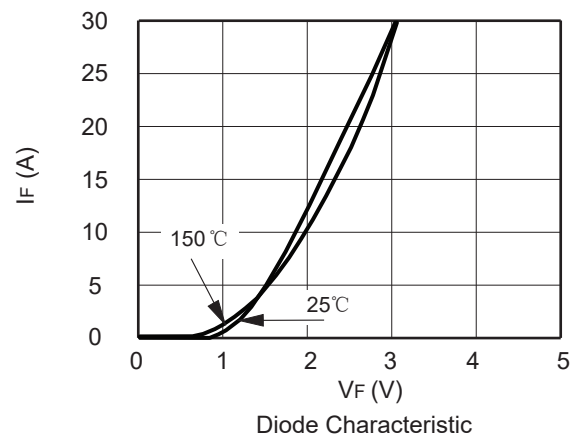
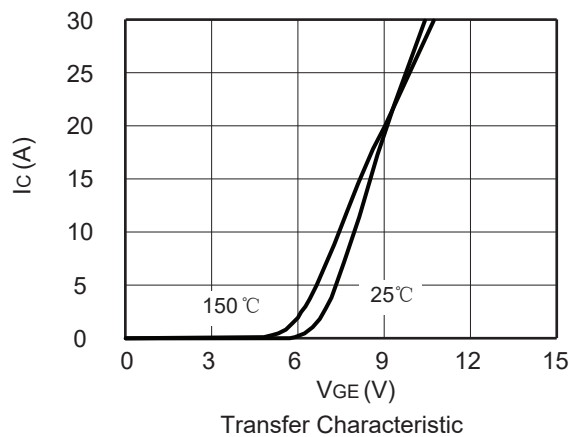
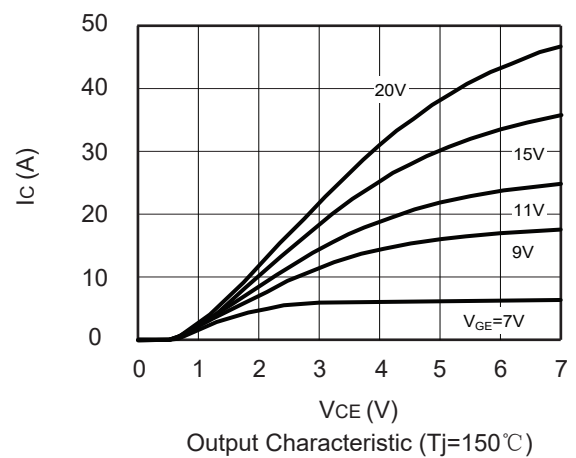
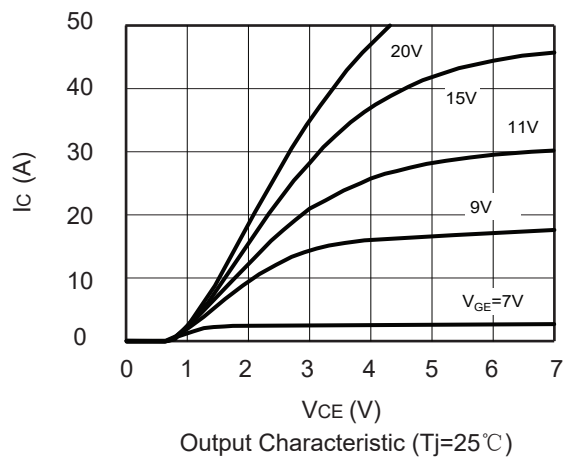
**Electrical Characteristic Of Diode**

| Symbol          | Characteristic                      | Test Condition                          |                      | Mim. | Typ. | Max. | Unit |
|-----------------|-------------------------------------|-----------------------------------------|----------------------|------|------|------|------|
| V <sub>F</sub>  | Diode Forward Voltage               | I <sub>F</sub> = 5A                     | T <sub>C</sub> =25℃  | ---  | 1.5  | 1.95 | V    |
|                 |                                     |                                         | T <sub>C</sub> =150℃ | ---  | 1.6  | ---  |      |
| t <sub>rr</sub> | Diode Reverse Recovery Time         | I <sub>F</sub> = 10A<br>di/dt = 200A/μs | T <sub>C</sub> =25℃  | ---  | 263  | ---  | ns   |
|                 |                                     |                                         | T <sub>C</sub> =150℃ | ---  | 262  | ---  |      |
| I <sub>rm</sub> | Diode Peak Reverse Recovery Current |                                         | T <sub>C</sub> =25℃  | ---  | 3.8  | ---  | A    |
|                 |                                     |                                         | T <sub>C</sub> =150℃ | ---  | 4.5  | ---  |      |
| Q <sub>rr</sub> | Diode Reverse Recovery Charge       |                                         | T <sub>C</sub> =25℃  | ---  | 0.4  | ---  | μC   |
|                 |                                     |                                         | T <sub>C</sub> =150℃ | ---  | 0.6  | ---  |      |

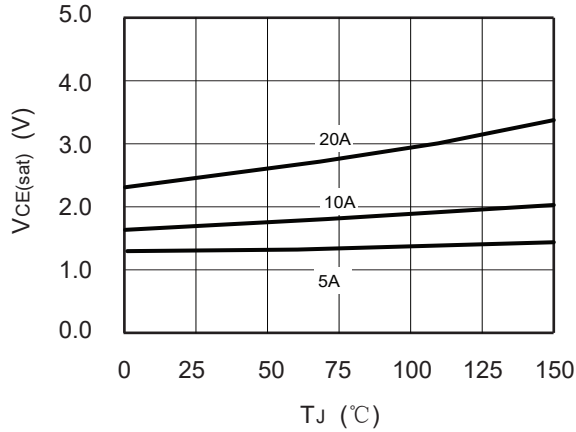
This product has been designed and qualified for the consumer market.

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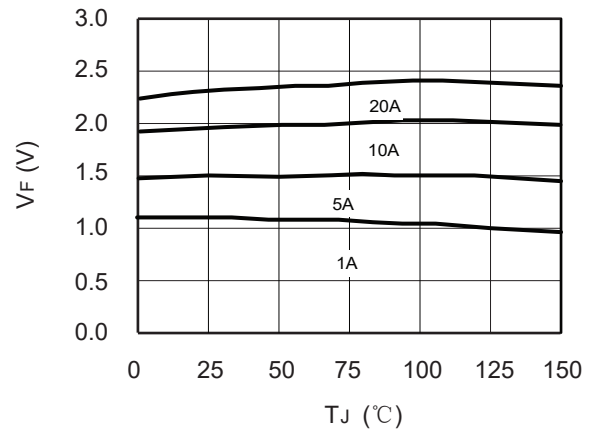
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**Typical electrical and thermal characteris**


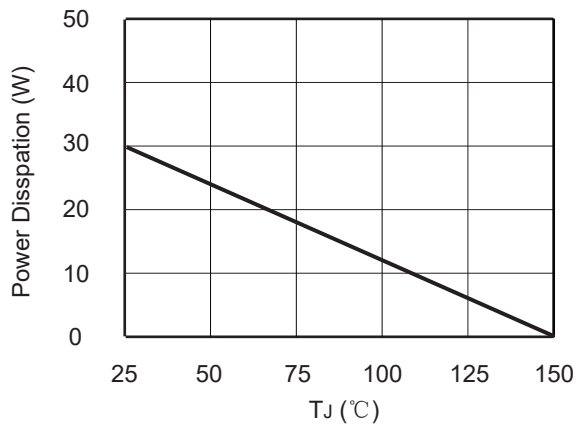
### Typical electrical and thermal characteris



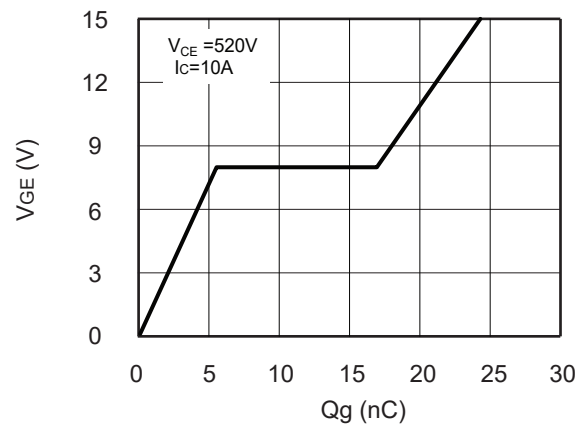
Collector-Emitter Saturation Voltage vs. Junction Temperature



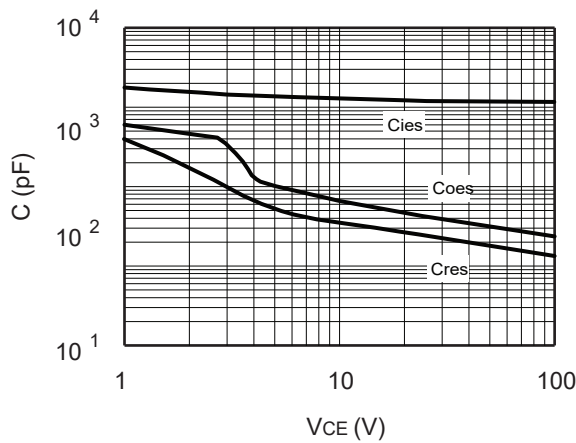
Diode Forward voltage vs. Junction Temperature



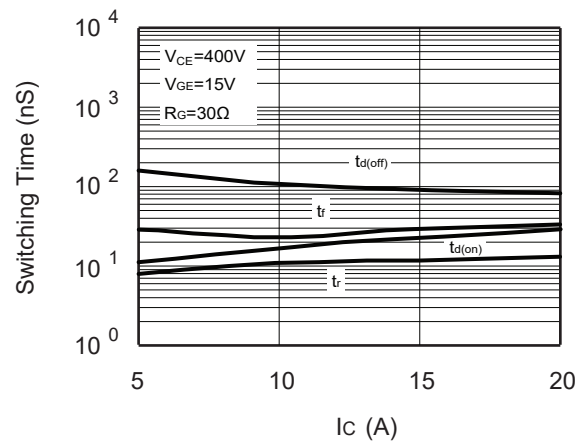
Power Dissipation as a Function of Case



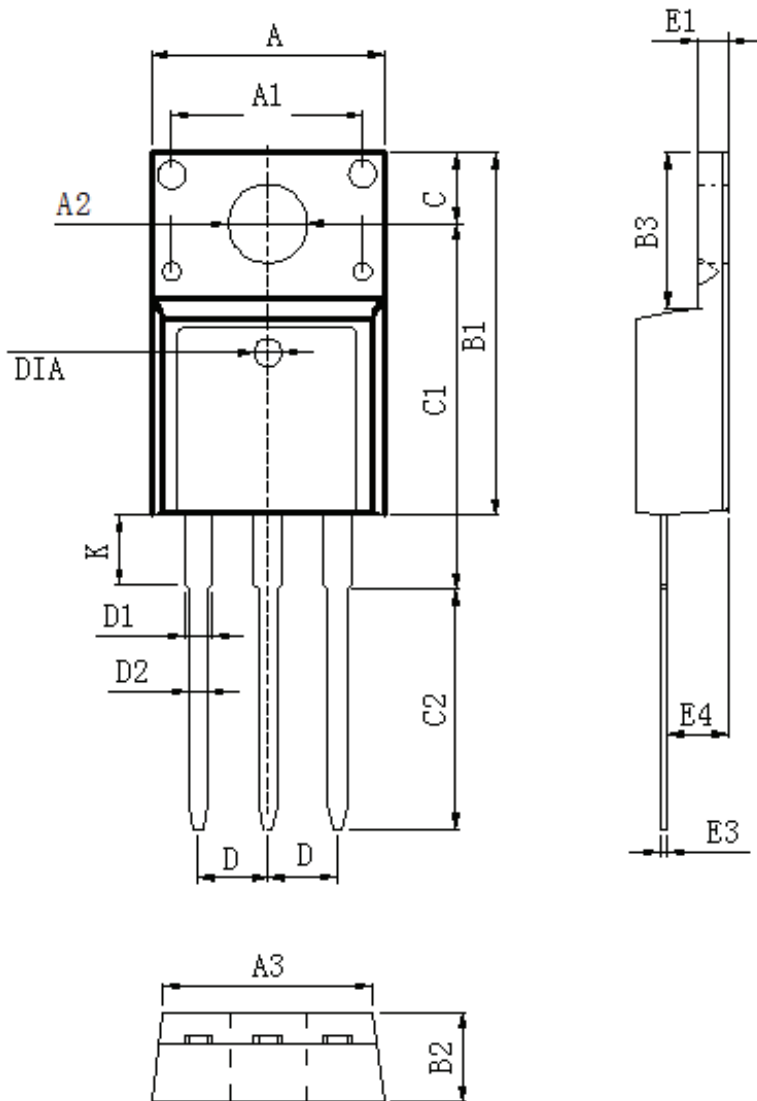
Gate-Charge Characteristics



Capacitance Characteristic



Switching Time vs. Collector Current

**Package Dimension**
**TO-220F**
**Unit :mm**


| DIM | MILLIMETERS            |
|-----|------------------------|
| A   | $10.16 \pm 0.3$        |
| A1  | $7.00 \pm 0.1$         |
| A2  | $3.3 \pm 0.2$          |
| A3  | $9.5 \pm 0.2$          |
| B1  | $15.87 \pm 0.3$        |
| B2  | $4.7 \pm 0.2$          |
| B3  | $6.68 \pm 0.4$         |
| C   | $3.3 \pm 0.2$          |
| C1  | $12.57 \pm 0.3$        |
| C2  | $10.02 \pm 0.5$        |
| D   | $2.54 \pm 0.05$        |
| D1  | $1.28 \pm 0.2$         |
| D2  | $0.8 \pm 0.1$          |
| K   | $3.1 \pm 0.3$          |
| E1  | $2.54 \pm 0.1$         |
| E3  | $0.5 \pm 0.1$          |
| E4  | $2.76 \pm 0.2$         |
| DIA | $\odot 1.5$ (deep 0.2) |