



## General Description

OST40N65HMF uses advanced Oriental-Semi's patented Trident-Gate Bipolar Transistor (TGBT™) technology to provide extremely low  $V_{CE(sat)}$ , low gate charge, and excellent switching performance. This device is suitable for mid to high range switching frequency converters.

## Features

- Advanced TGBT™ technology
- Excellent conduction and switching loss
- Excellent stability and uniformity
- Fast and soft antiparallel diode



## Applications

- Induction converters
- Uninterruptible power supplies

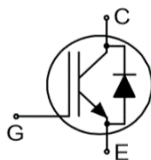
## Key Performance Parameters

| Parameter                       | Value | Unit        |
|---------------------------------|-------|-------------|
| $V_{CES, min} @ 25^{\circ}C$    | 650   | V           |
| Maximum junction temperature    | 175   | $^{\circ}C$ |
| $I_C, pulse$                    | 160   | A           |
| $V_{CE(sat), typ} @ V_{GE}=15V$ | 1.6   | V           |
| $Q_g$                           | 80    | nC          |

## Marking Information

| Product Name | Package | Marking    |
|--------------|---------|------------|
| OST40N65HMF  | TO247   | OST40N65HM |

## Package & Pin Information



**Absolute Maximum Ratings** at  $T_{vj}=25^{\circ}\text{C}$  unless otherwise noted

| Parameter                                                                                                                                                                                                            | Symbol                | Value      | Unit               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|--------------------|
| Collector emitter voltage                                                                                                                                                                                            | $V_{CES}$             | 650        | V                  |
| Gate emitter voltage                                                                                                                                                                                                 | $V_{GES}$             | $\pm 20$   | V                  |
| Transient gate emitter voltage, $T_P \leq 10\mu\text{s}$ , $D < 0.01$                                                                                                                                                |                       | $\pm 30$   | V                  |
| Continuous collector current <sup>1)</sup> , $T_C = 25^{\circ}\text{C}$                                                                                                                                              | $I_C$                 | 68         | A                  |
| Continuous collector current <sup>1)</sup> , $T_C = 100^{\circ}\text{C}$                                                                                                                                             |                       | 40         | A                  |
| Pulsed collector current <sup>2)</sup> , $T_C = 25^{\circ}\text{C}$                                                                                                                                                  | $I_{C, \text{pulse}}$ | 160        | A                  |
| Diode forward current <sup>1)</sup> , $T_C = 25^{\circ}\text{C}$                                                                                                                                                     | $I_F$                 | 68         | A                  |
| Diode forward current <sup>1)</sup> , $T_C = 100^{\circ}\text{C}$                                                                                                                                                    |                       | 40         | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C = 25^{\circ}\text{C}$                                                                                                                                                      | $I_{F, \text{pulse}}$ | 160        | A                  |
| Power dissipation <sup>3)</sup> , $T_C = 25^{\circ}\text{C}$                                                                                                                                                         | $P_D$                 | 250        | W                  |
| Power dissipation <sup>3)</sup> , $T_C = 100^{\circ}\text{C}$                                                                                                                                                        |                       | 125        | W                  |
| Operation and storage temperature                                                                                                                                                                                    | $T_{stg}, T_{vj}$     | -55 to 175 | $^{\circ}\text{C}$ |
| Short circuit withstand time<br>$V_{GE} = 15\text{ V}$ , $V_{CC} \leq 400\text{ V}$<br>Allowed number of short circuits < 1000<br>Time between short circuits: $\geq 1.0\text{ S}$<br>$T_{vj} = 150^{\circ}\text{C}$ | $t_{sc}$              | 10         | $\mu\text{s}$      |

**Thermal Characteristics**

| Parameter                               | Symbol          | Value | Unit                 |
|-----------------------------------------|-----------------|-------|----------------------|
| IGBT thermal resistance, junction-case  | $R_{\theta JC}$ | 0.60  | $^{\circ}\text{C/W}$ |
| Diode thermal resistance, junction-case | $R_{\theta JC}$ | 0.85  | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-ambient    | $R_{\theta JA}$ | 40    | $^{\circ}\text{C/W}$ |

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

| Parameter                            | Symbol        | Min. | Typ. | Max. | Unit          | Test condition                                                          |
|--------------------------------------|---------------|------|------|------|---------------|-------------------------------------------------------------------------|
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | 650  |      |      | V             | $V_{GE}=0\text{ V}$ , $I_C=0.5\text{ mA}$                               |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ |      | 1.6  | 2.0  | V             | $V_{GE}=15\text{ V}$ , $I_C=40\text{ A}$ , $T_{vj}=25^{\circ}\text{C}$  |
|                                      |               |      | 1.8  |      | V             | $V_{GE}=15\text{ V}$ , $I_C=40\text{ A}$ , $T_{vj}=125^{\circ}\text{C}$ |
|                                      |               |      | 1.9  |      |               | $V_{GE}=15\text{ V}$ , $I_C=40\text{ A}$ , $T_{vj}=175^{\circ}\text{C}$ |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | 4.0  | 5.0  | 6.0  | V             | $V_{CE}=V_{GE}$ , $I_D=0.5\text{ mA}$                                   |
| Diode forward voltage                | $V_F$         |      | 1.70 | 2.0  | V             | $V_{GE}=0\text{ V}$ , $I_F=40\text{ A}$ , $T_{vj}=25^{\circ}\text{C}$   |
|                                      |               |      | 1.55 |      |               | $V_{GE}=0\text{ V}$ , $I_F=40\text{ A}$ , $T_{vj}=125^{\circ}\text{C}$  |
|                                      |               |      | 1.5  |      |               | $V_{GE}=0\text{ V}$ , $I_F=40\text{ A}$ , $T_{vj}=175^{\circ}\text{C}$  |
| Gate-emitter leakage current         | $I_{GES}$     |      |      | 100  | nA            | $V_{CE}=0\text{ V}$ , $V_{GE}=20\text{ V}$                              |
| Zero gate voltage collector current  | $I_{CES}$     |      |      | 10   | $\mu\text{A}$ | $V_{CE}=650\text{ V}$ , $V_{GE}=0\text{ V}$                             |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ. | Max. | Unit | Test condition                                                                               |
|------------------------------|--------------|------|------|------|------|----------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{ies}$    |      | 4204 |      | pF   | $V_{GE}=0\text{ V}$ ,<br>$V_{CE}=25\text{ V}$ ,<br>$f=100\text{ kHz}$                        |
| Output capacitance           | $C_{oes}$    |      | 119  |      | pF   |                                                                                              |
| Reverse transfer capacitance | $C_{res}$    |      | 5.6  |      | pF   |                                                                                              |
| Turn-on delay time           | $t_{d(on)}$  |      | 52   |      | ns   | $V_{GE}=15\text{ V}$ ,<br>$V_{CC}=400\text{ V}$ ,<br>$R_G=10\ \Omega$ ,<br>$I_C=40\text{ A}$ |
| Rise time                    | $t_r$        |      | 78   |      | ns   |                                                                                              |
| Turn-off delay time          | $t_{d(off)}$ |      | 110  |      | ns   |                                                                                              |
| Fall time                    | $t_f$        |      | 42   |      | ns   |                                                                                              |
| Turn-on energy               | $E_{on}$     |      | 1.40 |      | mJ   |                                                                                              |
| Turn-off energy              | $E_{off}$    |      | 0.42 |      | mJ   |                                                                                              |
| Turn-on delay time           | $t_{d(on)}$  |      | 50   |      | ns   | $V_{GE}=15\text{ V}$ ,<br>$V_{CC}=400\text{ V}$ ,<br>$R_G=10\ \Omega$ ,<br>$I_C=20\text{ A}$ |
| Rise time                    | $t_r$        |      | 35   |      | ns   |                                                                                              |
| Turn-off delay time          | $t_{d(off)}$ |      | 137  |      | ns   |                                                                                              |
| Fall time                    | $t_f$        |      | 26   |      | ns   |                                                                                              |
| Turn-on energy               | $E_{on}$     |      | 0.46 |      | mJ   |                                                                                              |
| Turn-off energy              | $E_{off}$    |      | 0.22 |      | mJ   |                                                                                              |

### Gate Charge Characteristics

| Parameter             | Symbol   | Min. | Typ. | Max. | Unit | Test condition                                                         |
|-----------------------|----------|------|------|------|------|------------------------------------------------------------------------|
| Total gate charge     | $Q_g$    |      | 80   |      | nC   | $V_{GE}=15\text{ V}$ ,<br>$V_{CC}=520\text{ V}$ ,<br>$I_C=40\text{ A}$ |
| Gate-emitter charge   | $Q_{ge}$ |      | 45   |      | nC   |                                                                        |
| Gate-collector charge | $Q_{gc}$ |      | 14.6 |      | nC   |                                                                        |

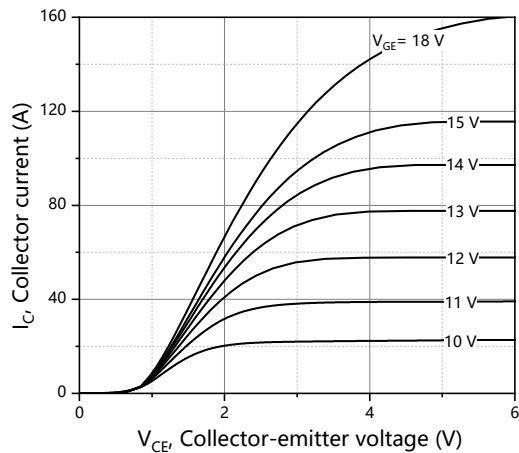
### Body Diode Characteristics

| Parameter                           | Symbol    | Min. | Typ. | Max. | Unit          | Test condition                                                                                                 |
|-------------------------------------|-----------|------|------|------|---------------|----------------------------------------------------------------------------------------------------------------|
| Diode reverse recovery time         | $t_{rr}$  |      | 98   |      | ns            | $V_R=400\text{ V}$ ,<br>$I_F=40\text{ A}$ ,<br>$di_F/dt=500\text{ A}/\mu\text{s}$<br>$T_{vj}=25^\circ\text{C}$ |
| Diode reverse recovery charge       | $Q_{rr}$  |      | 0.84 |      | $\mu\text{C}$ |                                                                                                                |
| Diode peak reverse recovery current | $I_{rrm}$ |      | 16   |      | A             |                                                                                                                |

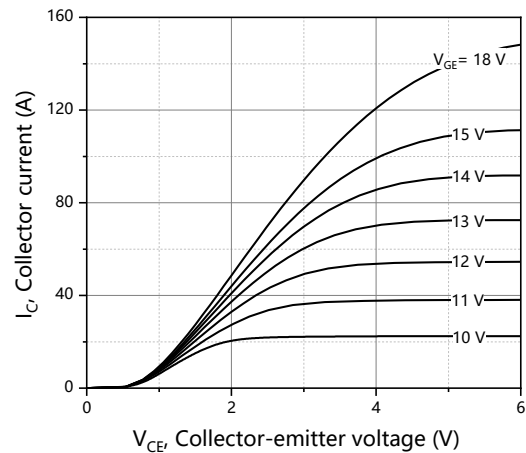
### Note

- 1) Calculated continuous current based on maximum allowable junction temperature.
- 2) Repetitive rating; pulse width limited by max. junction temperature.
- 3)  $P_d$  is based on max. junction temperature, using junction-case thermal resistance.

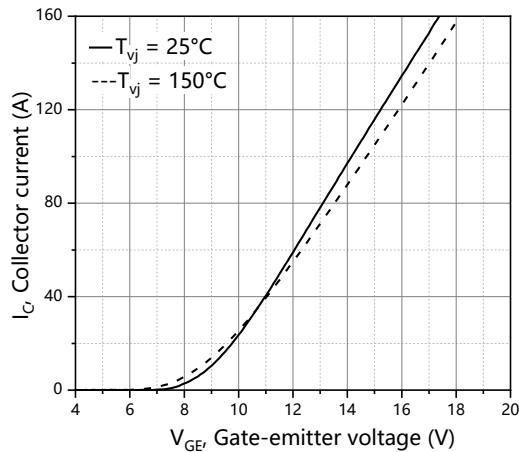
## Electrical Characteristics Diagrams



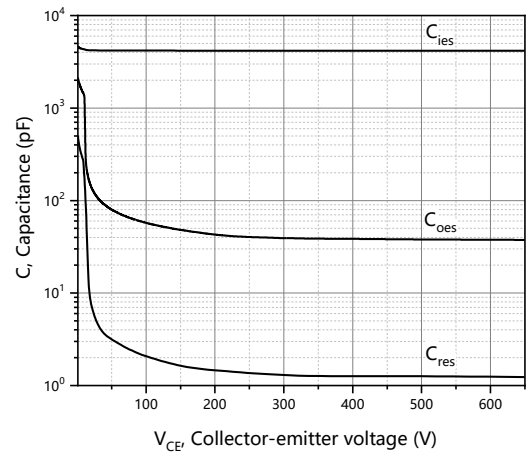
**Figure 1. Typical output characteristics**  
( $T_{vj}=25^{\circ}\text{C}$ )



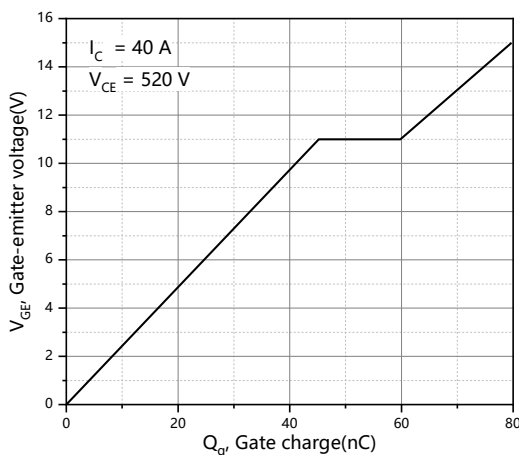
**Figure 2. Typical output characteristics**  
( $T_{vj}=150^{\circ}\text{C}$ )



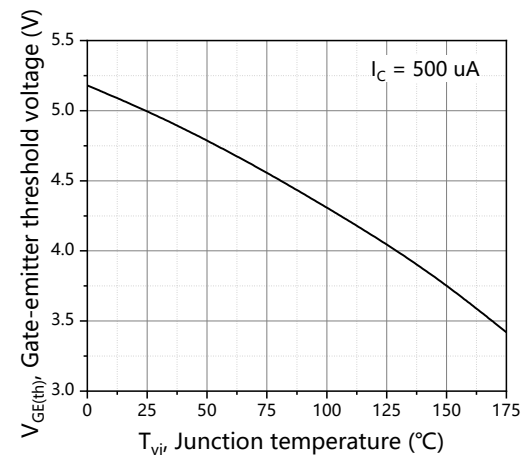
**Figure 3. Typical transfer characteristics**  
( $V_{CE}=20\text{V}$ )



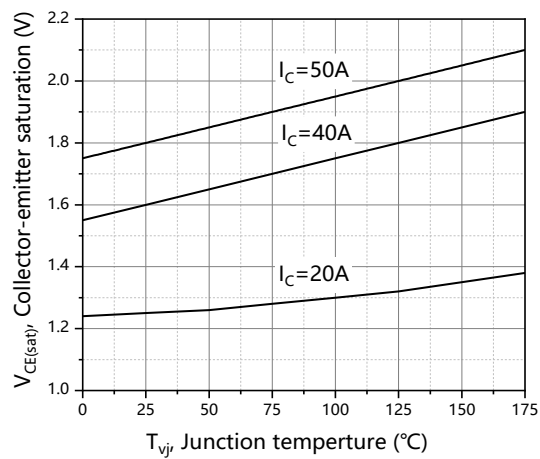
**Figure 4. Typical capacitance**  
( $V_{GE}=0\text{V}$ ,  $f=100\text{ kHz}$ )



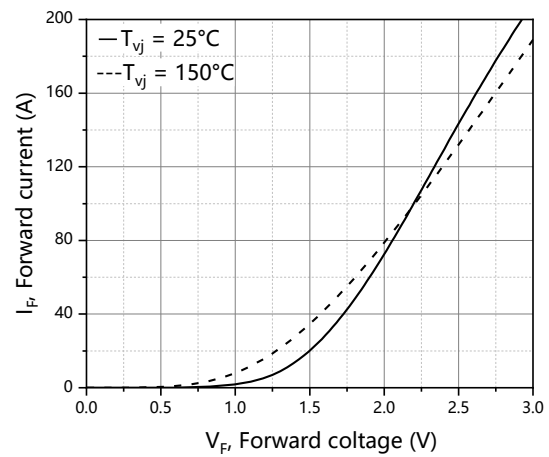
**Figure 5. Typical gate charge**



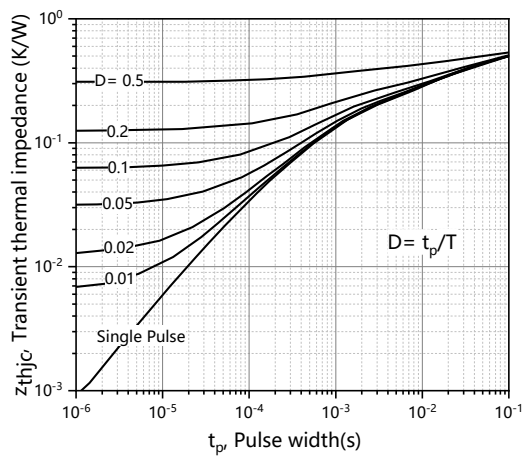
**Figure 6. Gate-emitter threshold voltage**



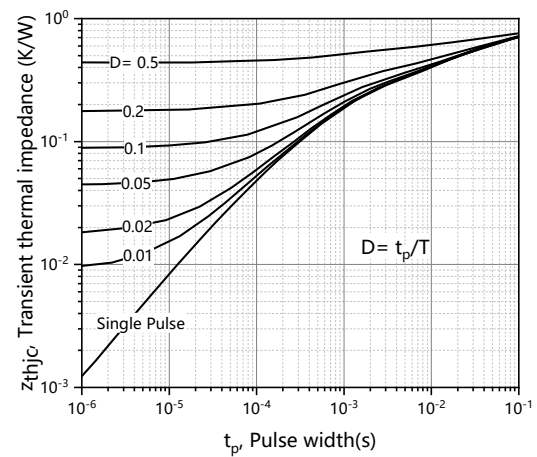
**Figure 7. Typical collector-emitter voltage**



**Figure 8. Forward characteristic of diode**

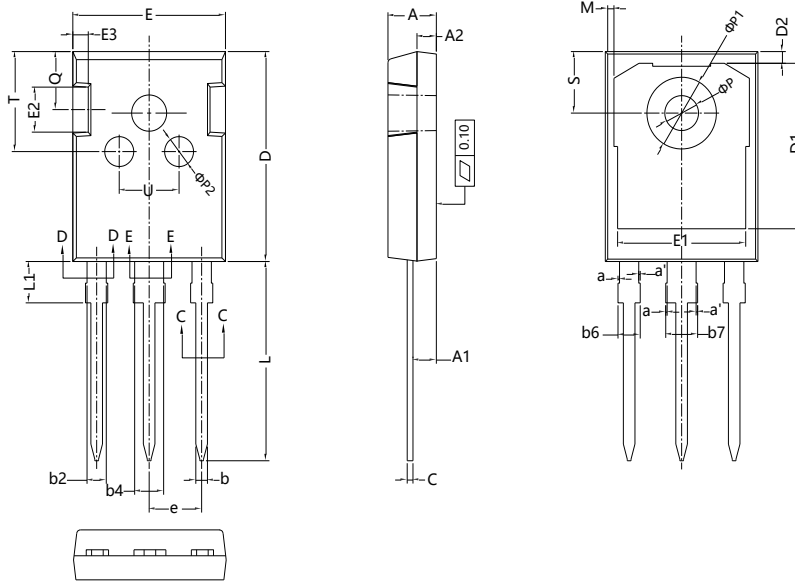


**Figure 9. IGBT transient thermal impedance**



**Figure 10. Diode transient thermal impedance**

## Package Information



| Symbol | mm        |       |       |
|--------|-----------|-------|-------|
|        | Min       | Nom   | Max   |
| A      | 4.90      | 5.00  | 5.10  |
| A1     | 2.31      | 2.41  | 2.51  |
| A2     | 1.90      | 2.00  | 2.10  |
| a      | 0.00      | -     | 0.15  |
| a'     | 0.00      | -     | 0.15  |
| b      | 1.16      | -     | 1.26  |
| b2     | 1.96      | -     | 2.06  |
| b4     | 2.96      | -     | 3.06  |
| b6     | -         | -     | 2.25  |
| b7     | -         | -     | 3.25  |
| c      | 0.59      | -     | 0.66  |
| c1     | 0.58      | 0.60  | 0.62  |
| 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     | 13.30 | 13.50 |
| E2     | 4.40      | 4.50  | 4.60  |
| E3     | 1.50      | 1.60  | 1.70  |
| e      | 5.436 BSC |       |       |
| L      | 19.80     | 19.92 | 20.10 |
| L1     | -         | -     | 4.30  |
| M      | 0.35      | -     | 0.95  |
| P      | 3.40      | 3.50  | 3.60  |
| P1     | 7.00      | -     | 7.40  |
| P2     | 2.40      | 2.5   | 2.6   |
| Q      | 5.60      | -     | 6.0   |
| S      | 6.05      | 6.15  | 6.25  |
| T      | 9.8       | -     | 10.20 |
| U      | 6.00      | -     | 6.40  |

Version 1: TO247-J package outline dimension

## Ordering Information

| Package Type | Units/ Tube | Tubes/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| TO247-J      | 30          | 20               | 600              | 4                       | 2400              |

## Product Information

| Product     | Package | Pb Free | RoHS | Halogen Free |
|-------------|---------|---------|------|--------------|
| OST40N65HMF | TO247   | yes     | yes  | yes          |

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