



## General Description

OST40N120HSVF 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
- Ultra-low  $V_f$  antiparallel diode



## Applications

- PV inverters
- Induction converters
- Uninterruptible power supplies

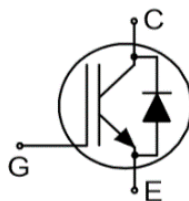
## Key Performance Parameters

| Parameter                       | Value | Unit        |
|---------------------------------|-------|-------------|
| $V_{CES, min} @ 25^{\circ}C$    | 1200  | V           |
| Maximum junction temperature    | 175   | $^{\circ}C$ |
| $I_C, pulse$                    | 160   | A           |
| $V_{CE(sat), typ} @ V_{GE}=15V$ | 1.45  | V           |
| $Q_g$                           | 212   | nC          |

## Marking Information

| Product Name  | Package | Marking      |
|---------------|---------|--------------|
| OST40N120HSVF | TO247   | OST40N120HSV |

## Package & Pin Information



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

| Parameter                                                               | Symbol                 | Value      | Unit               |
|-------------------------------------------------------------------------|------------------------|------------|--------------------|
| Collector emitter voltage                                               | $V_{CES}$              | 1200       | V                  |
| Gate emitter voltage                                                    | $V_{GES}$              | $\pm 20$   | V                  |
| Transient gate emitter voltage, $T_P \leq 0.5\mu\text{s}$ , $D < 0.001$ |                        | $\pm 25$   | V                  |
| Continuous collector current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$   | $I_C$                  | 56         | 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> , $T_C=25^{\circ}\text{C}$          | $I_F$                  | 56         | 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> , $T_C=25^{\circ}\text{C}$              | $P_D$                  | 536        | W                  |
| Power dissipation <sup>3)</sup> , $T_C=100^{\circ}\text{C}$             |                        | 268        | W                  |
| Operation and storage temperature                                       | $T_{stg}, T_{vj}$      | -55 to 175 | $^{\circ}\text{C}$ |

**Thermal Characteristics**

| Parameter                               | Symbol          | Value | Unit                 |
|-----------------------------------------|-----------------|-------|----------------------|
| IGBT thermal resistance, junction-case  | $R_{\theta JC}$ | 0.28  | $^{\circ}\text{C/W}$ |
| Diode thermal resistance, junction-case | $R_{\theta JC}$ | 0.82  | $^{\circ}\text{C/W}$ |
| 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  | $V_{(BR)CES}$ | 1200 |      |      | V             | $V_{GE}=0\text{ V}$ , $I_C=0.5\text{ mA}$                               |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ |      | 1.45 | 1.90 | V             | $V_{GE}=15\text{ V}$ , $I_C=40\text{ A}$ , $T_{vj}=25^{\circ}\text{C}$  |
|                                      |               |      | 1.58 |      | V             | $V_{GE}=15\text{ V}$ , $I_C=40\text{ A}$ , $T_{vj}=125^{\circ}\text{C}$ |
|                                      |               |      | 1.68 |      |               | $V_{GE}=15\text{ V}$ , $I_C=40\text{ A}$ , $T_{vj}=175^{\circ}\text{C}$ |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | 4.7  | 5.2  | 5.7  | V             | $V_{CE}=V_{GE}$ , $I_D=0.5\text{ mA}$                                   |
| Diode forward voltage                | $V_F$         |      | 1.10 | 2.40 | V             | $V_{GE}=0\text{ V}$ , $I_F=40\text{ A}$ , $T_{vj}=25^{\circ}\text{C}$   |
|                                      |               |      | 1.06 |      |               | $V_{GE}=0\text{ V}$ , $I_F=40\text{ A}$ , $T_{vj}=125^{\circ}\text{C}$  |
|                                      |               |      | 1.04 |      |               | $V_{GE}=0\text{ V}$ , $I_F=40\text{ A}$ , $T_{vj}=175^{\circ}\text{C}$  |
| 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   | $\mu\text{A}$ | $V_{CE}=1200\text{ V}$ , $V_{GE}=0\text{ V}$                            |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ.  | Max. | Unit | Test condition                                                                               |
|------------------------------|--------------|------|-------|------|------|----------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{ies}$    |      | 11540 |      | pF   | $V_{GE}=0\text{ V}$ ,<br>$V_{CE}=25\text{ V}$ ,<br>$f=100\text{ kHz}$                        |
| Output capacitance           | $C_{oes}$    |      | 176   |      | pF   |                                                                                              |
| Reverse transfer capacitance | $C_{res}$    |      | 7.5   |      | pF   |                                                                                              |
| Turn-on delay time           | $t_{d(on)}$  |      | 94    |      | ns   | $V_{GE}=15\text{ V}$ ,<br>$V_{CC}=600\text{ V}$ ,<br>$R_G=10\ \Omega$ ,<br>$I_C=40\text{ A}$ |
| Rise time                    | $t_r$        |      | 61    |      | ns   |                                                                                              |
| Turn-off delay time          | $t_{d(off)}$ |      | 216   |      | ns   |                                                                                              |
| Fall time                    | $t_f$        |      | 136   |      | ns   |                                                                                              |
| Turn-on energy               | $E_{on}$     |      | 7.14  |      | mJ   |                                                                                              |
| Turn-off energy              | $E_{off}$    |      | 1.25  |      | mJ   |                                                                                              |
| Turn-on delay time           | $t_{d(on)}$  |      | 84    |      | ns   | $V_{GE}=15\text{ V}$ ,<br>$V_{CC}=600\text{ V}$ ,<br>$R_G=10\ \Omega$ ,<br>$I_C=20\text{ A}$ |
| Rise time                    | $t_r$        |      | 42    |      | ns   |                                                                                              |
| Turn-off delay time          | $t_{d(off)}$ |      | 324   |      | ns   |                                                                                              |
| Fall time                    | $t_f$        |      | 126   |      | ns   |                                                                                              |
| Turn-on energy               | $E_{on}$     |      | 3.68  |      | mJ   |                                                                                              |
| Turn-off energy              | $E_{off}$    |      | 1.07  |      | mJ   |                                                                                              |

### Gate Charge Characteristics

| Parameter             | Symbol   | Min. | Typ. | Max. | Unit | Test condition                                                         |
|-----------------------|----------|------|------|------|------|------------------------------------------------------------------------|
| Total gate charge     | $Q_g$    |      | 212  |      | nC   | $V_{GE}=15\text{ V}$ ,<br>$V_{CC}=960\text{ V}$ ,<br>$I_C=40\text{ A}$ |
| Gate-emitter charge   | $Q_{ge}$ |      | 94   |      | nC   |                                                                        |
| Gate-collector charge | $Q_{gc}$ |      | 42   |      | nC   |                                                                        |

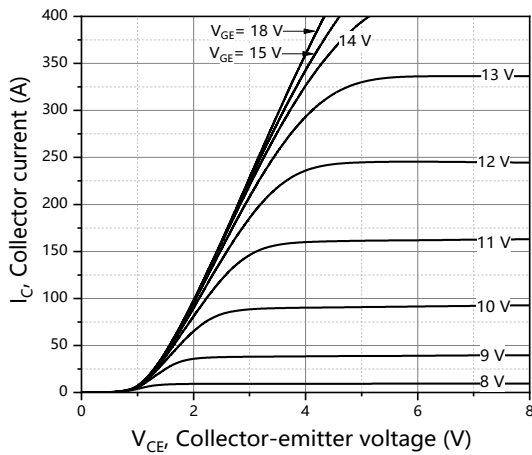
### Body Diode Characteristics

| Parameter                           | Symbol    | Min. | Typ. | Max. | Unit          | Test condition                                                                                                 |
|-------------------------------------|-----------|------|------|------|---------------|----------------------------------------------------------------------------------------------------------------|
| Diode reverse recovery time         | $t_{rr}$  |      | 516  |      | ns            | $V_R=600\text{ V}$ ,<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       | $Q_{rr}$  |      | 2.26 |      | $\mu\text{C}$ |                                                                                                                |
| Diode peak reverse recovery current | $I_{rrm}$ |      | 80.9 |      | A             |                                                                                                                |

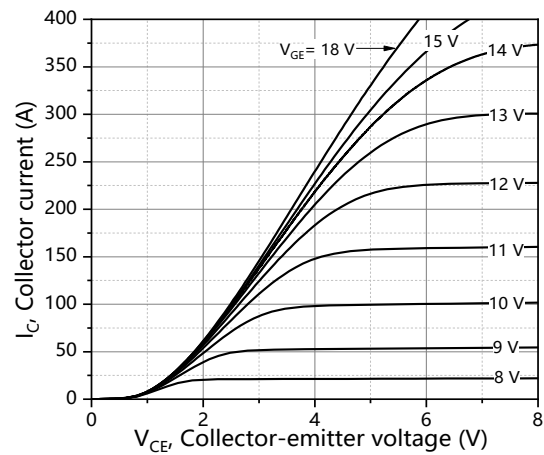
### Note

- 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.

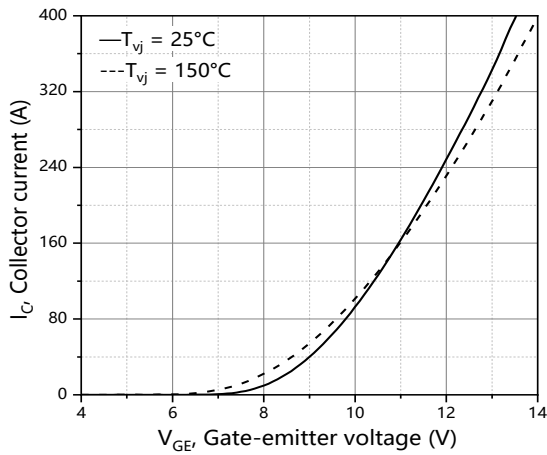
## Electrical Characteristics Diagrams



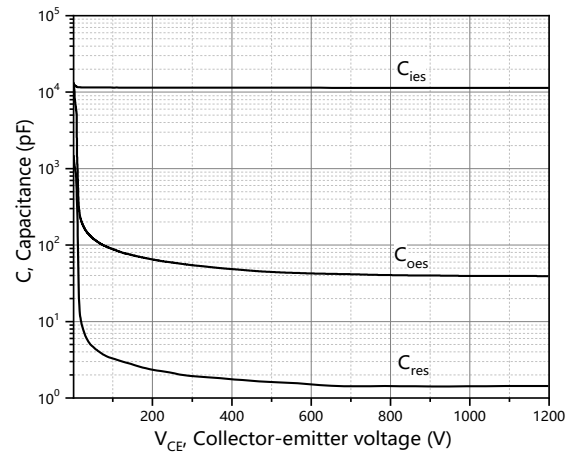
**Figure 1. Typical output characteristics**  
( $T_{vj}=25^{\circ}\text{C}$ )



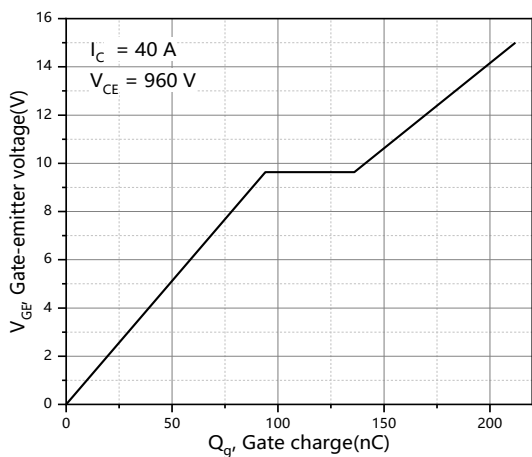
**Figure 2. Typical output characteristics**  
( $T_{vj}=150^{\circ}\text{C}$ )



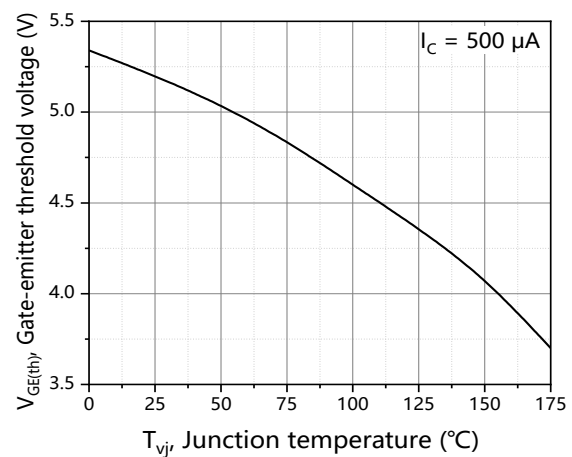
**Figure 3. Typical transfer characteristics**  
( $V_{CE}=20\text{V}$ )



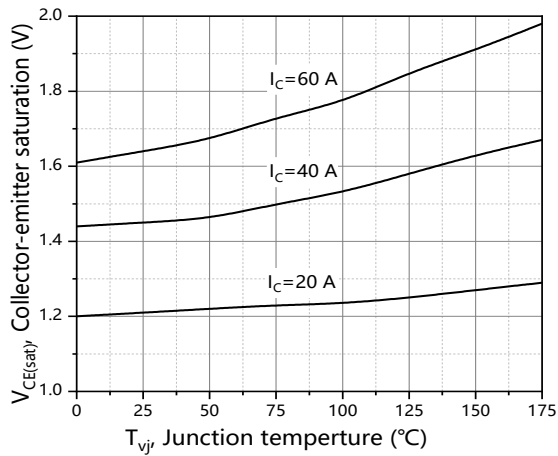
**Figure 4. Typical capacitance**  
( $V_{GE}=0\text{V}$ ,  $f=100\text{ kHz}$ )



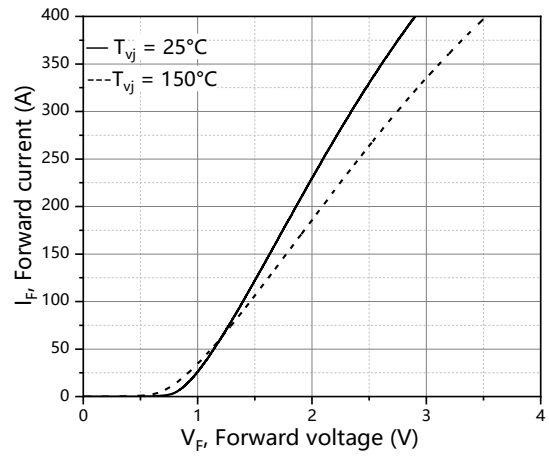
**Figure 5. Typical gate charge**



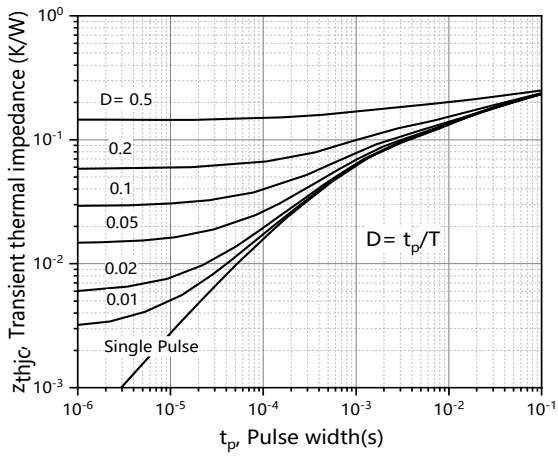
**Figure 6. Gate-emitter threshold voltage**



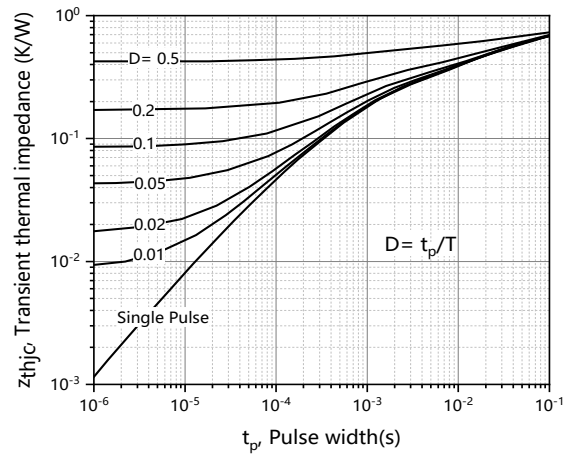
**Figure 7. Typical collector-emitter voltage**



**Figure 8. Forward characteristic of diode**

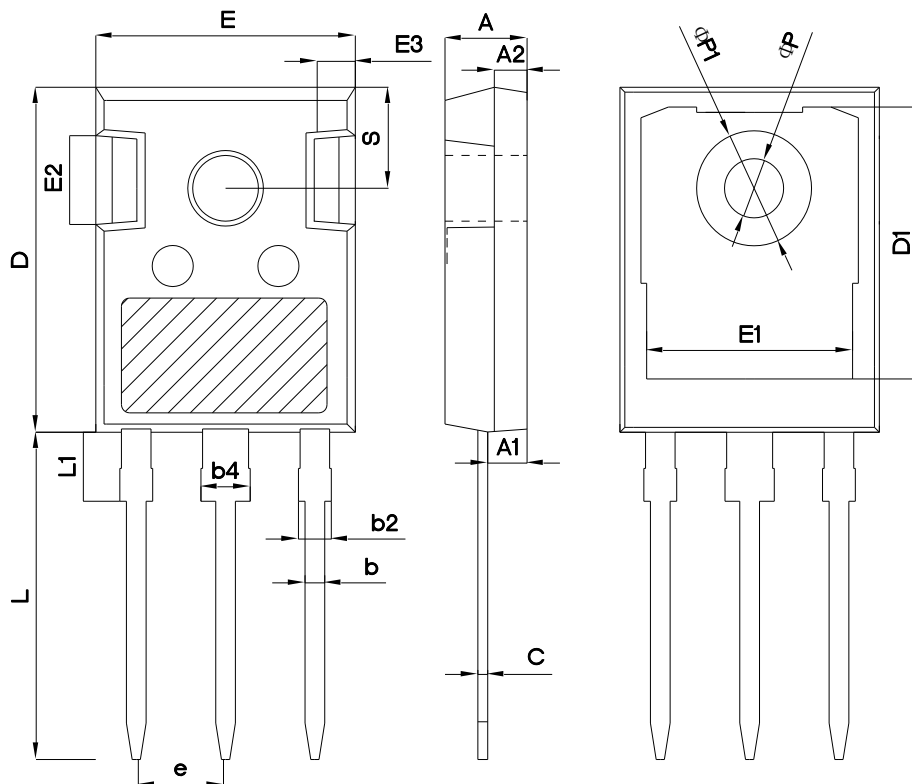


**Figure 9. IGBT transient thermal impedance**



**Figure 10. Diode transient thermal impedance**

## Package Information



| Symbol | mm       |       |       |
|--------|----------|-------|-------|
|        | Min      | Nom   | Max   |
| A      | 4.80     | 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      | 20.80    | 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      | 5.44 BSC |       |       |
| L      | 19.82    | 19.92 | 20.22 |
| L1     | -        | -     | 4.30  |
| ΦP     | 3.40     | 3.60  | 3.80  |
| ΦP1    | -        | -     | 7.30  |
| S      | 6.15 BSC |       |       |

Version 1: TO247-P package outline dimension

### Ordering Information

| Package Type | Units/ Tube | Tubes/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| TO247-P      | 30          | 11               | 330              | 6                       | 1980              |

### Product Information

| Product       | Package | Pb Free | RoHS | Halogen Free |
|---------------|---------|---------|------|--------------|
| OST40N120HSVF | TO247   | yes     | yes  | yes          |

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