



# STC20DE90HP

Hybrid emitter switched bipolar transistor

ESBT® 900 V - 20 A - 0.06 Ω

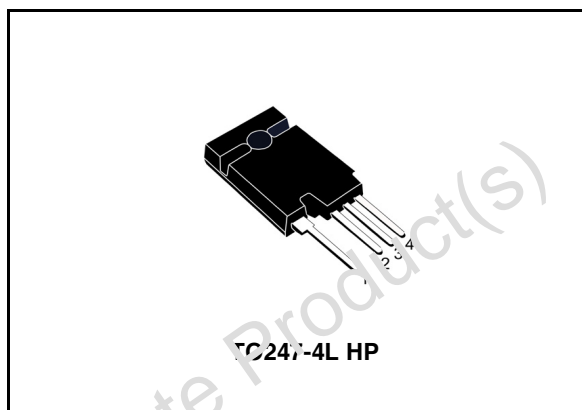
Preliminary Data

## General features

Table 1. General features

| $V_{CS(ON)}$ | $I_C$ | $R_{CS(ON)}$ |
|--------------|-------|--------------|
| 1.2 V        | 20 A  | 0.06 Ω       |

- Low equivalent on resistance
- Very fast-switch, up to 150 kHz
- Squared RBSOA, up to 900 V
- Very low  $C_{ISS}$  driven by  $R_G = 47 \Omega$
- In compliance with the 2002/93/EC European Directive



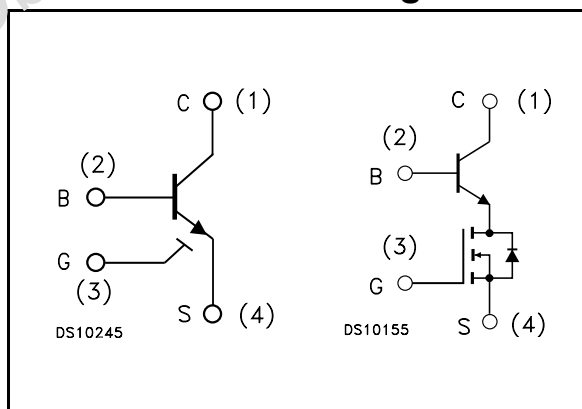
## Description

The STC20DE90HP is manufactured in a hybrid structure, using dedicated high voltage bipolar and low voltage MOSFET technologies, aimed to providing the best performance in ESBT topology. The STC20DE90HP is designed for use in power supply forward converter and three-phase power factor corrector applications.

## Applications

- SMPS forward converter
- Three-phase power factor corrector

## Internal schematic diagrams



## Order codes

| Part Number | Marking   | Package     | Packing |
|-------------|-----------|-------------|---------|
| STC20DE90HP | C20DE90HP | TO247-4L HP | Tube    |

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## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol       | Parameter   | Value      | Unit       |
|--------------|---|------------|------------|
| $V_{CS(SS)}$ | Collector-source voltage ( $V_{BS} = V_{GS} = 0V$ ) | 900        | V          |
| $V_{BS(OS)}$ | Base-source voltage ( $I_C = 0, V_{GS} = 0V$ )      | 30         | V          |
| $V_{SB(OS)}$ | Source-base voltage ( $I_C = 0, V_{GS} = 0V$ )      | 9          | V          |
| $V_{GS}$     | Gate-source voltage                                 | $\pm 20$   | V          |
| $I_C$        | Collector current                                   | 20         | A          |
| $I_{CM}$     | Collector peak current ( $t_P < 5ms$ )              | 60         | A          |
| $I_B$        | Base current  | 5          | A          |
| $I_{BM}$     | Base peak current ( $t_P < 1ms$ )                   | 20         | A          |
| $P_{tot}$    | Total dissipation at $T_C \leq 25^\circ C$          | 46         | W          |
| $T_{stg}$    | Storage temperature                                 | -40 to 150 | $^\circ C$ |
| $T_J$        | Max. operating junction temperature                 | 150        | $^\circ C$ |

**Table 3. Thermal data**

| Symbol         | Parameter                               | Value | Unit         |
|----------------|---|-------|--------------|
| $R_{thj-case}$ | Thermal resistance junction-case<br>max | 2.7   | $^\circ C/W$ |

## 2 Electrical characteristics

( $T_{\text{case}} = 25^{\circ}\text{C}$  unless otherwise specified)

**Table 4. Electrical characteristics**

| Symbol                           | Parameter   | Test Conditions  | Min. | Typ.        | Max. | Unit          |
|----------------------------------|---|--|------|-------------|------|---------------|
| $I_{\text{CS(SS)}}$              | Collector-source current<br>( $V_{\text{BS}} = V_{\text{GS}} = 0\text{V}$ ) | $V_{\text{CS(SS)}} = 900\text{V}$  |      |             | 100  | $\mu\text{A}$ |
| $I_{\text{BS(OS)}}$              | Base-source current<br>( $I_{\text{C}} = 0, V_{\text{GS}} = 0\text{V}$ )    | $V_{\text{BS(OS)}} = 30\text{V}$   |      |             | 10   | $\mu\text{A}$ |
| $I_{\text{SB(OS)}}$              | Source-base current<br>( $I_{\text{C}} = 0, V_{\text{GS}} = 0\text{V}$ )    | $V_{\text{SB(OS)}} = 9\text{V}$  |      |             | 100  | $\mu\text{A}$ |
| $I_{\text{GS(OS)}}$              | Gate-source leakage<br>( $V_{\text{BS}} = 0\text{V}$ )                      | $V_{\text{GS}} = \pm 20\text{V}$   |      |             | 500  | nA            |
| $V_{\text{CS(ON)}}$              | Collector-source ON<br>voltage  | $V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 20\text{A} \quad I_{\text{B}} = 4\text{A}$<br>$V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 10\text{A} \quad I_{\text{B}} = 1\text{A}$   |      | 1.2<br>0.65 |      | V<br>V        |
| $h_{\text{FE}}$                  | DC current gain   | $V_{\text{CS}} = 1\text{V} \quad V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 20\text{A}$<br>$V_{\text{CS}} = 1\text{V} \quad V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 10\text{A}$   |      | 4<br>12     |      |               |
| $V_{\text{BS(ON)}}$              | Base-source ON<br>voltage   | $V_{\text{GS}} = 0\text{V} \quad I_{\text{C}} = 20\text{A} \quad I_{\text{B}} = 4\text{A}$<br>$V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 10\text{A} \quad I_{\text{B}} = 1\text{A}$  |      | 1.8<br>1.2  |      | V<br>V        |
| $V_{\text{GS(th)}}$              | Gate threshold voltage  | $V_{\text{BS}} = V_{\text{GS}} \quad I_{\text{B}} = 250\mu\text{A}$  | 1.5  | 2.2         | 3    | V             |
| $C_{\text{iss}}$                 | Input capacitance   | $V_{\text{CS}} = 25\text{V} \quad f = 1\text{MHz}$<br>$V_{\text{GS}} = V_{\text{CB}} = 0\text{V}$  |      | 750         |      | pF            |
| $Q_{\text{GS(tot)}}$             | Gate-source Charge  | $V_{\text{CS}} = 25\text{V} \quad V_{\text{GS}} = 10\text{V}$<br>$V_{\text{CB}} = 0\text{V} \quad I_{\text{C}} = 20\text{A}$   |      | 12.5        |      | nC            |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | INDUCTIVE LOAD<br>Storage time<br>Fall time                                 | $V_{\text{GS}} = 10\text{V} \quad R_{\text{G}} = 47\Omega$<br>$V_{\text{Clamp}} = 720\text{V} \quad t_{\text{p}} = 4\mu\text{s}$<br>$I_{\text{C}} = 10\text{A} \quad I_{\text{B}} = 2\text{A}$   |      | 775<br>7    |      | ns<br>ns      |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | INDUCTIVE LOAD<br>Storage time<br>Fall time                                 | $V_{\text{GS}} = 10\text{V} \quad R_{\text{G}} = 47\Omega$<br>$V_{\text{Clamp}} = 720\text{V} \quad t_{\text{p}} = 4\mu\text{s}$<br>$I_{\text{C}} = 10\text{A} \quad I_{\text{B}} = 1\text{A}$   |      | 510<br>5    |      | ns<br>ns      |
| $V_{\text{CS(dyn)}}$             | Collector-source<br>dynamic voltage<br>(500ns)                              | $V_{\text{CC}} = V_{\text{Clamp}} = 400\text{V}$<br>$V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 10\text{A}$<br>$I_{\text{B}} = 2\text{A} \quad R_{\text{G}} = 47\Omega$<br>$t_{\text{peak}} = 500\text{ns} \quad I_{\text{Bpeak}} = 10\text{A}$ |      | 2.3         |      | V             |

Table 4. Electrical characteristics

| Symbol        | Parameter   | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|------|------|------|
| $V_{CS(dyn)}$ | Collector-source dynamic voltage (1 $\mu$ s)              | $V_{CC} = V_{Clamp} = 400V$<br>$V_{GS} = 10V$ $I_C = 10A$<br>$I_B = 2A$ $R_G = 47\Omega$<br>$t_{peak} = 500ns$ $I_{Bpeak} = 10A$ |      | 1    |      | V    |
| $V_{CSW}$     | Maximum collector-source voltage switched without snubber | $R_G = 47\Omega$ $h_{FE} = 5$ $I_C = 20A$  | 900  |      |      | V    |

Note (1) Pulsed duration = 300  $\mu$ s, duty cycle  $\leq 1.5\%$

## 2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

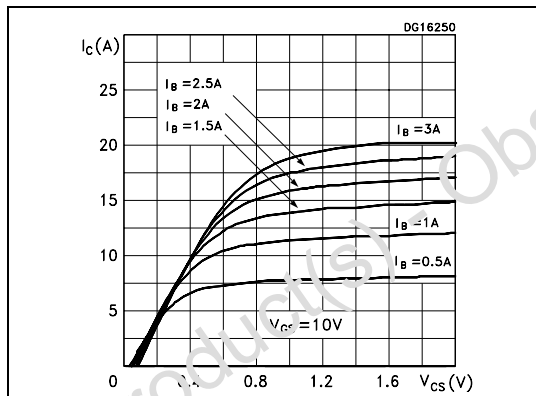


Figure 2. Dynamic collector-source saturation voltage

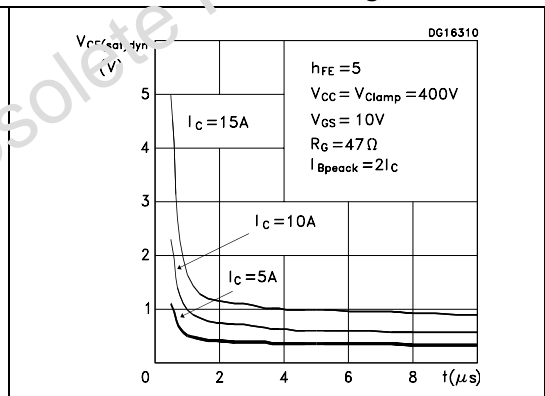


Figure 3. DC current gain

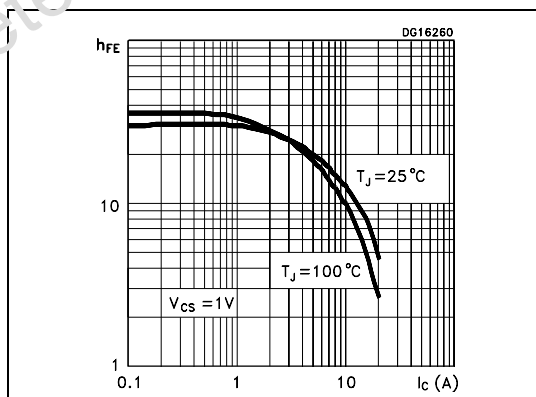


Figure 4. Gate threshold voltage vs temperature

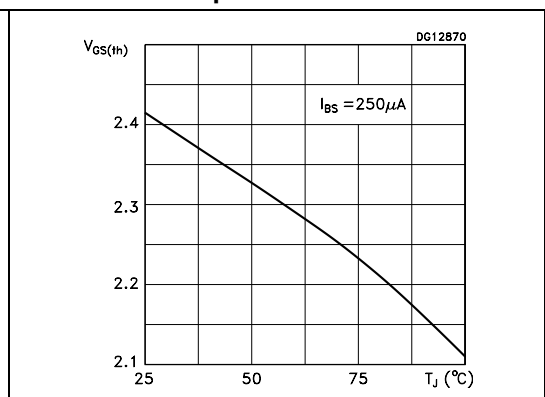


Figure 5. Collector-source On voltage Figure 6. Collector-source On voltage

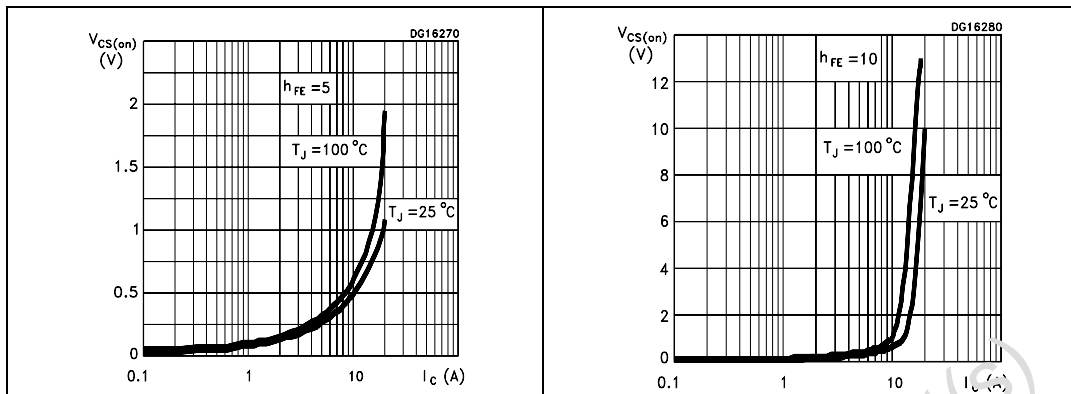


Figure 7. Base-source On voltage Figure 8. Base-source On voltage

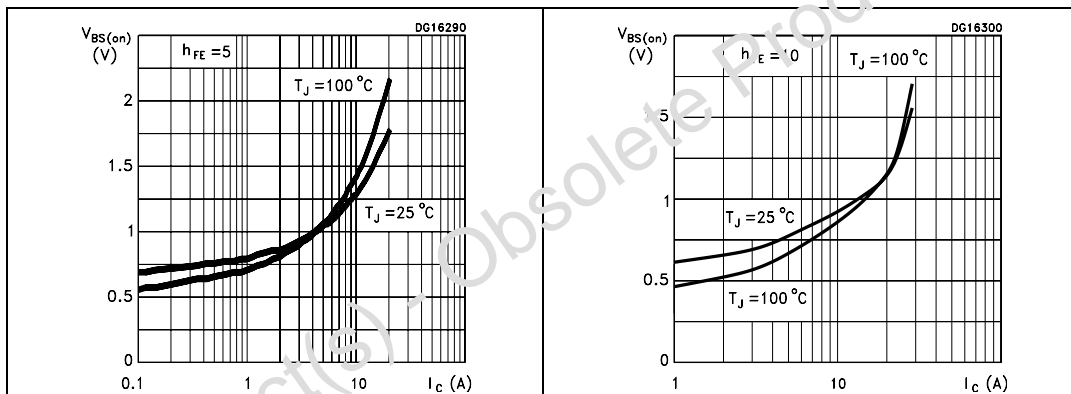
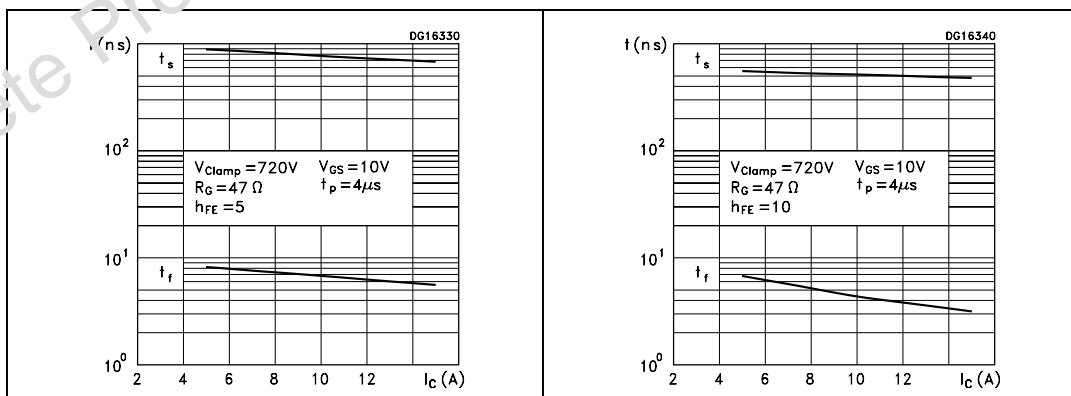
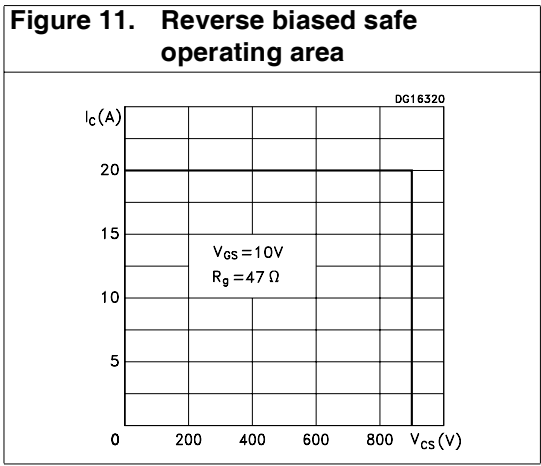


Figure 9. Inductive load switching time Figure 10. Inductive load switching time





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### 3 Package mechanical data

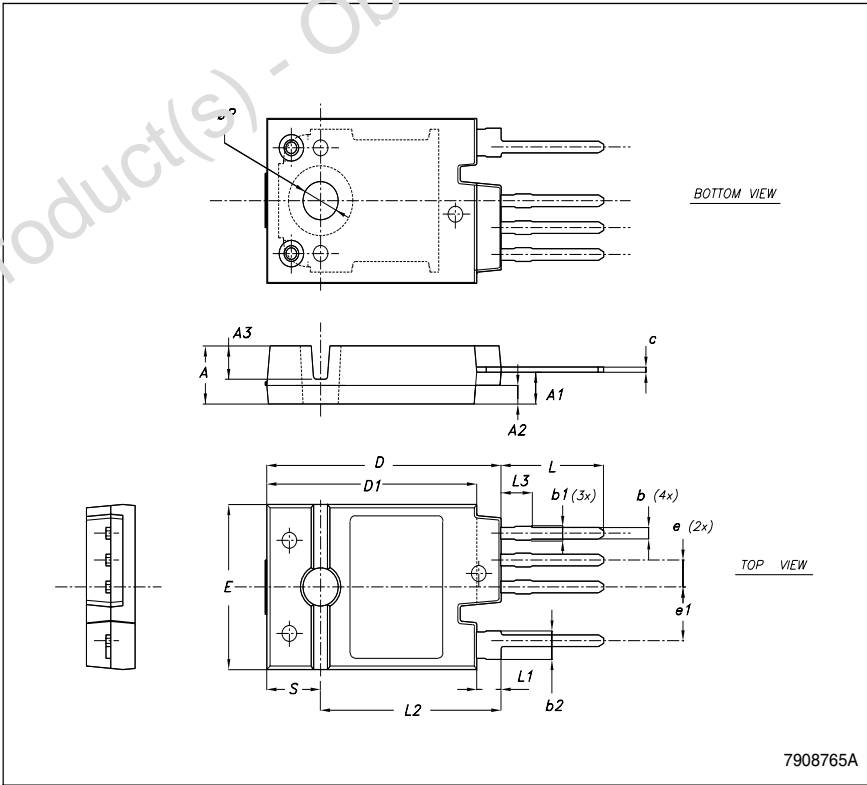
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**TO247-4LHP MECHANICAL DATA**

| DIM. | mm.   |       |       |
|------|-------|-------|-------|
|      | MIN.  | TYP   | MAX.  |
| A    | 5.50  | 5.65  | 5.80  |
| A1   | 2.85  | 3.15  | 3.25  |
| A2   |       | 1.92  |       |
| A3   |       | 3.18  |       |
| b    | 0.95  | 1.10  | 1.30  |
| b1   | 1.10  |       | 1.50  |
| b2   | 2.50  |       | 2.90  |
| c    | 0.40  |       | 0.80  |
| D    | 23.85 | 24    | 24.15 |
| D1   |       | 21.50 |       |
| E    | 15.45 | 15.60 | 15.75 |
| e    | 2.54  |       |       |
| e1   |       | 5.08  |       |
| L    | 10.20 |       | 10.80 |
| L1   | 2.20  | 2.50  | 2.80  |
| L2   |       | 19.50 |       |
| L3   |       | 3     |       |
| øP   | 3.55  |       | 3.65  |
| S    |       | 5.50  |       |



## 4 Revision history

Table 5. Revision history

| Date        | Revision | Changes        |
|-------------|----------|----------------|
| 10-Oct-2006 | 1        | First release. |

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