



# STP12IE95F4

Emitter Switched Bipolar Transistor  
ESBT® 950 V - 12 A - 0.083  $\Omega$

Preliminary Data

## General features

| $V_{CS(ON)}$ | $I_C$ | $R_{CS(ON)}$   |
|--------------|-------|----------------|
| 1V           | 12A   | 0.083 $\Omega$ |

- High voltage / high current Cascode configuration
- Low equivalent on resistance
- Very fast-switch up to 150 kHz
- Squared RBSOA up to 950V
- Very low  $C_{iss}$  driven by  $R_G = 47\Omega$
- Very low turn-off cross over time

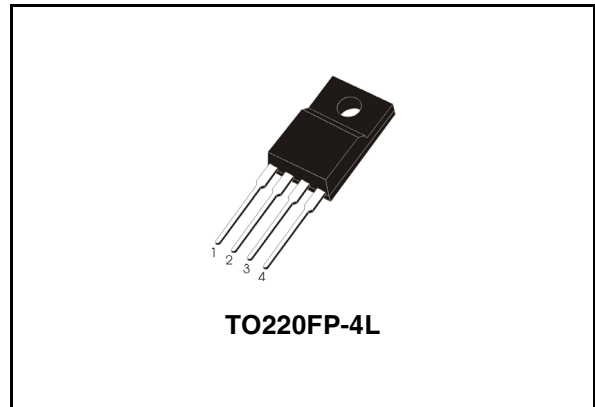
## Applications

- Flyback SMPS for adapter
- Flyback / forward SMPS for desktop

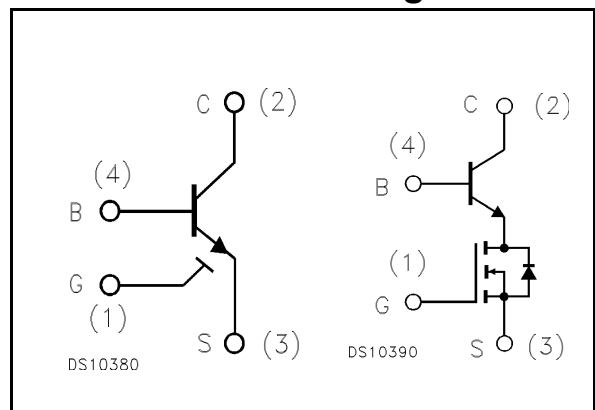
## Description

The STP12IE95F4 is manufactured in Monolithic ESBT Technology, aimed to provide best performances in high frequency / high voltage applications.

It is designed for use in Gate Driven based topologies.



## Internal schematic diagrams



## Order codes

| Part Number | Marking   | Package    | Packing |
|-------------|-----------|------------|---------|
| STP12IE95F4 | P12IE95F4 | TO220FP-4L | Tube    |

## Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum rating**

| Symbol       | Parameter                                                   | Value      | Unit             |
|--------------|-------------------------------------------------------------|------------|------------------|
| $V_{CS(SS)}$ | Collector-source voltage ( $V_{BS} = V_{GS} = 0\text{ V}$ ) | 950        | V                |
| $V_{BS(OS)}$ | Base-source voltage ( $I_C = 0, V_{GS} = 0\text{ V}$ )      | 30         | V                |
| $V_{SB(OS)}$ | Source-base voltage ( $I_C = 0, V_{GS} = 0\text{ V}$ )      | 17         | V                |
| $V_{GS}$     | Gate-source voltage                                         | $\pm 17$   | V                |
| $I_C$        | Collector current                                           | 12         | A                |
| $I_{CM}$     | Collector peak current ( $t_P < 5\text{ms}$ )               | 36         | A                |
| $I_B$        | Base current                                                | 5          | A                |
| $I_{BM}$     | Base peak current ( $t_P < 5\text{ms}$ )                    | 10         | A                |
| $P_{tot}$    | Total dissipation at $T_c = 25^\circ\text{C}$               | 21         | W                |
| $T_{stg}$    | Storage temperature                                         | -40 to 150 | $^\circ\text{C}$ |
| $T_J$        | Max. operating junction temperature                         | 150        | $^\circ\text{C}$ |

**Table 2. Thermal data**

| Symbol         | Parameter                            | Value | Unit               |
|----------------|--------------------------------------|-------|--------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 6     | $^\circ\text{C/W}$ |

## 2 Electrical characteristics

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

**Table 3. Electrical characteristics**

| Symbol                           | Parameter                                                           | Test Conditions                                                                                                                                                                                 | Min. | Typ.       | Max. | Unit          |
|----------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------|------|---------------|
| $I_{\text{CS(SS)}}$              | Collector-source current<br>( $V_{\text{BS}} = V_{\text{GS}} = 0$ ) | $V_{\text{CE}} = 950\text{V}$                                                                                                                                                                   |      |            | 100  | $\mu\text{A}$ |
| $I_{\text{BS(OS)}}$              | Base-source current<br>( $I_{\text{C}} = 0, V_{\text{GS}} = 0$ )    | $V_{\text{BS(OS)}} = 30\text{V}$                                                                                                                                                                |      |            | 10   | $\mu\text{A}$ |
| $I_{\text{SB(OS)}}$              | Source-base current<br>( $I_{\text{C}} = 0, V_{\text{GS}} = 0$ )    | $V_{\text{SB(OS)}} = 17\text{V}$                                                                                                                                                                |      |            | 100  | $\mu\text{A}$ |
| $I_{\text{GS(OS)}}$              | Gate-source leakage                                                 | $V_{\text{GS}} = \pm 17\text{V}$                                                                                                                                                                |      |            | 100  | nA            |
| $V_{\text{CS(ON)}}$              | Collector-source ON voltage                                         | $V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 12\text{A} \quad I_{\text{B}} = 2.4\text{A}$<br>$V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 6\text{A} \quad I_{\text{B}} = 0.6\text{A}$   |      | 1<br>0.6   |      | V<br>V        |
| $h_{\text{FE}}$                  | DC current gain                                                     | $V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 12\text{A} \quad V_{\text{CS}} = 1\text{V}$<br>$V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 6\text{A} \quad V_{\text{CS}} = 1\text{V}$     |      | 5<br>15    |      |               |
| $V_{\text{BS(ON)}}$              | Base Source ON voltage                                              | $V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 12\text{A} \quad I_{\text{B}} = 2.4\text{A}$<br>$V_{\text{GS}} = 10\text{V} \quad I_{\text{C}} = 6\text{A} \quad I_{\text{B}} = 0.6\text{A}$   |      | 1.5<br>1.2 |      | V<br>V        |
| $V_{\text{GS(th)}}$              | Gate threshold voltage                                              | $V_{\text{BS}} = V_{\text{GS}} \quad I_{\text{B}} = 250\mu\text{A}$                                                                                                                             | 2    | 3          | 4    | V             |
| $C_{\text{iss}}$                 | Input capacitance                                                   | $V_{\text{CS}} = 25\text{V} \quad f = 1\text{MHz}$<br>$V_{\text{GS}} = 0\text{V}$                                                                                                               |      | 520        |      | pF            |
| $Q_{\text{GS(tot)}}$             | Gate-source Charge                                                  | $V_{\text{CS}} = 25\text{V} \quad V_{\text{GS}} = 10\text{V}$<br>$V_{\text{CB}} = 0\text{V} \quad I_{\text{C}} = 4\text{A}$                                                                     |      | 21.3       |      | 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>$I_{\text{C}} = 6\text{A} \quad I_{\text{B}} = 1.2\text{A}$ |      | 610<br>10  |      | 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>$I_{\text{C}} = 6\text{A} \quad I_{\text{B}} = 0.6\text{A}$ |      | 360<br>10  |      | ns<br>ns      |
| $V_{\text{CSW}}$                 | Maximum collector-source voltage switched without snubber           | $R_{\text{G}} = 47\Omega$<br>$I_{\text{C}} = 12\text{A} \quad h_{\text{FE}} = 5$                                                                                                                | 950  |            |      | V             |

Table 3. Electrical characteristics

| Symbol        | Parameter                                | Test Conditions                                                                                                       | Min. | Typ. | Max. | Unit |
|---------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CS(dyn)}$ | Collector-source dynamic voltage (500ns) | $V_{CC}=V_{Clamp}=400V$<br>$V_{GS}=10V$ $I_C=6A$<br>$I_B=1.2A$ $t_{peak}=500ns$<br>$R_G=47\Omega$ $I_{Bpeak}=6A(I_C)$ |      | 3.37 |      | V    |
| $V_{CS(dyn)}$ | Collector-source dynamic voltage (1μs)   | $V_{CC}=V_{Clamp}=400V$<br>$V_{GS}=10V$ $I_C=6A$<br>$I_B=1.2A$ $t_{peak}=500ns$<br>$R_G=47\Omega$ $I_{Bpeak}=6A(I_C)$ |      | 1.75 |      | V    |

2.1 Electrical characteristics (curves)

Figure 1. DC current gain

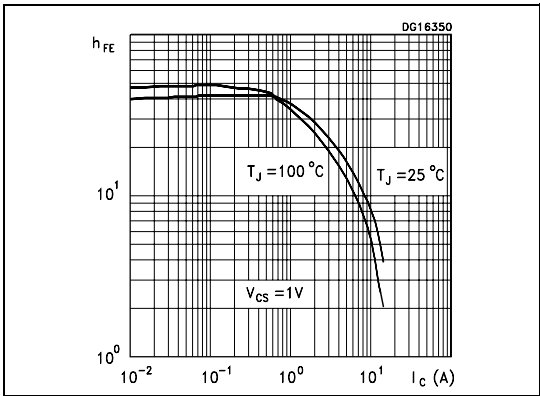


Figure 2. Collector-source On voltage

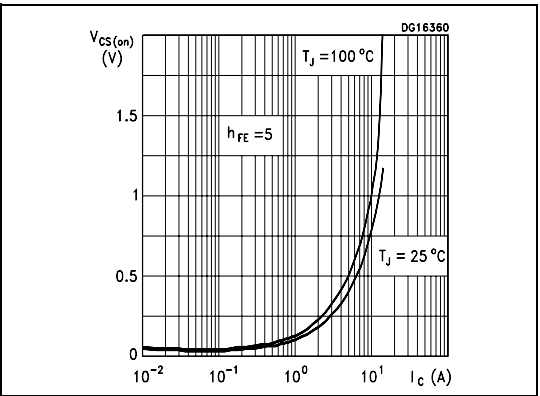


Figure 3. Collector-source On voltage Figure 4. Base-source On voltage

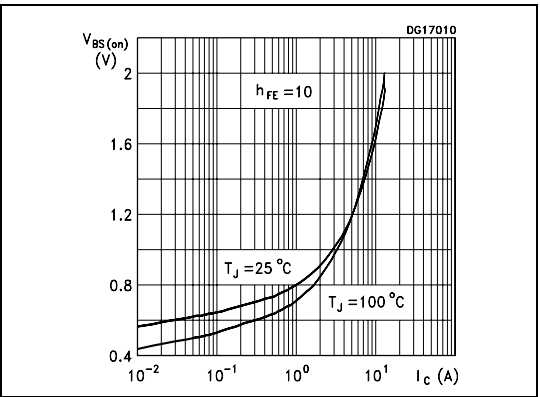
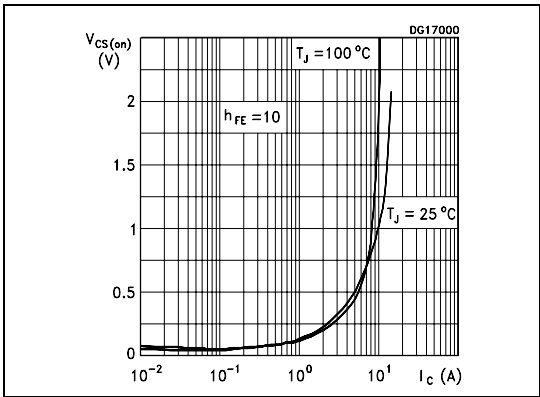


Figure 5. Reverse biased SOA

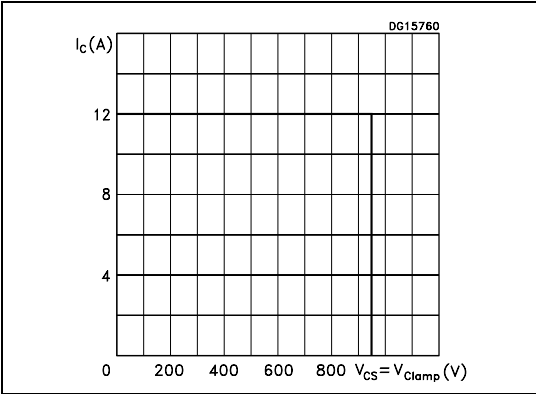


Figure 6. Dynamic collector-emitter voltage

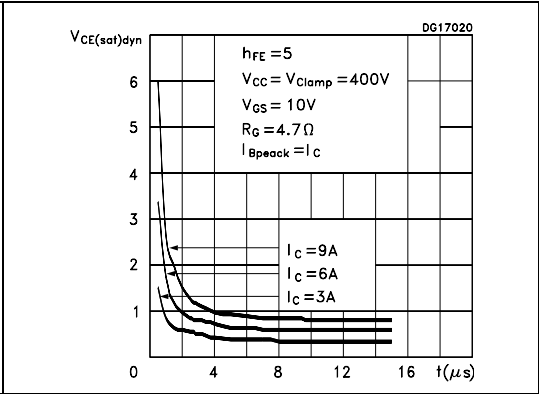


Figure 7. Inductive load switching time

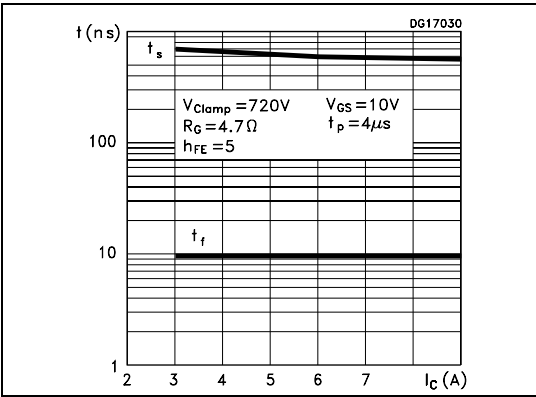
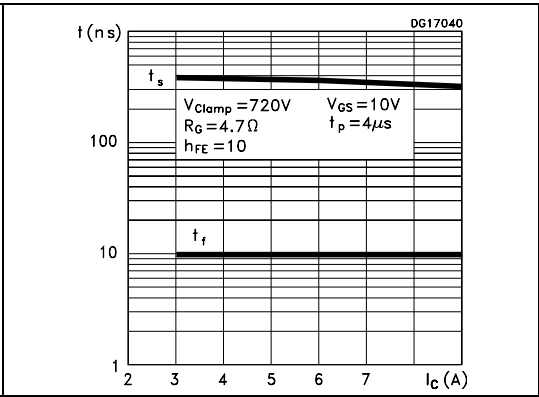
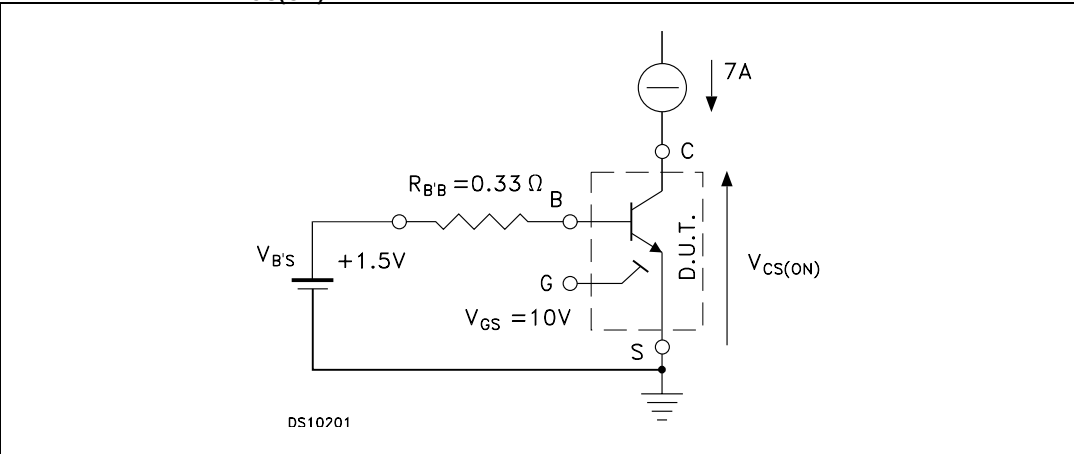


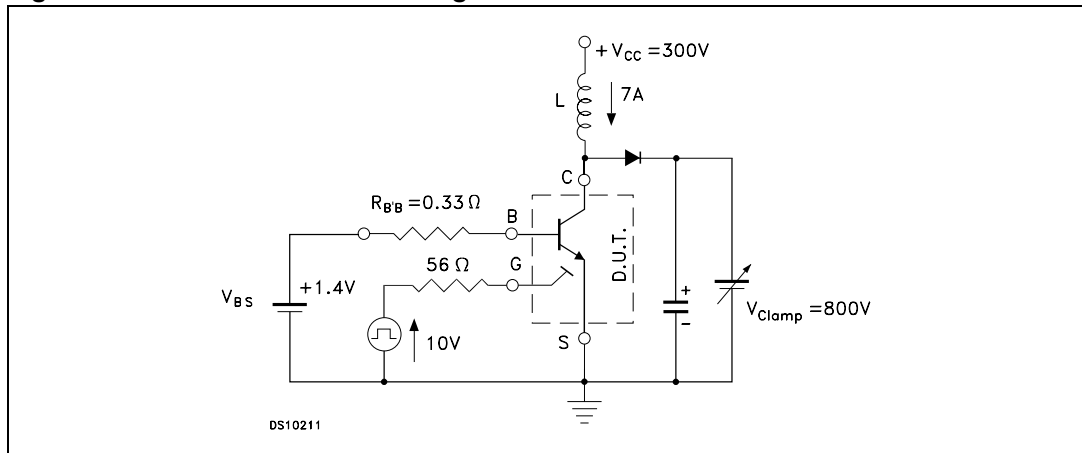
Figure 8. Inductive load switching time



## 2.2 Test circuits

Figure 9. Static  $V_{CS(ON)}$  test circuits



**Figure 10. Inductive load switching and RBSOA test circuit**

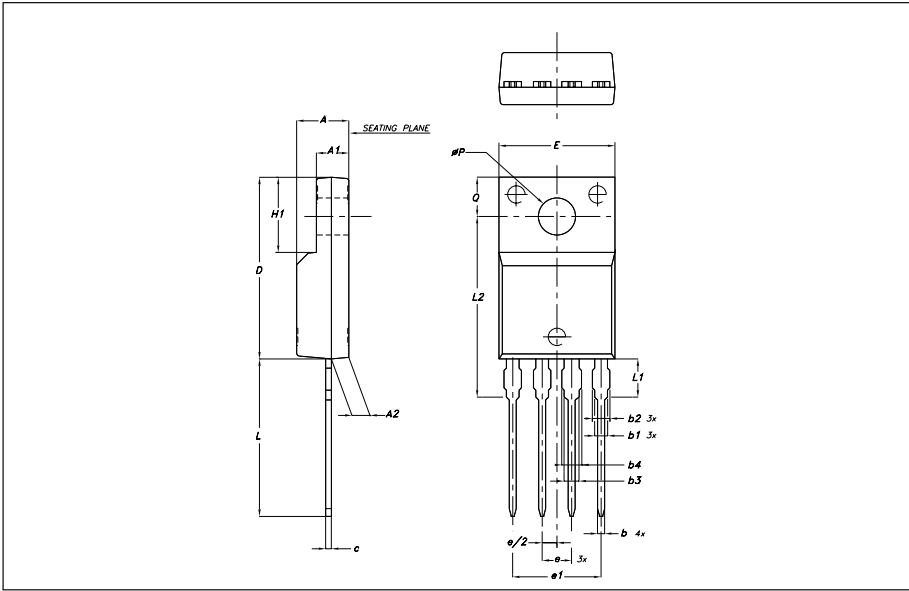
### 3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)



TO220FP-4L MECHANICAL DATA

| DIM.  | mm.   |       |       |
|-------|-------|-------|-------|
|       | MIN.  | TYP   | MAX.  |
| A     | 4.30  |       | 4.70  |
| A1    | 2.60  |       | 3     |
| A2    | 1.30  | 1.50  | 1.70  |
| b     | 0.50  |       | 0.70  |
| b1    | 1.05  |       |       |
| b2    |       |       | 1.30  |
| b3    | 1.25  |       |       |
| b4    |       |       | 1.50  |
| c     | 0.45  | 0.50  | 0.60  |
| D     | 15.50 |       | 15.90 |
| E     | 9.80  |       | 10.20 |
| e     | 2.29  | 2.54  | 2.79  |
| e1    |       | 7.62  |       |
| H1    | 6.30  |       | 6.70  |
| L     |       | 13.60 |       |
| L1    |       | 3.30  |       |
| L2    | 15.40 |       | 15.80 |
| Dia P | 3     |       | 3.40  |
| Q     | 3.30  |       | 3.50  |



## 4 Revision history

**Table 4. Revision history**

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 16-Jan-2007 | 1        | Initial release. |

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