

Silicon Diffused Power Transistor

BUT12AI

GENERAL DESCRIPTION

Improved high-voltage, high-speed glass-passivated npn power transistor in a TO220AB envelope specially suited for use in overhead/high frequency lighting ballast applications and converters, inverters, switching regulators, motor control systems, etc.

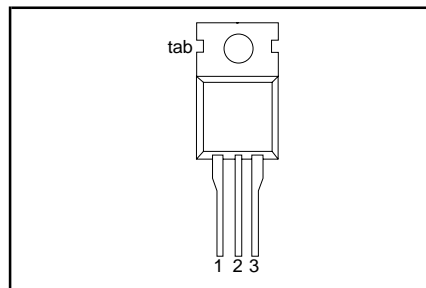
QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | TYP. | MAX. | UNIT |
|-------------|---------------------------------------|--|------|------|------|
| V_{CESM} | Collector-emitter voltage peak value | $V_{BE} = 0\text{ V}$ | - | 1000 | V |
| V_{CEO} | Collector-emitter voltage (open base) | | - | 450 | V |
| I_C | Collector current (DC) | | - | 8 | A |
| I_{CM} | Collector current peak value | | - | 20 | A |
| P_{tot} | Total power dissipation | $T_{hs} \leq 25\text{ }^\circ\text{C}$ | - | 110 | W |
| V_{CEsat} | Collector-emitter saturation voltage | $I_C = 5\text{ A}; I_B = 0.86\text{ A}$ | - | 1.5 | V |
| I_{Csat} | Collector saturation current | | 5 | - | A |
| t_f | Inductive fall time | $I_{Con} = 5\text{ A}; I_{Bon} = 1.0\text{ A}; T_j \leq 100\text{ }^\circ\text{C}$ | | 300 | ns |

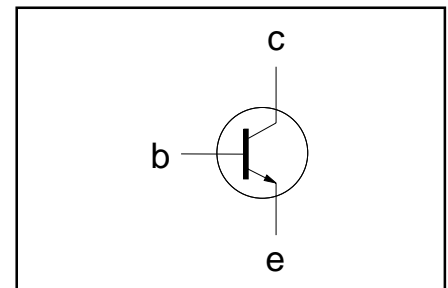
PINNING - TO220AB

| PIN | DESCRIPTION |
|-----|-------------|
| 1 | base |
| 2 | collector |
| 3 | emitter |
| tab | collector |

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

Limiting values in accordance with the Absolute Maximum Rating System (IEC 134)

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|------------|---------------------------------------|--|------|------|------------------|
| V_{CESM} | Collector-emitter voltage peak value | $V_{BE} = 0\text{ V}$ | - | 1000 | V |
| V_{CEO} | Collector-emitter voltage (open base) | | - | 450 | V |
| I_C | Collector current (DC) | | - | 8 | A |
| I_{CM} | Collector current peak value | | - | 20 | A |
| I_B | Base current (DC) | | - | 4 | A |
| I_{BM} | Base current peak value | | - | 6 | A |
| P_{tot} | Total power dissipation | $T_{hs} \leq 25\text{ }^\circ\text{C}$ | - | 110 | W |
| T_{stg} | Storage temperature | | -65 | 150 | $^\circ\text{C}$ |
| T_j | Junction temperature | | - | 150 | $^\circ\text{C}$ |

THERMAL RESISTANCES

| SYMBOL | PARAMETER | CONDITIONS | TYP. | MAX. | UNIT |
|----------------|----------------------|------------------------|------|------|------|
| $R_{th\ j-hs}$ | Junction to heatsink | with heatsink compound | - | 1.15 | K/W |
| $R_{th\ j-a}$ | Junction to ambient | in free air | - | 60 | K/W |

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STATIC CHARACTERISTICS

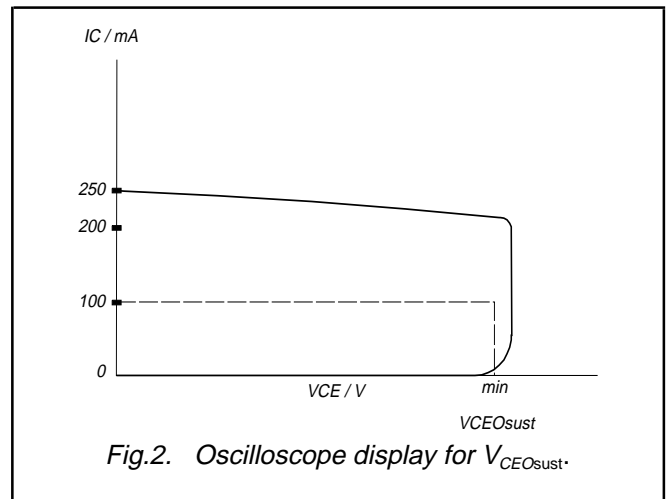
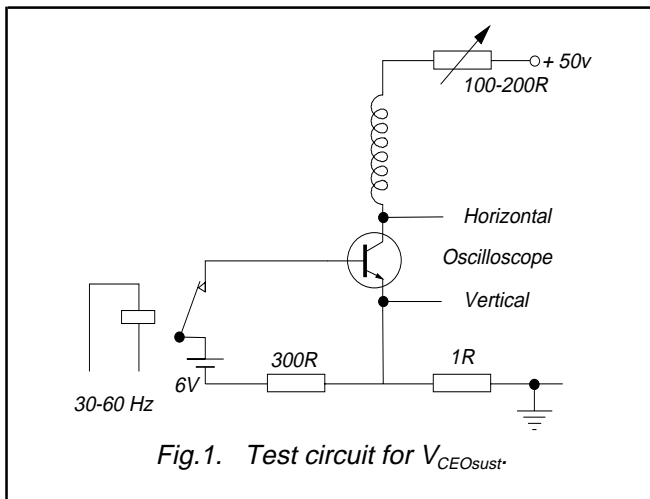
$T_{hs} = 25\text{ }^\circ\text{C}$ unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------|--|--|---|------|------|------|
| I_{CES} | Collector cut-off current ¹ | $V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ | - | - | 1.0 | mA |
| I_{CES} | | $V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ $T_j = 125\text{ }^\circ\text{C}$ | - | - | 3.0 | mA |
| I_{EBO} | Emitter cut-off current | $V_{EB} = 9\text{ V}; I_C = 0\text{ A}$ | - | - | 10 | mA |
| $V_{CEOsust}$ | Collector-emitter sustaining voltage | $I_B = 0\text{ A}; I_C = 100\text{ mA};$ $L = 25\text{ mH}$ | 450 | - | - | V |
| V_{CEsat} | Collector-emitter saturation voltages | $I_C = 5\text{ A}; I_B = 0.86\text{ A}$ | - | - | 1.5 | V |
| V_{BEsat} | | Base-emitter saturation voltage | $I_C = 5\text{ A}; I_B = 0.86\text{ A}$ | - | - | 1.3 |
| h_{FE} | DC current gain | $I_C = 10\text{ mA}; V_{CE} = 5\text{ V}$ | 10 | 18 | 35 | |
| h_{FE} | | $I_C = 1.0\text{ A}; V_{CE} = 5\text{ V}$ | 14 | 20 | 35 | |
| h_{FEsat} | | $I_C = 5.0\text{ A}; V_{CE} = 1.5\text{ V}$ | 5.8 | 10 | 12.5 | |

DYNAMIC CHARACTERISTICS

$T_{hs} = 25\text{ }^\circ\text{C}$ unless otherwise specified

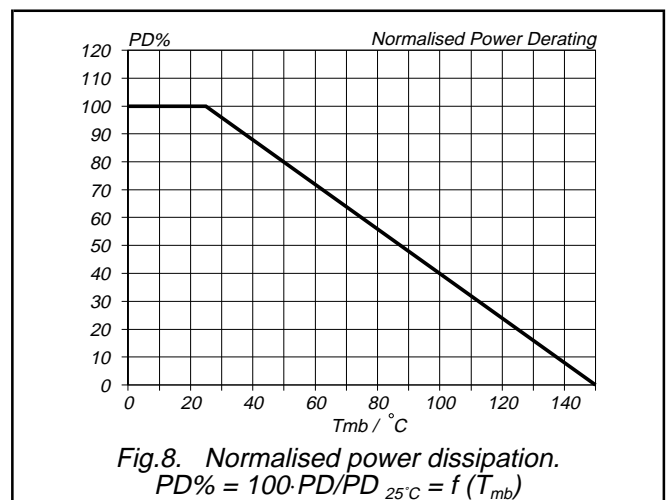
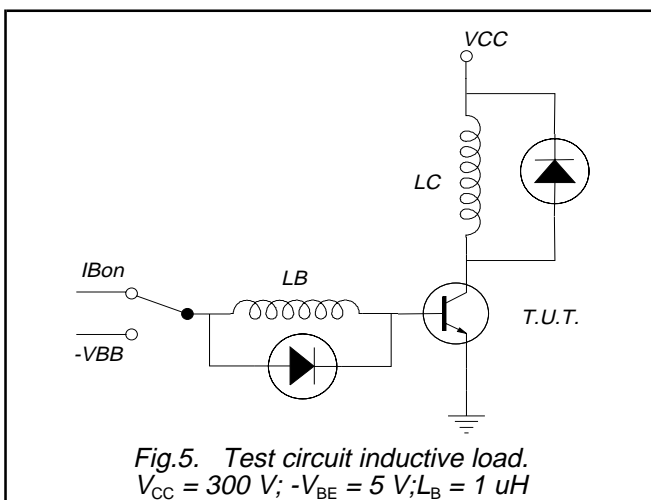
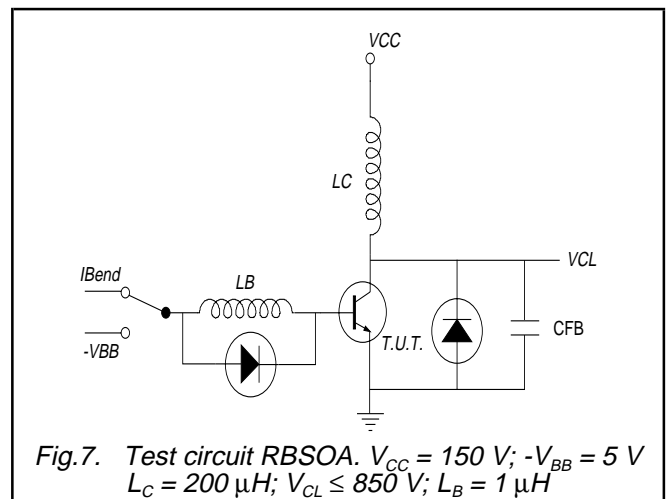
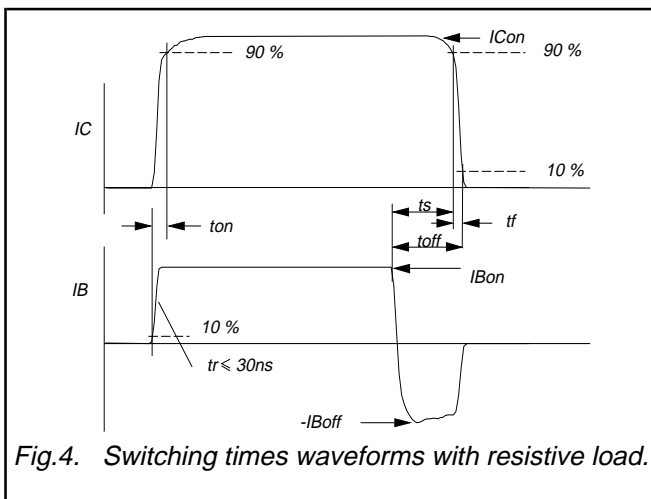
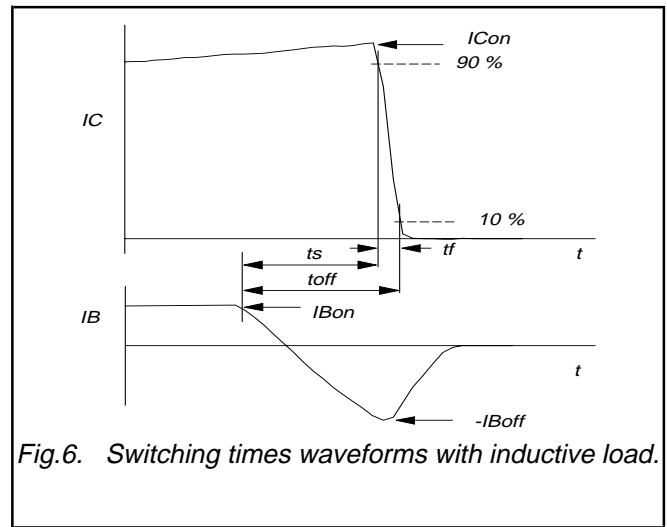
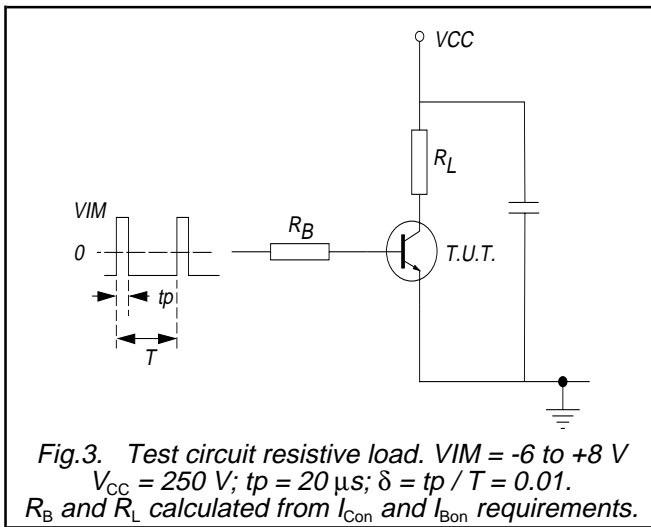
| SYMBOL | PARAMETER | CONDITIONS | TYP. | MAX. | UNIT |
|----------|---|--|------|------|---------------|
| t_{on} | Switching times (resistive load) Turn-on time Turn-off storage time Turn-off fall time | $I_{Con} = 5\text{ A}; I_{Bon} = -I_{Boff} = 1.0\text{ A}$ | - | 1.0 | μs |
| t_s | | | - | 4.0 | μs |
| t_f | | | - | 0.8 | μs |
| t_s | Switching times (inductive load) Turn-off storage time Turn-off fall time | $I_{Con} = 5\text{ A}; I_{Bon} = 1.0\text{ A}; L_B = 1\text{ }\mu\text{H};$ $-V_{BB} = 5\text{ V}; T_j = 100\text{ }^\circ\text{C}$ | 1.9 | 2.5 | μs |
| t_f | | | 150 | 300 | ns |



¹ Measured with half sine-wave voltage (curve tracer).

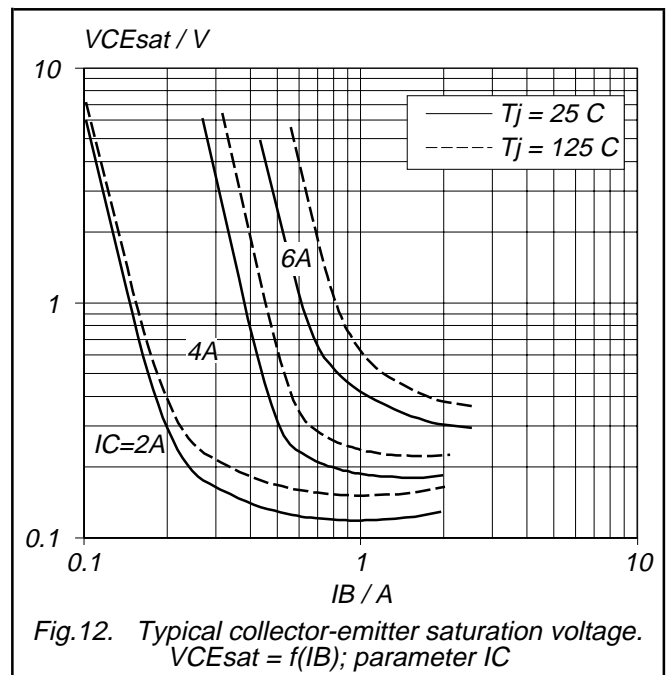
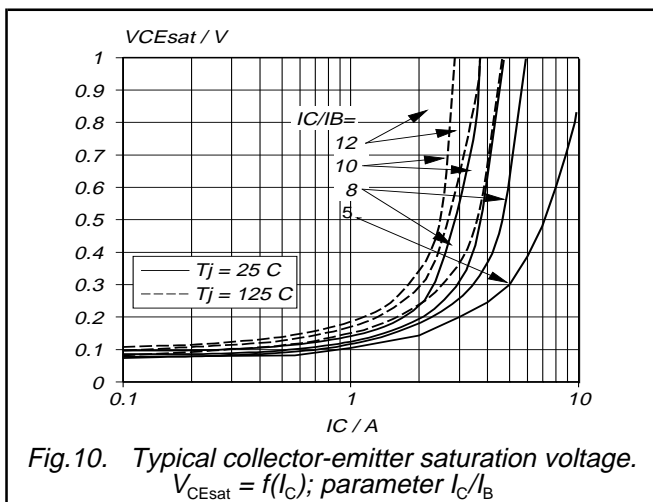
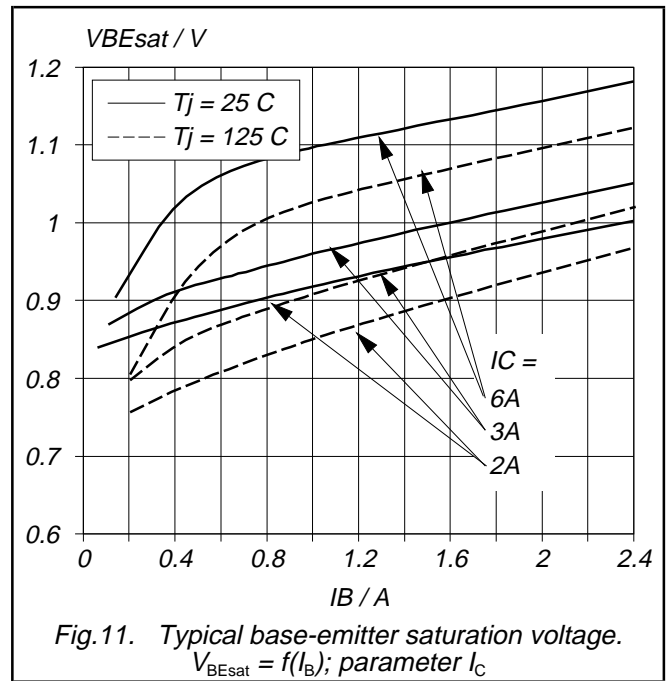
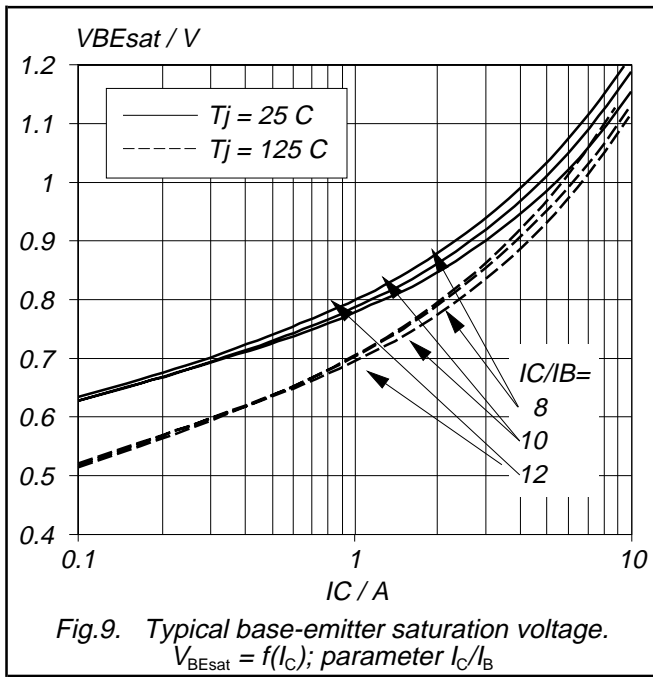
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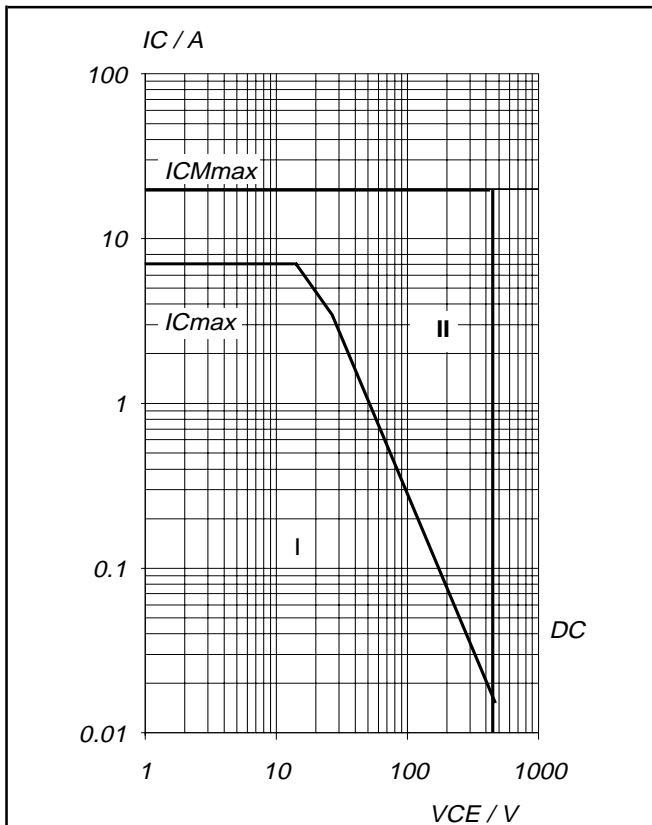


Fig.13. Forward bias safe operating area. $T_{mb} = 25^\circ\text{C}$

- I Region of permissible DC operation.
- II Extension for repetitive pulse operation.
- NB: Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

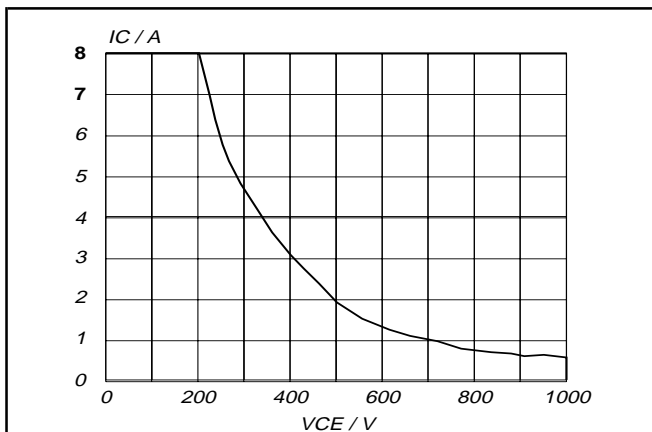


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

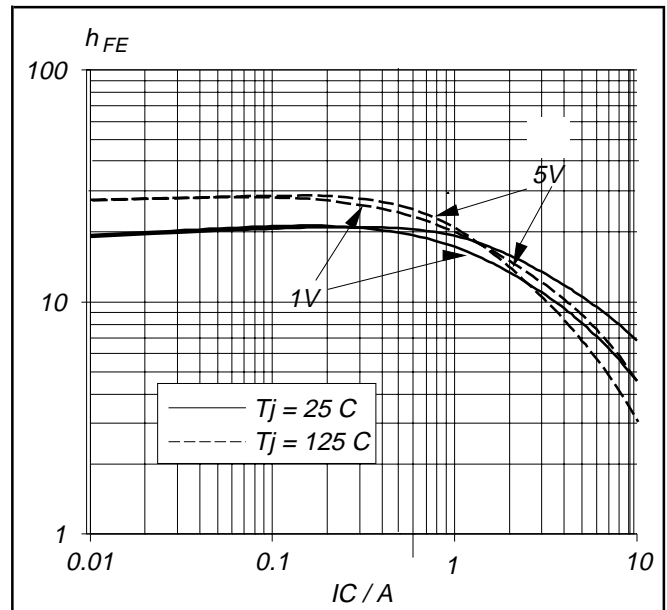


Fig.15. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

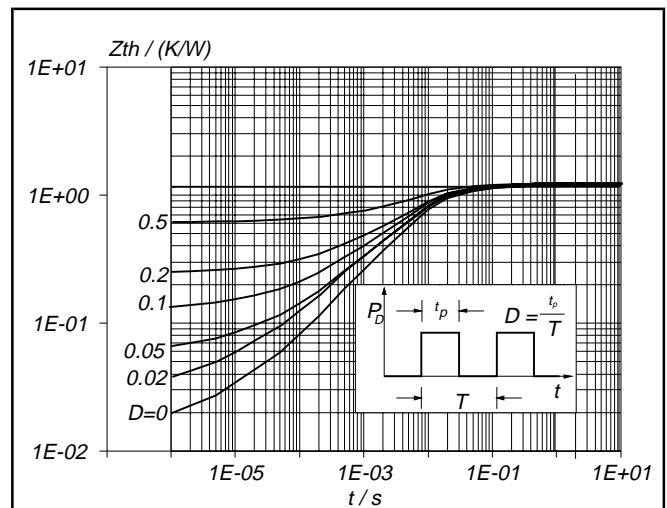


Fig.16. Transient thermal impedance. $Z_{th-j-mb} = f(t)$; parameter $D = t_p/T$

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MECHANICAL DATA



Notes

1. Refer to mounting instructions for TO220 envelopes.
2. Epoxy meets UL94 V0 at 1/8".

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DEFINITIONS

| | |
|--|---|
| Data sheet status | |
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| Limiting values | |
| Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| Application information | |
| Where application information is given, it is advisory and does not form part of the specification. | |
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