

# High voltage fast-switching NPN power transistor

Datasheet — production data

## Features

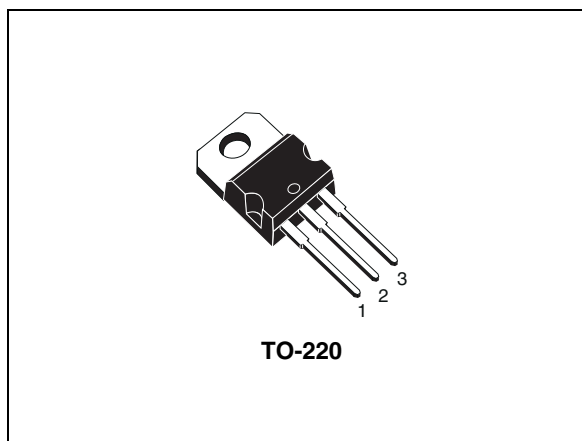
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed

## Applications

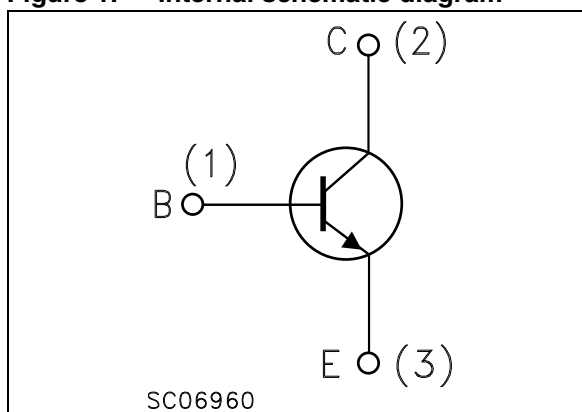
- Electronic ballast for fluorescent lighting
- Switch mode power supplies

## Description

This device is manufactured using high voltage multi epitaxial planar technology for high switching speeds and high voltage capability. It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining a wide RBSOA.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

| Order code | Marking <sup>(1)</sup>                              | Package | Packaging |
|------------|-----------------------------------------------------|---------|-----------|
| ST13005    | 13005 A<br>13005 C<br>13005 D<br>13005 E<br>13005 F | TO-220  | Tube      |

1. Product is pre-selected in DC current gain (group A, C, D, E and F). STMicroelectronics reserves the right to ship either groups according to production availability. Please contact your nearest STMicroelectronics sales office for delivery details.

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol    | Parameter                                  | Value       | Unit |
|-----------|--------------------------------------------|-------------|------|
| $V_{CES}$ | Collector-emitter voltage ( $V_{BE} = 0$ ) | 700         | V    |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )    | 400         | V    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )         | 9           | V    |
| $I_C$     | Collector current                          | 4           | A    |
| $I_{CM}$  | Collector peak current ( $t_P < 5$ ms)     | 8           | A    |
| $I_B$     | Base current                               | 2           | A    |
| $I_{BM}$  | Base peak current ( $t_P < 5$ ms)          | 4           | A    |
| $P_{TOT}$ | Total dissipation at $T_C \leq 25$ °C      | 75          | W    |
| $T_{STG}$ | Storage temperature                        | - 65 to 150 | °C   |
| $T_J$     | Max. operating junction temperature        | 150         | °C   |

**Table 3. Thermal data**

| Symbol         | Parameter                            | Value | Unit |
|----------------|--------------------------------------|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.7   | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-amb max  | 62.5  | °C/W |

## 2 Electrical characteristics

$T_{\text{case}} = 25\text{ °C}$  unless otherwise specified.

**Table 4. Electrical characteristics**

| Symbol                           | Parameter                                                      | Test conditions                                                                                                                                                                   | Min.                            | Typ. | Max.                             | Unit                           |
|----------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------|----------------------------------|--------------------------------|
| $I_{\text{CES}}$                 | Collector cut-off current<br>( $V_{\text{BE}} = 0$ )           | $V_{\text{CE}} = 700\text{ V}$<br>$V_{\text{CE}} = 700\text{ V } T_{\text{C}} = 125\text{ °C}$                                                                                    |                                 |      | 1<br>5                           | mA<br>mA                       |
| $I_{\text{EBO}}$                 | Emitter cut-off current<br>( $I_{\text{C}} = 0$ )              | $V_{\text{EB}} = 9\text{ V}$                                                                                                                                                      |                                 |      | 1                                | mA                             |
| $V_{\text{CEO(sus)}}^{(1)}$      | Collector-emitter<br>sustaining voltage ( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 10\text{ mA}$                                                                                                                                                     | 400                             |      |                                  | V                              |
| $V_{\text{CE(sat)}}^{(1)}$       | Collector-emitter<br>saturation voltage                        | $I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 0.2\text{ A}$<br>$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.5\text{ A}$<br>$I_{\text{C}} = 4\text{ A}$ $I_{\text{B}} = 1\text{ A}$ |                                 |      | 0.5<br>0.6<br>1                  | V<br>V<br>V                    |
| $V_{\text{BE(sat)}}^{(1)}$       | Base-emitter saturation<br>voltage                             | $I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 0.2\text{ A}$<br>$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.5\text{ A}$                                                            |                                 |      | 1.2<br>1.6                       | V<br>V                         |
| $h_{\text{FE}}^{(1)(2)}$         | DC current gain                                                | $I_{\text{C}} = 1\text{ A}$ $V_{\text{CE}} = 5\text{ V}$<br>Group A<br>Group C<br>Group D<br>Group E<br>Group F<br>$I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$       | 15<br>16<br>21<br>26<br>31<br>8 |      | 32<br>22<br>27<br>32<br>37<br>40 |                                |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Resistive load<br>Storage time<br>Fall time                    | $I_{\text{C}} = 2\text{ A}$ $V_{\text{CC}} = 125\text{ V}$<br>$I_{\text{B1}} = -I_{\text{B2}} = 0.4\text{ A}$<br>$t_{\text{p}} = 30\text{ }\mu\text{s}$                           | 1.5                             | 0.2  | 3                                | $\mu\text{s}$<br>$\mu\text{s}$ |

1. Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle  $\leq 2\%$ .
2. Product is pre-selected in DC current gain (group A, C, D, E and F). STMicroelectronics reserves the right to ship either groups according to production availability. Please contact your nearest STMicroelectronics sales office for delivery details

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

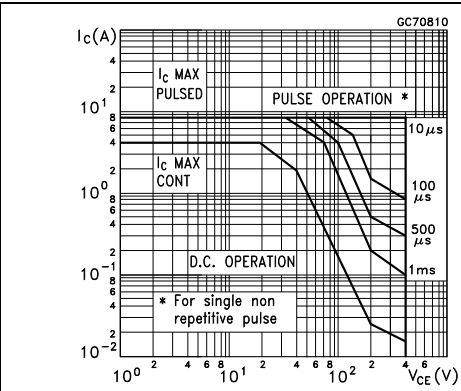


Figure 3. Derating curve

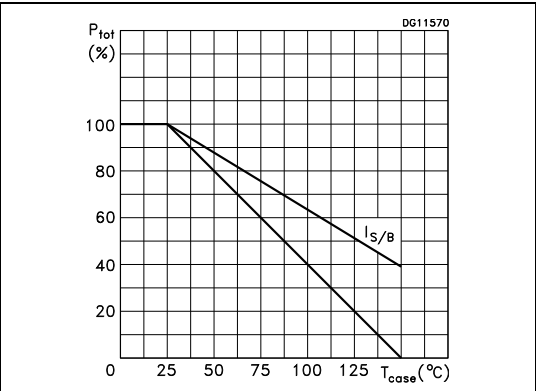


Figure 4. DC current gain ( $V_{CE} = 1.5 \text{ V}$ )

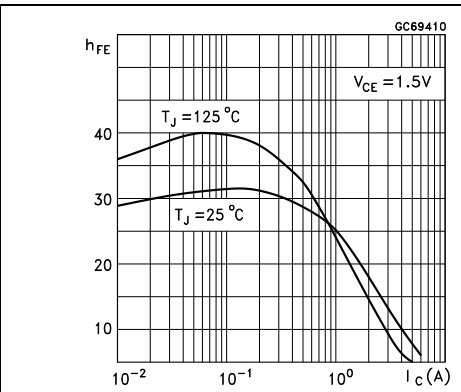


Figure 5. DC current gain ( $V_{CE} = 5 \text{ V}$ )

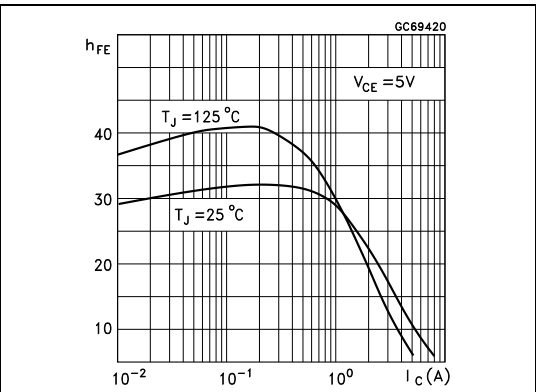


Figure 6. Collector-emitter saturation voltage

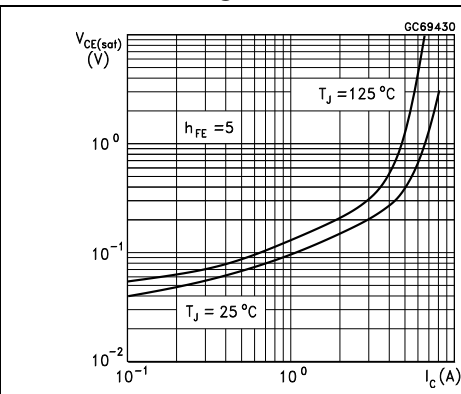


Figure 7. Base-emitter saturation voltage

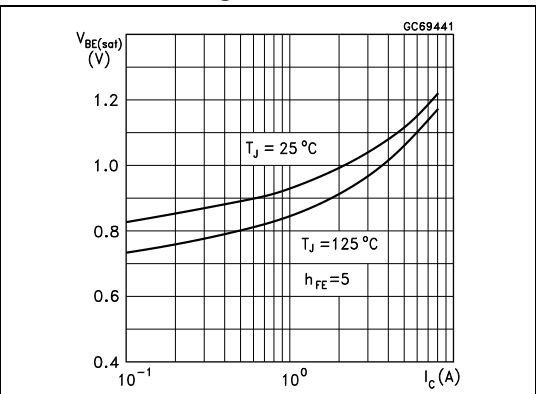


Figure 8. Inductive load fall time

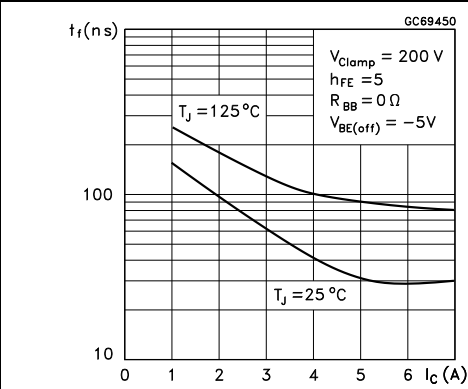


Figure 9. Inductive load storage time

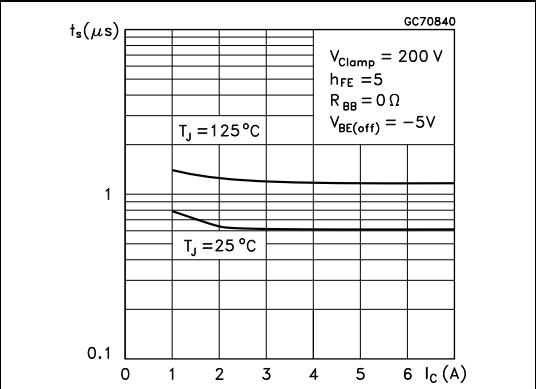


Figure 10. Resistive load fall time

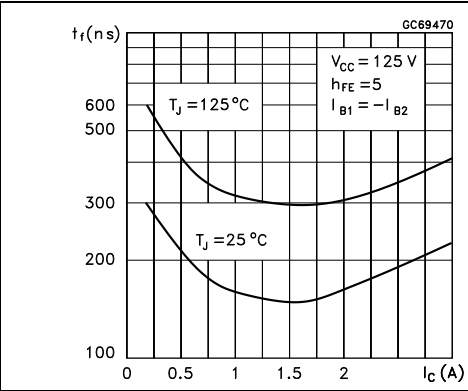


Figure 11. Resistive load storage time

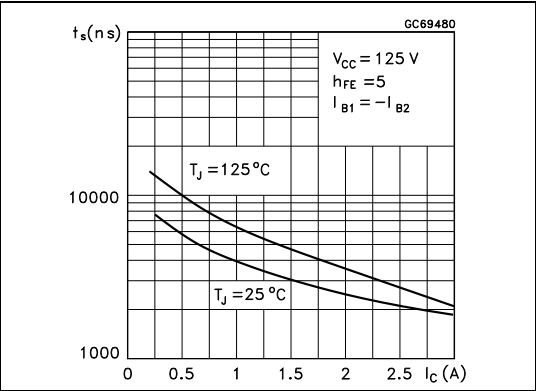
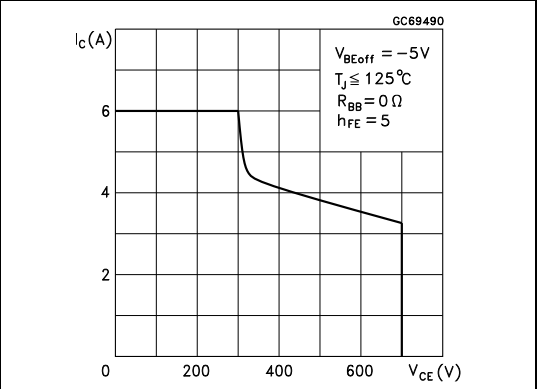


Figure 12. Reverse biased safe operating area



## 2.2 Test circuits

Figure 13. Inductive load switching test circuit

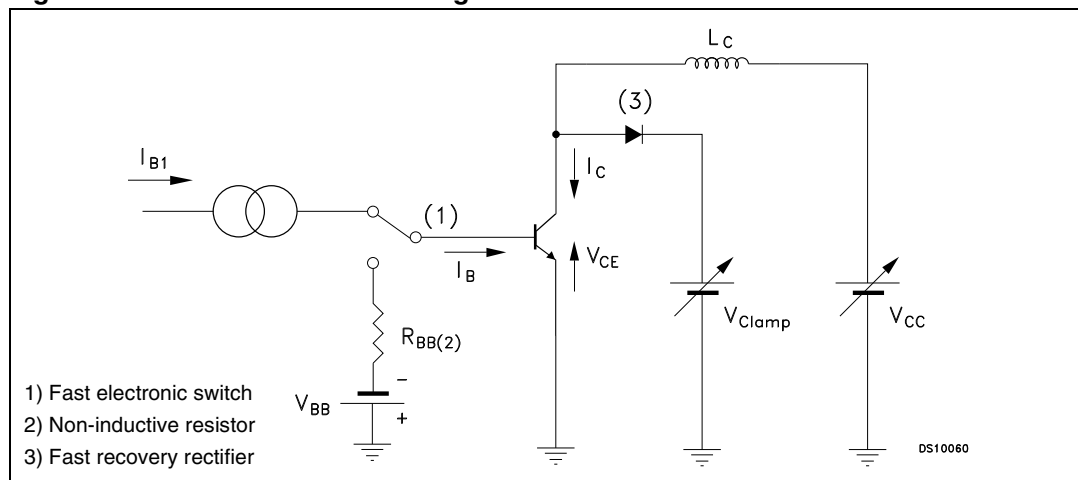
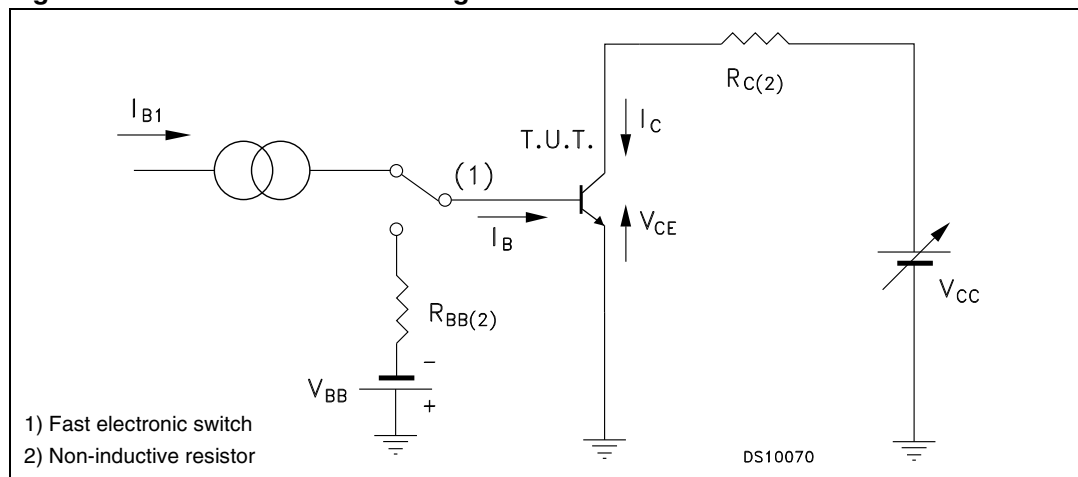


Figure 14. Resistive load switching test circuit



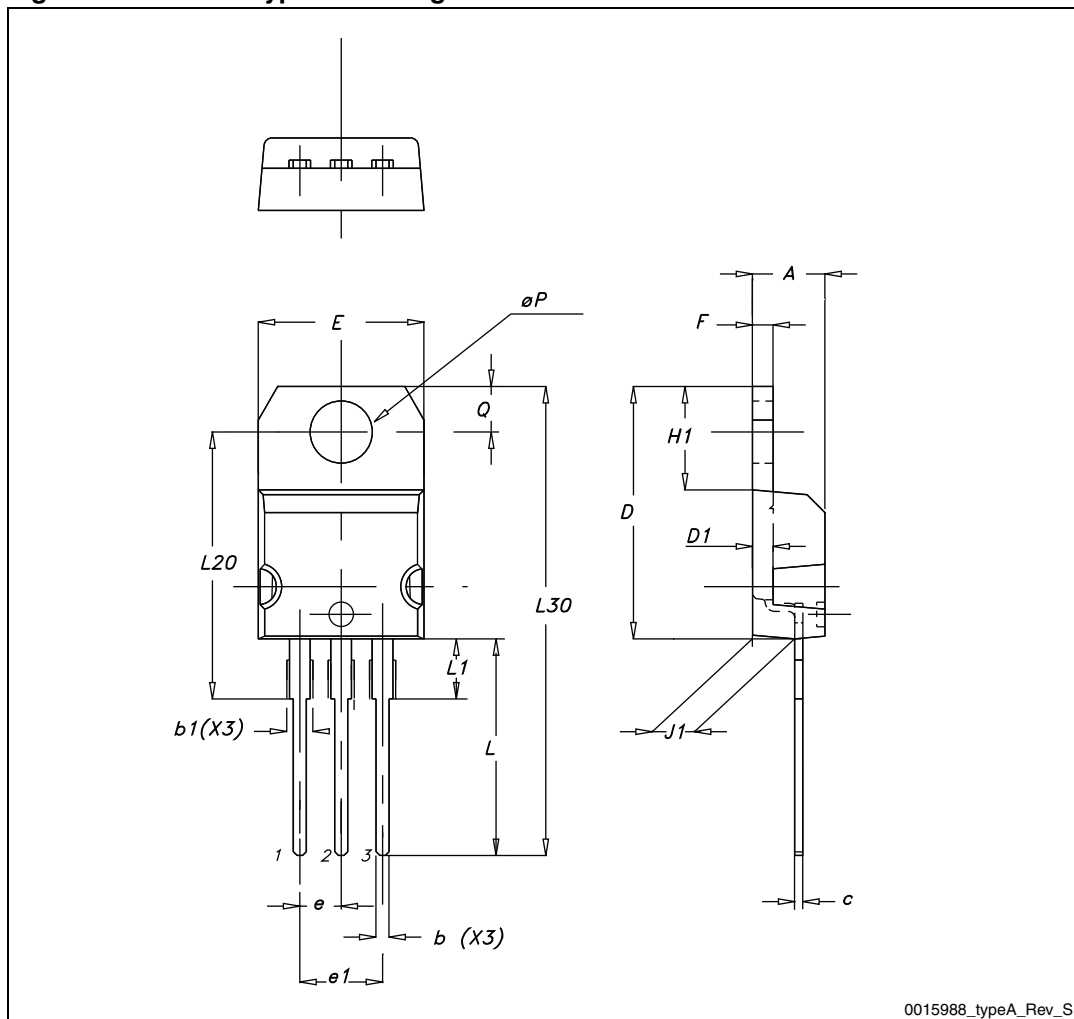
### 3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Table 5. TO-220 type A mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10    |       | 10.40 |
| e    | 2.40  |       | 2.70  |
| e1   | 4.95  |       | 5.15  |
| F    | 1.23  |       | 1.32  |
| H1   | 6.20  |       | 6.60  |
| J1   | 2.40  |       | 2.72  |
| L    | 13    |       | 14    |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| ØP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

Figure 15. TO-220 type A drawing



## 4 Revision history

**Table 6. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                       |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21-Jun-2004 | 6        |                                                                                                                                                                                                                                               |
| 22-Aug-2007 | 7        | Updated mechanical data according to PCN APM-PWR/07/2804                                                                                                                                                                                      |
| 12-Oct-2007 | 8        | Updated marking in <a href="#">Table 1</a>                                                                                                                                                                                                    |
| 15-Feb-2012 | 9        | <ul style="list-style-type: none"><li>– Updated marking in <a href="#">Table 1</a></li><li>– Inserted: <a href="#">Table 3</a></li><li>– Modified: <math>h_{FE}</math> in <a href="#">Table 4</a></li><li>– Updated mechanical data</li></ul> |
| 15-May-2012 | 10       | Updated marking in <a href="#">Table 1</a> and <a href="#">4</a>                                                                                                                                                                              |

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