

## Complementary power Darlington transistors

### Features

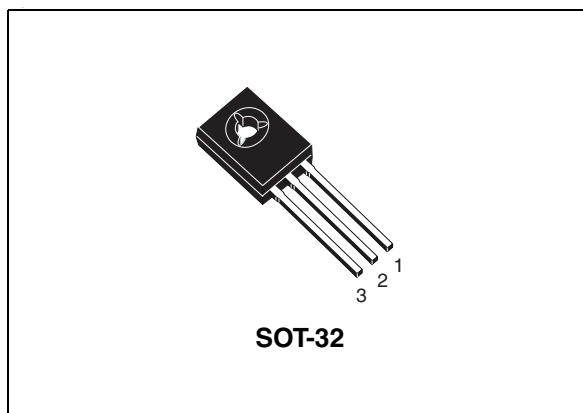
- Good  $h_{FE}$  linearity
- High  $f_T$  frequency
- Monolithic Darlington configuration with integrated antiparallel collector-emitter diode

### Applications

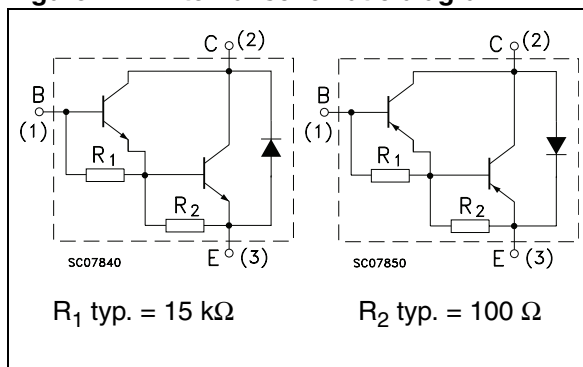
- Linear and switching industrial equipment

### Description

The devices are manufactured in planar technology with “base island” layout and monolithic Darlington configuration.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

| Order codes | Marking | Polarity | Package | Packaging |
|-------------|---------|----------|---------|-----------|
| 2N6036      | 2N6036  | NPN      | SOT-32  | Tube      |
| 2N6039      | 2N6039  | PNP      | SOT-32  | Tube      |

# 1 Absolute maximum ratings

**Table 2. Absolute maximum ratings**

| Symbol    | Parameter                                          | Value      | Unit             |
|-----------|----------------------------------------------------|------------|------------------|
| $V_{CBO}$ | Collector-base voltage ( $I_E = 0$ )               | 80         | V                |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )            |            |                  |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )                 | 5          | V                |
| $I_C$     | Collector current                                  | 4          | A                |
| $I_{CM}$  | Collector peak current                             | 8          | A                |
| $I_B$     | Base current                                       | 0.1        | A                |
| $P_{TOT}$ | Total dissipation at $T_{case} = 25^\circ\text{C}$ | 40         | W                |
| $T_{STG}$ | Storage temperature                                | -65 to 150 | $^\circ\text{C}$ |
| $T_J$     | Max. operating junction temperature                | 150        | $^\circ\text{C}$ |

*Note:* For PNP types voltage and current values are negative.

## 2 Electrical characteristics

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

**Table 3. Electrical characteristics**

| Symbol                      | Parameter                                                        | Test conditions                                                                                            | Min. | Typ. | Max.       | Unit     |
|-----------------------------|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------|------|------------|----------|
| $I_{\text{CEV}}$            | Collector cut-off current<br>( $V_{\text{BE}} = -1.5\text{ V}$ ) | $V_{\text{CE}} = 80\text{ V}$<br>$V_{\text{CE}} = 80\text{ V}, T_{\text{c}} = 125\text{ }^{\circ}\text{C}$ |      | -    | 0.1<br>0.5 | mA<br>mA |
| $I_{\text{CBO}}$            | Collector cut-off current<br>( $I_{\text{E}} = 0$ )              | $V_{\text{CB}} = 80\text{ V}$                                                                              |      | -    | 0.1        | mA       |
| $I_{\text{CEO}}$            | Collector cut-off current<br>( $I_{\text{B}} = 0$ )              | $V_{\text{CE}} = 80\text{ V}$                                                                              |      | -    | 0.1        | mA       |
| $I_{\text{EBO}}$            | Emitter cut-off current<br>( $I_{\text{C}} = 0$ )                | $V_{\text{EB}} = 5\text{ V}$                                                                               |      | -    | 2          | mA       |
| $V_{\text{CEO(sus)}}^{(1)}$ | Collector-emitter<br>sustaining voltage                          | $I_{\text{C}} = 100\text{ mA}$                                                                             | 80   | -    |            | V        |
| $V_{\text{CE(sat)}}^{(1)}$  | Collector-emitter saturation<br>voltage                          | $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 8\text{ mA}$                                                   |      | -    | 2          | V        |
|                             |                                                                  | $I_{\text{C}} = 4\text{ A}$ $I_{\text{B}} = 40\text{ mA}$                                                  |      | -    | 3          |          |
| $V_{\text{BE(sat)}}^{(1)}$  | Base-emitter saturation<br>voltage                               | $I_{\text{C}} = 4\text{ A}$ $I_{\text{B}} = 40\text{ mA}$                                                  |      | -    | 4          | V        |
| $V_{\text{BE(on)}}$         | Base-emitter on voltage                                          | $I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 3\text{ V}$                                                   |      | -    | 2.8        | V        |
| $h_{\text{FE}}^{(1)}$       | DC current gain                                                  | $I_{\text{C}} = 0.5\text{ A}$ $V_{\text{CE}} = 3\text{ V}$                                                 | 500  | -    |            |          |
|                             |                                                                  | $I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 3\text{ V}$                                                   | 750  | -    | 15000      |          |
|                             |                                                                  | $I_{\text{C}} = 4\text{ A}$ $V_{\text{CE}} = 3\text{ V}$                                                   | 100  | -    |            |          |
| $h_{\text{fe}}$             | Small signal current gain                                        | $I_{\text{C}} = 0.75\text{ A}$ $V_{\text{CE}} = 10\text{ V}$<br>$f = 1\text{ MHz}$                         | 25   | -    |            |          |
| $C_{\text{CBO}}$            | Collector base capacitance<br>( $I_{\text{E}} = 0$ )             | $V_{\text{CB}} = 10\text{ V}$ $f = 0.1\text{ MHz}$<br>for 2N6036<br>for 2N6039                             |      | -    | 100        | pF       |
|                             |                                                                  |                                                                                                            |      |      | 200        | pF       |

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

**Note:** For PNP types voltage and current values are negative.

2.1 Typical characteristic (curves)

Figure 2. DC current gain  
( $V_{CE} = 3\text{ V NPN}$ )

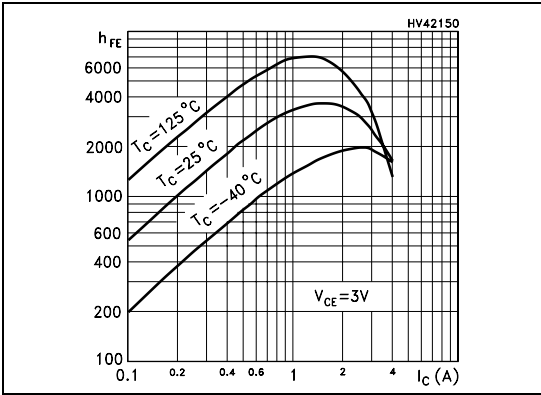


Figure 3. DC current gain  
( $V_{CE} = -3\text{ V PNP}$ )

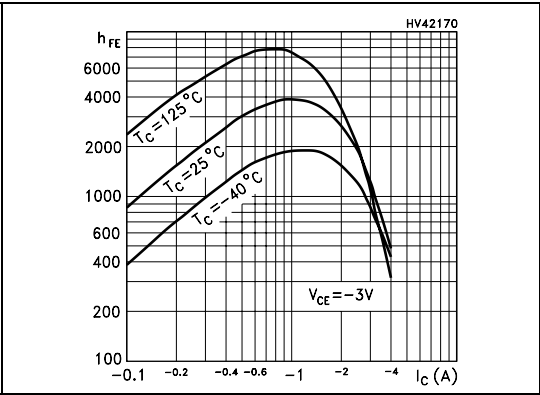


Figure 4. DC current gain  
( $V_{CE} = 5\text{ V NPN}$ )

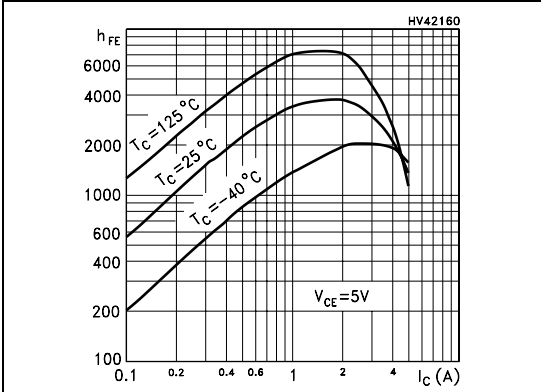


Figure 5. DC current gain  
( $V_{CE} = -5\text{ V PNP}$ )

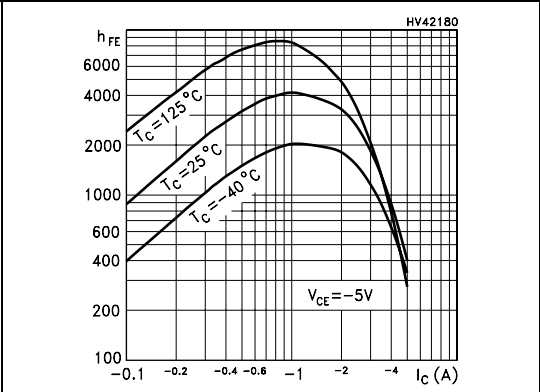


Figure 6. Collector-emitter saturation  
voltage (NPN)

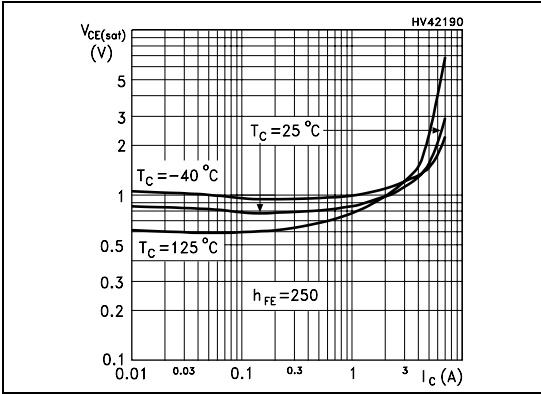


Figure 7. Collector-emitter saturation  
voltage (PNP)

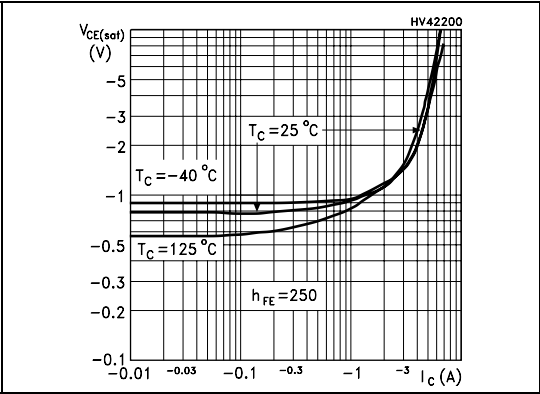


Figure 8. Base-emitter saturation voltage (NPN)

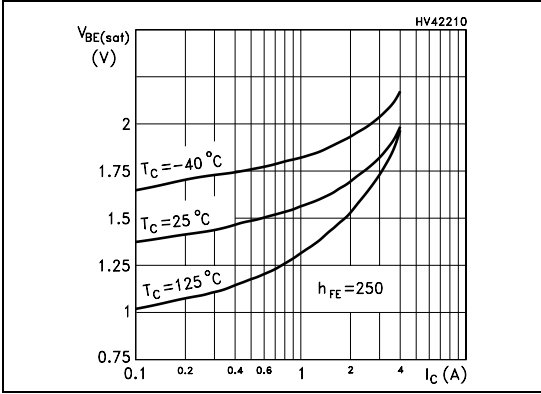


Figure 9. Base-emitter saturation voltage (PNP)

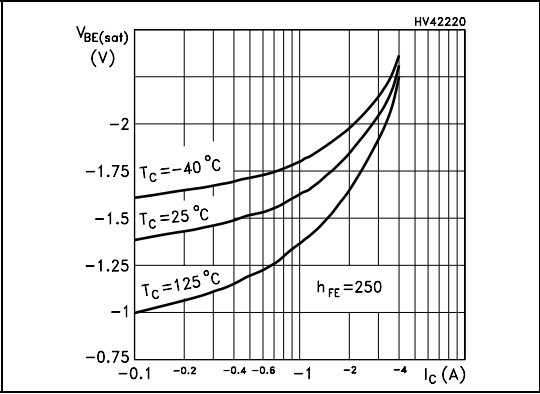


Figure 10. Base-emitter on voltage (NPN)

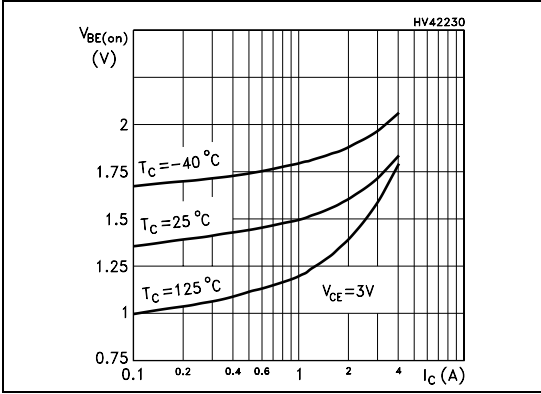


Figure 11. Base-emitter on voltage (PNP)

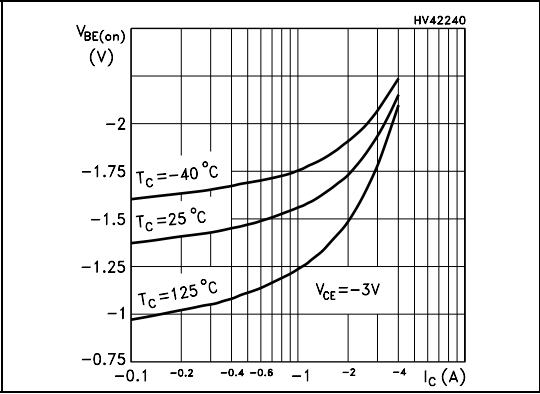


Figure 12. Resistive load switching time (NPN, on)

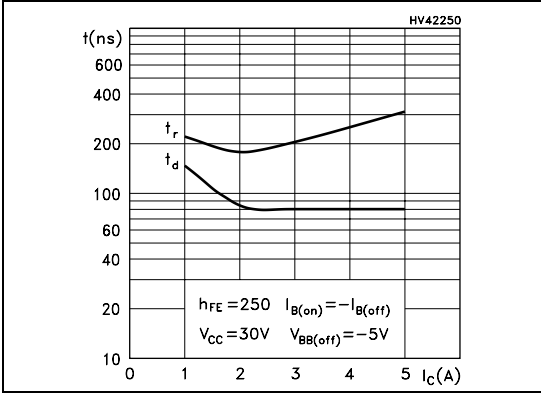


Figure 13. Resistive load switching time (PNP, on)

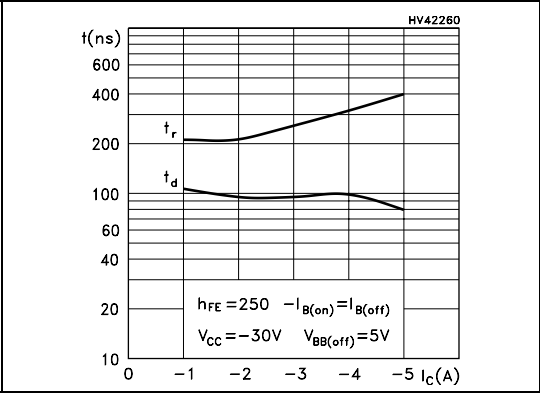
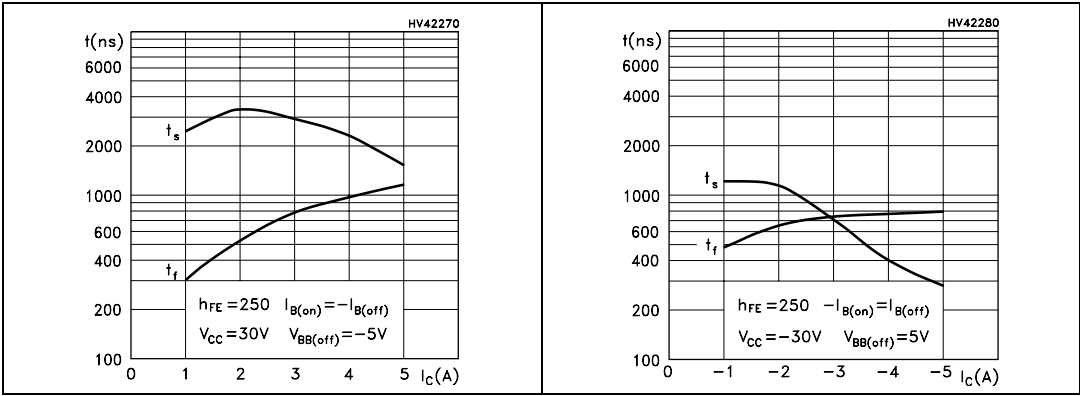


Figure 14. Resistive load switching time (NPN, off)      Figure 15. Resistive load switching time (PNP, off)

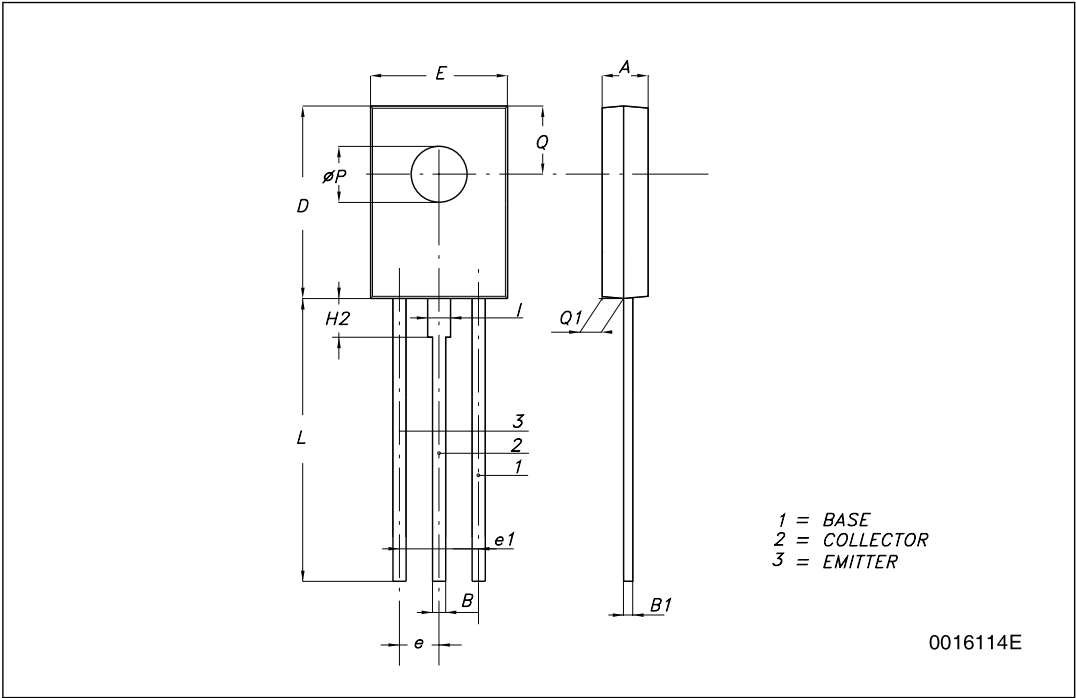


### 3      **Package mechanical data**

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.

SOT-32 (TO-126) MECHANICAL DATA

| DIM. | mm.  |      |       |
|------|------|------|-------|
|      | MIN. | TYP  | MAX.  |
| A    | 2.4  |      | 2.9   |
| B    | 0.64 |      | 0.88  |
| B1   | 0.39 |      | 0.63  |
| D    | 10.5 |      | 11.05 |
| E    | 7.4  |      | 7.8   |
| e    | 2.04 | 2.29 | 2.54  |
| e1   | 4.07 | 4.58 | 5.08  |
| L    | 15.3 |      | 16    |
| P    | 2.9  |      | 3.2   |
| Q    |      | 3.8  |       |
| Q1   | 1    |      | 1.52  |
| H2   |      | 2.15 |       |
| I    |      | 1.27 |       |



## 4 Revision history

**Table 4. Document revision history**

| Date        | Revision | Changes                                |
|-------------|----------|----------------------------------------|
| 21-Jun-2004 | 4        | Document migration, no content change. |
| 20-May-2009 | 5        | Modified SOT-32 mechanical data.       |

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