

## High voltage NPN power transistor for CRT TV

### Features

- State-of-the-art technology:
  - diffused collector “enhanced generation”
- Stable performance versus operating temperature variation
- Low base drive requirement
- Tight  $h_{FE}$  range at operating collector current
- Fully isolated power package UL compliant
- Integrated free wheeling diode

### Application

- Horizontal deflection output for CRT TV

### Description

The MD2009DFX is manufactured using diffused collector in planar technology adopting new and enhanced high voltage structure. The new MD product series show improved silicon efficiency bringing updated performance to the horizontal deflection stage.

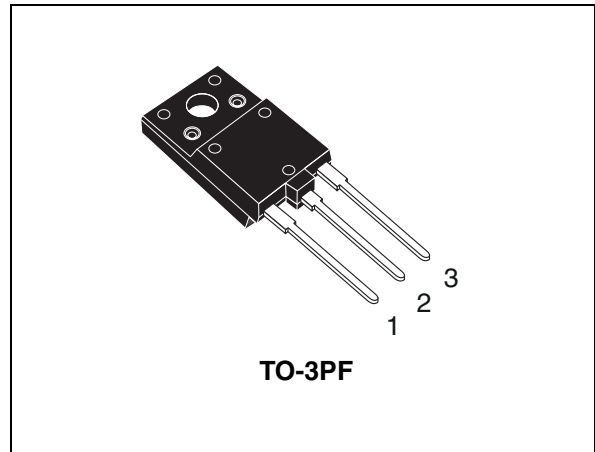


Figure 1. Internal schematic diagram

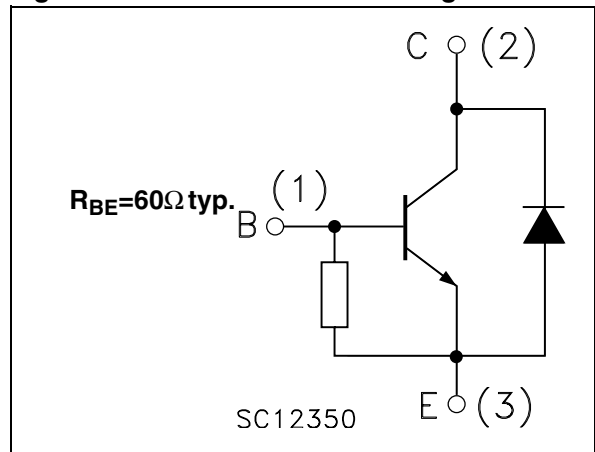


Table 1. Device summary

Order code	Marking	Package	Packaging
MD2009DFX	MD2009DFX	TO-3PF	Tube

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{BE} = 0$ )	1500	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	700	V
$V_{EBO}$	Base-emitter voltage ( $I_C = 0$ )	7	V
$I_C$	Collector current	10	A
$I_{CM}$	Collector peak current ( $t_P < 5\text{ms}$ )	16	A
$I_B$	Base current	6	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	58	W
$V_{ISO}$	Isolation withstand voltage (RMS) from all three leads to external heatsink	2500	V
$T_{stg}$	Storage temperature	-65 to 150 150	$^\circ\text{C}$
$T_J$	Max. operating junction temperature		

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.15	$^\circ\text{C/W}$

## 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
$I_{\text{CES}}$	Collector cut-off current ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 1500\text{V}$ $V_{\text{CE}} = 1500\text{V}$ , $T_{\text{c}} = 125^{\circ}\text{C}$			0.2 2	mA mA
$I_{\text{EBO}}$	Emitter cut-off current ( $I_{\text{C}} = 0$ )	$V_{\text{EB}} = 5\text{V}$	40		120	mA
$V_{(\text{BR})\text{EBO}}$	Emitter-base breakdown voltage ( $I_{\text{C}} = 0$ )	$I_{\text{E}} = 700\text{mA}$	10			V
$V_{\text{CE(sat)}}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 5.5\text{A}$ , $I_{\text{B}} = 1.4\text{A}$			2.8	V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 5.5\text{A}$ , $I_{\text{B}} = 1.4\text{A}$			1.3	V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = 1\text{A}$ , $V_{\text{CE}} = 5\text{V}$ $I_{\text{C}} = 5.5\text{A}$ , $V_{\text{CE}} = 1\text{V}$ $I_{\text{C}} = 5.5\text{A}$ , $V_{\text{CE}} = 5\text{V}$	5	18 4.7	7	
$V_{\text{F}}^{(1)}$	Diode forward voltage	$I_{\text{F}} = 5.5\text{A}$			1.6	V
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$I_{\text{C}} = 5\text{A}$ , $f_{\text{h}} = 16\text{KHz}$ $I_{\text{B(on)}} = 1.5\text{A}$ , $V_{\text{BE(off)}} = -2.7\text{V}$ $L_{\text{BB(off)}} = 6.2\mu\text{H}$		4.5 0.3	6 0.6	$\mu\text{s}$ $\mu\text{s}$

1. Pulse test: pulse duration  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

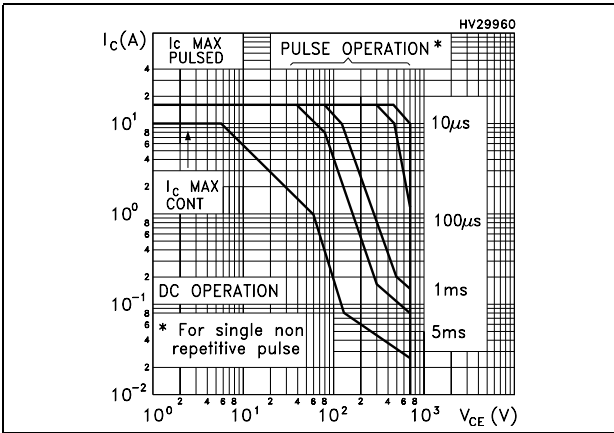


Figure 3. Derating curve

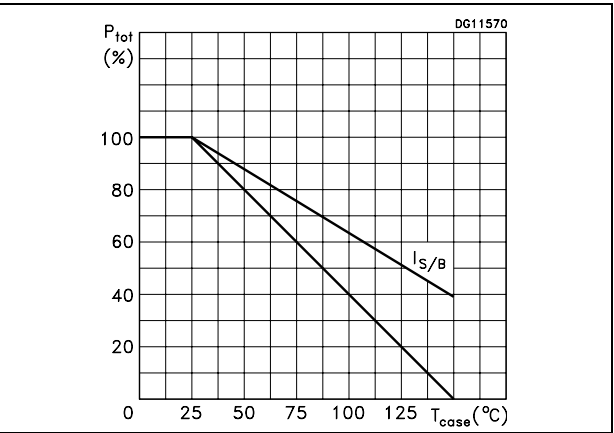


Figure 4. Output characteristics

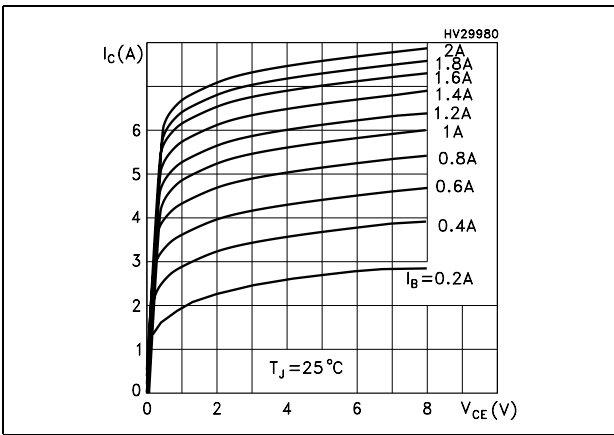


Figure 5. Reverse biased SOA

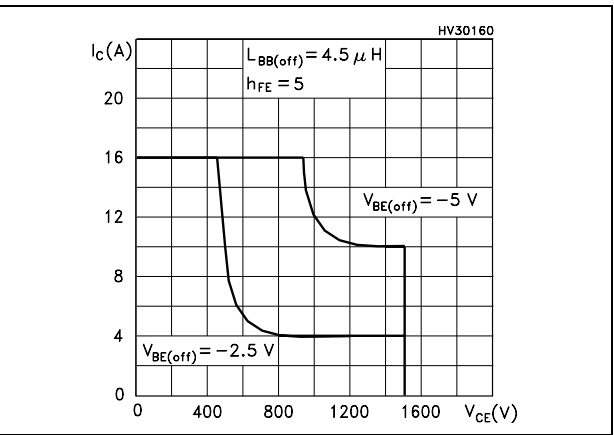


Figure 6. DC current gain ( $V_{CE} = 1\text{ V}$ )

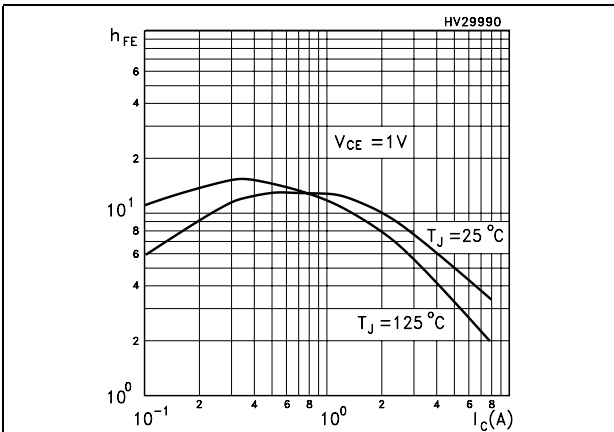


Figure 7. DC current gain ( $V_{CE} = 5\text{ V}$ )

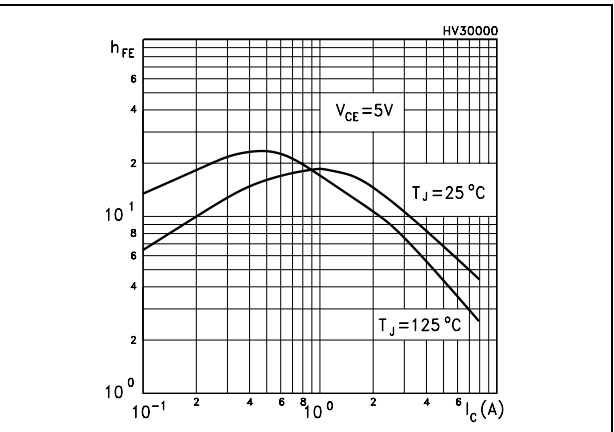


Figure 8. Collector-emitter saturation voltage    Figure 9. Base-emitter saturation voltage

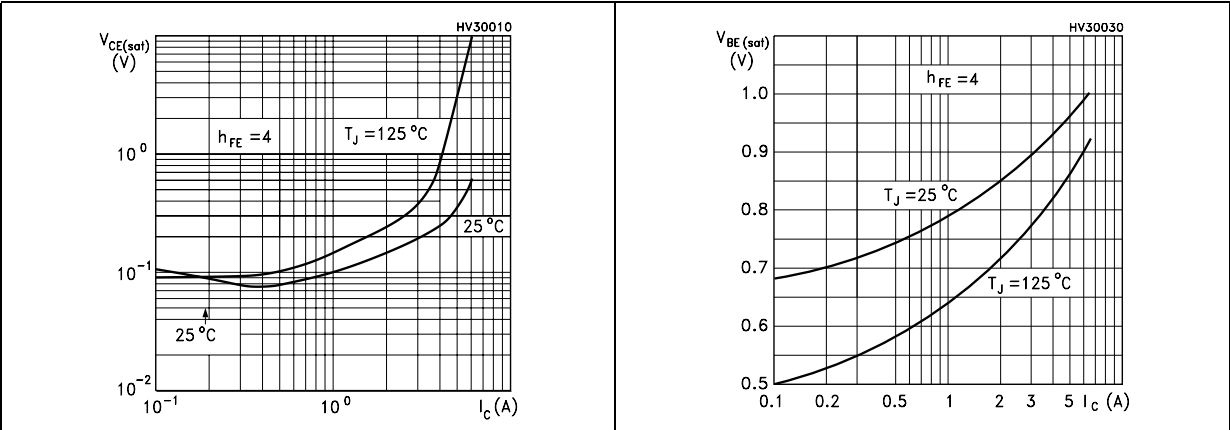
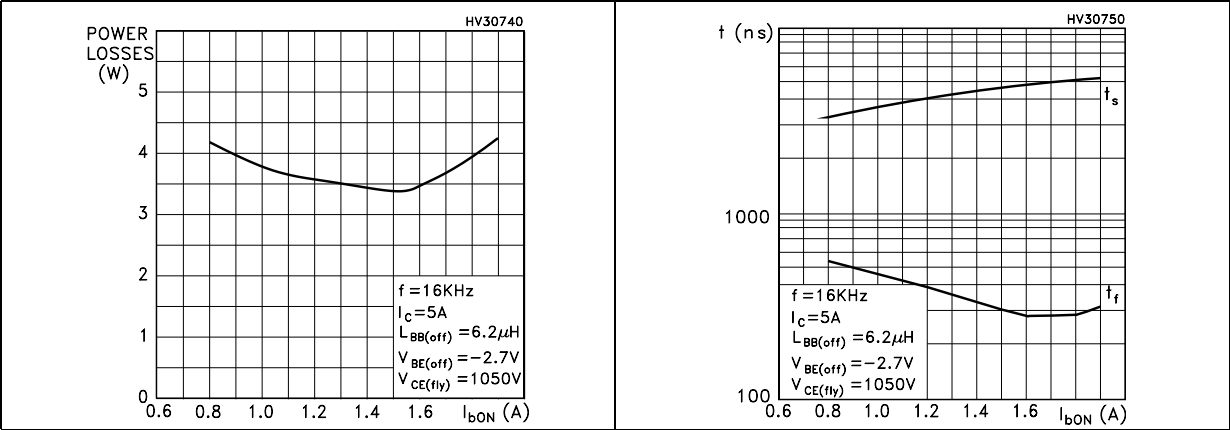


Figure 10. Power losses    Figure 11. Inductive load switching time



### 3 Test circuits

Figure 12. Power losses and inductive load switching test circuit

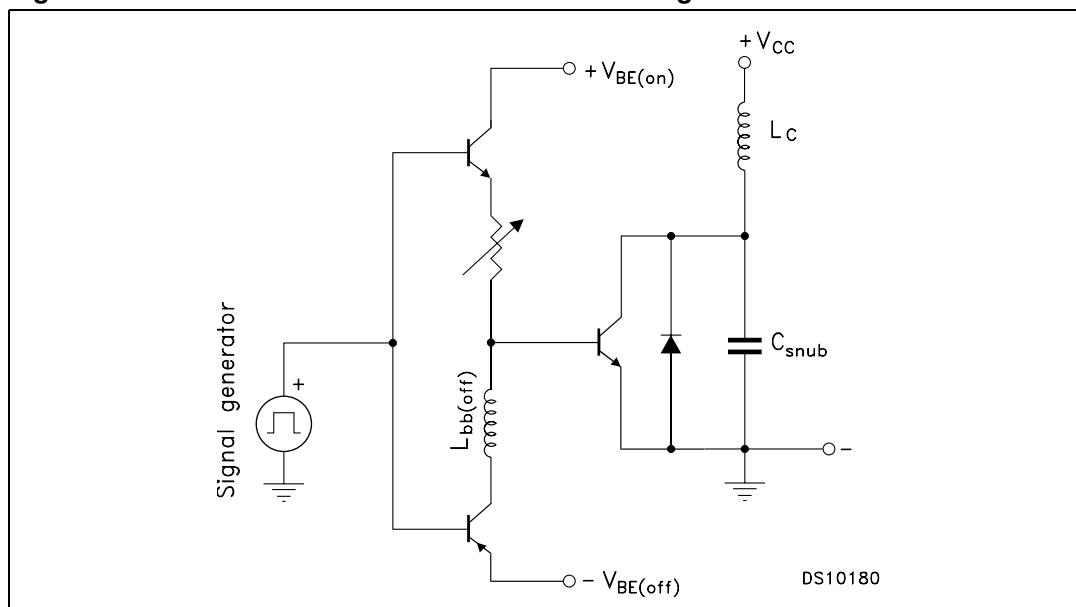
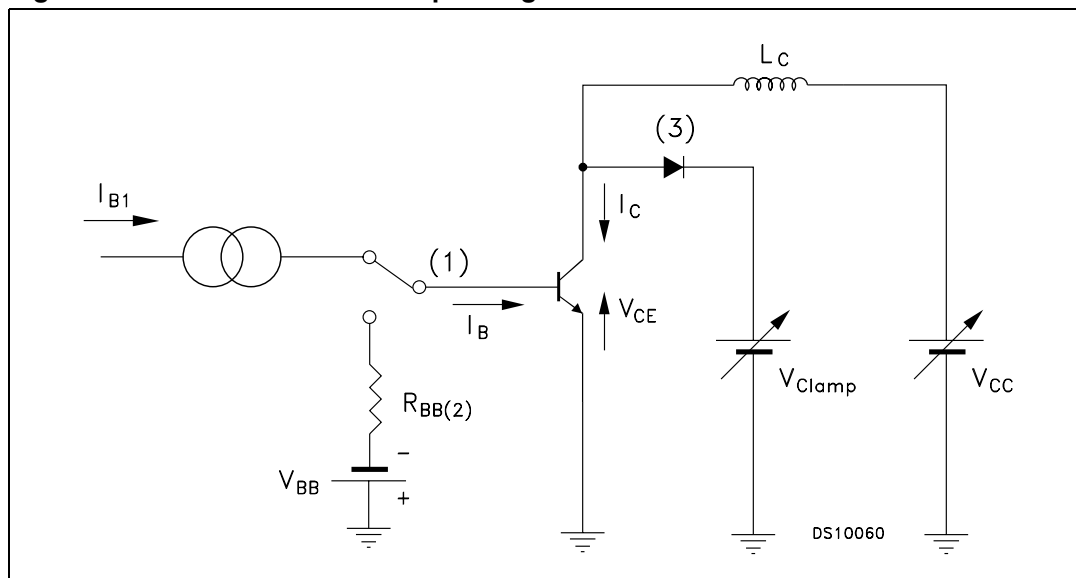


Figure 13. Reverse biased safe operating area test circuit

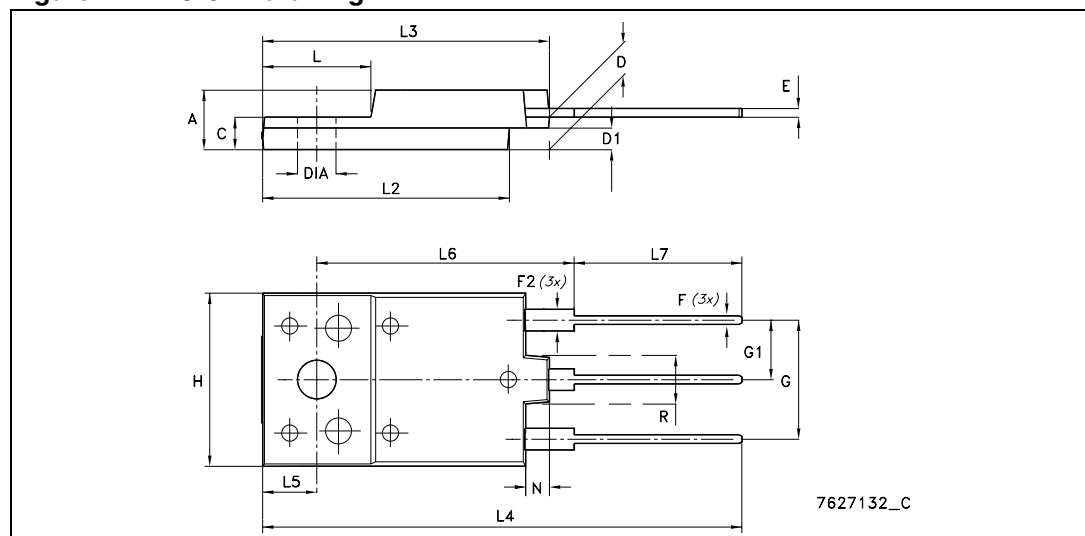


## 4 Package mechanical data

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 is an ST trademark.

**Table 5. TO-3PF package mechanical data**

Dim.	mm.		
	min.	typ.	max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

**Figure 14. TO-3PF drawing**



## 5 Revision history

**Table 6. Document revision history**

Date	Revision	Changes
27-Feb-2006	1	First release
28-Mar-2006	2	New curves 9 and 10 inserted
22-May-2006	3	Values changed on <a href="#">Table 2</a> and <a href="#">Table 4</a>
20-Oct-2006	4	New hFE limits shown on <a href="#">Table 4</a>
10-Aug-2009	5	Update mechanical data Document reformatted, no content change

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