

## 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 MD2009DFP 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.

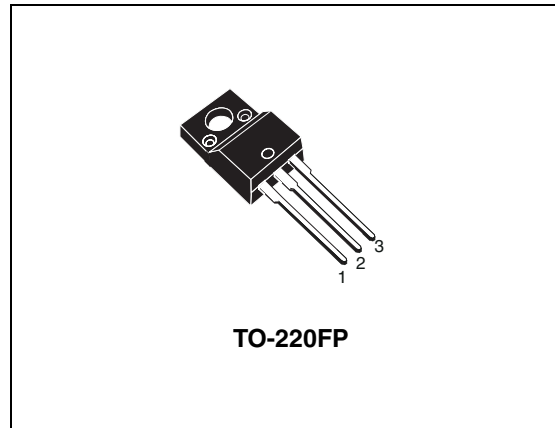


Figure 1. Internal schematic diagram

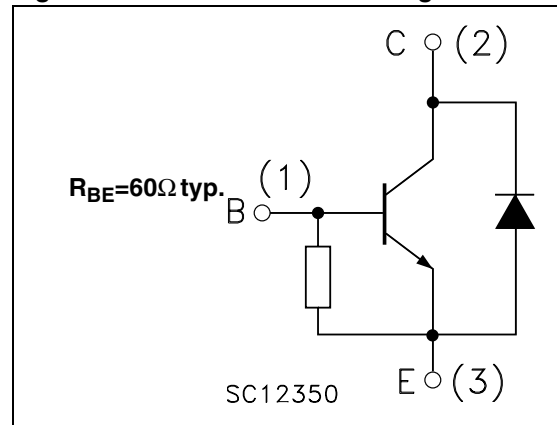


Table 1. Device summary

Order code	Marking	Package	Packaging
MD2009DFP	MD2009DFP	TO-220FP	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 $T_C = 25^\circ\text{C}$	40	W
$V_{ISO}$	Isolation withstand voltage (RMS) from all three leads to external heatsink	2500	V
$T_{stg}$	Storage temperature	-65 to 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	3.12	$^\circ\text{C/W}$

## 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
$t_{\text{s}}$	Inductive load Storage time	$I_{\text{C}} = 5\text{A}, f_{\text{h}} = 16\text{KHz}$ $I_{\text{B(on)}} = 1.5\text{A}, V_{\text{BE(off)}} = -2.7\text{V}$		4.5	6	$\mu\text{s}$
$t_{\text{f}}$	Fall time	$L_{\text{BB(off)}} = 6.2\mu\text{H}$		0.3	0.6	$\mu\text{s}$

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

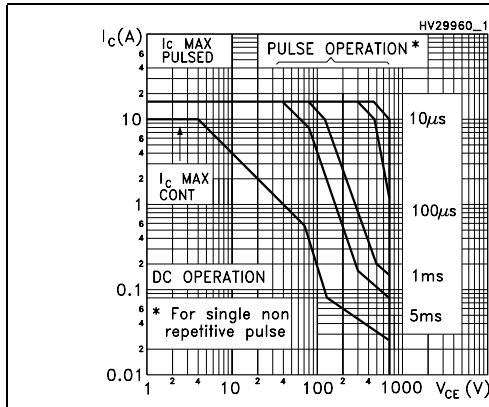


Figure 3. Derating curve

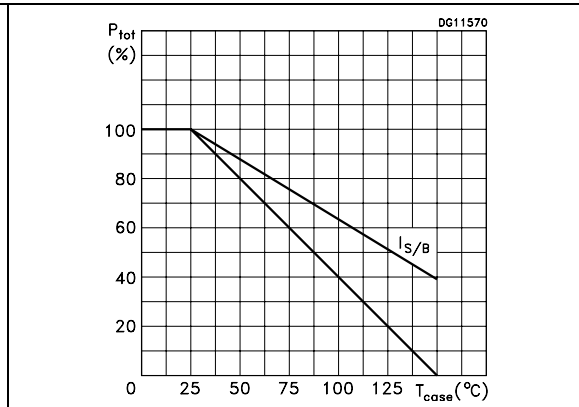


Figure 4. Output characteristics

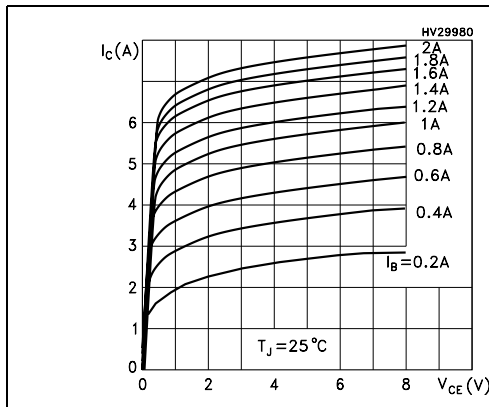


Figure 5. Reverse biased SOA

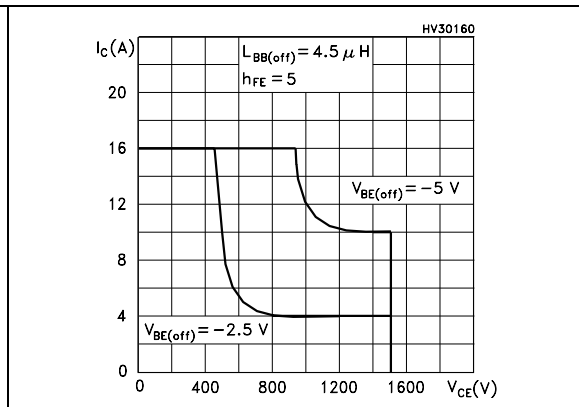


Figure 6. DC current gain ( $V_{CE} = 1\text{V}$ )

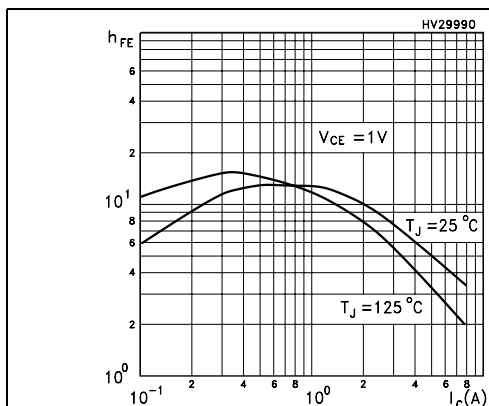


Figure 7. DC current gain ( $V_{CE} = 5\text{V}$ )

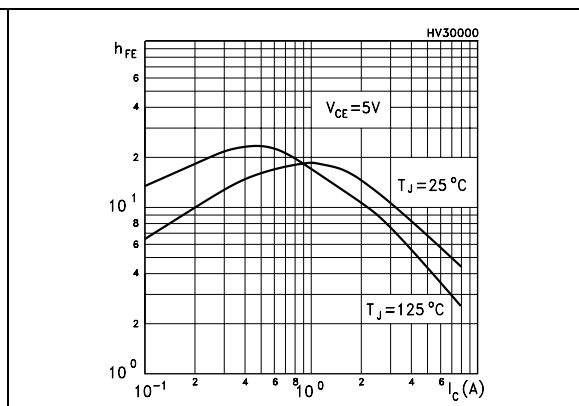


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage

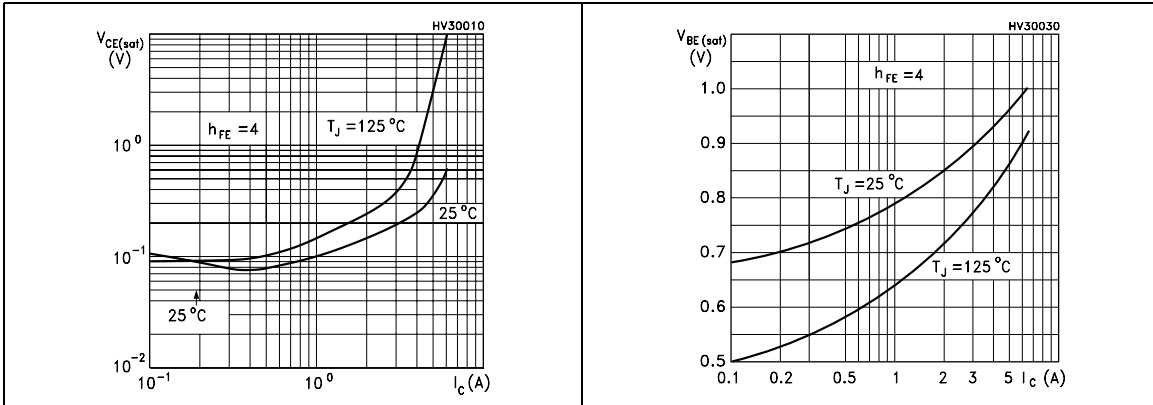
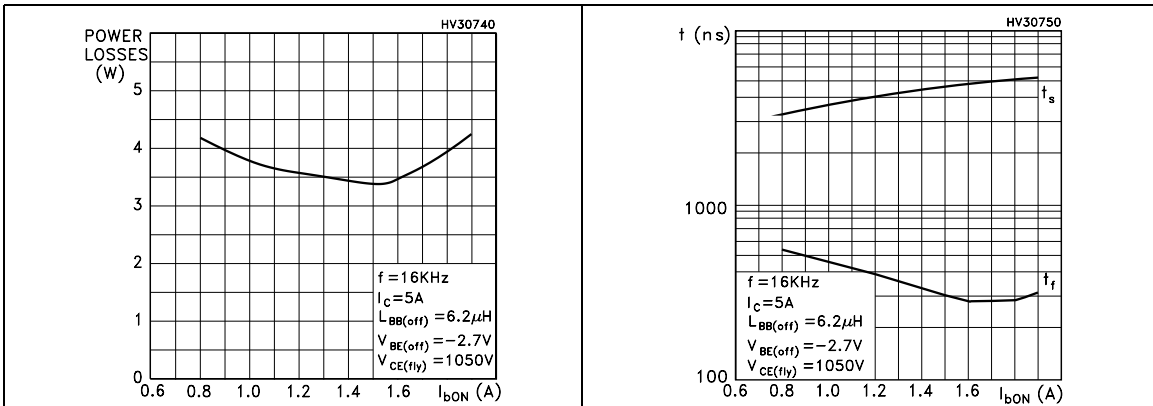


Figure 10. Power losses

Figure 11. Inductive load switching time



### 3 Test circuits

Figure 12. Power losses and inductive load switching test circuit

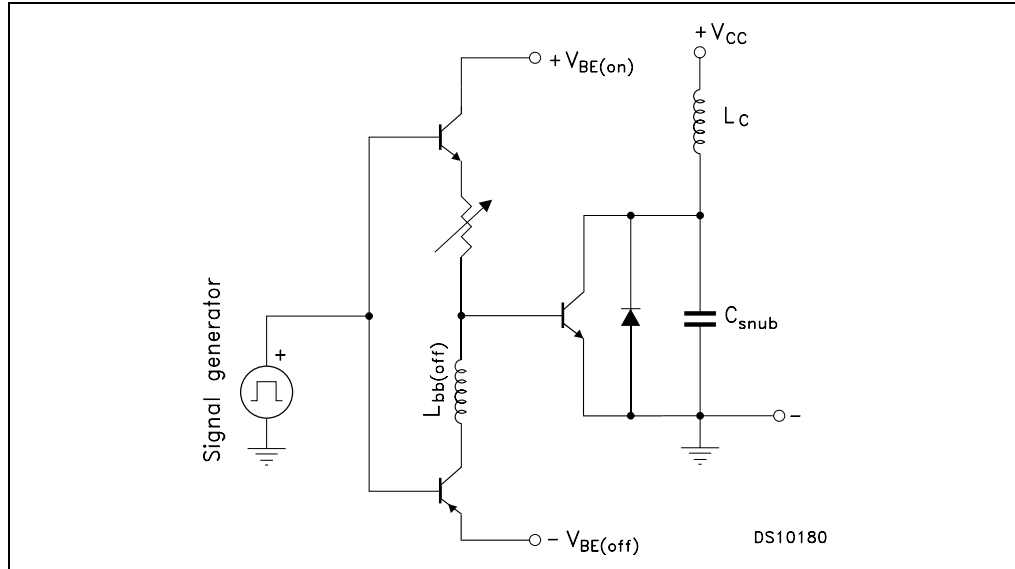
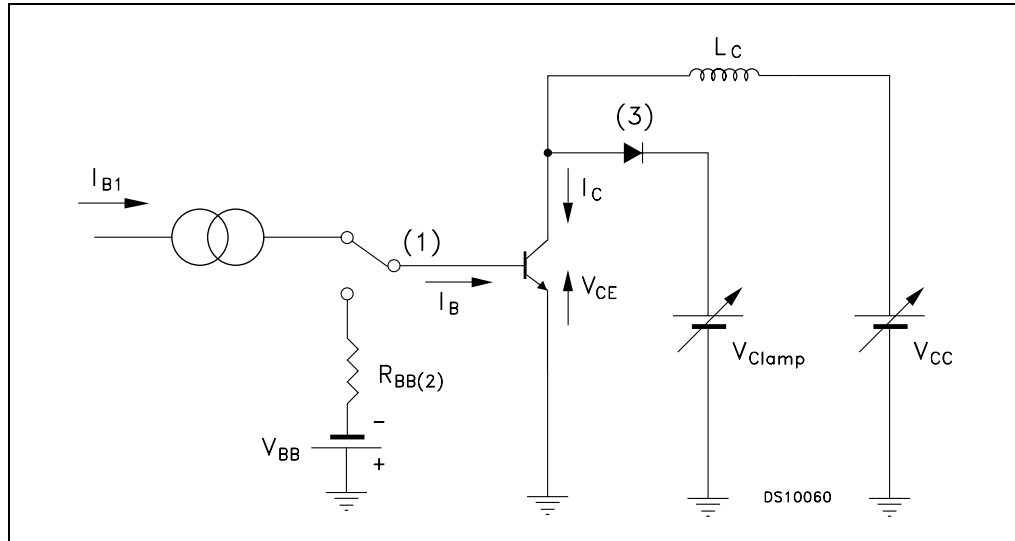


Figure 13. Reverse biased safe operating area test circuit

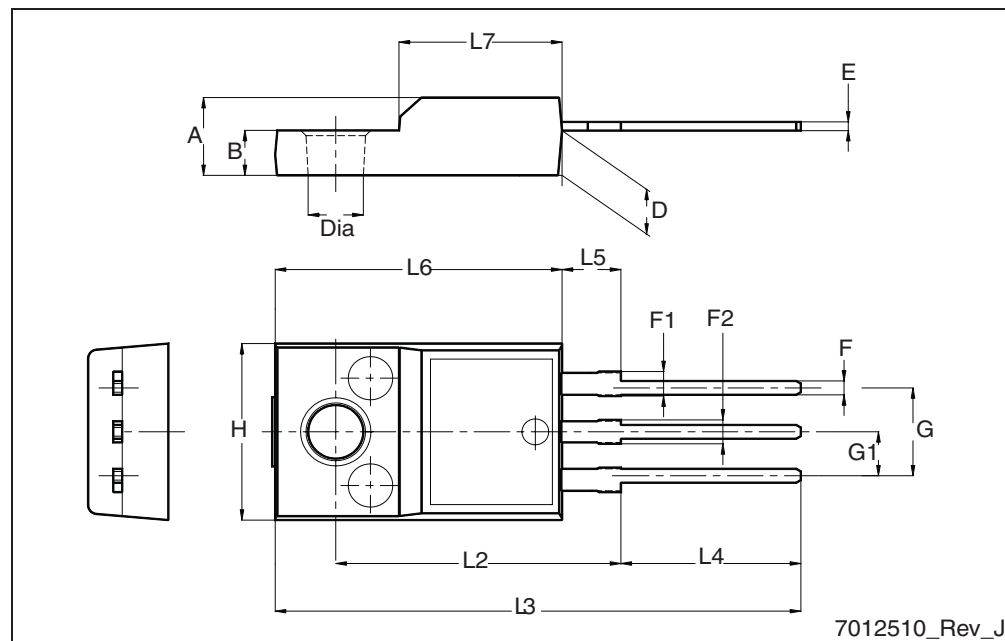


## 4 Package mechanical data

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TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2





## 5 Revision history

Table 5. Document revision history

Date	Revision	Changes
11-Aug-2009	1	First release

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