

## High voltage fast-switching NPN power transistor

### Features

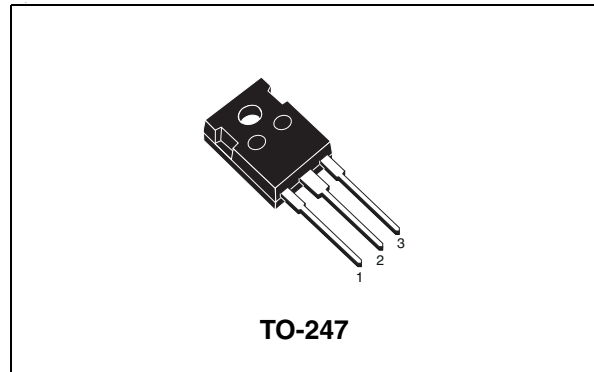
- High voltage capability
- High DC current gain
- Minimum lot to lot spread for reliable operation

### Application

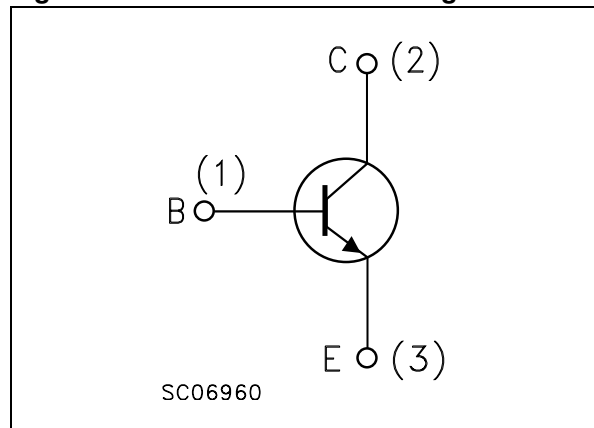
- Switching mode power supplies

### Description

The STW2040 is manufactured using diffused collector in planar technology adopting base island layout.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STW2040	W2040	TO-247	Tube

# 1 Absolute maximum ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{CE} = 0$ )	700	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	500	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ )	9	V
$I_C$	Collector current	20	A
$I_{CM}$	Collector peak current	30	A
$I_B$	Base current	7	A
$I_{BM}$	Base peak current	10	A
$P_{TOT}$	Total dissipation at $T_c = 25\text{ °C}$	125	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
$R_{thJC}$	Thermal resistance junction-case max	1	°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 ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 700\text{ V}$			250	$\mu\text{A}$
$I_{\text{EBO}}$	Emitter cut-off current ( $I_{\text{C}} = 0$ )	$V_{\text{EB}} = 9\text{ V}$			1	mA
$V_{(\text{BR})\text{CEO}}$	Collector-emitter breakdown voltage ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 10\text{ mA}$	500			V
$V_{\text{CE}(\text{sat})}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 6\text{ A}$ $I_{\text{B}} = 1.2\text{ A}$ $I_{\text{C}} = 12\text{ A}$ $I_{\text{B}} = 2.4\text{ A}$ $I_{\text{C}} = 20\text{ A}$ $I_{\text{B}} = 4\text{ A}$		0.2 0.3 0.6	0.5	V V V
$V_{\text{BE}(\text{sat})}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 6\text{ A}$ $I_{\text{B}} = 1.2\text{ A}$ $I_{\text{C}} = 12\text{ A}$ $I_{\text{B}} = 2.4\text{ A}$			1.2 1.5	V V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = 10\text{ mA}$ $V_{\text{CE}} = 5\text{ V}$ $I_{\text{C}} = 6\text{ A}$ $V_{\text{CE}} = 5\text{ V}$ $I_{\text{C}} = 12\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	8 15 10	21	27	
$t_{\text{on}}$ $t_{\text{f}}$ $t_{\text{s}}$	Resistive load Turn-on time Fall time Storage time	$V_{\text{CC}} = 200\text{ V}$ $V_{\text{BE}(\text{off})} = -5\text{ V}$ $I_{\text{C}} = 7.5\text{ A}$ $I_{\text{B}(\text{on})} = 1.5\text{ A}$ $I_{\text{B}(\text{off})} = -3\text{ A}$		140 100 1.6		ns ns $\mu\text{s}$
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$V_{\text{CL}} = 250\text{ V}$ $V_{\text{BE}(\text{off})} = -5\text{ V}$ $I_{\text{C}} = 7.5\text{ A}$ $I_{\text{B}(\text{on})} = 1.5\text{ A}$ $I_{\text{B}(\text{off})} = -3\text{ A}$		1.8 30		$\mu\text{s}$ ns

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

## 2.1 Electrical characteristic (curves)

Figure 2. Safe operating area

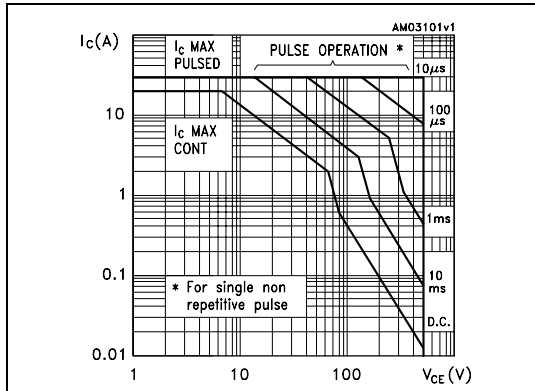


Figure 3. Derating curve

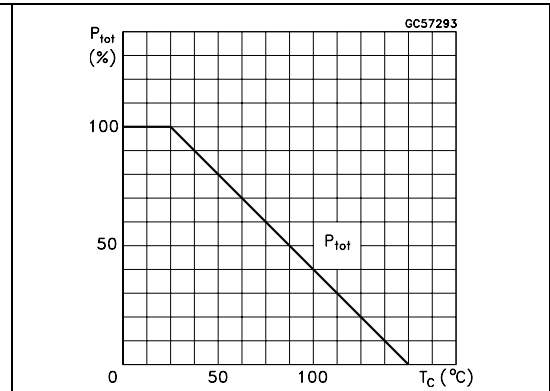


Figure 4. Reverse biased safe operating area

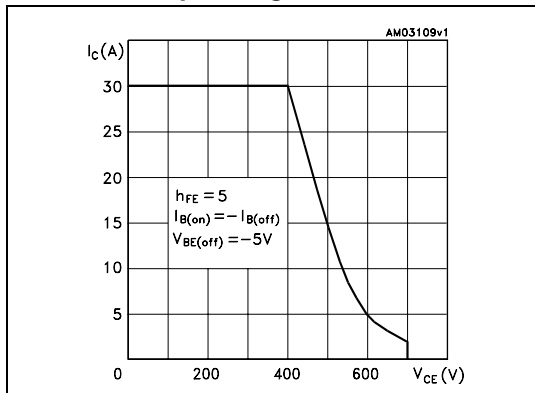


Figure 5. Output characteristics

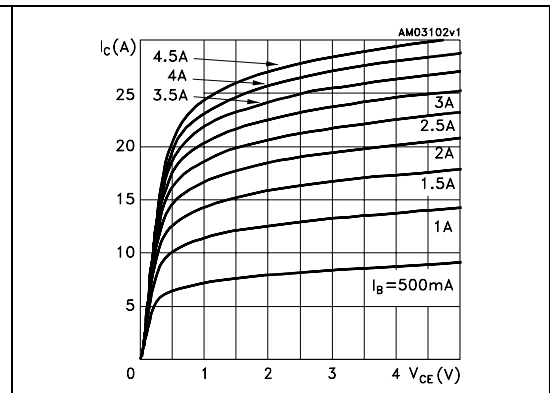


Figure 6. DC current gain ( $V_{CE} = 1 V$ )

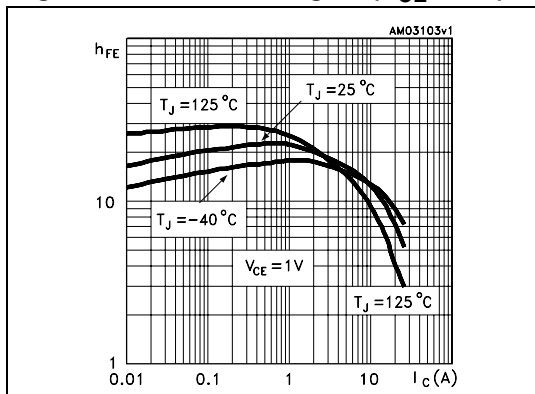
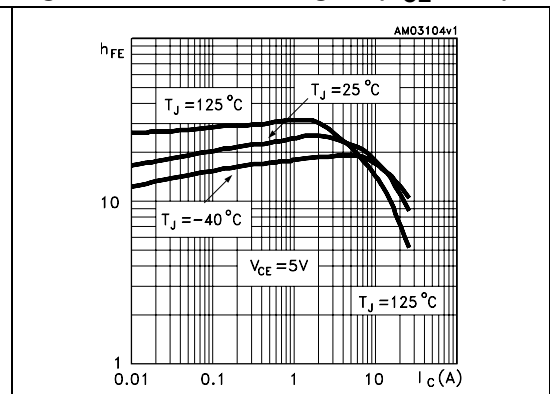
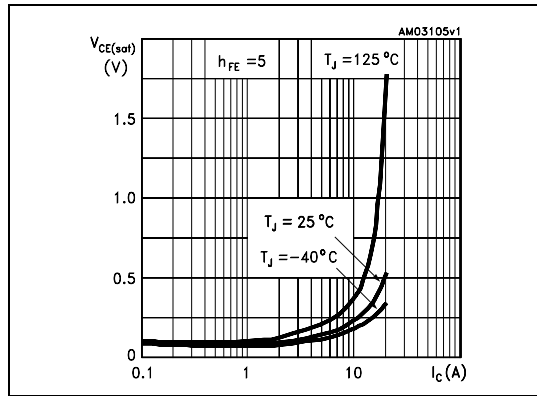


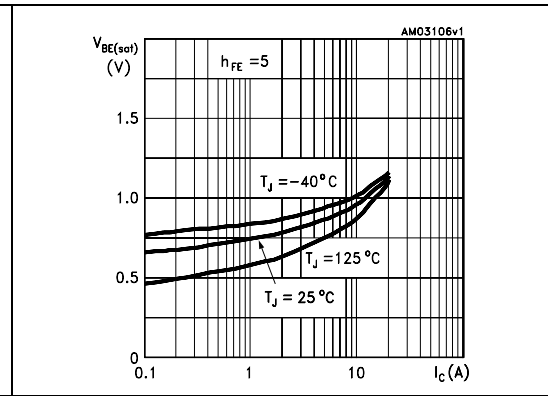
Figure 7. DC current gain ( $V_{CE} = 5 V$ )



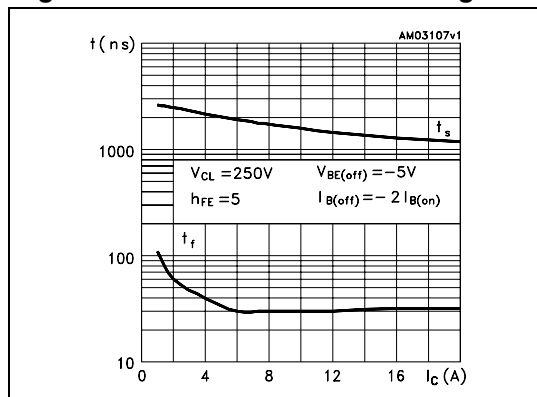
**Figure 8. Collector-emitter saturation voltage**



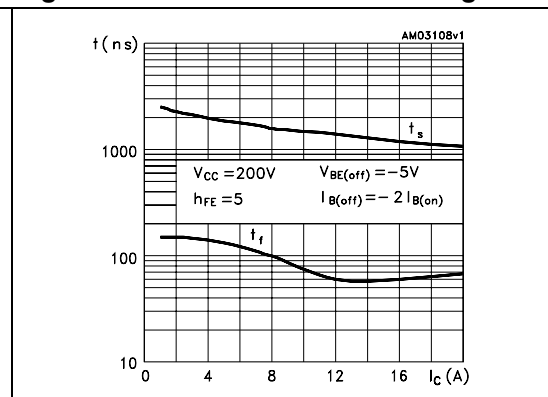
**Figure 9. Base-emitter saturation voltage**



**Figure 10. Inductive load switching time**

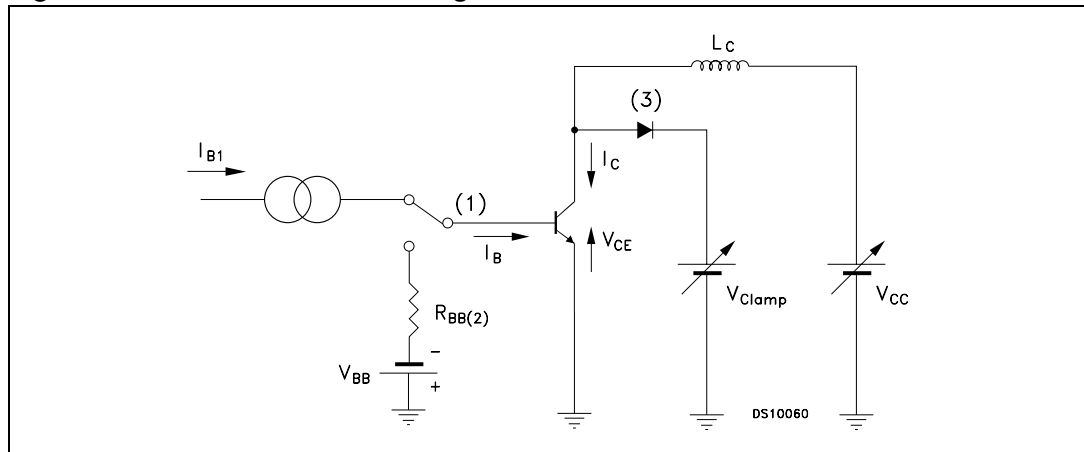


**Figure 11. Resistive load switching time**



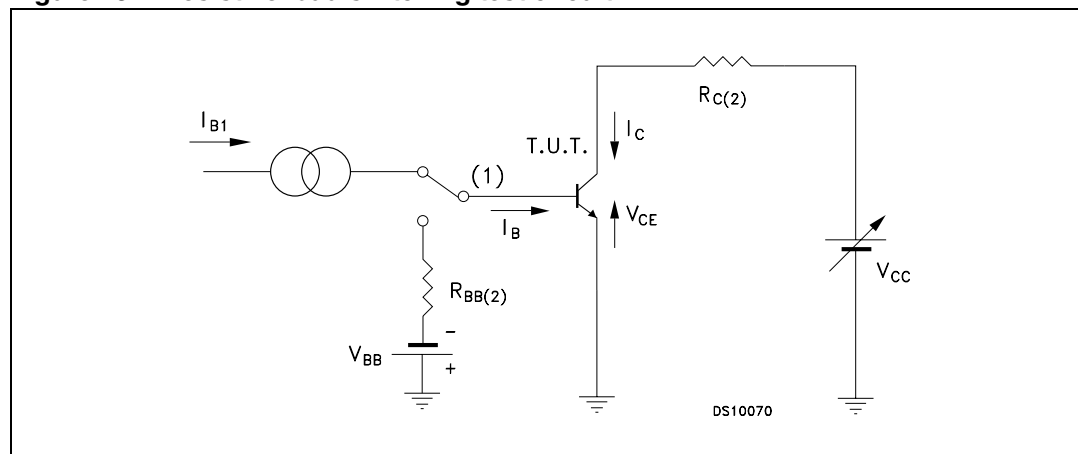
## 2.2 Test circuits

**Figure 12. Inductive load switching test circuit**



1. Fast electronic switch
2. Non-inductive resistor
3. Fast recovery rectifier

Figure 13. Resistive load switching test circuit



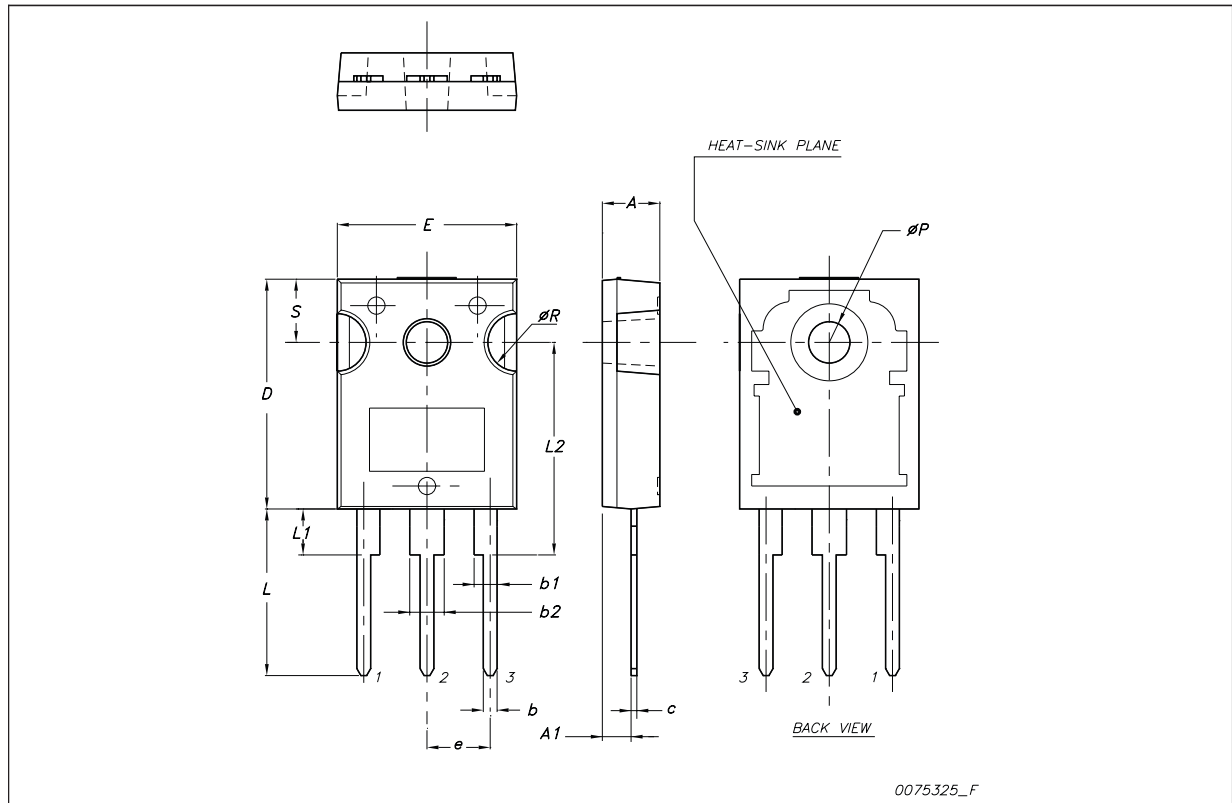
1. Fast electronic switch
2. Non-inductive resistor

### 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.

**TO-247 mechanical data**

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	





## 4 Revision history

**Table 5. Document revision history**

Date	Revision	Changes
07-Nov-2008	1	Initial release.
10-Jun-2009	2	Document status promoted from preliminary data to datasheet.

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