



# NPN Transistor Bare Die, 2N3227

Rev 1.0  
02/09/17

**Very High Speed Saturated Switch in bare die form**  
Complement PNP 2N4209 or 2N5771

## Features:

- Collector current up to 200mA
- Fast  $t_{on} + t_{off}$  switching times
- Characterized at temperature extremes
- High Reliability Gold Back Metal
- High Reliability tested grades for Military + Space

## Ordering Information:

The following part suffixes apply:

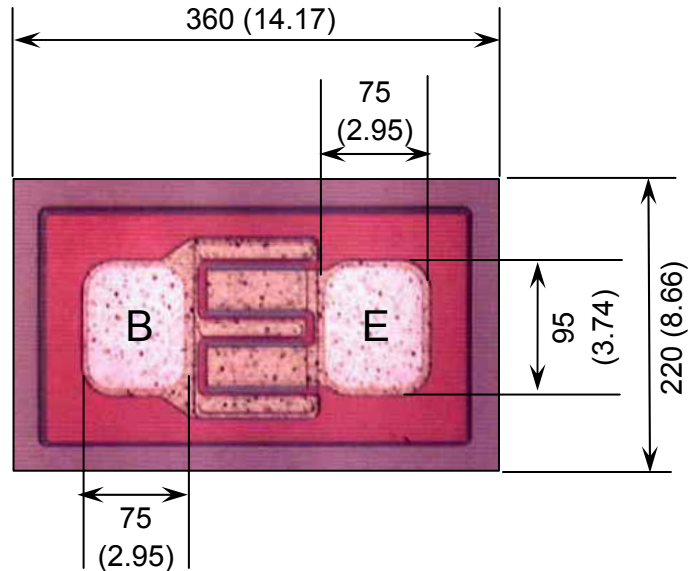
- No suffix - MIL-STD-750 /2072 Visual Inspection
- "H" - MIL-STD-750 /2072 Visual Inspection  
+ MIL-PRF-38534 Class H LAT
- "K" - MIL-STD-750 /2072 Visual Inspection  
+ MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

[www.siliconsupplies.com/quality/bare-die-lot-qualification](http://www.siliconsupplies.com/quality/bare-die-lot-qualification)

## Die Dimensions in $\mu\text{m}$ (mils)



**E = EMITTER B = BASE**

**DIE BACK = COLLECTOR**

## Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – Specific request
- Unsawn Wafer – Specific request
- With additional electrical selection – Specific request
- Sawn as pairs or adjacent pair pick – Specific request

## Mechanical Specification

Die Size (Excluding Saw Street)	360 x 220 14.17 x 8.66	$\mu\text{m}$ mils
Base Pad Size Emitter Pad Size	75 x 95 2.95 x 3.74	$\mu\text{m}$ mils
Die Thickness	180 ( $\pm 20$ ) 7.09 ( $\pm 0.79$ )	$\mu\text{m}$ mils
Top Metal Composition	Al - 1.3 $\mu\text{m}$	
Back Metal Composition	AuAs - 0.9 $\mu\text{m}$	





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## Absolute Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	VALUE	UNIT
Collector-Base Voltage	$V_{CBO}$	40	V
Collector-Emitter Voltage	$V_{CEO}$	20	V
Emitter-Base Voltage	$V_{EBO}$	6	V
Collector Current	$I_C$	200	mA
Junction & Storage Temperature	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$

## Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\mu\text{A}, I_E = 0$	40	-	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 10\text{mA}, I_B = 0$	20	-	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C = 10\mu\text{A}, V_{BE} = 0$	40	-	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\mu\text{A}, I_C = 0$	6	-	-	V
Collector Cut-off Current	$I_{CBO}$	$V_{CB} = 20\text{V}, I_E = 0$	-	-	200	nA
		$V_{CB} = 20\text{V}, I_E = 0, T_A = 125^\circ\text{C}^1$	-	-	50	$\mu\text{A}$
<b>ON CHARACTERISTICS</b>						
Forward-Current Transfer Ratio	$h_{FE}$	$V_{CE} = 1\text{V}, I_C = 10\text{mA}$	100	-	300	-
		$V_{CE} = 1\text{V}, I_C = 10\text{mA}, T_A = -55^\circ\text{C}^1$	40	-	-	-
		$V_{CE} = 1\text{V}, I_C = 100\text{mA}$	30	-	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 10\text{mA}, I_B = 1\text{mA}$	-	-	0.25	V
		$I_C = 100\text{mA}, I_B = 10\text{mA}$	-	-	0.45	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = 10\text{mA}, I_B = 1\text{mA}$	0.7	-	0.85	V
		$I_C = 100\text{mA}, I_B = 10\text{mA}$	0.8	-	1.4	V
<b>SMALL SIGNAL CHARACTERISTICS<sup>1</sup></b>						
Current Gain – Bandwidth Product	$f_T$	$I_C = 10\text{mA}, V_{CE} = 10\text{V}, f = 100\text{MHz}$	500	-	-	-
Output Capacitance	$C_{obo}$	$V_{CB} = 5\text{V}, I_E = 0, f = 1\text{MHz}$	-	-	4	pF
Input Capacitance	$C_{ibo}$	$V_{EB} = 0.5\text{V}, I_C = 0, f = 1\text{MHz}$	-	-	5	
<b>SWITCHING CHARACTERISTICS<sup>1</sup></b>						
Turn-On Time	$t_{on}$	$V_{CC} = 3\text{V}, I_C = 10\text{mA}, I_{B1} = 3\text{mA}, I_{B2} = -1.5\text{mA}$	-	-	12	ns
Turn-Off Time	$t_{off}$	$V_{CC} = 3\text{V}, I_C = 10\text{mA}, I_{B1} = 3\text{mA}, I_{B2} = -1.5\text{mA}$	-	-	18	
Storage Time	$t_s$	$I_C = 100\text{mA}, V_{CC} = 10\text{V}, I_{B1} = I_{B1} = 10\text{mA}$	-	-	13	
Fall Time	$t_f$	$I_C = 100\text{mA}, V_{CC} = 10\text{V}, I_{B1} = I_{B1} = 10\text{mA}$	-	-	15	

Note 1: Not production testing in die form, characterized by chip design and tested in package LAT





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## Typical Electrical Characteristics

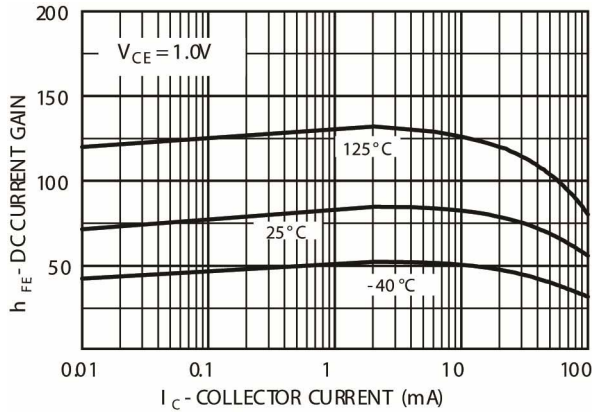


Fig 1 - DC Current Gain versus Collector Current

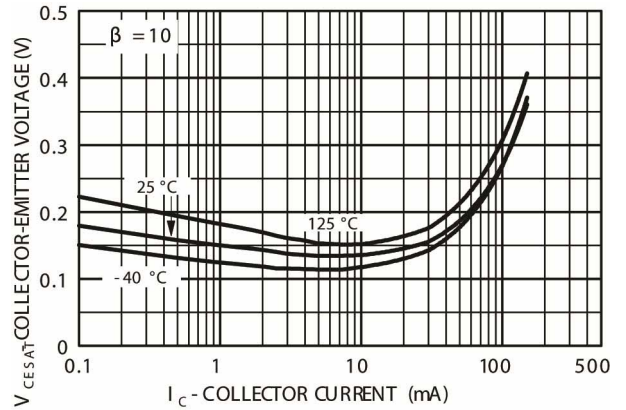


Fig 2 - Collector-Emitter Saturation Voltage versus Collector Current

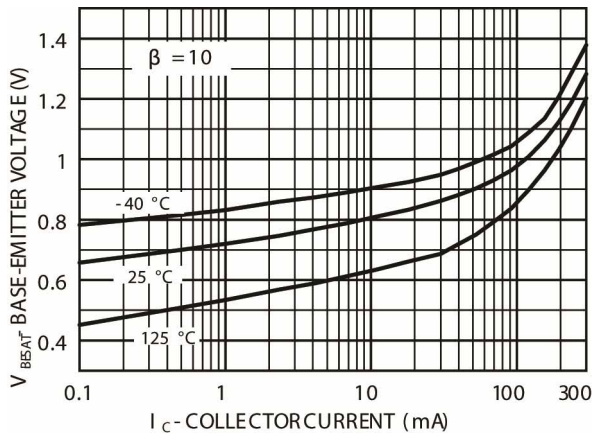


Fig 3 - Base-Emitter Saturation Voltage versus Collector Current

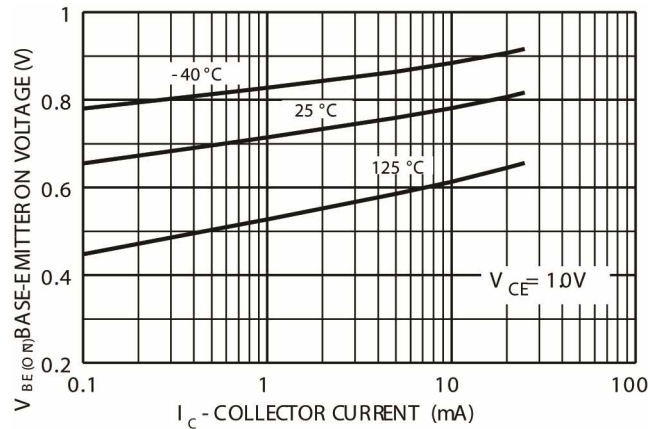


Fig 4 - Base-Emitter ON Voltage versus Collector Current

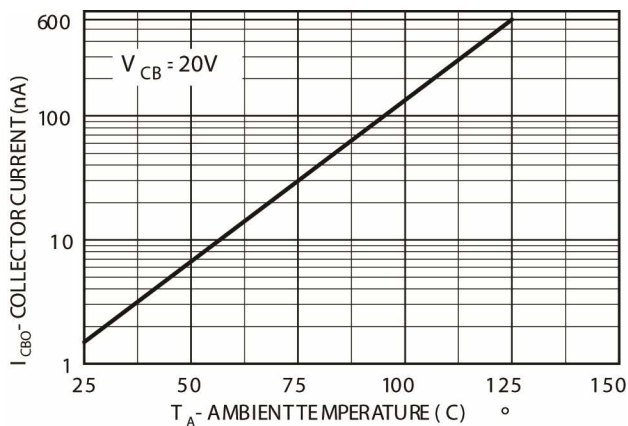


Fig 5 - Collector-Cut-off Current versus Ambient Temperature

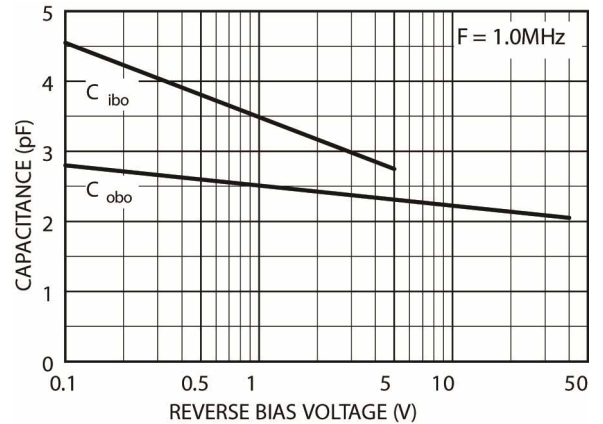


Fig 6 - Output Capacitance versus Reverse Bias Voltage





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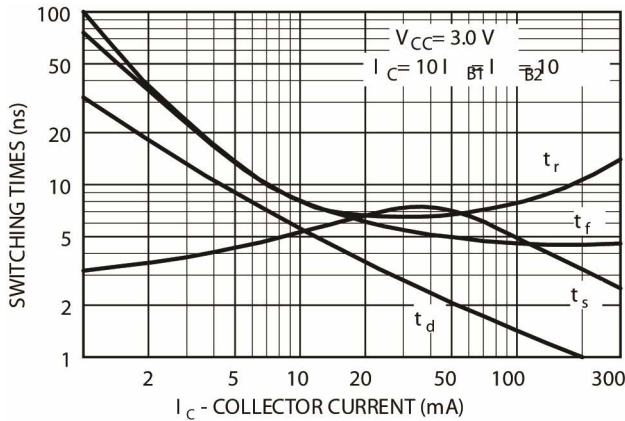


Fig 7 - Switching Times versus Collector Current

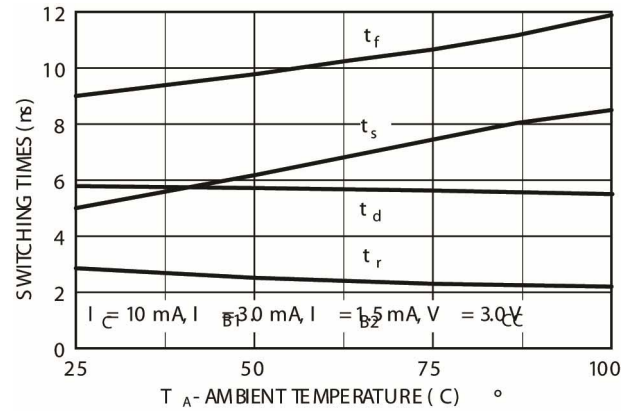


Fig 8 - Switching Times versus Ambient Temperature

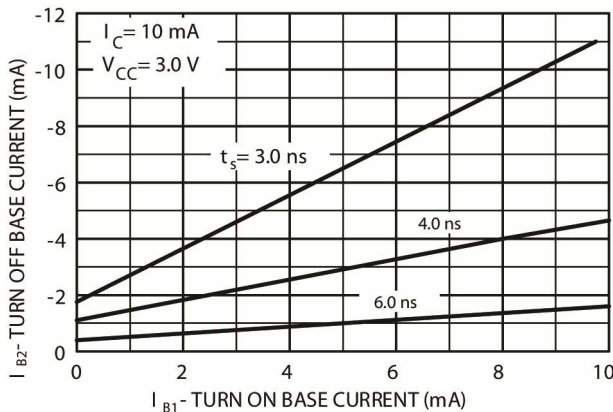


Fig 8 - Storage Time versus Turn On and Turn Off Base Currents

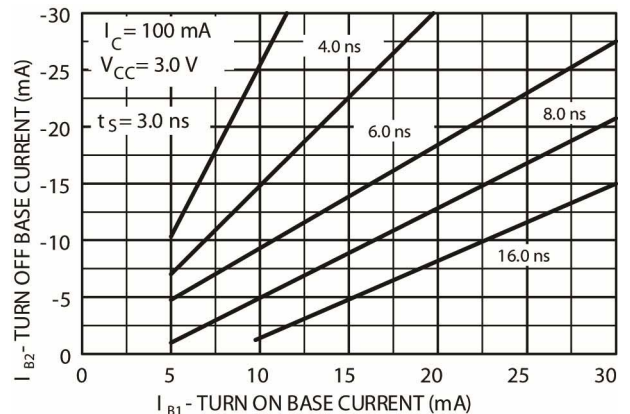


Fig 9 - Storage Time versus Turn On and Turn Off Base Currents

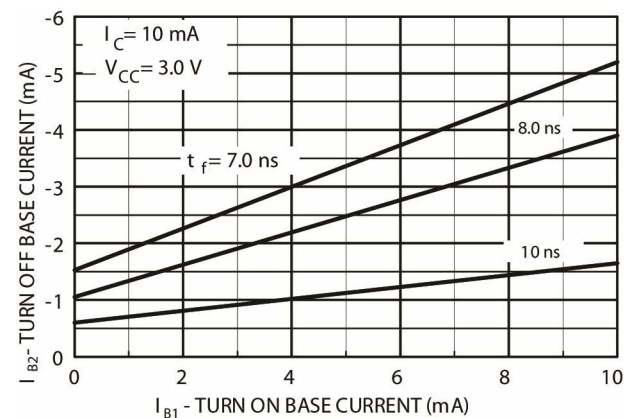


Fig 10 - Fall Time versus Turn On and Turn Off Base Currents

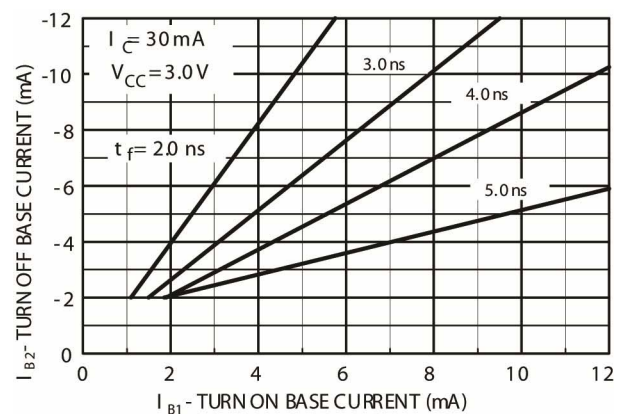


Fig 11 - Fall Time versus Turn On and Turn Off Base Currents

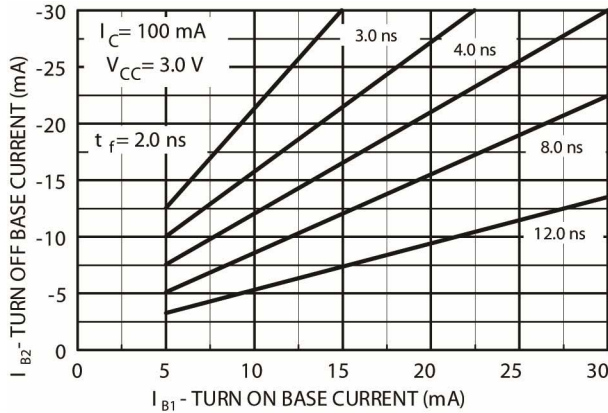




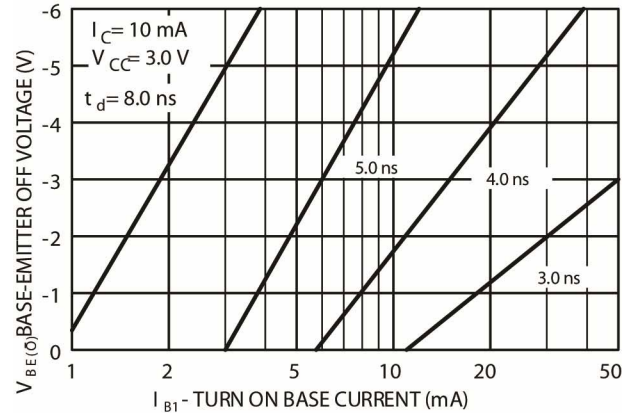
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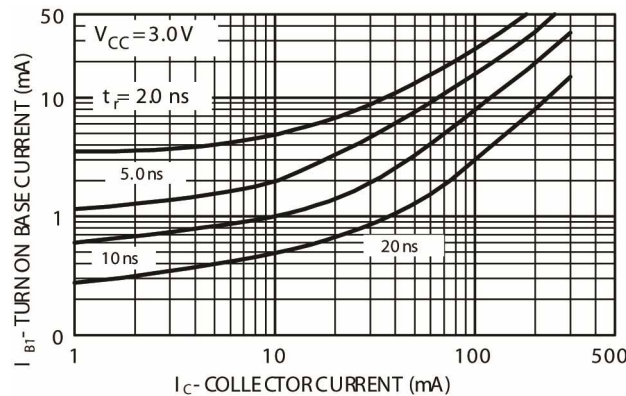
## Typical Electrical Characteristics (Continued)



**Fig 12** - Fall Time versus Turn On and Turn Off Base Currents



**Fig 13** - Delay Time versus Base-Emitter Off Voltage and Turn On Base Current



**Fig 14** - Rise Time vs. Turn On Base Current and Collector Current

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