



NPN Transistor Bare Die, 2N3013

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:

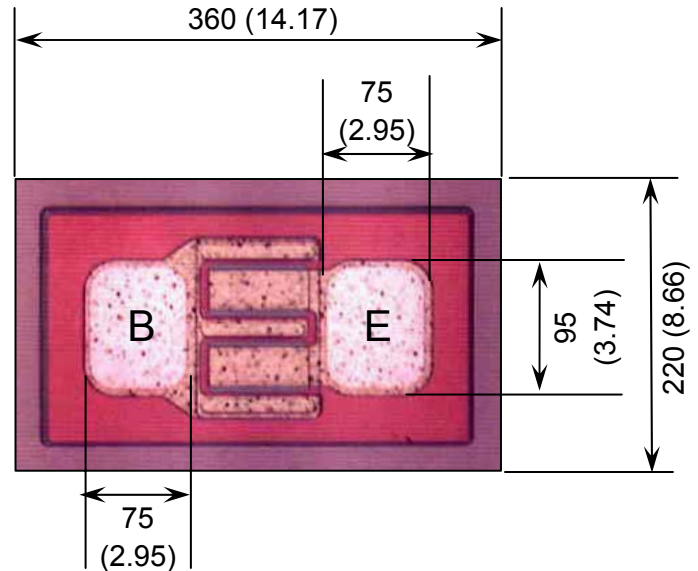
- No suffix - MIL-STD-750 /2072 Visual Inspection
- "H" - MIL-STD-750 /2072 Visual Inspection
+ MIL-PRF-38534 Class H LAT
- "K" - MIL-STD-750 /2072 Visual Inspection
+ MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

www.siliconsupplies.com/quality/bare-die-lot-qualification

Die Dimensions in μm (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	μm mils
Base Pad Size Emitter Pad Size	75 x 95 2.95 x 3.74	μm mils
Die Thickness	180 (± 20) 7.09 (± 0.79)	μm mils
Top Metal Composition	Al - 1.3 μm	
Back Metal Composition	AuAs - 0.9 μm	





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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}	15	V
Emitter-Base Voltage	V_{EBO}	5	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
OFF CHARACTERISTICS						
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\mu\text{A}, I_E = 0$	40	-	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 10\text{mA}, I_B = 0$	15	-	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C = 100\mu\text{A}, V_{BE} = 0$	40	-	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\mu\text{A}, I_C = 0$	5	-	-	V
Collector Cutoff Current	I_{CES}	$V_{CE} = 20\text{V}, V_{BE} = 0\text{V}$	-	-	300	nA
		$T_A = +125^\circ\text{C}, V_{CE} = 20\text{V}, V_{BE} = 0\text{V}$	-	-	40	μA
ON CHARACTERISTICS						
Forward-Current Transfer Ratio	h_{FE}	$V_{CE} = 0.4\text{V}, I_C = 30\text{mA}$	30	-	120	-
		$T_A = -55^\circ\text{C}, V_{CE} = 0.4\text{V}, I_C = 30\text{mA}$	12	-	-	-
		$V_{CE} = 0.5\text{V}, I_C = 100\text{mA}$	25	-	-	-
		$V_{CE} = 1\text{V}, I_C = 300\text{mA}$	15	-	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 30\text{mA}, I_B = 3\text{mA}$	-	-	0.18	V
		$T_A = +125^\circ\text{C}, I_C = 30\text{mA}, I_B = 3\text{mA}$	-	-	0.25	V
		$I_C = 100\text{mA}, I_B = 10\text{mA}$	-	-	0.28	V
		$I_C = 300\text{mA}, I_B = 30\text{mA}$	-	-	0.5	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = 30\text{mA}, I_B = 3\text{mA}$	0.75	-	0.95	V
		$I_C = 100\text{mA}, I_B = 10\text{mA}$	-	-	1.20	V
		$I_C = 300\text{mA}, I_B = 30\text{mA}$	-	-	1.70	V
SMALL SIGNAL CHARACTERISTICS¹						
Current Gain – Bandwidth Product	f_T	$I_C = 30\text{mA}, V_{CE} = 10\text{V}, f = 100\text{MHz}$	350	-	-	MHz
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	
SWITCHING CHARACTERISTICS¹						
Turn-On Time	t_{on}	$V_{CC} = 15\text{V}, I_C = 300\text{mA}, I_{B1} = 30\text{mA}$	-	-	15	ns
Turn-Off Time	t_{off}	$V_{CC} = 15\text{V}, I_C = 300\text{mA}, I_{B1} = I_{B2} = 30\text{mA}$	-	-	25	
Storage Time	t_s	$I_{B1} = I_{B2} = I_C = 10\text{mA}$	-	-	18	

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





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Typical Electrical Characteristics

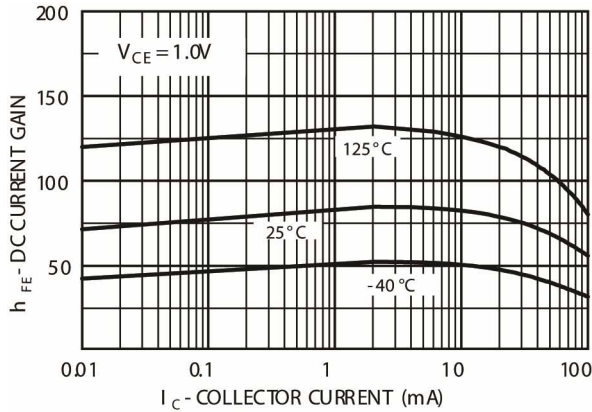


Fig 1 - DC Current Gain versus Collector Current

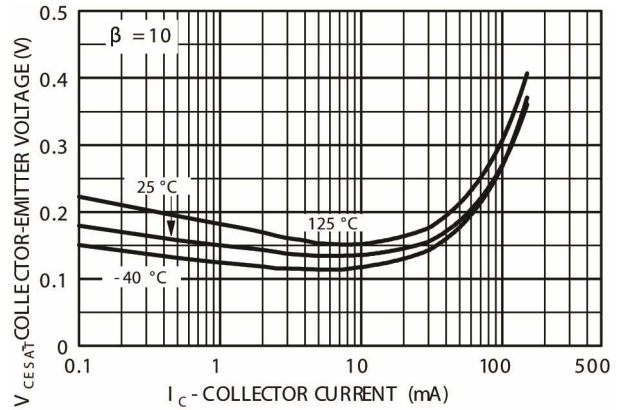


Fig 2 - Collector-Emitter Saturation Voltage versus Collector Current

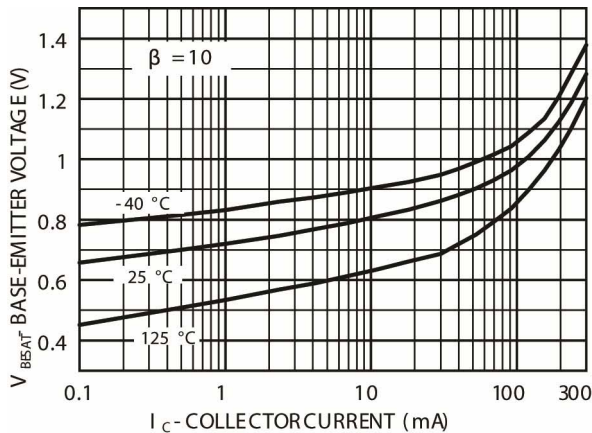


Fig 3 - Base-Emitter Saturation Voltage versus Collector Current

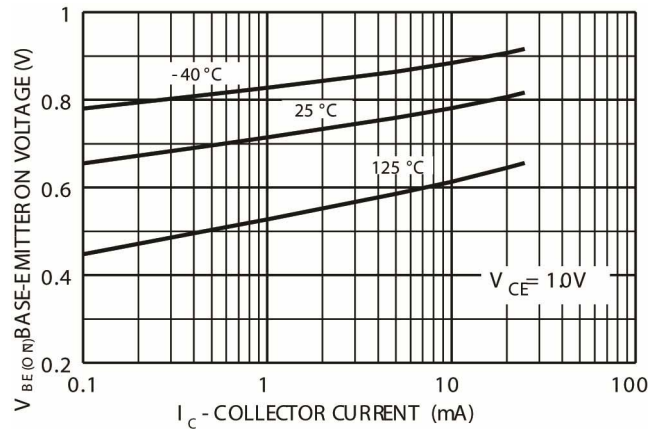


Fig 4 - Base-Emitter ON Voltage versus Collector Current

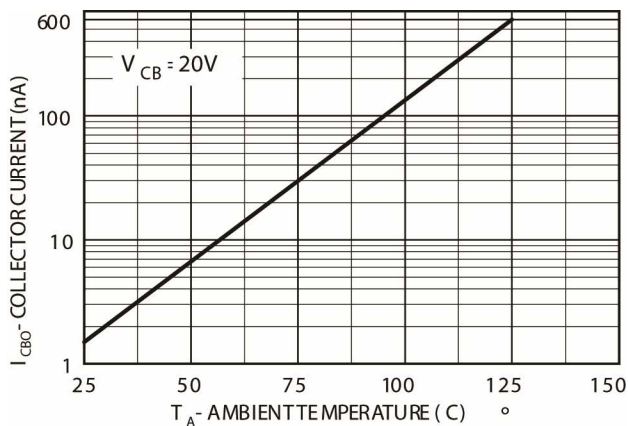


Fig 5 - Collector-Cut-off Current versus Ambient Temperature

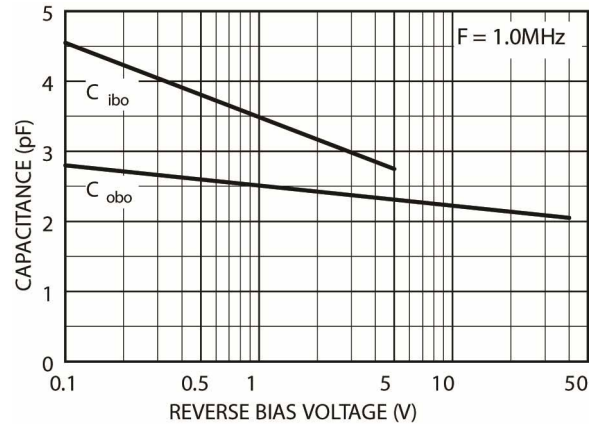


Fig 6 - Output Capacitance versus Reverse Bias Voltage





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Typical Electrical Characteristics (Continued)

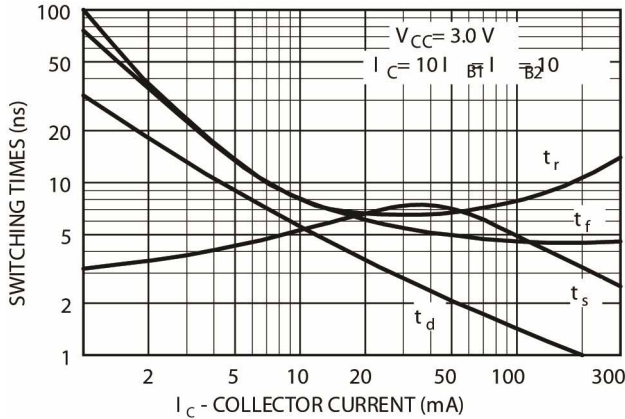


Fig 7 - Switching Times versus Collector Current

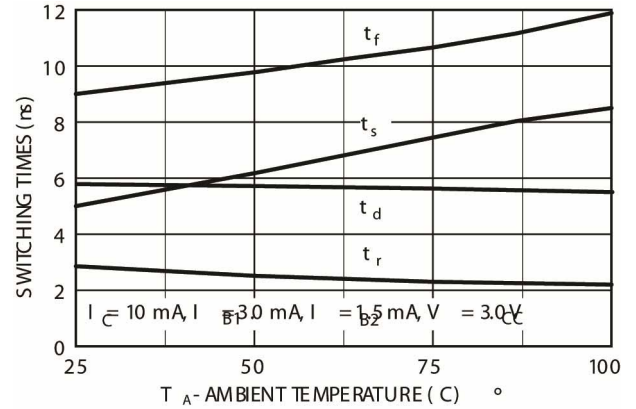


Fig 8 - Switching Times versus Ambient Temperature

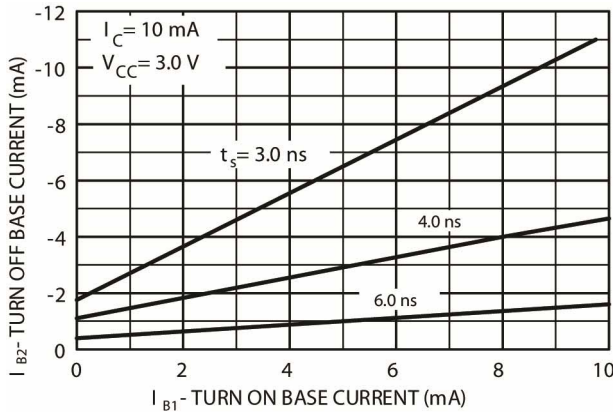


Fig 8 - Storage Time versus Turn On and Turn Off Base Currents

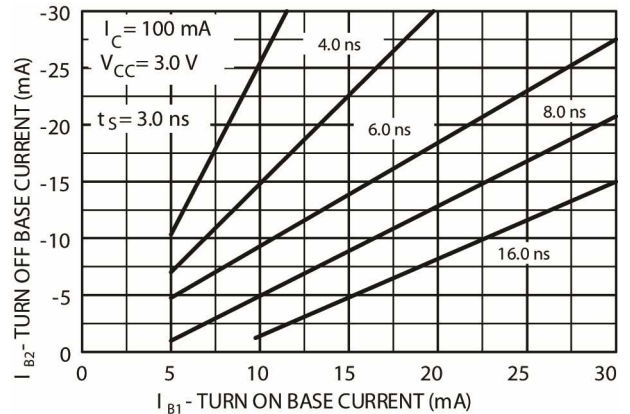


Fig 9 - Storage Time versus Turn On and Turn Off Base Currents

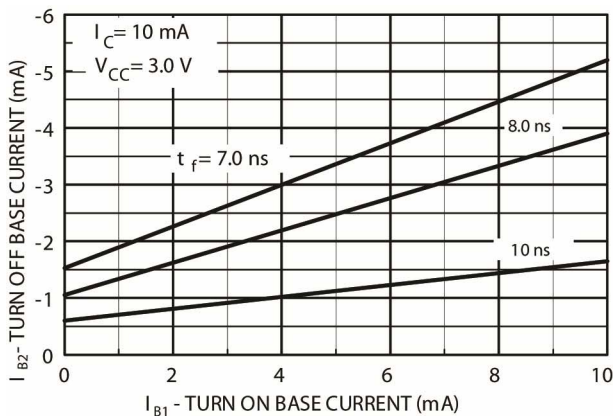


Fig 10 - Fall Time versus Turn On and Turn Off Base Currents

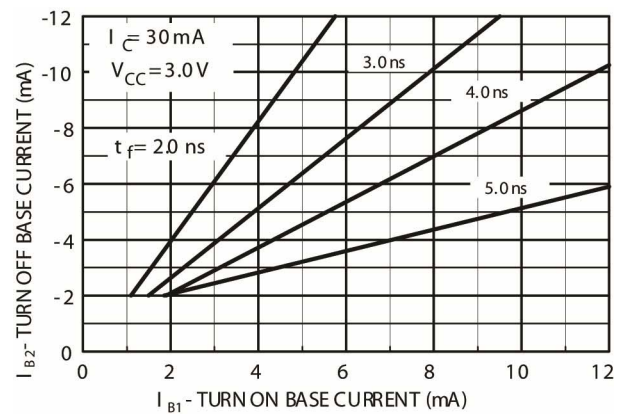


Fig 11 - Fall Time versus Turn On and Turn Off Base Currents





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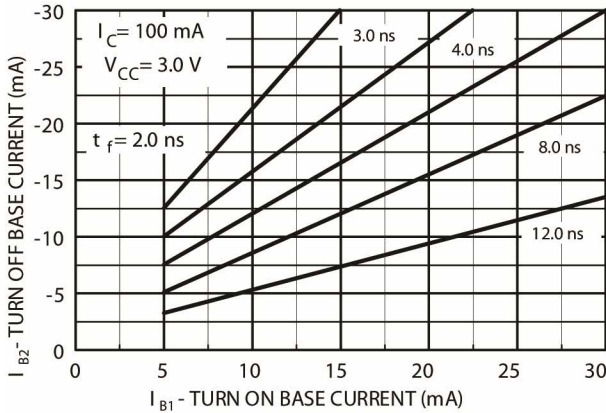


Fig 12 - Fall Time versus Turn On and Turn Off Base Currents

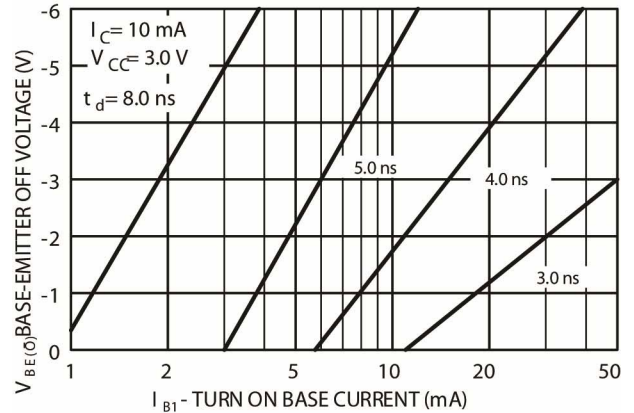


Fig 13 - Delay Time versus Base-Emitter Off Voltage and Turn On Base Current

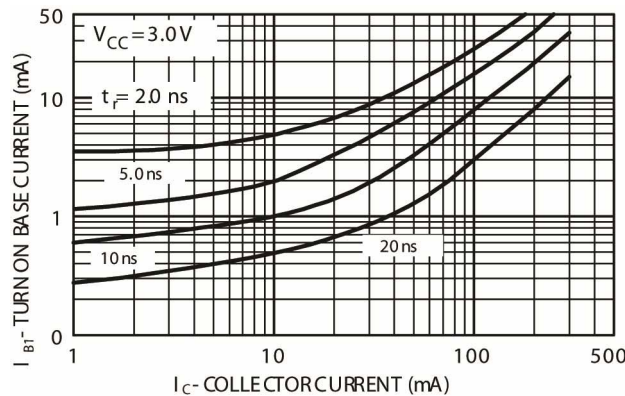


Fig 14 - Rise Time vs. Turn On Base Current and Collector Current

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