



PNP Transistor Bare Die, 2N2904

Rev 1.0
02/09/17

General purpose medium power amplifier or switch in bare die form
Complement to NPN 2N2222A

Features:

- High DC Current Gain 0.1mA to 500mA
- Low Collector-Emitter Saturation Voltage
- 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.

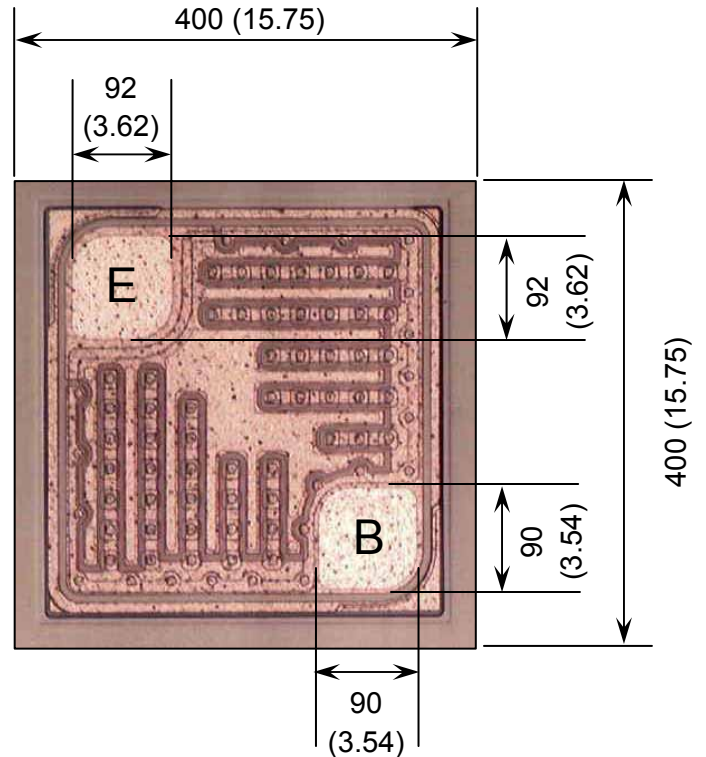
For further information on LAT process flows see below.

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

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

Die Dimensions in μm (mils)



E = EMITTER B = BASE

DIE BACK = COLLECTOR

Mechanical Specification

Die Size (Excluding Saw Street)	400 x 400 9.84 x 10.63	μm mils
Base Pad Size	90 x 90 3.54 x 3.54	μm mils
Emitter Pad Size	92 x 92 3.62 x 3.62	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}	-60	V
Collector-Emitter Voltage	V_{CEO}	-40	V
Emitter-Base Voltage	V_{EBO}	-5	V
Collector Current	I_C	-600	mA
Junction Temperature	T_J	150	$^\circ\text{C}$
Storage Temperature	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	$V_{(BR)CBO}$	$I_C = -10\mu\text{A}$	-60	-	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -10\text{mA}$	-40	-	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10\mu\text{A}$	-5	-	-	V
Collector Cut-off Current	I_{CEX}	$V_{CE} = -30\text{V}, V_{EB} = -0.5\text{V}$	-	-	-50	nA
	I_{CBO}	$V_{CB} = -50\text{V}$	-	-	-20	nA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = -4\text{V}$	-	-	-50	nA
ON CHARACTERISTICS						
Forward-Current Transfer Ratio	h_{FE}	$V_{CE} = -10\text{V}, I_C = -0.1\text{mA}$	20	-	-	-
		$V_{CE} = -10\text{V}, I_C = -1\text{mA}$	25	-	-	-
		$V_{CE} = -10\text{V}, I_C = -10\text{mA}$	35	-	-	-
		$V_{CE} = -10\text{V}, I_C = -500\text{mA}$	20	-	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = -150\text{mA}, I_B = -15\text{mA}$	-	-	-0.4	V
		$I_C = -500\text{mA}, I_B = -50\text{mA}$	-	-	-1.6	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = -150\text{mA}, I_B = -15\text{mA}$	-	-	-1.3	V
		$I_C = -500\text{mA}, I_B = -50\text{mA}$	-	-	-2.6	V
SMALL SIGNAL CHARACTERISTICS¹						
Transition Frequency	f_T	$V_{CE} = -20\text{V}, I_E = 50\text{mA}$	200	-	-	MHz
Output Capacitance	C_{obo}	$V_{CB} = -10\text{V}, I_E = 0, f = 1\text{MHz}$	-	-	8	pF
Input Capacitance	C_{ibo}	$V_{EB} = -2\text{V}, I_C = 0, f = 1\text{MHz}$	-	-	30	
SWITCHING CHARACTERISTICS¹						
Delay Time	t_d	$V_{CC} = -30\text{V},$ $I_C = -150\text{mA}, I_{B1} = -15\text{mA}$	-	-	10	ns
Rise Time	t_r		-	-	40	
Storage Time	t_s	$V_{CC} = -6\text{V}, I_C = -150\text{mA}$ $I_{B1} = I_{B2} = -15\text{mA}$	-	-	80	
Fall Time	t_f		-	-	30	

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





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Typical Electrical Characteristics

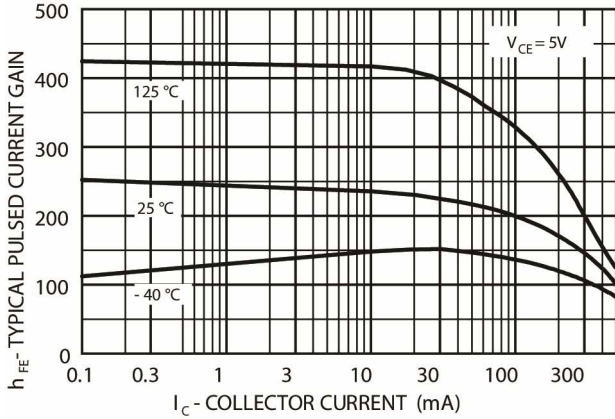


Fig 1 - Typical Pulsed Current Gain versus Collector Current

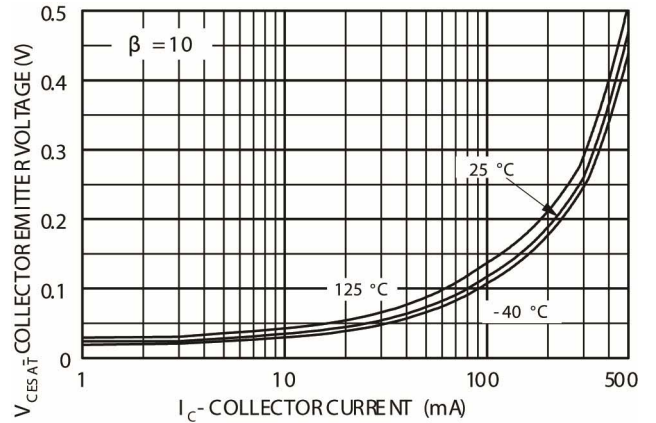


Fig 2 - Collector-Emitter Saturation Voltage versus Collector Current

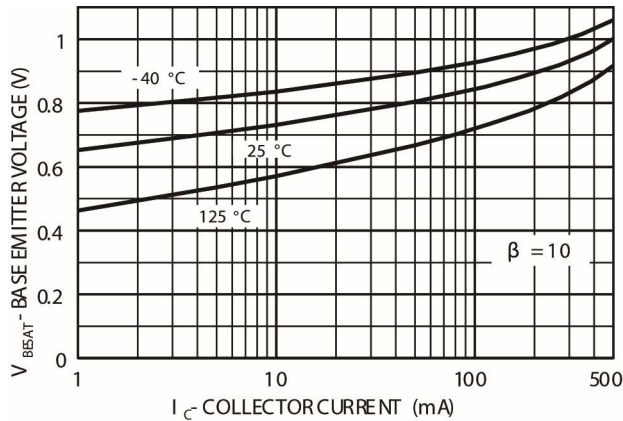


Fig 3 - Base-Emitter Saturation Voltage versus Collector Current

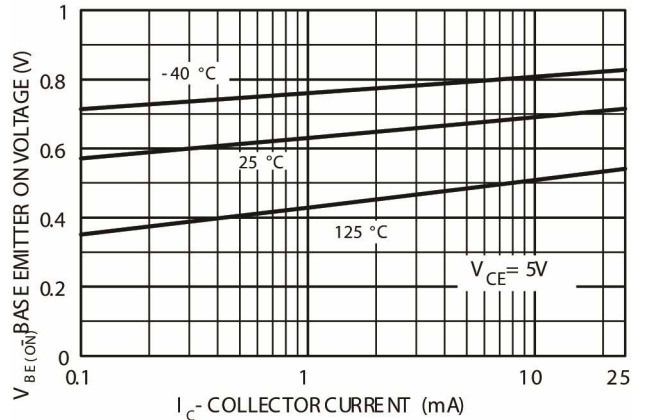


Fig 4 - Base-Emitter ON Voltage versus Collector Current

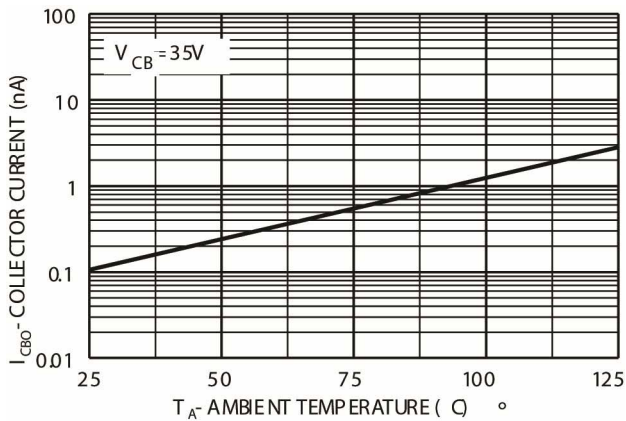


Fig 5 - Collector-Cut-off Current versus Ambient Temperature

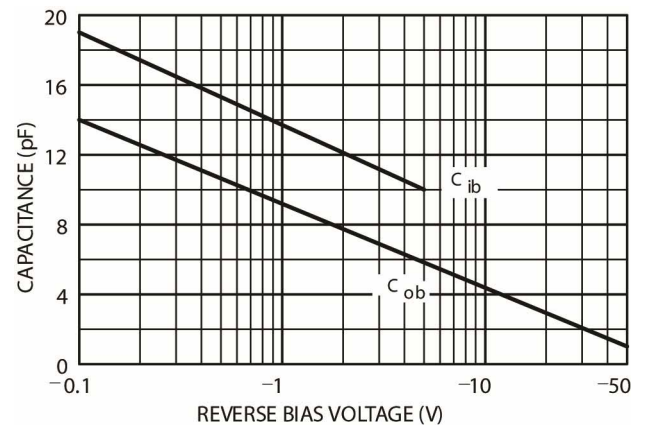


Fig 6 - Capacitance versus Reverse Bias Voltage





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Typical Electrical Characteristics (Continued)

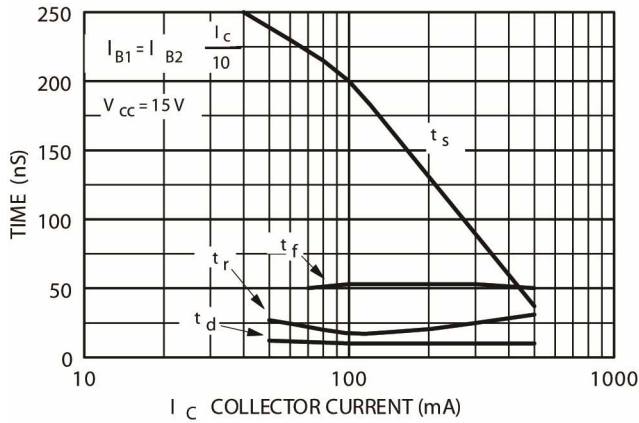


Fig 7 – Switching Times versus Collector Current

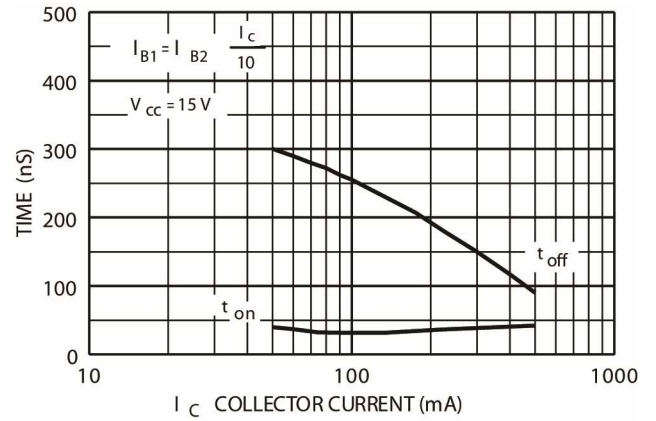


Fig 8 - Turn On and Turn Off Times versus Collector Current

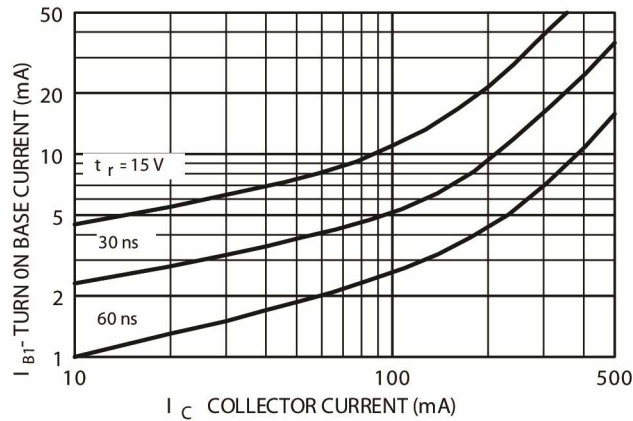


Fig 9 – Rise Time versus Collector and Turn On Base Currents





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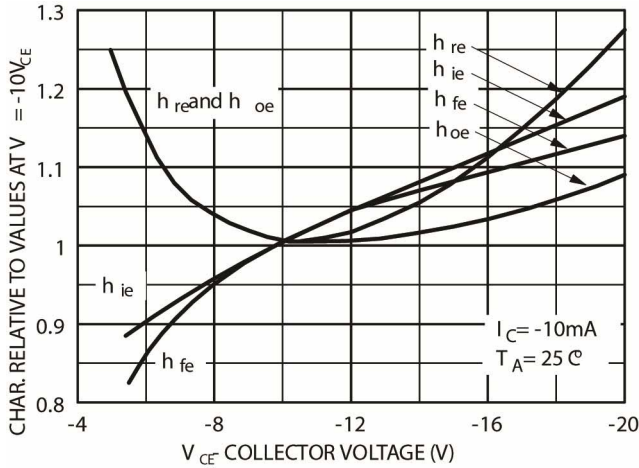


Fig 10 – Common Emitter Characteristics

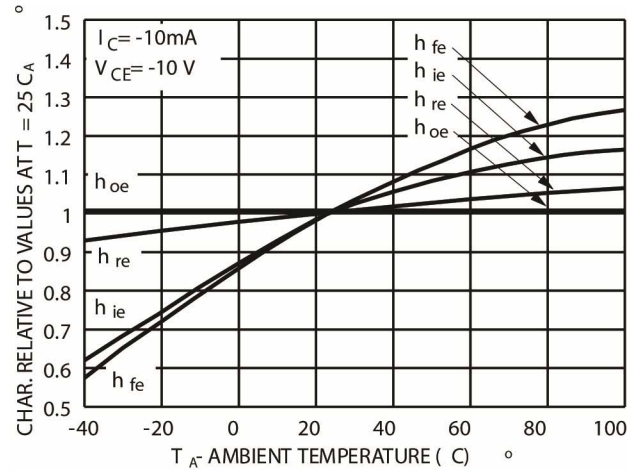


Fig 11 – Common Emitter Characteristics

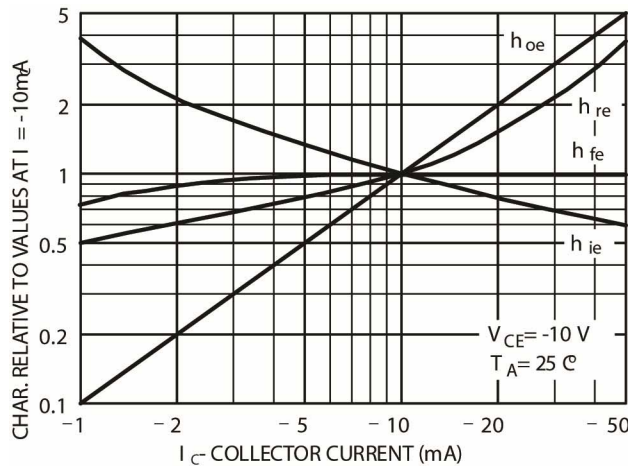


Fig 12 – Common Emitter Characteristics

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