ELECTRONICS, INC.
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2N3904
Silicon NPN Transistor
General Purpose
TO–92 Type Package

Absolute Maximum Ratings:

Collector–Emitter Voltage, V_{CEO} 40V
Collector–Base Voltage, V_{CB} 60V
Emitter–Base Voltage, V_{EBO} 6V
Continuous Collector Current, I_C 200mA
Total Device Dissipation (T_A = +25°C), P_D 625mW
Derate Above 25°C . . . . . 2.8mW/°C
Total Device Dissipation (T_C = +25°C), P_D 1.5W
Derate Above 25°C . . . . . 12mW/°C
Operating Junction Temperature Range, T_J . . . . . –55° to +150°C
Storage Temperature Range, T_{stg} . . . . . –55° to +150°C
Thermal Resistance, Junction to Case, R_{thJC} . . . . . 83.3°C/W
Thermal Resistance, Junction to Ambient, R_{thJA} . . . . . 200°C/W

Electrical Characteristics: (T_A = +25°C unless otherwise specified)

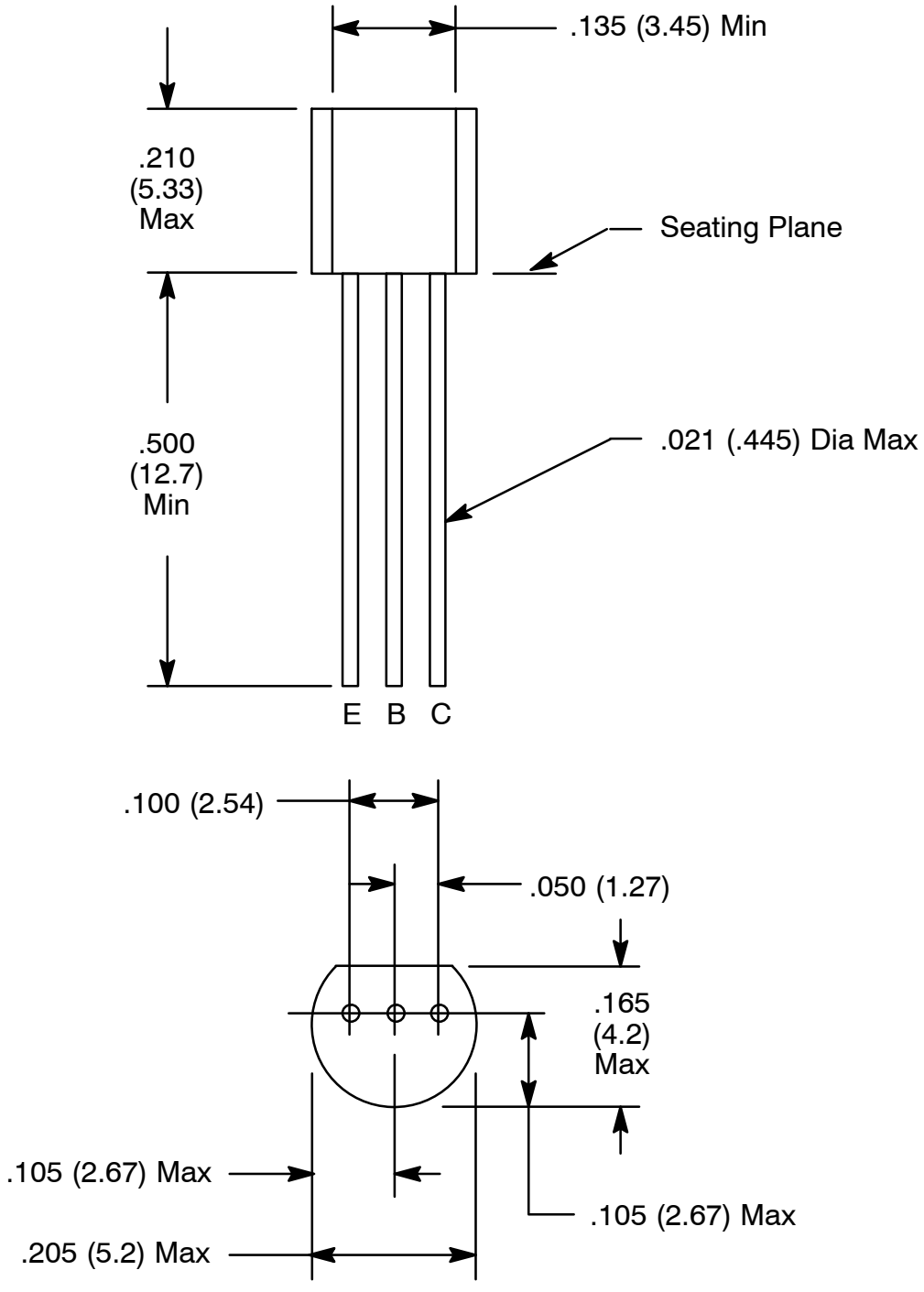
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF Characteristics						
Collector–Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0, Note 1	40	–	–	V
Collector–Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 10μA, I_E = 0	60	–	–	V
Emitter–Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 10μA, I_C = 0	6	–	–	V
Collector Cutoff Current	I_{CEX}	V_{CE} = 30V, V_{EB} = 3V	–	–	50	nA
Base Cutoff Current	I_{BL}	V_{CE} = 30V, V_{EB} = 3V	–	–	50	nA
ON Characteristics (Note 1)						
DC Current Gain	h_{FE}	V_{CE} = 1V, I_C = 0.1mA	40	–	–	
		V_{CE} = 1V, I_C = 1mA	70	–	–	
		V_{CE} = 1V, I_C = 10mA	100	–	300	
		V_{CE} = 1V, I_C = 50mA	60	–	–	
		V_{CE} = 1V, I_C = 100mA	30	–	–	

Note 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.

Electrical Characteristics (Cont'd): (T_A = +25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
ON Characteristics (Cont'd) (Note 1)						
Collector−Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 10mA, I_B = 1mA	–	–	0.2	V
		I_C = 50mA, I_B = 5mA	–	–	0.3	V
Base−Emitter Saturation Voltage	$V_{BE(sat)}$	I_C = 10mA, I_B = 1mA	0.65	–	0.85	V
		I_C = 50mA, I_B = 5mA	–	–	0.95	V
Small−Signal Characteristics						
Current Gain−Bandwidth Product	f_T	I_C = 10mA, V_{CE} = 20V, f = 100MHz	300	–	–	MHz
Output Capacitance	C_{obo}	V_{CB} = 5V, I_E = 0, f = 1MHz	–	–	4.0	pF
Input Capacitance	C_{ibo}	V_{CB} = 0.5V, I_C = 0, f = 1MHz	–	–	8.0	pF
Input Impedance	h_{ie}	I_C = 1mA, V_{CE} = 10V, f = 1kHz	1.0	–	10	kΩ
Voltage Feedback Ratio	h_{re}	I_C = 1mA, V_{CE} = 10V, f = 1kHz	0.5	–	8.0	x 10^{-4}
Small−Signal Current Gain	h_{fe}	I_C = 1mA, V_{CE} = 10V, f = 1kHz	100	–	400	
Output Admittance	h_{oe}	I_C = 1mA, V_{CE} = 10V, f = 1kHz	1.0	–	30	μmhos
Noise Figure	NF	I_C = 100μA, V_{CE} = 5V, R_S = 1kΩ, f = 10Hz to 15.7kHz	–	–	5.0	db
Switching Characteristics						
Delay Time	t_d	V_{CC} = 3V, V_{EB} = 0.5V, I_C = 10mA, I_{B1} = 1mA	–	–	35	ns
Rise Time	t_r		–	–	35	ns
Storage Time	t_s	V_{CC} = 3V, I_C = 10mA, I_{B1} = I_{B2} = 1mA	–	–	200	ns
Fall Time	t_f		–	–	50	ns

Note 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.


.135 (3.45) Min
.210
(5.33)
Max
Seating Plane
.500
(12.7)
Min
.021 (.445) Dia Max
E B C
.100 (2.54)
.050 (1.27)
.165
(4.2)
Max
.105 (2.67) Max
.105 (2.67) Max
.205 (5.2) Max

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