2N499
(JAN2N499 AVAILABLE)

2N499A
(JAN2N499A AVAILABLE)

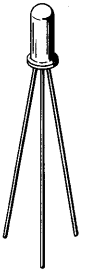
2N502

2N502A
(JAN2N502A AVAILABLE)

2N502B
(JAN2N502B AVAILABLE)

2N1742

Germanium PNP high frequency transistors designed for driver applications, small-signal amplification, wide band video amplifiers, and VHF/UHF oscillators.



CASE 149
(TO-1)

2N499, 2N499A
JAN2N499, JAN2N499A

CASE 31
(TO-5)

2N502,A,B,
JAN2N502A,B,
2N1742

MAXIMUM RATINGS

Rating	Symbol	2N499 JAN2N499 2N499A JAN2N499A	2N502	2N502A, B JAN2N502A JAN2N502B	2N1742	Unit
Collector-Base Voltage	V_{CB}	30	20	30	20	Vdc
Emitter-Base Voltage	V_{EB}	0.5	0.5	0.5	0.5	Vdc
Collector Current	I_C	50	50	50	50	mAdc
Total Device Dissipation	P_D	60	60	75	60	mW
Operating Junction Temperature Range	T_J	100	100	100	125	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector Cutoff Current		I_{CBO}			μAdc
(V_{CB} = 10 Vdc, I_E = 0)	2N502, A, B		-	5.0	
	JAN2N502A, B		-	4.0	
	2N1742		-	10	
(V_{CB} = 15 Vdc, I_E = 0)	2N499, A, JAN2N499, A		-	10	
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product		f_T			MHz
(I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 20 MHz)	2N499, A, JAN2N499, A		120	-	
(I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	JAN2N502A, B		150	600	
Output Capacitance		C_{ob}			pF
(V_{CB} = 10 Vdc, I_E = 0, f = 4.0 MHz)	2N499, A, JAN2N499, A		-	2.5	
	2N502		-	2.0	
	2N502A, B		-	1.6	
	JAN2N502A, B		-	1.6	
Small-Signal Current Gain		h_{fe}			-
(I_C = 1.0 mAdc, V_{CE} = 9.0 Vdc, f = 1.0 kHz)	2N499, A, JAN2N499, A		20	80	
(I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N502		9.0	-	
	2N502A		15	-	
	2N502B		20	80	
	JAN2N502A		15	200	
	JAN2N502B		25	80	
Collector-Base Time Constant		$r_b'C_c$			ps
(I_E = 2.0 mAdc, V_{CB} = 10 Vdc, f = 46 MHz)	JAN2N499, A		5.0	50	
	2N499		-	250	
	2N499A		5.0	250	
	2N502		-	120	
	2N502A, B		5.0	50	
	JAN2N502A, B		5.0	25	
Noise Figure		NF			dB
(V_{CB} = 10 Vdc, I_E = 2.0 mAdc, f = 200 MHz)	2N502A, JAN2N502A		-	7.0	
	2N502B, JAN2N502B		-	7.0	
(V_{CC} = 12 Vdc, I_E = 2.5 mAdc, f = 200 MHz)	2N1742		-	5.5	
FUNCTIONAL TESTS					
Power Gain		P_G			dB
(V_{CB} = 10 Vdc, I_E = 2.0 mAdc, f = 100 MHz)	2N499, A, JAN2N499, A		7.5	-	
(V_{CB} = 10 Vdc, I_E = 2.0 mAdc, f = 200 MHz)	2N502		8.0	-	
	2N502A		10	-	
	2N502B		10	-	
	JAN2N502A, B		10	20	
(V_{CB} = 12 Vdc, I_E = 2.5 mAdc, f = 200 MHz)	2N1742		14	19	

2N508 (GERMANIUM)

FOR SPECIFICATIONS, SEE 2N322 DATA.

2N554 (GERMANIUM)
2N555

For Specifications, See 2N178 Data.

JAN 2N559-1 (GERMANIUM)
JAN 2N559-2
JAN 2N559-3*

PNP germanium mesa transistors designed for military and industrial high-reliability, high-speed switching applications.

CASE 22
(TO-18)

Collector connected to case

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	15	Vdc
Collector-Base Voltage	V_{CB}	15	Vdc
Emitter-Base Voltage	V_{EB}	5	Vdc
Collector Current	I_C	50	mAdc
Base Current	I_B	50	mAdc
Emitter Current	I_E	50	mAdc
Total Device Dissipation @ $T_A = 25^oC$ Derate above 25^oC	P_D	150 2.0	mW $mW/^oC$
Total Device Dissipation @ $T_C = 25^oC$ Derate above 25^oC	P_D	300 4.0	mW $mW/^oC$
Operating Junction Temperature Range	T_J	-65 to +100	^oC
Storage Temperature Range	T_{stg}	-65 to +150	^oC

* Level 3 reliability data shown for information only. Qualification tests will be initiated upon established customer requirements.

RELIABILITY RATINGS†

Reliability Level Indicator	QUALITY LEVELS (LTPD)				RELIABILITY LEVELS Maximum failure rate (λ) during first 1000 hours with 90% confidence.						Est. Max Failure Rate in Conservatively Designed Equipment %/1000 Hrs
					Operation Life		Storage Life				
	Group A Subgroups		Group B Subgroups		$P_D = 150$ mW $I_E = 50$ mA $T_A = 25°C$		$T_A = 100°C$		$T_A = 150°C$		
	Major Defect	Minor Defect	Major Defect	Minor Defect	Major Defect	Minor Defect	Major Defect	Minor Defect	Major Defect	Minor Defect	
(1)	3.0	5.0	10	20	10	20	10	20	20	—	0.1
(2)	1.5	3.0	5	15	5	15	1.5	3	7	20	0.01
(3)*	1.0	2.0	3	7	2	5	0.2	0.5	1	3	0.001

† This table relates the statistical sampling requirements in the specification to the reliability levels for the transistor.

* Level 3 reliability data shown for information only. Qualification tests will be initiated upon established customer requirements.

TABLE I – GROUP A INSPECTION

Examination or Test	MIL-STD-750 Method	LTPD for Respective Reliability Level						Symbol	Limit				Unit
		Total ①			Major				Requirement Limit		Defect Classification		
		(1)	(2)	(3)	(1)	(2)	(3)		Min	Max	Minor	Major	
SUBGROUP 1													
Visual and Mechanical Examination	2071	10	7	5	7	5	3	—	—	—	—	—	—
SUBGROUP 2		5	3	2	3	1.5	1.0						
Emitter-Base Cutoff Current (V_{EB} = -1 Vdc)	3061 Condition D							I_{EBO}	—	5	>5 to 10	>10	μAdc
Collector-Base Cutoff Current (V_{CB} = -5 Vdc)	3036 Condition D							I_{CBO}	—	3	>3 to 5	>5	μAdc
Emitter-Base Breakdown Voltage (I_E = -200 μAdc)	3026 Condition D							BV_{EBO}	5	—	3.5 to <5	<3.5	Vdc
Collector-Emitter Breakdown Voltage (I_C = -100 μAdc)	3011 Condition C							BV_{CES}	15	—	12 to <15	<12	Vdc
SUBGROUP 3		5	3	2	3	1.5	1.0						
Collector-Emitter Saturation Voltage (I_C = -50 mAdc, I_B = -1.5 mAdc)	3071							$V_{CE(sat)}$	—	1	>1.0 to 1.2	>1.2	Vdc
(I_C = -10 mAdc, I_B = -0.4 mAdc)									—	0.3	>0.3 to 0.35	>0.35	
Base-Emitter Saturation Voltage (I_C = -10 mAdc, I_B = -0.4 mAdc)	3066 Condition A							$V_{BE(sat)}$	0.32	0.44	0.30 to <0.32 and 0.44 to 0.50	<0.30 and >0.50	Vdc
DC Current Gain (I_C = -10 mAdc, V_{CE} = -0.5 Vdc)	3076							h_{FE}	25	150	20 to <25 and >150 to 200	<20 and >200	—
SUBGROUP 4		5	3	2	3	1.5	1.0						
Rise Time (V_{CC} = -3.5 Vdc, $V_{BE(off)}$ = 0.5 Vdc, I_{B1} = -0.55 mAdc, R_C = 300 ohms, C_{CE} = 150 pF, $C_{CB} = 2^{+0.5}_{-0}$ pF)	3251 Condition A							t_r	—	95	>95 to 115	>115	ns
Storage Time (V_{CC} = -3.5 Vdc, I_{B1} = -1 mAdc, I_{B2} = 0.25 mAdc, R_C = 300 ohms)	3251 Condition A							t_s	—	95	>95 to 115	>115	ns
Fall Time (V_{CC} = -3.5 Vdc, I_{B1} = -1 mAdc, I_{B2} = 0.25 mAdc, R_C = 300 ohms, $C_{CB} = 2^{+0.5}_{-0}$ pF)	3251 Condition A							t_f	—	100	>100 to 120	>120	ns

NOTES:

TABLE II – GROUP B INSPECTION

Examination or Test	MIL-STD-750 Method	LTPD for Respective Reliability Level						Symbol	Limit				Unit
		Total ①			Major				Requirement Limit		Defect Classification		
		(1)	(2)	(3)	(1)	(2)	(3)		Min	Max	Minor	Major	
SUBGROUP 1													
Physical Dimensions	2066	20	15	7	—	—	—	—	—	—	—	—	—
SUBGROUP 2		5	3	2	3	1.5	1						
Moisture Resistance (No initial conditioning; one cycle; only steps 1 to 6)	1021							—	—	—	—	—	—
End-Point Tests:													
Emitter-Base Cutoff Current (V_{EB} = -1 Vdc)	3061 Condition D							I_{EBO}	—	10	>10 to 20	>20	μAdc
Collector-Base Cutoff Current (V_{CB} = -5 Vdc)	3036 Condition D							I_{CBO}	—	5	> 5 to 10	>10	μAdc
DC Current Gain (I_C = -10 mAdc, V_{CE} = -0.5 Vdc)	3076							h_{FE}	20	200	15 to < 20 and >200 to 250	< 15 and >250	—
SUBGROUP 3		20	15	7	10	5	3						
Tension	2036 Condition A							—	—	—	—	—	—
Solderability	2026							—	—	—	—	—	—
Temperature Cycling (5 cycles) $T_{(high)} = 100^{+5}_{-0}$ °C 2N559 (1) $T_{(high)} = 150 \pm 5$ °C 2N559 (2), 2N559 (3)	1051 Condition B							—	—	—	—	—	—
Thermal Shock (Glass Strain)	1056 Condition A							—	—	—	—	—	—
Moisture Resistance	1021							—	—	—	—	—	—
End-Point Tests: Same as Subgroup 2													
SUBGROUP 4		20	15	7	10	5	3						
Shock (Non-operating; 5 blows: 1500 G in Orientations X_1, Y_1, Y_2, and Z_1 (total = 20 blows)	2016							—	—	—	—	—	—
Constant Acceleration (20,000 G, Orientations X_1, Y_1, Y_2, and Z_1)	2006							—	—	—	—	—	—
Vibration Fatigue (No bias applied)	2046							—	—	—	—	—	—
Vibration, Variable Frequency (1 cycle each in Orientations X_1, Y_1, and Z_1)	2056							—	—	—	—	—	—
End-Point Tests: Same as Subgroup 2													
SUBGROUP 5		20	15	7	10	5	3						
Terminal Strength - Lead Fatigue ②	2036 Condition E							—	—	—	—	—	—
SUBGROUP 6		20	—	—	10	—	—						
High-Temperature Life (Non-operating) (T_{stg} = 100 $^{+0}_{-5}$ °C 2N559 (1) ONLY	1031							—	—	—	—	—	—
End-Point Tests: Same as Subgroup 2													
SUBGROUP 7		—	20	3	—	7	1						
High-Temperature Life (Non-operating) (T_{stg} = 150 $^{+0}_{-5}$ °C) 2N559 (2), 2N559 (3)	1031							—	—	—	—	—	—
End-Point Tests: Same as Subgroup 2													
SUBGROUP 8		20	15	5	10	5	2						
Steady-State Operation Life (I_E = 50 $^{+0}_{-5}$ mAdc, P_D = 150 $^{+0}_{-15}$ mW, T_A = 25 ± 3°C)	1026							—	—	—	—	—	—
End-Point Tests: Same as Subgroup 2													

NOTES: ① Total is defined as the sum of the major and minor defectives.

② Rejects from prior electrical-test samples from the same lot may be used for this test.

TABLE III – GROUP C INSPECTION*

Examination or Test	MIL-STD-750 Method	LTPD for Respective Reliability Level						Symbol	Limit				Unit
		Total ①			Major				Requirement Limit		Defect Classification		
		(1)	(2)	(3)	(1)	(2)	(3)		Min	Max	Minor	Major	
SUBGROUP 1		10	7	5	5	3	2						
Output Capacitance (V_{CB} = -5 Vdc, I_E = 0, f = 100 kHz)	3236							C_{ob}	—	6	>6 to 10	>10	pF
Current-Gain — Bandwidth Product (I_E = 10 mAdc, V_C = -1 Vdc, f = 100 MHz)	3261							f_T	300	1000	250 to <300 and >1000	<250	MHz
Delay Plus Rise Time (V_{CC} = -3.5 Vdc, $V_{BE(off)}$ = 0.5 Vdc, I_{B1} = -1 mAdc, R_C = 300 ohms, $C_{CB} = 2^{+0.5}_{-0}$ pF, C_{BE} = 2 ±0.5 pF	3251 Condition A							$t_d + t_r$	—	50	>50 to 75	>75	ns
SUBGROUP 2		10	7	5	5	3	2						
Collector-Emitter Cutoff Current (V_{CE} = 5 Vdc, T_A = +55°C)	3041 Condition C							I_{CES}	—	40	>40 to 50	>50	μAdc
DC Current Gain (I_C = -10 mAdc, V_{CE} = -0.5 Vdc, T_A = -55°C)	3076							h_{FE}	10	—	8 to <10	<8	—
SUBGROUP 3		20	15	7	10	5	3						
Salt Atmosphere (Corrosion)	1041							—	—	—	—	—	—
End-Point Tests: Same as Group B, Subgroup 2													
SUBGROUP 4		—	20	10	—	10	5						
High-Temperature Life (Non-operating) (T_{stg} = 100^{+0}_{-5} °C)	1031							—	—	—	—	—	—
End-Point Tests:													
Emitter-Base Breakdown Voltage (I_E = -300 μAdc)	3026 Condition D							BV_{EBO}	5	—	3.5 to <5	<3.5	Vdc
Collector-Emitter Breakdown Voltage (I_C = -100 μAdc)	3011 Condition C							BV_{CES}	12	—	8 to <12	<8	Vdc
Collector-Emitter Saturation Voltage (I_C = -10 mAdc, I_B = -0.5 mAdc)	3071							$V_{CE(sat)}$	—	0.3	>0.3 to 0.6	>0.6	Vdc
Base-Emitter Saturation Voltage (I_C = -10 mAdc, I_B = -0.4 mAdc)	3066 Condition A							$V_{BE(sat)}$	0.31	0.47	0.25 to <0.31 and >0.47 to 0.55	<0.25 and >0.55	Vdc
Delay Time (V_{CC} = -3.5 Vdc, $V_{BE(off)}$ = 0.5 Vdc, I_{B1} = -0.55 mAdc, R_C = 300 ohms, C_{CE} = 150 pF, $C_{CB} = 2^{+0.5}_{-0}$ pF, C_{BE} = 2 ±0.5 pF)	3251 Condition A							t_d	10	35	<10 and >35 to 45	>45	ns
Rise Time (V_{CC} = -3.5 Vdc, $V_{BE(off)}$ = 0.5 Vdc, I_{B1} = -0.55 mAdc, R_C = 300 ohms, C_{CE} = 150 pF, $C_{CB} = 2^{+0.5}_{-0}$ pF)	3251 Condition A							t_r	15	105	<15 and >105 to 125	>125	ns
Storage Time (V_{CC} = -3.5 Vdc, I_{B1} = -1 mAdc, I_{B2} = 0.25 mAdc, R_C = 300 ohms)	3251 Condition A							t_s	15	105	<15 and >105 to 125	>125	ns

* Group C is to be performed on the first lot and every 6 months thereafter.
NOTE: ① Total is defined as the sum of the major and minor defectives.

2N618 (GERMANIUM)

For Specifications, See 2N375 Data.

2N1959 (SILICON)

CASE 31
(TO-5)

Collector connected to case

NPN silicon annular transistor designed for high-speed, medium-power saturated switching applications.

MAXIMUM RATINGS

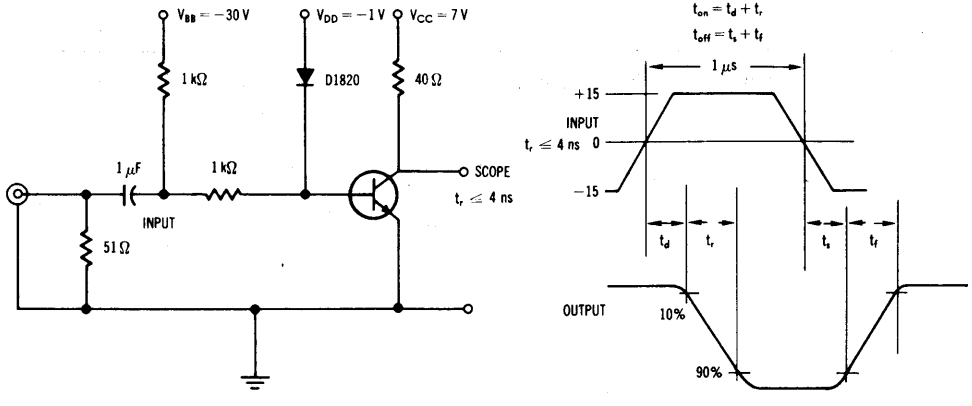
Rating	Symbol	Value	Unit
Collector-Emitter Voltage R_{BE} = 10 ohms	V_{CER}	40	Vdc
Collector-Base Voltage	V_{CB}	60	Vdc
Emitter-Base Voltage	V_{EB}	5	Vdc
Collector Current	I_C	500	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	600 4.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	2.0 1.3	Watts mW/°C
Operating Junction Temperature Range	T_J	-65to + 175	°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified)

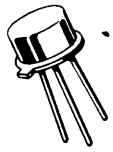
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (I_C = 50 μAdc, R_{BE} = 10 ohms)	BV_{CER}	40	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	BV_{CBO}	60	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	BV_{EBO}	5.0	—	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0) (V_{CB} = 30 Vdc, I_E = 0, T_A = 150°C)	I_{CBO}	— —	0.5 300	μAdc
ON CHARACTERISTICS				
DC Current Gain (I_C = 150 mAdc, V_{CE} = 10 Vdc)	h_{FE}	40	120	—
Collector-Emitter Saturation Voltage (I_C = 150 mAdc, I_B = 15 mAdc)	$V_{CE(sat)}$	—	0.45	Vdc
Base-Emitter Saturation Voltage (I_C = 150 mAdc, I_B = 15 mAdc)	$V_{BE(sat)}$	—	1.3	Vdc
DYNAMIC CHARACTERISTICS				
Current-Gain—Bandwidth Product (I_C = 25 mAdc, V_{CB} = 10 Vdc, f = 100 MHz)	f_T	100	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	18	pF
Turn-On Time (Figure 1 (V_{CC} = 7 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_{on}	—	65	ns
Turn-Off Time	t_{off}	—	45	ns
Storage Time	t_s	—	25	ns

*t_{on}, t_{off}, and t_s measured from 50% point of input pulse.

FIGURE 1 — SWITCHING TIME TEST CIRCUIT

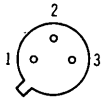


2N2193AS (SILICON)



NPN silicon annular transistors for high-current switching and amplifier applications.

CASE 79
(TO-39)
Collector connected to case



STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

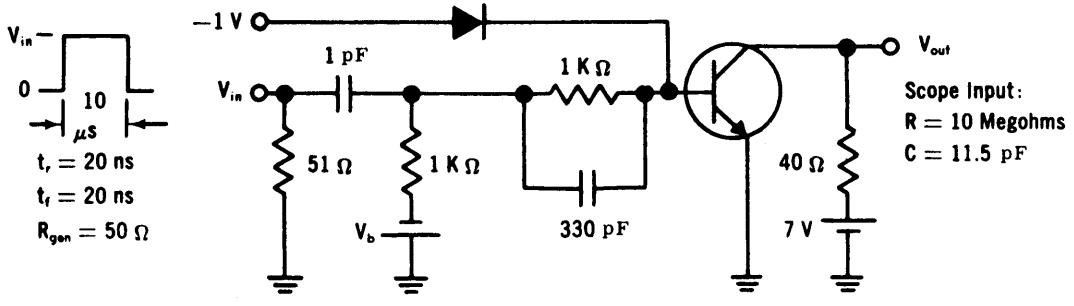
***MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CB}	80	Vdc
Collector-Emitter Voltage	V_{CEO}	50	Vdc
Emitter-Base Voltage	V_{EB}	8.0	Vdc
Collector Current	I_C	1.0	Adc
Total Device Dissipation @ 25°C Ambient Temperature Derating Factor Above 25°C	P_D	0.8 4.56	Watt mW/°C
Total Device Dissipation @ 25°C Case Temperature Derating Factor Above 25°C	P_D	2.8 16	Watts mW/°C
Junction Temperature, Operating	T_J	-65 to +200	°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

* Indicates JEDEC Registered Data

FIGURE 1

$V_{in} = 15\ V, V_b = 15\ V$



*ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	BV_{CBO}	80	-	Vdc
Collector Emitter-Open Base Sustain Voltage [1] (I_C = 25 mA pulsed, I_B = 0)	$V_{CEO(sus)}$	50	-	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	BV_{EBO}	8.0	-	Vdc
Collector Cutoff Current (V_{CB} = 60 Vdc, I_E = 0)	I_{CBO}	-	0.010	μAdc
(V_{CB} = 60 Vdc, I_E = 0, T_A = 150°C)		-	25	
Emitter Cutoff Current (V_{EB} = 5 Vdc, I_C = 0)	I_{EBO}	-	0.050	μAdc
Collector-Emitter Saturation Voltage (I_C = 150 mAdc, I_B = 15 mAdc)	$V_{CE(sat)}$	-	0.25	Vdc
Base-Emitter Saturation Voltage (I_C = 150 mAdc, I_B = 15 mAdc)	$V_{BE(sat)}$	-	1.3	Vdc
DC Current Gain [1] (I_C = 0.1 mAdc, V_{CE} = 10 Vdc)	h_{FE}			-
(I_C = 10 mAdc, V_{CE} = 10 Vdc)		30	-	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = -55°C)		20	-	
(I_C = 150 mAdc, V_{CE} = 10 Vdc)		40	120	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc)		30	-	
(I_C = 500 mAdc, V_{CE} = 10 Vdc)		20	-	
(I_C = 1.0 Adc, V_{CE} = 10 Vdc)				
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	-	20	pF
Small Signal Current Gain (I_C = 50 mA, V_{CE} = 10 V, f = 20 MHz)	h_{fe}	2.5	-	-
Rise Time	t_r	-	70	ns
Storage Time	t_s	-	150	ns
Fall Time	t_f	-	50	ns

* Indicates JEDEC Registered Data

[1] Pulse Test: PW ≤ 300 μs Duty Cycle ≤ 2%