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TYPES 2N1303, 2N1305, 2N1307, AND 2N1309
P-N-P ALLOY-JUNCTION GERMANIUM TRANSISTORS

electrical characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	2N1303			2N1305			2N1307			2N1309			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = -100\ \mu a$, $I_E = 0$	−30	—	—	−30	—	—	−30	—	—	−30	—	—	v
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = -100\ \mu a$, $I_C = 0$	−25	—	—	−25	—	—	−25	—	—	−25	—	—	v
*V_{PT}	Punch Through Voltage†	$V_{EBfl} = -1$ v	−25	—	—	−20	—	—	−15	—	—	−15	—	—	v
*I_{CBO}	Collector Cutoff Current	$V_{CB} = -25$ v, $I_E = 0$	—	−2	−6	—	−2	−6	—	−2	−6	—	−2	−6	μa
*I_{EBO}	Emitter Cutoff Current	$V_{EB} = -25$ v, $I_C = 0$	—	−1.5	−6	—	−1.5	−6	—	−1.5	−6	—	−1.5	−6	μa
*h_{FE}	Static Forward Current Transfer Ratio	$V_{CE} = -1$ v, $I_C = -10$ ma	20	100	—	40	115	200	60	130	300	80	160	—	—
		$V_{CE} = -0.35$ v, $I_C = -200$ ma	10	45	—	15	55	—	20	65	—	20	75	—	—
*V_{BE}	Base-Emitter Voltage	$I_B = -0.5$ ma, $I_C = -10$ ma	−0.15	−0.25	−0.40	−0.15	−0.25	−0.35	−0.15	−0.25	−0.35	−0.15	−0.25	−0.35	v
*$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_B = -0.5$ ma, $I_C = -10$ ma	—	−0.08	−0.20	—	—	—	—	—	—	—	—	—	v
		$I_B = -0.25$ ma, $I_C = -10$ ma	—	—	—	—	−0.08	−0.20	—	—	—	—	—	—	v
		$I_B = -0.17$ ma, $I_C = -10$ ma	—	—	—	—	—	—	—	−0.08	−0.20	—	—	—	v
		$I_B = -0.13$ ma, $I_C = -10$ ma	—	—	—	—	—	—	—	—	—	—	−0.08	−0.20	v
h_{ib}	Small-Signal Common-Base Input Impedance	$V_{CB} = -5$ v, $I_E = 1$ ma, $f = 1$ kc	—	29	—	—	29	—	—	29	—	—	29	—	ohm
h_{rb}	Small-Signal Common-Base Reverse Voltage Transfer Ratio	$V_{CB} = -5$ v, $I_E = 1$ ma, $f = 1$ kc	—	7×10^{-4}	—	—	7×10^{-4}	—	—	7×10^{-4}	—	—	7×10^{-4}	—	—
h_{ob}	Small-Signal Common-Base Output Admittance	$V_{CB} = -5$ v, $I_E = 1$ ma, $f = 1$ kc	—	0.40	—	—	0.40	—	—	0.40	—	—	0.40	—	μmho
h_{fe}	Small-Signal Common-Emitter Forward Current Transfer Ratio	$V_{CE} = -5$ v, $I_C = -1$ ma, $f = 1$ kc	—	115	—	—	130	—	—	150	—	—	190	—	—
*f_{hfb}	Common-Base Alpha—Cutoff Frequency	$V_{CB} = -5$ v, $I_E = 1$ ma	3	12	—	5	14	—	10	16	—	15	20	—	mc
*C_{ob}	Common-Base Open-Circuit Output Capacitance	$V_{CB} = -5$ v, $I_E = 0$, $f = 1$ mc	—	10	20	—	10	20	—	10	20	—	10	20	pf
C_{ib}	Common-Base Open-Circuit Input Capacitance	$V_{EB} = -5$ v, $I_C = 0$, $f = 1$ mc	—	9	—	—	9	—	—	9	—	—	9	—	pf

†V_{PT} is determined by measuring the emitter-base floating potential V_{EBfl}. The collector-base voltage, V_{CB}, is increased until $V_{EBfl} = -1$ volt; this value of $V_{CB} = (V_{PT} - 1$ v).

switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS††	2N1303			2N1305			2N1307			2N1309			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
t_d	Delay Time	$I_C = -10$ ma, $I_{B(1)} = -1.3$ ma	—	0.06	—	—	0.06	—	—	0.06	—	—	0.05	—	μsec
t_r	Rise Time	$I_{B(2)} = 0.7$ ma, $V_{BE(off)} = 0.8$ v	—	0.18	—	—	0.18	—	—	0.14	—	—	0.14	—	μsec
t_s	Storage Time	$R_L = 1$ k Ω (See Fig. 1)	—	0.80	—	—	0.80	—	—	0.78	—	—	0.76	—	μsec
t_f	Fall Time		—	0.38	—	—	0.38	—	—	0.36	—	—	0.30	—	μsec
Q_{sb}	Stored Base Charge	$I_{B(1)} = -1$ ma, $I_C = -10$ ma (See Fig. 2)	—	960	—	—	920	—	—	880	—	—	800	—	pcb

††Voltage and current values shown are nominal, exact values vary slightly with device parameters.

operating characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	2N1303			2N1305			2N1307			2N1309			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
NF	Spot Noise Figure	$V_{CB} = -5$ v $I_E = 1$ ma $f = 1$ kc, $R_G = 1$ k Ω	—	4	—	—	4	—	—	3	—	—	3	—	db