2N2060,A
2N2223,A
2N2480,A

2N2060 JAN, JTX, JTXV AVAILABLE
CASE 654-07, STYLE 1

DUAL AMPLIFIER TRANSISTOR

NPN SILICON

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Refer to MD2218 for graphs.

MAXIMUM RATINGS

Rating	Symbol	2N2060,A 2N2223,A	2N2480	2N2480A	Unit
Collector-Emitter Voltage	V_{CEO}	60	40	40	Vdc
Collector-Emitter Voltage	V_{CER}	80	—	—	Vdc
Collector-Base Voltage	V_{CBO}	100	75	80	Vdc
Emitter-Base Voltage	V_{EBO}	7.0	5.0	5.0	Vdc
Collector Current — Continuous	I_C	500			mAdc
		One Die	All Die Equal Power		
Total Device Dissipation @ T_A = 25°C	P_D				mW
2N2060,A		0.5	0.6		
2N2223,A		0.5	0.6		
2N2480,A		0.3	0.6		
Derate above 25°C					mW/°C
2N2060,A		2.86	3.43		
2N2223,A		2.86	3.43		
2N2480,A		1.72	3.43		
Total Device Dissipation @ T_C = 25°C	P_D				Watts
2N2060,A		1.5	3.0		
2N2223,A		1.6	3.0		
2N2480,A		1.0	2.0		
Derate above 25°C					mW/°C
2N2060,A		8.6	17.2		
2N2223,A		9.1	11.4		
2N2480,A		5.7	11.4		
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200			°C

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I_C = 100 mAdc, R_{BE} ≤ 10 ohms)	2N2060, 2N2060A, 2N2223, 2N2223A	$V_{CER(sus)}$	80	—	Vdc
Collector-Emitter Sustaining Voltage(1)		$V_{CEO(sus)}$			Vdc
(I_C = 20 mAdc, I_B = 0)	2N2480		40	—	
	2N2480A		40	—	
(I_C = 30 mAdc, I_B = 0)	2N2060, 2N2060A, 2N2223, 2N2223A		60	—	
				—	
Collector-Base Breakdown Voltage		$V_{(BR)CBO}$			Vdc
(I_C = 100 μAdc, I_E = 0)	2N2060, 2N2060A, 2N2223, 2N2223A		100	—	
	2N2480*		75	—	
	2N2480A*		80	—	
Emitter-Base Breakdown Voltage		$V_{(BR)EBO}$			Vdc
(I_E = 100 μAdc, I_C = 0)	2N2060, 2N2060A, 2N2223, 2N2223A		7.0	—	
	2N2480, 2N2480A		5.0	—	
Collector Cutoff Current		I_{CBO}			μAdc
(V_{CB} = 30 Vdc, I_E = 0, T_A = 150°C)	2N2480, 2N2480A		—	15	
(V_{CB} = 60 Vdc, I_E = 0)	2N2480		—	0.050	
	2N2480A		—	0.020	
(V_{CB} = 80 Vdc, I_E = 0)	2N2060, 2N2060A		—	0.002	
	2N2223, 2N2223A		—	0.010	
(V_{CB} = 80 Vdc, I_E = 0, T_A = 150°C)	2N2060, 2N2060A		—	10	
	2N2223, 2N2223A		—	15	
Emitter Cutoff Current		I_{EBO}			nAdc
(V_{BE} = 5.0 Vdc, I_C = 0)	2N2060, 2N2060A		—	2.0	
	2N2223, 2N2223A		—	10	
	2N2480		—	50	
	2N2480A		—	20	

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

Characteristic		Symbol	Min	Max	Unit
ON CHARACTERISTICS					
DC Current Gain		h_{FE}			—
(I_C = 10 μAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A		25	75	
	2N2223, 2N2223A		15	—	
(I_C = 100 μAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A		30	90	
	2N2223, 2N2223A		25	150	
	2N2480		20	—	
	2N2480A		35	—	
(I_C = 1.0 mAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A		40	120	
	2N2480		30	350	
	2N2480A		50	200	
(I_C = 10 mAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A		50	150	
	2N2223, 2N2223A		50	200	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$			Vdc
(I_C = 50 mAdc, I_B = 5.0 mAdc)	2N2060A		—	0.6	
	2N2060, 2N2223, 2N2223A, 2N2480A		—	1.2	
	2N2480		—	1.3	
Base-Emitter Saturation Voltage		$V_{BE(sat)}$			Vdc
(I_C = 50 mAdc, I_B = 5.0 mAdc)	2N2060, 2N2060A,				
	2N2223, 2N2223A, 2N2480A		—	0.9	
	2N2480		—	1.0	
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product		f_T			MHz
(I_C = 50 mAdc, V_{CE} = 10 Vdc,	2N2223, 2N2223A				
f = 20 MHz)	2N2480, 2N2480A		50	—	
	2N2060, 2N2060A		60	—	
Output Capacitance		C_{obo}			pF
(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	2N2060, 2N2060A, 2N2223, 2N2223A		—	15	
	2N2480A		—	18	
	2N2480		—	20	
Input Capacitance		C_{ibo}	—	85	pF
(V_{BE} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	2N2060, 2N2060A, 2N2223, 2N2223A, 2N2480A				
Input Impedance		h_{ie}			ohms
(I_C = 1.0 mAdc, V_{CE} = 5.0 Vdc,	2N2060, 2N2060A		1000	4000	
f = 1.0 kHz)	2N2480A		1000	5000	
Input Impedance		h_{ib}			ohms
(I_C = 1.0 mAdc, V_{CB} = 5.0 Vdc,	2N2060, 2N2060A, 2N2223,				
f = 1.0 kHz)	2N2223A		20	30	
	2N2480A		20	35	
Voltage Feedback Ratio		h_{rb}	—	3.0	X 10^{-4}
(I_C = 1.0 mAdc, V_{CB} = 5.0 Vdc,					
f = 1.0 kHz)	2N2223, 2N2223A				
Small-Signal Current Gain		h_{fe}			—
(I_C = 1.0 mAdc, V_{CE} = 5.0 Vdc,	2N2060, 2N2060A		50	150	
f = 1.0 kHz)	2N2223, 2N2223A		40	200	
	2N2480A		50	300	
Output Admittance		h_{oe}	—	16	μmhos
(I_C = 1.0 mAdc, V_{CE} = 5.0 Vdc,					
f = 1.0 kHz)	2N2060, 2N2060A, 2N2480A				
Output Admittance		h_{ob}	—	0.5	μmhos
(I_C = 1.0 mAdc, V_{CB} = 5.0 Vdc,					
f = 1.0 kHz)	2N2223, 2N2223A				
Noise Figure		NF			dB
(I_C = 0.3 mAdc, V_{CE} = 10 Vdc,					
R_S = 510 Ω,					
f = 1.0 kHz, BW = 1.0 Hz)	2N2480, 2N2480A		—	8.0	
(I_C = 0.3 mAdc, V_{CE} = 10 Vdc,					

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

Characteristic		Symbol	Min	Max	Unit
R_S = 510 Ω, f = 1.0 kHz, BW = 200 Hz)	2N2060, 2N2060A		—	8.0	
(I_C = 0.3 mAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz, BW = 15.7 kHz)(2)			—	8.0	
MATCHING CHARACTERISTICS					
DC Current Gain Ratio(3)		h_{FE1}/h_{FE2}			—
(I_C = 100 μAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A, 2N2223A		0.9	1.0	
	2N2223, 2N2480, 2N2480A		0.8	1.0	
(I_C = 1.0 mAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A		0.9	1.0	
	2N2480, 2N2480		0.8	1.0	
Base-Emitter Voltage Differential		$\lvert V_{BE1}-V_{BE2}\rvert$			mVdc
(I_C = 100 μAdc, V_{CE} = 5.0 Vdc)	2N2060A		—	3.0	
	2N2060, 2N2223A, 2N2480A		—	5.0	
	2N2480		—	10	
	2N2223		—	15	
(I_C = 1.0 mAdc, V_{CE} = 5.0 Vdc)	2N2060, 2N2060A, 2N2480A		—	5.0	
	2N2480		—	10	
Base-Emitter Voltage Differential Change Due to Temperature		$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T}$			μV/°C
(I_C = 100 μAdc, V_{CE} = 5.0 Vdc, T_A = −55°C to +125°C)	2N2060A		—	5.0	
	2N2060		—	10	
	2N2223, 2N2223A		—	25	
	2N2480, 2N2480A		—	15	

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(2) Amplifier: 3.0 Db points at 25 Hz and 10 kHz with a roll-off of 6.9 dB per octave.
(3) The lowest h_{FE} reading is taken as h_{FE1} for this ratio.

FIGURE 1 — DC CURRENT GAIN versus COLLECTOR CURRENT

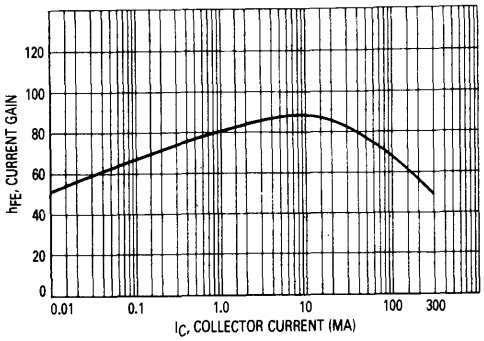

FIGURE 2 — "ON" VOLTAGES