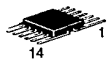
MD2369,A,B
MD2369,AF,BF
MQ2369

MD2369,A,B
CASE 654-07, STYLE 1

MD2369,AF,BF
CASE 610A-04, STYLE 1



MQ2369
CASE 607-04, STYLE 1

DUAL
GENERAL PURPOSE TRANSISTOR

NPN SILICON

5

MAXIMUM RATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	V_{CEO}	15		Vdc
Collector-Base Voltage	V_{CBO}	40		Vdc
Emitter-Base Voltage	V_{EBO}	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
MD2369,A,B		550	600	
MD2369,AF,BF		350	400	
MQ2369		400	600	
Derate above 25°C				mW/°C
MD2369,A,B		3.14	3.42	
MD2369F,AF,BF		2.0	2.28	
MQ2369		2.28	3.42	
Total Device Dissipation @ T_C = 25°C	P_D			Watts
MD2369,A,B		1.4	2.0	
MD2369,AF,BF		0.7	1.4	
MQ2369		0.7	2.8	
Derate above 25°C				mW/°C
MD2369,A,B		8.0	11.4	
MD2369,AF,BF		4.0	80	
MQ2369		4.0	16	
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic		Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case		$R_{\theta JC}$			°C/W
	MD2369,A,B		125	87.5	
	MD2369,AF,BF		250	125	
	MQ2369		250	62.6	
Thermal Resistance, Junction to Ambient		$R_{\theta JA}$(1)			°C/W
	MD2369,A,B		319	292	
	MD2369,AF,BF		500	438	
	MQ2369		438	292	
			Junction to Ambient	Junction to Case	
Coupling Factor	MD2369,A,B		83	40	%
	MD2369,AF,BF		75	0	
	MQ2369 (Q1-Q2)		57	0	
	(Q1-Q3 or Q1-Q4)		55	0	

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	15	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	$V_{(BR)CBO}$	40	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	$V_{(BR)EBO}$	5.0	—	—	Vdc
Collector Cutoff Current (V_{CB} = 20 Vdc, I_E = 0)	I_{CBO}	—	—	0.03	μAdc
(V_{CB} = 20 Vdc, I_E = 0, T_A = +150°C)		—	—	30	
ON CHARACTERISTICS(2)					
DC Current Gain (I_C = 10 mAdc, V_{CE} = 1.0 Vdc)	h_{FE}	40	95	140	—
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc, T_A = −55°C)		20	—	—	

MD2369,A,B, MD2369,AF,BF, MQ2369

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

Characteristic		Symbol	Min	Typ	Max	Unit
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)		$V_{CE(sat)}$	—	—	0.25	Vdc
Base-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)		$V_{BE(sat)}$	0.7	—	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(2) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)		f_T	500	800	—	MHz
Output Capacitance (V_{CB} = 5.0 Vdc, I_E = 0, f = 100 kHz)		C_{obo}	—	—	4.0	pF
Input Capacitance (V_{BE} = 1.0 Vdc, I_C = 0, f = 100 MHz)		C_{ibo}	—	—	4.0	pF
SWITCHING CHARACTERISTICS						
Storage Time (V_{CC} = 10 Vdc, I_C = I_{B1} = I_{B2} = 10 mAdc)		t_s	—	—	13	ns
Turn-On Time (V_{CC} = 3.0 Vdc, $V_{BE(off)}$ = 1.5 Vdc, I_C = 10 mAdc, I_{B1} = 3.0 mAdc)		t_{on}	—	—	15	ns
Turn-Off Time (V_{CC} = 3.0 Vdc, I_C = 10 mAdc, I_{B1} = 3.0 mAdc, I_{B2} = 1.5 mAdc)		t_{off}	—	—	20	ns
MATCHING CHARACTERISTICS						
DC Current Gain Ratio(3) (I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc)	MD2369A, MD2369AF MD2369B, MD2369BF	h_{FE1}/h_{FE2}	0.9 0.8	— —	1.0 1.0	—
Base-Emitter Voltage Differential (I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc)	MD2369A, MD2369AF MD2369B, MD2369BF	$\lvert V_{BE1}-V_{BE2}\rvert$	— —	— —	5.0 10	mVdc
Base-Emitter Voltage Differential Gradient (I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc, T_A = −55 to +125°C)	MD2369A, MD2369AF MD2369B, MD2369BF	$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_A}$	— —	— —	10 20	μV/°C

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(3) The lowest h_{FE} reading is taken as h_{FE1} for this test.

FIGURE 1 – STORAGE TIME TEST CIRCUIT

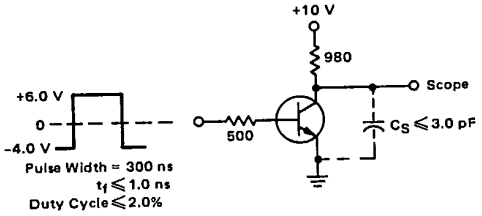


FIGURE 2 – TURN-ON TIME

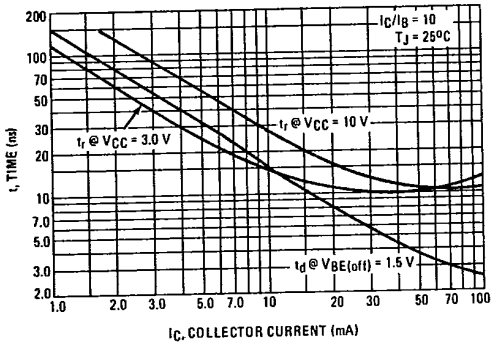


FIGURE 3 – TURN-OFF TIME

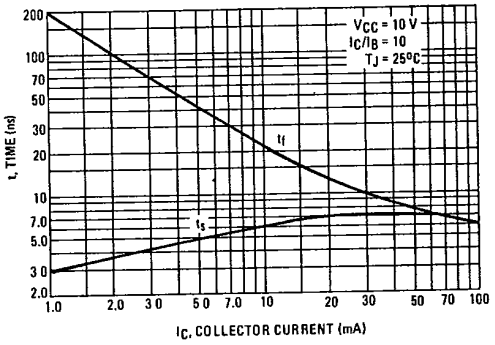


FIGURE 4 – TURN-ON TEST CIRCUIT

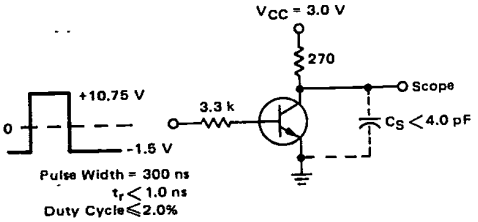


FIGURE 5 – TURN-OFF TEST CIRCUIT

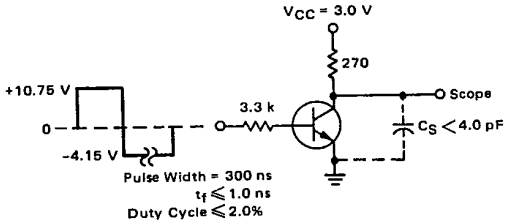


FIGURE 6 – CAPACITANCE

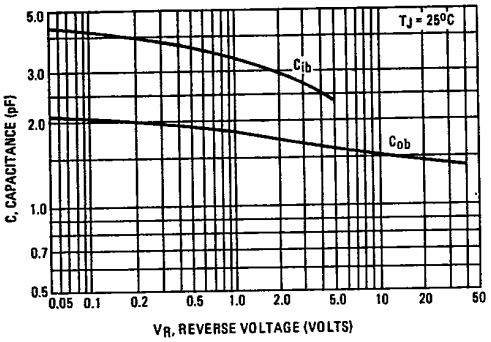


FIGURE 7 – CURRENT-GAIN–BANDWIDTH PRODUCT

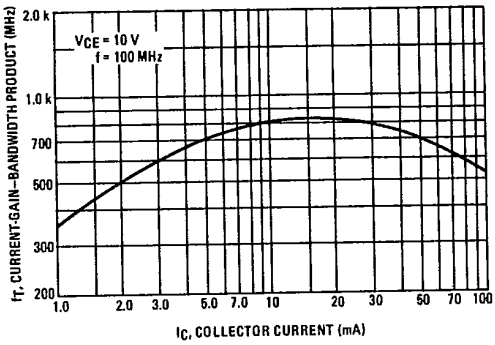


FIGURE 8 – DC CURRENT GAIN

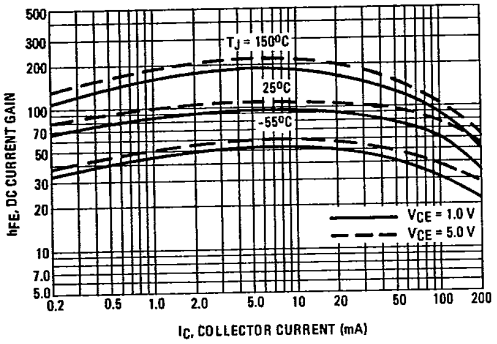


FIGURE 9 – "ON" VOLTAGES

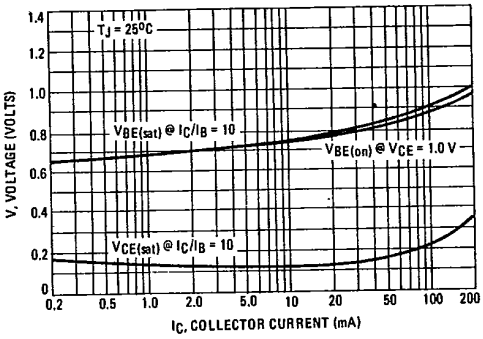


FIGURE 10 – COLLECTOR SATURATION REGION

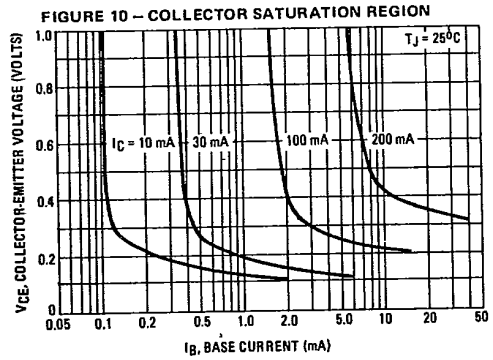
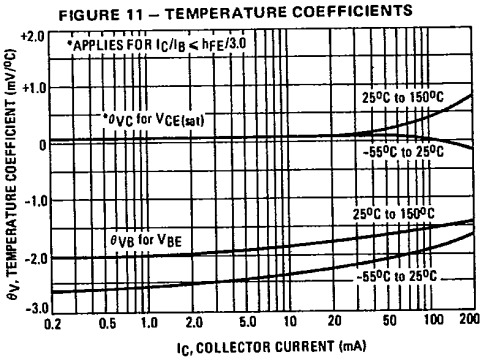


FIGURE 11 – TEMPERATURE COEFFICIENTS



T-29-27

MD2904,A,F,AF
MD2905,A,AF
MQ2904, MQ2905A

MD2904,A
MD2905,A
CASE 654-07, STYLE 1

MD2904F,AF
MD2905,AF
CASE 610A-04, STYLE 1

MQ2904
MQ2905A
CASE 607-04, STYLE 1

DUAL
AMPLIFIER TRANSISTOR
PNP SILICON

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MAXIMUM RATINGS

Rating	Symbol	MD2904,F MD2905,F MQ2904	MD2904A,AF MD2905A,AF MQ2905A	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	Vdc
Collector-Base Voltage	V_{CBO}	60		Vdc
Emitter-Base Voltage	V_{EBO}	5.0		Vdc
Collector Current — Continuous	I_C	600		mAdc
		One Die	All Die Equal Power	
Total Device Dissipation @ T_A = 25°C	P_D			mW
MD2904,A, MD2905,A		575	625	
MD2904F,AF, MD2905,AF		350	400	
MQ2904, MQ2905A		400	600	mW/°C
Derate above 25°C				
MD2904,A, MD2905,A		3.29	3.57	
MD2904,F,AF, MD2905,AF		2.0	2.28	
MQ2904, MQ2905A		2.28	3.42	
Total Device Dissipation @ T_C = 25°C	P_D			Watts
MD2904,A, MD2905,A		1.8	2.5	
MD2904F,AF, MD2905F,AF		1.0	2.0	
MQ2904, MQ2905A		0.9	3.6	mW/°C
Derate above 25°C				
MD2904,A, MD2905,A		10.3	14.3	
MD2904F,AF, MD2905,AF		5.71	11.4	
MQ2904, MQ2905A		5.13	20.5	
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$			°C/W
MD2904,A, MD2905,A		97	70	
MD2904F,AF, MD2905,AF		175	87.5	
MQ2904, MQ2905A		195	48.8	
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$(1)			°C/W
MD2904,A, MD2905,A		304	280	
MD2904F,AF, MD2905,AF		500	438	
MQ2904, MQ2905A		438	292	
		Junction to Ambient	Junction to Case	
Coupling Factor				%
MD2904,A, MD2905,A		84	44	
MD2904F,AF, MD2905,AF		75	0	
MQ2904, MQ2905A (Q1-Q2)		57	0	
(Q1-Q3 or Q1-Q4)		55	0	

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I_C = 10 mAdc, I_B = 0) MD2904, MD2905	$V_{(BR)CEO}$	40	—	—	Vdc
MD2904A, MD2905A		60	—	—	
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	$V_{(BR)CBO}$	60	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	$V_{(BR)EBO}$	5.0	—	—	Vdc
Collector Cutoff Current	I_{CBO}				μAdc
(V_{CB} = 50 Vdc, I_E = 0)		—	—	0.020	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 150°C)		—	—	30	

MD2904,A,F,AF, MD2905,A,AF, MQ2904, MQ2905A

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

Characteristic		Symbol	Min	Typ	Max	Unit
Emitter Cutoff Current (V_{BE} = 3.0 Vdc, I_C = 0)		I_{EBO}	—	—	30	nAdc
ON CHARACTERISTICS(2)						
DC Current Gain		h_{FE}				—
(I_C = 0.1 mAdc, V_{CE} = 10 Vdc)	MD2904		20	50	—	
	MD2904A		40	70	—	
	MD2905		35	70	—	
	MD2905A		75	150	—	
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)	MD2904		25	75	—	
	MD2904A		40	75	—	
	MD2905		50	100	—	
	MD2905A		100	175	—	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)	MD2904		35	90	—	
	MD2904A		40	90	—	
	MD2905		75	110	—	
	MD2905A		100	200	—	
(I_C = 150 mAdc, V_{CE} = 10 Vdc)	MD2904,A, MD2905,A		40 100	90 200	120 300	
(I_C = 500 mAdc, V_{CE} = 10 Vdc)	MD2904		20	60	—	
	MD2904A		40	80	—	
	MD2905		30	130	—	
	MD2905A		50	150	—	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$				Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)			—	0.25	0.4	
(I_C = 500 mAdc, I_B = 50 mAdc)			—	0.5	1.6	
Base-Emitter Saturation Voltage		$V_{BE(sat)}$				Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)			—	0.88	1.3	
(I_C = 500 mAdc, I_B = 50 mAdc)			—	1.0	2.6	
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(3) (I_C = 50 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)		f_T	200	320	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)		C_{obo}	—	5.8	8.0	pF
Input Capacitance (V_{BE} = 2.0 Vdc, I_C = 0, f = 100 kHz)		C_{ibo}	—	16	30	pF
SWITCHING CHARACTERISTICS						
Turn-On Time	(V_{CC} = 30 Vdc, V_{BE} = 0.5 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_{on}	—	—	45	ns
Delay Time		t_d	—	—	12	ns
Rise Time		t_r	—	—	35	ns
Turn-Off Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_{off}	—	—	130	ns
Storage Time		t_s	—	—	100	ns
Fall Time		t_f	—	—	40	ns

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(3) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

MD2904,A,F,AF, MD2905,A,AF, MQ2904, MQ2905A

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FIGURE 1 – DC CURRENT GAIN

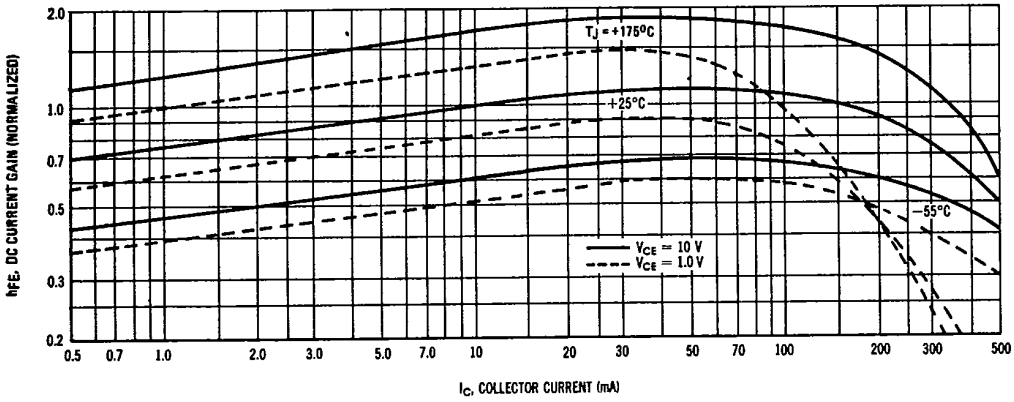


FIGURE 2 – "ON" VOLTAGES

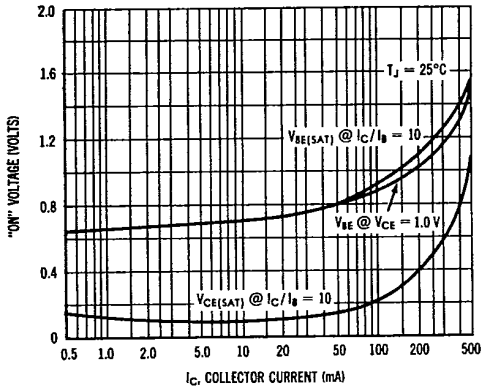
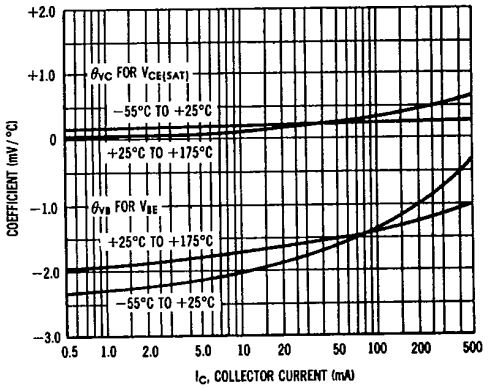


FIGURE 3 – TEMPERATURE COEFFICIENTS



NOISE FIGURE

V_{CE} = 10 V, T_A = 25°C

FIGURE 4 – FREQUENCY EFFECTS

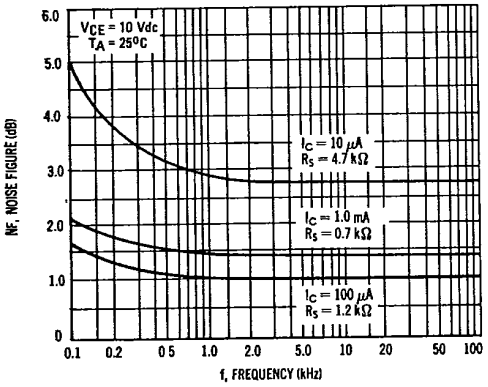
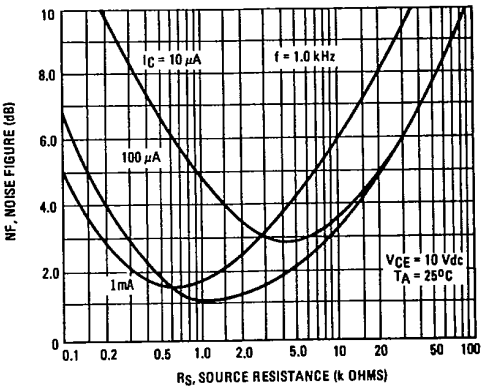


FIGURE 5 – SOURCE RESISTANCE EFFECTS



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MD2904,A,F,AF, MD2905,A,AF, MQ2904, MQ2905A

FIGURE 6 – CURRENT-GAIN BANDWIDTH PRODUCT

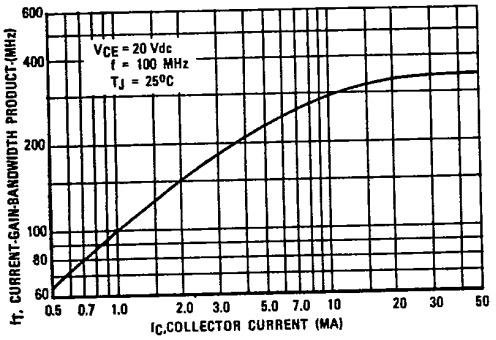

FIGURE 7 – CAPACITANCE

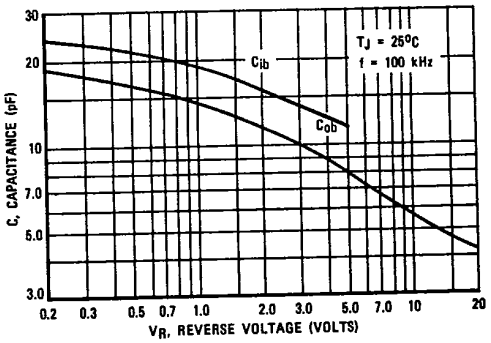

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FIGURE 8 – TURN ON TIME

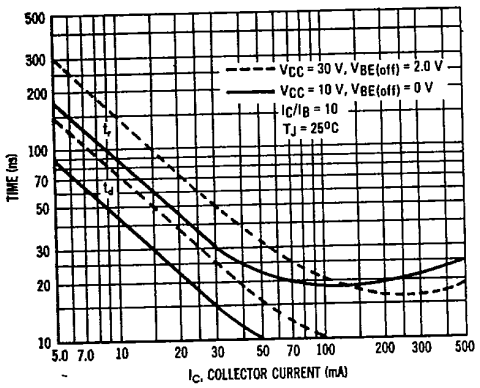


FIGURE 9 – CHARGE DATA

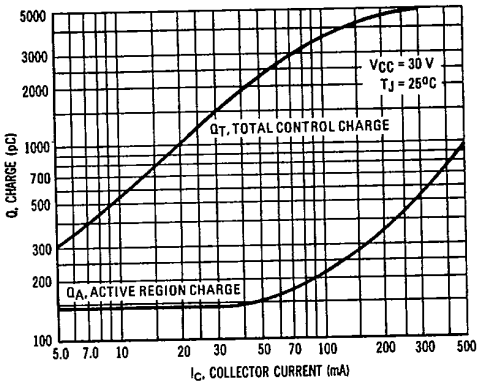


FIGURE 10 – STORAGE TIME

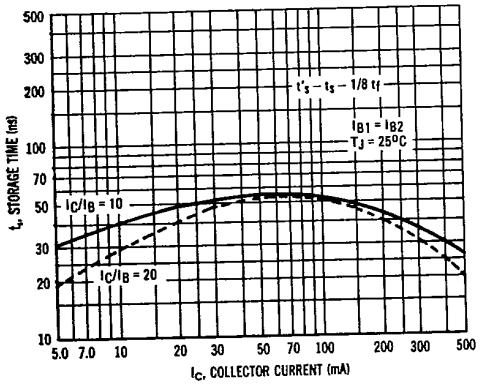
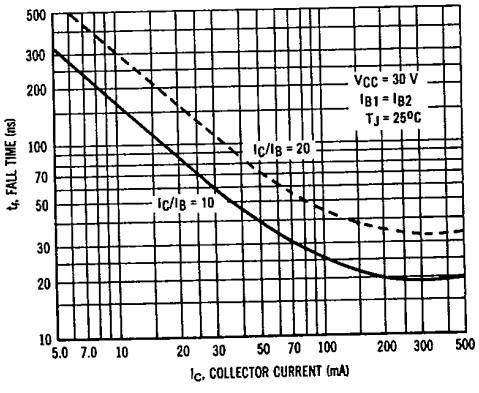


FIGURE 11 – FALL TIME



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MD2904,A,F,AF, MD2905,A,AF, MQ2904, MQ2905A

FIGURE 12 – DELAY AND RISE TIME TEST CIRCUIT

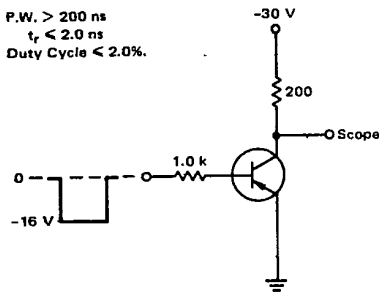
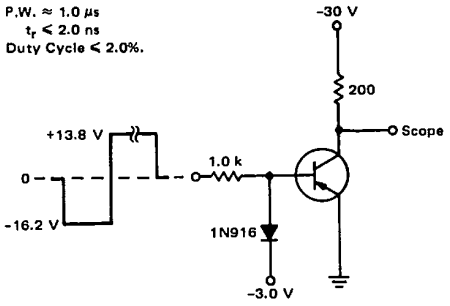


FIGURE 13 – STORAGE AND FALL TIME TEST CIRCUIT



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