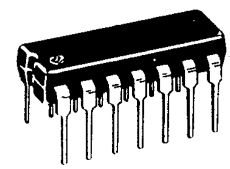
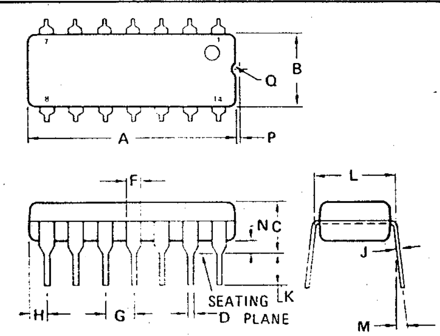
MOTOROLA

MPQ6001,N
MPQ6002,N
MPQ6501,N
MPQ6502,N

QUAD DUAL-IN-LINE SILICON COMPLEMENTARY PAIR TRANSISTORS

CASE 646
PLASTIC PACKAGE





DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	18.16	18.80	0.715	0.740
B	6.10	6.60	0.240	0.260
C	4.06	4.57	0.160	0.180
D	0.38	0.51	0.015	0.020
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.32	1.83	0.052	0.072
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.37	7.87	0.290	0.310
M	–	10^0	–	10^0
N	0.51	1.02	0.020	0.040
P	0.13	0.38	0.005	0.015
Q	0.51	0.76	0.020	0.030

NOTES:

1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL

QUAD DUAL-IN-LINE SILICON ANNULAR♦ COMPLEMENTARY PAIR TRANSISTORS

. . . designed for high-speed switching circuits, DC to VHF amplifier applications and complementary circuitry.

- Maximum Power Dissipation @ $T_A = 25^oC$
  P_D = 1.25 Watts – MPQ6001,MPQ6002,MPQ6501,MPQ6502
  = 0.9 Watts – MPQ6001N,MPQ6002N,MPQ6501N,MPQ6502N
- DC Current Gain Specified – 1.0 to 300 mAdc
- High Current-Gain–Bandwidth Product –
  f_T = 400 MHz (Typ) @ I_C = 50 mAdc
- NPN Transistor Similar to 2N2218 or 2N2219
- PNP Transistor Similar to 2N2904 or 2N2905
- Compact Size Compatible with IC Automatic Insertion Equipment

MAXIMUM RATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	V_{CEO}	30		Vdc
Collector-Base Voltage	V_{CB}	60		Vdc
Emitter-Base Voltage	V_{EB}	5.0		Vdc
Collector Current — Continuous	I_C	500		mAdc
		Each Transistor	Four Transistors Equal Power	
Total Power Dissipation @ $T_A = 25^oC$ (1)	P_D			Watts
MPQ6001, MPQ6002, MPQ6501, MPQ6502		0.65	1.25	
MPQ6001N, MPQ6002N, MPQ6501N, MPQ6502N		0.5	0.9	
Derate above 25^oC				$mW/^oC$
MPQ6001, MPQ6002, MPQ6501, MPQ6502		5.18	10	
MPQ6001N, MPQ6002N, MPQ6501N, MPQ6502N		4.0	7.2	
Total Power Dissipation @ $T_C = 25^oC$	P_D			Watts
MPQ6001, MPQ6002, MPQ6501, MPQ6502		1.0	3.0	
MPQ6001N, MPQ6002N, MPQ6501N, MPQ6502N		0.825	2.4	
Derate above 25^oC				$mW/^oC$
MPQ6001, MPQ6002, MPQ6501, MPQ6502		8.0	24	
MPQ6001N, MPQ6002N, MPQ6501N, MPQ6502N		6.7	19.2	
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150		^oC

(1) Second Breakdown occurs at power levels greater than 3 times the power dissipation rating.

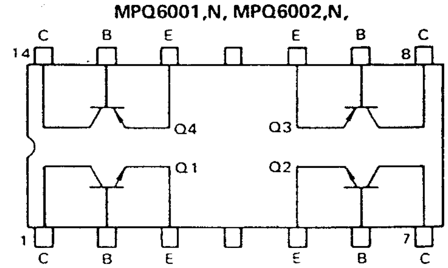
THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance				$^oC/W$
Each Die				
	MPQ6001, MPQ6002, MPQ6501, MPQ6502	125	193	
	MPQ6001N, MPQ6002N, MPQ6501N, MPQ6502N	151	250	
Effective, 4 Die				
	MPQ6001, MPQ6002, MPQ6501, MPQ6502	41.6	100	
	MPQ6001N, MPQ6002N, MPQ6501N, MPQ6502N	52	134	
Coupling Factors				
Q1-Q4 or Q2-Q3	MPQ6001, MPQ6002 MPQ6501, MPQ6502	30	60	%
	MPQ6001N, MPQ6002N MPQ6501N, MPQ6502N	34	70	
Q1-Q2 or Q3-Q4	MPQ6001, MPQ6002 MPQ6501, MPQ6502	2.0	24	
	MPQ6001N, MPQ6002N MPQ6501N, MPQ6502N	2.0	26	

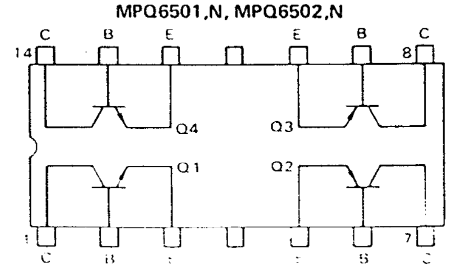
♦Annular Semiconductors Patented by Motorola Inc.

CONNECTION DIAGRAM

MPQ6001,N, MPQ6002,N,



MPQ6501,N, MPQ6502,N



DS 4557 R2

THERMAL COUPLING AND EFFECTIVE THERMAL RESISTANCE

In multiple chip devices, coupling of heat between die occurs. The junction temperature can be calculated as follows:

(1) $\Delta T_{J1} = R_{\theta 1} P_{D1} + R_{\theta 2} K_{\theta 2} P_{D2} + R_{\theta 3} K_{\theta 3} P_{D3} + R_{\theta 4} K_{\theta 4} P_{D4}$

Where ΔT_{J1} is the change in junction temperature of die 1
$R_{\theta 1}$ thru 4 is the thermal resistance of die 1 through 4
P_{D1} thru 4 is the power dissipated in die 1 through 4
$K_{\theta 2}$ thru 4 is the thermal coupling between die 1 and die 2 through 4.

An effective package thermal resistance can be defined as follows:

(2) $R_{\theta(EFF)} = \Delta T_{J1}/P_{DT}$

where: P_{DT} is the total package power dissipation.

Assuming equal thermal resistance for each die, equation (1) simplifies to

(3) $\Delta T_{J1} = R_{\theta 1} (P_{D1} + K_{\theta 2} P_{D2} + K_{\theta 3} P_{D3} + K_{\theta 4} P_{D4})$

For the conditions where $P_{D1} = P_{D2} = P_{D3} = P_{D4}$, $P_{DT} = 4 P_D$, equation (3) can be further simplified and by substituting into equation (2) results in

(4) $R_{\theta(EFF)} = R_{\theta 1}(1 + K_{\theta 2} + K_{\theta 3} + K_{\theta 4})/4$

Values for the coupling factors when either the case or the ambient is used as a reference are given in the table on page 1. If significant power is to be dissipated in two die, die at the opposite ends of the package should be used so that lowest possible junction temperatures will result.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted)

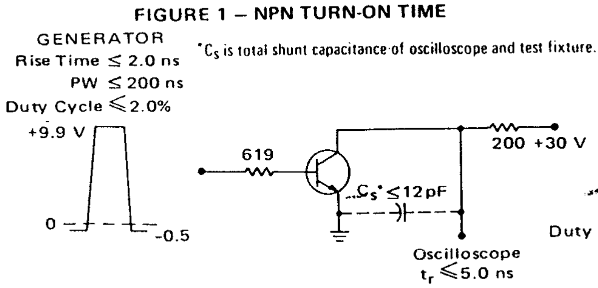
Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (I_C = 10 mAdc, I_B = 0)		BV_{CEO}	30	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)		BV_{CBO}	60	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)		BV_{EBO}	5.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0)		I_{CBO}	–	–	30	nAdc
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)		I_{EBO}	–	–	30	nAdc
ON CHARACTERISTICS						
DC Current Gain(1) (I_C = 1.0 mAdc, V_{CE} = 10 Vdc	MPQ6001,N - MPQ6501,N	h_{FE}	25	–	–	–
	MPQ6002,N - MPQ6502,N		50	–	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)	MPQ6001,N - MPQ6501,N		35	–	–	
	MPQ6002,N - MPQ6502,N		75	–	–	
(I_C = 150 mAdc, V_{CE} = 10 Vdc)	MPQ6001,N - MPQ6501,N		40	–	–	
	MPQ6002,N - MPQ6502,N		100	–	–	
(I_C = 300 mAdc, V_{CE} = 10 Vdc)	MPQ6001,N - MPQ6501,N		20	–	–	
	MPQ6002,N - MPQ6502,N		30	–	–	
Collector-Emitter Saturation Voltage (1) (I_C = 150 mAdc, I_B = 15 mAdc)		$V_{CE(sat)}$	–	–	0.4	Vdc
(I_C = 300 mAdc, I_B = 30 mAdc)			–	–	1.4	
Base-Emitter Saturation Voltage (1) (I_C = 150 mAdc, I_B = 15 mAdc)		$V_{BE(sat)}$	–	–	1.3	Vdc
(I_C = 300 mAdc, I_B = 30 mAdc)			–	–	2.0	
DYNAMIC CHARACTERISTICS						
Current-Gain–Bandwidth Product (1) (I_C = 50 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)		f_T	200	350	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)	PNP	C_{ob}	–	6.0	8.0	pF
	NPN		–	4.5	8.0	
Input Capacitance (V_{EB} = 2.0 Vdc, I_C = 0, f = 100 kHz)	PNP	C_{ib}	–	20	30	pF
	NPN		–	17	30	
SWITCHING CHARACTERISTICS						
Turn-On Time (V_{CC} = 30 Vdc, $V_{BE(off)}$ = 0.5 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc, Figure 1)		t_{on}	–	30	–	ns
Turn-Off Time (V_{CC} = 30 Vdc, I_C = 150 mAdc, $I_{B1} = I_{B2}$ = 15 mAdc, Figure 2)		t_{off}	–	225	–	ns

(1)Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle = 2%.

NPN SATURATED SWITCHING TIME TEST CIRCUITS

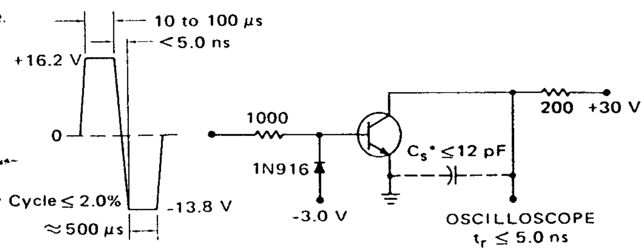
For PNP Switching Tests, reverse the diodes, voltage polarities, and input pulses.

FIGURE 1 – NPN TURN-ON TIME



*C_s is total shunt capacitance of oscilloscope and test fixture.

FIGURE 2 – NPN TURN-OFF TIME



NPN DATA

FIGURE 3 – NORMALIZED DC CURRENT GAIN

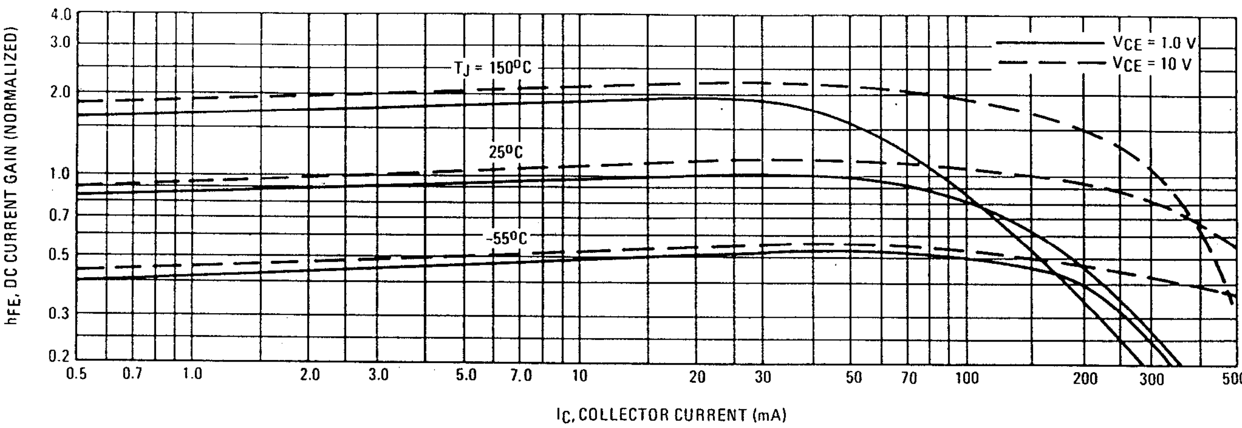


FIGURE 4 – "ON" VOLTAGES

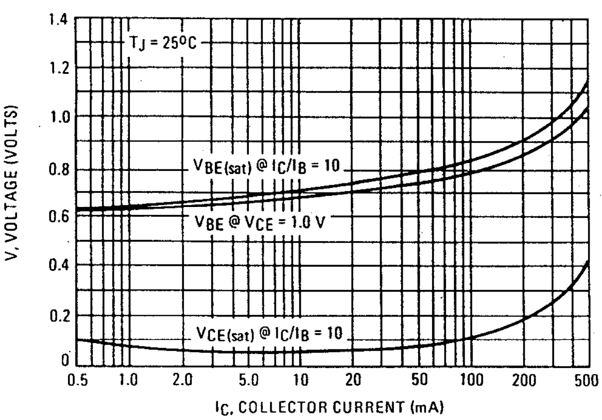
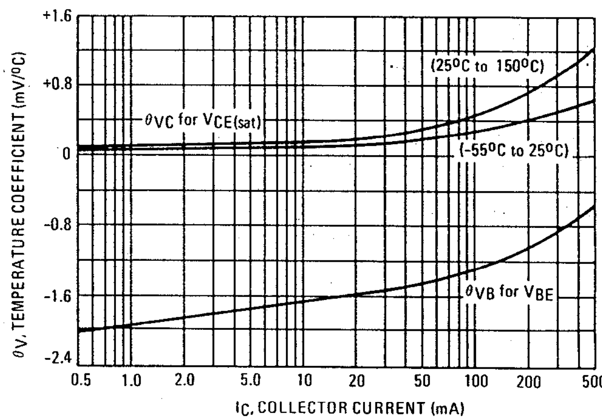


FIGURE 5 – TEMPERATURE COEFFICIENTS



NOISE FIGURE

(V_{CE} = 10 Vdc, T_A = 25°C)

FIGURE 6 – FREQUENCY EFFECTS

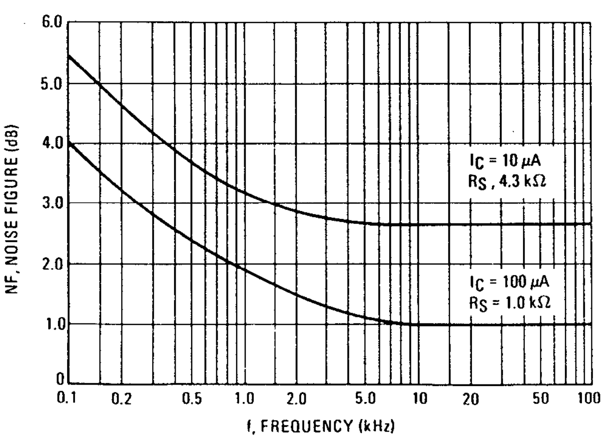
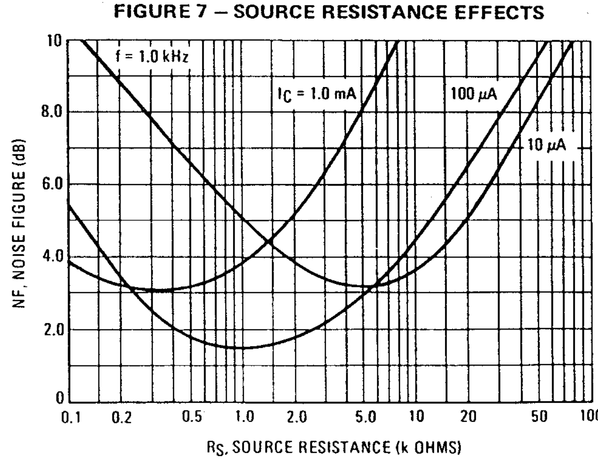


FIGURE 7 – SOURCE RESISTANCE EFFECTS



NPN DATA

FIGURE 8 – CURRENT-GAIN – BANDWIDTH PRODUCT

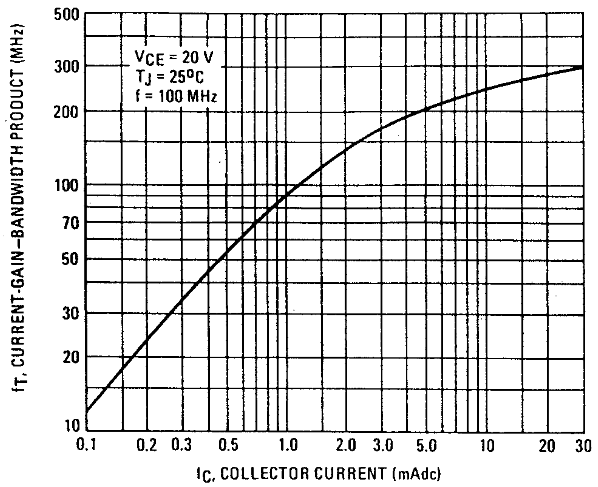
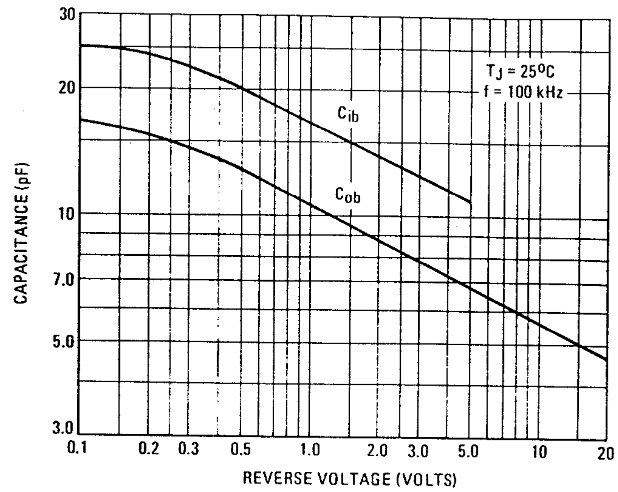


FIGURE 9 – CAPACITANCE



SWITCHING TIME CHARACTERISTICS

FIGURE 10 – TURN-ON TIME

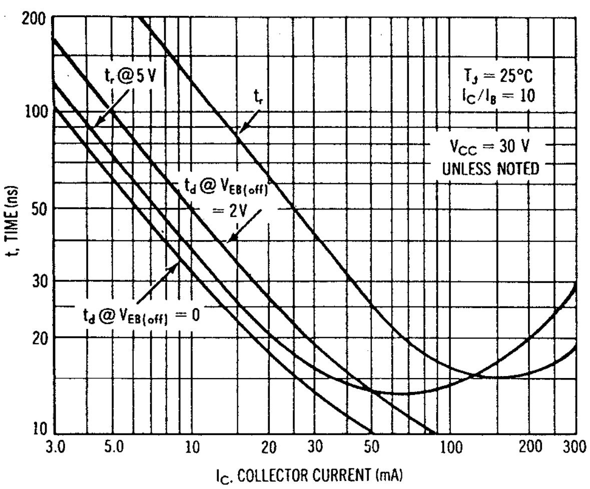


FIGURE 11 – CHARGE DATA

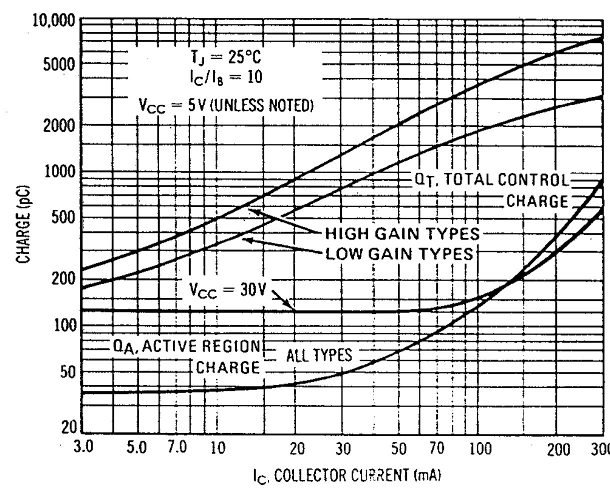
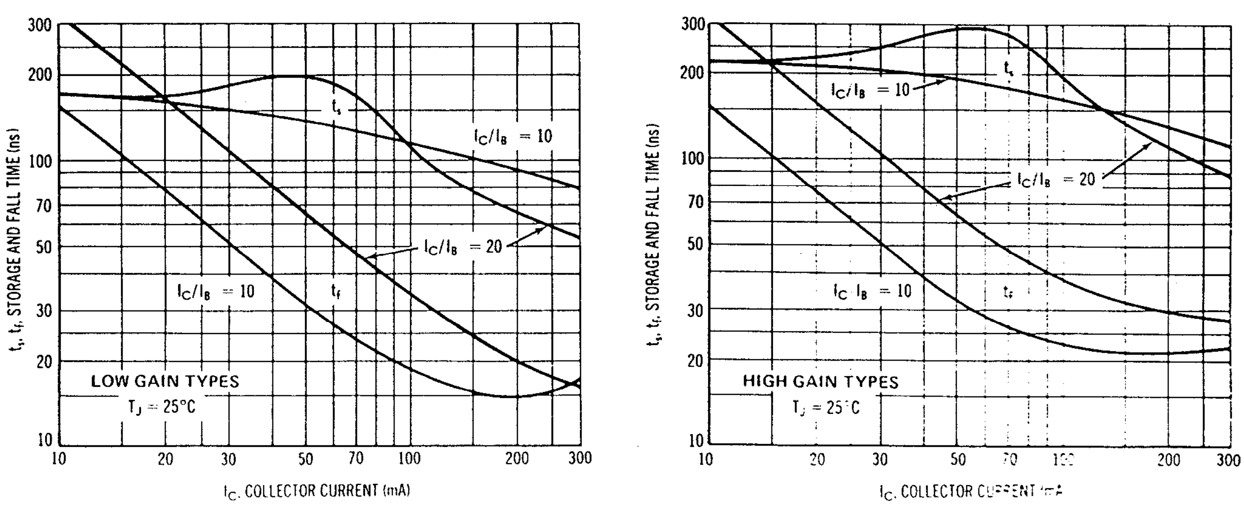


FIGURE 12 – TURN-OFF TIME



PNP DATA

FIGURE 13 — DC CURRENT GAIN

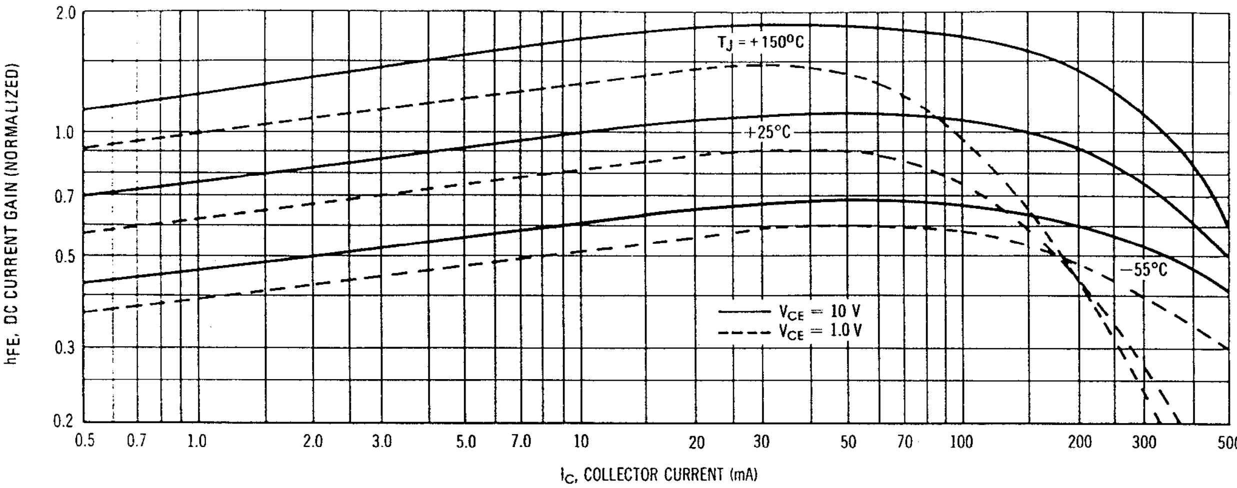


FIGURE 14 — "ON" VOLTAGES

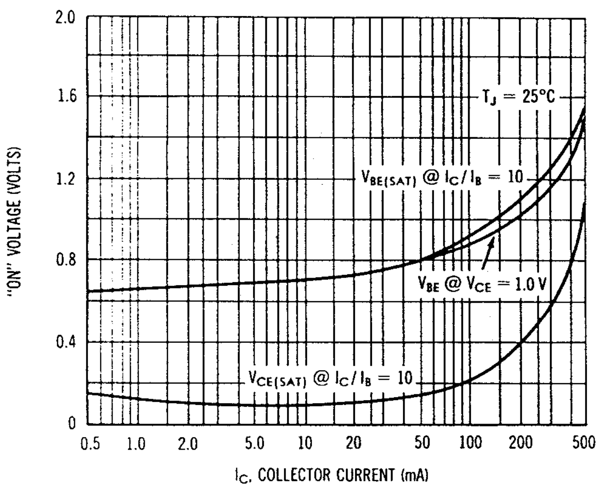
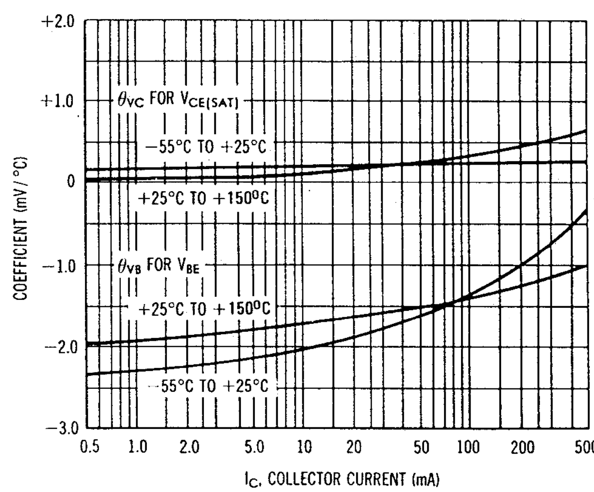


FIGURE 15 — TEMPERATURE COEFFICIENTS



NOISE FIGURE

(V_{CE} = 10 V, T_A = 25°C)

FIGURE 16 — FREQUENCY EFFECTS

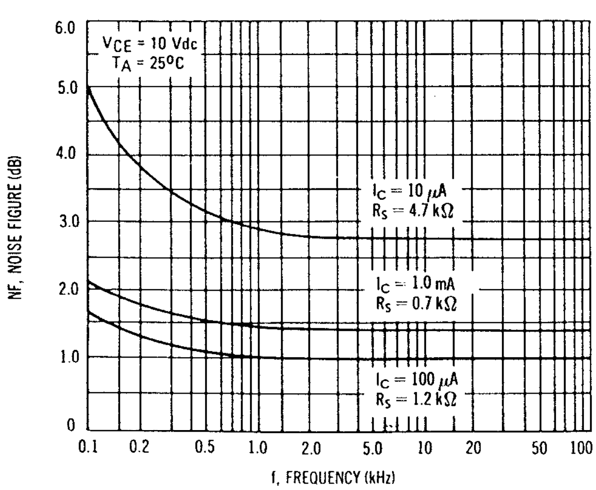
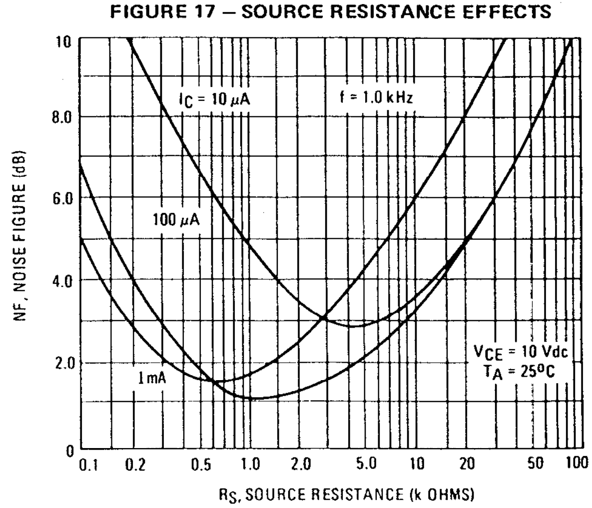


FIGURE 17 — SOURCE RESISTANCE EFFECTS



PNP DATA

FIGURE 18 – CURRENT-GAIN BANDWIDTH PRODUCT

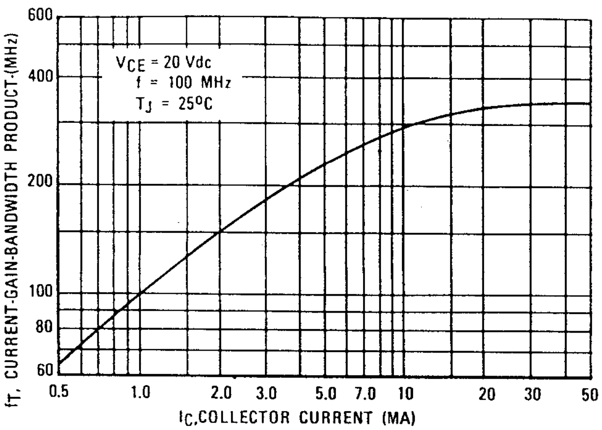


FIGURE 19 – CAPACITANCE

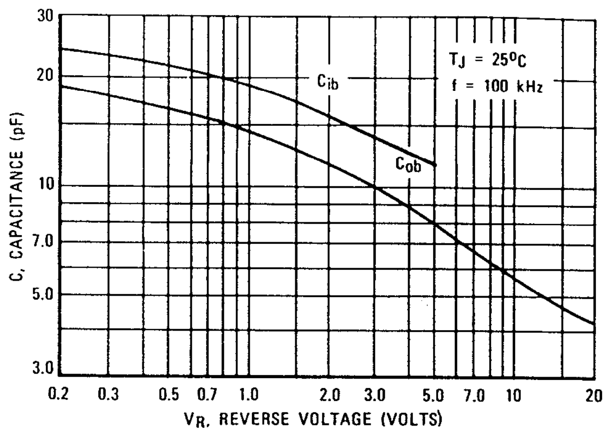


FIGURE 20 – TURN ON TIME

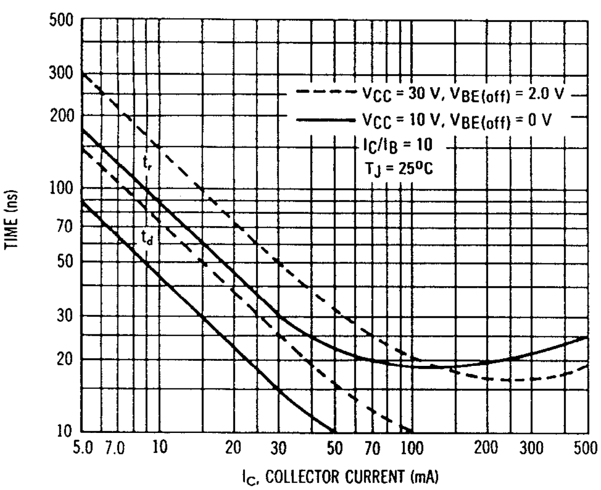


FIGURE 21 – CHARGE DATA

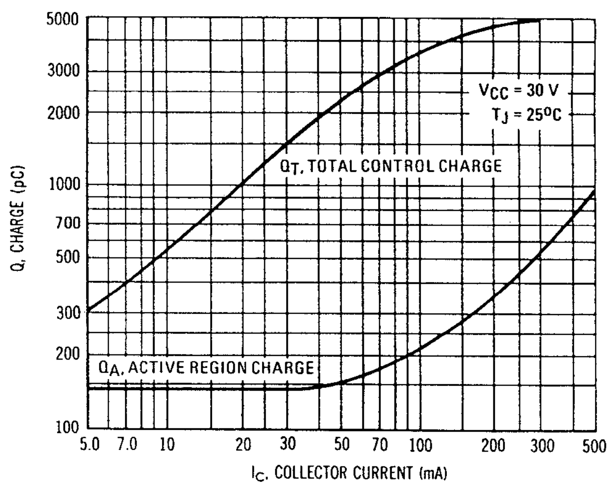


FIGURE 22 – STORAGE TIME

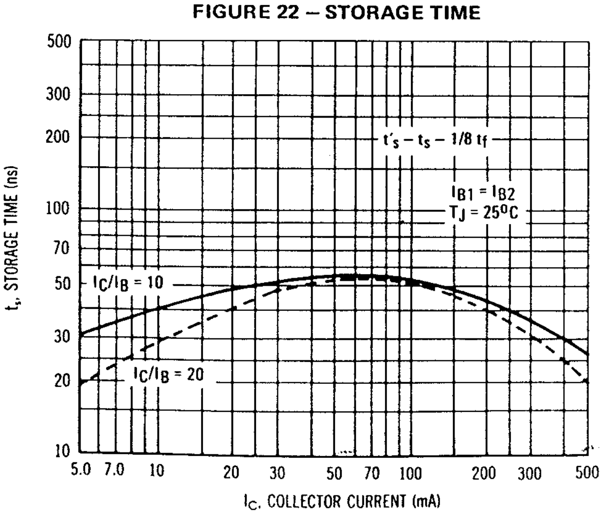


FIGURE 23 – FALL TIME